LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS

ADMINISTRATIVE RECORD

Volume 29

2018

Bate Stamp Numbers

00881293 - 00882115

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Department of the Army
Longhorn Army Ammunition Plant

1976 – 2018

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD – CHRONOLOGICAL INDEX

VOLUME 29

2018

A. Title: Report (cont'd) – Draft Quarterly Evaluation Report 4th Quarter (October - December) 2017, Groundwater Treatment Plant, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Bhate Environmental Associates, Inc.
Recipient: U. S. Army Corps of Engineers
Date: May 1, 2018
Bate Stamp: 00881293 – 00881413

B. Title: Final Meeting Minutes – Longhorn Army Ammunition Plant, Monthly Managers' Meeting Minutes
Author(s): Bhate Environmental Associates, Inc.
Recipient: All Parties
Date: May 9, 2018
Bate Stamp: 00881414 – 00881445

C. Title: Report – Final Land Use Control Remedial Design/Remedial Action Construction Report, LHAAP-001-R-01 and LHAAP-003-R-01, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Bhate Environmental Associates, Inc.
Recipient: All Stakeholders
Date: May 9, 2018
Bate Stamp: 00881446 – 00881548

D. Title: Report – Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Bhate Environmental Associates, Inc.
Recipient: Environmental Protection Agency
Date: May 16, 2018
Bate Stamp: 00881549 – 00882115

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121903.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121903.D
Lab Smp Id: VSTD00.5 Client Smp ID: VSTD00.5
Inj Date : 19-DEC-2017 10:10
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD00.5;VSTD00.5;1;1;
Misc Info : HS15080001;WATER;0;1;
Comment :
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Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 13:27 Cal File: D121911.D
Als bottle: 3 Calibration Sample, Level: 1
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
31 1,1,1-Trichloroethane	97	5.657	5.657	(0.979)	2140	0.50000	0.52(aM)
* 1 Pentafluorobenzene	168	5.779	5.779	(1.000)	266257	50.0000	
$ 30 Dibromofluoromethane	113	5.693	5.693	(0.985)	1363	0.50000	0.56(aM)
* 36 1,4-Difluorobenzene	114	6.569	6.569	(1.000)	394668	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.058	6.058	(1.048)	1684	0.50000	0.56(aM)
* 47 Chlorobenzene-d5	117	9.524	9.524	(1.000)	354076	50.0000	
$ 48 Toluene-d8	98	8.093	8.093	(0.850)	5924	0.50000	0.63(Ta)
$ 69 4-Bromofluorobenzene	95	10.698	10.698	(1.123)	2922	0.50000	0.85(a)
* 70 1,4-Dichlorobenzene-d4	152	11.838	11.838	(1.000)	145249	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.878	10.878	(0.919)	2079	0.50000	0.60(aM)
53 1,1,2-Trichloroethane	83	8.593	8.593	(0.902)	1254	0.50000	0.57(aM)
32 1,1-Dichloropropene	75	5.850	5.850	(0.891)	2906	0.50000	0.02(aM)
22 1,1-Dichloroethane	63	4.281	4.281	(0.741)	2841	0.50000	0.51(aM)
11 1,1-Dichloroethene	96	2.753	2.753	(0.476)	924	0.50000	0.42(aM)
90 1,2,4-Trichlorobenzene	180	13.821	13.821	(1.168)	1076	0.50000	0.37(aM)
89 1,2-Dibromo-3-Chloropropane	75	13.015	13.015	(1.099)	130	0.50000	0.75(aM)
57 1,2-Dibromoethane	107	9.072	9.072	(0.952)	1418	0.50000	0.52(aM)
88 1,2-Dichlorobenzene	146	12.229	12.229	(1.033)	2995	0.50000	0.57(aM)
33 1,2-Dichloroethane	62	6.145	6.145	(0.936)	2076	0.50000	0.49(aM)
42 1,2-Dichloropropane	63	7.066	7.066	(1.076)	1527	0.50000	0.49(aM)
83 1,3-Dichlorobenzene	146	11.764	11.764	(0.994)	3180	0.50000	0.58(aM)

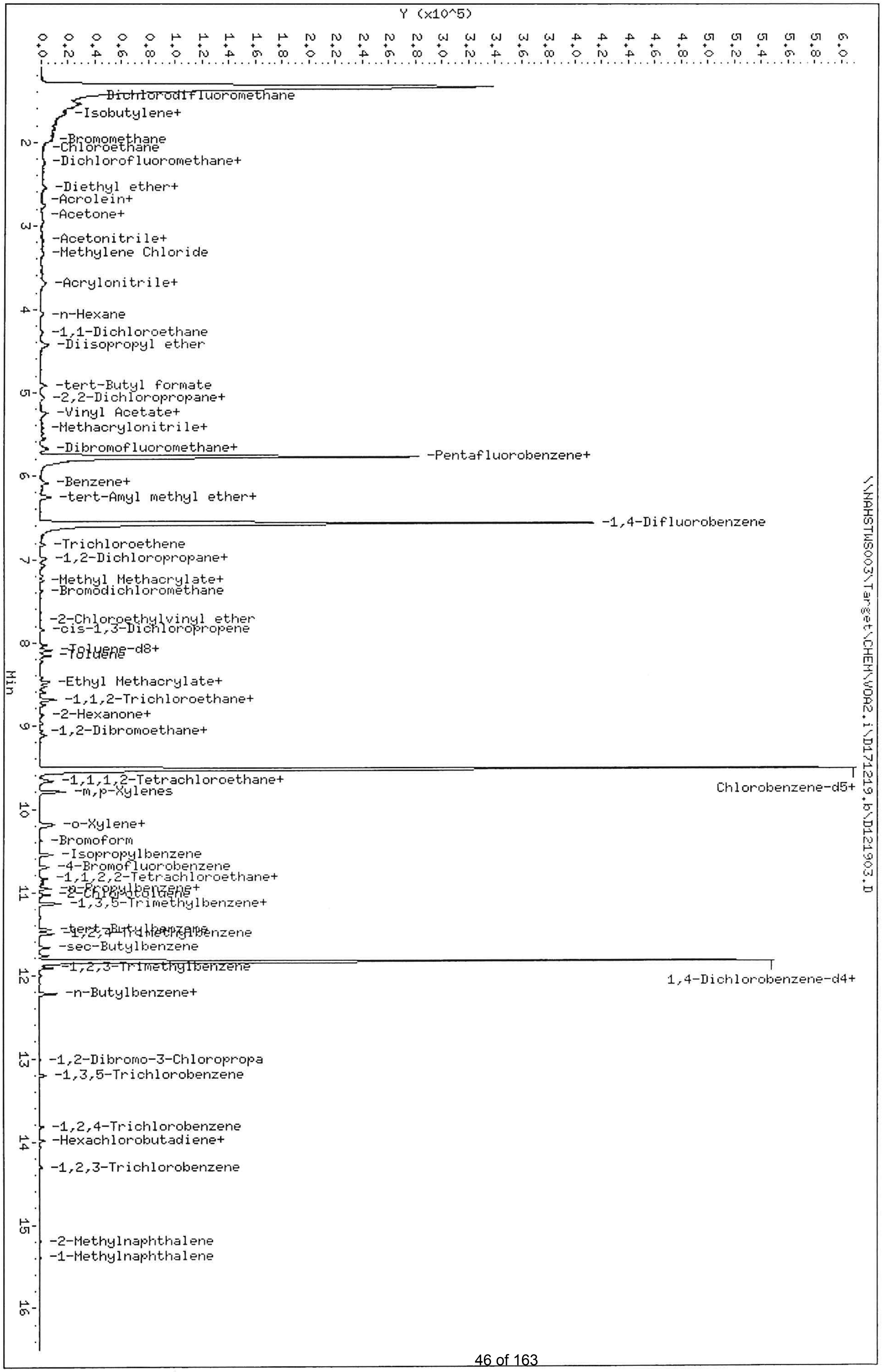
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121903.D
Report Date: 08-Feb-2018 16:59

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	AMOUNTS ON-COL (ug/l)
84 1,4-Dichlorobenzene	146	11.863	11.863	(1.002)	3007	0.50000	0.57(a)
24 2-Butanone	43	5.169	5.169	(0.895)	1469	1.00000	1.02(aM)
52 2-Hexanone	43	8.873	8.873	(0.932)	2281	1.00000	1.09(aM)
45 4-Methyl-2-Pentanone	43	8.032	8.032	(0.843)	3651	1.00000	1.13(aM)
10 Acetone	43	2.865	2.865	(0.496)	2564	1.00000	0.62(aM)
37 Benzene	78	6.087	6.087	(0.927)	5673	0.50000	0.54(aM)
39 Bromodichloromethane	83	7.377	7.377	(1.123)	1975	0.50000	0.53(aM)
66 Bromoform	173	10.374	10.374	(1.089)	1005	0.50000	0.47(aM)
6 Bromomethane	94	1.964	1.964	(0.340)	1436	0.50000	(aM)
19 Carbon Disulfide	76	2.952	2.952	(0.511)	5535	1.00000	1.10(aM)
34 Carbon Tetrachloride	117	5.821	5.821	(0.886)	2469	0.50000	0.65(aM)
59 Chlorobenzene	112	9.556	9.556	(1.003)	4146	0.50000	0.56(Ta)
7 Chloroethane	64	2.028	2.028	(0.351)	945	0.50000	0.43(aM)
28 Chloroform	83	5.497	5.497	(0.951)	2630	0.50000	0.54(aM)
3 Chloromethane	50	1.595	1.595	(0.276)	3374	0.50000	(aM)
27 cis-1,2-Dichloroethene	96	5.076	5.076	(0.878)	1778	0.50000	0.58(aM)
46 cis-1,3-Dichloropropene	75	7.846	7.846	(1.194)	1950	0.50000	0.46(aM)
55 Dibromochloromethane	129	8.972	8.972	(0.942)	1549	0.50000	0.50(aM)
2 Dichlorodifluoromethane	85	1.450	1.450	(0.251)	1000	0.50000	0.43(aM)
61 Ethylbenzene	106	9.668	9.668	(1.015)	2309	0.50000	0.59(aM)
67 Isopropylbenzene	105	10.548	10.548	(1.107)	7040	0.50000	0.58(aM)
17 Methylene Chloride	84	3.334	3.334	(0.577)	1769	0.50000	0.60(aM)
56 Tetrachloroethene	164	8.693	8.693	(0.913)	2878	0.50000	(aM)
50 Toluene	91	8.160	8.160	(0.857)	6264	0.50000	0.55(Ta)
20 trans-1,2-Dichloroethene	96	3.677	3.677	(0.636)	930	0.50000	0.39(aM)
51 trans-1,3-Dichloropropene	75	8.420	8.420	(1.282)	1589	0.50000	0.44(aM)
38 Trichloroethene	130	6.816	6.816	(1.038)	1748	0.50000	0.59(aM)
8 Trichlorofluoromethane	101	2.237	2.237	(0.387)	1431	0.50000	0.43(aM)
5 Vinyl Chloride	62	1.681	1.681	(0.291)	1626	0.50000	0.49(aM)
62 m,p-Xylenes	106	9.790	9.790	(1.028)	5758	1.00000	1.20(aM)
63 o-Xylene	106	10.185	10.185	(1.069)	2985	0.50000	0.59(aM)
M 95 Xylenes (total)	106				8743	1.50000	(a)
71 1,2,3-Trichloropropane	75	10.904	10.904	(0.921)	1951	0.50000	0.56(aM)
93 1,2,3-Trichlorobenzene	182	14.312	14.312	(1.209)	885	0.50000	0.35(aM)
79 1,2,4-Trimethylbenzene	105	11.504	11.504	(0.972)	6162	0.50000	0.63(a)
75 1,3,5-Trimethylbenzene	105	11.138	11.138	(0.941)	5847	0.50000	0.62(a)
26 2,2-Dichloropropane	77	5.048	5.048	(0.873)	1940	0.50000	0.50(aM)
54 1,3-Dichloropropane	76	8.754	8.754	(0.919)	2515	0.50000	0.57(aM)
76 2-Chlorotoluene	91	11.026	11.026	(0.931)	4934	0.50000	0.59(aM)
77 4-Chlorotoluene	91	11.138	11.138	(0.941)	5428	0.50000	0.60(aM)
82 p-Isopropyltoluene	119	11.822	11.822	(0.999)	5487	0.50000	0.61(aM)
29 Bromochloromethane	128	5.368	5.368	(0.929)	717	0.50000	0.49(aM)
74 Bromobenzene	156	10.833	10.833	(0.915)	2009	0.50000	0.62(aM)
44 Dibromomethane	93	7.191	7.191	(1.095)	773	0.50000	0.47(aM)
91 Hexachlorobutadiene	225	13.988	13.988	(1.182)	963	0.50000	0.29(aM)
73 n-Propylbenzene	91	10.958	10.958	(0.926)	7204	0.50000	0.58(Ta)
87 n-Butylbenzene	91	12.226	12.226	(1.033)	3627	0.50000	0.54(aM)
81 sec-Butylbenzene	105	11.668	11.668	(0.986)	6241	0.50000	0.59(aM)
92 Naphthalene	128	14.068	14.068	(1.188)	1123	0.50000	(aM)
78 tert-Butylbenzene	119	11.453	11.453	(0.967)	4677	0.50000	0.59(Ta)
60 1,1,1,2-Tetrachloroethane	131	9.646	9.646	(1.013)	1467	0.50000	0.51(aM)
64 Styrene	104	10.201	10.201	(1.071)	4321	0.50000	0.54(aM)

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121903.D
Report Date: 08-Feb-2018 16:59

QC Flag Legend

T - Target compound detected outside RT window.
a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.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Date : 19-DEC-2017 10:10
Client ID: VSTD00.5
Sample Info: VSTD00.5;VSTD00.5;1;1;
Purge Volume: 5.0
Column phase: DB624
Instrument: VOA2.i
Operator: AP
Column diameter: 0.18
\\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121903.D
Y (x10^5)
Min
Dichlorodifluoromethane
Isobutylene+
Bromomethane
Chloroethane
Dichlorofluoromethane+
Diethyl ether+
Acrolein+
Acetone+
Acetonitrile+
Methylene Chloride
Acrylonitrile+
n-Hexane
1,1-Dichloroethane
Diisopropyl ether
tert-Butyl formate
2,2-Dichloropropane+
Vinyl Acetate+
Methacrylonitrile+
Dibromofluoromethane+
Pentafluorobenzene+
Benzene+
tert-Amyl methyl ether+
1,4-Difluorobenzene
Trichloroethene
1,2-Dichloropropane+
Methyl Methacrylate+
Bromodichloromethane
2-Chloroethylvinyl ether
cis-1,3-Dichloropropene
Toluene-d8+
Toluene
Ethyl Methacrylate+
1,1,2-Trichloroethane+
2-Hexanone+
1,2-Dibromoethane+
1,1,1,2-Tetrachloroethane+
m,p-Xylenes
Chlorobenzene-d5+
o-Xylene+
Bromoform
Isopropylbenzene
4-Bromofluorobenzene
1,1,2,2-Tetrachloroethane+
n-Propylbenzene+
2-Chlorotoluene
1,3,5-Trimethylbenzene+
tert-Butylbenzene
1,2,4-Trimethylbenzene
sec-Butylbenzene
1,2,3-Trimethylbenzene
1,4-Dichlorobenzene-d4+
n-Butylbenzene+
1,2-Dibromo-3-Chloropropa
1,3,5-Trichlorobenzene
1,2,4-Trichlorobenzene
Hexachlorobutadiene+
1,2,3-Trichlorobenzene
2-Methylnaphthalene
1-Methylnaphthalene

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121904.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121904.D
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Inj Date : 19-DEC-2017 10:34
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD001;VSTD001;1;2;
Misc Info : HS15080001;WATER;0;1;
Comment :
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Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 10:10 Cal File: D121903.D
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Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
31 1,1,1-Trichloroethane	97	5.654	5.654	(0.979)	4089	1.00000	1.03(a)
* 1 Pentafluorobenzene	168	5.776	5.776	(1.000)	254673	50.0000	
$ 30 Dibromofluoromethane	113	5.689	5.689	(0.985)	2553	1.00000	1.11(aM)
* 36 1,4-Difluorobenzene	114	6.572	6.572	(1.000)	370301	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.062	6.062	(1.049)	2757	1.00000	0.97(Ta)
* 47 Chlorobenzene-d5	117	9.524	9.524	(1.000)	335559	50.0000	
$ 48 Toluene-d8	98	8.090	8.090	(0.849)	10331	1.00000	1.16(Ta)
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	4145	1.00000	1.28(a)
* 70 1,4-Dichlorobenzene-d4	152	11.838	11.838	(1.000)	139780	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.875	10.875	(0.919)	3917	1.00000	1.17(aM)
53 1,1,2-Trichloroethane	83	8.603	8.603	(0.903)	2335	1.00000	1.13(aM)
32 1,1-Dichloropropene	75	5.856	5.856	(0.891)	4681	1.00000	0.71(aM)
22 1,1-Dichloroethane	63	4.284	4.284	(0.742)	5842	1.00000	1.09(aM)
11 1,1-Dichloroethene	96	2.763	2.763	(0.478)	2233	1.00000	1.06(aM)
90 1,2,4-Trichlorobenzene	180	13.821	13.821	(1.168)	2691	1.00000	0.97(Ta)
89 1,2-Dibromo-3-Chloropropane	75	13.009	13.009	(1.099)	527	1.00000	1.44(aM)
57 1,2-Dibromoethane	107	9.068	9.068	(0.952)	2693	1.00000	1.04(Ta)
88 1,2-Dichlorobenzene	146	12.229	12.229	(1.033)	5826	1.00000	1.15(aM)
33 1,2-Dichloroethane	62	6.142	6.142	(0.935)	3910	1.00000	1.09(aM)
42 1,2-Dichloropropane	63	7.073	7.073	(1.076)	3194	1.00000	1.09(aM)
83 1,3-Dichlorobenzene	146	11.770	11.770	(0.994)	5888	1.00000	1.12(aM)

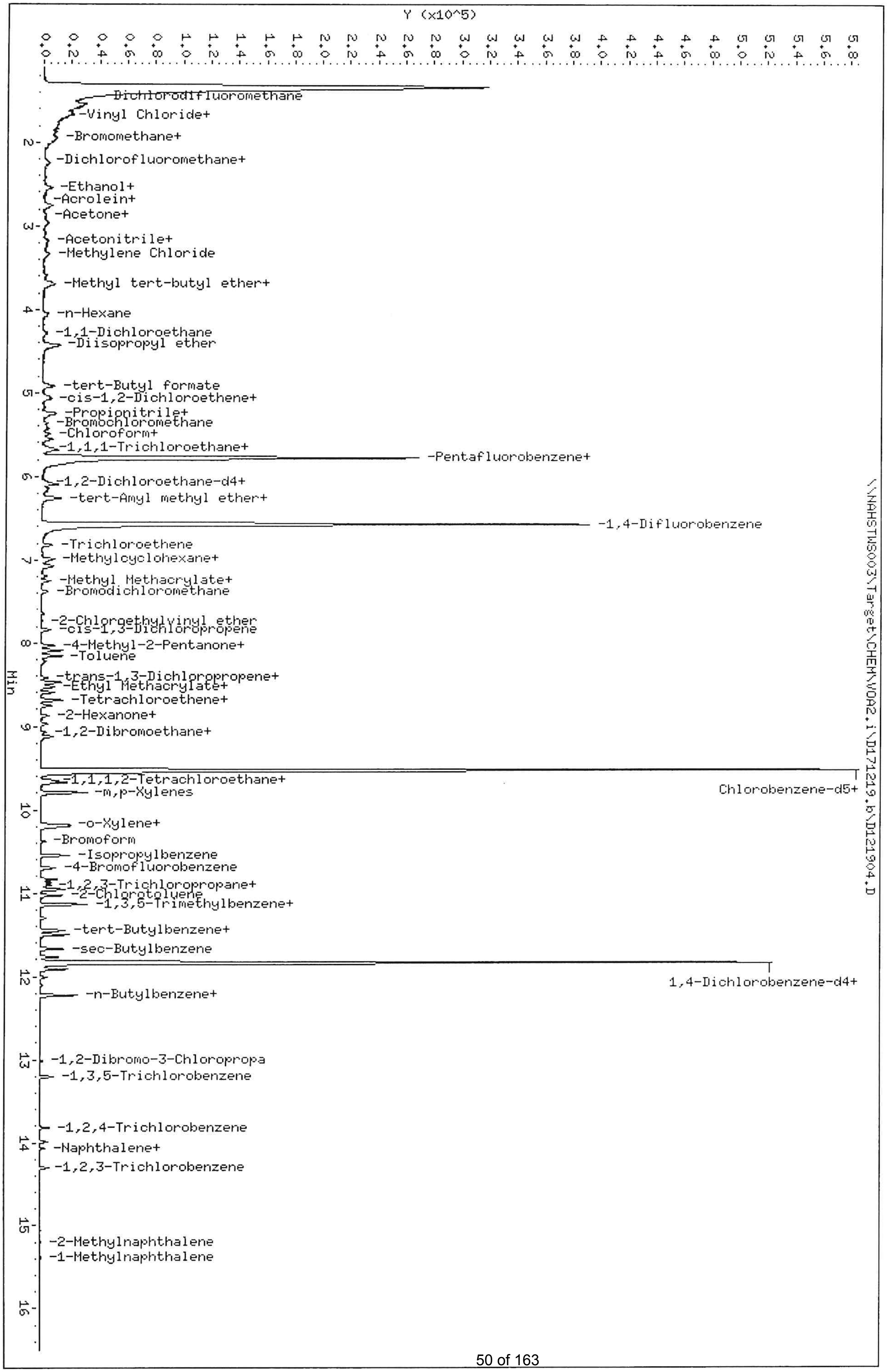
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121904.D
Report Date: 08-Feb-2018 16:59

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
84 1,4-Dichlorobenzene	146	11.860	11.860	(1.002)	5915	1.00000	1.18(aM)
24 2-Butanone	43	5.166	5.166	(0.894)	3060	2.00000	2.22(aM)
52 2-Hexanone	43	8.873	8.873	(0.932)	4407	2.00000	2.24(Ta)
45 4-Methyl-2-Pentanone	43	8.032	8.032	(0.843)	7137	2.00000	2.34(a)
10 Acetone	43	2.866	2.866	(0.496)	3611	2.00000	2.03(aM)
37 Benzene	78	6.094	6.094	(0.927)	11705	1.00000	1.20(aM)
39 Bromodichloromethane	83	7.377	7.377	(1.123)	3729	1.00000	1.08(aM)
66 Bromoform	173	10.371	10.371	(1.089)	1745	1.00000	0.87(aM)
6 Bromomethane	94	1.938	1.938	(0.336)	2542	1.00000	(aM)
19 Carbon Disulfide	76	2.962	2.962	(0.513)	9653	2.00000	2.01(aM)
34 Carbon Tetrachloride	117	5.824	5.824	(0.886)	3778	1.00000	1.07(TaM)
59 Chlorobenzene	112	9.556	9.556	(1.003)	8040	1.00000	1.16(a)
7 Chloroethane	64	2.031	2.031	(0.352)	2295	1.00000	1.11(aM)
28 Chloroform	83	5.494	5.494	(0.951)	4849	1.00000	1.04(Ta)
3 Chloromethane	50	1.595	1.595	(0.276)	5969	1.00000	0.47(aM)
27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.877)	2859	1.00000	0.98(Ta)
46 cis-1,3-Dichloropropene	75	7.843	7.843	(1.193)	3975	1.00000	1.00(aM)
55 Dibromochloromethane	129	8.969	8.969	(0.942)	2995	1.00000	1.03(aM)
2 Dichlorodifluoromethane	85	1.447	1.447	(0.251)	2091	1.00000	0.96(aM)
61 Ethylbenzene	106	9.675	9.675	(1.016)	4343	1.00000	1.17(aMH)
67 Isopropylbenzene	105	10.548	10.548	(1.107)	13289	1.00000	1.16(a)
17 Methylene Chloride	84	3.328	3.328	(0.576)	3087	1.00000	1.10(aM)
56 Tetrachloroethene	164	8.687	8.687	(0.912)	3904	1.00000	0.24(a)
50 Toluene	91	8.160	8.160	(0.857)	12691	1.00000	1.19(Ta)
20 trans-1,2-Dichloroethene	96	3.665	3.665	(0.634)	2177	1.00000	0.95(aM)
51 trans-1,3-Dichloropropene	75	8.417	8.417	(1.281)	3358	1.00000	0.99(aM)
38 Trichloroethene	130	6.819	6.819	(1.038)	2998	1.00000	1.09(aM)
8 Trichlorofluoromethane	101	2.259	2.259	(0.391)	3095	1.00000	0.98(aM)
5 Vinyl Chloride	62	1.678	1.678	(0.291)	3210	1.00000	1.02(Ta)
62 m,p-Xylenes	106	9.794	9.794	(1.028)	10553	2.00000	2.33(a)
63 o-Xylene	106	10.176	10.176	(1.068)	5578	1.00000	1.17(a)
M 95 Xylenes (total)	106				16131	3.00000	(a)
71 1,2,3-Trichloropropane	75	10.907	10.907	(0.921)	3980	1.00000	1.19(Ta)
93 1,2,3-Trichlorobenzene	182	14.305	14.305	(1.208)	2091	1.00000	0.88(aM)
79 1,2,4-Trimethylbenzene	105	11.501	11.501	(0.972)	11202	1.00000	1.20(a)
75 1,3,5-Trimethylbenzene	105	11.135	11.135	(0.941)	10681	1.00000	1.17(a)
26 2,2-Dichloropropane	77	5.044	5.044	(0.873)	4044	1.00000	1.08(aM)
54 1,3-Dichloropropane	76	8.757	8.757	(0.919)	4979	1.00000	1.20(aM)
76 2-Chlorotoluene	91	11.029	11.029	(0.932)	9692	1.00000	1.22(Ta)
77 4-Chlorotoluene	91	11.141	11.141	(0.941)	10294	1.00000	1.19(a)
82 p-Isopropyltoluene	119	11.819	11.819	(0.998)	9663	1.00000	1.12(a)
29 Bromochloromethane	128	5.372	5.372	(0.930)	1289	1.00000	0.93(aM)
74 Bromobenzene	156	10.837	10.837	(0.915)	3330	1.00000	1.07(a)
44 Dibromomethane	93	7.188	7.188	(1.094)	1461	1.00000	0.96(aM)
91 Hexachlorobutadiene	225	13.985	13.985	(1.181)	1399	1.00000	0.66(aM)
73 n-Propylbenzene	91	10.952	10.952	(0.925)	13821	1.00000	1.16(Ta)
87 n-Butylbenzene	91	12.223	12.223	(1.033)	7076	1.00000	1.10(a)
81 sec-Butylbenzene	105	11.671	11.671	(0.986)	11416	1.00000	1.13(a)
92 Naphthalene	128	14.065	14.065	(1.188)	3453	1.00000	(a)
78 tert-Butylbenzene	119	11.449	11.449	(0.967)	8889	1.00000	1.16(a)
60 1,1,1,2-Tetrachloroethane	131	9.643	9.643	(1.012)	2945	1.00000	1.09(a)
64 Styrene	104	10.198	10.198	(1.071)	8599	1.00000	1.13(a)

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121904.D
Report Date: 08-Feb-2018 16:59

QC Flag Legend

T - Target compound detected outside RT window.
a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.
H - Operator selected an alternate compound hit.


Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121904.D
Date : 19-DEC-2017 10:34
Client ID: VSTD001
Sample Info: VSTD001;VSTD001;1;2;
Purge Volume: 5.0
Column phase: DB624
Instrument: VOA2.i
Operator: AP
Column diameter: 0.18
\\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121904.D
Y (x10^5)
Min
-Dichlorodifluoromethane
-Vinyl Chloride+
-Bromomethane+
-Dichlorofluoromethane+
-Ethanol+
-Acrolein+
-Acetone+
-Acetonitrile+
-Methylene Chloride
-Methyl tert-butyl ether+
-n-Hexane
-1,1-Dichloroethane
-Diisopropyl ether
-tert-Butyl formate
-cis-1,2-Dichloroethene+
-Propionitrile+
-Bromochloromethane
-Chloroform+
-1,1,1-Trichloroethane+
-Pentafluorobenzene+
-1,2-Dichloroethane-d4+
-tert-Amyl methyl ether+
-1,4-Difluorobenzene
-Trichloroethene
-Methylcyclohexane+
-Methyl Methacrylate+
-Bromodichloromethane
-2-Chloroethylvinyl ether
-cis-1,3-Dichloropropene
-4-Methyl-2-Pentanone+
-Toluene
-trans-1,3-Dichloropropene+
-Ethyl Methacrylate+
-Tetrachloroethene+
-2-Hexanone+
-1,2-Dibromoethane+
-1,1,1,2-Tetrachloroethane+
-m,p-Xylenes
Chlorobenzene-d5+
-o-Xylene+
-Bromoform
-Isopropylbenzene
-4-Bromofluorobenzene
-1,2,3-Trichloropropane+
-2-Chlorotoluene
-1,3,5-Trimethylbenzene+
-tert-Butylbenzene+
-sec-Butylbenzene
1,4-Dichlorobenzene-d4+
-n-Butylbenzene+
-1,2-Dibromo-3-Chloropropa
-1,3,5-Trichlorobenzene
-1,2,4-Trichlorobenzene
-Naphthalene+
-1,2,3-Trichlorobenzene
-2-Methylnaphthalene
-1-Methylnaphthalene

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121905.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121905.D
Lab Smp Id: VSTD002 Client Smp ID: VSTD002
Inj Date : 19-DEC-2017 10:59
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD002;VSTD002;1;3;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\CHEM\VOA2.i\D171219.b\8260LL.m
Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 10:34 Cal File: D121904.D
Als bottle: 5 Calibration Sample, Level: 3
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

							AMOUNTS	
		QUANT SIG					CAL-AMT	ON-COL
	Compounds	MASS	RT	EXP RT	REL RT	RESPONSE	(ug/l)	(ug/l)
	31 1,1,1-Trichloroethane	97	5.654	5.654	(0.978)	7739	2.00000	1.92(a)
*	1 Pentafluorobenzene	168	5.779	5.779	(1.000)	259826	50.0000	
$	30 Dibromofluoromethane	113	5.683	5.683	(0.983)	4981	2.00000	2.12(a)
*	36 1,4-Difluorobenzene	114	6.572	6.572	(1.000)	391700	50.0000	
$	35 1,2-Dichloroethane-d4	65	6.058	6.058	(1.048)	5934	2.00000	2.05(Ta)
*	47 Chlorobenzene-d5	117	9.524	9.524	(1.000)	346408	50.0000	
$	48 Toluene-d8	98	8.093	8.093	(0.850)	18565	2.00000	2.03(Ta)
$	69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	7156	2.00000	2.14(a)
*	70 1,4-Dichlorobenzene-d4	152	11.835	11.835	(1.000)	146224	50.0000	
	68 1,1,2,2-Tetrachloroethane	83	10.872	10.872	(0.919)	7449	2.00000	2.13(aM)
	53 1,1,2-Trichloroethane	83	8.603	8.603	(0.903)	4222	2.00000	1.99(a)
	32 1,1-Dichloropropene	75	5.856	5.856	(0.891)	7445	2.00000	1.55(aM)
	22 1,1-Dichloroethane	63	4.274	4.274	(0.740)	10955	2.00000	2.01(aM)
	11 1,1-Dichloroethene	96	2.760	2.760	(0.478)	4364	2.00000	2.03(aM)
	90 1,2,4-Trichlorobenzene	180	13.818	13.818	(1.168)	5108	2.00000	1.77(Ta)
	89 1,2-Dibromo-3-Chloropropane	75	13.012	13.012	(1.100)	1073	2.00000	2.30(aM)
	57 1,2-Dibromoethane	107	9.065	9.065	(0.952)	5304	2.00000	1.99(Ta)
	88 1,2-Dichlorobenzene	146	12.223	12.223	(1.033)	10774	2.00000	2.04(a)
	33 1,2-Dichloroethane	62	6.155	6.155	(0.937)	7652	2.00000	2.11(aM)
	42 1,2-Dichloropropane	63	7.069	7.069	(1.076)	6767	2.00000	2.19(aM)
	83 1,3-Dichlorobenzene	146	11.764	11.764	(0.994)	11327	2.00000	2.07(a)

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121905.D
Report Date: 08-Feb-2018 16:59

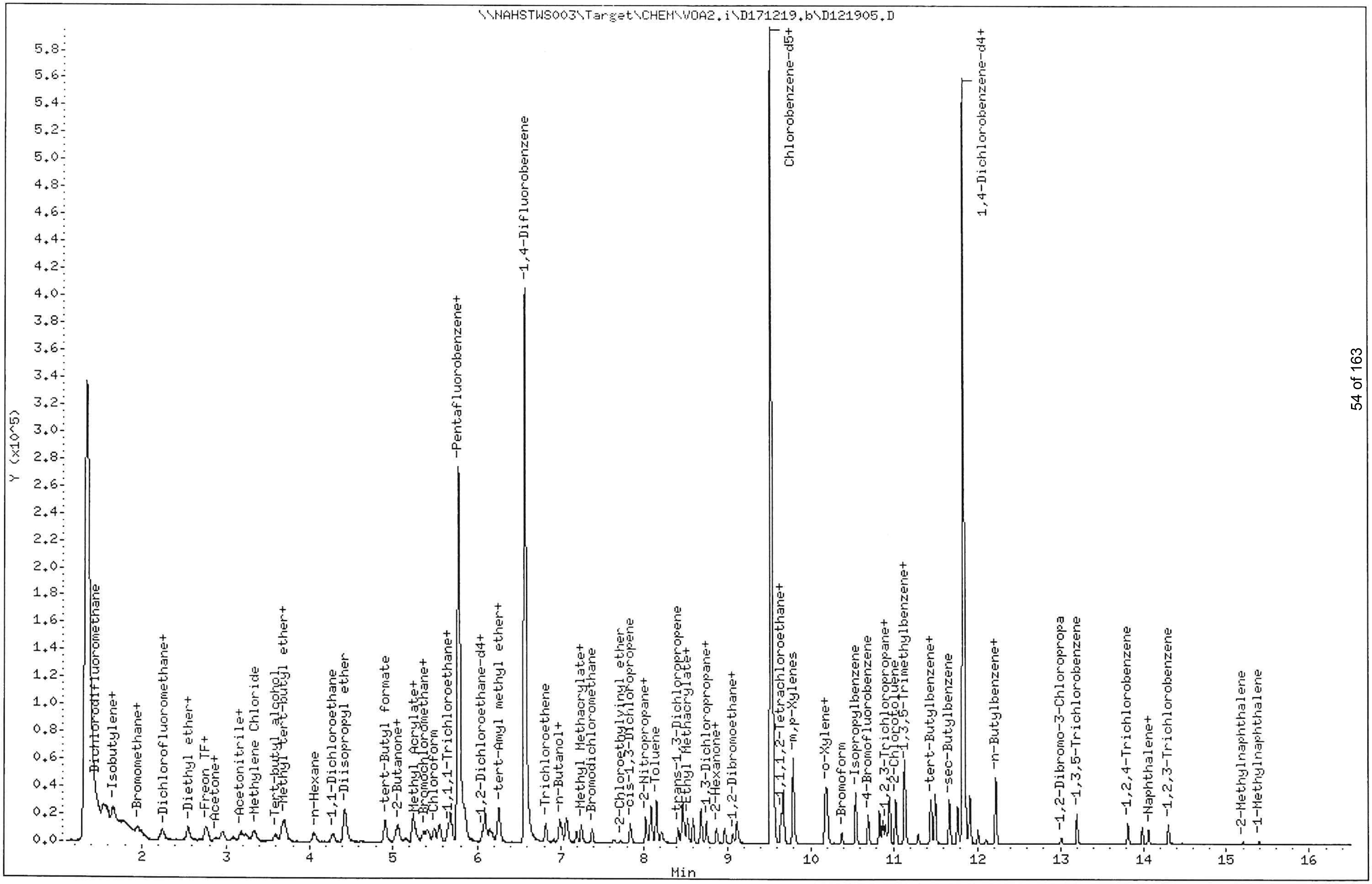
	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	AMOUNTS ON-COL (ug/l)
	84 1,4-Dichlorobenzene	146	11.860	11.860	(1.002)	10483	2.00000	2.00(a)
	24 2-Butanone	43	5.170	5.170	(0.895)	5411	4.00000	3.85(aM)
	52 2-Hexanone	43	8.873	8.873	(0.932)	8511	4.00000	4.19(a)
	45 4-Methyl-2-Pentanone	43	8.029	8.029	(0.843)	12860	4.00000	4.09(a)
	10 Acetone	43	2.872	2.872	(0.497)	4810	4.00000	3.36(aM)
	37 Benzene	78	6.094	6.094	(0.927)	20675	2.00000	2.00(a)
	39 Bromodichloromethane	83	7.377	7.377	(1.123)	7033	2.00000	1.92(Ta)
	66 Bromoform	173	10.378	10.378	(1.090)	3966	2.00000	1.93(aM)
	6 Bromomethane	94	1.951	1.951	(0.338)	4860	2.00000	0.36(aM)
	19 Carbon Disulfide	76	2.959	2.959	(0.512)	17850	4.00000	3.64(aM)
	34 Carbon Tetrachloride	117	5.837	5.837	(0.888)	8167	2.00000	2.19(TaM)
	59 Chlorobenzene	112	9.556	9.556	(1.003)	14887	2.00000	2.08(a)
	7 Chloroethane	64	2.038	2.038	(0.353)	4553	2.00000	2.16(aM)
	28 Chloroform	83	5.494	5.494	(0.951)	9662	2.00000	2.03(Ta)
	3 Chloromethane	50	1.605	1.605	(0.278)	10010	2.00000	1.39(aM)
	27 cis-1,2-Dichloroethene	96	5.070	5.070	(0.877)	6103	2.00000	2.06(aM)
	46 cis-1,3-Dichloropropene	75	7.839	7.839	(1.193)	7958	2.00000	1.89(aM)
	55 Dibromochloromethane	129	8.969	8.969	(0.942)	5749	2.00000	1.92(Ta)
	2 Dichlorodifluoromethane	85	1.447	1.447	(0.250)	3705	2.00000	1.66(aM)
	61 Ethylbenzene	106	9.672	9.672	(1.015)	7922	2.00000	2.07(aMH)
	67 Isopropylbenzene	105	10.545	10.545	(1.107)	23813	2.00000	2.01(a)
	17 Methylene Chloride	84	3.341	3.341	(0.578)	5681	2.00000	1.99(aM)
	56 Tetrachloroethene	164	8.687	8.687	(0.912)	5759	2.00000	1.07(a)
	50 Toluene	91	8.157	8.157	(0.856)	22911	2.00000	2.08(a)
	20 trans-1,2-Dichloroethene	96	3.677	3.677	(0.636)	4940	2.00000	2.12(a)
	51 trans-1,3-Dichloropropene	75	8.417	8.417	(1.281)	6256	2.00000	1.75(aM)
	38 Trichloroethene	130	6.819	6.819	(1.038)	5320	2.00000	1.83(a)
	8 Trichlorofluoromethane	101	2.256	2.256	(0.390)	5870	2.00000	1.83(aM)
	5 Vinyl Chloride	62	1.682	1.682	(0.291)	6459	2.00000	2.02(aM)
	62 m,p-Xylenes	106	9.794	9.794	(1.028)	19203	4.00000	4.11(a)
	63 o-Xylene	106	10.176	10.176	(1.068)	9802	2.00000	2.00(a)
M	95 Xylenes (total)	106				29005	6.00000	(a)
	71 1,2,3-Trichloropropane	75	10.904	10.904	(0.921)	7447	2.00000	2.13(a)
	93 1,2,3-Trichlorobenzene	182	14.302	14.302	(1.209)	4663	2.00000	1.87(Ta)
	79 1,2,4-Trimethylbenzene	105	11.498	11.498	(0.972)	20183	2.00000	2.07(a)
	75 1,3,5-Trimethylbenzene	105	11.132	11.132	(0.941)	19907	2.00000	2.09(a)
	26 2,2-Dichloropropane	77	5.054	5.054	(0.875)	7433	2.00000	1.96(aM)
	54 1,3-Dichloropropane	76	8.754	8.754	(0.919)	8573	2.00000	2.00(a)
	76 2-Chlorotoluene	91	11.029	11.029	(0.932)	18179	2.00000	2.18(a)
	77 4-Chlorotoluene	91	11.138	11.138	(0.941)	19291	2.00000	2.13(a)
	82 p-Isopropyltoluene	119	11.818	11.818	(0.999)	17740	2.00000	1.97(a)
	29 Bromochloromethane	128	5.375	5.375	(0.930)	2655	2.00000	1.88(a)
	74 Bromobenzene	156	10.833	10.833	(0.915)	6776	2.00000	2.08(a)
	44 Dibromomethane	93	7.191	7.191	(1.094)	3077	2.00000	1.92(a)
	91 Hexachlorobutadiene	225	13.988	13.988	(1.182)	2593	2.00000	1.51(aM)
	73 n-Propylbenzene	91	10.955	10.955	(0.926)	26316	2.00000	2.12(a)
	87 n-Butylbenzene	91	12.223	12.223	(1.033)	12425	2.00000	1.85(a)
	81 sec-Butylbenzene	105	11.664	11.664	(0.986)	21328	2.00000	2.02(a)
	92 Naphthalene	128	14.065	14.065	(1.188)	8523	2.00000	0.61(a)
	78 tert-Butylbenzene	119	11.449	11.449	(0.967)	16377	2.00000	2.05(a)
	60 1,1,1,2-Tetrachloroethane	131	9.646	9.646	(1.013)	5468	2.00000	1.97(a)
	64 Styrene	104	10.198	10.198	(1.071)	15951	2.00000	2.04(a)

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121905.D
Report Date: 08-Feb-2018 16:59

QC Flag Legend

T - Target compound detected outside RT window.
a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.
H - Operator selected an alternate compound hit.

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121905.D
Date : 19-DEC-2017 10:59
Client ID: VSTD002 Instrument: VOA2.i
Sample Info: VSTD002;VSTD002;1;3;
Purge Volume: 5.0 Operator: AP
Column phase: DB624 Column diameter: 0.18



Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121906.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121906.D
Lab Smp Id: VSTD005 Client Smp ID: VSTD005
Inj Date : 19-DEC-2017 11:23
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD005;VSTD005;1;4;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\CHEM\VOA2.i\D171219.b\8260LL.m
Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 10:59 Cal File: D121905.D
Als bottle: 6 Calibration Sample, Level: 4
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
31 1,1,1-Trichloroethane	97	5.654	5.654	(0.978)	19452	5.00000	4.61(a)
* 1 Pentafluorobenzene	168	5.779	5.779	(1.000)	272617	50.0000	
$ 30 Dibromofluoromethane	113	5.689	5.689	(0.984)	11996	5.00000	4.88(a)
* 36 1,4-Difluorobenzene	114	6.569	6.569	(1.000)	412491	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.058	6.058	(1.048)	13758	5.00000	4.53(a)
* 47 Chlorobenzene-d5	117	9.527	9.527	(1.000)	373656	50.0000	
$ 48 Toluene-d8	98	8.090	8.090	(0.849)	44645	5.00000	4.53(a)
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	17276	5.00000	4.80(a)
* 70 1,4-Dichlorobenzene-d4	152	11.838	11.838	(1.000)	161728	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.869	10.869	(0.918)	18597	5.00000	4.82(aM)
53 1,1,2-Trichloroethane	83	8.593	8.593	(0.902)	10807	5.00000	4.72(a)
32 1,1-Dichloropropene	75	5.853	5.853	(0.891)	15499	5.00000	3.97(a)
22 1,1-Dichloroethane	63	4.287	4.287	(0.742)	27067	5.00000	4.75(Ta)
11 1,1-Dichloroethene	96	2.747	2.747	(0.475)	10340	5.00000	4.59(a)
90 1,2,4-Trichlorobenzene	180	13.818	13.818	(1.167)	14191	5.00000	4.45(a)
89 1,2-Dibromo-3-Chloropropane	75	13.012	13.012	(1.099)	2812	5.00000	4.71(a)
57 1,2-Dibromoethane	107	9.065	9.065	(0.952)	13628	5.00000	4.76(Ta)
88 1,2-Dichlorobenzene	146	12.226	12.226	(1.033)	27735	5.00000	4.77(a)
33 1,2-Dichloroethane	62	6.145	6.145	(0.936)	19328	5.00000	5.21(M)
42 1,2-Dichloropropane	63	7.066	7.066	(1.076)	16698	5.00000	5.13(M)
83 1,3-Dichlorobenzene	146	11.767	11.767	(0.994)	28316	5.00000	4.68(a)

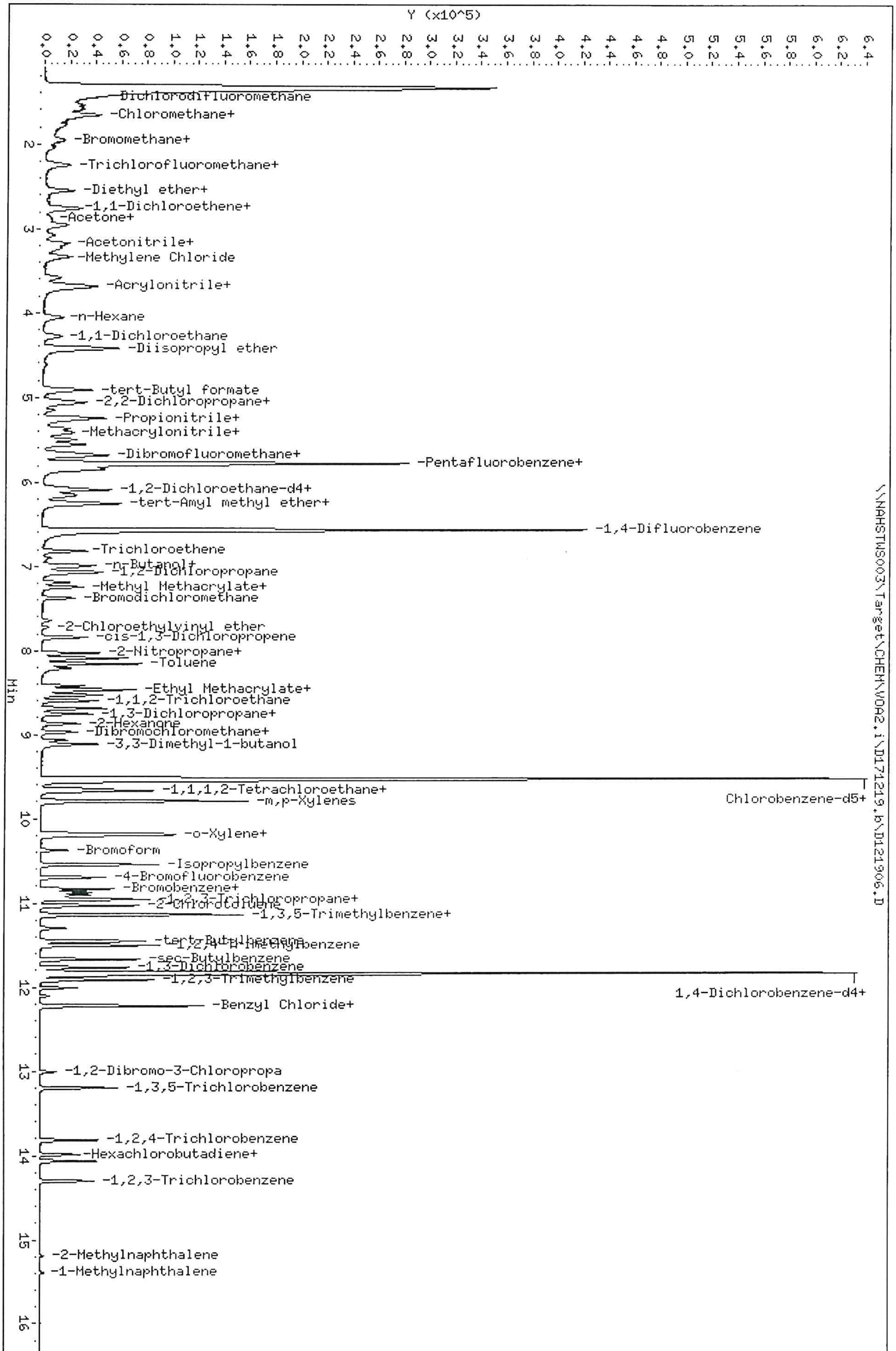
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121906.D
Report Date: 08-Feb-2018 16:59

	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
	84 1,4-Dichlorobenzene	146	11.857	11.857	(1.002)	26891	5.00000	4.64(a)
	24 2-Butanone	43	5.144	5.144	(0.890)	14793	10.0000	10.05(M)
	52 2-Hexanone	43	8.869	8.869	(0.931)	20452	10.0000	9.34
	45 4-Methyl-2-Pentanone	43	8.025	8.025	(0.842)	32602	10.0000	9.61
	10 Acetone	43	2.866	2.866	(0.496)	8024	10.0000	6.74(T)
	37 Benzene	78	6.090	6.090	(0.927)	52138	5.00000	4.80(a)
	39 Bromodichloromethane	83	7.380	7.380	(1.124)	17741	5.00000	4.61(Ta)
	66 Bromoform	173	10.374	10.374	(1.089)	10411	5.00000	4.69(Ta)
	6 Bromomethane	94	1.951	1.951	(0.338)	11772	5.00000	4.12(TaM)
	19 Carbon Disulfide	76	2.959	2.959	(0.512)	45421	10.0000	8.83
	34 Carbon Tetrachloride	117	5.831	5.831	(0.888)	18004	5.00000	4.59(aM)
	59 Chlorobenzene	112	9.553	9.553	(1.003)	37334	5.00000	4.85(a)
	7 Chloroethane	64	2.034	2.034	(0.352)	13535	5.00000	6.13(M)
	28 Chloroform	83	5.494	5.494	(0.951)	23836	5.00000	4.79(a)
	3 Chloromethane	50	1.598	1.598	(0.277)	22250	5.00000	4.01(Ta)
	27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.877)	14731	5.00000	4.74(a)
	46 cis-1,3-Dichloropropene	75	7.839	7.839	(1.193)	20685	5.00000	4.68(a)
	55 Dibromochloromethane	129	8.972	8.972	(0.942)	15049	5.00000	4.66(Ta)
	2 Dichlorodifluoromethane	85	1.447	1.447	(0.250)	10402	5.00000	4.46(TaM)
	61 Ethylbenzene	106	9.668	9.668	(1.015)	19113	5.00000	4.64(aH)
	67 Isopropylbenzene	105	10.551	10.551	(1.107)	60307	5.00000	4.73(a)
	17 Methylene Chloride	84	3.340	3.340	(0.578)	14132	5.00000	4.73(a)
	56 Tetrachloroethene	164	8.686	8.686	(0.912)	12517	5.00000	3.90(a)
	50 Toluene	91	8.157	8.157	(0.856)	57868	5.00000	4.88(a)
	20 trans-1,2-Dichloroethene	96	3.668	3.668	(0.635)	11542	5.00000	4.74(a)
	51 trans-1,3-Dichloropropene	75	8.420	8.420	(1.282)	16929	5.00000	4.50(a)
	38 Trichloroethene	130	6.812	6.812	(1.037)	13693	5.00000	4.48(a)
	8 Trichlorofluoromethane	101	2.249	2.249	(0.389)	14728	5.00000	4.38(Ta)
	5 Vinyl Chloride	62	1.678	1.678	(0.290)	15224	5.00000	4.55(a)
	62 m,p-Xylenes	106	9.790	9.790	(1.028)	47823	10.0000	9.49
	63 o-Xylene	106	10.179	10.179	(1.068)	24981	5.00000	4.74(a)
M	95 Xylenes (total)	106				72804	15.0000	(a)
	71 1,2,3-Trichloropropane	75	10.901	10.901	(0.921)	18621	5.00000	4.83(a)
	93 1,2,3-Trichlorobenzene	182	14.302	14.302	(1.208)	13224	5.00000	4.81(a)
	79 1,2,4-Trimethylbenzene	105	11.497	11.497	(0.971)	50539	5.00000	4.69(a)
	75 1,3,5-Trimethylbenzene	105	11.132	11.132	(0.940)	49475	5.00000	4.71(a)
	26 2,2-Dichloropropane	77	5.048	5.048	(0.873)	18442	5.00000	4.64(a)
	54 1,3-Dichloropropane	76	8.754	8.754	(0.919)	21911	5.00000	4.75(a)
	76 2-Chlorotoluene	91	11.026	11.026	(0.931)	43425	5.00000	4.72(a)
	77 4-Chlorotoluene	91	11.138	11.138	(0.941)	47906	5.00000	4.78(a)
	82 p-Isopropyltoluene	119	11.818	11.818	(0.998)	46314	5.00000	4.65(a)
	29 Bromochloromethane	128	5.368	5.368	(0.929)	7151	5.00000	4.84(a)
	74 Bromobenzene	156	10.833	10.833	(0.915)	16961	5.00000	4.72(a)
	44 Dibromomethane	93	7.194	7.194	(1.095)	8132	5.00000	4.82(a)
	91 Hexachlorobutadiene	225	13.994	13.994	(1.182)	6524	5.00000	4.00(a)
	73 n-Propylbenzene	91	10.955	10.955	(0.925)	64421	5.00000	4.71(a)
	87 n-Butylbenzene	91	12.223	12.223	(1.033)	33851	5.00000	4.57(a)
	81 sec-Butylbenzene	105	11.668	11.668	(0.986)	52080	5.00000	4.48(a)
	92 Naphthalene	128	14.065	14.065	(1.188)	34239	5.00000	3.64(a)
	78 tert-Butylbenzene	119	11.453	11.453	(0.967)	40621	5.00000	4.61(a)
	60 1,1,1,2-Tetrachloroethane	131	9.646	9.646	(1.012)	13932	5.00000	4.67(a)
	64 Styrene	104	10.198	10.198	(1.070)	39508	5.00000	4.70(a)

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121906.D
Report Date: 08-Feb-2018 16:59

QC Flag Legend

T - Target compound detected outside RT window.
a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.
H - Operator selected an alternate compound hit.


Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121906.D
Date : 19-DEC-2017 11:23
Client ID: VSTD005
Sample Info: VSTD005;VSTD005;1;4;
Purge Volume: 5.0
Column phase: DB624
Instrument: VOA2.i
Operator: AP
Column diameter: 0.18
\\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121906.D
Y (x10^5)
Min
-Dichlorodifluoromethane
-Chloromethane+
-Bromomethane+
-Trichlorofluoromethane+
-Diethyl ether+
-1,1-Dichloroethene+
-Acetone+
-Acetonitrile+
-Methylene Chloride
-Acrylonitrile+
-n-Hexane
-1,1-Dichloroethane
-Diisopropyl ether
-tert-Butyl formate
-2,2-Dichloropropane+
-Propionitrile+
-Methacrylonitrile+
-Dibromofluoromethane+
-Pentafluorobenzene+
-1,2-Dichloroethane-d4+
-tert-Amyl methyl ether+
-1,4-Difluorobenzene
-Trichloroethene
-n-Butanol+
-1,2-Dichloropropane
-Methyl Methacrylate+
-Bromodichloromethane
-2-Chloroethylvinyl ether
-cis-1,3-Dichloropropene
-2-Nitropropane+
-Toluene
-Ethyl Methacrylate+
-1,1,2-Trichloroethane
-1,3-Dichloropropane+
-2-Hexanone
-Dibromochloromethane+
-3,3-Dimethyl-1-butanol
-1,1,1,2-Tetrachloroethane+
-m,p-Xylenes
Chlorobenzene-d5+
-o-Xylene+
-Bromoform
-Isopropylbenzene
-4-Bromofluorobenzene
-Bromobenzene+
-1,2,3-Trichloropropane+
-2-Chlorotoluene
-1,3,5-Trimethylbenzene+
-tert-Butylbenzene
-1,2,4-Trimethylbenzene
-sec-Butylbenzene
-1,3-Dichlorobenzene
-1,2,3-Trimethylbenzene
1,4-Dichlorobenzene-d4+
-Benzyl Chloride+
-1,2-Dibromo-3-Chloropropa
-1,3,5-Trichlorobenzene
-1,2,4-Trichlorobenzene
-Hexachlorobutadiene+
-1,2,3-Trichlorobenzene
-2-Methylnaphthalene
-1-Methylnaphthalene

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121907.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121907.D
Lab Smp Id: VSTD010 Client Smp ID: VSTD010
Inj Date : 19-DEC-2017 11:47
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD010;VSTD010;1;5;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\CHEM\VOA2.i\D171219.b\8260LL.m
Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 11:23 Cal File: D121906.D
Als bottle: 7 Calibration Sample, Level: 5
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
31 1,1,1-Trichloroethane	97	5.654	5.654	(0.978)	37895	10.0000	10.30
* 1 Pentafluorobenzene	168	5.779	5.779	(1.000)	237830	50.0000	
$ 30 Dibromofluoromethane	113	5.689	5.689	(0.984)	21200	10.0000	9.89
* 36 1,4-Difluorobenzene	114	6.572	6.572	(1.000)	352105	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.062	6.062	(1.049)	27168	10.0000	10.26
* 47 Chlorobenzene-d5	117	9.524	9.524	(1.000)	328049	50.0000	
$ 48 Toluene-d8	98	8.090	8.090	(0.849)	84452	10.0000	9.76
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	32136	10.0000	10.17
* 70 1,4-Dichlorobenzene-d4	152	11.834	11.834	(1.000)	144718	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.872	10.872	(0.919)	34314	10.0000	9.93
53 1,1,2-Trichloroethane	83	8.597	8.597	(0.903)	19720	10.0000	9.82
32 1,1-Dichloropropene	75	5.853	5.853	(0.891)	28773	10.0000	9.74
22 1,1-Dichloroethane	63	4.281	4.281	(0.741)	50157	10.0000	10.10
11 1,1-Dichloroethene	96	2.750	2.750	(0.476)	20686	10.0000	10.53
90 1,2,4-Trichlorobenzene	180	13.821	13.821	(1.168)	28692	10.0000	10.06
89 1,2-Dibromo-3-Chloropropane	75	13.012	13.012	(1.100)	5460	10.0000	9.60
57 1,2-Dibromoethane	107	9.065	9.065	(0.952)	25156	10.0000	10.00
88 1,2-Dichlorobenzene	146	12.226	12.226	(1.033)	51831	10.0000	9.96
33 1,2-Dichloroethane	62	6.569	6.569	(1.000)	11455	10.0000	3.59(a)
42 1,2-Dichloropropane	63	7.066	7.066	(1.075)	29213	10.0000	10.53(M)
83 1,3-Dichlorobenzene	146	11.767	11.767	(0.994)	52296	10.0000	9.66

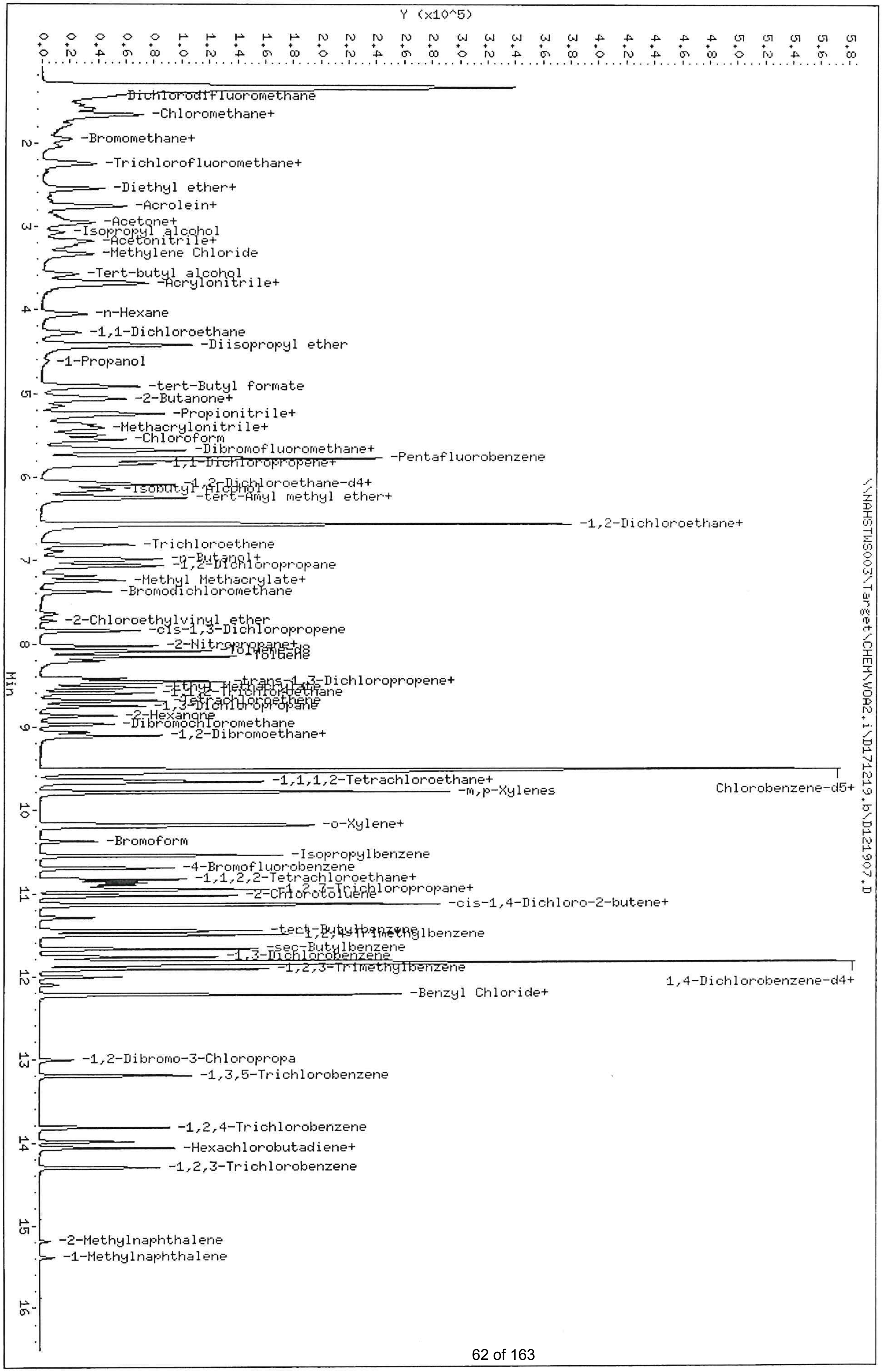
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121907.D
Report Date: 08-Feb-2018 16:59

							AMOUNTS	
		QUANT SIG					CAL-AMT	ON-COL
	Compounds	MASS	RT	EXP RT	REL RT	RESPONSE	(ug/l)	(ug/l)
	84 1,4-Dichlorobenzene	146	11.860	11.860	(1.002)	50273	10.0000	9.70
	24 2-Butanone	43	5.147	5.147	(0.891)	25131	20.0000	19.58
	52 2-Hexanone	43	8.869	8.869	(0.931)	38430	20.0000	19.99
	45 4-Methyl-2-Pentanone	43	8.029	8.029	(0.843)	60355	20.0000	20.27
	10 Acetone	43	2.862	2.862	(0.495)	15119	20.0000	17.28
	37 Benzene	78	6.094	6.094	(0.927)	94240	10.0000	10.17
	39 Bromodichloromethane	83	7.377	7.377	(1.123)	33081	10.0000	10.08
	66 Bromoform	173	10.374	10.374	(1.089)	19346	10.0000	9.94 (T)
	6 Bromomethane	94	1.948	1.948	(0.337)	19732	10.0000	10.22 (M)
	19 Carbon Disulfide	76	2.952	2.952	(0.511)	91292	20.0000	20.36
	34 Carbon Tetrachloride	117	5.837	5.837	(0.888)	34246	10.0000	10.23 (M)
	59 Chlorobenzene	112	9.553	9.553	(1.003)	67378	10.0000	9.97
	7 Chloroethane	64	2.034	2.034	(0.352)	20139	10.0000	10.46 (M)
	28 Chloroform	83	5.494	5.494	(0.951)	44244	10.0000	10.20
	3 Chloromethane	50	1.595	1.595	(0.276)	43035	10.0000	10.06 (T)
	27 cis-1,2-Dichloroethene	96	5.070	5.070	(0.877)	26852	10.0000	9.92
	46 cis-1,3-Dichloropropene	75	7.839	7.839	(1.193)	39110	10.0000	10.38
	55 Dibromochloromethane	129	8.972	8.972	(0.942)	28378	10.0000	10.01
	2 Dichlorodifluoromethane	85	1.447	1.447	(0.250)	21870	10.0000	10.75 (T)
	61 Ethylbenzene	106	9.668	9.668	(1.015)	35642	10.0000	9.85 (H)
	67 Isopropylbenzene	105	10.548	10.548	(1.107)	114863	10.0000	10.26
	17 Methylene Chloride	84	3.331	3.331	(0.576)	25318	10.0000	9.72
	56 Tetrachloroethene	164	8.690	8.690	(0.912)	22413	10.0000	9.74
	50 Toluene	91	8.157	8.157	(0.856)	104621	10.0000	10.06
	20 trans-1,2-Dichloroethene	96	3.665	3.665	(0.634)	21988	10.0000	10.35
	51 trans-1,3-Dichloropropene	75	8.417	8.417	(1.281)	33383	10.0000	10.41
	38 Trichloroethene	130	6.816	6.816	(1.037)	25682	10.0000	9.84
	8 Trichlorofluoromethane	101	2.249	2.249	(0.389)	32301	10.0000	11.01
	5 Vinyl Chloride	62	1.681	1.681	(0.291)	29755	10.0000	10.20
	62 m,p-Xylenes	106	9.790	9.790	(1.028)	89427	20.0000	20.22
	63 o-Xylene	106	10.182	10.182	(1.069)	44528	10.0000	9.62
M	95 Xylenes (total)	106				133955	30.0000	(a)
	71 1,2,3-Trichloropropane	75	10.904	10.904	(0.921)	34398	10.0000	9.97
	93 1,2,3-Trichlorobenzene	182	14.299	14.299	(1.208)	25930	10.0000	10.55
	79 1,2,4-Trimethylbenzene	105	11.501	11.501	(0.972)	93133	10.0000	9.66
	75 1,3,5-Trimethylbenzene	105	11.135	11.135	(0.941)	93296	10.0000	9.93
	26 2,2-Dichloropropane	77	5.044	5.044	(0.873)	35680	10.0000	10.29
	54 1,3-Dichloropropane	76	8.754	8.754	(0.919)	38920	10.0000	9.61
	76 2-Chlorotoluene	91	11.029	11.029	(0.932)	78484	10.0000	9.54
	77 4-Chlorotoluene	91	11.138	11.138	(0.941)	87380	10.0000	9.76
	82 p-Isopropyltoluene	119	11.818	11.818	(0.999)	88488	10.0000	9.93
	29 Bromochloromethane	128	5.362	5.362	(0.928)	13447	10.0000	10.44
	74 Bromobenzene	156	10.833	10.833	(0.915)	30785	10.0000	9.58
	44 Dibromomethane	93	7.191	7.191	(1.094)	15302	10.0000	10.64
	91 Hexachlorobutadiene	225	13.988	13.988	(1.182)	13741	10.0000	10.00
	73 n-Propylbenzene	91	10.952	10.952	(0.925)	120968	10.0000	9.88
	87 n-Butylbenzene	91	12.223	12.223	(1.033)	66777	10.0000	10.08
	81 sec-Butylbenzene	105	11.668	11.668	(0.986)	104072	10.0000	10.00
	92 Naphthalene	128	14.065	14.065	(1.188)	75559	10.0000	9.75
	78 tert-Butylbenzene	119	11.449	11.449	(0.967)	77835	10.0000	9.88
	60 1,1,1,2-Tetrachloroethane	131	9.643	9.643	(1.012)	26535	10.0000	10.13
	64 Styrene	104	10.198	10.198	(1.071)	75784	10.0000	10.27

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121907.D
Report Date: 08-Feb-2018 16:59

QC Flag Legend

T - Target compound detected outside RT window.
a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.
H - Operator selected an alternate compound hit.


Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121907.D
Date : 19-DEC-2017 11:47
Client ID: VSTD010
Sample Info: VSTD010;VSTD010;1;5;
Purge Volume: 5.0
Column phase: DB624
Instrument: VOA2.i
Operator: AP
Column diameter: 0.18
\\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121907.D
Y (x10^5)
Min
-Dichlorodifluoromethane
-Chloromethane+
-Bromomethane+
-Trichlorofluoromethane+
-Diethyl ether+
-Acrolein+
-Acetone+
-Isopropyl alcohol
-Acetonitrile+
-Methylene Chloride
-Tert-butyl alcohol
-Acrylonitrile+
-n-Hexane
-1,1-Dichloroethane
-Diisopropyl ether
-1-Propanol
-tert-Butyl formate
-2-Butanone+
-Propionitrile+
-Methacrylonitrile+
-Chloroform
-Dibromofluoromethane+
-Pentafluorobenzene
-1,1-Dichloropropene+
-1,2-Dichloroethane-d4+
-Isobutyl Alcohol
-tert-Amyl methyl ether+
-1,2-Dichloroethane+
-Trichloroethene
-n-Butanol+
-1,2-Dichloropropane
-Methyl Methacrylate+
-Bromodichloromethane
-2-Chloroethylvinyl ether
-cis-1,3-Dichloropropene
-2-Nitropropane+
-Toluene
-trans-1,3-Dichloropropene+
-1,1,2-Trichloroethane
-Tetrachloroethene
-1,3-Dichloropropane
-2-Hexanone
-Dibromochloromethane
-1,2-Dibromoethane+
-1,1,1,2-Tetrachloroethane+
-m,p-Xylenes
Chlorobenzene-d5+
-o-Xylene+
-Bromoform
-Isopropylbenzene
-4-Bromofluorobenzene
-1,1,2,2-Tetrachloroethane+
-1,2,3-Trichloropropane+
-2-Chlorotoluene
-cis-1,4-Dichloro-2-butene+
-tert-Butylbenzene
-1,2,4-Trimethylbenzene
-sec-Butylbenzene
-1,3-Dichlorobenzene
-1,2,3-Trimethylbenzene
1,4-Dichlorobenzene-d4+
-Benzyl Chloride+
-1,2-Dibromo-3-Chloropropa
-1,3,5-Trichlorobenzene
-1,2,4-Trichlorobenzene
-Hexachlorobutadiene+
-1,2,3-Trichlorobenzene
-2-Methylnaphthalene
-1-Methylnaphthalene

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121908.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121908.D
Lab Smp Id: VSTD020 Client Smp ID: VSTD020
Inj Date : 19-DEC-2017 12:14
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD020;VSTD020;1;6;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\CHEM\VOA2.i\D171219.b\8260LL.m
Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 11:47 Cal File: D121907.D
Als bottle: 8 Calibration Sample, Level: 6
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	AMOUNTS ON-COL (ug/l)
31 1,1,1-Trichloroethane	97	5.654	5.654	(0.978)	78591	20.0000	20.54
* 1 Pentafluorobenzene	168	5.782	5.782	(1.000)	247505	50.0000	
$ 30 Dibromofluoromethane	113	5.686	5.686	(0.983)	42633	20.0000	19.11
* 36 1,4-Difluorobenzene	114	6.572	6.572	(1.000)	377533	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.055	6.055	(1.047)	54044	20.0000	19.62
* 47 Chlorobenzene-d5	117	9.527	9.527	(1.000)	340657	50.0000	
$ 48 Toluene-d8	98	8.093	8.093	(0.849)	169178	20.0000	18.83
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	63474	20.0000	19.35
* 70 1,4-Dichlorobenzene-d4	152	11.834	11.834	(1.000)	152059	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.872	10.872	(0.919)	66290	20.0000	18.27
53 1,1,2-Trichloroethane	83	8.593	8.593	(0.902)	40699	20.0000	19.53
32 1,1-Dichloropropene	75	5.850	5.850	(0.890)	61975	20.0000	20.52
22 1,1-Dichloroethane	63	4.274	4.274	(0.739)	102995	20.0000	19.93
11 1,1-Dichloroethene	96	2.750	2.750	(0.476)	43049	20.0000	21.07
90 1,2,4-Trichlorobenzene	180	13.818	13.818	(1.168)	67305	20.0000	22.46
89 1,2-Dibromo-3-Chloropropane	75	13.012	13.012	(1.100)	11302	20.0000	18.40
57 1,2-Dibromoethane	107	9.068	9.068	(0.952)	52264	20.0000	20.02
88 1,2-Dichlorobenzene	146	12.223	12.223	(1.033)	108285	20.0000	19.81
33 1,2-Dichloroethane	62	6.142	6.142	(0.935)	73153	20.0000	21.88
42 1,2-Dichloropropane	63	7.069	7.069	(1.076)	57317	20.0000	19.27(M)
83 1,3-Dichlorobenzene	146	11.770	11.770	(0.995)	112309	20.0000	19.74

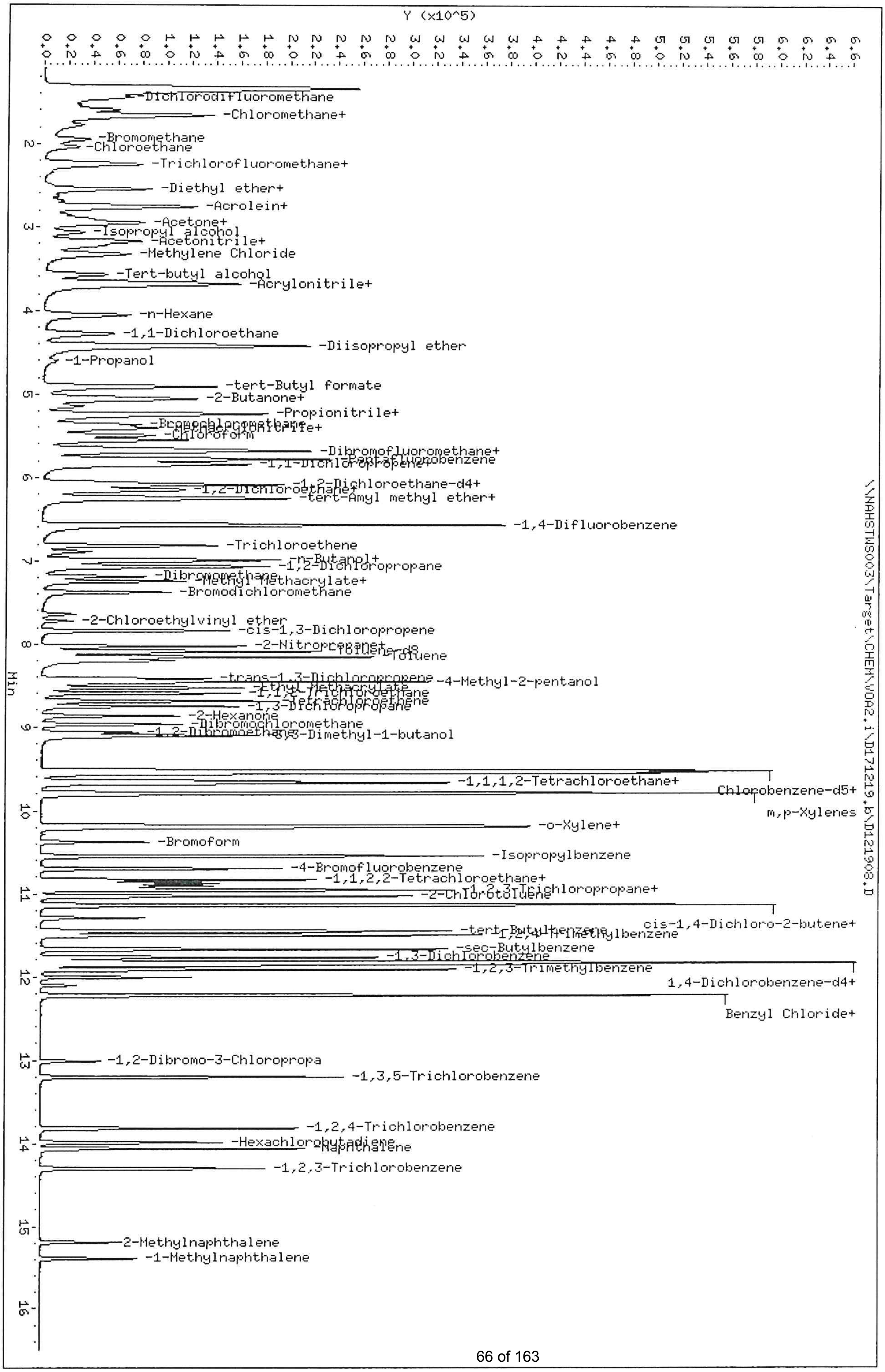
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121908.D
Report Date: 08-Feb-2018 16:59

	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	AMOUNTS ON-COL (ug/l)
	84 1,4-Dichlorobenzene	146	11.860	11.860	(1.002)	103710	20.0000	19.06
	24 2-Butanone	43	5.141	5.141	(0.889)	48984	40.0000	36.67
	52 2-Hexanone	43	8.866	8.866	(0.931)	75537	40.0000	37.84
	45 4-Methyl-2-Pentanone	43	8.029	8.029	(0.843)	116500	40.0000	37.69
	10 Acetone	43	2.856	2.856	(0.494)	33367	40.0000	39.27
	37 Benzene	78	6.087	6.087	(0.926)	188661	20.0000	18.99
	39 Bromodichloromethane	83	7.377	7.377	(1.123)	70757	20.0000	20.12
	66 Bromoform	173	10.374	10.374	(1.089)	41520	20.0000	20.54
	6 Bromomethane	94	1.941	1.941	(0.336)	37890	20.0000	20.97(M)
	19 Carbon Disulfide	76	2.952	2.952	(0.511)	193500	40.0000	41.47
	34 Carbon Tetrachloride	117	5.837	5.837	(0.888)	68216	20.0000	19.02(MH)
	59 Chlorobenzene	112	9.553	9.553	(1.003)	138156	20.0000	19.69
	7 Chloroethane	64	2.047	2.047	(0.354)	40521	20.0000	20.23(M)
	28 Chloroform	83	5.494	5.494	(0.950)	88595	20.0000	19.63
	3 Chloromethane	50	1.595	1.595	(0.276)	90594	20.0000	21.34
	27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.876)	53810	20.0000	19.10
	46 cis-1,3-Dichloropropene	75	7.839	7.839	(1.193)	83791	20.0000	20.75
	55 Dibromochloromethane	129	8.969	8.969	(0.941)	60863	20.0000	20.69
	2 Dichlorodifluoromethane	85	1.447	1.447	(0.250)	47446	20.0000	22.42
	61 Ethylbenzene	106	9.675	9.675	(1.015)	75990	20.0000	20.23(H)
	67 Isopropylbenzene	105	10.548	10.548	(1.107)	237346	20.0000	20.43
	17 Methylene Chloride	84	3.331	3.331	(0.576)	50656	20.0000	18.69
	56 Tetrachloroethene	164	8.686	8.686	(0.912)	46886	20.0000	21.37
	50 Toluene	91	8.157	8.157	(0.856)	217602	20.0000	20.15
	20 trans-1,2-Dichloroethene	96	3.671	3.671	(0.635)	45649	20.0000	20.65
	51 trans-1,3-Dichloropropene	75	8.417	8.417	(1.281)	71936	20.0000	20.93
	38 Trichloroethene	130	6.822	6.822	(1.038)	56994	20.0000	20.38
	8 Trichlorofluoromethane	101	2.256	2.256	(0.390)	67183	20.0000	22.01
	5 Vinyl Chloride	62	1.681	1.681	(0.291)	63525	20.0000	20.94
	62 m,p-Xylenes	106	9.790	9.790	(1.028)	184416	40.0000	40.15
	63 o-Xylene	106	10.175	10.175	(1.068)	95335	20.0000	19.84
M	95 Xylenes (total)	106				279751	60.0000	(a)
	71 1,2,3-Trichloropropane	75	10.901	10.901	(0.921)	69837	20.0000	19.27
	93 1,2,3-Trichlorobenzene	182	14.302	14.302	(1.209)	57198	20.0000	22.15
	79 1,2,4-Trimethylbenzene	105	11.501	11.501	(0.972)	197269	20.0000	19.47
	75 1,3,5-Trimethylbenzene	105	11.132	11.132	(0.941)	192655	20.0000	19.53
	26 2,2-Dichloropropane	77	5.048	5.048	(0.873)	72639	20.0000	20.14
	54 1,3-Dichloropropane	76	8.751	8.751	(0.918)	81872	20.0000	19.47
	76 2-Chlorotoluene	91	11.029	11.029	(0.932)	167050	20.0000	19.33
	77 4-Chlorotoluene	91	11.138	11.138	(0.941)	180539	20.0000	19.19
	82 p-Isopropyltoluene	119	11.818	11.818	(0.999)	189137	20.0000	20.20
	29 Bromochloromethane	128	5.365	5.365	(0.928)	28167	20.0000	21.01
	74 Bromobenzene	156	10.833	10.833	(0.915)	64552	20.0000	19.13
	44 Dibromomethane	93	7.191	7.191	(1.094)	32043	20.0000	20.79
	91 Hexachlorobutadiene	225	13.991	13.991	(1.182)	30591	20.0000	21.69
	73 n-Propylbenzene	91	10.955	10.955	(0.926)	257005	20.0000	19.99
	87 n-Butylbenzene	91	12.223	12.223	(1.033)	149001	20.0000	21.41
	81 sec-Butylbenzene	105	11.668	11.668	(0.986)	223410	20.0000	20.44
	92 Naphthalene	128	14.061	14.061	(1.188)	161007	20.0000	20.32
	78 tert-Butylbenzene	119	11.453	11.453	(0.968)	164758	20.0000	19.91
	60 1,1,1,2-Tetrachloroethane	131	9.646	9.646	(1.012)	55350	20.0000	20.36
	64 Styrene	104	10.198	10.198	(1.070)	156998	20.0000	20.48

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121908.D
Report Date: 08-Feb-2018 16:59

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.
H - Operator selected an alternate compound hit.


Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121908.D
Date : 19-DEC-2017 12:14
Client ID: VSTD020
Sample Info: VSTD020;VSTD020;1;6;
Purge Volume: 5.0
Column phase: DB624
Instrument: VOA2.i
Operator: AP
Column diameter: 0.18
\\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121908.D
Y (x10^5)
Min
-Dichlorodifluoromethane
-Chloromethane+
-Bromomethane
-Chloroethane
-Trichlorofluoromethane+
-Diethyl ether+
-Acrolein+
-Acetone+
-Isopropyl alcohol
-Acetonitrile+
-Methylene Chloride
-Tert-butyl alcohol
-Acrylonitrile+
-n-Hexane
-1,1-Dichloroethane
-Diisopropyl ether
-1-Propanol
-tert-Butyl formate
-2-Butanone+
-Propionitrile+
-Chloroform
-Dibromofluoromethane+
-Pentafluorobenzene
-1,2-Dichloroethane-d4+
-tert-Amyl methyl ether+
-1,4-Difluorobenzene
-Trichloroethene
-n-Butanol+
-1,2-Dichloropropane
-Dibromomethane
-Methyl Methacrylate+
-Bromodichloromethane
-2-Chloroethylvinyl ether
-cis-1,3-Dichloropropene
-2-Nitropropane+
-Toluene
-trans-1,3-Dichloropropene
-4-Methyl-2-pentanol
-Ethyl Methacrylate
-1,1,2-Trichloroethane
-Tetrachloroethene
-1,3-Dichloropropane
-2-Hexanone
-Dibromochloromethane
-3,3-Dimethyl-1-butanol
-1,1,1,2-Tetrachloroethane+
Chlorobenzene-d5+
m,p-Xylenes
-o-Xylene+
-Bromoform
-Isopropylbenzene
-4-Bromofluorobenzene
-1,1,2,2-Tetrachloroethane+
-1,2,3-Trichloropropane+
-2-Chlorotoluene
cis-1,4-Dichloro-2-butene+
-tert-Butylbenzene
-1,2,4-Trimethylbenzene
-sec-Butylbenzene
-1,3-Dichlorobenzene
-1,2,3-Trimethylbenzene
1,4-Dichlorobenzene-d4+
Benzyl Chloride+
-1,2-Dibromo-3-Chloropropa
-1,3,5-Trichlorobenzene
-1,2,4-Trichlorobenzene
-Hexachlorobutadiene
-Naphthalene
-1,2,3-Trichlorobenzene
-2-Methylnaphthalene
-1-Methylnaphthalene

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121909.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121909.D
Lab Smp Id: VSTD050 Client Smp ID: VSTD050
Inj Date : 19-DEC-2017 12:39
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD050;VSTD050;1;7;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\CHEM\VOA2.i\D171219.b\8260LL.m
Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 12:14 Cal File: D121908.D
Als bottle: 9 Calibration Sample, Level: 7
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
31 1,1,1-Trichloroethane	97	5.654	5.654	(0.978)	186795	50.0000	51.22
* 1 Pentafluorobenzene	168	5.782	5.782	(1.000)	235952	50.0000	
$ 30 Dibromofluoromethane	113	5.686	5.686	(0.983)	101827	50.0000	47.89
* 36 1,4-Difluorobenzene	114	6.572	6.572	(1.000)	375071	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.058	6.058	(1.048)	130826	50.0000	49.82
* 47 Chlorobenzene-d5	117	9.527	9.527	(1.000)	338284	50.0000	
$ 48 Toluene-d8	98	8.093	8.093	(0.849)	393321	50.0000	44.09
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	152091	50.0000	46.69
* 70 1,4-Dichlorobenzene-d4	152	11.838	11.838	(1.000)	148533	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.872	10.872	(0.918)	161093	50.0000	45.46
53 1,1,2-Trichloroethane	83	8.593	8.593	(0.902)	99527	50.0000	48.09
32 1,1-Dichloropropene	75	5.856	5.856	(0.891)	151900	50.0000	52.00
22 1,1-Dichloroethane	63	4.281	4.281	(0.740)	247818	50.0000	50.30
11 1,1-Dichloroethene	96	2.750	2.750	(0.476)	103192	50.0000	52.98
90 1,2,4-Trichlorobenzene	180	13.817	13.817	(1.167)	164262	50.0000	56.13
89 1,2-Dibromo-3-Chloropropane	75	13.009	13.009	(1.099)	30643	50.0000	50.13
57 1,2-Dibromoethane	107	9.065	9.065	(0.952)	128740	50.0000	49.67
88 1,2-Dichlorobenzene	146	12.226	12.226	(1.033)	257317	50.0000	48.19
33 1,2-Dichloroethane	62	6.142	6.142	(0.935)	175492	50.0000	52.99
42 1,2-Dichloropropane	63	7.069	7.069	(1.076)	140543	50.0000	47.57
83 1,3-Dichlorobenzene	146	11.767	11.767	(0.994)	265949	50.0000	47.86

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121909.D
Report Date: 08-Feb-2018 16:59

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
84 1,4-Dichlorobenzene	146	11.860	11.860	(1.002)	253757	50.0000	47.75
24 2-Butanone	43	5.147	5.147	(0.890)	124936	100.000	98.12
52 2-Hexanone	43	8.866	8.866	(0.931)	187852	100.000	94.77
45 4-Methyl-2-Pentanone	43	8.029	8.029	(0.843)	288559	100.000	94.02
10 Acetone	43	2.862	2.862	(0.495)	83806	100.000	107.31
37 Benzene	78	6.097	6.097	(0.928)	475144	50.0000	48.14
39 Bromodichloromethane	83	7.377	7.377	(1.123)	173751	50.0000	49.74
66 Bromoform	173	10.374	10.374	(1.089)	107385	50.0000	53.51
6 Bromomethane	94	1.944	1.944	(0.336)	88179	50.0000	54.81
19 Carbon Disulfide	76	2.952	2.952	(0.511)	464487	100.000	104.44
34 Carbon Tetrachloride	117	5.830	5.830	(0.887)	153362	50.0000	43.04(H)
59 Chlorobenzene	112	9.556	9.556	(1.003)	330208	50.0000	47.39
7 Chloroethane	64	2.041	2.041	(0.353)	86782	50.0000	45.45(M)
28 Chloroform	83	5.494	5.494	(0.950)	215735	50.0000	50.15
3 Chloromethane	50	1.595	1.595	(0.276)	201934	50.0000	51.19
27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.876)	133957	50.0000	49.90
46 cis-1,3-Dichloropropene	75	7.839	7.839	(1.193)	211359	50.0000	52.69
55 Dibromochloromethane	129	8.969	8.969	(0.941)	149132	50.0000	51.06
2 Dichlorodifluoromethane	85	1.447	1.447	(0.250)	110936	50.0000	54.99
61 Ethylbenzene	106	9.672	9.672	(1.015)	175926	50.0000	47.18(H)
67 Isopropylbenzene	105	10.548	10.548	(1.107)	550664	50.0000	47.73
17 Methylene Chloride	84	3.334	3.334	(0.577)	123761	50.0000	47.92
56 Tetrachloroethene	164	8.690	8.690	(0.912)	108668	50.0000	52.16
50 Toluene	91	8.160	8.160	(0.857)	501085	50.0000	46.74
20 trans-1,2-Dichloroethene	96	3.668	3.668	(0.634)	115924	50.0000	55.03
51 trans-1,3-Dichloropropene	75	8.420	8.420	(1.281)	182394	50.0000	53.43
38 Trichloroethene	130	6.819	6.819	(1.038)	136623	50.0000	49.17
8 Trichlorofluoromethane	101	2.256	2.256	(0.390)	157909	50.0000	54.27
5 Vinyl Chloride	62	1.681	1.681	(0.291)	146127	50.0000	50.52
62 m,p-Xylenes	106	9.790	9.790	(1.028)	427108	100.000	93.66
63 o-Xylene	106	10.179	10.179	(1.068)	229237	50.0000	48.05
M 95 Xylenes (total)	106				656345	150.000	(a)
71 1,2,3-Trichloropropane	75	10.904	10.904	(0.921)	172192	50.0000	48.66
93 1,2,3-Trichlorobenzene	182	14.302	14.302	(1.208)	135765	50.0000	53.84
79 1,2,4-Trimethylbenzene	105	11.501	11.501	(0.972)	454906	50.0000	45.97
75 1,3,5-Trimethylbenzene	105	11.135	11.135	(0.941)	445617	50.0000	46.25
26 2,2-Dichloropropane	77	5.041	5.041	(0.872)	174913	50.0000	50.88
54 1,3-Dichloropropane	76	8.754	8.754	(0.919)	195730	50.0000	46.89
76 2-Chlorotoluene	91	11.029	11.029	(0.932)	384723	50.0000	45.59
77 4-Chlorotoluene	91	11.141	11.141	(0.941)	427083	50.0000	46.48
82 p-Isopropyltoluene	119	11.818	11.818	(0.998)	433050	50.0000	47.36
29 Bromochloromethane	128	5.365	5.365	(0.928)	65939	50.0000	51.61
74 Bromobenzene	156	10.833	10.833	(0.915)	156920	50.0000	47.62
44 Dibromomethane	93	7.191	7.191	(1.094)	77818	50.0000	50.83
91 Hexachlorobutadiene	225	13.991	13.991	(1.182)	68105	50.0000	50.01
73 n-Propylbenzene	91	10.955	10.955	(0.925)	584086	50.0000	46.51
87 n-Butylbenzene	91	12.223	12.223	(1.033)	339560	50.0000	49.97
81 sec-Butylbenzene	105	11.667	11.667	(0.986)	510740	50.0000	47.83
92 Naphthalene	128	14.061	14.061	(1.188)	395649	50.0000	51.94
78 tert-Butylbenzene	119	11.452	11.452	(0.967)	385055	50.0000	47.64
60 1,1,1,2-Tetrachloroethane	131	9.646	9.646	(1.012)	134297	50.0000	49.74
64 Styrene	104	10.201	10.201	(1.071)	374411	50.0000	49.20

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Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121909.D
Report Date: 08-Feb-2018 16:59
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QC Flag Legend

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a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
M - Compound response manually integrated.
H - Operator selected an alternate compound hit.
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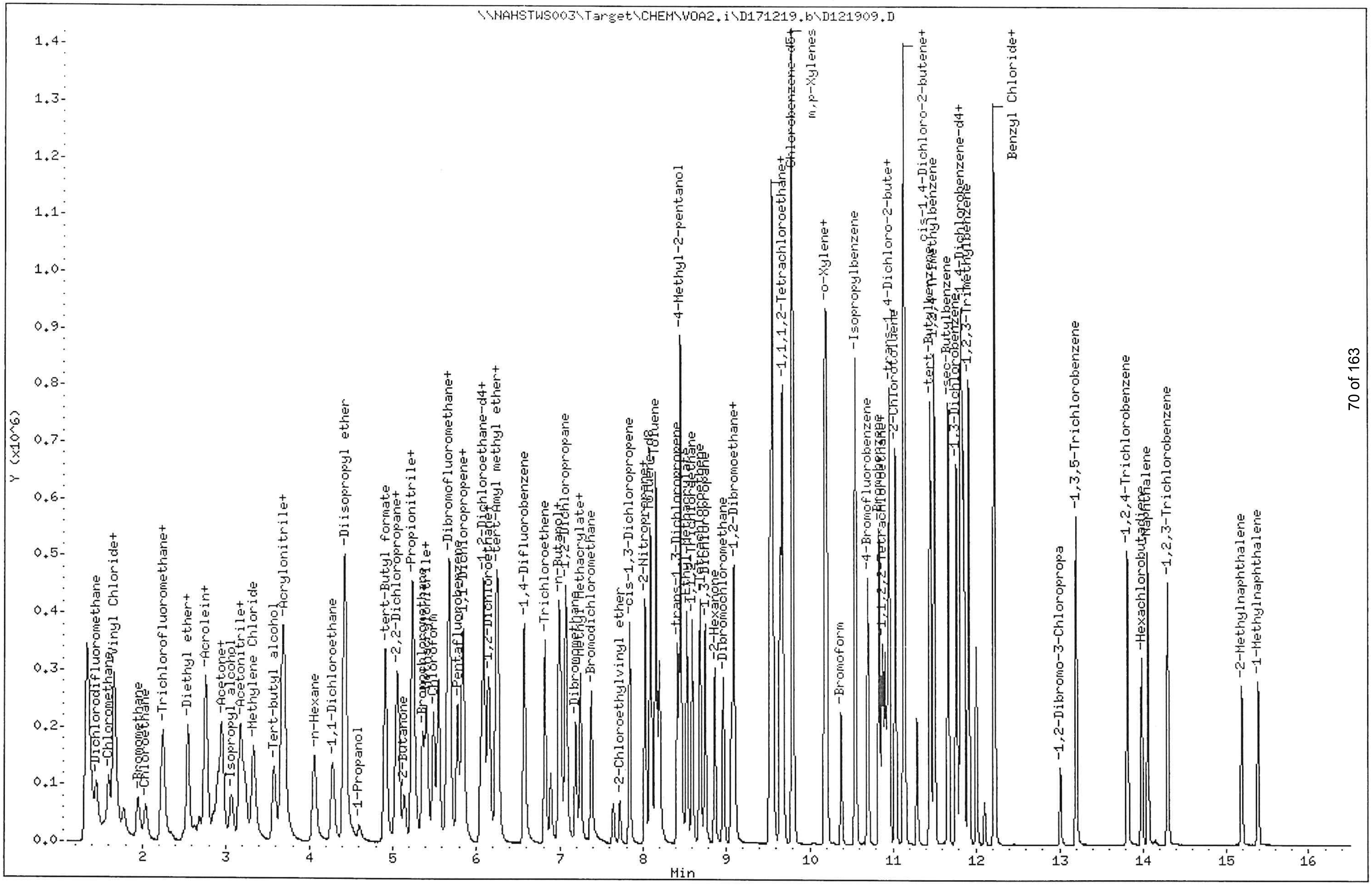
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121909.D
Date : 19-DEC-2017 12:39
Client ID: VSTD050
Sample Info: VSTD050;VSTD050;1;7;
Purge Volume: 5.0
Column phase: DB624

Instrument: VOA2.i

Operator: AP
Column diameter: 0.18



Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121910.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121910.D
Lab Smp Id: VSTD100 Client Smp ID: VSTD100
Inj Date : 19-DEC-2017 13:03
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD100;VSTD100;1;8;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\CHEM\VOA2.i\D171219.b\8260LL.m
Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 12:39 Cal File: D121909.D
Als bottle: 10 Calibration Sample, Level: 8
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
	31 1,1,1-Trichloroethane	97	5.657	5.657	(0.978)	359337	100.000	100.16
*	1 Pentafluorobenzene	168	5.786	5.786	(1.000)	232106	50.0000	
$	30 Dibromofluoromethane	113	5.686	5.686	(0.983)	196966	100.000	94.18
*	36 1,4-Difluorobenzene	114	6.575	6.575	(1.000)	367391	50.0000	
$	35 1,2-Dichloroethane-d4	65	6.062	6.062	(1.048)	261877	100.000	101.39
*	47 Chlorobenzene-d5	117	9.527	9.527	(1.000)	334258	50.0000	
$	48 Toluene-d8	98	8.096	8.096	(0.850)	740602	100.000	84.03
$	69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	294343	100.000	91.46
*	70 1,4-Dichlorobenzene-d4	152	11.838	11.838	(1.000)	145669	50.0000	
	68 1,1,2,2-Tetrachloroethane	83	10.875	10.875	(0.919)	316208	100.000	90.99
	53 1,1,2-Trichloroethane	83	8.597	8.597	(0.902)	192511	100.000	94.14
	32 1,1-Dichloropropene	75	5.856	5.856	(0.891)	286474	100.000	100.99
	22 1,1-Dichloroethane	63	4.281	4.281	(0.740)	476188	100.000	98.26
	11 1,1-Dichloroethene	96	2.750	2.750	(0.475)	200113	100.000	104.46
	90 1,2,4-Trichlorobenzene	180	13.821	13.821	(1.168)	328605	100.000	114.50
	89 1,2-Dibromo-3-Chloropropane	75	13.009	13.009	(1.099)	61519	100.000	102.05
	57 1,2-Dibromoethane	107	9.068	9.068	(0.952)	256307	100.000	100.08
	88 1,2-Dichlorobenzene	146	12.226	12.226	(1.033)	479561	100.000	91.59
	33 1,2-Dichloroethane	62	6.148	6.148	(0.935)	337824	100.000	104.25
	42 1,2-Dichloropropane	63	7.069	7.069	(1.075)	271672	100.000	93.88
	83 1,3-Dichlorobenzene	146	11.770	11.770	(0.994)	508346	100.000	93.29

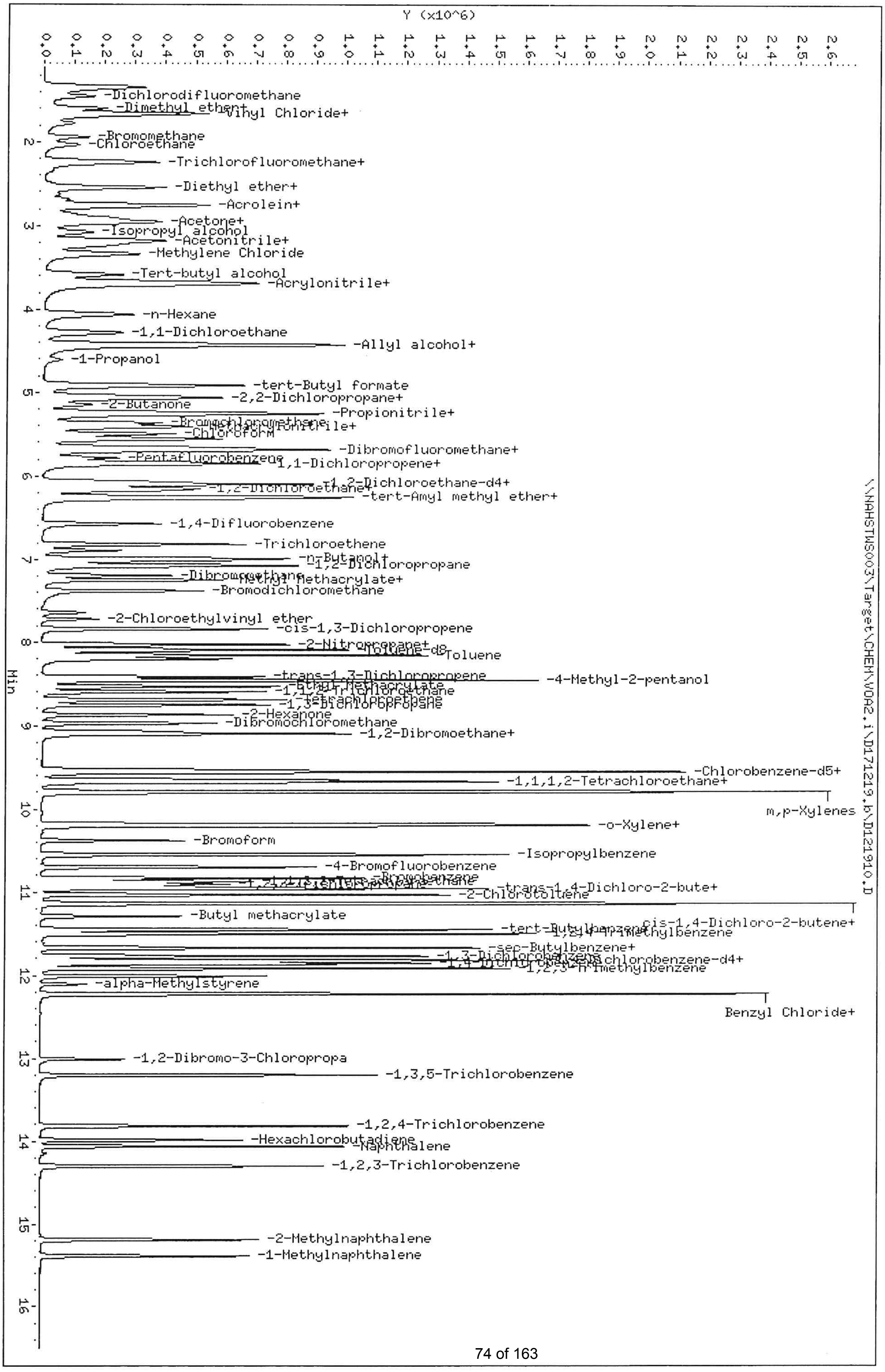
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121910.D
Report Date: 08-Feb-2018 16:59

	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
	84 1,4-Dichlorobenzene	146	11.863	11.863	(1.002)	493502	100.000	94.69
	24 2-Butanone	43	5.150	5.150	(0.890)	260350	200.000	207.87(A)
	52 2-Hexanone	43	8.869	8.869	(0.931)	381694	200.000	194.89
	45 4-Methyl-2-Pentanone	43	8.032	8.032	(0.843)	569796	200.000	187.89
	10 Acetone	43	2.862	2.862	(0.495)	155352	200.000	204.30(A)
	37 Benzene	78	6.094	6.094	(0.927)	907206	100.000	93.85
	39 Bromodichloromethane	83	7.377	7.377	(1.122)	343436	100.000	100.37
	66 Bromoform	173	10.378	10.378	(1.089)	219356	100.000	110.63
	6 Bromomethane	94	1.938	1.938	(0.335)	161998	100.000	104.53
	19 Carbon Disulfide	76	2.955	2.955	(0.511)	891341	200.000	203.74(A)
	34 Carbon Tetrachloride	117	5.837	5.837	(0.888)	314365	100.000	90.08(MH)
	59 Chlorobenzene	112	9.556	9.556	(1.003)	627395	100.000	91.14
	7 Chloroethane	64	2.038	2.038	(0.352)	169642	100.000	90.33
	28 Chloroform	83	5.497	5.497	(0.950)	415480	100.000	98.18
	3 Chloromethane	50	1.595	1.595	(0.276)	389398	100.000	101.26
	27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.876)	260493	100.000	98.64
	46 cis-1,3-Dichloropropene	75	7.842	7.842	(1.193)	413879	100.000	105.33
	55 Dibromochloromethane	129	8.972	8.972	(0.942)	294218	100.000	101.95
	2 Dichlorodifluoromethane	85	1.450	1.450	(0.251)	216165	100.000	108.94
	61 Ethylbenzene	106	9.675	9.675	(1.015)	328547	100.000	89.17(H)
	67 Isopropylbenzene	105	10.548	10.548	(1.107)	1024383	100.000	89.87
	17 Methylene Chloride	84	3.334	3.334	(0.576)	243786	100.000	95.95
	56 Tetrachloroethene	164	8.693	8.693	(0.912)	206898	100.000	102.09
	50 Toluene	91	8.160	8.160	(0.857)	942268	100.000	88.95
	20 trans-1,2-Dichloroethene	96	3.668	3.668	(0.634)	220029	100.000	106.18
	51 trans-1,3-Dichloropropene	75	8.420	8.420	(1.281)	370545	100.000	110.82
	38 Trichloroethene	130	6.822	6.822	(1.038)	264221	100.000	97.09
	8 Trichlorofluoromethane	101	2.249	2.249	(0.389)	302337	100.000	105.64
	5 Vinyl Chloride	62	1.681	1.681	(0.291)	289377	100.000	101.71
	62 m,p-Xylenes	106	9.794	9.794	(1.028)	794645	200.000	176.35
	63 o-Xylene	106	10.182	10.182	(1.069)	430424	100.000	91.30
M	95 Xylenes (total)	106				1225069	300.000	(a)
	71 1,2,3-Trichloropropane	75	10.904	10.904	(0.921)	342153	100.000	98.60
	93 1,2,3-Trichlorobenzene	182	14.302	14.302	(1.208)	286124	100.000	115.71
	79 1,2,4-Trimethylbenzene	105	11.504	11.504	(0.972)	847846	100.000	87.38
	75 1,3,5-Trimethylbenzene	105	11.135	11.135	(0.941)	830511	100.000	87.89
	26 2,2-Dichloropropane	77	5.044	5.044	(0.872)	339030	100.000	100.26
	54 1,3-Dichloropropane	76	8.757	8.757	(0.919)	385871	100.000	93.56
	76 2-Chlorotoluene	91	11.032	11.032	(0.932)	725093	100.000	87.62
	77 4-Chlorotoluene	91	11.141	11.141	(0.941)	797152	100.000	88.47
	82 p-Isopropyltoluene	119	11.822	11.822	(0.999)	821994	100.000	91.67
	29 Bromochloromethane	128	5.368	5.368	(0.928)	132951	100.000	105.79
	74 Bromobenzene	156	10.833	10.833	(0.915)	300219	100.000	92.90
	44 Dibromomethane	93	7.194	7.194	(1.094)	154979	100.000	103.34
	91 Hexachlorobutadiene	225	13.988	13.988	(1.182)	134255	100.000	100.96
	73 n-Propylbenzene	91	10.958	10.958	(0.926)	1101290	100.000	89.41
	87 n-Butylbenzene	91	12.223	12.223	(1.033)	641790	100.000	96.30
	81 sec-Butylbenzene	105	11.671	11.671	(0.986)	958811	100.000	91.57
	92 Naphthalene	128	14.065	14.065	(1.188)	794606	100.000	106.92
	78 tert-Butylbenzene	119	11.453	11.453	(0.967)	717972	100.000	90.57
	60 1,1,1,2-Tetrachloroethane	131	9.649	9.649	(1.013)	262051	100.000	98.24
	64 Styrene	104	10.201	10.201	(1.071)	698309	100.000	92.88

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121910.D
Report Date: 08-Feb-2018 16:59

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).
A - Target compound detected but, quantitated amount
    exceeded maximum amount.
M - Compound response manually integrated.
H - Operator selected an alternate compound hit.


Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121910.D
Date : 19-DEC-2017 13:03
Client ID: VSTD100
Sample Info: VSTD100;VSTD100;1;8;
Purge Volume: 5.0
Column phase: DB624
Instrument: VOA2.i
Operator: AP
Column diameter: 0.18
\\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121910.D
Y (x10^6)
Min
-Dichlorodifluoromethane
-Dimethyl ether+
Vinyl Chloride+
-Bromomethane
-Chloroethane
-Trichlorofluoromethane+
-Diethyl ether+
-Acrolein+
-Acetone+
-Isopropyl alcohol
-Acetonitrile+
-Methylene Chloride
-Tert-butyl alcohol
-Acrylonitrile+
-n-Hexane
-1,1-Dichloroethane
-Allyl alcohol+
-1-Propanol
-tert-Butyl formate
-2,2-Dichloropropane+
-2-Butanone
-Propionitrile+
-Bromochloromethane
-Chloroform
-Dibromofluoromethane+
-Pentafluorobenzene
-1,1-Dichloropropene+
-1,2-Dichloroethane-d4+
-1,2-Dichloroethane
-tert-Amyl methyl ether+
-1,4-Difluorobenzene
-Trichloroethene
-n-Butanol+
-1,2-Dichloropropane
-Dibromomethane
Methyl Methacrylate+
-Bromodichloromethane
-2-Chloroethylvinyl ether
-cis-1,3-Dichloropropene
-2-Nitropropane+
Toluene-d8
Toluene
-trans-1,3-Dichloropropene
-4-Methyl-2-pentanol
-Ethyl Methacrylate
-1,1,2-Trichloroethane
-Tetrachloroethene
-1,3-Dichloropropane
-2-Hexanone
-Dibromochloromethane
-1,2-Dibromoethane+
-Chlorobenzene-d5+
-1,1,1,2-Tetrachloroethane+
m,p-Xylenes
-o-Xylene+
-Bromoform
-Isopropylbenzene
-4-Bromofluorobenzene
-Bromobenzene
-trans-1,4-Dichloro-2-butene+
-2-Chlorotoluene
-Butyl methacrylate
-tert-Butylbenzene
cis-1,4-Dichloro-2-butene+
1,2,4-Trimethylbenzene
-sec-Butylbenzene+
-1,3-Dichlorobenzene
chlorobenzene-d4+
-1,4-Dichlorobenzene
1,2,3-Trimethylbenzene
-alpha-Methylstyrene
Benzyl Chloride+
-1,2-Dibromo-3-Chloropropa
-1,3,5-Trichlorobenzene
-1,2,4-Trichlorobenzene
-Hexachlorobutadiene
-Naphthalene
-1,2,3-Trichlorobenzene
-2-Methylnaphthalene
-1-Methylnaphthalene

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121911.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121911.D
Lab Smp Id: VSTD200 Client Smp ID: VSTD200
Inj Date : 19-DEC-2017 13:27
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD200;VSTD200;1;9;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\CHEM\VOA2.i\D171219.b\8260LL.m
Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 13:03 Cal File: D121910.D
Als bottle: 11 Calibration Sample, Level: 9
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
31 1,1,1-Trichloroethane	97	5.661	5.661	(0.978)	716255	200.000	189.95
* 1 Pentafluorobenzene	168	5.786	5.786	(1.000)	243965	50.0000	
$ 30 Dibromofluoromethane	113	5.686	5.686	(0.983)	380348	200.000	173.03
* 36 1,4-Difluorobenzene	114	6.575	6.575	(1.000)	381634	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.062	6.062	(1.048)	509778	200.000	187.78
* 47 Chlorobenzene-d5	117	9.531	9.531	(1.000)	346750	50.0000	
$ 48 Toluene-d8	98	8.096	8.096	(0.850)	1426526	200.000	156.03
$ 69 4-Bromofluorobenzene	95	10.702	10.702	(1.123)	567658	200.000	170.03
* 70 1,4-Dichlorobenzene-d4	152	11.841	11.841	(1.000)	146695	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.878	10.878	(0.919)	606455	200.000	173.30
53 1,1,2-Trichloroethane	83	8.603	8.603	(0.903)	381912	200.000	180.04
32 1,1-Dichloropropene	75	5.856	5.856	(0.891)	583601	200.000	198.95
22 1,1-Dichloroethane	63	4.281	4.281	(0.740)	939835	200.000	184.52
11 1,1-Dichloroethene	96	2.741	2.741	(0.474)	381816	200.000	189.62
90 1,2,4-Trichlorobenzene	180	13.821	13.821	(1.167)	633301	200.000	219.14(A)
89 1,2-Dibromo-3-Chloropropane	75	13.012	13.012	(1.099)	121157	200.000	199.07
57 1,2-Dibromoethane	107	9.075	9.075	(0.952)	509836	200.000	191.90
88 1,2-Dichlorobenzene	146	12.229	12.229	(1.033)	893240	200.000	169.40
33 1,2-Dichloroethane	62	6.148	6.148	(0.935)	662291	200.000	196.84
42 1,2-Dichloropropane	63	7.073	7.073	(1.076)	535297	200.000	178.08
83 1,3-Dichlorobenzene	146	11.774	11.774	(0.994)	974555	200.000	177.60

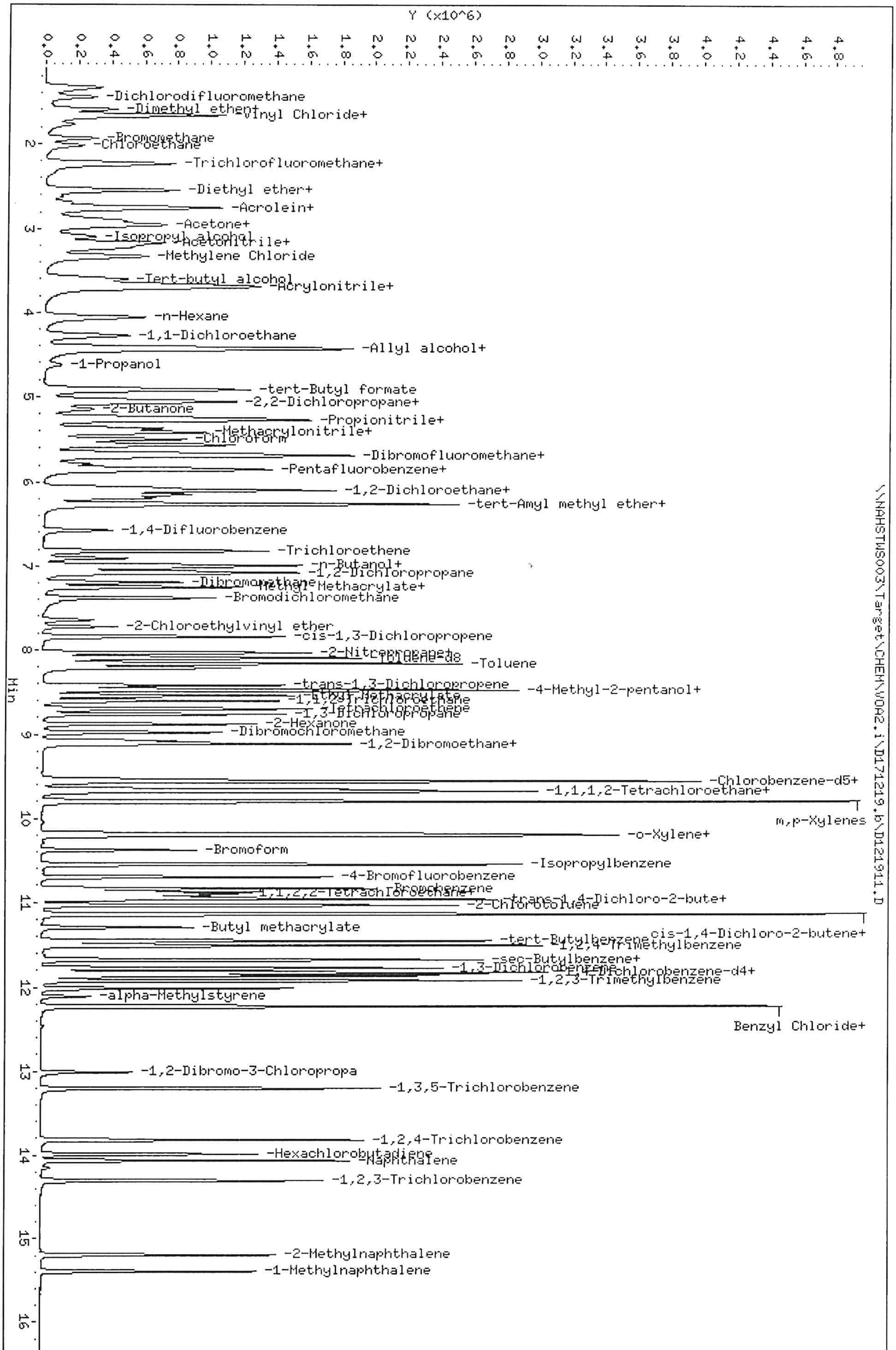
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121911.D
Report Date: 08-Feb-2018 16:59

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
84 1,4-Dichlorobenzene	146	11.867	11.867	(1.002)	947137	200.000	180.46
24 2-Butanone	43	5.150	5.150	(0.890)	514478	400.000	390.80(A)
52 2-Hexanone	43	8.876	8.876	(0.931)	755178	400.000	371.70(A)
45 4-Methyl-2-Pentanone	43	8.038	8.038	(0.843)	1095468	400.000	348.22(A)
10 Acetone	43	2.866	2.866	(0.495)	314789	400.000	396.04(A)
37 Benzene	78	6.100	6.100	(0.928)	1754958	200.000	174.77
39 Bromodichloromethane	83	7.381	7.381	(1.122)	670027	200.000	188.52
66 Bromoform	173	10.378	10.378	(1.089)	437607	200.000	212.75(A)
6 Bromomethane	94	1.935	1.935	(0.335)	315966	200.000	196.11(M)
19 Carbon Disulfide	76	2.956	2.956	(0.511)	1798818	400.000	391.19(A)
34 Carbon Tetrachloride	117	5.837	5.837	(0.888)	620089	200.000	171.05(M)
59 Chlorobenzene	112	9.559	9.559	(1.003)	1205848	200.000	168.86
7 Chloroethane	64	2.015	2.015	(0.348)	326706	200.000	165.51(M)
28 Chloroform	83	5.497	5.497	(0.950)	806092	200.000	181.23
3 Chloromethane	50	1.592	1.592	(0.275)	800291	200.000	198.92
27 cis-1,2-Dichloroethene	96	5.070	5.070	(0.876)	513279	200.000	184.92
46 cis-1,3-Dichloropropene	75	7.846	7.846	(1.193)	817440	200.000	200.27(A)
55 Dibromochloromethane	129	8.975	8.975	(0.942)	587599	200.000	196.27
2 Dichlorodifluoromethane	85	1.444	1.444	(0.250)	437112	200.000	209.58(A)
61 Ethylbenzene	106	9.678	9.678	(1.015)	645405	200.000	168.85(H)
67 Isopropylbenzene	105	10.551	10.551	(1.107)	1929664	200.000	163.19
17 Methylene Chloride	84	3.331	3.331	(0.576)	484417	200.000	181.40
56 Tetrachloroethene	164	8.693	8.693	(0.912)	413430	200.000	198.24
50 Toluene	91	8.167	8.167	(0.857)	1826045	200.000	166.17
20 trans-1,2-Dichloroethene	96	3.661	3.661	(0.633)	442346	200.000	203.10(A)
51 trans-1,3-Dichloropropene	75	8.420	8.420	(1.281)	745710	200.000	214.71(A)
38 Trichloroethene	130	6.822	6.822	(1.038)	531039	200.000	187.86
8 Trichlorofluoromethane	101	2.240	2.240	(0.387)	605156	200.000	201.17(A)
5 Vinyl Chloride	62	1.678	1.678	(0.290)	570730	200.000	190.86
62 m,p-Xylenes	106	9.800	9.800	(1.028)	1525807	400.000	326.42(A)
63 o-Xylene	106	10.185	10.185	(1.069)	826994	200.000	169.11
M 95 Xylenes (total)	106				2352801	600.000	(a)
71 1,2,3-Trichloropropane	75	10.907	10.907	(0.921)	503444	200.000	144.06
93 1,2,3-Trichlorobenzene	182	14.305	14.305	(1.208)	548103	200.000	220.11(A)
79 1,2,4-Trimethylbenzene	105	11.507	11.507	(0.972)	1593131	200.000	163.04
75 1,3,5-Trimethylbenzene	105	11.141	11.141	(0.941)	1548771	200.000	162.76
26 2,2-Dichloropropane	77	5.045	5.045	(0.872)	669571	200.000	188.38
54 1,3-Dichloropropane	76	8.760	8.760	(0.919)	755983	200.000	176.70
76 2-Chlorotoluene	91	11.039	11.039	(0.932)	1389990	200.000	166.80
77 4-Chlorotoluene	91	11.148	11.148	(0.941)	1499500	200.000	165.26
82 p-Isopropyltoluene	119	11.828	11.828	(0.999)	1563485	200.000	173.15
29 Bromochloromethane	128	5.375	5.375	(0.929)	256786	200.000	194.41
74 Bromobenzene	156	10.840	10.840	(0.915)	580164	200.000	178.28
44 Dibromomethane	93	7.195	7.195	(1.094)	308722	200.000	198.18
91 Hexachlorobutadiene	225	13.991	13.991	(1.182)	266365	200.000	199.34
73 n-Propylbenzene	91	10.965	10.965	(0.926)	2079135	200.000	167.63
87 n-Butylbenzene	91	12.226	12.226	(1.033)	1229106	200.000	183.15
81 sec-Butylbenzene	105	11.674	11.674	(0.986)	1819078	200.000	172.51
92 Naphthalene	128	14.065	14.065	(1.188)	1461418	200.000	195.70
78 tert-Butylbenzene	119	11.459	11.459	(0.968)	1361470	200.000	170.56
60 1,1,1,2-Tetrachloroethane	131	9.653	9.653	(1.013)	514128	200.000	185.80
64 Styrene	104	10.208	10.208	(1.071)	1321701	200.000	169.46

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121911.D
Report Date: 08-Feb-2018 16:59

QC Flag Legend

a - Target compound detected but, quantitated amount Below Limit Of Quantitation(BLOQ).
A - Target compound detected but, quantitated amount exceeded maximum amount.
M - Compound response manually integrated.
H - Operator selected an alternate compound hit.



Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121911.D
Date : 19-DEC-2017 13:27
Client ID: VSTD200
Sample Info: VSTD200;VSTD200;1;9;
Purge Volume: 5.0
Column phase: DB624
Instrument: VOA2.i
Operator: AP
Column diameter: 0.18
\\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121911.D
Y (x10^6)
Min
-Dichlorodifluoromethane
-Dimethyl ether
-Vinyl Chloride+
-Bromomethane
-Chloroethane
-Trichlorofluoromethane+
-Diethyl ether+
-Acrolein+
-Acetone+
-Isopropyl alcohol
-Acetonitrile+
-Methylene Chloride
-Tert-butyl alcohol
-Acrylonitrile+
-n-Hexane
-1,1-Dichloroethane
-Allyl alcohol+
-1-Propanol
-tert-Butyl formate
-2,2-Dichloropropane+
-2-Butanone
-Propionitrile+
-Methacrylonitrile+
-Chloroform
-Dibromofluoromethane+
-Pentafluorobenzene+
-1,2-Dichloroethane+
-tert-Amyl methyl ether+
-1,4-Difluorobenzene
-Trichloroethene
-n-Butanol+
-1,2-Dichloropropane
-Dibromomethane
-Methyl Methacrylate+
-Bromodichloromethane
-2-Chloroethylvinyl ether
-cis-1,3-Dichloropropene
-2-Nitropropane+
-Toluene-d8
-Toluene
-trans-1,3-Dichloropropene
-4-Methyl-2-pentanol+
-Ethyl Methacrylate
-1,1,2-Trichloroethane
-Tetrachloroethene
-1,3-Dichloropropane
-2-Hexanone
-Dibromochloromethane
-1,2-Dibromoethane+
-Chlorobenzene-d5+
-1,1,1,2-Tetrachloroethane+
m,p-Xylenes
-o-Xylene+
-Bromoform
-Isopropylbenzene
-4-Bromofluorobenzene
-1,1,2,2-Tetrachloroethane+
-Bromobenzene
-trans-1,4-Dichloro-2-bute+
-2-Chlorotoluene
-Butyl methacrylate
-tert-Butylbenzene
cis-1,4-Dichloro-2-butene+
-1,2,4-Trimethylbenzene
-sec-Butylbenzene+
-1,3-Dichlorobenzene
-1,4-Dichlorobenzene-d4+
-1,2,3-Trimethylbenzene
-alpha-Methylstyrene
Benzyl Chloride+
-1,2-Dibromo-3-Chloropropa
-1,3,5-Trichlorobenzene
-1,2,4-Trichlorobenzene
-Hexachlorobutadiene
-Naphthalene
-1,2,3-Trichlorobenzene
-2-Methylnaphthalene
-1-Methylnaphthalene

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121913.D
Report Date: 08-Feb-2018 16:59

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121913.D
Lab Smp Id: VSTD-ICV Client Smp ID: VSTD-ICV
Inj Date : 19-DEC-2017 14:16
Operator : AP Inst ID: VOA2.i
Smp Info : VSTD-ICV;VSTD-ICV;2;;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\CHEM\VOA2.i\D171219.b\8260LL.m
Meth Date : 08-Feb-2018 16:59 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 13:27 Cal File: D121911.D
Als bottle: 13 QC Sample: METHSPIKE
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/l)	FINAL (ug/l)
31 1,1,1-Trichloroethane	97	5.651	5.661	(0.978)	179115	49.0617	49.06
* 1 Pentafluorobenzene	168	5.779	5.786	(1.000)	236216	50.0000	
$ 30 Dibromofluoromethane	113	5.686	5.686	(0.984)	101991	47.9227	47.92
* 36 1,4-Difluorobenzene	114	6.575	6.575	(1.000)	371286	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.062	6.062	(1.049)	130923	49.8088	49.80
* 47 Chlorobenzene-d5	117	9.527	9.531	(1.000)	338097	50.0000	
$ 48 Toluene-d8	98	8.093	8.096	(0.849)	388288	43.5582	43.55
$ 69 4-Bromofluorobenzene	95	10.695	10.702	(1.123)	150830	46.3351	46.33
* 70 1,4-Dichlorobenzene-d4	152	11.834	11.841	(1.000)	149771	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.869	10.878	(0.918)	162360	45.4433	45.44
53 1,1,2-Trichloroethane	83	8.597	8.603	(0.902)	100546	48.6143	48.61
32 1,1-Dichloropropene	75	5.853	5.856	(0.890)	148378	51.3040	51.30
22 1,1-Dichloroethane	63	4.281	4.281	(0.741)	237141	48.0860	48.08
11 1,1-Dichloroethene	96	2.753	2.741	(0.476)	98125	50.3313	50.33
90 1,2,4-Trichlorobenzene	180	13.818	13.821	(1.168)	162937	55.2230	55.22
89 1,2-Dibromo-3-Chloropropane	75	13.009	13.012	(1.099)	29561	47.9848	47.98
57 1,2-Dibromoethane	107	9.065	9.075	(0.952)	129329	49.9262	49.92
88 1,2-Dichlorobenzene	146	12.223	12.229	(1.033)	254978	47.3643	47.36
33 1,2-Dichloroethane	62	6.145	6.148	(0.935)	168706	51.4651	51.46
42 1,2-Dichloropropane	63	7.066	7.073	(1.075)	139163	47.5870	47.58
83 1,3-Dichlorobenzene	146	11.767	11.774	(0.994)	263425	47.0213	47.02

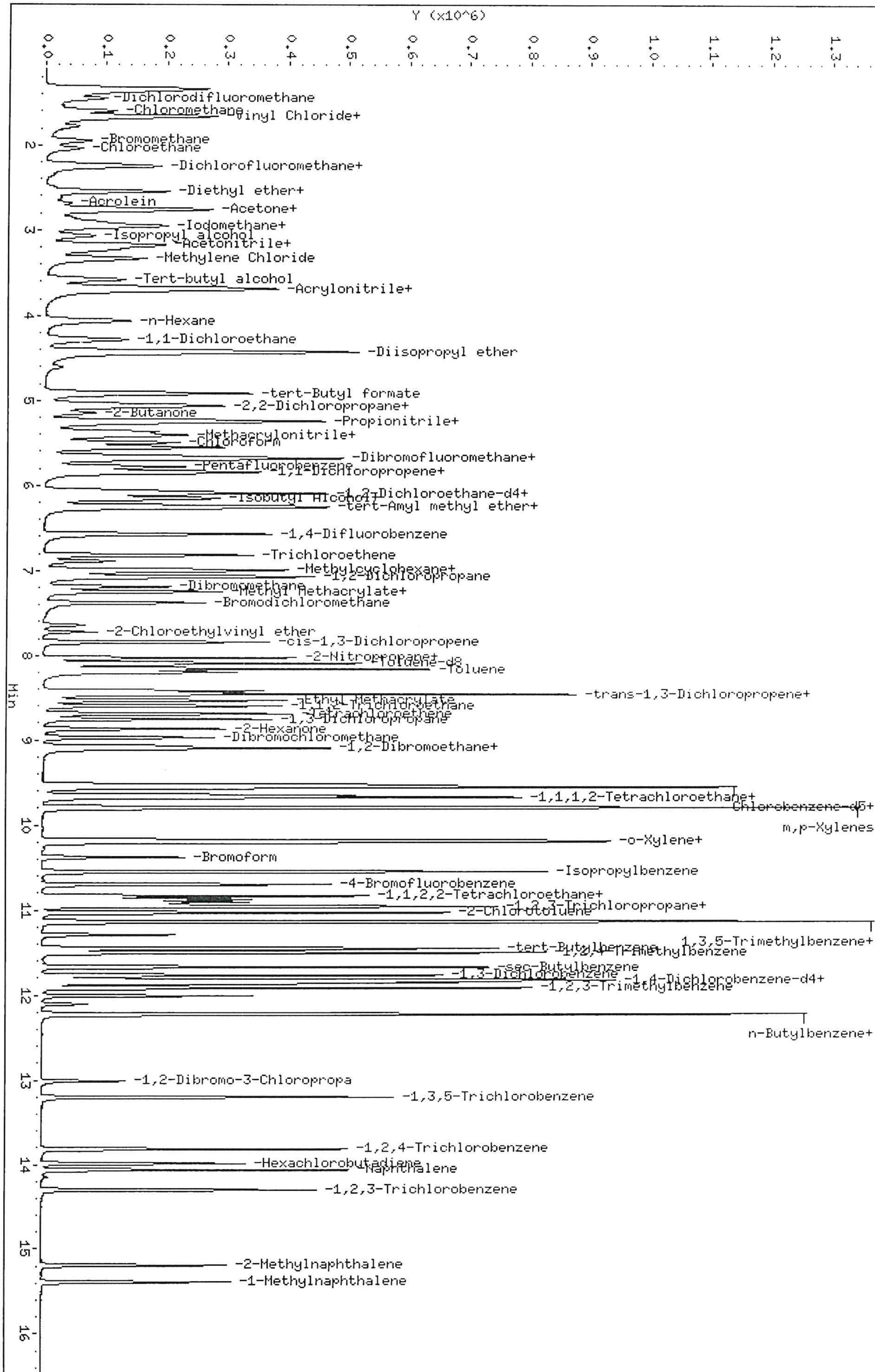
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121913.D
Report Date: 08-Feb-2018 16:59

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/l)	CONCENTRATIONS FINAL (ug/l)
84 1,4-Dichlorobenzene	146	11.860	11.867	(1.002)	251434	46.9240	46.92
24 2-Butanone	43	5.144	5.150	(0.890)	125859	98.7418	98.74
52 2-Hexanone	43	8.866	8.876	(0.931)	188174	94.9905	94.99
45 4-Methyl-2-Pentanone	43	8.029	8.038	(0.843)	288228	93.9658	93.96
10 Acetone	43	2.856	2.866	(0.494)	79464	101.521	101.52
37 Benzene	78	6.094	6.100	(0.927)	468722	47.9805	47.98
39 Bromodichloromethane	83	7.377	7.381	(1.122)	172162	49.7905	49.79
66 Bromoform	173	10.374	10.378	(1.089)	107206	53.4548	53.45
6 Bromomethane	94	1.945	1.935	(0.337)	87966	54.6082	54.60
19 Carbon Disulfide	76	2.955	2.956	(0.511)	453389	101.834	101.83
34 Carbon Tetrachloride	117	5.834	5.837	(0.887)	150248	42.6028	42.60
59 Chlorobenzene	112	9.556	9.559	(1.003)	324514	46.6069	46.60
7 Chloroethane	64	2.038	2.015	(0.353)	80390	42.0641	42.06
28 Chloroform	83	5.494	5.497	(0.951)	210974	48.9888	48.98
3 Chloromethane	50	1.598	1.592	(0.277)	216344	54.8507	54.85
27 cis-1,2-Dichloroethene	96	5.070	5.070	(0.877)	133003	49.4916	49.49
46 cis-1,3-Dichloropropene	75	7.839	7.846	(1.192)	209138	52.6682	52.66
55 Dibromochloromethane	129	8.972	8.975	(0.942)	147898	50.6666	50.66
2 Dichlorodifluoromethane	85	1.450	1.444	(0.251)	108668	53.8135	53.81
61 Ethylbenzene	106	9.672	9.678	(1.015)	172020	46.1581	46.15
67 Isopropylbenzene	105	10.548	10.551	(1.107)	539189	46.7681	46.76
17 Methylene Chloride	84	3.331	3.331	(0.576)	125545	48.5572	48.55
56 Tetrachloroethene	164	8.690	8.693	(0.912)	105833	50.7856	50.78
50 Toluene	91	8.160	8.167	(0.857)	492502	45.9648	45.96
20 trans-1,2-Dichloroethene	96	3.668	3.661	(0.635)	111703	52.9702	52.97
51 trans-1,3-Dichloropropene	75	8.417	8.420	(1.280)	183760	54.3849	54.38
38 Trichloroethene	130	6.816	6.822	(1.037)	132301	48.1090	48.10
8 Trichlorofluoromethane	101	2.253	2.240	(0.390)	154364	52.9999	52.99
5 Vinyl Chloride	62	1.681	1.678	(0.291)	149803	51.7410	51.74
62 m,p-Xylenes	106	9.794	9.800	(1.028)	417543	91.6149	91.61
63 o-Xylene	106	10.179	10.185	(1.068)	222400	46.6435	46.64
M 95 Xylenes (total)	106				639943	138.258	138.25
71 1,2,3-Trichloropropane	75	10.904	10.907	(0.921)	174309	48.8560	48.85
93 1,2,3-Trichlorobenzene	182	14.302	14.305	(1.209)	139440	54.8472	54.84
79 1,2,4-Trimethylbenzene	105	11.501	11.507	(0.972)	442889	44.3952	44.39
75 1,3,5-Trimethylbenzene	105	11.132	11.141	(0.941)	436227	44.9020	44.90
26 2,2-Dichloropropane	77	5.044	5.045	(0.873)	169895	49.3690	49.36
54 1,3-Dichloropropane	76	8.754	8.760	(0.919)	196311	47.0599	47.05
76 2-Chlorotoluene	91	11.029	11.039	(0.932)	378502	44.4881	44.48
77 4-Chlorotoluene	91	11.138	11.148	(0.941)	413336	44.6186	44.61
82 p-Isopropyltoluene	119	11.818	11.828	(0.999)	427373	46.3580	46.35
29 Bromochloromethane	128	5.365	5.375	(0.928)	67528	52.8019	52.80
74 Bromobenzene	156	10.833	10.840	(0.915)	154221	46.4200	46.42
44 Dibromomethane	93	7.191	7.195	(1.094)	77635	51.2278	51.22
91 Hexachlorobutadiene	225	13.988	13.991	(1.182)	68432	49.8346	49.83
73 n-Propylbenzene	91	10.955	10.965	(0.926)	571686	45.1465	45.14
87 n-Butylbenzene	91	12.223	12.226	(1.033)	330221	48.1964	48.19
81 sec-Butylbenzene	105	11.671	11.674	(0.986)	500608	46.5017	46.50
92 Naphthalene	128	14.061	14.065	(1.188)	397816	51.7926	51.79
78 tert-Butylbenzene	119	11.453	11.459	(0.968)	371229	45.5516	45.55
60 1,1,1,2-Tetrachloroethane	131	9.649	9.653	(1.013)	134061	49.6900	49.68
64 Styrene	104	10.201	10.208	(1.071)	365703	48.0891	48.08

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121913.D
Date : 19-DEC-2017 14:16
Client ID: VSTD-ICV
Sample Info: VSTD-ICV;VSTD-ICV;2;;
Purge Volume: 5.0
Column phase: DB624

Instrument: VOA2.i
Operator: AP
Column diameter: 0.18

\\NAHSTWS003\Target\CHEM\VOA2.i\D171219.b\D121913.D



FORM 5
VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: Contract:

Lab Code: Case No.: SAS No.: SDG No.: HS17121400

Lab File ID: D123101 BFB Injection Date: 12/31/17

Instrument ID: VOA2 BFB Injection Time: 1339

GC Column: DB624 ID: 0.18 (mm) Heated Purge: (Y/N) N

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	18.9
75	30.0 - 60.0% of mass 95	46.4
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.7
173	Less than 2.0% of mass 174	0.0 (0.0)1
174	Greater than 50.0% of mass 95	86.7
175	5.0 - 9.0% of mass 174	6.1 (7.0)1
176	95.0 - 101.0% of mass 174	87.4 (100.8)1
177	5.0 - 9.0% of mass 176	6.0 (6.8)2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	CCV	CCV	D123102	12/31/17	1404
02	VLCSW-171231	VLCSW-171231	D123103	12/31/17	1428
03	VBLKW-171231	VBLKW-171231	D123105	12/31/17	1517
04	HS17121400-0	HS17121400-02	D123110	12/31/17	1720
05	HS17121400-0	HS17121400-01	D123114	12/31/17	1858
06	HS17121224-0	HS17121224-01M	D123127	01/01/18	0044
07	HS17121224-0	HS17121224-01M	D123128	01/01/18	0109
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page 1 of 1

FORM V VOA

FORM 7B
VOLATILE CALIBRATION VERIFICATION SUMMARY

Lab Name: Contract:

Lab Code: Case No.: SAS No.: SDG No.: HS17121400

Instrument ID: VOA2 Calibration Date: 12/31/17 Time: 1404

Lab File ID: D123102 Init. Calib. Date(s): 12/19/17 12/19/17

Init. Calib. Times: 1010 1327

GC Column: DB624 ID: 0.18 (mm)

COMPOUND	RRF or AMOUNT	RRF50.000 or AMOUNT	CCAL RRF50.000	MIN RRF	%D or %DRIFT	MAX %D or %DRIFT	CURV TYPE
1,1,1-Trichloroethane	0.7730000	0.7834339	0.7834339	0.1	1.35	20.00	AVRG
1,1,1,2-Tetrachloroethane	0.3990000	0.4087837	0.4087837	0.1	2.45	20.00	AVRG
tert-Butylbenzene	2.7210000	2.5109828	2.5109828	0.1	-7.72	20.00	AVRG
Naphthalene	50.534291	50.000000	2.5922796	0.2	1.07	20.00	LINR
sec-Butylbenzene	3.5940000	3.4383425	3.4383425	0.1	-4.33	20.00	AVRG
1,1,2,2-Tetrachloroethane	1.1930000	1.0296246	1.0296246	0.3	-13.69	20.00	AVRG
1,1,2-Trichloroethane	0.3060000	0.2967527	0.2967527	0.1	-3.02	20.00	AVRG
1,1-Dichloropropene	55.339572	50.000000	0.4305061	0.1	10.68	20.00	LINR
1,1-Dichloroethane	1.0440000	1.0211278	1.0211278	0.2	-2.19	20.00	AVRG
1,1-Dichloroethene	0.4120000	0.4477394	0.4477394	0.1	8.67	20.00	AVRG
1,2,4-Trichlorobenzene	0.9850000	1.0807638	1.0807638	0.2	9.72	20.00	AVRG
1,2-Dibromo-3-Chloropropane	45.120955	50.000000	0.1854610	0.05	-9.76	20.00	LINR
1,2-Dibromoethane	0.3830000	0.3898563	0.3898563	0.1	1.79	20.00	AVRG
1,2-Dichlorobenzene	1.7970000	1.6511734	1.6511734	0.4	-8.12	20.00	AVRG
1,2-Dichloroethane	55.344501	50.000000	0.4885679	0.1	10.69	20.00	LINR
1,2-Dichloropropane	0.3940000	0.3959015	0.3959015	0.1	0.48	20.00	AVRG
1,3-Dichlorobenzene	1.8700000	1.7376490	1.7376490	0.6	-7.08	20.00	AVRG
1,4-Dichlorobenzene	1.7890000	1.6616677	1.6616677	0.4	-7.12	20.00	AVRG
2-Butanone	0.2700000	0.2468740	0.2468740	0.1	-8.56	20.00	AVRG
2-Hexanone	0.2930000	0.2651312	0.2651312	0.1	-9.51	20.00	AVRG
4-Methyl-2-Pentanone	0.4540000	0.4144808	0.4144808	0.1	-8.70	20.00	AVRG
Acetone	94.842113	100.00000	0.1573868	0.1	-5.16	20.00	LINR
Benzene	1.3160000	1.3372083	1.3372083	0.5	1.61	20.00	AVRG
Bromodichloromethane	0.4660000	0.4795462	0.4795462	0.2	2.91	20.00	AVRG
Bromoform	0.2970000	0.3131957	0.3131957	0.1	5.45	20.00	AVRG
Bromomethane	55.990199	50.000000	0.3814083	0.1	11.98	20.00	LINR
Carbon Disulfide	0.9420000	0.9802868	0.9802868	0.1	4.06	20.00	AVRG
Carbon Tetrachloride	0.4750000	0.4294329	0.4294329	0.1	-9.59	20.00	AVRG
Chlorobenzene	1.0300000	1.0009252	1.0009252	0.5	-2.82	20.00	AVRG
Chloroethane	0.4040000	0.3716144	0.3716144	0.1	-8.02	20.00	AVRG
Chloroform	0.9120000	0.8900055	0.8900055	0.2	-2.41	20.00	AVRG
Chloromethane	53.642269	50.000000	0.8960420	0.1	7.28	20.00	LINR
cis-1,2-Dichloroethene	0.5690000	0.5747831	0.5747831	0.1	1.02	20.00	AVRG
cis-1,3-Dichloropropene	0.5350000	0.5950174	0.5950174	0.2	11.22	20.00	AVRG
Dibromochloromethane	0.4320000	0.4420124	0.4420124	0.1	2.32	20.00	AVRG
Dichlorodifluoromethane	0.4270000	0.4274784	0.4274784	0.1	0.11	20.00	AVRG
Ethylbenzene	0.5510000	0.5387145	0.5387145	0.1	-2.23	20.00	AVRG
Isopropylbenzene	1.7050000	1.7094839	1.7094839	0.1	0.26	20.00	AVRG
Methylene Chloride	0.5470000	0.5129354	0.5129354	0.1	-6.23	20.00	AVRG
Tetrachloroethene	55.199033	50.000000	0.3393426	0.2	10.40	20.00	LINR
Toluene	1.5840000	1.5305698	1.5305698	0.4	-3.37	20.00	AVRG
trans-1,2-Dichloroethene	0.4460000	0.4940603	0.4940603	0.1	10.78	20.00	AVRG

FORM 7B
VOLATILE CALIBRATION VERIFICATION SUMMARY

Lab Name: Contract:

Lab Code: Case No.: SAS No.: SDG No.: HS1712140

Instrument ID: VOA2 Calibration Date: 12/31/17 Time: 1404

Lab File ID: D123102 Init. Calib. Date(s): 12/19/17 12/19/17

Init. Calib. Times: 1010 1327

GC Column: DB624 ID: 0.18 (mm)

COMPOUND	RRF or AMOUNT	RRF50.000 or AMOUNT	CCAL RRF50.000	MIN RRF	%D or %DRIFT	MAX %D or %DRIFT	CURV TYPE
trans-1,3-Dichloropropene	0.4550000	0.5111178	0.5111178	0.1	12.33	20.00	AVRG
Trichloroethene	0.3700000	0.3886201	0.3886201	0.2	5.03	20.00	AVRG
Trichlorofluoromethane	0.6160000	0.6655858	0.6655858	0.1	8.05	20.00	AVRG
Vinyl Chloride	0.6130000	0.6361688	0.6361688	0.1	3.78	20.00	AVRG
m,p-Xylenes	0.6740000	0.6544416	0.6544416	0.1	-2.90	20.00	AVRG
o-Xylene	0.7050000	0.6927751	0.6927751	0.3	-1.73	20.00	AVRG
Xylenes (total)	0.6190000	0.6178747	0.6178747	0.1	-0.18	20.00	AVRG
1,2,3-Trichloropropane	1.1910000	1.0950432	1.0950432	0.1	-8.06	20.00	AVRG
1,2,3-Trichlorobenzene	0.8490000	0.9206641	0.9206641	0.1	8.44	20.00	AVRG
1,2,4-Trimethylbenzene	3.3300000	2.9414887	2.9414887	0.1	-11.67	20.00	AVRG
1,3,5-Trimethylbenzene	3.2430000	2.9257814	2.9257814	0.1	-9.78	20.00	AVRG
2,2-Dichloropropane	0.7280000	0.7708198	0.7708198	0.1	5.88	20.00	AVRG
1,3-Dichloropropane	0.6170000	0.5926122	0.5926122	0.1	-3.95	20.00	AVRG
2-Chlorotoluene	2.8400000	2.4939296	2.4939296	0.1	-12.18	20.00	AVRG
4-Chlorotoluene	3.0920000	2.7441465	2.7441465	0.1	-11.25	20.00	AVRG
p-Isopropyltoluene	3.0780000	2.9208622	2.9208622	0.1	-5.10	20.00	AVRG
Bromochloromethane	0.2700000	0.2818500	0.2818500	0.1	4.39	20.00	AVRG
Bromobenzene	1.1090000	1.0003348	1.0003348	0.1	-9.80	20.00	AVRG
Dibromomethane	0.2040000	0.2202961	0.2202961	0.1	7.99	20.00	AVRG
Hexachlorobutadiene	52.873285	50.000000	0.4845284	0.1	5.75	20.00	LINR
n-Propylbenzene	4.2270000	3.8888054	3.8888054	0.1	-8.00	20.00	AVRG
n-Butylbenzene	2.2870000	2.2817135	2.2817135	0.05	-0.23	20.00	AVRG
Styrene	1.1240000	1.1369645	1.1369645	0.3	1.15	20.00	AVRG
1,2-Dichloroethane-d4	0.5560000	0.5226369	0.5226369	0.1	-6.00	20.00	AVRG
Dibromofluoromethane	0.4500000	0.4232590	0.4232590	0.1	-5.94	20.00	AVRG
Toluene-d8	1.3180000	1.2274044	1.2274044	0.1	-6.87	20.00	AVRG
4-Bromofluorobenzene	0.4810000	0.4741749	0.4741749	0.1	-1.42	20.00	AVRG

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FORM VII VOA

FORM 7B
VOLATILE CALIBRATION VERIFICATION SUMMARY

Lab Name: Contract:

Lab Code: Case No.: SAS No.: SDG No.: HS17121400

Instrument ID: VOA2 Calibration Date: 01/01/18 Time: 0133

Lab File ID: D123129 Init. Calib. Date(s): 12/19/17 12/19/17

Init. Calib. Times: 1010 1327

GC Column: DB624 ID: 0.18 (mm)

COMPOUND	RRF or AMOUNT	RRF50.000 or AMOUNT	CCAL RRF50.000	MIN RRF	%D or %DRIFT	MAX %D or %DRIFT	CURV TYPE
1,1,1-Trichloroethane	0.7730000	0.7345603	0.7345603	0.1	-4.97	50.00	AVRG
1,1,1,2-Tetrachloroethane	0.3990000	0.3878466	0.3878466	0.1	-2.80	50.00	AVRG
tert-Butylbenzene	2.7210000	2.3251743	2.3251743	0.1	-14.55	50.00	AVRG
Naphthalene	50.422099	50.000000	2.5865840	0.2	0.84	50.00	LINR
sec-Butylbenzene	3.5940000	3.0788206	3.0788206	0.1	-14.33	50.00	AVRG
1,1,2,2-Tetrachloroethane	1.1930000	1.0194698	1.0194698	0.3	-14.54	50.00	AVRG
1,1,2-Trichloroethane	0.3060000	0.2880370	0.2880370	0.1	-5.87	50.00	AVRG
1,1-Dichloropropene	49.603025	50.000000	0.3866199	0.1	-0.79	50.00	LINR
1,1-Dichloroethane	1.0440000	0.9682337	0.9682337	0.2	-7.26	50.00	AVRG
1,1-Dichloroethene	0.4120000	0.4082224	0.4082224	0.1	-0.92	50.00	AVRG
1,2,4-Trichlorobenzene	0.9850000	1.0040318	1.0040318	0.2	1.93	50.00	AVRG
1,2-Dibromo-3-Chloropropane	46.711683	50.000000	0.1920784	0.05	-6.58	50.00	LINR
1,2-Dibromoethane	0.3830000	0.3839427	0.3839427	0.1	0.25	50.00	AVRG
1,2-Dichlorobenzene	1.7970000	1.5599921	1.5599921	0.4	-13.19	50.00	AVRG
1,2-Dichloroethane	51.377117	50.000000	0.4536080	0.1	2.75	50.00	LINR
1,2-Dichloropropane	0.3940000	0.3679965	0.3679965	0.1	-6.60	50.00	AVRG
1,3-Dichlorobenzene	1.8700000	1.6138171	1.6138171	0.6	-13.70	50.00	AVRG
1,4-Dichlorobenzene	1.7890000	1.5160043	1.5160043	0.4	-15.26	50.00	AVRG
2-Butanone	0.2700000	0.2661324	0.2661324	0.1	-1.43	50.00	AVRG
2-Hexanone	0.2930000	0.2817528	0.2817528	0.1	-3.84	50.00	AVRG
4-Methyl-2-Pentanone	0.4540000	0.4348170	0.4348170	0.1	-4.22	50.00	AVRG
Acetone	104.38284	100.00000	0.1728369	0.1	4.38	50.00	LINR
Benzene	1.3160000	1.2313394	1.2313394	0.5	-6.43	50.00	AVRG
Bromodichloromethane	0.4660000	0.4511987	0.4511987	0.2	-3.18	50.00	AVRG
Bromoform	0.2970000	0.3120199	0.3120199	0.1	5.06	50.00	AVRG
Bromomethane	46.945176	50.000000	0.3224283	0.1	-6.11	50.00	LINR
Carbon Disulfide	0.9420000	0.9064839	0.9064839	0.1	-3.77	50.00	AVRG
Carbon Tetrachloride	0.4750000	0.3949022	0.3949022	0.1	-16.86	50.00	AVRG
Chlorobenzene	1.0300000	0.9482240	0.9482240	0.5	-7.94	50.00	AVRG
Chloroethane	0.4040000	0.3471433	0.3471433	0.1	-14.07	50.00	AVRG
Chloroform	0.9120000	0.8427925	0.8427925	0.2	-7.59	50.00	AVRG
Chloromethane	50.641248	50.000000	0.8467903	0.1	1.28	50.00	LINR
cis-1,2-Dichloroethene	0.5690000	0.5404282	0.5404282	0.1	-5.02	50.00	AVRG
cis-1,3-Dichloropropene	0.5350000	0.5365532	0.5365532	0.2	0.29	50.00	AVRG
Dibromochloromethane	0.4320000	0.4270479	0.4270479	0.1	-1.15	50.00	AVRG
Dichlorodifluoromethane	0.4270000	0.3741881	0.3741881	0.1	-12.37	50.00	AVRG
Ethylbenzene	0.5510000	0.4989157	0.4989157	0.1	-9.45	50.00	AVRG
Isopropylbenzene	1.7050000	1.5850098	1.5850098	0.1	-7.04	50.00	AVRG
Methylene Chloride	0.5470000	0.4938533	0.4938533	0.1	-9.72	50.00	AVRG
Tetrachloroethene	49.359535	50.000000	0.3045222	0.2	-1.28	50.00	LINR
Toluene	1.5840000	1.4357542	1.4357542	0.4	-9.36	50.00	AVRG
trans-1,2-Dichloroethene	0.4460000	0.4518983	0.4518983	0.1	1.32	50.00	AVRG

FORM 7B
VOLATILE CALIBRATION VERIFICATION SUMMARY

Lab Name: Contract:

Lab Code: Case No.: SAS No.: SDG No.: HS1712140

Instrument ID: VOA2 Calibration Date: 01/01/18 Time: 0133

Lab File ID: D123129 Init. Calib. Date(s): 12/19/17 12/19/17

Init. Calib. Times: 1010 1327

GC Column: DB624 ID: 0.18 (mm)

COMPOUND	RRF or AMOUNT	RRF50.000 or AMOUNT	CCAL RRF50.000	MIN RRF	%D or %DRIFT	MAX %D or %DRIFT	CURV TYPE
trans-1,3-Dichloropropene	0.4550000	0.4724271	0.4724271	0.1	3.83	50.00	AVRG
Trichloroethene	0.3700000	0.3600414	0.3600414	0.2	-2.69	50.00	AVRG
Trichlorofluoromethane	0.6160000	0.6129933	0.6129933	0.1	-0.49	50.00	AVRG
Vinyl Chloride	0.6130000	0.5874974	0.5874974	0.1	-4.16	50.00	AVRG
m,p-Xylenes	0.6740000	0.6064089	0.6064089	0.1	-10.03	50.00	AVRG
o-Xylene	0.7050000	0.6473246	0.6473246	0.3	-8.18	50.00	AVRG
Xylenes (total)	0.6190000	0.5603096	0.5603096	0.1	-9.48	50.00	AVRG
1,2,3-Trichloropropane	1.1910000	1.0839644	1.0839644	0.1	-8.99	50.00	AVRG
1,2,3-Trichlorobenzene	0.8490000	0.8878406	0.8878406	0.1	4.57	50.00	AVRG
1,2,4-Trimethylbenzene	3.3300000	2.7044192	2.7044192	0.1	-18.79	50.00	AVRG
1,3,5-Trimethylbenzene	3.2430000	2.6552399	2.6552399	0.1	-18.12	50.00	AVRG
2,2-Dichloropropane	0.7280000	0.5966358	0.5966358	0.1	-18.04	50.00	AVRG
1,3-Dichloropropane	0.6170000	0.5806728	0.5806728	0.1	-5.89	50.00	AVRG
2-Chlorotoluene	2.8400000	2.3147231	2.3147231	0.1	-18.50	50.00	AVRG
4-Chlorotoluene	3.0920000	2.5268170	2.5268170	0.1	-18.28	50.00	AVRG
p-Isopropyltoluene	3.0780000	2.6035774	2.6035774	0.1	-15.41	50.00	AVRG
Bromochloromethane	0.2700000	0.2739339	0.2739339	0.1	1.46	50.00	AVRG
Bromobenzene	1.1090000	0.9413587	0.9413587	0.1	-15.12	50.00	AVRG
Dibromomethane	0.2040000	0.2077250	0.2077250	0.1	1.82	50.00	AVRG
Hexachlorobutadiene	46.391042	50.000000	0.4256136	0.1	-7.22	50.00	LINR
n-Propylbenzene	4.2270000	3.5433670	3.5433670	0.1	-16.17	50.00	AVRG
n-Butylbenzene	2.2870000	2.0465665	2.0465665	0.05	-10.51	50.00	AVRG
Styrene	1.1240000	1.0647645	1.0647645	0.3	-5.27	50.00	AVRG
1,2-Dichloroethane-d4	0.5560000	0.5281435	0.5281435	0.1	-5.01	50.00	AVRG
Dibromofluoromethane	0.4500000	0.4281762	0.4281762	0.1	-4.85	50.00	AVRG
Toluene-d8	1.3180000	1.2418907	1.2418907	0.1	-5.77	50.00	AVRG
4-Bromofluorobenzene	0.4810000	0.4801812	0.4801812	0.1	-0.17	50.00	AVRG

page 2 of 2

FORM VII VOA

FORM 8
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: Contract:

Lab Code: Case No.: SAS No.: SDG No.: HS17121400

Lab File ID (Standard): D123102 Date Analyzed: 12/31/17

Instrument ID: VOA2 Time Analyzed: 1404

GC Column: DB624 ID: 0.18 (mm) Heated Purge: (Y/N) N

		IS1 AREA #	RT #	IS2 (DFB) AREA #	RT #	IS3 (CBZ) AREA #	RT #
	12 HOUR STD	227284	5.78	337296	6.57	312351	9.53
	UPPER LIMIT	454568	6.28	674592	7.07	624702	10.03
	LOWER LIMIT	113642	5.28	168648	6.07	156176	9.03
	CLIENT SAMPLE NO.						
01	VLCSW-171231	232173	5.78	350112	6.57	319446	9.53
02	VBLKW-171231	248348	5.78	350622	6.57	318957	9.52
03	HS17121400-02	244487	5.78	348629	6.57	317807	9.52
04	HS17121400-01	241830	5.78	341994	6.57	320761	9.52
05	HS17121224-01	230121	5.78	338952	6.57	312265	9.52
06	HS17121224-01	227155	5.78	338925	6.57	312827	9.53
07							
08							
09							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

IS1 = Pentafluorobenzene
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = + 0.50 minutes of internal standard RT
RT LOWER LIMIT = - 0.50 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.
* Values outside of QC limits.

page 1 of 2

FORM VIII VOA

ALS

FORM 8
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: Contract:

Lab Code: Case No.: SAS No.: SDG No.: HS17121400

Lab File ID (Standard): D123102 Date Analyzed: 12/31/17

Instrument ID: VOA2 Time Analyzed: 1404

GC Column: DB624 ID: 0.18 (mm) Heated Purge: (Y/N) N

		IS4 (DCB) AREA #	RT #	AREA #	RT #	AREA #	RT #
	12 HOUR STD	146365	11.84				
	UPPER LIMIT	292730	12.34				
	LOWER LIMIT	73183	11.34				
	CLIENT SAMPLE NO.						
01	VLCSW-171231	147881	11.83				
02	VBLKW-171231	141116	11.83				
03	HS17121400-02	139719	11.83				
04	HS17121400-01	147858	11.83				
05	HS17121224-01	147666	11.83				
06	HS17121224-01	149308	11.84				
07							
08							
09							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

IS4 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = + 0.50 minutes of internal standard RT
RT LOWER LIMIT = - 0.50 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.
* Values outside of QC limits.

page 2 of 2

FORM VIII VOA

MSVOA02 -Logbook

Batch: 30338
Date: 12-31-2017
Method: 8260
Comments:

Analyst: Anjana Poluri
Reviewer:
Laboratory: Houston

#	Samp ID	Type	Analyzed	DF	Init Wt/Vol	Final Vol	File ID	Matrix	Status	pH
1	BFB	TUNE	12-31-2017 01:39 pm	1.00	50 mL	50 mL	D123101.D	Liquid	Y	NA
	Auto find/purged									
2	CCV	CCV	12-31-2017 02:04 pm	1.00	50 mL	50 mL	D123102.D	Liquid	Y	NA
	10 uL cal std/50 mL DI									
3	VLCSW-171231	LCS	12-31-2017 02:28 pm	1.00	50 mL	50 mL	D123103.D	Liquid	Y	NA
	10 uL cal std/50 mL DI									
4	BLK	SAMP	12-31-2017 02:53 pm	1.00	50 mL	50 mL	D123104.D	Liquid	Y	NA
	CLeanup Blk									
5	VBLKW-171231	MBLK	12-31-2017 03:17 pm	1.00	50 mL	50 mL	D123105.D	Liquid	Y	NA
6	HS17121158-03	SAMP	12-31-2017 03:42 pm	1.00	50 mL	50 mL	D123106.D	Liquid	Y	<2
7	HS17121168-02	SAMP	12-31-2017 04:06 pm	1.00	50 mL	50 mL	D123107.D	Liquid	Y	<2
8	HS17121169-02	SAMP	12-31-2017 04:31 pm	1.00	50 mL	50 mL	D123108.D	Liquid	Y	<2
9	HS17121224-09	SAMP	12-31-2017 04:56 pm	1.00	50 mL	50 mL	D123109.D	Liquid	Y	<2
10	HS17121400-02	SAMP	12-31-2017 05:20 pm	1.00	50 mL	50 mL	D123110.D	Liquid	Y	<2
11	HS17121168-01	SAMP	12-31-2017 05:45 pm	1.00	50 mL	50 mL	D123111.D	Liquid	Y	<2
12	HS17121224-01	SAMP	12-31-2017 06:09 pm	1.00	50 mL	50 mL	D123112.D	Liquid	Y	<2
13	HS17121224-08	SAMP	12-31-2017 06:34 pm	1.00	50 mL	50 mL	D123113.D	Liquid	Y	<2
14	HS17121400-01	SAMP	12-31-2017 06:58 pm	1.00	50 mL	50 mL	D123114.D	Liquid	Y	<2
15	HS17121224-05	SAMP	12-31-2017 07:23 pm	1.00	50 mL	50 mL	D123115.D	Liquid	Y	<2
16	HS17121224-05	SAMP	12-31-2017 07:50 pm	10.00	5 mL	50 mL	D123116.D	Liquid	Y	<2
17	HS17121224-06	SAMP	12-31-2017 08:17 pm	5.00	10 mL	50 mL	D123117.D	Liquid	Y	<2
18	HS17121224-06	SAMP	12-31-2017 08:45 pm	50.00	1 mL	50 mL	D123118.D	Liquid	Y	<2
19	HS17121169-01	SAMP	12-31-2017 09:12 pm	10.00	5 mL	50 mL	D123119.D	Liquid	Y	<2
20	HS17121169-01	SAMP	12-31-2017 09:39 pm	100.0(	500 µL	50 mL	D123120.D	Liquid	Y	<2
21	HS17121224-02	SAMP	12-31-2017 10:06 pm	10.00	5 mL	50 mL	D123121.D	Liquid	Y	<2
22	HS17121224-02	SAMP	12-31-2017 10:33 pm	100.0(	500 µL	50 mL	D123122.D	Liquid	Y	<2
23	HS17121224-04	SAMP	12-31-2017 11:01 pm	10.00	5 mL	50 mL	D123123.D	Liquid	Y	<2
24	HS17121224-04	SAMP	12-31-2017 11:28 pm	100.0(	500 µL	50 mL	D123124.D	Liquid	Y	<2
25	HS17121224-03	SAMP	12-31-2017 11:53 pm	100.0(	500 µL	50 mL	D123125.D	Liquid	Y	<2
26	HS17121224-03	SAMP	01-01-2018 12:20 am	1000.0	50 µL	50 mL	D123126.D	Liquid	Y	<2
27	HS17121224-01MS	MS	01-01-2018 12:44 am	1.00	50 mL	50 mL	D123127.D	Liquid	Y	<2
	8 uL cal std/40 mL sample									
28	HS17121224-01MSD	MSD	01-01-2018 01:09 am	1.00	50 mL	50 mL	D123128.D	Liquid	Y	<2
	8 uL cal std/40 mL sample									
29	CCV_END	CCV	01-01-2018 01:33 am	1.00	50 mL	50 mL	D123129.D	Liquid	Y	NA
	10 uL cal std/50 mL DI									
30	BFB	TUNE	01-01-2018 01:58 am	1.00	50 mL	50 mL	E123101.D	Liquid	Y	NA
31	CCV	CCV	01-01-2018 02:23 am	1.00	50 mL	50 mL	E123102.D	Liquid	Y	NA
	10 uL cal std/50 mL DI									
32	CCV	CCV	01-01-2018 02:47 am	1.00	50 mL	50 mL	E123103.D	Liquid	Y	NA
	10 uL cal std/50 mL DI									
33	VLCSW-171231	LCS	01-01-2018 03:12 am	1.00	50 mL	50 mL	E123104.D	Liquid	Y	NA
	10 uL cal std/50 mL DI									
34	BLK	SAMP	01-01-2018 03:37 am	1.00	50 mL	50 mL	E123105.D	Liquid	Y	NA
	Cleanup blk									
35	VBLKW-171231	MBLK	01-01-2018 04:01 am	1.00	50 mL	50 mL	E123106.D	Liquid	Y	NA

MSVOA02 -Logbook

#	Samp ID	Type	Analyzed	DF	Init Wt/Vol	Final Vol	File ID	Matrix	Status	pH
36	HS17121073-10	SAMP	01-01-2018 04:26 am	1.00	50 mL	50 mL	E123107.D	Liquid	Y	<2
37	HS17121073-08	SAMP	01-01-2018 04:50 am	1.00	50 mL	50 mL	E123108.D	Liquid	Y	<2
38	HS17121073-09	SAMP	01-01-2018 05:15 am	1.00	50 mL	50 mL	E123109.D	Liquid	Y	<2
39	HS17121073-08MS *8 uL cal std/40 mL sample*	MS	01-01-2018 05:40 am	1.00	50 mL	50 mL	E123110.D	Liquid	Y	<2
40	HS17121073-08MSD *8 uL cal std/40 mL sample*	MSD	01-01-2018 06:04 am	1.00	50 mL	50 mL	E123111.D	Liquid	Y	<2
41	HS17121037-03	SAMP	01-01-2018 06:29 am	1.00	50 mL	50 mL	E123112.D	Liquid	Y	<2
42	HS17121006-03	SAMP	01-01-2018 06:54 am	1.00	50 mL	50 mL	E123113.D	Liquid	Y	<2
43	HS17121219-05	SAMP	01-01-2018 07:18 am	1.00	50 mL	50 mL	E123114.D	Liquid	Y	<2
44	HS17121219-06	SAMP	01-01-2018 07:43 am	1.00	50 mL	50 mL	E123115.D	Liquid	Y	<2
45	HS17121006-01	SAMP	01-01-2018 08:08 am	1.00	50 mL	50 mL	E123116.D	Liquid	Y	<2
46	HS17121006-02	SAMP	01-01-2018 08:32 am	1.00	50 mL	50 mL	E123117.D	Liquid	Y	<2
47	HS17121171-15	SAMP	01-01-2018 08:57 am	1.00	50 mL	50 mL	E123118.D	Liquid	Y	<2
48	HS17121171-16	SAMP	01-01-2018 09:21 am	1.00	50 mL	50 mL	E123119.D	Liquid	Y	<2
49	HS17121171-17	SAMP	01-01-2018 09:46 am	1.00	50 mL	50 mL	E123120.D	Liquid	Y	<2
50	HS17121171-18	SAMP	01-01-2018 10:11 am	1.00	50 mL	50 mL	E123121.D	Liquid	Y	<2
51	HS17121171-19	SAMP	01-01-2018 10:35 am	1.00	50 mL	50 mL	E123122.D	Liquid	Y	<2
52	HS17121171-20	SAMP	01-01-2018 11:00 am	1.00	50 mL	50 mL	E123123.D	Liquid	Y	<2
53	HS17121171-21	SAMP	01-01-2018 11:24 am	1.00	50 mL	50 mL	E123124.D	Liquid	Y	<2
54	HS17121171-21	SAMP	01-01-2018 11:52 am	10.00	5 mL	50 mL	E123125.D	Liquid	Y	<2
55	HS17121073-03	SAMP	01-01-2018 12:16 pm	100.0(	500 µL	50 mL	E123126.D	Liquid	Y	<2
56	HS17121073-03	SAMP	01-01-2018 12:44 pm	1000.0	50 µL	50 mL	E123127.D	Liquid	Y	<2
57	HS17121073-06	SAMP	01-01-2018 01:08 pm	100.0(	500 µL	50 mL	E123128.D	Liquid	Y	<2
58	HS17121073-06	SAMP	01-01-2018 01:36 pm	1000.0	50 µL	50 mL	E123129.D	Liquid	Y	<2

Chemical	Value
SURR ID	29814-99-03
IS ID	29814-99-04
LCS/MS ID	29814-99-01
CAL STD ID	29814-99-01
BFB ID	29814-99-03
pH Paper	634-37-03

ALS

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123101.D

Page 2

Date : 31-DEC-2017 13:39

Client ID: BFB

Instrument: VOA2.i

Sample Info: BFB;BFB;3;;BFB

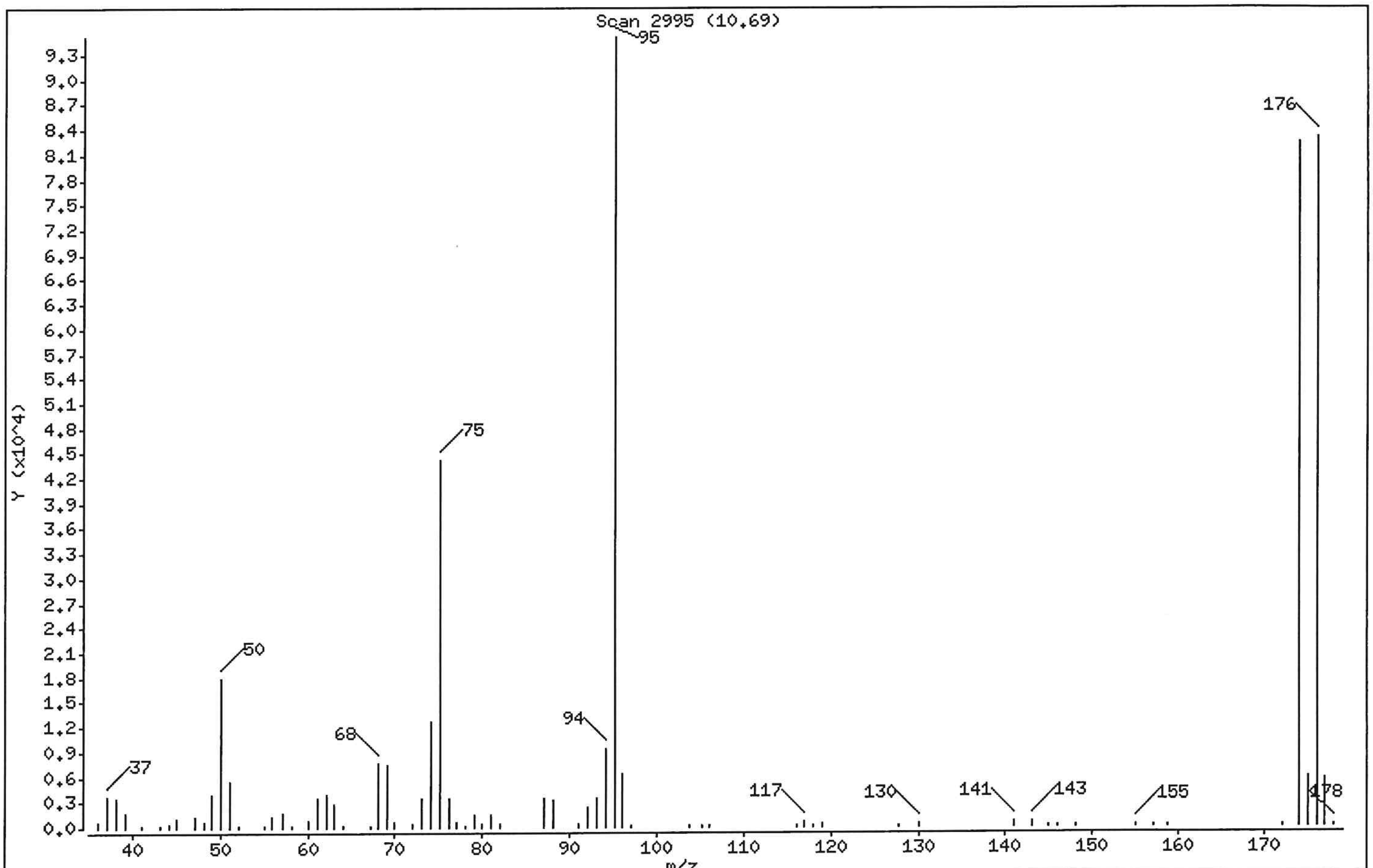
Volume Injected (uL): 2.0

Operator: AP

Column phase: DB624

Column diameter: 0.18

1 bfb



m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
95	Base Peak, 100% relative abundance	100.00
50	15.00 - 40.00% of mass 95	18.94
75	30.00 - 60.00% of mass 95	46.44
96	5.00 - 9.00% of mass 95	6.67
173	Less than 2.00% of mass 174	0.00 (0.00)
174	Greater than 50.00% of mass 95	86.67
175	5.00 - 9.00% of mass 174	6.10 (7.04)
176	95.00 - 101.00% of mass 174	87.40 (100.84)
177	5.00 - 9.00% of mass 176	5.99 (6.85)

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123101.D

Date : 31-DEC-2017 13:39

Client ID: BFB

Instrument: VOA2.i

Sample Info: BFB;BFB;3;;BFB

Volume Injected (uL): 2.0

Operator: AP

Column phase: DB624

Column diameter: 0.18

Data File: D123101.D

Spectrum: Scan 2995 (10.69)

Location of Maximum: 95.10

Number of points: 70

m/z	Y	m/z	Y	m/z	Y	m/z	Y
36.00	619	60.10	853	80.90	1581	127.80	228
37.10	3633	61.10	3473	82.00	478	130.00	458
38.10	3566	62.10	3859	87.00	3554	141.00	737
39.10	1752	63.10	2859	88.00	3308	143.00	732
41.10	303	64.00	216	91.00	350	145.00	192
43.10	249	67.10	153	92.10	2431	145.90	281
44.10	460	68.10	7760	93.00	3459	148.00	192
45.00	1004	69.10	7520	94.10	9447	155.00	321
47.10	1343	70.00	712	95.10	95192	157.00	151
48.10	607	72.00	411	96.10	6349	158.80	158
49.10	3926	73.10	3507	97.10	157	172.20	189
50.10	18032	74.10	12652	103.80	248	174.00	82504
51.10	5374	75.10	44208	105.20	171	175.10	5807
52.20	260	76.10	3572	106.00	233	176.00	83200
55.10	232	77.10	760	116.00	157	177.00	5699
56.00	1334	78.00	264	117.00	551	178.00	220
57.10	1833	79.00	1485	117.90	245		
58.10	151	80.00	514	119.00	427		

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123101.D

Page 1

Date : 31-DEC-2017 13:39

Client ID: BFB

Instrument: VOA2.i

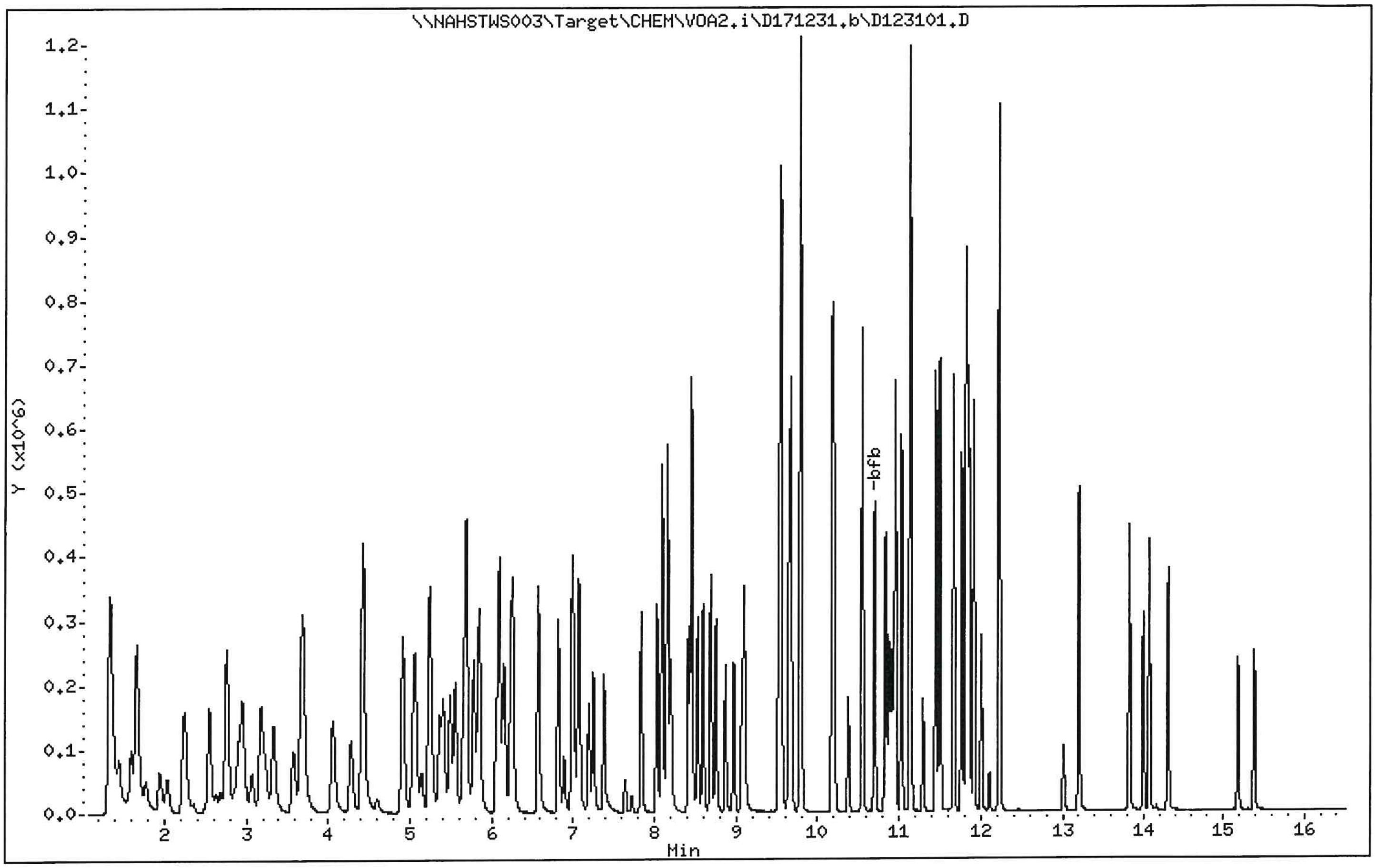
Sample Info: BFB;BFB;3;;BFB

Volume Injected (uL): 2.0

Operator: AP

Column phase: DB624

Column diameter: 0.18



Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123102.D
Report Date: 08-Feb-2018 17:09

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123102.D
Lab Smp Id: CCV   Client Smp ID: CCV
Inj Date : 31-DEC-2017 14:04
Operator : AP   Inst ID: VOA2.i
Smp Info : CCV;CCV;2;;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\chem\voa2.i\D171231.b\8260LL.m
Meth Date : 08-Feb-2018 17:09 VOA2.i   Quant Type: ISTD
Cal Date : 19-DEC-2017 12:14   Cal File: D121908.D
Als bottle: 2   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: HP RTE   Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
31 1,1,1-Trichloroethane	97	5.654	5.654	(0.978)	178062	50.0000	50.69
* 1 Pentafluorobenzene	168	5.782	5.782	(1.000)	227284	50.0000	
$ 30 Dibromofluoromethane	113	5.689	5.689	(0.984)	96200	50.0000	46.97
* 36 1,4-Difluorobenzene	114	6.572	6.572	(1.000)	337296	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.055	6.055	(1.047)	118787	50.0000	46.96
* 47 Chlorobenzene-d5	117	9.527	9.527	(1.000)	312351	50.0000	
$ 48 Toluene-d8	98	8.093	8.093	(0.849)	383381	50.0000	46.55
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	148109	50.0000	49.24
* 70 1,4-Dichlorobenzene-d4	152	11.838	11.838	(1.000)	146365	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.872	10.872	(0.918)	150701	50.0000	43.16
53 1,1,2-Trichloroethane	83	8.593	8.593	(0.902)	92691	50.0000	48.51
32 1,1-Dichloropropene	75	5.856	5.856	(0.891)	145208	50.0000	55.33
22 1,1-Dichloroethane	63	4.277	4.277	(0.740)	232086	50.0000	48.91
11 1,1-Dichloroethene	96	2.750	2.750	(0.476)	101764	50.0000	54.24
90 1,2,4-Trichlorobenzene	180	13.818	13.818	(1.167)	158186	50.0000	54.86
89 1,2-Dibromo-3-Chloropropane	75	13.009	13.009	(1.099)	27145	50.0000	45.12
57 1,2-Dibromoethane	107	9.065	9.065	(0.952)	121772	50.0000	50.88
88 1,2-Dichlorobenzene	146	12.223	12.223	(1.033)	241674	50.0000	45.93
33 1,2-Dichloroethane	62	6.145	6.145	(0.935)	164792	50.0000	55.34
42 1,2-Dichloropropane	63	7.066	7.066	(1.075)	133536	50.0000	50.26
83 1,3-Dichlorobenzene	146	11.767	11.767	(0.994)	254331	50.0000	46.45

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123102.D
Report Date: 08-Feb-2018 17:09

	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
	84 1,4-Dichlorobenzene	146	11.860	11.860	(1.002)	243210	50.0000	46.44
	24 2-Butanone	43	5.144	5.144	(0.890)	112221	100.000	91.50
	52 2-Hexanone	43	8.866	8.866	(0.931)	165628	100.000	90.50
	45 4-Methyl-2-Pentanone	43	8.025	8.025	(0.842)	258927	100.000	91.37
	10 Acetone	43	2.862	2.862	(0.495)	71543	100.000	94.84
	37 Benzene	78	6.090	6.090	(0.927)	451035	50.0000	50.82
	39 Bromodichloromethane	83	7.377	7.377	(1.123)	161749	50.0000	51.49
	66 Bromoform	173	10.378	10.378	(1.089)	97827	50.0000	52.79
	6 Bromomethane	94	1.941	1.941	(0.336)	86688	50.0000	55.99
	19 Carbon Disulfide	76	2.952	2.952	(0.511)	445607	100.000	104.01
	34 Carbon Tetrachloride	117	5.834	5.834	(0.888)	144846	50.0000	45.20
	59 Chlorobenzene	112	9.553	9.553	(1.003)	312640	50.0000	48.60
	7 Chloroethane	64	2.041	2.041	(0.353)	84462	50.0000	45.93
	28 Chloroform	83	5.494	5.494	(0.950)	202284	50.0000	48.81
	3 Chloromethane	50	1.588	1.588	(0.275)	203656	50.0000	53.64
	27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.876)	130639	50.0000	50.52
	46 cis-1,3-Dichloropropene	75	7.839	7.839	(1.193)	200697	50.0000	55.63
	55 Dibromochloromethane	129	8.972	8.972	(0.942)	138063	50.0000	51.19
	2 Dichlorodifluoromethane	85	1.447	1.447	(0.250)	97159	50.0000	50.00
	61 Ethylbenzene	106	9.672	9.672	(1.015)	168268	50.0000	48.87
	67 Isopropylbenzene	105	10.548	10.548	(1.107)	533959	50.0000	50.13
	17 Methylene Chloride	84	3.334	3.334	(0.577)	116582	50.0000	46.86
	56 Tetrachloroethene	164	8.690	8.690	(0.912)	105994	50.0000	55.15
	50 Toluene	91	8.157	8.157	(0.856)	478075	50.0000	48.29
	20 trans-1,2-Dichloroethene	96	3.671	3.671	(0.635)	112292	50.0000	55.34
	51 trans-1,3-Dichloropropene	75	8.417	8.417	(1.281)	172398	50.0000	56.16
	38 Trichloroethene	130	6.819	6.819	(1.038)	131080	50.0000	52.46
	8 Trichlorofluoromethane	101	2.256	2.256	(0.390)	151277	50.0000	53.98
	5 Vinyl Chloride	62	1.685	1.685	(0.291)	144591	50.0000	51.90
	62 m,p-Xylenes	106	9.790	9.790	(1.028)	408831	100.000	97.09
	63 o-Xylene	106	10.179	10.179	(1.068)	216389	50.0000	49.12
M	95 Xylenes (total)	106				625220	150.000	(a)
	71 1,2,3-Trichloropropane	75	10.904	10.904	(0.921)	160276	50.0000	45.96
	93 1,2,3-Trichlorobenzene	182	14.302	14.302	(1.208)	134753	50.0000	54.23
	79 1,2,4-Trimethylbenzene	105	11.501	11.501	(0.972)	430531	50.0000	44.16
	75 1,3,5-Trimethylbenzene	105	11.132	11.132	(0.940)	428232	50.0000	45.10
	26 2,2-Dichloropropane	77	5.041	5.041	(0.872)	175195	50.0000	52.90
	54 1,3-Dichloropropane	76	8.754	8.754	(0.919)	185103	50.0000	48.03
	76 2-Chlorotoluene	91	11.029	11.029	(0.932)	365024	50.0000	43.90
	77 4-Chlorotoluene	91	11.138	11.138	(0.941)	401647	50.0000	44.36
	82 p-Isopropyltoluene	119	11.818	11.818	(0.998)	427512	50.0000	47.45
	29 Bromochloromethane	128	5.365	5.365	(0.928)	64060	50.0000	52.05
	74 Bromobenzene	156	10.833	10.833	(0.915)	146414	50.0000	45.09
	44 Dibromomethane	93	7.188	7.188	(1.094)	74305	50.0000	53.97
	91 Hexachlorobutadiene	225	13.991	13.991	(1.182)	70918	50.0000	52.87
	73 n-Propylbenzene	91	10.955	10.955	(0.925)	569185	50.0000	45.99
	87 n-Butylbenzene	91	12.223	12.223	(1.033)	333963	50.0000	49.87
	81 sec-Butylbenzene	105	11.668	11.668	(0.986)	503253	50.0000	47.83
	92 Naphthalene	128	14.061	14.061	(1.188)	379419	50.0000	50.53
	78 tert-Butylbenzene	119	11.453	11.453	(0.967)	367520	50.0000	46.14
	60 1,1,1,2-Tetrachloroethane	131	9.646	9.646	(1.012)	127684	50.0000	51.22
	64 Styrene	104	10.198	10.198	(1.070)	355132	50.0000	50.54

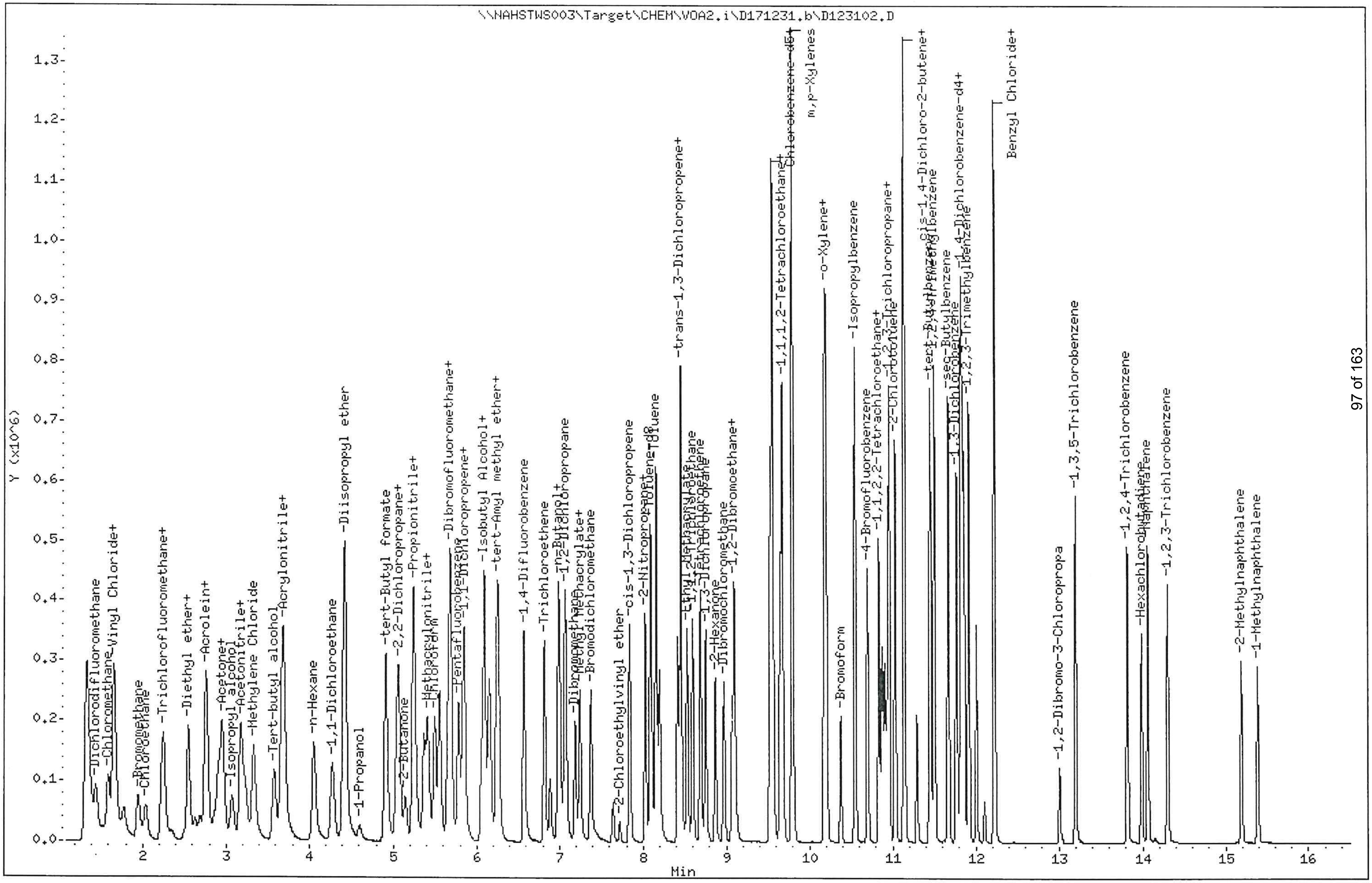
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123102.D
Report Date: 08-Feb-2018 17:09

QC Flag Legend

a - Target compound detected but, quantitated amount
    Below Limit Of Quantitation(BLOQ).

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123102.D
Date : 31-DEC-2017 14:04
Client ID: CCV
Sample Info: CCV;CCV;2;;
Purge Volume: 5.0
Column phase: DB624

Instrument: VOA2.i
Operator: AP
Column diameter: 0.18



Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123103.D
Report Date: 08-Feb-2018 17:09

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123103.D
Lab Smp Id: VLCSW-171231 Client Smp ID: VLCSW-171231
Inj Date : 31-DEC-2017 14:28
Operator : AP Inst ID: VOA2.i
Smp Info : VLCSW-171231;VLCSW-171231;3;;LCS
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\chem\voa2.i\D171231.b\8260LL.m
Meth Date : 08-Feb-2018 17:09 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 12:14 Cal File: D121908.D
Als bottle: 3 QC Sample: LCS
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

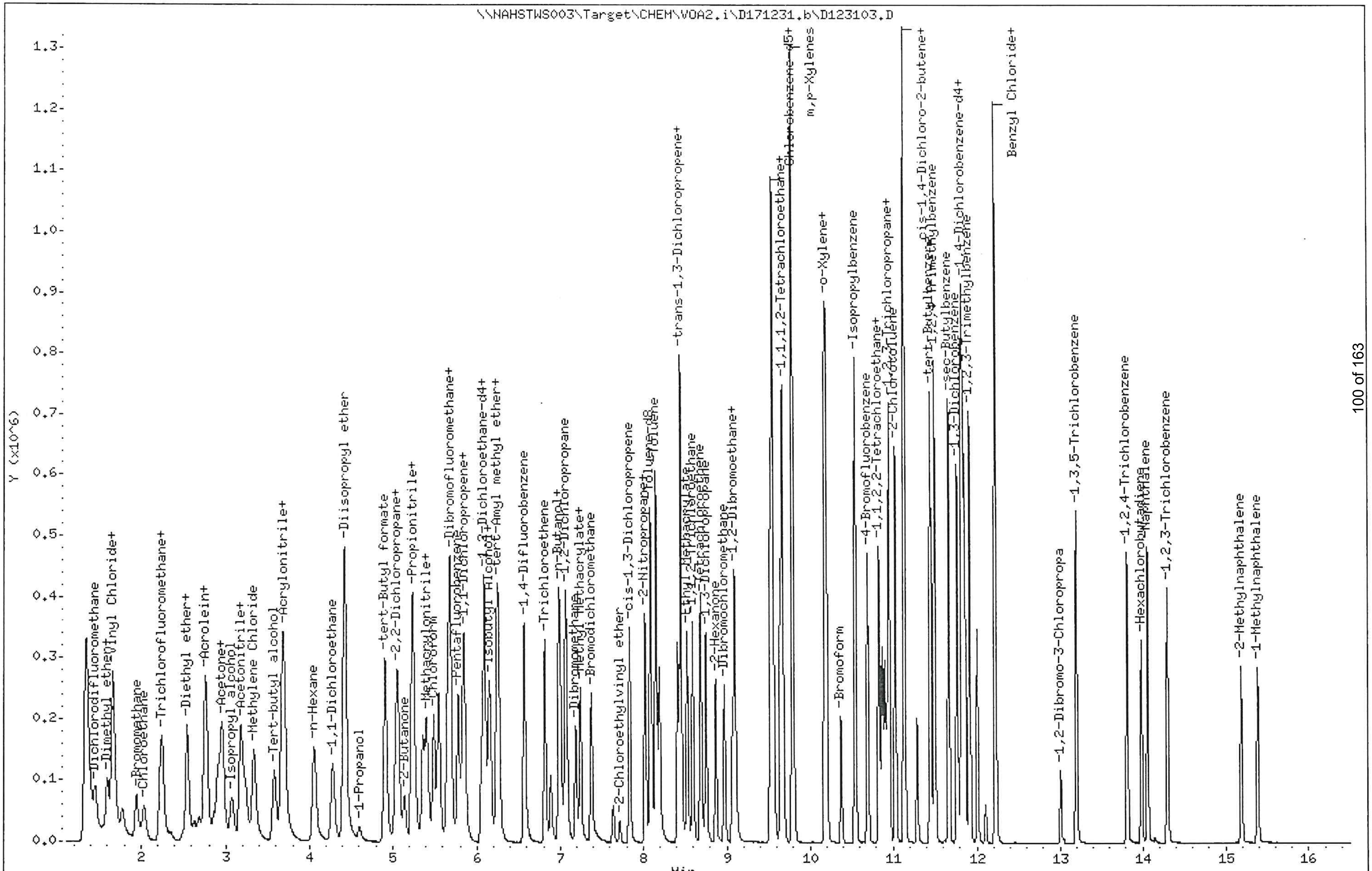
Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/l)	FINAL (ug/l)
31 1,1,1-Trichloroethane	97	5.654	5.654	(0.978)	171718	47.8547	47.85
* 1 Pentafluorobenzene	168	5.779	5.782	(1.000)	232173	50.0000	
$ 30 Dibromofluoromethane	113	5.686	5.689	(0.984)	99128	47.3885	47.38
* 36 1,4-Difluorobenzene	114	6.572	6.572	(1.000)	350112	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.058	6.055	(1.048)	121862	47.1689	47.16
* 47 Chlorobenzene-d5	117	9.527	9.527	(1.000)	319446	50.0000	
$ 48 Toluene-d8	98	8.093	8.093	(0.849)	392219	46.5681	46.56
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	153094	49.7765	49.77
* 70 1,4-Dichlorobenzene-d4	152	11.834	11.838	(1.000)	147881	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.872	10.872	(0.919)	146527	41.5359	41.53
53 1,1,2-Trichloroethane	83	8.593	8.593	(0.902)	90075	46.0943	46.09
32 1,1-Dichloropropene	75	5.856	5.856	(0.891)	139971	51.3244	51.32
22 1,1-Dichloroethane	63	4.284	4.277	(0.741)	225301	46.4807	46.48
11 1,1-Dichloroethene	96	2.753	2.750	(0.476)	94660	49.3995	49.39
90 1,2,4-Trichlorobenzene	180	13.817	13.818	(1.168)	153234	52.5982	52.59
89 1,2-Dibromo-3-Chloropropane	75	13.009	13.009	(1.099)	26376	43.4139	43.41
57 1,2-Dibromoethane	107	9.065	9.065	(0.952)	118224	48.3039	48.30
88 1,2-Dichlorobenzene	146	12.223	12.223	(1.033)	233845	43.9938	43.99
33 1,2-Dichloroethane	62	6.145	6.145	(0.935)	152345	49.2804	49.28
42 1,2-Dichloropropane	63	7.069	7.066	(1.076)	129453	46.9438	46.94
83 1,3-Dichlorobenzene	146	11.767	11.767	(0.994)	245556	44.3919	44.39

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123103.D
Report Date: 08-Feb-2018 17:09

	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/l)	CONCENTRATIONS FINAL (ug/l)
	84 1,4-Dichlorobenzene	146	11.857	11.860	(1.002)	235222	44.4594	44.45
	24 2-Butanone	43	5.144	5.144	(0.890)	108816	86.8575	86.85
	52 2-Hexanone	43	8.866	8.866	(0.931)	161951	86.5263	86.52
	45 4-Methyl-2-Pentanone	43	8.029	8.025	(0.843)	255275	88.0817	88.08
	10 Acetone	43	2.856	2.862	(0.494)	68837	89.1969	89.19
	37 Benzene	78	6.094	6.090	(0.927)	435166	47.2396	47.23
	39 Bromodichloromethane	83	7.377	7.377	(1.123)	156945	48.1347	48.13
	66 Bromoform	173	10.374	10.378	(1.089)	95718	50.5132	50.51
	6 Bromomethane	94	1.941	1.941	(0.336)	85834	54.1944	54.19
	19 Carbon Disulfide	76	2.955	2.952	(0.511)	431981	98.7150	98.71
	34 Carbon Tetrachloride	117	5.834	5.834	(0.888)	136308	40.9876	40.98
	59 Chlorobenzene	112	9.553	9.553	(1.003)	305466	46.4327	46.43
	7 Chloroethane	64	2.038	2.041	(0.353)	80986	43.1139	43.11
	28 Chloroform	83	5.493	5.494	(0.951)	196984	46.5368	46.53
	3 Chloromethane	50	1.591	1.588	(0.275)	193609	49.8558	49.85
	27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.877)	125121	47.3694	47.36
	46 cis-1,3-Dichloropropene	75	7.839	7.839	(1.193)	194892	52.0488	52.04
	55 Dibromochloromethane	129	8.969	8.972	(0.941)	134079	48.6143	48.61
	2 Dichlorodifluoromethane	85	1.447	1.447	(0.250)	92301	46.5043	46.50
	61 Ethylbenzene	106	9.672	9.672	(1.015)	161739	45.9333	45.93
	67 Isopropylbenzene	105	10.548	10.548	(1.107)	517914	47.5456	47.54
	17 Methylene Chloride	84	3.334	3.334	(0.577)	114439	45.0325	45.03
	56 Tetrachloroethene	164	8.690	8.690	(0.912)	102757	52.2357	52.23
	50 Toluene	91	8.160	8.157	(0.857)	468018	46.2300	46.23
	20 trans-1,2-Dichloroethene	96	3.671	3.671	(0.635)	106296	51.2839	51.28
	51 trans-1,3-Dichloropropene	75	8.417	8.417	(1.281)	165207	51.8510	51.85
	38 Trichloroethene	130	6.819	6.819	(1.038)	127063	48.9987	48.99
	8 Trichlorofluoromethane	101	2.256	2.256	(0.390)	148345	51.8203	51.82
	5 Vinyl Chloride	62	1.678	1.685	(0.290)	138226	48.5737	48.57
	62 m,p-Xylenes	106	9.790	9.790	(1.028)	397178	92.2346	92.23
	63 o-Xylene	106	10.179	10.179	(1.068)	211437	46.9333	46.93
M	95 Xylenes (total)	106				608615	139.168	139.16
	71 1,2,3-Trichloropropane	75	10.904	10.904	(0.921)	157169	44.6150	44.61
	93 1,2,3-Trichlorobenzene	182	14.302	14.302	(1.209)	130196	51.8657	51.86
	79 1,2,4-Trimethylbenzene	105	11.501	11.501	(0.972)	417571	42.3923	42.39
	75 1,3,5-Trimethylbenzene	105	11.135	11.132	(0.941)	414908	43.2534	43.25
	26 2,2-Dichloropropane	77	5.044	5.041	(0.873)	169202	50.0238	50.02
	54 1,3-Dichloropropane	76	8.754	8.754	(0.919)	178741	45.3497	45.34
	76 2-Chlorotoluene	91	11.029	11.029	(0.932)	354956	42.2537	42.25
	77 4-Chlorotoluene	91	11.138	11.138	(0.941)	393530	43.0235	43.02
	82 p-Isopropyltoluene	119	11.818	11.818	(0.999)	407643	44.7830	44.78
	29 Bromochloromethane	128	5.368	5.365	(0.929)	62014	49.3348	49.33
	74 Bromobenzene	156	10.833	10.833	(0.915)	143613	43.7795	43.77
	44 Dibromomethane	93	7.188	7.188	(1.094)	71234	49.8468	49.84
	91 Hexachlorobutadiene	225	13.987	13.991	(1.182)	68912	50.8342	50.83
	73 n-Propylbenzene	91	10.955	10.955	(0.926)	551824	44.1350	44.13
	87 n-Butylbenzene	91	12.223	12.223	(1.033)	321788	47.5659	47.56
	81 sec-Butylbenzene	105	11.667	11.668	(0.986)	483657	45.5013	45.50
	92 Naphthalene	128	14.061	14.061	(1.188)	370060	48.7642	48.76
	78 tert-Butylbenzene	119	11.449	11.453	(0.967)	352496	43.8058	43.80
	60 1,1,1,2-Tetrachloroethane	131	9.646	9.646	(1.012)	121998	47.8589	47.85
	64 Styrene	104	10.198	10.198	(1.070)	344378	47.9289	47.92

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123103.D
Date : 31-DEC-2017 14:28
Client ID: VLCSW-171231
Instrument: VOA2.i
Sample Info: VLCSW-171231;VLCSW-171231;3;;LCS
Purge Volume: 5.0
Operator: AP
Column phase: DB624
Column diameter: 0.18



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Report Date: 08-Feb-2018 17:09

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123105.D
Lab Smp Id: VBLKW-171231 Client Smp ID: VBLKW-171231
Inj Date : 31-DEC-2017 15:17
Operator : AP Inst ID: VOA2.i
Smp Info : VBLKW-171231;VBLKW-171231;3;;BLANK
Misc Info : HS15080001;WATER;0;1;
Comment :
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Meth Date : 08-Feb-2018 17:09 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 12:14 Cal File: D121908.D
Als bottle: 5 QC Sample: BLANK
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

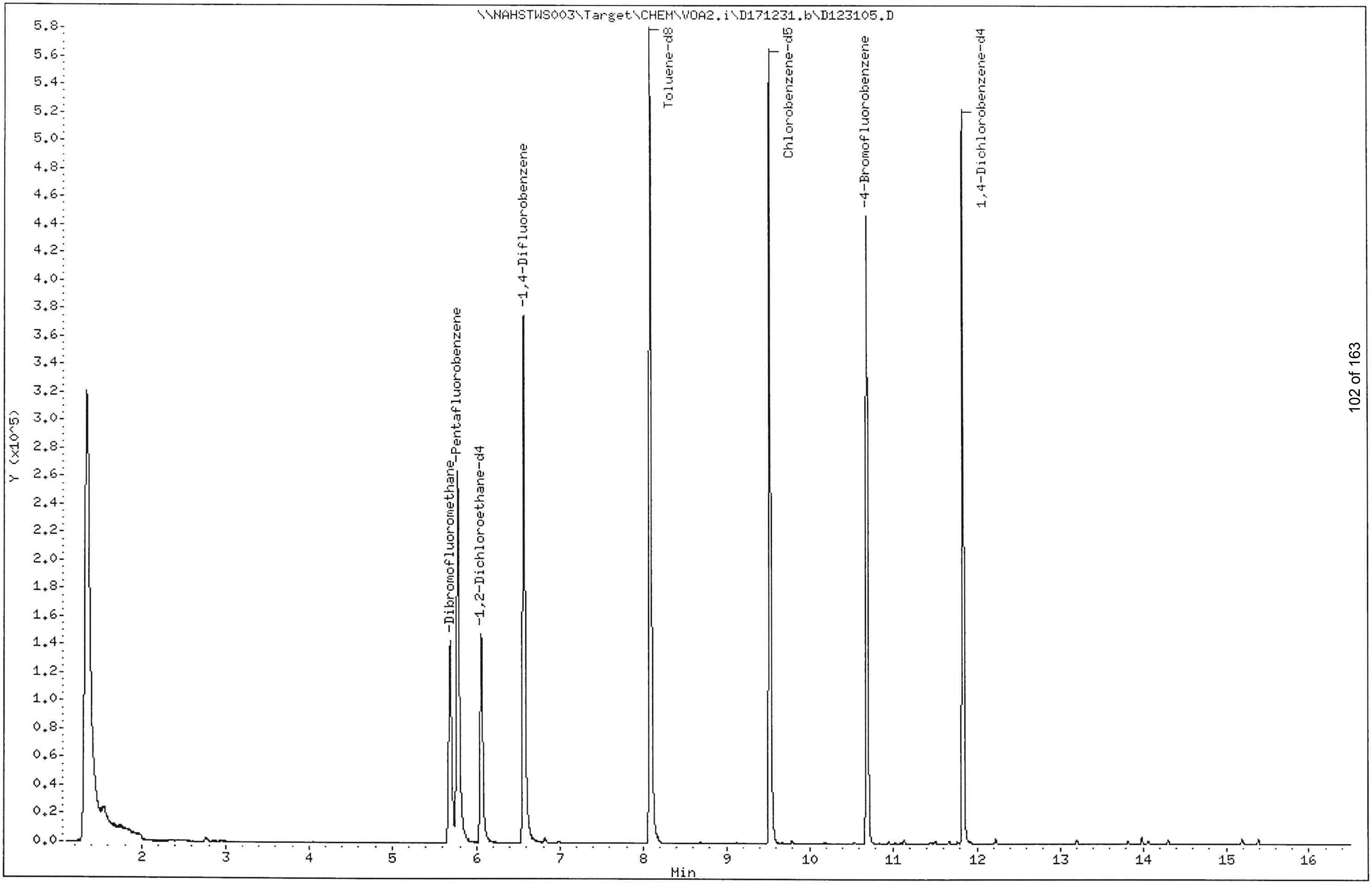
Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

							CONCENTRATIONS ON-COLUMN (ug/l)	FINAL (ug/l)
	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	ON-COLUMN (ug/l)	FINAL (ug/l)
*	1 Pentafluorobenzene	168	5.779	5.782	(1.000)	248348	50.0000	
$	30 Dibromofluoromethane	113	5.686	5.689	(0.984)	110129	49.2186	49.21
*	36 1,4-Difluorobenzene	114	6.569	6.572	(1.000)	350622	50.0000	
$	35 1,2-Dichloroethane-d4	65	6.052	6.055	(1.047)	126009	45.5974	45.59
*	47 Chlorobenzene-d5	117	9.524	9.527	(1.000)	318957	50.0000	
$	48 Toluene-d8	98	8.090	8.093	(0.849)	408314	48.5534	48.55
$	69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	147537	48.0432	48.04
*	70 1,4-Dichlorobenzene-d4	152	11.834	11.838	(1.000)	141116	50.0000	

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123105.D
Date : 31-DEC-2017 15:17
Client ID: VBLKW-171231
Sample Info: VBLKW-171231;VBLKW-171231;3;;BLANK
Purge Volume: 5.0
Column phase: DB624

Instrument: VOA2.i

Operator: AP
Column diameter: 0.18



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Report Date: 08-Feb-2018 17:09

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Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123110.D
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Inj Date : 31-DEC-2017 17:20
Operator : AP Inst ID: VOA2.i
Smp Info : HS17121400-02;HS17121400-02;;;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\chem\voa2.i\D171231.b\8260LL.m
Meth Date : 08-Feb-2018 17:09 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 12:14 Cal File: D121908.D
Als bottle: 10
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/l)	CONCENTRATIONS FINAL (ug/l)
* 1 Pentafluorobenzene	168	5.776	5.782	(1.000)	244487	50.0000	
$ 30 Dibromofluoromethane	113	5.689	5.689	(0.985)	109352	49.6431	49.64
* 36 1,4-Difluorobenzene	114	6.568	6.572	(1.000)	348629	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.058	6.055	(1.049)	125985	46.3087	46.30
* 47 Chlorobenzene-d5	117	9.524	9.527	(1.000)	317807	50.0000	
$ 48 Toluene-d8	98	8.089	8.093	(0.849)	404386	48.2603	48.26
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	146963	48.0295	48.02
* 70 1,4-Dichlorobenzene-d4	152	11.834	11.838	(1.000)	139719	50.0000	

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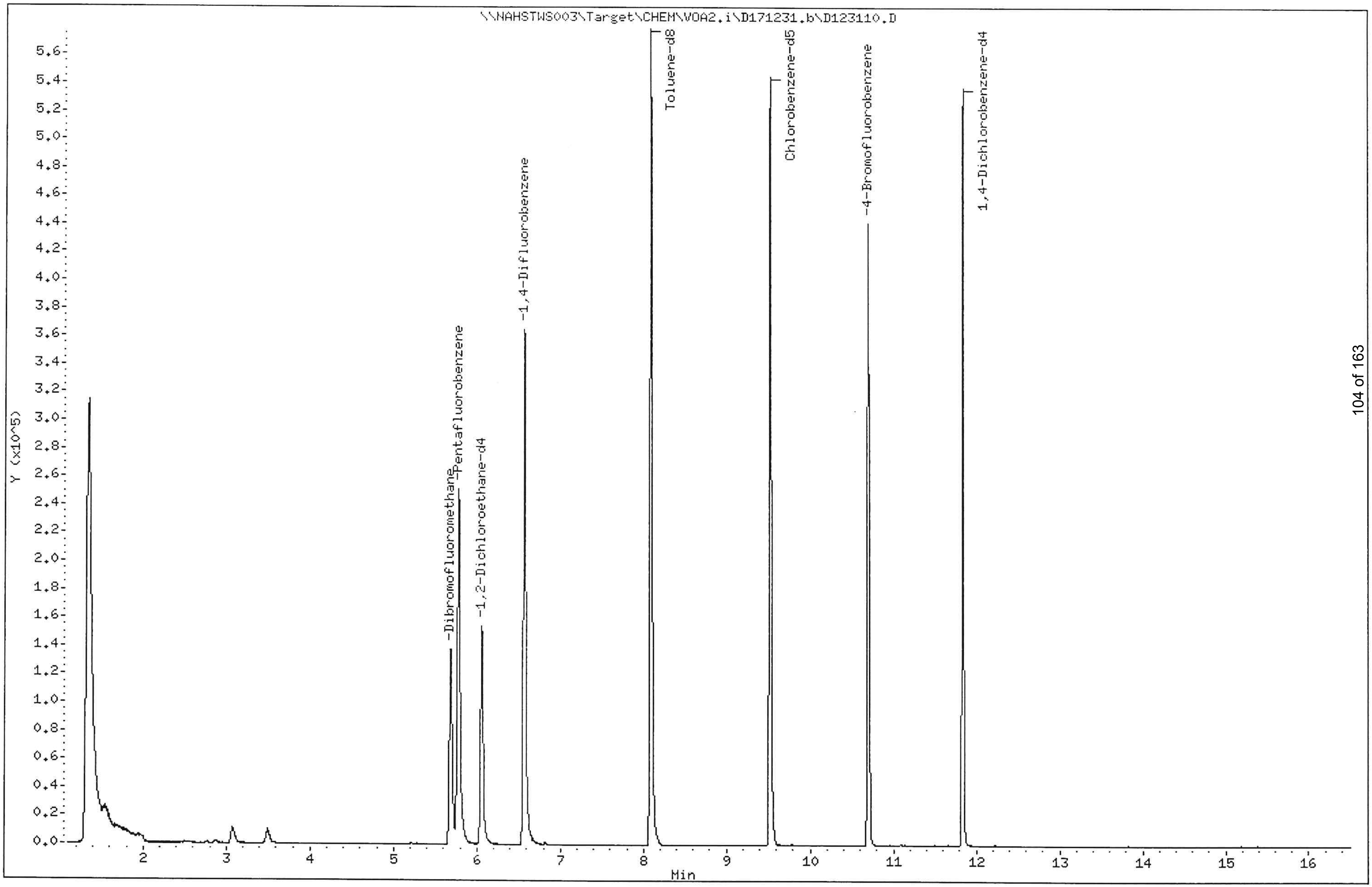
Date : 31-DEC-2017 17:20
Client ID: HS17121400-02
Sample Info: HS17121400-02;HS17121400-02;;;
Purge Volume: 5.0
Column phase: DB624

Instrument: VOA2.i

Operator: AP
Column diameter: 0.18



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Report Date: 08-Feb-2018 17:09

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123114.D
Lab Smp Id: HS17121400-01 Client Smp ID: HS17121400-01
Inj Date : 31-DEC-2017 18:58
Operator : AP Inst ID: VOA2.i
Smp Info : HS17121400-01;HS17121400-01;;;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\chem\voa2.i\D171231.b\8260LL.m
Meth Date : 08-Feb-2018 17:09 VOA2.i Quant Type: ISTD
Cal Date : 19-DEC-2017 12:14 Cal File: D121908.D
Als bottle: 14
Dil Factor: 1.00000
Integrator: HP RTE Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

							CONCENTRATIONS	
		QUANT SIG					ON-COLUMN	FINAL
Compounds		MASS	RT	EXP RT	REL RT	RESPONSE	(ug/l)	(ug/l)
*	1 Pentafluorobenzene	168	5.779	5.782	(1.000)	241830	50.0000	
$	30 Dibromofluoromethane	113	5.686	5.689	(0.984)	108301	49.7062	49.70
*	36 1,4-Difluorobenzene	114	6.571	6.572	(1.000)	341994	50.0000	
$	35 1,2-Dichloroethane-d4	65	6.058	6.055	(1.048)	122615	45.5651	45.56
*	47 Chlorobenzene-d5	117	9.524	9.527	(1.000)	320761	50.0000	
$	48 Toluene-d8	98	8.089	8.093	(0.849)	401282	47.4488	47.44
$	69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	150026	48.5790	48.57
*	70 1,4-Dichlorobenzene-d4	152	11.834	11.838	(1.000)	147858	50.0000	
	27 cis-1,2-Dichloroethene	96	5.063	5.067	(0.876)	10347	3.76083	3.76(a)

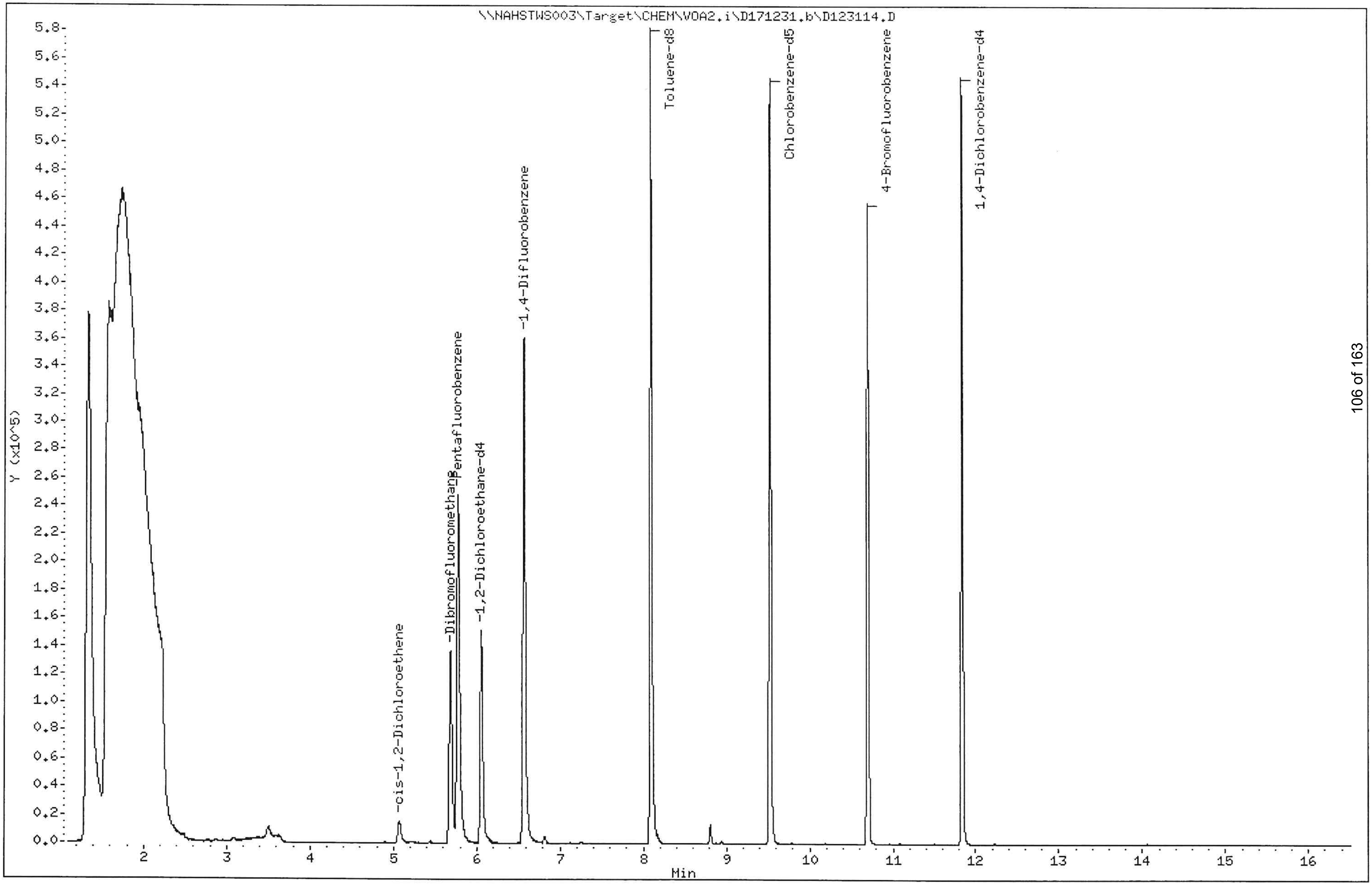
QC Flag Legend

a - Target compound detected but, quantitated amount
Below Limit Of Quantitation(BLOQ).

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123114.D
Date : 31-DEC-2017 18:58
Client ID: HS17121400-01
Sample Info: HS17121400-01;HS17121400-01;;;
Purge Volume: 5.0
Column phase: DB624

Instrument: VOA2.i

Operator: AP
Column diameter: 0.18



Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123114.D

Date : 31-DEC-2017 18:58

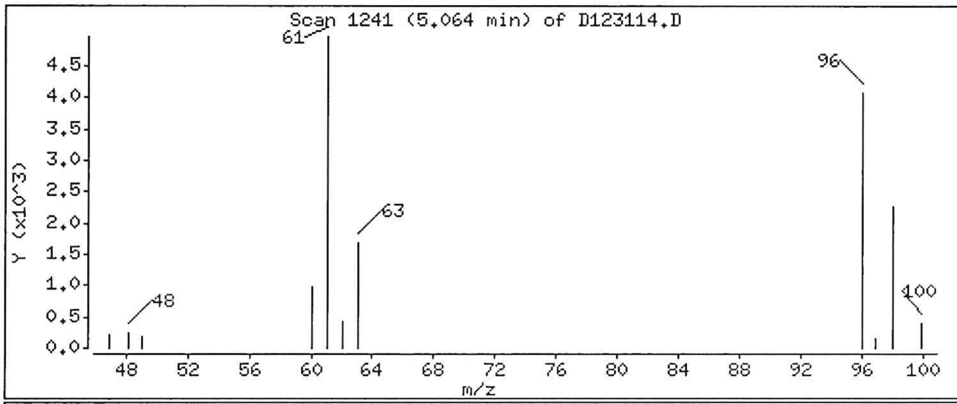
Client ID: HS17121400-01 | Instrument: VOA2.i

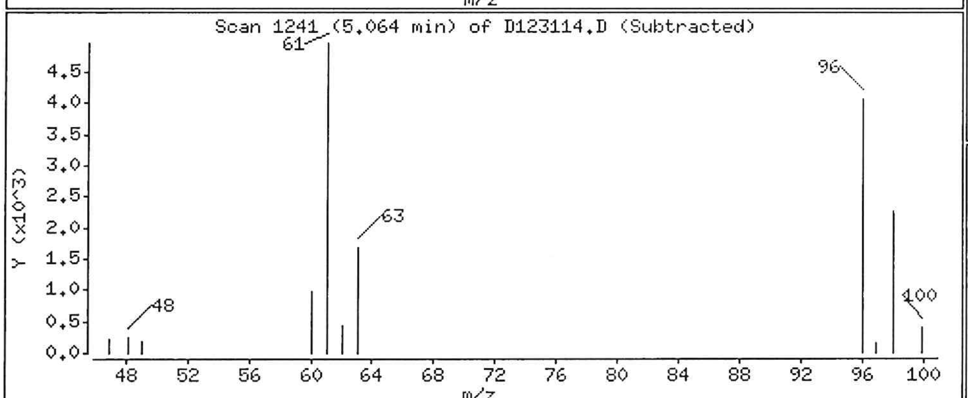
Sample Info: HS17121400-01;HS17121400-01;;;

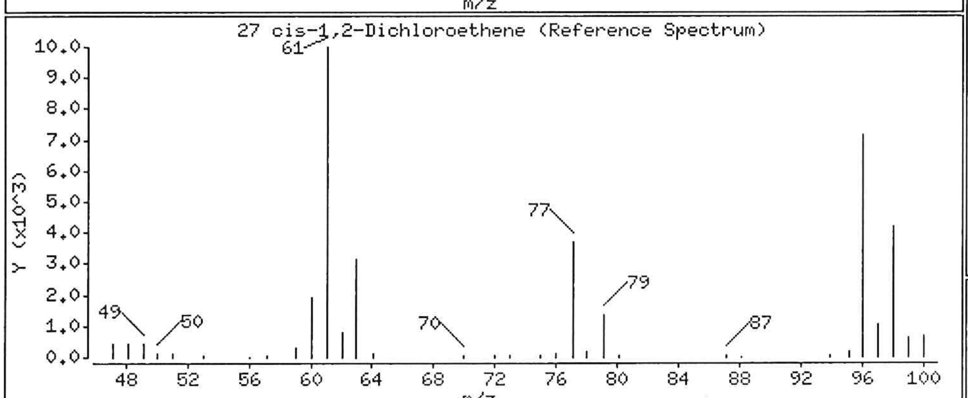
Purge Volume: 5.0 | Operator: AP

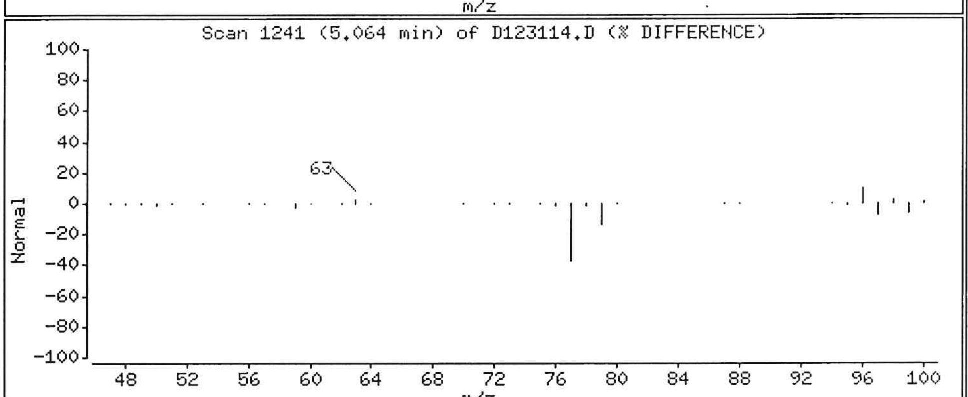
Column phase: DB624 | Column diameter: 0.18

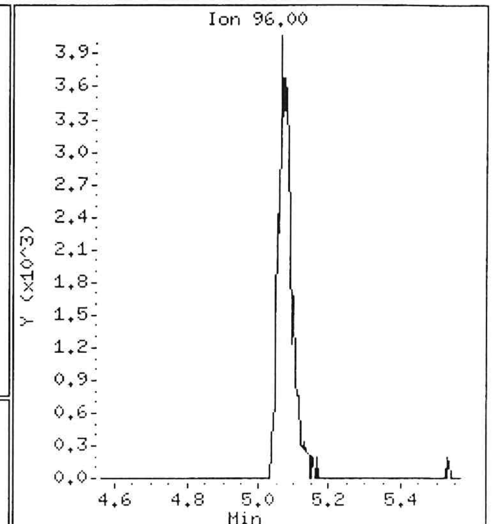
27 cis-1,2-Dichloroethene | Concentration: 3.76 ug/l | Review Code:

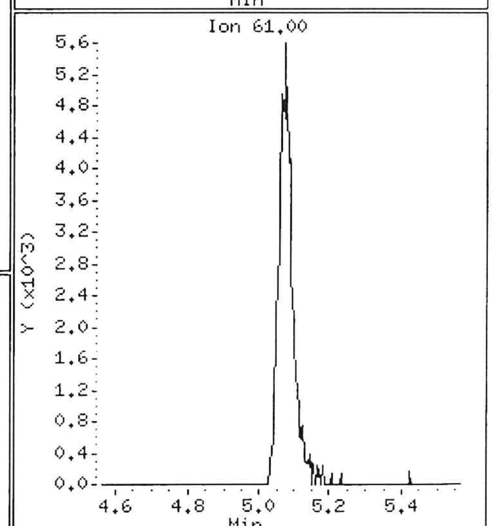


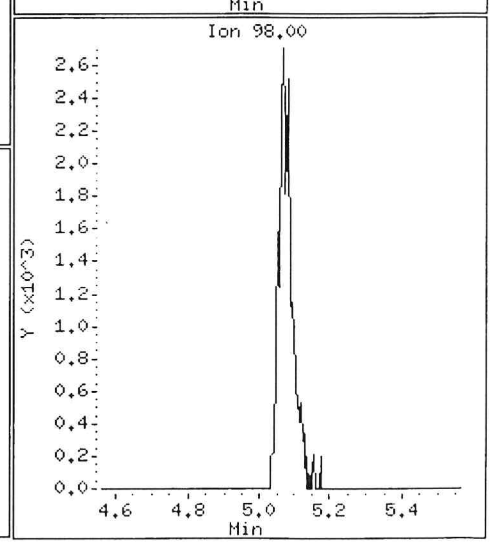












Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123127.D
Report Date: 08-Feb-2018 17:09

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123127.D
Lab Smp Id: HS17121224-01MS   Client Smp ID: HS17121224-01MS
Inj Date : 01-JAN-2018 00:44
Operator : AP   Inst ID: VOA2.i
Smp Info : HS17121224-01MS;HS17121224-01MS;3;;MS
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\chem\voa2.i\D171231.b\8260LL.m
Meth Date : 08-Feb-2018 17:09 VOA2.i   Quant Type: ISTD
Cal Date : 19-DEC-2017 12:14   Cal File: D121908.D
Als bottle: 21   QC Sample: MS
Dil Factor: 1.00000
Integrator: HP RTE   Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

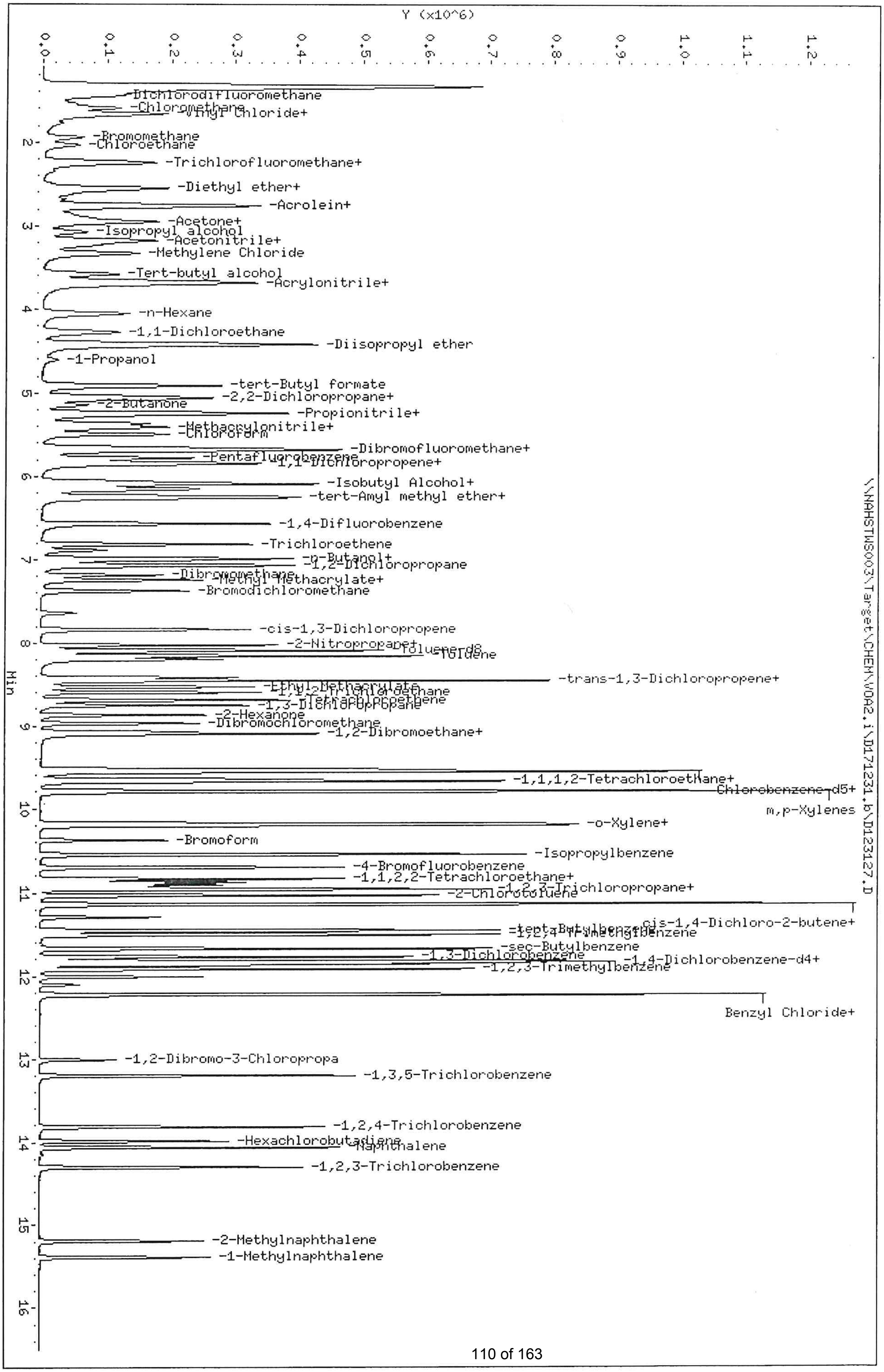
Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/l)	CONCENTRATIONS FINAL (ug/l)
31 1,1,1-Trichloroethane	97	5.651	5.654	(0.978)	173916	48.8994	48.89
* 1 Pentafluorobenzene	168	5.779	5.782	(1.000)	230121	50.0000	
$ 30 Dibromofluoromethane	113	5.683	5.689	(0.983)	99252	47.8709	47.87
* 36 1,4-Difluorobenzene	114	6.572	6.572	(1.000)	338952	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.058	6.055	(1.048)	119908	46.8265	46.82
* 47 Chlorobenzene-d5	117	9.524	9.527	(1.000)	312265	50.0000	
$ 48 Toluene-d8	98	8.093	8.093	(0.850)	383964	46.6363	46.63
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	147778	49.1530	49.15
* 70 1,4-Dichlorobenzene-d4	152	11.834	11.838	(1.000)	147666	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.872	10.872	(0.919)	142303	40.3973	40.39
53 1,1,2-Trichloroethane	83	8.597	8.593	(0.903)	85797	44.9148	44.91
32 1,1-Dichloropropene	75	5.853	5.856	(0.891)	136052	51.5337	51.53
22 1,1-Dichloroethane	63	4.281	4.277	(0.741)	219590	45.7065	45.70
11 1,1-Dichloroethene	96	2.747	2.750	(0.475)	97799	51.4927	51.49
90 1,2,4-Trichlorobenzene	180	13.814	13.818	(1.167)	141805	48.7460	48.74
89 1,2-Dibromo-3-Chloropropane	75	13.009	13.009	(1.099)	25453	41.9737	41.97
57 1,2-Dibromoethane	107	9.065	9.065	(0.952)	114562	47.8841	47.88
88 1,2-Dichlorobenzene	146	12.223	12.223	(1.033)	226910	42.7513	42.75
33 1,2-Dichloroethane	62	6.145	6.145	(0.935)	151297	50.5554	50.55
42 1,2-Dichloropropane	63	7.066	7.066	(1.075)	123842	46.3877	46.38
83 1,3-Dichlorobenzene	146	11.767	11.767	(0.994)	236316	42.7836	42.78

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123127.D
Report Date: 08-Feb-2018 17:09

	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/l)	CONCENTRATIONS FINAL (ug/l)
	84 1,4-Dichlorobenzene	146	11.857	11.860	(1.002)	224403	42.4763	42.47
	24 2-Butanone	43	5.147	5.144	(0.891)	108113	87.0658	87.06
	52 2-Hexanone	43	8.866	8.866	(0.931)	157478	86.0713	86.07
	45 4-Methyl-2-Pentanone	43	8.026	8.025	(0.843)	247953	87.5227	87.52
	10 Acetone	43	2.859	2.862	(0.495)	71357	93.3944	93.39
	37 Benzene	78	6.091	6.090	(0.927)	424120	47.5564	47.55
	39 Bromodichloromethane	83	7.377	7.377	(1.123)	151097	47.8669	47.86
	66 Bromoform	173	10.374	10.378	(1.089)	90923	49.0862	49.08
	6 Bromomethane	94	1.935	1.941	(0.335)	70466	44.4584	44.45
	19 Carbon Disulfide	76	2.952	2.952	(0.511)	429426	99.0062	99.00
	34 Carbon Tetrachloride	117	5.831	5.834	(0.887)	141334	43.8982	43.89
	59 Chlorobenzene	112	9.553	9.553	(1.003)	293796	45.6857	45.68
	7 Chloroethane	64	2.034	2.041	(0.352)	82297	44.2025	44.20
	28 Chloroform	83	5.494	5.494	(0.951)	192140	45.7972	45.79
	3 Chloromethane	50	1.592	1.588	(0.275)	203798	53.0068	53.00
	27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.877)	124396	47.5149	47.51
	46 cis-1,3-Dichloropropene	75	7.839	7.839	(1.193)	182912	50.4578	50.45
	55 Dibromochloromethane	129	8.969	8.972	(0.942)	127728	47.3766	47.37
	2 Dichlorodifluoromethane	85	1.450	1.447	(0.251)	108794	55.3028	55.30
	61 Ethylbenzene	106	9.668	9.672	(1.015)	157350	45.7145	45.71
	67 Isopropylbenzene	105	10.545	10.548	(1.107)	504851	47.4122	47.41
	17 Methylene Chloride	84	3.334	3.334	(0.577)	115107	45.6993	45.69
	56 Tetrachloroethene	164	8.690	8.690	(0.912)	99913	51.9489	51.94
	50 Toluene	91	8.157	8.157	(0.856)	453870	45.8635	45.86
	20 trans-1,2-Dichloroethene	96	3.671	3.671	(0.635)	105515	51.3610	51.36
	51 trans-1,3-Dichloropropene	75	8.417	8.417	(1.281)	154912	50.2207	50.22
	38 Trichloroethene	130	6.816	6.819	(1.037)	124529	49.6026	49.60
	8 Trichlorofluoromethane	101	2.253	2.256	(0.390)	149913	52.8350	52.83
	5 Vinyl Chloride	62	1.678	1.685	(0.290)	143715	50.9529	50.95
	62 m,p-Xylenes	106	9.790	9.790	(1.028)	383483	91.1023	91.10
	63 o-Xylene	106	10.175	10.179	(1.068)	202134	45.9001	45.90
M	95 Xylenes (total)	106				585617	137.002	137.00
	71 1,2,3-Trichloropropane	75	10.904	10.904	(0.921)	147179	41.8400	41.83
	93 1,2,3-Trichlorobenzene	182	14.299	14.302	(1.208)	123997	49.4682	49.46
	79 1,2,4-Trimethylbenzene	105	11.501	11.501	(0.972)	401757	40.8462	40.84
	75 1,3,5-Trimethylbenzene	105	11.132	11.132	(0.941)	398100	41.5616	41.56
	26 2,2-Dichloropropane	77	5.041	5.041	(0.872)	147221	43.9134	43.91
	54 1,3-Dichloropropane	76	8.751	8.754	(0.919)	170685	44.3017	44.30
	76 2-Chlorotoluene	91	11.029	11.029	(0.932)	343788	40.9839	40.98
	77 4-Chlorotoluene	91	11.138	11.138	(0.941)	375304	41.0907	41.09
	82 p-Isopropyltoluene	119	11.818	11.818	(0.999)	389481	42.8500	42.85
	29 Bromochloromethane	128	5.365	5.365	(0.928)	59812	48.0073	48.00
	74 Bromobenzene	156	10.833	10.833	(0.915)	135830	41.4672	41.46
	44 Dibromomethane	93	7.188	7.188	(1.094)	68345	49.3998	49.39
	91 Hexachlorobutadiene	225	13.988	13.991	(1.182)	61289	45.2289	45.22
	73 n-Propylbenzene	91	10.955	10.955	(0.926)	530888	42.5223	42.52
	87 n-Butylbenzene	91	12.220	12.223	(1.033)	298175	44.1396	44.13
	81 sec-Butylbenzene	105	11.668	11.668	(0.986)	464879	43.7984	43.79
	92 Naphthalene	128	14.061	14.061	(1.188)	358413	47.2823	47.28
	78 tert-Butylbenzene	119	11.449	11.453	(0.967)	346706	43.1489	43.14
	60 1,1,1,2-Tetrachloroethane	131	9.643	9.646	(1.012)	117226	47.0444	47.04
	64 Styrene	104	10.198	10.198	(1.071)	328096	46.7130	46.71



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Date : 01-JAN-2018 00:44
Client ID: HS171224-01MS
Sample Info: HS171224-01MS;HS171224-01MS;3;;MS
Purge Volume: 5.0
Column phase: DB624
Instrument: VOA2.i
Operator: AP
Column diameter: 0.18
\\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123127.D
Y (x10^6)
Min
-Dichlorodifluoromethane
-Chloromethane
-Vinyl Chloride+
-Bromomethane
-Chloroethane
-Trichlorofluoromethane+
-Diethyl ether+
-Acrolein+
-Acetone+
-Isopropyl alcohol
-Acetonitrile+
-Methylene Chloride
-Tert-butyl alcohol
-Acrylonitrile+
-n-Hexane
-1,1-Dichloroethane
-Diisopropyl ether
-1-Propanol
-tert-Butyl formate
-2,2-Dichloropropane+
-2-Butanone
-Propionitrile+
-Methacrylonitrile+
-Chloroform
-Dibromofluoromethane+
-Pentafluorobenzene
-1,1-Dichloropropene+
-Isobutyl Alcohol+
-tert-Amyl methyl ether+
-1,4-Difluorobenzene
-Trichloroethene
-n-Butanol+
-1,2-Dichloropropane
-Dibromomethane
-Methyl Methacrylate+
-Bromodichloromethane
-cis-1,3-Dichloropropene
-2-Nitropropane+
-Toluene-d8
-Toluene
-trans-1,3-Dichloropropene+
-Ethyl Methacrylate
-1,1,2-Trichloroethane
-Tetrachloroethene
-1,3-Dichloropropane
-2-Hexanone
-Dibromochloromethane
-1,2-Dibromoethane+
-1,1,1,2-Tetrachloroethane+
Chlorobenzene-d5+
m,p-Xylenes
-o-Xylene+
-Bromoform
-Isopropylbenzene
-4-Bromofluorobenzene
-1,1,2,2-Tetrachloroethane+
-1,2,3-Trichloropropane+
-2-Chlorotoluene
cis-1,4-Dichloro-2-butene+
-tert-Butylbenzene
-1,2,4-Trimethylbenzene
-sec-Butylbenzene
-1,3-Dichlorobenzene
-1,4-Dichlorobenzene-d4+
-1,2,3-Trimethylbenzene
Benzyl Chloride+
-1,2-Dibromo-3-Chloropropa
-1,3,5-Trichlorobenzene
-1,2,4-Trichlorobenzene
-Hexachlorobutadiene
-Naphthalene
-1,2,3-Trichlorobenzene
-2-Methylnaphthalene
-1-Methylnaphthalene

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Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123128.D
Report Date: 08-Feb-2018 17:09
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Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123128.D
Lab Smp Id: HS17121224-01MSD            Client Smp ID: HS17121224-01MSD
Inj Date   : 01-JAN-2018 01:09
Operator   : AP                         Inst ID: VOA2.i
Smp Info   : HS17121224-01MSD;HS17121224-01MSD;3;;MSD
Misc Info  : HS15080001;WATER;0;1;
Comment    :
Method     : \\nahstws003\Target\chem\voa2.i\D171231.b\8260LL.m
Meth Date  : 08-Feb-2018 17:09 VOA2.i   Quant Type: ISTD
Cal Date   : 19-DEC-2017 12:14          Cal File: D121908.D
Als bottle: 21                          QC Sample: MSD
Dil Factor: 1.00000
Integrator: HP RTE                      Compound Sublist: dn_bhate.sub
Target Version:  4.14
Processing Host: NAHSTW7056
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Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

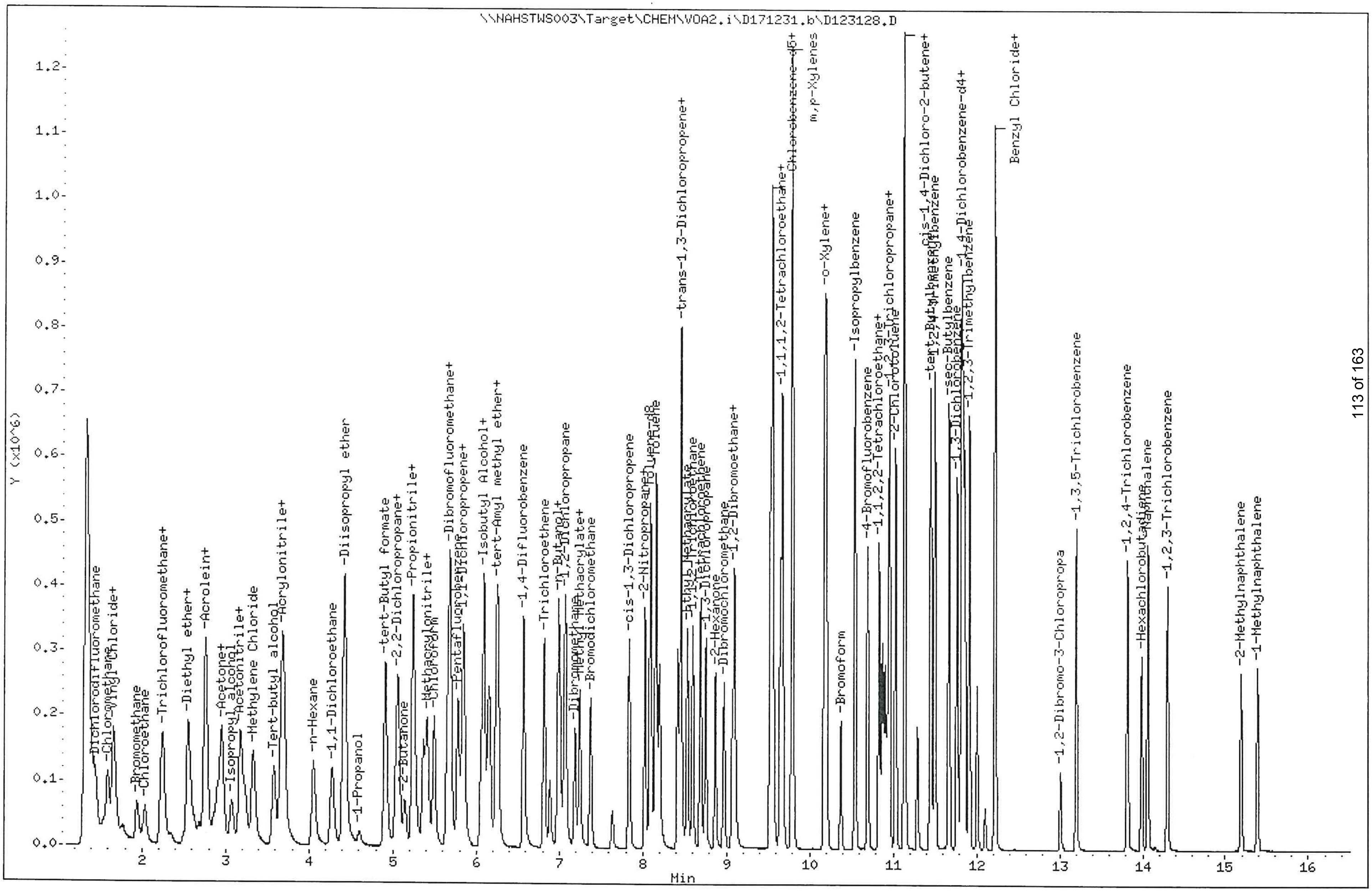
Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/l)	CONCENTRATIONS FINAL (ug/l)
31 1,1,1-Trichloroethane	97	5.648	5.654	(0.977)	171931	48.9725	48.97
* 1 Pentafluorobenzene	168	5.783	5.782	(1.000)	227155	50.0000	
$ 30 Dibromofluoromethane	113	5.683	5.689	(0.983)	99011	48.3782	48.37
* 36 1,4-Difluorobenzene	114	6.572	6.572	(1.000)	338925	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.055	6.055	(1.047)	120984	47.8636	47.86
* 47 Chlorobenzene-d5	117	9.527	9.527	(1.000)	312827	50.0000	
$ 48 Toluene-d8	98	8.090	8.093	(0.849)	386220	46.8261	46.82
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	148731	49.3811	49.38
* 70 1,4-Dichlorobenzene-d4	152	11.835	11.838	(1.000)	149308	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.872	10.872	(0.919)	144993	40.7083	40.70
53 1,1,2-Trichloroethane	83	8.590	8.593	(0.902)	86729	45.3211	45.32
32 1,1-Dichloropropene	75	5.850	5.856	(0.890)	138798	52.5969	52.59
22 1,1-Dichloroethane	63	4.278	4.277	(0.740)	220157	46.4228	46.42
11 1,1-Dichloroethene	96	2.750	2.750	(0.476)	96012	51.2119	51.21
90 1,2,4-Trichlorobenzene	180	13.818	13.818	(1.168)	146361	49.7588	49.75
89 1,2-Dibromo-3-Chloropropane	75	13.009	13.009	(1.099)	26564	43.3068	43.30
57 1,2-Dibromoethane	107	9.065	9.065	(0.952)	114445	47.7492	47.74
88 1,2-Dichlorobenzene	146	12.223	12.223	(1.033)	223255	41.6001	41.60
33 1,2-Dichloroethane	62	6.142	6.145	(0.935)	145541	48.6321	48.63
42 1,2-Dichloropropane	63	7.066	7.066	(1.075)	122438	45.8655	45.86
83 1,3-Dichlorobenzene	146	11.767	11.767	(0.994)	232534	41.6359	41.63

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123128.D
Report Date: 08-Feb-2018 17:09

	Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	CONCENTRATIONS ON-COLUMN (ug/l)	FINAL (ug/l)
	84 1,4-Dichlorobenzene	146	11.860	11.860	(1.002)	223574	41.8540	41.85
	24 2-Butanone	43	5.141	5.144	(0.889)	107561	87.7523	87.75
	52 2-Hexanone	43	8.866	8.866	(0.931)	160945	87.8082	87.80
	45 4-Methyl-2-Pentanone	43	8.029	8.025	(0.843)	251132	88.4856	88.48
	10 Acetone	43	2.859	2.862	(0.495)	72194	95.7822	95.78
	37 Benzene	78	6.087	6.090	(0.926)	422773	47.4091	47.40
	39 Bromodichloromethane	83	7.377	7.377	(1.123)	151059	47.8587	47.85
	66 Bromoform	173	10.378	10.378	(1.089)	92582	49.8920	49.89
	6 Bromomethane	94	1.935	1.941	(0.335)	68995	44.0785	44.07
	19 Carbon Disulfide	76	2.949	2.952	(0.510)	422646	98.7154	98.71
	34 Carbon Tetrachloride	117	5.831	5.834	(0.887)	140648	43.6886	43.68
	59 Chlorobenzene	112	9.550	9.553	(1.002)	292197	45.3555	45.35
	7 Chloroethane	64	2.035	2.041	(0.352)	77805	42.3354	42.33
	28 Chloroform	83	5.494	5.494	(0.950)	191091	46.1418	46.14
	3 Chloromethane	50	1.595	1.588	(0.276)	189945	49.9954	49.99
	27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.876)	121758	47.1145	47.11
	46 cis-1,3-Dichloropropene	75	7.836	7.839	(1.192)	180267	49.7321	49.73
	55 Dibromochloromethane	129	8.969	8.972	(0.941)	128268	47.4914	47.49
	2 Dichlorodifluoromethane	85	1.447	1.447	(0.250)	105630	54.3956	54.39
	61 Ethylbenzene	106	9.672	9.672	(1.015)	155586	45.1208	45.12
	67 Isopropylbenzene	105	10.545	10.548	(1.107)	498027	46.6873	46.68
	17 Methylene Chloride	84	3.328	3.334	(0.576)	111651	44.9060	44.90
	56 Tetrachloroethene	164	8.690	8.690	(0.912)	97741	50.6881	50.68
	50 Toluene	91	8.157	8.157	(0.856)	450471	45.4383	45.43
	20 trans-1,2-Dichloroethene	96	3.661	3.671	(0.633)	104296	51.4305	51.43
	51 trans-1,3-Dichloropropene	75	8.417	8.417	(1.281)	155068	50.2753	50.27
	38 Trichloroethene	130	6.816	6.819	(1.037)	123267	49.1038	49.10
	8 Trichlorofluoromethane	101	2.250	2.256	(0.389)	145852	52.0749	52.07
	5 Vinyl Chloride	62	1.678	1.685	(0.290)	139478	50.0964	50.09
	62 m,p-Xylenes	106	9.790	9.790	(1.028)	381064	90.3650	90.36
	63 o-Xylene	106	10.176	10.179	(1.068)	202782	45.9646	45.96
M	95 Xylenes (total)	106				583846	136.330	136.32
	71 1,2,3-Trichloropropane	75	10.904	10.904	(0.921)	148171	41.6588	41.65
	93 1,2,3-Trichlorobenzene	182	14.302	14.302	(1.209)	124889	49.2761	49.27
	79 1,2,4-Trimethylbenzene	105	11.501	11.501	(0.972)	394486	39.6659	39.66
	75 1,3,5-Trimethylbenzene	105	11.132	11.132	(0.941)	392018	40.4765	40.47
	26 2,2-Dichloropropane	77	5.041	5.041	(0.872)	144816	43.7600	43.76
	54 1,3-Dichloropropane	76	8.751	8.754	(0.918)	172718	44.7488	44.74
	76 2-Chlorotoluene	91	11.029	11.029	(0.932)	338614	39.9232	39.92
	77 4-Chlorotoluene	91	11.138	11.138	(0.941)	369459	40.0059	40.00
	82 p-Isopropyltoluene	119	11.819	11.818	(0.999)	387038	42.1130	42.11
	29 Bromochloromethane	128	5.359	5.365	(0.927)	59788	48.6146	48.61
	74 Bromobenzene	156	10.830	10.833	(0.915)	135883	41.0272	41.02
	44 Dibromomethane	93	7.191	7.188	(1.094)	67393	48.7156	48.71
	91 Hexachlorobutadiene	225	13.988	13.991	(1.182)	63426	46.3015	46.30
	73 n-Propylbenzene	91	10.955	10.955	(0.926)	519861	41.1812	41.18
	87 n-Butylbenzene	91	12.220	12.223	(1.033)	298570	43.7120	43.71
	81 sec-Butylbenzene	105	11.668	11.668	(0.986)	460849	42.9412	42.94
	92 Naphthalene	128	14.062	14.061	(1.188)	360790	47.0701	47.07
	78 tert-Butylbenzene	119	11.449	11.453	(0.967)	341296	42.0085	42.00
	60 1,1,1,2-Tetrachloroethane	131	9.643	9.646	(1.012)	115679	46.3402	46.34
	64 Styrene	104	10.198	10.198	(1.070)	327282	46.5133	46.51

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123128.D
Date : 01-JAN-2018 01:09
Client ID: HS17121224-01MSD
Sample Info: HS17121224-01MSD;HS17121224-01MSD;3;;MSD
Purge Volume: 5.0
Column phase: DB624

Instrument: VOA2.i
Operator: AP
Column diameter: 0.18



Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123129.D
Report Date: 08-Feb-2018 17:09

ALS Laboratory Group

Data file : \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123129.D
Lab Smp Id: CCV_END   Client Smp ID: CCV_END
Inj Date : 01-JAN-2018 01:33
Operator : AP   Inst ID: VOA2.i
Smp Info : CCV_END;CCV_END;2;;
Misc Info : HS15080001;WATER;0;1;
Comment :
Method : \\nahstws003\Target\chem\voa2.i\D171231.b\8260LL.m
Meth Date : 08-Feb-2018 17:09 VOA2.i   Quant Type: ISTD
Cal Date : 19-DEC-2017 12:14   Cal File: D121908.D
Als bottle: 22   Continuing Calibration Sample
Dil Factor: 1.00000
Integrator: HP RTE   Compound Sublist: dn_bhate.sub
Target Version: 4.14
Processing Host: NAHSTW7056

Concentration Formula: Amt * DF * (Uf/Vo)*1 * CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
Uf	5.000	ng unit correction factor
Vo	5.000	sample purged
Va	0.00000	
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
31 1,1,1-Trichloroethane	97	5.651	5.651	(0.978)	166469	50.0000	47.52
* 1 Pentafluorobenzene	168	5.779	5.779	(1.000)	226624	50.0000	
$ 30 Dibromofluoromethane	113	5.686	5.686	(0.984)	97035	50.0000	47.52
* 36 1,4-Difluorobenzene	114	6.569	6.569	(1.000)	338413	50.0000	
$ 35 1,2-Dichloroethane-d4	65	6.058	6.058	(1.048)	119690	50.0000	47.46
* 47 Chlorobenzene-d5	117	9.524	9.524	(1.000)	309332	50.0000	
$ 48 Toluene-d8	98	8.090	8.090	(0.849)	384277	50.0000	47.11
$ 69 4-Bromofluorobenzene	95	10.695	10.695	(1.123)	148582	50.0000	49.88
* 70 1,4-Dichlorobenzene-d4	152	11.835	11.835	(1.000)	146586	50.0000	
68 1,1,2,2-Tetrachloroethane	83	10.872	10.872	(0.919)	149440	50.0000	42.73
53 1,1,2-Trichloroethane	83	8.594	8.594	(0.902)	89127	50.0000	47.10
32 1,1-Dichloropropene	75	5.850	5.850	(0.891)	132386	50.0000	50.20
22 1,1-Dichloroethane	63	4.274	4.274	(0.740)	218190	50.0000	46.11
11 1,1-Dichloroethene	96	2.750	2.750	(0.476)	93545	50.0000	50.01
90 1,2,4-Trichlorobenzene	180	13.814	13.814	(1.167)	146541	50.0000	50.74
89 1,2-Dibromo-3-Chloropropane	75	13.009	13.009	(1.099)	28156	50.0000	46.71
57 1,2-Dibromoethane	107	9.068	9.068	(0.952)	118879	50.0000	50.15
88 1,2-Dichlorobenzene	146	12.223	12.223	(1.033)	228673	50.0000	43.40
33 1,2-Dichloroethane	62	6.145	6.145	(0.936)	155324	50.0000	51.98
42 1,2-Dichloropropane	63	7.066	7.066	(1.076)	125624	50.0000	47.13
83 1,3-Dichlorobenzene	146	11.767	11.767	(0.994)	236563	50.0000	43.14

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123129.D
Report Date: 08-Feb-2018 17:09

Compounds	QUANT SIG MASS	RT	EXP RT	REL RT	RESPONSE	AMOUNTS CAL-AMT (ug/l)	ON-COL (ug/l)
84 1,4-Dichlorobenzene	146	11.857	11.857	(1.002)	222225	50.0000	42.37
24 2-Butanone	43	5.147	5.147	(0.891)	119541	100.000	97.75
52 2-Hexanone	43	8.866	8.866	(0.931)	174365	100.000	96.20
45 4-Methyl-2-Pentanone	43	8.026	8.026	(0.843)	268970	100.000	95.84
10 Acetone	43	2.859	2.859	(0.495)	72974	100.000	97.07
37 Benzene	78	6.087	6.087	(0.927)	421634	50.0000	47.35
39 Bromodichloromethane	83	7.377	7.377	(1.123)	154499	50.0000	49.02
66 Bromoform	173	10.378	10.378	(1.090)	96642	50.0000	52.66
6 Bromomethane	94	1.932	1.932	(0.334)	72358	50.0000	46.46
19 Carbon Disulfide	76	2.949	2.949	(0.510)	410862	100.000	96.18
34 Carbon Tetrachloride	117	5.834	5.834	(0.888)	135222	50.0000	42.06
59 Chlorobenzene	112	9.553	9.553	(1.003)	293408	50.0000	46.05
7 Chloroethane	64	2.031	2.031	(0.352)	78671	50.0000	42.90
28 Chloroform	83	5.491	5.491	(0.950)	190240	50.0000	46.04
3 Chloromethane	50	1.592	1.592	(0.275)	191903	50.0000	50.64
27 cis-1,2-Dichloroethene	96	5.067	5.067	(0.877)	122474	50.0000	47.50
46 cis-1,3-Dichloropropene	75	7.839	7.839	(1.193)	183726	50.0000	50.76
55 Dibromochloromethane	129	8.969	8.969	(0.942)	132141	50.0000	49.47
2 Dichlorodifluoromethane	85	1.447	1.447	(0.250)	84800	50.0000	43.77
61 Ethylbenzene	106	9.672	9.672	(1.015)	154379	50.0000	45.27
67 Isopropylbenzene	105	10.545	10.545	(1.107)	491867	50.0000	46.63
17 Methylene Chloride	84	3.331	3.331	(0.576)	109252	50.0000	44.04
56 Tetrachloroethene	164	8.690	8.690	(0.912)	94228	50.0000	49.37
50 Toluene	91	8.157	8.157	(0.856)	444299	50.0000	45.32
20 trans-1,2-Dichloroethene	96	3.665	3.665	(0.634)	102411	50.0000	50.61
51 trans-1,3-Dichloropropene	75	8.414	8.414	(1.281)	161749	50.0000	52.52
38 Trichloroethene	130	6.816	6.816	(1.038)	123219	50.0000	49.15
8 Trichlorofluoromethane	101	2.250	2.250	(0.389)	138919	50.0000	49.71
5 Vinyl Chloride	62	1.675	1.675	(0.290)	132835	50.0000	47.82
62 m,p-Xylenes	106	9.790	9.790	(1.028)	375281	100.000	89.99
63 o-Xylene	106	10.176	10.176	(1.068)	200301	50.0000	45.91
M 95 Xylenes (total)	106				575582	150.000	(a)
71 1,2,3-Trichloropropane	75	10.901	10.901	(0.921)	158745	50.0000	45.46
93 1,2,3-Trichlorobenzene	182	14.299	14.299	(1.208)	128534	50.0000	51.65
79 1,2,4-Trimethylbenzene	105	11.498	11.498	(0.972)	396373	50.0000	40.59
75 1,3,5-Trimethylbenzene	105	11.132	11.132	(0.941)	389366	50.0000	40.94
26 2,2-Dichloropropane	77	5.038	5.038	(0.872)	135212	50.0000	40.95
54 1,3-Dichloropropane	76	8.754	8.754	(0.919)	179677	50.0000	47.07
76 2-Chlorotoluene	91	11.029	11.029	(0.932)	339306	50.0000	40.74
77 4-Chlorotoluene	91	11.138	11.138	(0.941)	370396	50.0000	40.85
82 p-Isopropyltoluene	119	11.818	11.818	(0.999)	381648	50.0000	42.29
29 Bromochloromethane	128	5.365	5.365	(0.928)	61937	50.0000	50.48
74 Bromobenzene	156	10.830	10.830	(0.915)	138009	50.0000	42.44
44 Dibromomethane	93	7.191	7.191	(1.095)	71839	50.0000	52.00
91 Hexachlorobutadiene	225	13.988	13.988	(1.182)	62389	50.0000	46.39
73 n-Propylbenzene	91	10.955	10.955	(0.926)	519408	50.0000	41.90
87 n-Butylbenzene	91	12.220	12.220	(1.033)	300931	50.0000	44.87
81 sec-Butylbenzene	105	11.668	11.668	(0.986)	451312	50.0000	42.83
92 Naphthalene	128	14.062	14.062	(1.188)	379157	50.0000	50.42
78 tert-Butylbenzene	119	11.449	11.449	(0.967)	340838	50.0000	42.73
60 1,1,1,2-Tetrachloroethane	131	9.646	9.646	(1.013)	120011	50.0000	48.61
64 Styrene	104	10.198	10.198	(1.071)	329469	50.0000	47.35

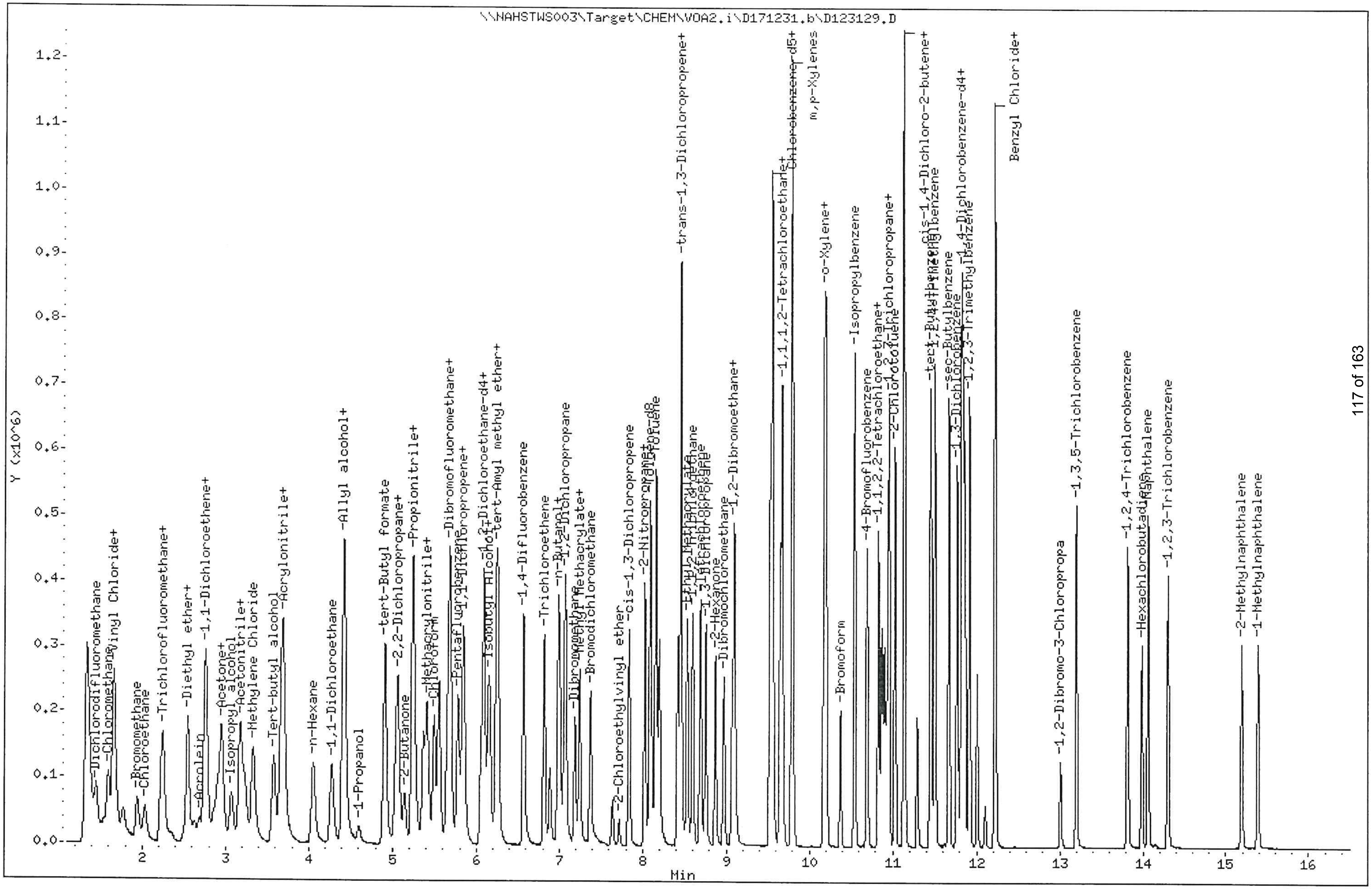
Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123129.D
Report Date: 08-Feb-2018 17:09

QC Flag Legend

a - Target compound detected but, quantitated amount
Below Limit Of Quantitation(BLOQ).

Data File: \\NAHSTWS003\Target\CHEM\VOA2.i\D171231.b\D123129.D
Date : 01-JAN-2018 01:33
Client ID: CCV_END
Sample Info: CCV_END;CCV_END;2;;
Purge Volume: 5.0
Column phase: DB624

Instrument: VOA2.i
Operator: AP
Column diameter: 0.18



Wet Chemistry Raw Data

Bhate Environmental Associates, Inc.
Project: GROUNDWATER TREATMENT PLANT
Bi-WEEKLY SAMPLES
ALS WO# HS17121400

Sequence: 011218 HS17121400
Operator: alshs.nouser

Printed: 1/18/2018 2:05:34 PM

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2
#Samples: 57

Created: 1/15/2018 10:27:05 AM by alshs.nouser
Last Update: 1/18/2018 2:03:44 PM by alshs.nouser

No.	Name	Comment	Pos.	Type	Dil. Factor	Program	Inj. Vol.
1	STD1		28	Standard	1.0000	anions3	20.0
2	STD2		29	Standard	1.0000	anions3	20.0
3	STD3		30	Standard	1.0000	anions3	20.0
4	STD4		31	Standard	1.0000	anions3	20.0
5	STD5		32	Standard	1.0000	anions3	20.0
6	STD6		33	Standard	1.0000	anions3	20.0
7	ICV		34	Unknown	1.0000	anions3	20.0
8	ICB		35	Unknown	1.0000	anions3	20.0
9	CCV		1	Unknown	1.0000	anions3	20.0
10	CCB		2	Unknown	1.0000	anions3	20.0
11	HS18010445-04		21	Unknown	1.0000	anions3	20.0
12	HS18010445-09		24	Unknown	1.0000	anions3	20.0
13	HS18010445-15		25	Unknown	1.0000	anions3	20.0
14	HS18010445-04MS		22	Unknown	1.0000	anions3	20.0
15	HS18010445-04MSD		23	Unknown	1.0000	anions3	20.0
16	DI H2O		14	Unknown	1.0000	anions3	20.0
17	WBLKW1-011218		26	Unknown	1.0000	anions3	20.0
18	WLCSW1-011218		27	Unknown	1.0000	anions3	20.0
19	WLCSDW1-011218		28	Unknown	1.0000	anions3	20.0
20	CCV1		3	Unknown	1.0000	anions3	20.0
21	CCB		4	Unknown	1.0000	anions3	20.0
22	HS18010434-01		29	Unknown	1.0000	anions3	20.0
23	HS18010434-01DF20		30	Unknown	20.0000	anions3	20.0
24	HS18010434-01DF100		31	Unknown	100.0000	anions3	20.0
25	DI H2O		14	Unknown	1.0000	anions3	20.0
26	DI H2O		14	Unknown	1.0000	anions3	20.0
27	HS18010444-01		32	Unknown	1.0000	anions3	20.0
28	HS18010444-01MS		33	Unknown	1.0000	anions3	20.0
29	HS18010444-01MSD		34	Unknown	1.0000	anions3	20.0
30	HS18010444-02		35	Unknown	1.0000	anions3	20.0
31	HS18010444-05		36	Unknown	1.0000	anions3	20.0
32	CCV		1	Unknown	1.0000	anions3	20.0
33	CCB		2	Unknown	1.0000	anions3	20.0
34	HS18010483-01		37	Unknown	1.0000	anions3	20.0

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2 Created: 1/15/2018 10:27:05 AM by alshs.nouser
#Samples: 57 Last Update: 1/18/2018 2:03:44 PM by alshs.nouser

No.	Name	Method	Status	Inj. Date/Time	Weight	ISTD Amount
1	STD1	122617	Finished	12/22/2017 1:25:08 PM	1.0000	1.0000
2	STD2	122617	Finished	12/22/2017 1:46:49 PM	1.0000	1.0000
3	STD3	122617	Finished	12/22/2017 2:08:31 PM	1.0000	1.0000
4	STD4	122617	Finished	12/22/2017 2:30:12 PM	1.0000	1.0000
5	STD5	122617	Finished	12/22/2017 2:51:54 PM	1.0000	1.0000
6	STD6	122617	Finished	12/22/2017 3:13:35 PM	1.0000	1.0000
7	ICV	122617	Finished	12/22/2017 3:35:17 PM	1.0000	1.0000
8	ICB	122617	Finished	12/22/2017 3:56:59 PM	1.0000	1.0000
9	CCV	122617	Finished	1/12/2018 2:24:13 PM	1.0000	1.0000
10	CCB	122617	Finished	1/12/2018 2:45:55 PM	1.0000	1.0000
11	HS18010445-04	122617	Finished	1/12/2018 3:07:37 PM	1.0000	1.0000
12	HS18010445-09	122617	Finished	1/12/2018 3:35:08 PM	1.0000	1.0000
13	HS18010445-15	122617	Finished	1/12/2018 3:56:50 PM	1.0000	1.0000
14	HS18010445-04MS	122617	Finished	1/12/2018 4:18:32 PM	1.0000	1.0000
15	HS18010445-04MSD	122617	Finished	1/12/2018 4:40:14 PM	1.0000	1.0000
16	DI H2O	122617	Finished	1/12/2018 5:01:55 PM	1.0000	1.0000
17	WBLKW1-011218	122617	Finished	1/12/2018 5:23:38 PM	1.0000	1.0000
18	WLCSW1-011218	122617	Finished	1/12/2018 5:45:20 PM	1.0000	1.0000
19	WLCSDW1-011218	122617	Finished	1/12/2018 6:07:03 PM	1.0000	1.0000
20	CCV1	122617	Finished	1/12/2018 6:28:45 PM	1.0000	1.0000
21	CCB	122617	Finished	1/12/2018 6:50:27 PM	1.0000	1.0000
22	HS18010434-01	122617	Finished	1/12/2018 7:12:09 PM	1.0000	1.0000
23	HS18010434-01DF20	122617	Finished	1/12/2018 7:33:51 PM	1.0000	1.0000
24	HS18010434-01DF100	122617	Finished	1/12/2018 7:55:32 PM	1.0000	1.0000
25	DI H2O	122617	Finished	1/12/2018 8:17:14 PM	1.0000	1.0000
26	DI H2O	122617	Finished	1/12/2018 8:38:56 PM	1.0000	1.0000
27	HS18010444-01	122617	Finished	1/12/2018 9:00:38 PM	1.0000	1.0000
28	HS18010444-01MS	122617	Finished	1/12/2018 9:22:19 PM	1.0000	1.0000
29	HS18010444-01MSD	122617	Finished	1/12/2018 9:44:01 PM	1.0000	1.0000
30	HS18010444-02	122617	Finished	1/12/2018 10:05:43 PM	1.0000	1.0000
31	HS18010444-05	122617	Finished	1/12/2018 10:27:24 PM	1.0000	1.0000
32	CCV	122617	Finished	1/12/2018 10:49:05 PM	1.0000	1.0000
33	CCB	122617	Finished	1/12/2018 11:10:48 PM	1.0000	1.0000
34	HS18010483-01	122617	Finished	1/12/2018 11:32:29 PM	1.0000	1.0000

Sequence:	011218	Page 3 of 6
Operator:	alshs.nouser	Printed: 1/18/2018 2:05:34 PM

Title: Temporary sequence for manual data acquisition

Datasource:	HP0307B_local		
Location:	ICS3000_2\2_Data\01-2018		
Timebase:	ICS3000_2	Created:	1/15/2018 10:27:05 AM by alshs.nouser
#Samples:	57	Last Update:	1/18/2018 2:03:44 PM by alshs.nouser

No.	Name	Sample ID	Replicate ID
1	STD1		01
2	STD2		01
3	STD3		01
4	STD4		01
5	STD5		01
6	STD6		01
7	ICV		01
8	ICB		01
9	CCV		01
10	CCB		01
11	HS18010445-04		01
12	HS18010445-09		01
13	HS18010445-15		01
14	HS18010445-04MS		01
15	HS18010445-04MSD		01
16	DI H2O		01
17	WBLKW1-011218		01
18	WLCSW1-011218		01
19	WLCSDW1-011218		01
20	CCV1		01
21	CCB		01
22	HS18010434-01		01
23	HS18010434-01DF20		01
24	HS18010434-01DF100		01
25	DI H2O		01
26	DI H2O		01
27	HS18010444-01		01
28	HS18010444-01MS		01
29	HS18010444-01MSD		01
30	HS18010444-02		01
31	HS18010444-05		01
32	CCV		01
33	CCB		01
34	HS18010483-01		01

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2 Created: 1/15/2018 10:27:05 AM by alshs.nouser
#Samples: 57 Last Update: 1/18/2018 2:03:44 PM by alshs.nouser

No.	Name	Comment	Pos.	Type	Dil. Factor	Program	Inj. Vol.
35	HS18010483-01DF20		38	Unknown	20.0000	anions3	20.0
36	HS18010483-01DF200		39	Unknown	200.0000	anions3	20.0
37	HS18010483-02		40	Unknown	1.0000	anions3	20.0
38	HS18010483-02DF20		41	Unknown	20.0000	anions3	20.0
39	HS18010483-02DF200		42	Unknown	200.0000	anions3	20.0
40	HS18010483-03		43	Unknown	1.0000	anions3	20.0
41	HS18010483-03DF20		44	Unknown	20.0000	anions3	20.0
42	HS18010483-03DF200		45	Unknown	200.0000	anions3	20.0
43	DI H2O		14	Unknown	1.0000	anions3	20.0
44	CCV1		3	Unknown	1.0000	anions3	20.0
45	CCB		4	Unknown	1.0000	anions3	20.0
46	HS17121400-01DF5		49	Unknown	5.0000	anions3	20.0
47	HS18010486-01DF20		46	Unknown	20.0000	anions3	20.0
48	HS18010486-01DF40		47	Unknown	40.0000	anions3	20.0
49	HS18010486-01DF5		48	Unknown	5.0000	anions3	20.0
50	DI H2O		14	Unknown	1.0000	anions3	20.0
51	DI H2O		14	Unknown	1.0000	anions3	20.0
52	DI H2O		14	Unknown	1.0000	anions3	20.0
53	CCV		1	Unknown	1.0000	anions3	20.0
54	CCB		2	Unknown	1.0000	anions3	20.0
55	CCB		2	Unknown	1.0000	anions3	20.0
56	CCB		2	Unknown	1.0000	anions3	20.0
57	CCB		2	Unknown	1.0000	anions3	20.0

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2 Created: 1/15/2018 10:27:05 AM by alshs.nouser
#Samples: 57 Last Update: 1/18/2018 2:03:44 PM by alshs.nouser

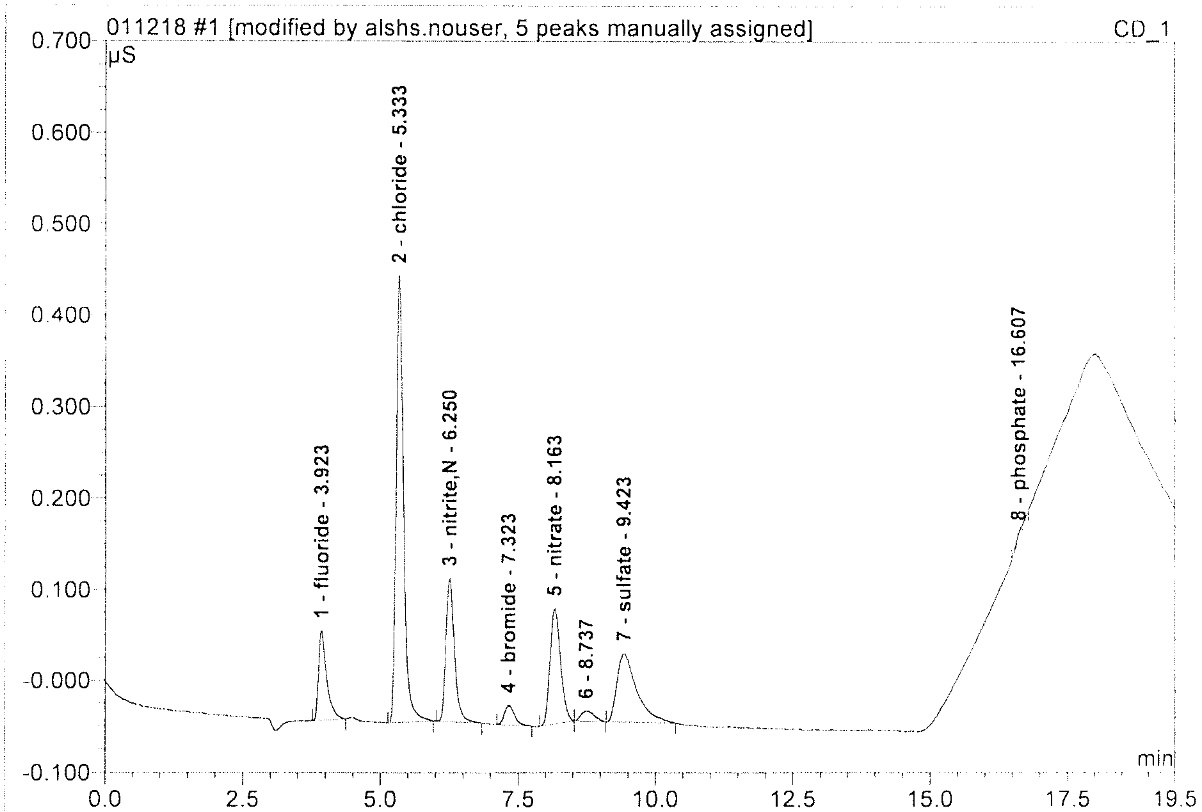
No.	Name	Method	Status	Inj. Date/Time	Weight	ISTD Amount
35	HS18010483-01DF20	122617	Finished	1/12/2018 11:54:11 PM	1.0000	1.0000
36	HS18010483-01DF200	122617	Finished	1/13/2018 12:15:53 AM	1.0000	1.0000
37	HS18010483-02	122617	Finished	1/13/2018 12:37:34 AM	1.0000	1.0000
38	HS18010483-02DF20	122617	Finished	1/13/2018 12:59:16 AM	1.0000	1.0000
39	HS18010483-02DF200	122617	Finished	1/13/2018 1:20:57 AM	1.0000	1.0000
40	HS18010483-03	122617	Finished	1/13/2018 1:42:39 AM	1.0000	1.0000
41	HS18010483-03DF20	122617	Finished	1/13/2018 2:04:21 AM	1.0000	1.0000
42	HS18010483-03DF200	122617	Finished	1/13/2018 2:26:03 AM	1.0000	1.0000
43	DI H2O	122617	Finished	1/13/2018 2:47:44 AM	1.0000	1.0000
44	CCV1	122617	Finished	1/13/2018 3:09:25 AM	1.0000	1.0000
45	CCB	122617	Finished	1/13/2018 3:31:07 AM	1.0000	1.0000
46	HS17121400-01DF5	122617	Finished	1/13/2018 3:52:48 AM	1.0000	1.0000
47	HS18010486-01DF20	122617	Finished	1/13/2018 4:14:30 AM	1.0000	1.0000
48	HS18010486-01DF40	122617	Finished	1/13/2018 4:36:12 AM	1.0000	1.0000
49	HS18010486-01DF5	122617	Finished	1/13/2018 4:57:54 AM	1.0000	1.0000
50	DI H2O	122617	Finished	1/13/2018 5:19:35 AM	1.0000	1.0000
51	DI H2O	122617	Finished	1/13/2018 5:41:17 AM	1.0000	1.0000
52	DI H2O	122617	Finished	1/13/2018 6:02:58 AM	1.0000	1.0000
53	CCV	122617	Finished	1/13/2018 6:24:40 AM	1.0000	1.0000
54	CCB	122617	Finished	1/13/2018 6:46:22 AM	1.0000	1.0000
55	CCB	122617	Finished	1/13/2018 7:08:04 AM	1.0000	1.0000
56	CCB	122617	Finished	1/13/2018 7:29:46 AM	1.0000	1.0000
57	CCB	122617	Finished	1/13/2018 7:51:28 AM	1.0000	1.0000

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2
#Samples: 57
Created: 1/15/2018 10:27:05 AM by alshs.nouser
Last Update: 1/18/2018 2:03:44 PM by alshs.nouser

No.	Name	Sample ID	Replicate ID
35	HS18010483-01DF20		01
36	HS18010483-01DF200		01
37	HS18010483-02		01
38	HS18010483-02DF20		01
39	HS18010483-02DF200		01
40	HS18010483-03		01
41	HS18010483-03DF20		01
42	HS18010483-03DF200		01
43	DI H2O		01
44	CCV1		01
45	CCB		01
46	HS17121400-01DF5		01
47	HS18010486-01DF20		01
48	HS18010486-01DF40		01
49	HS18010486-01DF5		01
50	DI H2O		01
51	DI H2O		01
52	DI H2O		01
53	CCV		01
54	CCB		01
55	CCB		01
56	CCB		01
57	CCB		01

1 STD1

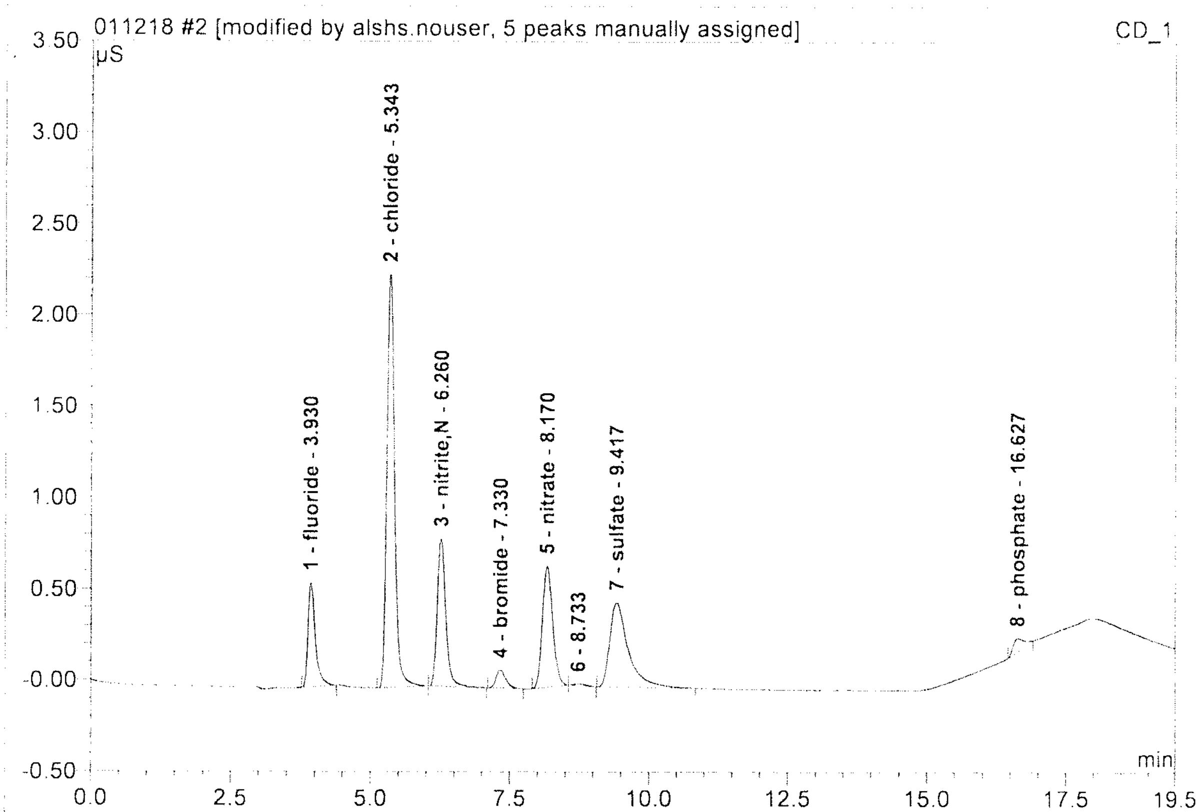
Sample Name:	**STD1**	*Injection Volume:*	**20.0**
Vial Number:	**28**	*Channel:*	**CD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**12/22/2017 13:25**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.92	fluoride	0.098	0.017	8.77	0.106	1.
2	5.33	chloride	0.489	0.077	40.28	0.528	1.
3	6.25	nitrite,N	0.158	0.029	15.02	0.088	1.
4	7.32	bromide	0.022	0.005	2.42	0.361	1.
5	8.16	nitrate	0.127	0.028	14.77	0.221	1.
7	9.42	sulfate	0.075	0.031	16.45	1.827	1
8	16.61	phosphate	0.008	0.001	0.62	0.637	1.
Total:			0.977	0.188	98.33	3.767	

2 STD2

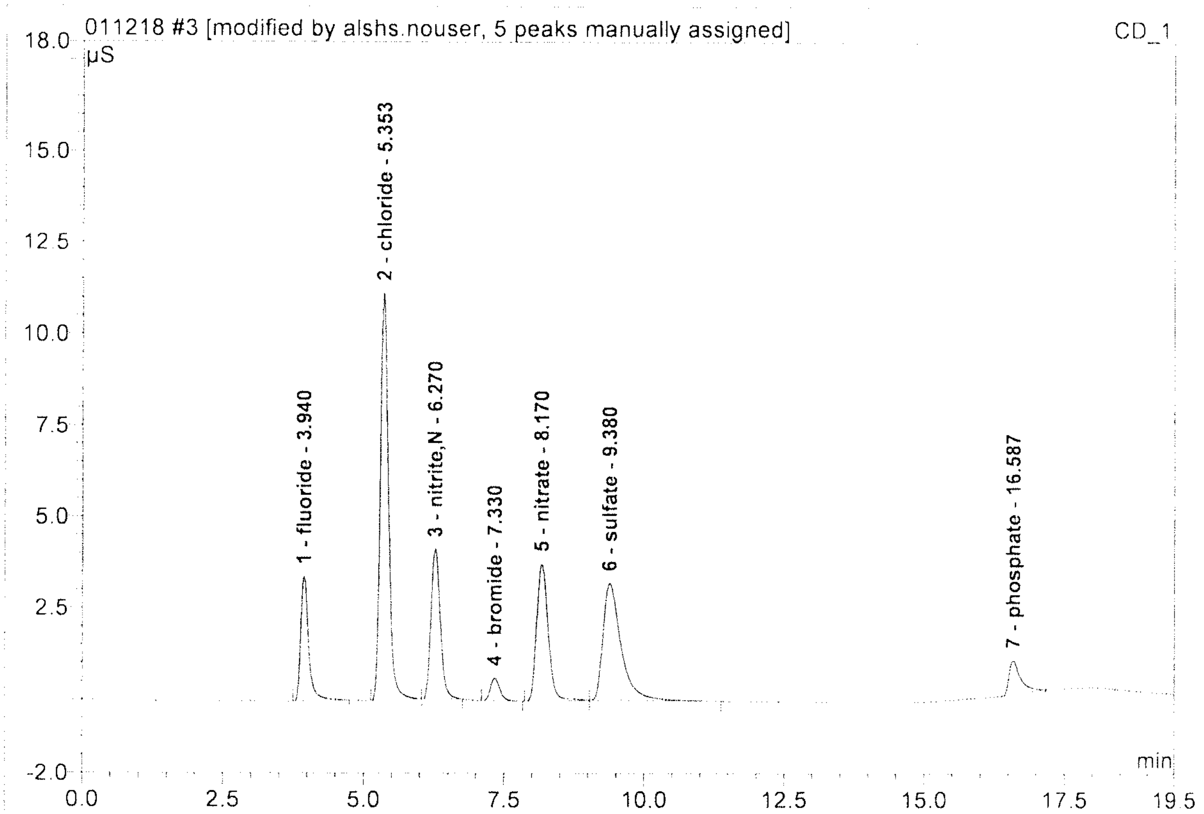
Sample Name:	**STD2**	*Injection Volume:*	**20.0**
Vial Number:	**29**	*Channel:*	**CD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**12/22/2017 13:46**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.93	fluoride	0.573	0.087	9.11	0.356	1.
2	5.34	chloride	2.263	0.361	37.67	1.951	1.
3	6.26	nitrite,N	0.809	0.146	15.20	0.398	1.
4	7.33	bromide	0.099	0.020	2.09	0.555	1.
5	8.17	nitrate	0.665	0.144	15.06	0.451	1.
7	9.42	sulfate	0.466	0.182	18.96	2.808	1.
8	16.63	phosphate	0.072	0.016	1.63	0.704	1.
Total:			4.946	0.956	99.71	7.222	

3 STD3

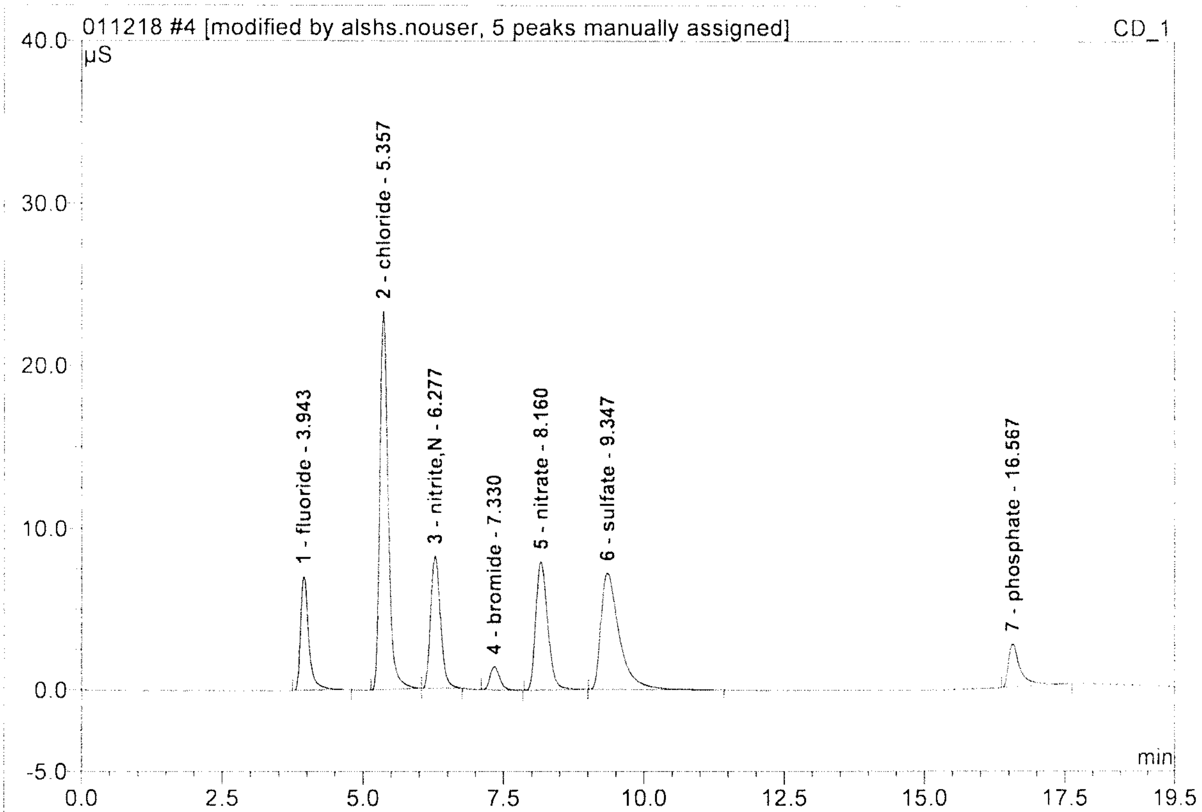
Sample Name:	**STD3**	*Injection Volume:*	**20.0**
Vial Number:	**30**	*Channel:*	**CD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**12/22/2017 14:08**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.94	fluoride	3.393	0.551	9.76	1.997	1.
2	5.35	chloride	11.128	1.873	33.17	9.523	1.
3	6.27	nitrite,N	4.085	0.788	13.96	2.101	1.
4	7.33	bromide	0.623	0.123	2.17	1.844	1.
5	8.17	nitrate	3.738	0.895	15.85	1.938	1.
6	9.38	sulfate	3.196	1.198	21.21	9.444	1.
7	16.59	phosphate	0.923	0.219	3.89	1.658	1.
Total:			27.087	5.648	100.00	28.504	

4 STD4

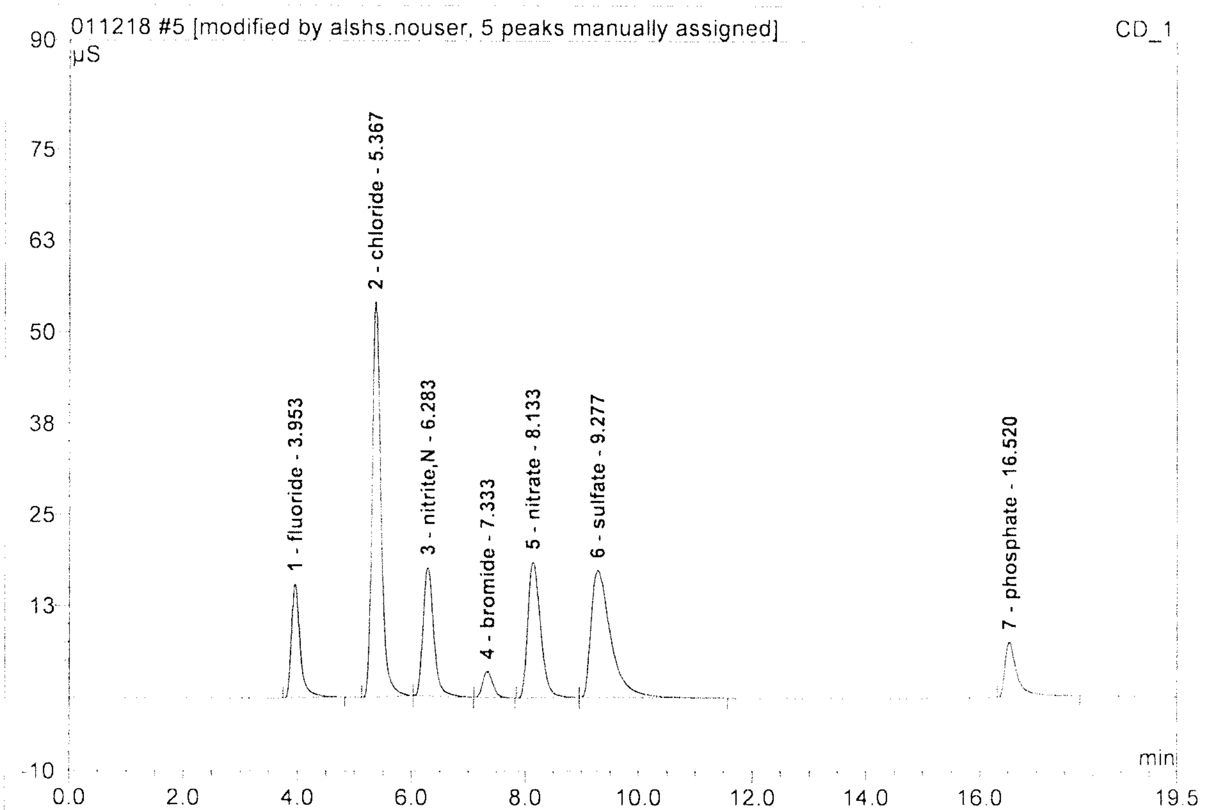
Sample Name:	**STD4**	*Injection Volume:*	**20.0**
Vial Number:	**31**	*Channel:*	**CD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**12/22/2017 14:30**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.94	fluoride	7.064	1.198	9.54	4.287	1.
2	5.36	chloride	23.299	4.031	32.10	20.325	1.
3	6.28	nitrite,N	8.165	1.648	13.12	4.380	1.
4	7.33	bromide	1.446	0.288	2.29	3.919	1.
5	8.16	nitrate	7.954	1.964	15.64	4.056	1.
6	9.35	sulfate	7.209	2.756	21.95	19.615	1.
7	16.57	phosphate	2.673	0.672	5.35	3.773	1.
Total:			57.810	12.558	100.00	60.355	

5 STD5

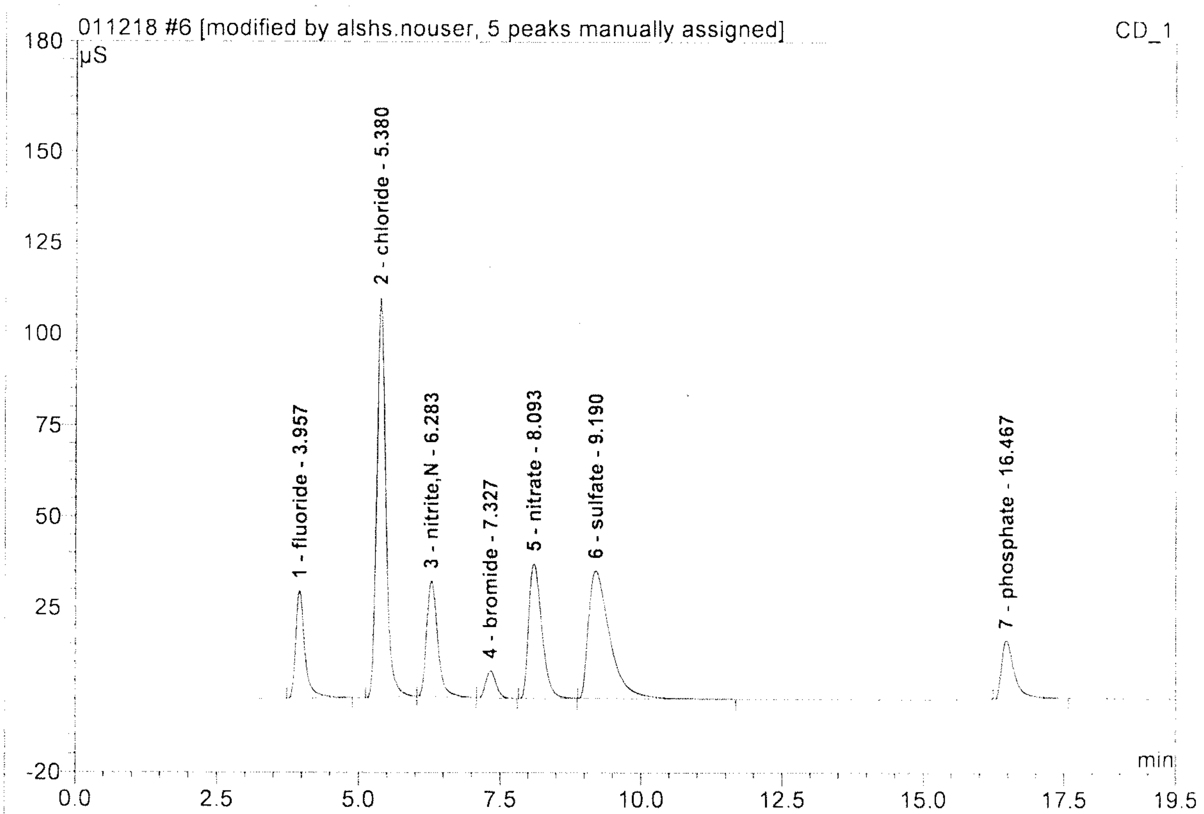
Sample Name:	**STD5**	*Injection Volume:*	**20.0**
Vial Number:	**32**	*Channel:*	**CD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**12/22/2017 14:51**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.95	fluoride	15.541	2.768	9.02	9.839	1.
2	5.37	chloride	54.014	9.696	31.60	48.688	1.
3	6.28	nitrite,N	17.530	3.808	12.41	10.107	1.
4	7.33	bromide	3.605	0.739	2.41	9.590	1.
5	8.13	nitrate	18.561	4.805	15.66	9.682	1.
6	9.28	sulfate	17.340	7.010	22.85	47.393	1.
7	16.52	phosphate	7.504	1.857	6.05	9.315	1.
Total:			134.094	30.684	100.00	144.614	

6 STD6

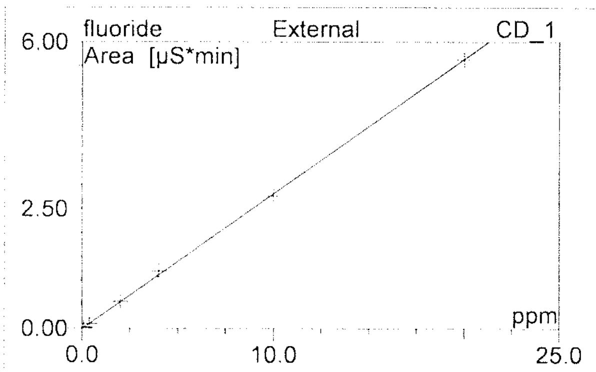
Sample Name:	**STD6**	*Injection Volume:*	**20.0**
Vial Number:	**33**	*Channel:*	**CD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**12/22/2017 15:13**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**

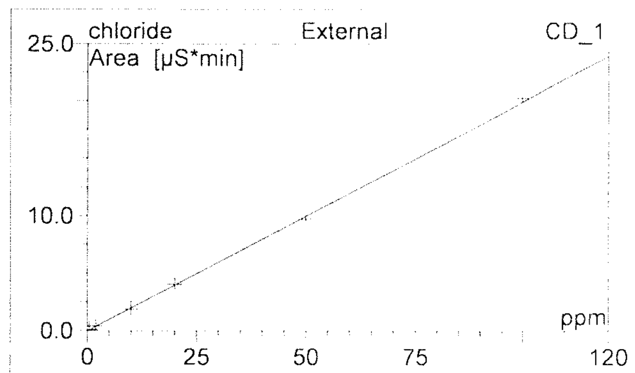


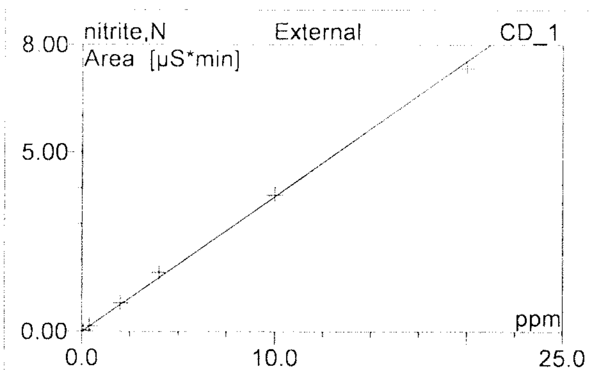
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.96	fluoride	29.589	5.615	8.72	19.915	1.
2	5.38	chloride	109.651	20.261	31.47	101.579	1
3	6.28	nitrite,N	31.765	7.324	11.37	19.426	1.
4	7.33	bromide	7.529	1.586	2.46	20.233	1.
5	8.09	nitrate	37.090	10.091	15.67	20.153	1.
6	9.19	sulfate	35.049	15.283	23.73	101.413	1.
7	16.47	phosphate	16.011	4.231	6.57	20.413	1.
Total:			266.684	64.393	100.00	303.131	

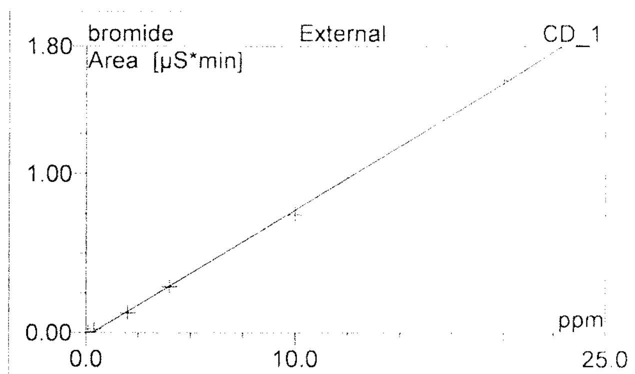
6 STD6

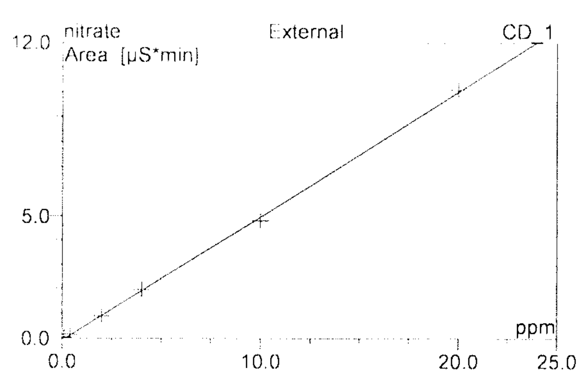
Sample Name:	**STD6**	*Injection Volume:*	**20.0**
Vial Number:	**33**	*Channel:*	**CD_1**
Sample Type:	**standard**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.0000**
Recording Time:	**##############**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**

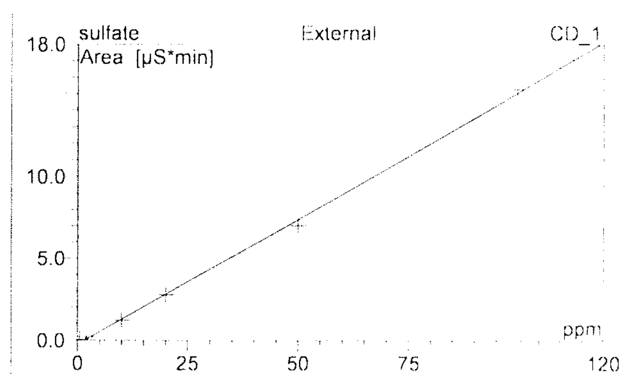


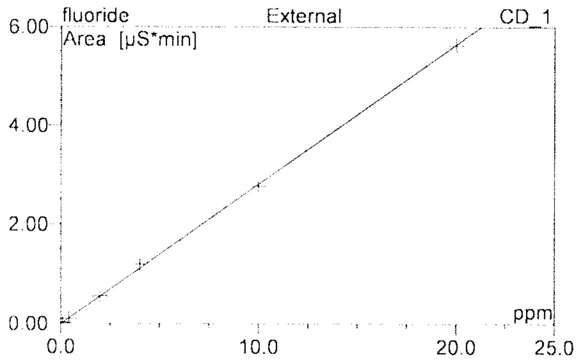


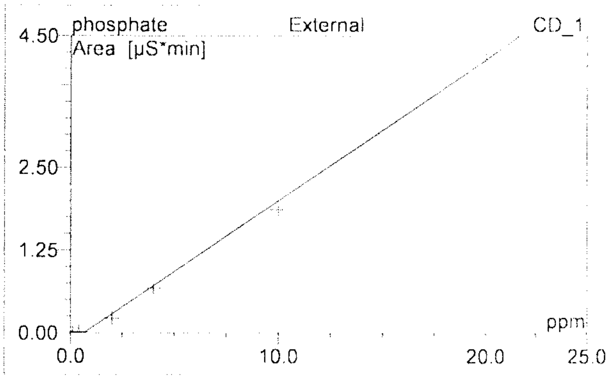










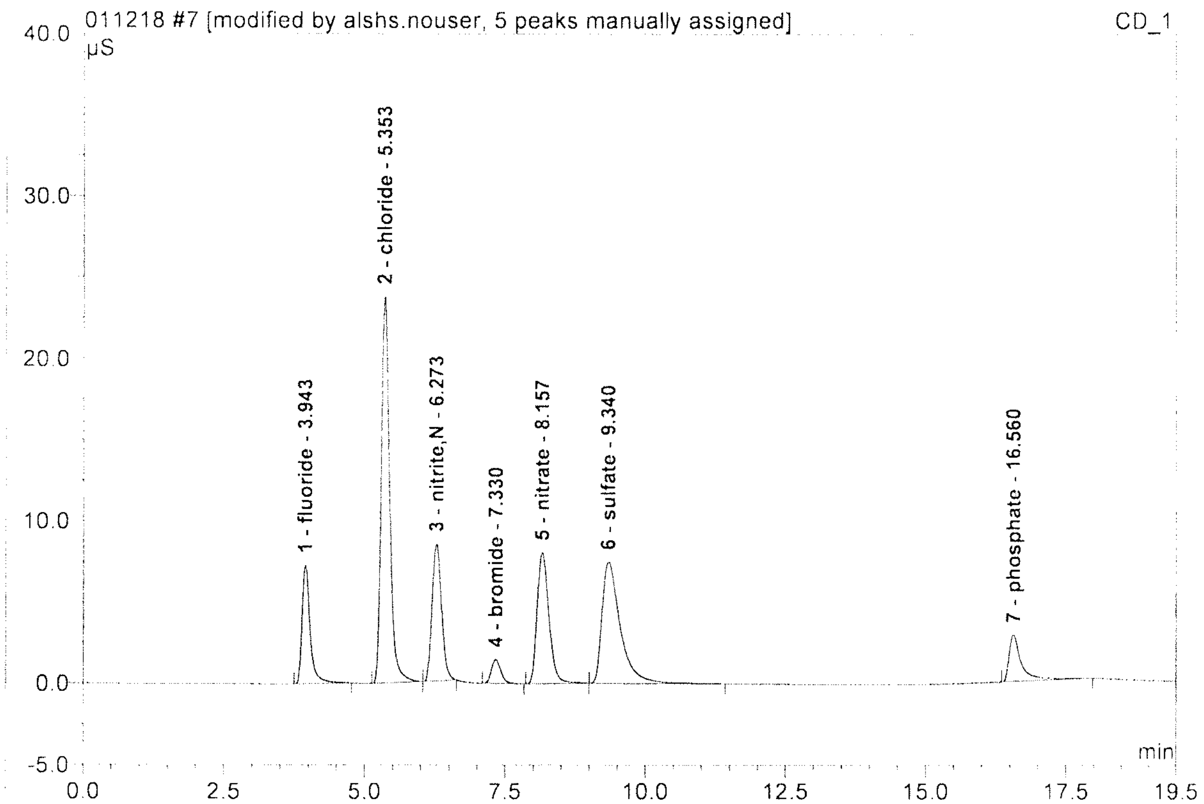


No.	Ret.Time min	Peak Name	Cal.Type	Points	Coeff.Det. %	Offset	Slope	Curve
1	3.96	fluoride	XLOff	6	99.9150	-0.0132	0.2826	0.000
2	5.38	chloride	YLOff	6	99.9456	-0.0286	0.1997	0.000
3	6.28	nitrite,N	XLOff	6	99.8217	-0.0044	0.3773	0.000
4	7.33	bromide	LOff	6	99.8843	-0.0241	0.0796	0.000
5	8.09	nitrate	LOff	6	99.9502	-0.0833	0.5049	0.000
6	9.19	sulfate	LOff	6	99.8438	-0.2483	0.1532	0.000
7	16.47	phosphate	LOff	6	99.6028	-0.1350	0.2139	0.000
Average:					99.8519	-0.0767	0.2587	0.0000

No.	Ret.Time min	Peak Name	Cal.Type	Points	Corr.Coeff. %	RF-Value	Std.Dev.	RSD %
1	3.96	fluoride	XLOff	6	99.957	3.538	0.016	14.155
2	5.38	chloride	YLOff	6	99.973	5.006	0.041	11.373
3	6.28	nitrite,N	XLOff	6	99.911	2.651	0.031	18.861
4	7.33	bromide	LOff	6	99.942	12.563	0.023	5.082
5	8.09	nitrate	LOff	6	99.975	1.981	0.097	3.257
6	9.19	sulfate	LOff	6	99.922	6.529	0.262	5.930
7	16.47	phosphate	LOff	6	99.801	4.676	0.117	10.000
Average:					99.9259	5.2777	0.0838	9.8082

7 ICV

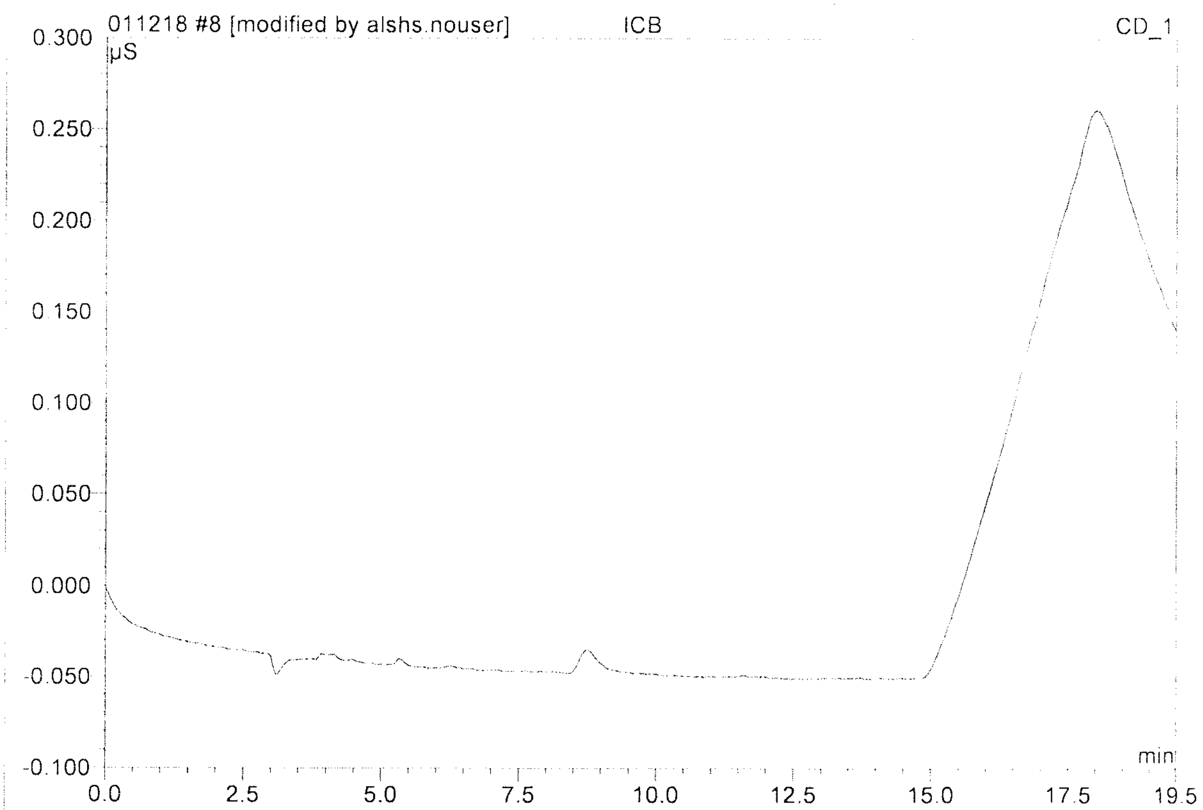
Sample Name:	**ICV**	*Injection Volume:*	**20.0**
Vial Number:	**34**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**12/22/2017 15:35**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.94	fluoride	7.284	1.220	9.55	4.364	1.
2	5.35	chloride	23.765	4.073	31.87	20.535	1.
3	6.27	nitrite,N	8.419	1.653	12.94	4.394	1.
4	7.33	bromide	1.467	0.289	2.26	3.934	1.
5	8.16	nitrate	8.061	1.982	15.51	4.091	1.
6	9.34	sulfate	7.465	2.819	22.06	20.030	1.
7	16.56	phosphate	2.856	0.741	5.80	4.098	1.
Total:			59.317	12.779	100.00	61.446	

8 ICB

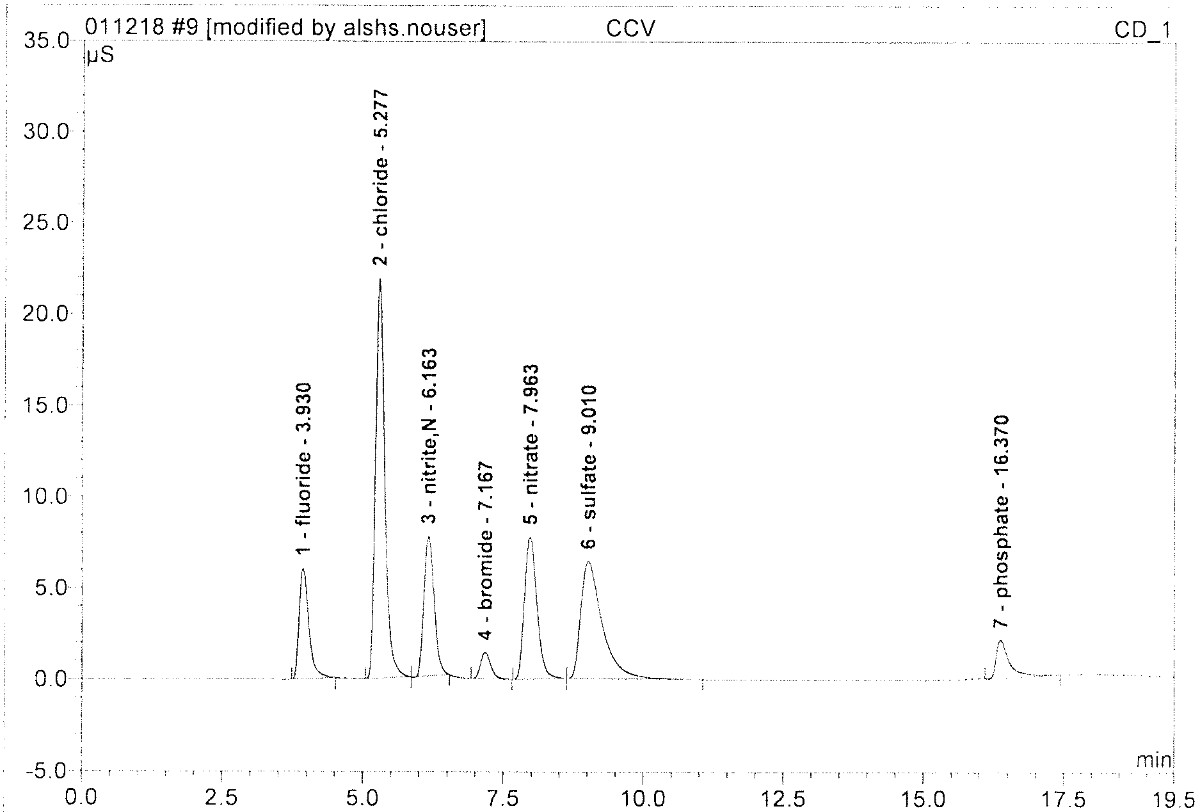
Sample Name:	ICB	*Injection Volume:*	20.0
Vial Number:	35	*Channel:*	CD_1
Sample Type:	unknown	*Wavelength:*	n.a.
Control Program:	anions3	*Bandwidth:*	n.a.
Quantif. Method:	122617	*Dilution Factor:*	1.
Recording Time:	12/22/2017 15:56	*Sample Weight:*	1.0000
Run Time (min):	19.50	*Sample Amount:*	1.0000



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
Total:			0.000	0.000	0.00	0.000	

9 CCV

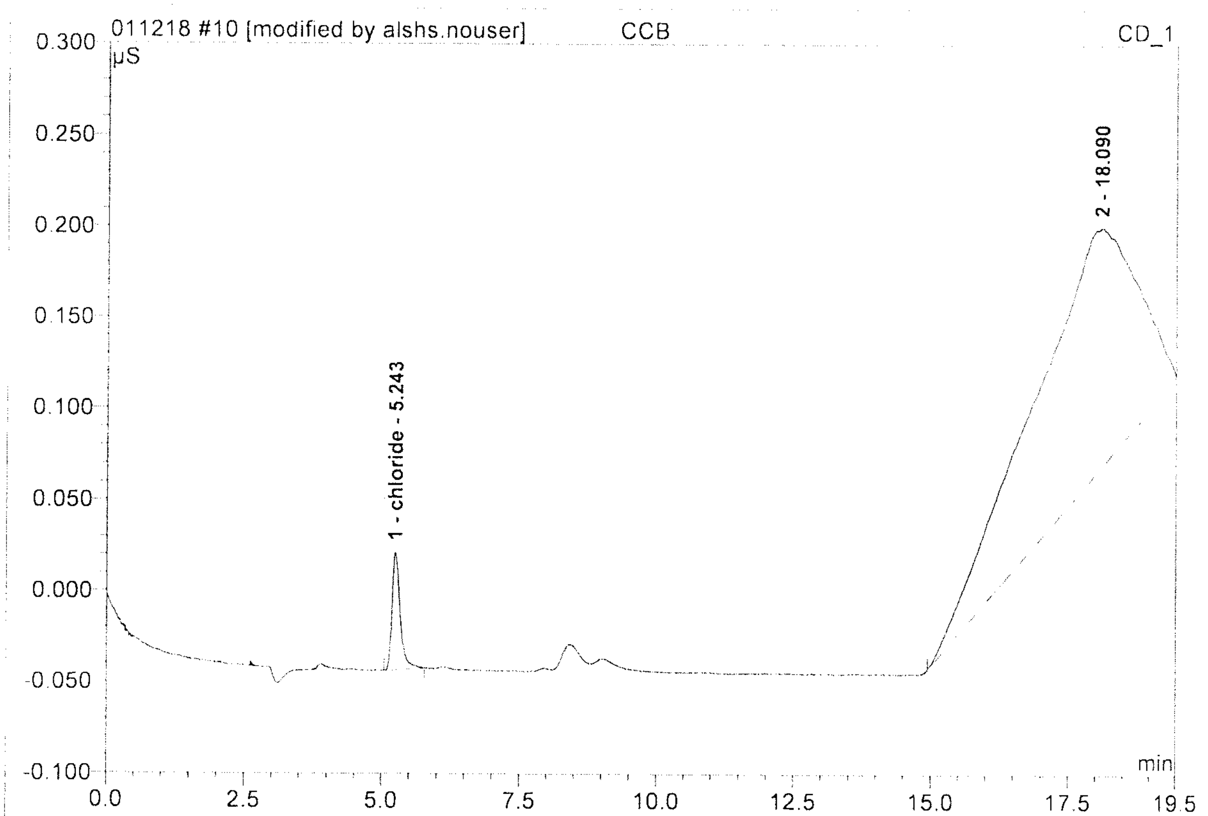
Sample Name:	**CCV**	*Injection Volume:*	**20.0**
Vial Number:	**1**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 14:24**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.93	fluoride	6.050	1.205	9.45	4.312	1.
2	5.28	chloride	21.874	4.160	32.61	20.970	1.
3	6.16	nitrite,N	7.659	1.642	12.87	4.363	1.
4	7.17	bromide	1.442	0.302	2.37	4.101	1.
5	7.96	nitrate	7.769	2.018	15.82	4.162	1.
6	9.01	sulfate	6.432	2.848	22.33	20.219	1.
7	16.37	phosphate	2.090	0.582	4.56	3.351	1.
Total:			53.315	12.757	100.00	61.478	

10 CCB

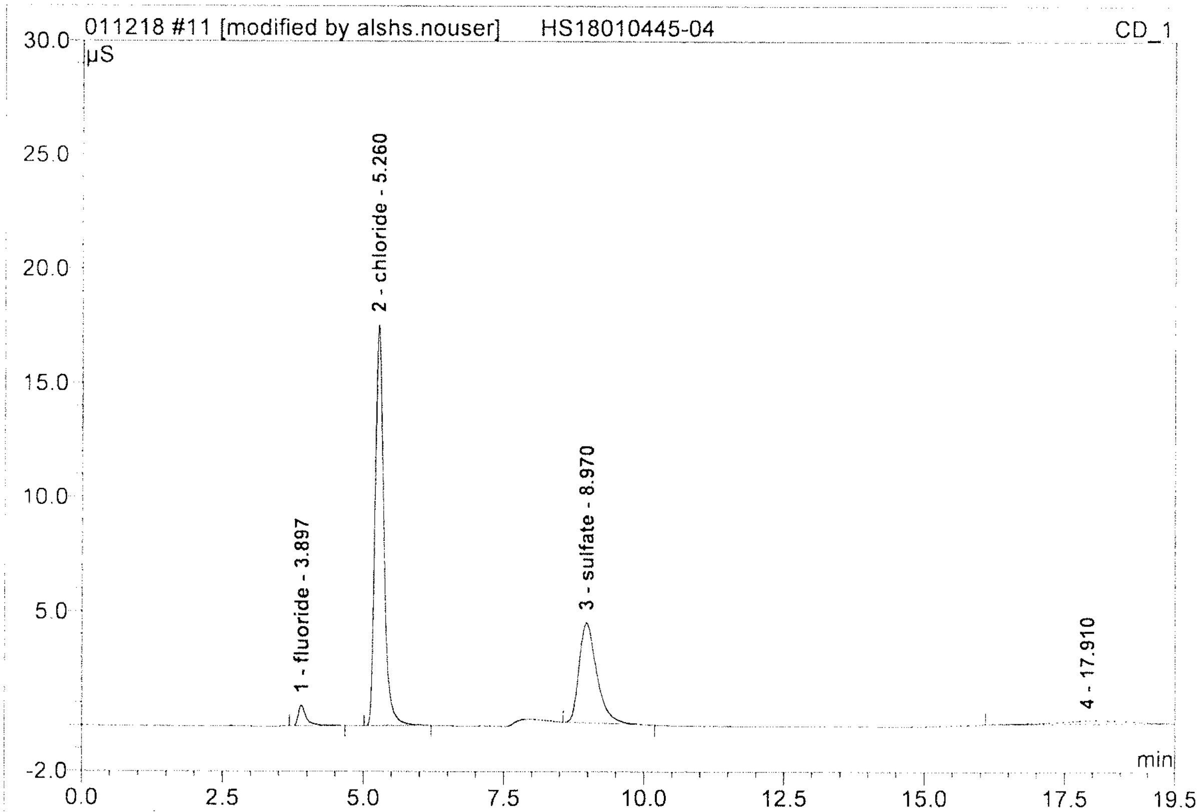
Sample Name:	**CCB**	*Injection Volume:*	**20.0**
Vial Number:	**2**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 14:45**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	5.24	chloride	0.065	0.011	3.55	0.199	1.
Total:			0.065	0.011	3.55	0.199	

11 HS18010445-04

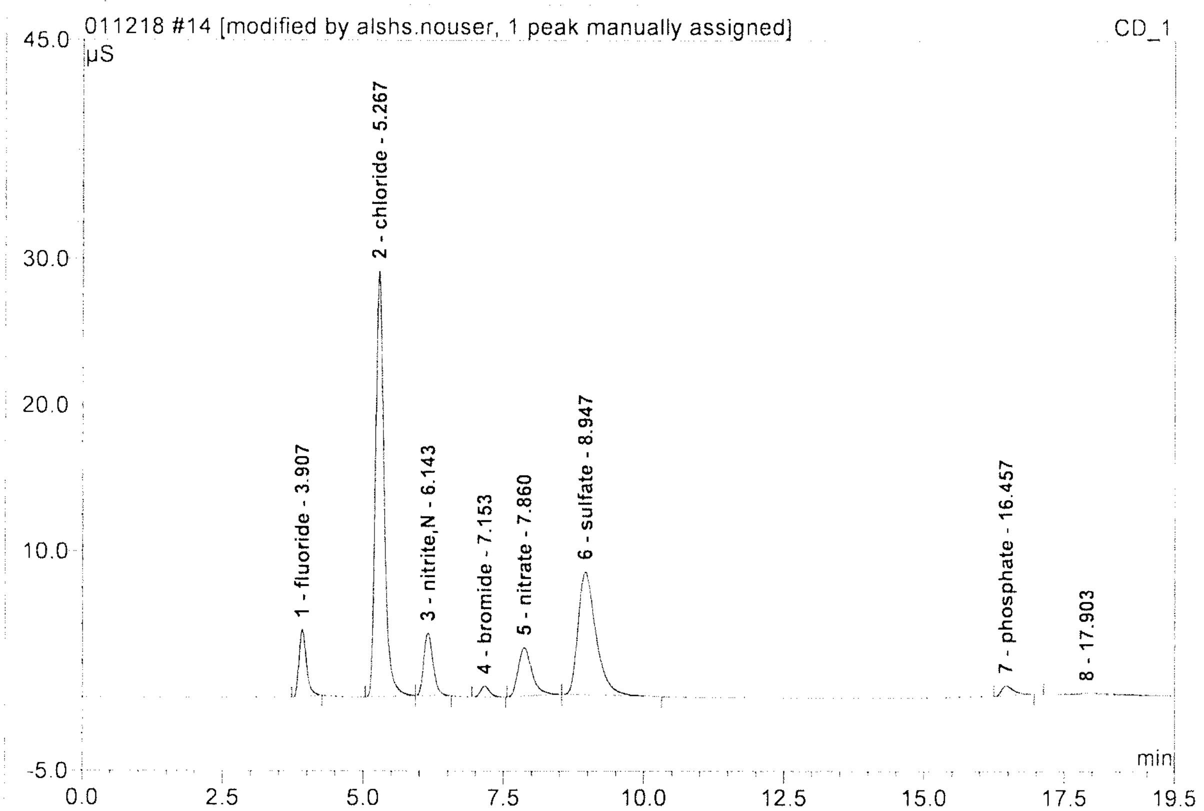
Sample Name:	**HS18010445-04**	*Injection Volume:*	**20.0**
Vial Number:	**21**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 15:07**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.90	fluoride	0.927	0.157	3.04	0.602	1.
2	5.26	chloride	17.578	3.135	60.64	15.837	1.
3	8.97	sulfate	4.401	1.621	31.36	12.207	1.
Total:			22.906	4.913	95.03	28.646	

14 HS18010445-04MS

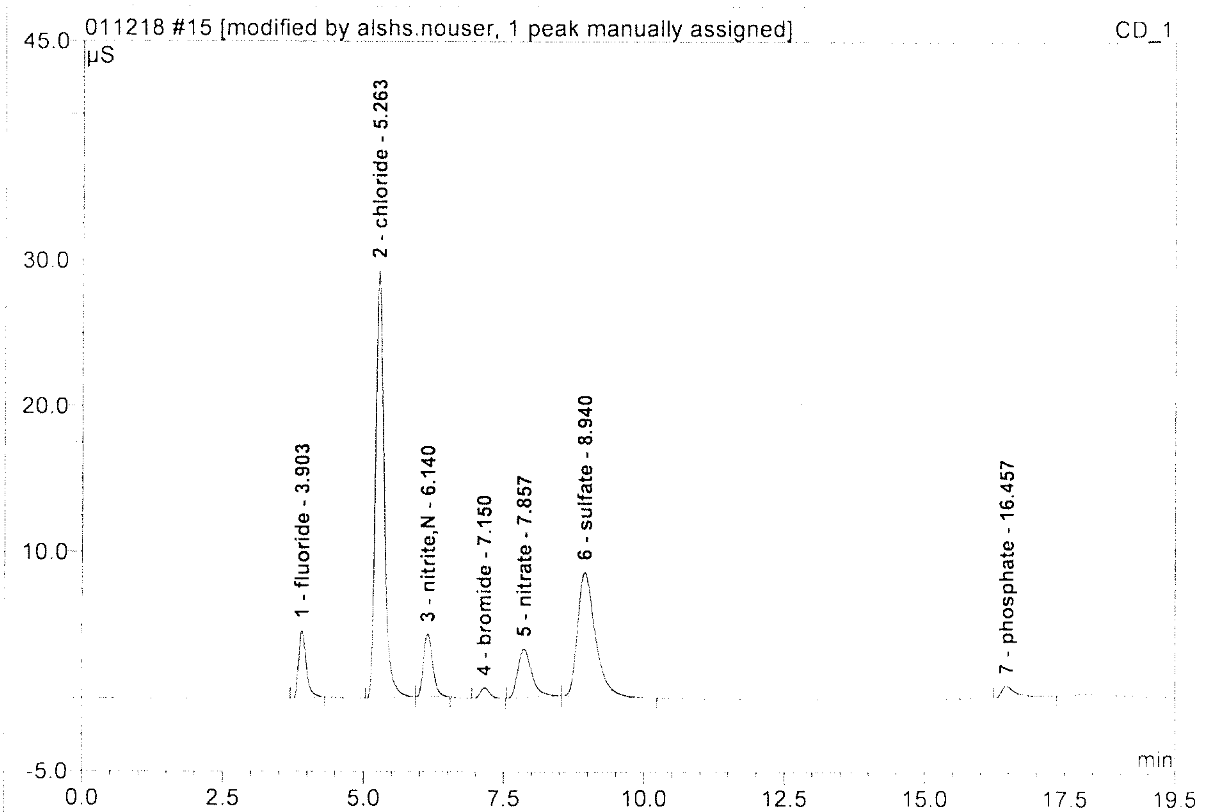
Sample Name:	**HS18010445-04MS**	*Injection Volume:*	**20.0**
Vial Number:	**22**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 16:18**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.91	fluoride	4.583	0.710	6.31	2.557	1.
2	5.27	chloride	29.097	5.151	45.84	25.933	1.
3	6.14	nitrite,N	4.274	0.830	7.39	2.212	1.
4	7.15	bromide	0.744	0.140	1.24	2.055	1.
5	7.86	nitrate	3.319	0.963	8.57	2.073	1.
6	8.95	sulfate	8.435	3.129	27.84	22.053	1.
7	16.46	phosphate	0.686	0.177	1.57	1.458	1.
Total:			51.136	11.100	98.77	58.342	

15 HS18010445-04MSD

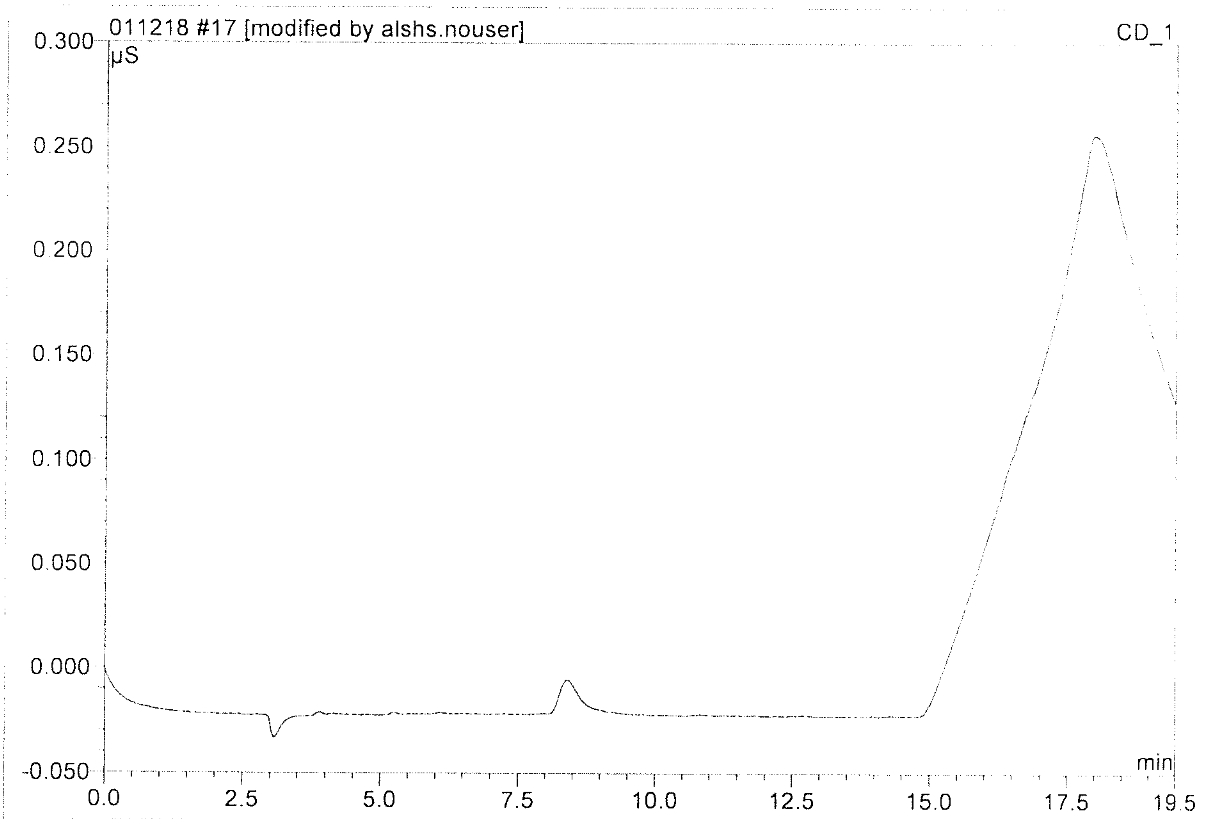
Sample Name:	**HS18010445-04MSD**	*Injection Volume:*	**20.0**
Vial Number:	**23**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 16:40**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.90	fluoride	4.663	0.725	6.47	2.611	1.
2	5.26	chloride	29.284	5.162	46.08	25.984	1.
3	6.14	nitrite,N	4.315	0.833	7.44	2.221	1.
4	7.15	bromide	0.750	0.141	1.26	2.069	1.
5	7.86	nitrate	3.341	0.966	8.62	2.078	1.
6	8.94	sulfate	8.508	3.144	28.07	22.149	1.
7	16.46	phosphate	0.795	0.232	2.07	1.715	1.
Total:			51.656	11.202	100.00	58.827	

17 WBLKW1-011218

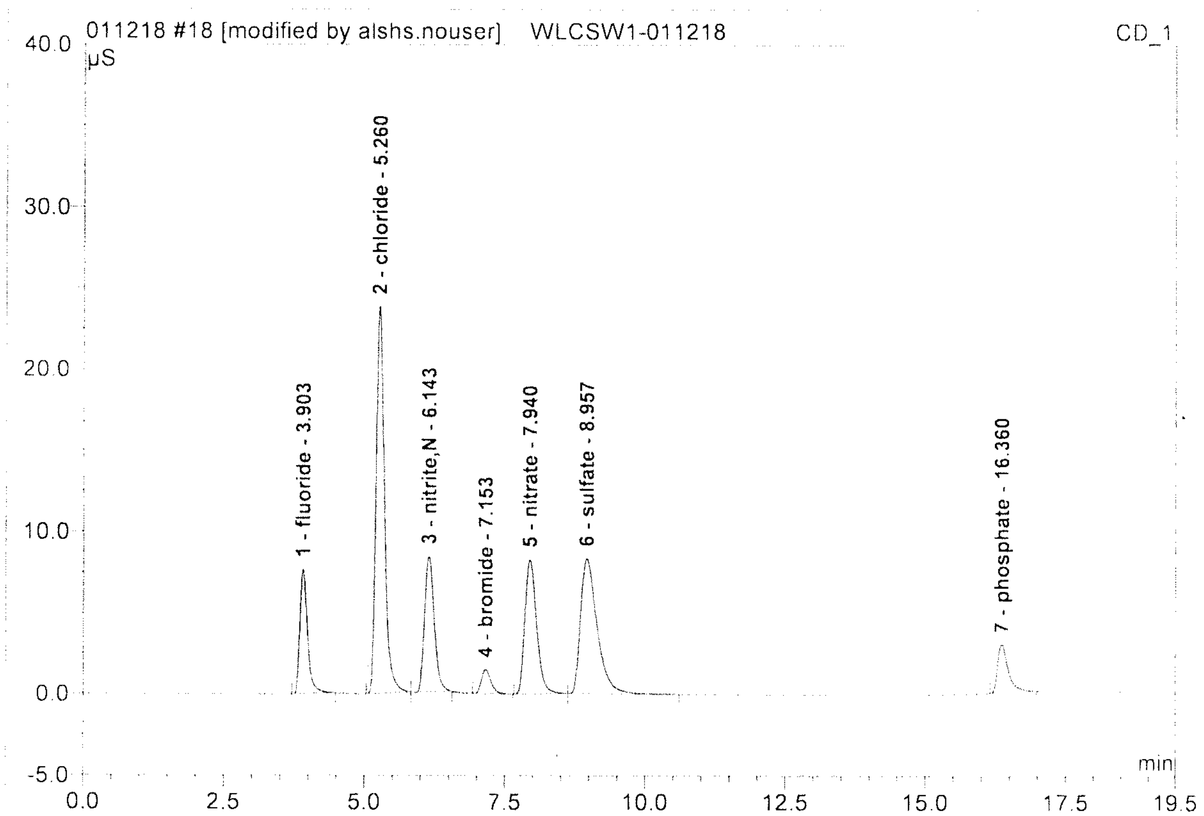
Sample Name:	**WBLKW1-011218**	*Injection Volume:*	**20.0**
Vial Number:	**26**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 17:23**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
Total:			0.000	0.000	0.00	0.000	

18 WLCSW1-011218

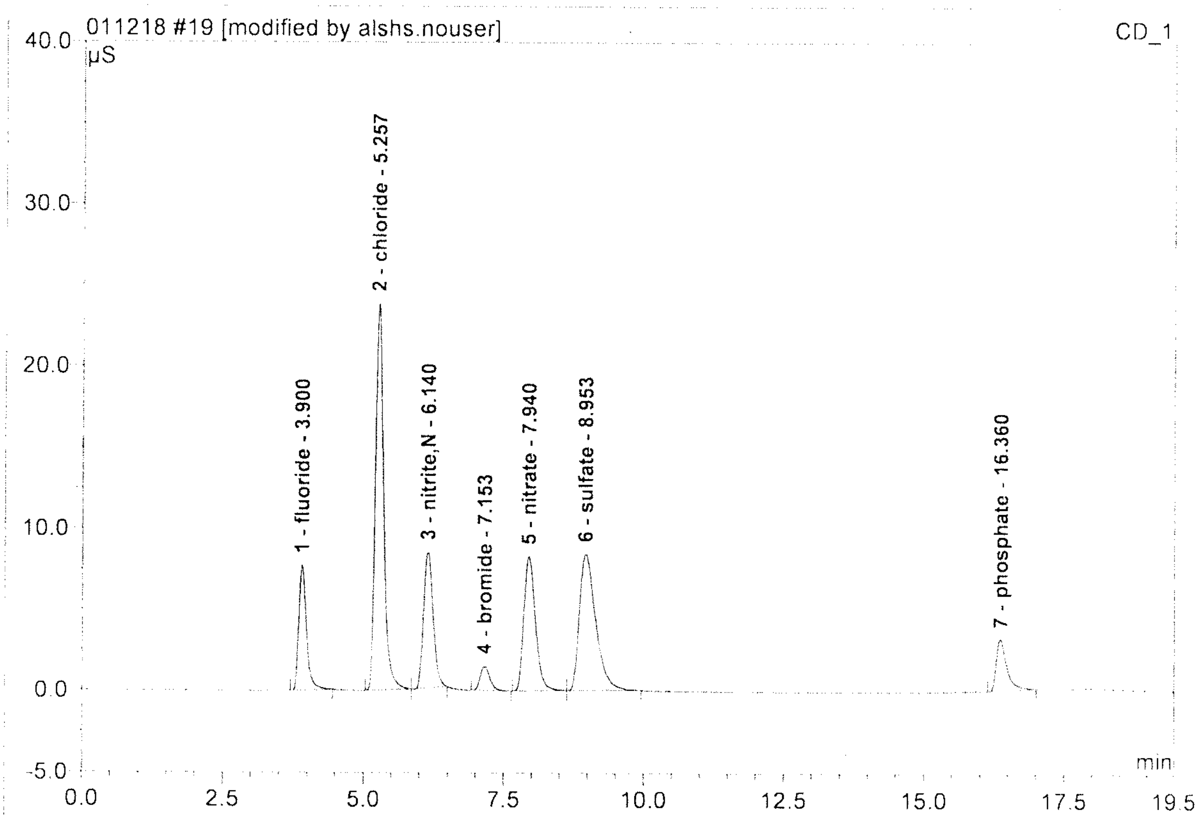
Sample Name:	**WLCSW1-011218**	*Injection Volume:*	**20.0**
Vial Number:	**27**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 17:45**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.90	fluoride	7.666	1.220	9.53	4.362	1.
2	5.26	chloride	23.815	4.098	32.01	20.657	1.
3	6.14	nitrite,N	8.338	1.652	12.90	4.390	1.
4	7.15	bromide	1.500	0.299	2.34	4.060	1.
5	7.94	nitrate	8.284	2.003	15.64	4.132	1.
6	8.96	sulfate	8.349	2.867	22.40	20.342	1.
7	16.36	phosphate	2.999	0.664	5.19	3.737	1.
Total:			60.950	12.802	100.00	61.681	

19 WLCSDW1-011218

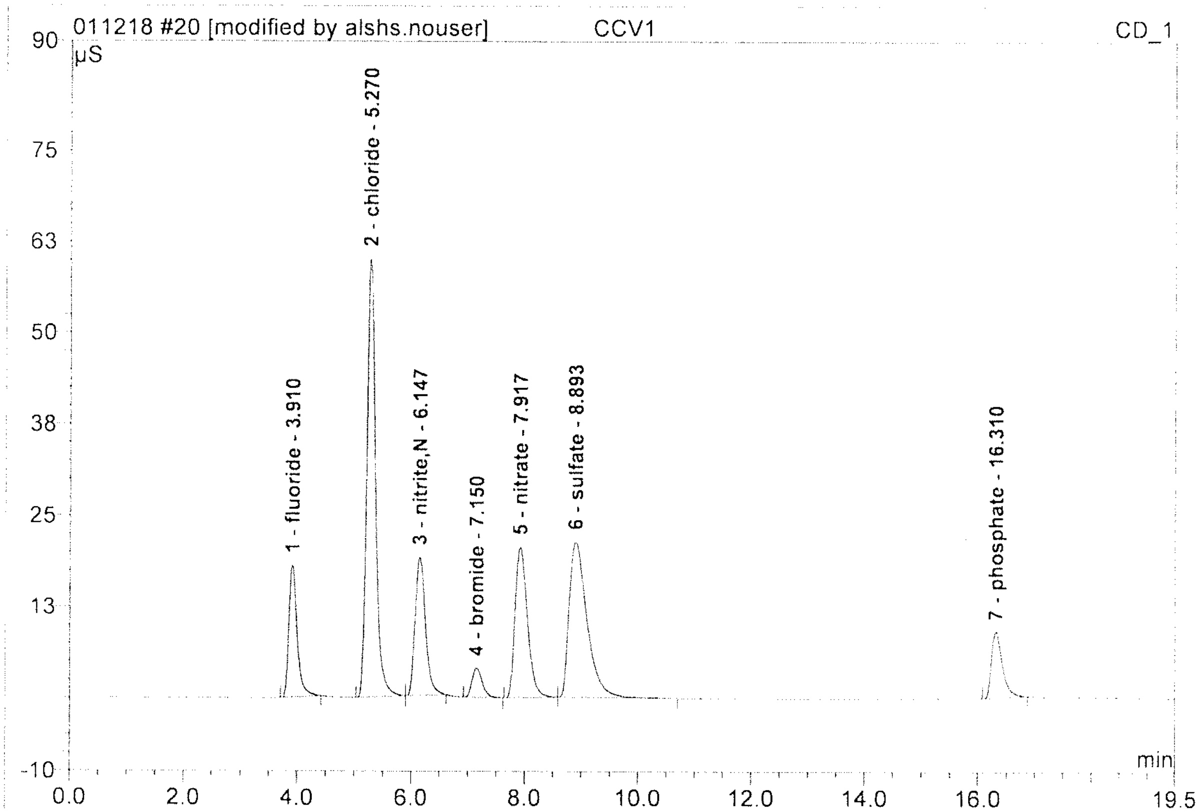
Sample Name:	**WLCSDW1-011218**	*Injection Volume:*	**20.0**
Vial Number:	**28**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 18:07**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.90	fluoride	7.716	1.220	9.53	4.363	1.
2	5.26	chloride	23.809	4.104	32.05	20.688	1.
3	6.14	nitrite,N	8.393	1.640	12.81	4.359	1.
4	7.15	bromide	1.502	0.300	2.34	4.065	1.
5	7.94	nitrate	8.284	2.004	15.65	4.135	1.
6	8.95	sulfate	8.439	2.843	22.21	20.185	1.
7	16.36	phosphate	3.158	0.693	5.41	3.871	1.
Total:			61.302	12.803	100.00	61.665	

20 CCV1

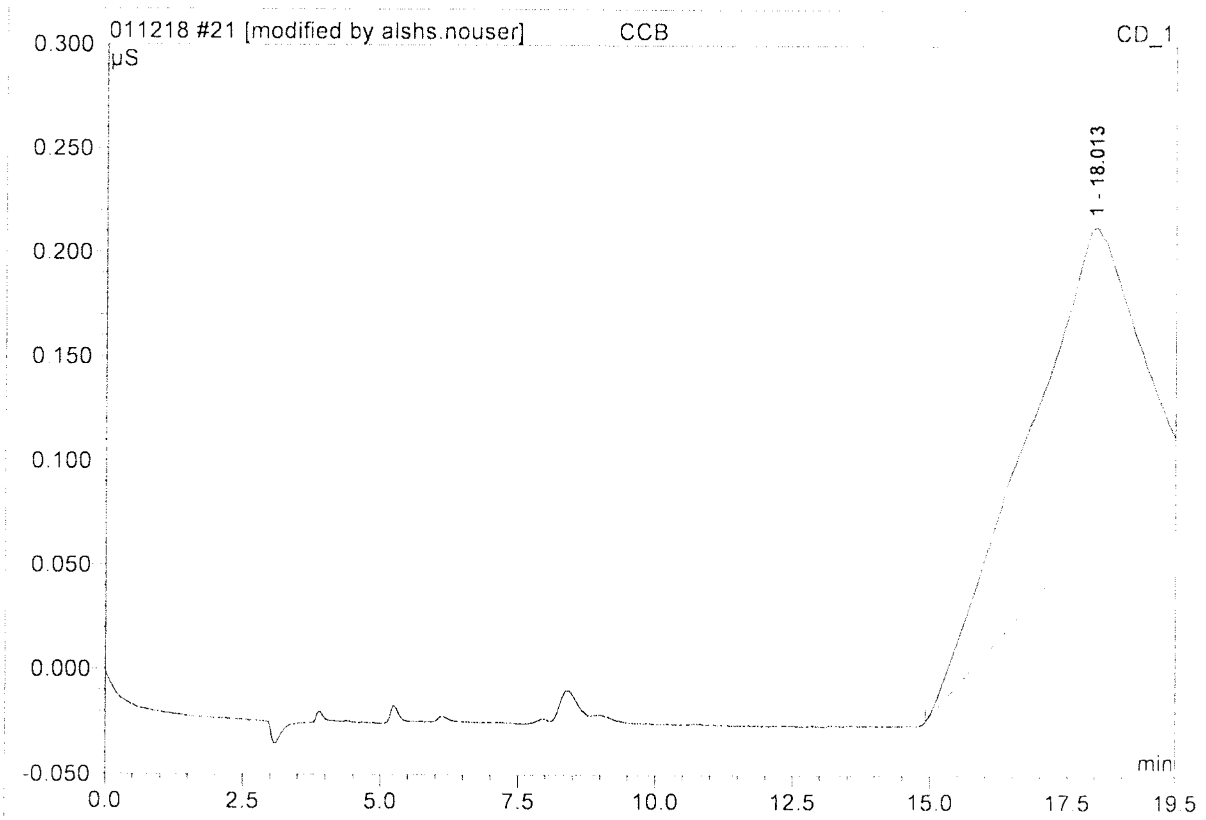
Sample Name:	**CCV1**	*Injection Volume:*	**20.0**
Vial Number:	**3**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 18:28**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.91	fluoride	18.153	3.044	9.07	10.818	1.
2	5.27	chloride	60.061	10.593	31.56	53.175	1.
3	6.15	nitrite,N	19.030	4.075	12.14	10.812	1.
4	7.15	bromide	4.039	0.836	2.49	10.799	1.
5	7.92	nitrate	20.700	5.209	15.52	10.483	1.
6	8.89	sulfate	21.380	7.787	23.20	52.465	1.
7	16.31	phosphate	9.084	2.017	6.01	10.061	1.
Total:			152.447	33.560	100.00	158.613	

21 CCB

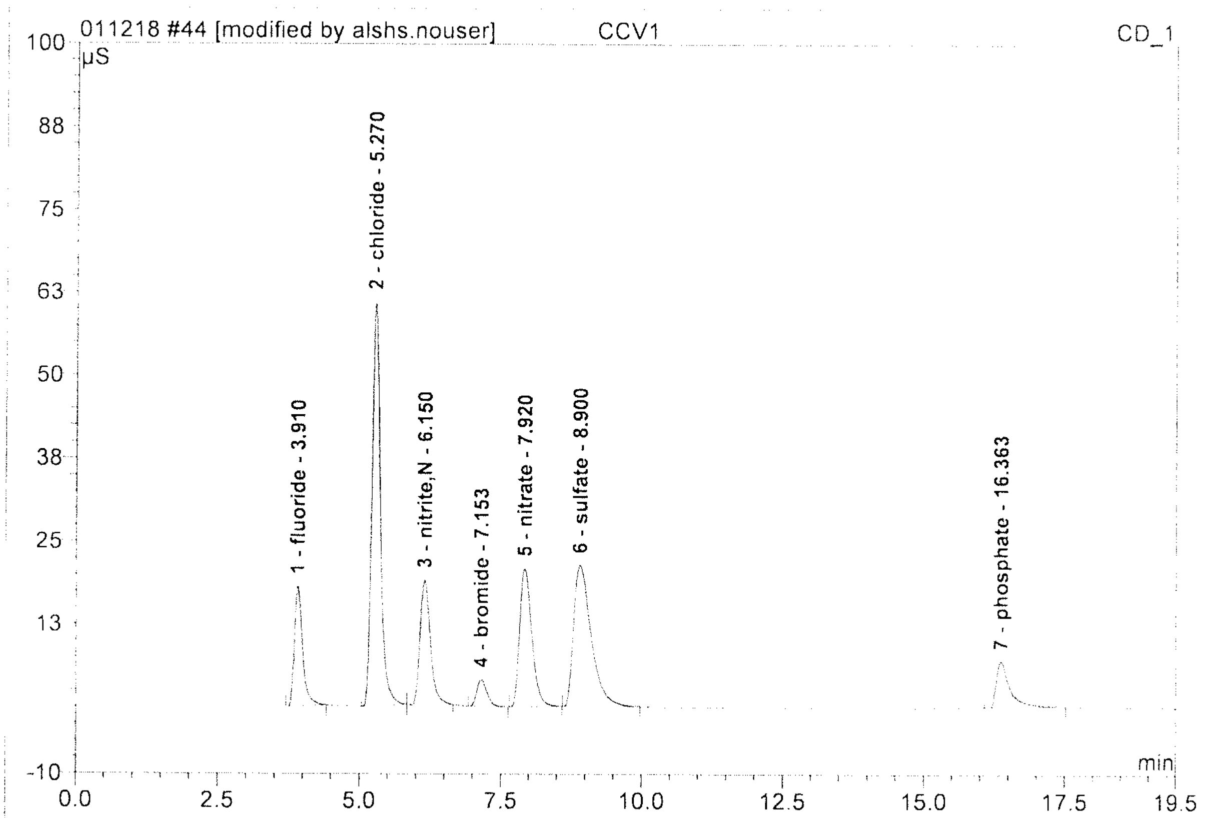
Sample Name:	**CCB**	*Injection Volume:*	**20.0**
Vial Number:	**4**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/12/2018 18:50**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
Total:			0.000	0.000	0.00	0.000	

44 CCV1

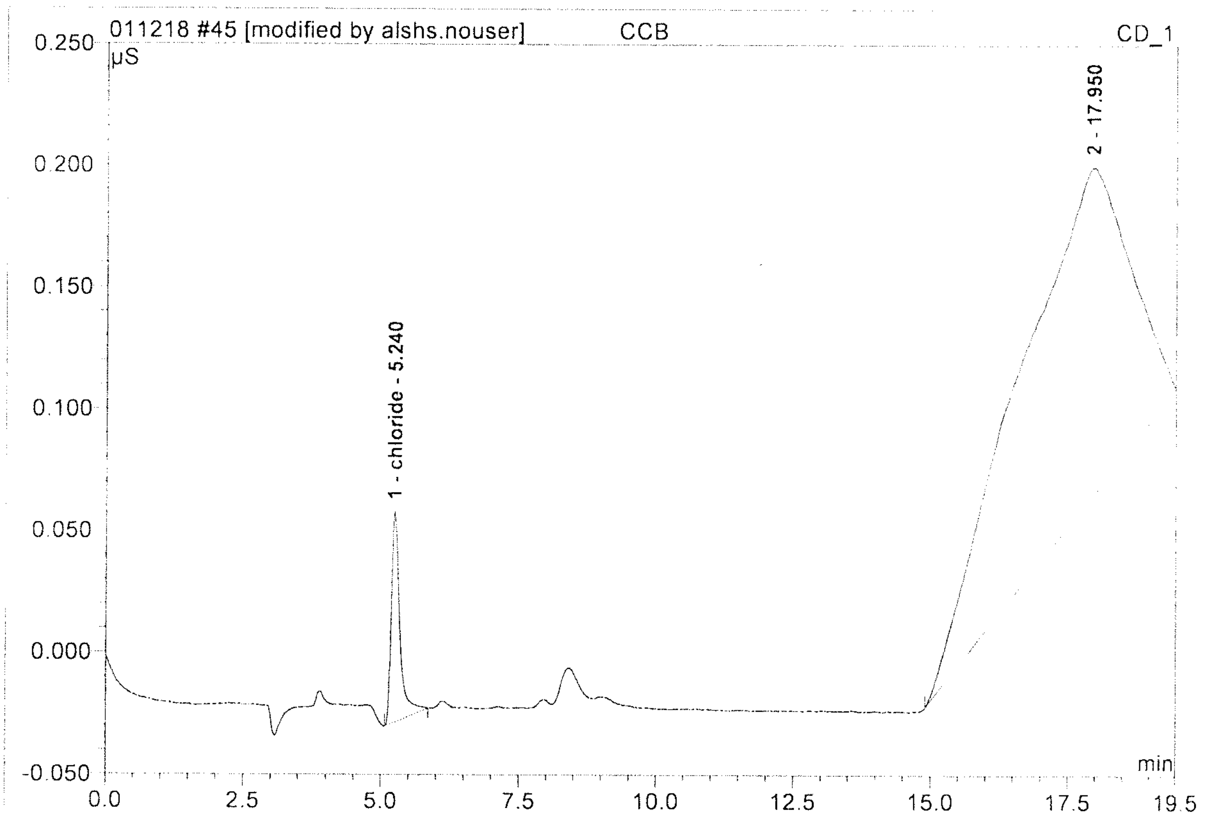
Sample Name:	**CCV1**	*Injection Volume:*	**20.0**
Vial Number:	**3**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/13/2018 3:09**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.91	fluoride	18.116	3.049	9.13	10.834	1.
2	5.27	chloride	60.900	10.611	31.78	53.267	1.
3	6.15	nitrite,N	18.813	4.009	12.00	10.637	1.
4	7.15	bromide	4.045	0.837	2.51	10.816	1.
5	7.92	nitrate	20.898	5.237	15.68	10.538	1.
6	8.90	sulfate	21.373	7.739	23.17	52.153	1.
7	16.36	phosphate	6.892	1.912	5.73	9.572	1.
Total:			151.037	33.394	100.00	157.818	

45 CCB

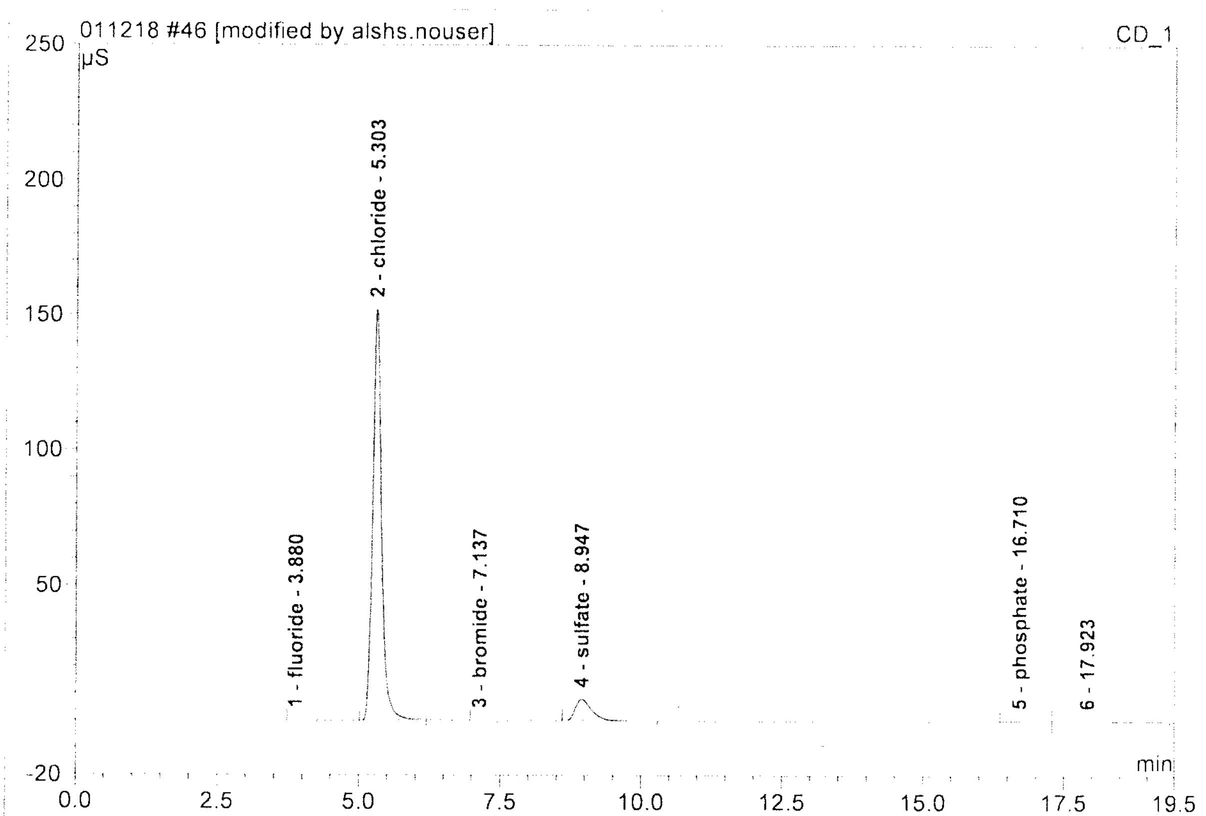
Sample Name:	CCB	*Injection Volume:*	20.0
Vial Number:	4	*Channel:*	CD_1
Sample Type:	unknown	*Wavelength:*	n.a.
Control Program:	anions3	*Bandwidth:*	n.a.
Quantif. Method:	122617	*Dilution Factor:*	1.
Recording Time:	1/13/2018 3:31	*Sample Weight:*	1.0000
Run Time (min):	19.50	*Sample Amount:*	1.0000



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	5.24	chloride	0.086	0.016	4.51	0.221	1.
Total:			0.086	0.016	4.51	0.221	

46 HS17121400-01DF5

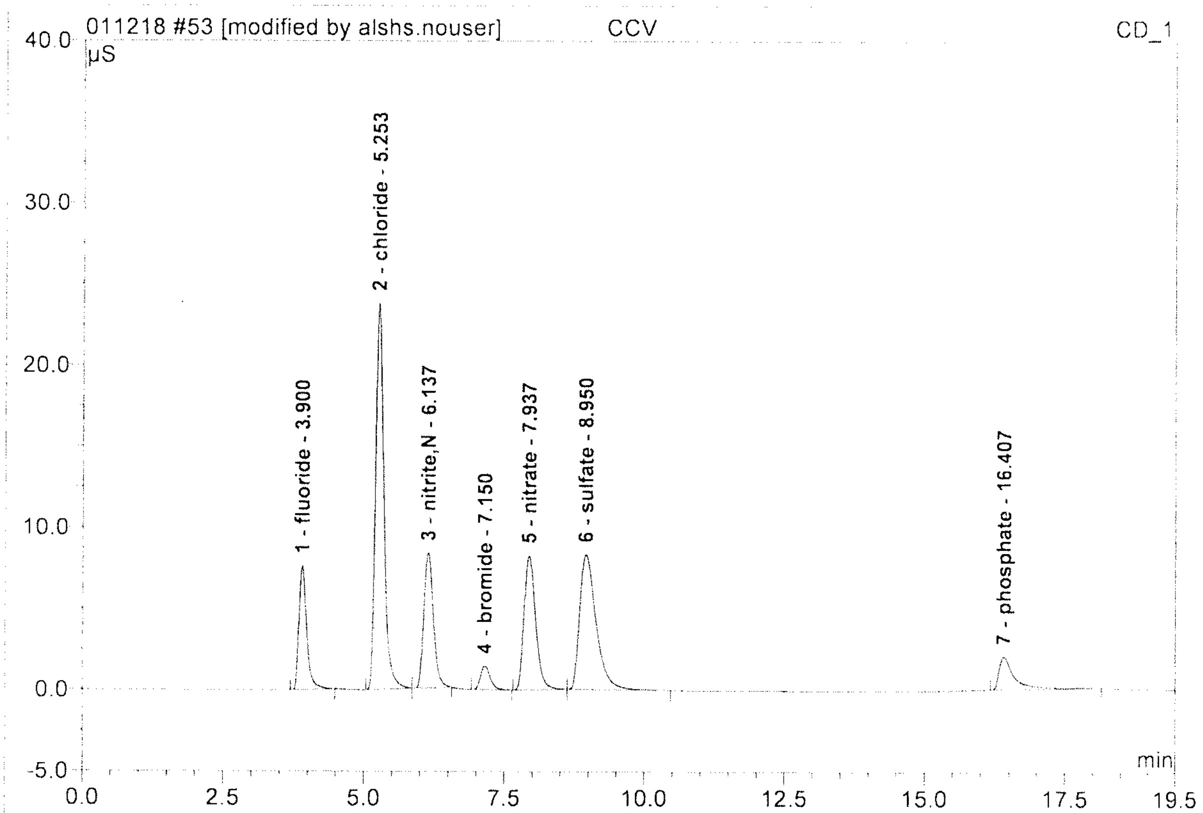
Sample Name:	HS17121400-01DF5	*Injection Volume:*	20.0
Vial Number:	49	*Channel:*	CD_1
Sample Type:	unknown	*Wavelength:*	n.a.
Control Program:	anions3	*Bandwidth:*	n.a.
Quantif. Method:	122617	*Dilution Factor:*	5.
Recording Time:	1/13/2018 3:52	*Sample Weight:*	1.0000
Run Time (min):	19.50	*Sample Amount:*	1.0000



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.88	fluoride	0.029	0.005	0.02	0.326	5.
2	5.30	chloride	151.772	27.332	90.77	684.887	5.
3	7.14	bromide	0.068	0.013	0.04	2.318	5.
4	8.95	sulfate	7.909	2.685	8.92	95.771	5.
5	16.71	phosphate	0.070	0.033	0.11	3.935	5.
Total:			159.849	30.068	99.85	787.237	

53 CCV

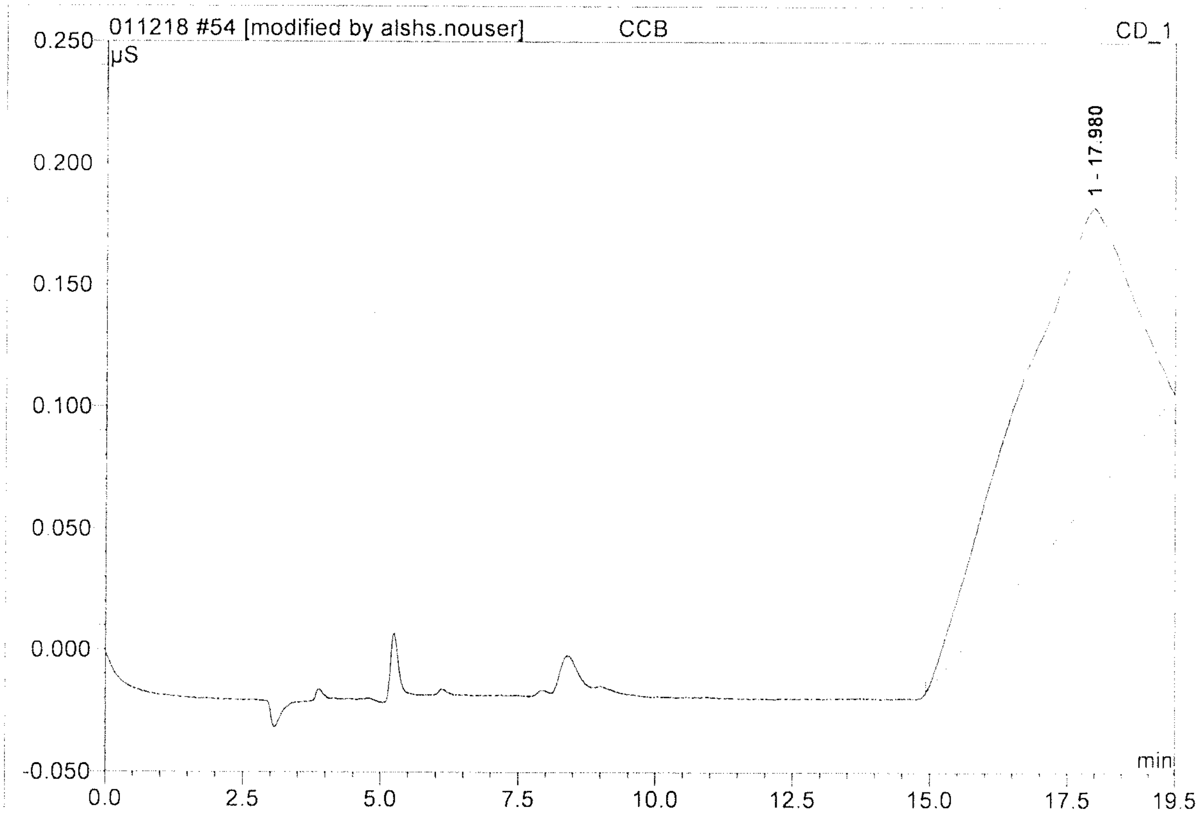
Sample Name:	**CCV**	*Injection Volume:*	**20.0**
Vial Number:	**1**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/13/2018 6:24**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.90	fluoride	7.613	1.211	9.53	4.332	1.
2	5.25	chloride	23.799	4.076	32.08	20.551	1.
3	6.14	nitrite,N	8.292	1.642	12.92	4.363	1.
4	7.15	bromide	1.483	0.296	2.33	4.023	1.
5	7.94	nitrate	8.253	1.988	15.64	4.103	1.
6	8.95	sulfate	8.305	2.831	22.28	20.106	1.
7	16.41	phosphate	2.035	0.664	5.23	3.737	1.
Total:			59.780	12.708	100.00	61.214	

54 CCB

Sample Name:	CCB	*Injection Volume:*	20.0
Vial Number:	2	*Channel:*	CD_1
Sample Type:	unknown	*Wavelength:*	n.a.
Control Program:	anions3	*Bandwidth:*	n.a.
Quantif. Method:	122617	*Dilution Factor:*	1.
Recording Time:	1/13/2018 6:46	*Sample Weight:*	1.0000
Run Time (min):	19.50	*Sample Amount:*	1.0000



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
Total:			0.000	0.000	0.00	0.000	

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2
#Samples: 101
Created: 1/15/2018 10:27:53 AM by alshs.nouser
Last Update: 1/18/2018 2:08:50 PM by alshs.nouser

No.	Name	Comment	Pos.	Type	Dil. Factor	Program
1	STD1		28	Standard	1.0000	anions3
2	STD2		29	Standard	1.0000	anions3
3	STD3		30	Standard	1.0000	anions3
4	STD4		31	Standard	1.0000	anions3
5	STD5		32	Standard	1.0000	anions3
6	STD6		33	Standard	1.0000	anions3
7	ICV		34	Unknown	1.0000	anions3
8	ICB		35	Unknown	1.0000	anions3
9	CCV		1	Unknown	1.0000	anions3
10	CCB		2	Unknown	1.0000	anions3
11	WBLKW1-011518		5	Unknown	1.0000	anions3
12	WLCSW1-011518		6	Unknown	1.0000	anions3
13	WLCSDW1-011518		7	Unknown	1.0000	anions3
14	HS17121442-02DF50	9056_W CL	8	Unknown	50.0000	anions3
15	HS17121442-02DF100		9	Unknown	100.0000	anions3
16	HS17121442-19DF100		10	Unknown	100.0000	anions3
17	HS17121442-19MSDF100		11	Unknown	100.0000	anions3
18	HS17121442-19MSDDF100		12	Unknown	100.0000	anions3
19	HS17121400-01DF10	RR FROM 1-12-18	30	Unknown	10.0000	anions3
20	DI H2O		14	Unknown	1.0000	anions3
21	CCV1		3	Unknown	1.0000	anions3
22	CCB		4	Unknown	1.0000	anions3
23	HS17121442-03DF100		13	Unknown	100.0000	anions3
24	HS17121442-04DF100		15	Unknown	100.0000	anions3
25	HS17121442-05DF100		16	Unknown	100.0000	anions3
26	HS17121442-06DF100		17	Unknown	100.0000	anions3
27	HS17121442-07DF100		18	Unknown	100.0000	anions3
28	HS17121442-08DF100		19	Unknown	100.0000	anions3
29	HS17121442-09DF100		20	Unknown	100.0000	anions3
30	HS17121442-11DF100		21	Unknown	100.0000	anions3
31	HS17121442-12DF100		22	Unknown	100.0000	anions3
32	DI H2O		14	Unknown	1.0000	anions3
33	CCV		1	Unknown	1.0000	anions3
34	CCB		2	Unknown	1.0000	anions3

Sequence: 011518
Operator: alshs.nouser

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2
#Samples: 101

Created: 1/15/2018 10:27:53 AM by alshs.nouser
Last Update: 1/18/2018 2:08:50 PM by alshs.nouser

No.	Name	Inj. Vol.	Method	Status	Inj. Date/Time	Weight
1	STD1	20.0	122617	Finished	12/22/2017 1:25:08 PM	1.0000
2	STD2	20.0	122617	Finished	12/22/2017 1:46:49 PM	1.0000
3	STD3	20.0	122617	Finished	12/22/2017 2:08:31 PM	1.0000
4	STD4	20.0	122617	Finished	12/22/2017 2:30:12 PM	1.0000
5	STD5	20.0	122617	Finished	12/22/2017 2:51:54 PM	1.0000
6	STD6	20.0	122617	Finished	12/22/2017 3:13:35 PM	1.0000
7	ICV	20.0	122617	Finished	12/22/2017 3:35:17 PM	1.0000
8	ICB	20.0	122617	Finished	12/22/2017 3:56:59 PM	1.0000
9	CCV	20.0	122617	Finished	1/15/2018 11:07:35 AM	1.0000
10	CCB	20.0	122617	Finished	1/15/2018 11:29:17 AM	1.0000
11	WBLKW1-011518	20.0	122617	Finished	1/15/2018 11:50:59 AM	1.0000
12	WLCSW1-011518	20.0	122617	Finished	1/15/2018 12:12:40 PM	1.0000
13	WLCSDW1-011518	20.0	122617	Finished	1/15/2018 12:34:22 PM	1.0000
14	HS17121442-02DF50	20.0	122617	Finished	1/15/2018 12:56:04 PM	1.0000
15	HS17121442-02DF100	20.0	122617	Finished	1/15/2018 1:17:46 PM	1.0000
16	HS17121442-19DF100	20.0	122617	Finished	1/15/2018 1:39:28 PM	1.0000
17	HS17121442-19MSDF100	20.0	122617	Finished	1/15/2018 2:01:10 PM	1.0000
18	HS17121442-19MSDDF100	20.0	122617	Finished	1/15/2018 2:22:52 PM	1.0000
19	HS17121400-01DF10	20.0	122617	Finished	1/15/2018 2:44:34 PM	1.0000
20	DI H2O	20.0	122617	Finished	1/15/2018 3:06:15 PM	1.0000
21	CCV1	20.0	122617	Finished	1/15/2018 3:27:57 PM	1.0000
22	CCB	20.0	122617	Finished	1/15/2018 3:49:39 PM	1.0000
23	HS17121442-03DF100	20.0	122617	Finished	1/15/2018 4:11:20 PM	1.0000
24	HS17121442-04DF100	20.0	122617	Finished	1/15/2018 4:33:03 PM	1.0000
25	HS17121442-05DF100	20.0	122617	Finished	1/15/2018 4:54:44 PM	1.0000
26	HS17121442-06DF100	20.0	122617	Finished	1/15/2018 5:16:26 PM	1.0000
27	HS17121442-07DF100	20.0	122617	Finished	1/15/2018 5:38:09 PM	1.0000
28	HS17121442-08DF100	20.0	122617	Finished	1/15/2018 5:59:50 PM	1.0000
29	HS17121442-09DF100	20.0	122617	Finished	1/15/2018 6:21:32 PM	1.0000
30	HS17121442-11DF100	20.0	122617	Finished	1/15/2018 6:43:14 PM	1.0000
31	HS17121442-12DF100	20.0	122617	Finished	1/15/2018 7:04:56 PM	1.0000
32	DI H2O	20.0	122617	Finished	1/15/2018 7:26:37 PM	1.0000
33	CCV	20.0	122617	Finished	1/15/2018 7:48:19 PM	1.0000
34	CCB	20.0	122617	Finished	1/15/2018 8:10:01 PM	1.0000

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2 Created: 1/15/2018 10:27:53 AM by alshs.nouser
#Samples: 101 Last Update: 1/18/2018 2:08:50 PM by alshs.nouser

No.	Name	ISTD Amount	Sample ID	Replicate ID
1	STD1	1.0000		01
2	STD2	1.0000		01
3	STD3	1.0000		01
4	STD4	1.0000		01
5	STD5	1.0000		01
6	STD6	1.0000		01
7	ICV	1.0000		01
8	ICB	1.0000		01
9	CCV	1.0000		01
10	CCB	1.0000		01
11	WBLKW1-011518	1.0000		01
12	WLCSW1-011518	1.0000		01
13	WLCSDW1-011518	1.0000		01
14	HS17121442-02DF50	1.0000		01
15	HS17121442-02DF100	1.0000		01
16	HS17121442-19DF100	1.0000		01
17	HS17121442-19MSDF100	1.0000		01
18	HS17121442-19MSDDF100	1.0000		01
19	HS17121400-01DF10	1.0000		01
20	DI H2O	1.0000		01
21	CCV1	1.0000		01
22	CCB	1.0000		01
23	HS17121442-03DF100	1.0000		01
24	HS17121442-04DF100	1.0000		01
25	HS17121442-05DF100	1.0000		01
26	HS17121442-06DF100	1.0000		01
27	HS17121442-07DF100	1.0000		01
28	HS17121442-08DF100	1.0000		01
29	HS17121442-09DF100	1.0000		01
30	HS17121442-11DF100	1.0000		01
31	HS17121442-12DF100	1.0000		01
32	DI H2O	1.0000		01
33	CCV	1.0000		01
34	CCB	1.0000		01

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2 Created: 1/15/2018 10:27:53 AM by alshs.nouser
#Samples: 101 Last Update: 1/18/2018 2:08:50 PM by alshs.nouser

No.	Name	Comment	Pos.	Type	Dil. Factor	Program
35	HS17121442-13DF100		23	Unknown	100.0000	anions3
36	HS17121442-14DF100		24	Unknown	100.0000	anions3
37	HS17121442-15DF100		25	Unknown	100.0000	anions3
38	HS17121442-16DF100		26	Unknown	100.0000	anions3
39	HS17121442-17DF100		27	Unknown	100.0000	anions3
40	HS17121442-18DF100		28	Unknown	100.0000	anions3
41	HS17121442-20DF100		29	Unknown	100.0000	anions3
42	DI H2O		14	Unknown	1.0000	anions3
43	CCV1		3	Unknown	1.0000	anions3
44	CCB		4	Unknown	1.0000	anions3
45	WBLKW2-011518	300_W	31	Unknown	1.0000	anions3
46	WLCSW2-011518		32	Unknown	1.0000	anions3
47	WLCSDW2-011518		33	Unknown	1.0000	anions3
48	HS18010579-01	NO3	34	Unknown	1.0000	anions3
49	HS18010579-01MS	NO3	35	Unknown	1.0000	anions3
50	HS18010579-01MSD	NO3	36	Unknown	1.0000	anions3
51	DI H2O		37	Unknown	1.0000	anions3
52	HS18010337-02	F	38	Unknown	1.0000	anions3
53	DI H2O		37	Unknown	1.0000	anions3
54	DI H2O		37	Unknown	1.0000	anions3
55	CCV		1	Unknown	1.0000	anions3
56	CCB		2	Unknown	1.0000	anions3
57	HS18010435-01DF20	CL	39	Unknown	20.0000	anions3
58	HS18010435-01DF200	SO4	40	Unknown	200.0000	anions3
59	HS18010435-02DF20	CL	41	Unknown	20.0000	anions3
60	HS18010435-02DF200	SO4	42	Unknown	200.0000	anions3
61	HS18010435-03DF20	CL	43	Unknown	20.0000	anions3
62	HS18010435-03DF200	SO4	44	Unknown	200.0000	anions3
63	HS18010435-04DF20	CL	45	Unknown	20.0000	anions3
64	HS18010435-04DF200	SO4	46	Unknown	200.0000	anions3
65	DI H2O		37	Unknown	1.0000	anions3
66	DI H2O		37	Unknown	1.0000	anions3
67	CCV1		3	Unknown	1.0000	anions3
68	CCB		4	Unknown	1.0000	anions3

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2 Created: 1/15/2018 10:27:53 AM by alshs.nouser
#Samples: 101 Last Update: 1/18/2018 2:08:50 PM by alshs.nouser

No.	Name	Inj. Vol.	Method	Status	Inj. Date/Time	Weight
35	HS17121442-13DF100	20.0	122617	Finished	1/15/2018 8:31:43 PM	1.0000
36	HS17121442-14DF100	20.0	122617	Finished	1/15/2018 8:53:25 PM	1.0000
37	HS17121442-15DF100	20.0	122617	Finished	1/15/2018 9:15:07 PM	1.0000
38	HS17121442-16DF100	20.0	122617	Finished	1/15/2018 9:36:49 PM	1.0000
39	HS17121442-17DF100	20.0	122617	Finished	1/15/2018 9:58:31 PM	1.0000
40	HS17121442-18DF100	20.0	122617	Finished	1/15/2018 10:20:13 PM	1.0000
41	HS17121442-20DF100	20.0	122617	Finished	1/15/2018 10:41:55 PM	1.0000
42	DI H2O	20.0	122617	Finished	1/15/2018 11:03:36 PM	1.0000
43	CCV1	20.0	122617	Finished	1/15/2018 11:25:18 PM	1.0000
44	CCB	20.0	122617	Finished	1/15/2018 11:47:00 PM	1.0000
45	WBLKW2-011518	20.0	122617	Finished	1/16/2018 12:08:43 AM	1.0000
46	WLCSW2-011518	20.0	122617	Finished	1/16/2018 12:30:24 AM	1.0000
47	WLCSDW2-011518	20.0	122617	Finished	1/16/2018 12:52:06 AM	1.0000
48	HS18010579-01	20.0	122617	Finished	1/16/2018 1:13:48 AM	1.0000
49	HS18010579-01MS	20.0	122617	Finished	1/16/2018 1:35:30 AM	1.0000
50	HS18010579-01MSD	20.0	122617	Finished	1/16/2018 1:57:11 AM	1.0000
51	DI H2O	20.0	122617	Finished	1/16/2018 2:18:53 AM	1.0000
52	HS18010337-02	20.0	122617	Finished	1/16/2018 2:40:35 AM	1.0000
53	DI H2O	20.0	122617	Finished	1/16/2018 3:02:16 AM	1.0000
54	DI H2O	20.0	122617	Finished	1/16/2018 3:23:58 AM	1.0000
55	CCV	20.0	122617	Finished	1/16/2018 3:45:40 AM	1.0000
56	CCB	20.0	122617	Finished	1/16/2018 4:07:21 AM	1.0000
57	HS18010435-01DF20	20.0	122617	Finished	1/16/2018 4:29:03 AM	1.0000
58	HS18010435-01DF200	20.0	122617	Finished	1/16/2018 4:50:44 AM	1.0000
59	HS18010435-02DF20	20.0	122617	Finished	1/16/2018 5:12:26 AM	1.0000
60	HS18010435-02DF200	20.0	122617	Finished	1/16/2018 5:34:08 AM	1.0000
61	HS18010435-03DF20	20.0	122617	Finished	1/16/2018 5:55:49 AM	1.0000
62	HS18010435-03DF200	20.0	122617	Finished	1/16/2018 6:17:32 AM	1.0000
63	HS18010435-04DF20	20.0	122617	Finished	1/16/2018 6:39:14 AM	1.0000
64	HS18010435-04DF200	20.0	122617	Finished	1/16/2018 7:00:55 AM	1.0000
65	DI H2O	20.0	122617	Finished	1/16/2018 7:22:37 AM	1.0000
66	DI H2O	20.0	122617	Finished	1/16/2018 7:44:20 AM	1.0000
67	CCV1	20.0	122617	Finished	1/16/2018 8:06:02 AM	1.0000
68	CCB	20.0	122617	Finished	1/16/2018 8:27:44 AM	1.0000

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase ICS3000_2 Created: 1/15/2018 10:27:53 AM by alshs.nouser
#Samples 101 Last Update: 1/18/2018 2:08:50 PM by alshs.nouser

No.	Name	ISTD Amount	Sample ID	Replicate ID
35	HS17121442-13DF100	1.0000		01
36	HS17121442-14DF100	1.0000		01
37	HS17121442-15DF100	1.0000		01
38	HS17121442-16DF100	1.0000		01
39	HS17121442-17DF100	1.0000		01
40	HS17121442-18DF100	1.0000		01
41	HS17121442-20DF100	1.0000		01
42	DI H2O	1.0000		01
43	CCV1	1.0000		01
44	CCB	1.0000		01
45	WBLKW2-011518	1.0000		01
46	WLCSW2-011518	1.0000		01
47	WLCSDW2-011518	1.0000		01
48	HS18010579-01	1.0000		01
49	HS18010579-01MS	1.0000		01
50	HS18010579-01MSD	1.0000		01
51	DI H2O	1.0000		01
52	HS18010337-02	1.0000		01
53	DI H2O	1.0000		01
54	DI H2O	1.0000		01
55	CCV	1.0000		01
56	CCB	1.0000		01
57	HS18010435-01DF20	1.0000		01
58	HS18010435-01DF200	1.0000		01
59	HS18010435-02DF20	1.0000		01
60	HS18010435-02DF200	1.0000		01
61	HS18010435-03DF20	1.0000		01
62	HS18010435-03DF200	1.0000		01
63	HS18010435-04DF20	1.0000		01
64	HS18010435-04DF200	1.0000		01
65	DI H2O	1.0000		01
66	DI H2O	1.0000		01
67	CCV1	1.0000		01
68	CCB	1.0000		01

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2 Created: 1/15/2018 10:27:53 AM by alshs.nouser
#Samples: 101 Last Update: 1/18/2018 2:08:50 PM by alshs.nouser

No	Name	Comment	Pos.	Type	Dil. Factor	Program
69	MBLK-124177	9056_S	47	Unknown	1.0000	anions3
70	LCS-124177		48	Unknown	1.0000	anions3
71	LCSD-124177	ADDED OUT OF HT	49	Unknown	1.0000	anions3
72	HS17120456-42DF10		50	Unknown	10.0000	anions3
73	HS17120456-42MSDF10		51	Unknown	10.0000	anions3
74	HS17120456-42MSDDF10		52	Unknown	10.0000	anions3
75	HS17120535-03DF10		53	Unknown	10.0000	anions3
76	HS17120535-07DF20		54	Unknown	20.0000	anions3
77	HS17120535-104DF10		55	Unknown	10.0000	anions3
78	DI H2O		37	Unknown	1.0000	anions3
79	CCV		1	Unknown	1.0000	anions3
80	CCB		2	Unknown	1.0000	anions3
81	HS17120535-12DF10		56	Unknown	10.0000	anions3
82	HS17120535-21DF10		57	Unknown	10.0000	anions3
83	HS17120535-26DF10		58	Unknown	10.0000	anions3
84	HS17120535-41DF10		59	Unknown	10.0000	anions3
85	HS17120535-46DF10		60	Unknown	10.0000	anions3
86	HS17120535-51DF10		61	Unknown	10.0000	anions3
87	HS17120535-54DF10		62	Unknown	10.0000	anions3
88	HS17120535-64DF10		63	Unknown	10.0000	anions3
89	HS17120535-70DF10		64	Unknown	10.0000	anions3
90	DI H2O		37	Unknown	1.0000	anions3
91	CCV1		3	Unknown	1.0000	anions3
92	CCB		4	Unknown	1.0000	anions3
93	HS17120535-89DF10		65	Unknown	10.0000	anions3
94	HS17120535-94DF10		66	Unknown	10.0000	anions3
95	HS17120535-99DF10		67	Unknown	10.0000	anions3
96	DI H2O		37	Unknown	1.0000	anions3
97	DI H2O		37	Unknown	1.0000	anions3
98	CCV		1	Unknown	1.0000	anions3
99	CCB		2	Unknown	1.0000	anions3
100	CCB		37	Unknown	1.0000	anions3
101	CCB		37	Unknown	1.0000	anions3

Title: Temporary sequence for manual data acquisition
Datasource: HP0307B_local
Location: ICS3000_2\2_Data\01-2018
Timebase: ICS3000_2 Created: 1/15/2018 10:27:53 AM by alshs.nouser
#Samples: 101 Last Update: 1/18/2018 2:08:50 PM by alshs.nouser

No.	Name	Inj. Vol.	Method	Status	Inj. Date/Time	Weight
69	MBLK-124177	20.0	122617	Finished	1/16/2018 8:49:26 AM	1.0000
70	LCS-124177	20.0	122617	Finished	1/16/2018 9:11:08 AM	1.0000
71	LCSD-124177	20.0	122617	Finished	1/16/2018 9:32:50 AM	1.0000
72	HS17120456-42DF10	20.0	122617	Finished	1/16/2018 9:54:32 AM	1.0000
73	HS17120456-42MSDF10	20.0	122617	Finished	1/16/2018 10:16:14 AM	1.0000
74	HS17120456-42MSDDF10	20.0	122617	Finished	1/16/2018 10:37:55 AM	1.0000
75	HS17120535-03DF10	20.0	122617	Finished	1/16/2018 10:59:37 AM	1.0000
76	HS17120535-07DF20	20.0	122617	Finished	1/16/2018 11:21:19 AM	1.0000
77	HS17120535-104DF10	20.0	122617	Finished	1/16/2018 11:43:01 AM	1.0000
78	DI H2O	20.0	122617	Finished	1/16/2018 12:04:42 PM	1.0000
79	CCV	20.0	122617	Finished	1/16/2018 12:26:24 PM	1.0000
80	CCB	20.0	122617	Finished	1/16/2018 12:48:06 PM	1.0000
81	HS17120535-12DF10	20.0	122617	Finished	1/16/2018 1:09:47 PM	1.0000
82	HS17120535-21DF10	20.0	122617	Finished	1/16/2018 1:31:29 PM	1.0000
83	HS17120535-26DF10	20.0	122617	Finished	1/16/2018 1:53:12 PM	1.0000
84	HS17120535-41DF10	20.0	122617	Finished	1/16/2018 2:14:54 PM	1.0000
85	HS17120535-46DF10	20.0	122617	Finished	1/16/2018 2:36:36 PM	1.0000
86	HS17120535-51DF10	20.0	122617	Finished	1/16/2018 2:58:18 PM	1.0000
87	HS17120535-54DF10	20.0	122617	Finished	1/16/2018 3:19:59 PM	1.0000
88	HS17120535-64DF10	20.0	122617	Finished	1/16/2018 3:41:41 PM	1.0000
89	HS17120535-70DF10	20.0	122617	Finished	1/16/2018 4:03:23 PM	1.0000
90	DI H2O	20.0	122617	Finished	1/16/2018 4:25:05 PM	1.0000
91	CCV1	20.0	122617	Finished	1/16/2018 4:46:46 PM	1.0000
92	CCB	20.0	122617	Finished	1/16/2018 5:08:28 PM	1.0000
93	HS17120535-89DF10	20.0	122617	Finished	1/16/2018 5:30:09 PM	1.0000
94	HS17120535-94DF10	20.0	122617	Finished	1/16/2018 5:51:51 PM	1.0000
95	HS17120535-99DF10	20.0	122617	Finished	1/16/2018 6:13:32 PM	1.0000
96	DI H2O	20.0	122617	Finished	1/16/2018 6:35:15 PM	1.0000
97	DI H2O	20.0	122617	Finished	1/16/2018 6:56:57 PM	1.0000
98	CCV	20.0	122617	Finished	1/16/2018 7:18:38 PM	1.0000
99	CCB	20.0	122617	Finished	1/16/2018 7:40:20 PM	1.0000
100	CCB	20.0	122617	Finished	1/16/2018 8:02:02 PM	1.0000
101	CCB	20.0	122617	Finished	1/16/2018 8:23:44 PM	1.0000

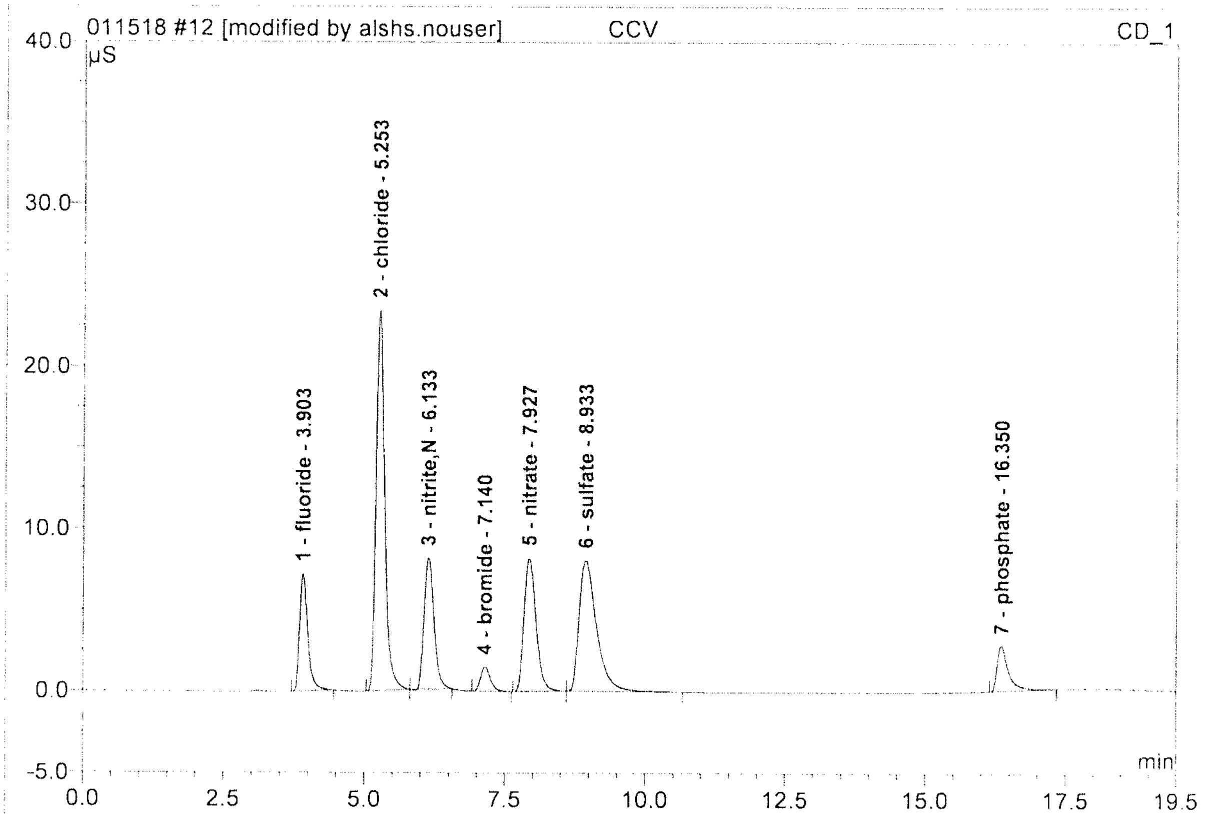
Title: Temporary sequence for manual data acquisition

Datasource:	HP0307B_local		
Location:	ICS3000_2\2_Data\01-2018		
Timebase:	ICS3000_2	Created:	1/15/2018 10:27:53 AM by alshs.nouser
#Samples:	101	Last Update:	1/18/2018 2:08:50 PM by alshs.nouser

No.	Name	ISTD Amount	Sample ID	Replicate ID
69	MBLK-124177	1.0000		01
70	LCS-124177	1.0000		01
71	LCSD-124177	1.0000		01
72	HS17120456-42DF10	1.0000		01
73	HS17120456-42MSDF10	1.0000		01
74	HS17120456-42MSDDF10	1.0000		01
75	HS17120535-03DF10	1.0000		01
76	HS17120535-07DF20	1.0000		01
77	HS17120535-104DF10	1.0000		01
78	DI H2O	1.0000		01
79	CCV	1.0000		01
80	CCB	1.0000		01
81	HS17120535-12DF10	1.0000		01
82	HS17120535-21DF10	1.0000		01
83	HS17120535-26DF10	1.0000		01
84	HS17120535-41DF10	1.0000		01
85	HS17120535-46DF10	1.0000		01
86	HS17120535-51DF10	1.0000		01
87	HS17120535-54DF10	1.0000		01
88	HS17120535-64DF10	1.0000		01
89	HS17120535-70DF10	1.0000		01
90	DI H2O	1.0000		01
91	CCV1	1.0000		01
92	CCB	1.0000		01
93	HS17120535-89DF10	1.0000		01
94	HS17120535-94DF10	1.0000		01
95	HS17120535-99DF10	1.0000		01
96	DI H2O	1.0000		01
97	DI H2O	1.0000		01
98	CCV	1.0000		01
99	CCB	1.0000		01
100	CCB	1.0000		01
101	CCB	1.0000		01

12 CCV

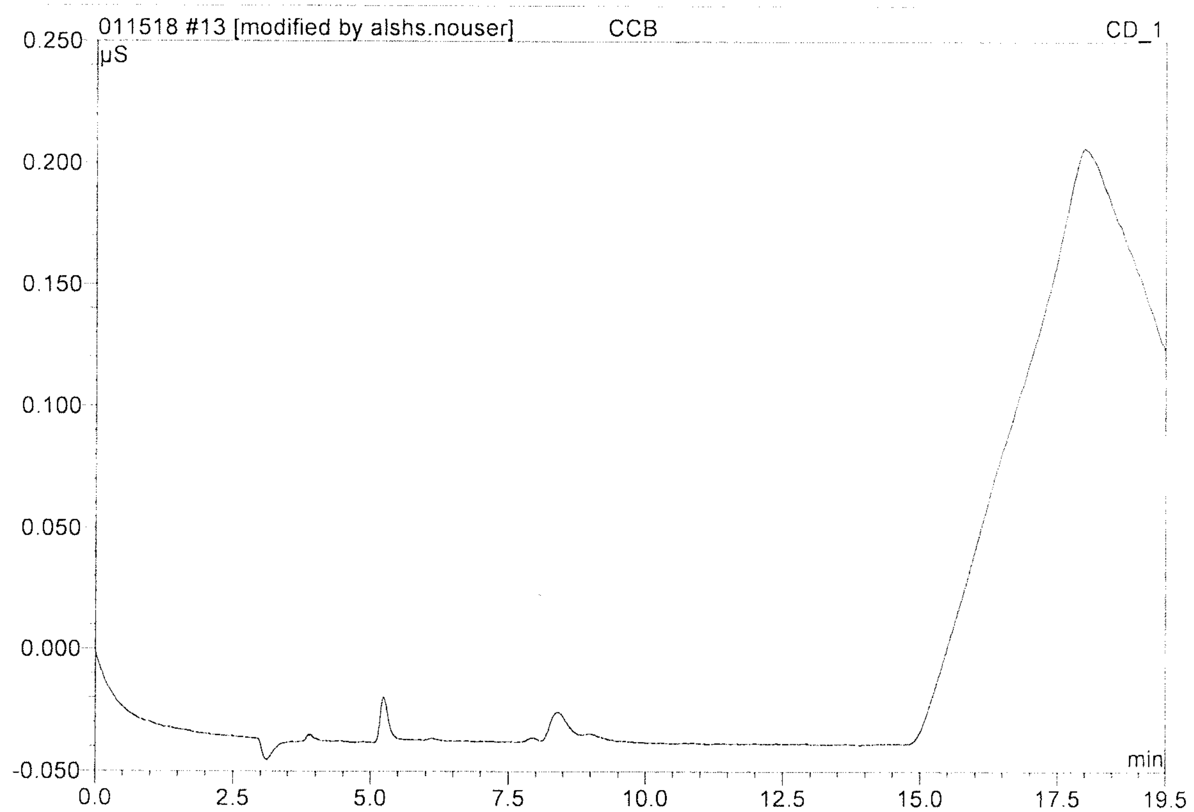
Sample Name:	**CCV**	*Injection Volume:*	**20.0**
Vial Number:	**1**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/15/2018 11:07**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.90	fluoride	7.201	1.210	9.37	4.327	1.
2	5.25	chloride	23.416	4.153	32.17	20.934	1.
3	6.13	nitrite,N	8.073	1.648	12.77	4.381	1.
4	7.14	bromide	1.497	0.303	2.35	4.108	1.
5	7.93	nitrate	8.225	2.029	15.72	4.185	1.
6	8.93	sulfate	8.064	2.912	22.56	20.634	1.
7	16.35	phosphate	2.760	0.654	5.07	3.691	1.
Total:			59.236	12.909	100.00	62.259	

13 CCB

Sample Name:	**CCB**	*Injection Volume:*	**20.0**
Vial Number:	**2**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/15/2018 11:29**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**

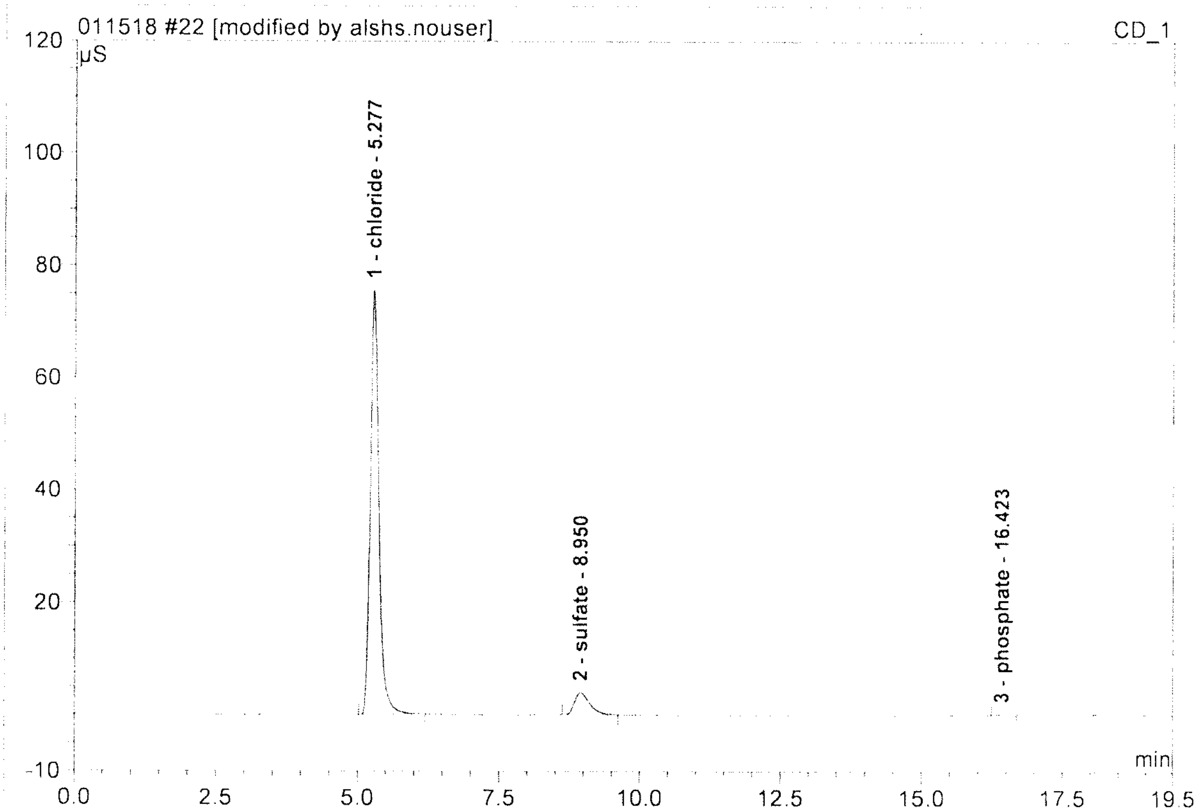


No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
Total:			0.000	0.000	0.00	0.000	

22 HS17121400-01DF10

RR FROM 1-12-18

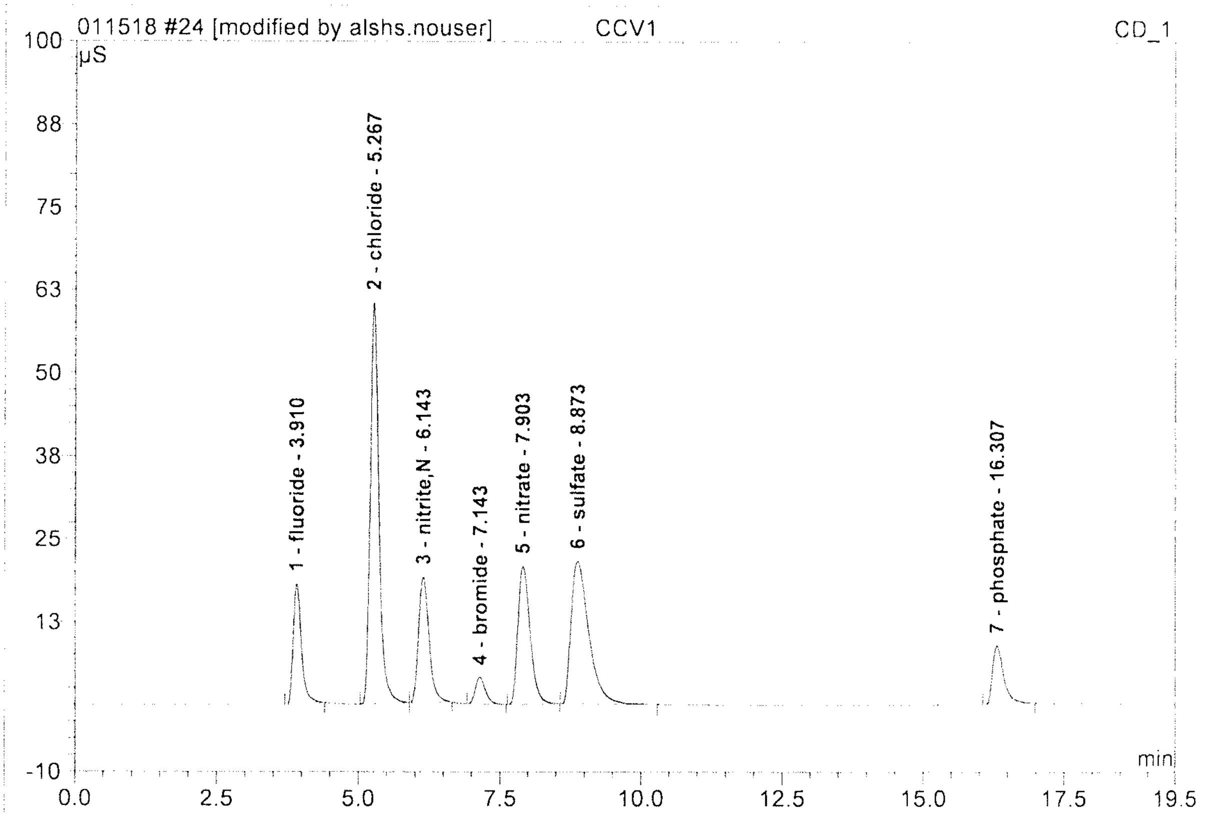
Sample Name:	**HS17121400-01DF10**	*Injection Volume:*	**20.0**
Vial Number:	**30**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**10.**
Recording Time:	**1/15/2018 14:44**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	5.28	chloride	75.576	13.426	91.50	673.601	10.
2	8.95	sulfate	3.883	1.231	8.39	96.568	10.
3	16.42	phosphate	0.079	0.017	0.12	7.117	10.
Total:			79.538	14.674	100.00	777.286	

24 CCV1

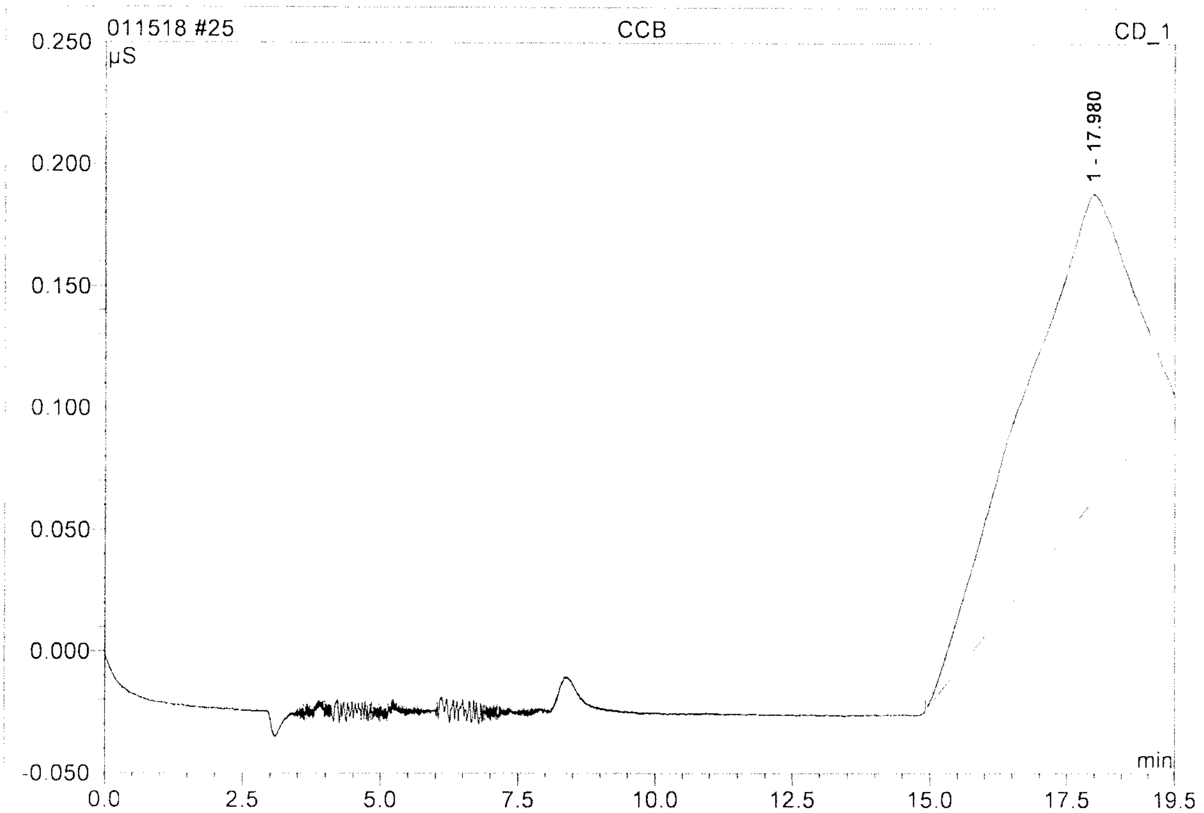
Sample Name:	**CCV1**	*Injection Volume:*	**20.0**
Vial Number:	**3**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/15/2018 15:27**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
1	3.91	fluoride	18.168	3.042	9.02	10.810	1.
2	5.27	chloride	60.477	10.648	31.58	53.451	1.
3	6.14	nitrite,N	18.973	4.073	12.08	10.807	1.
4	7.14	bromide	4.045	0.839	2.49	10.837	1.
5	7.90	nitrate	20.877	5.254	15.58	10.572	1.
6	8.87	sulfate	21.581	7.845	23.26	52.842	1.
7	16.31	phosphate	8.836	2.020	5.99	10.077	1.
Total:			152.958	33.720	100.00	159.395	

25 CCB

Sample Name:	**CCB**	*Injection Volume:*	**20.0**
Vial Number:	**4**	*Channel:*	**CD_1**
Sample Type:	**unknown**	*Wavelength:*	**n.a.**
Control Program:	**anions3**	*Bandwidth:*	**n.a.**
Quantif. Method:	**122617**	*Dilution Factor:*	**1.**
Recording Time:	**1/15/2018 15:49**	*Sample Weight:*	**1.0000**
Run Time (min):	**19.50**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount ppm	Dil.Fac.
Total:			0.000	0.000	0.00	0.000	

Subject: **Final Minutes, Monthly Managers' Meeting (MMM), Longhorn Army Ammunition Plant (LHAAP)**

Location of Meeting: **In-Person at LHAAP Field Trailer and via Conference Call-In 515-603-3155 with Code 1063533#**

Date of Meeting: **April 19, 2018 – 10:00 AM Central Daylight Time (CDT)**

Attendees:

Army BRAC:	Rose Zeiler (RMZ)
EPA:	Rich Mayer (RM) and Dorelle Harrison
USGS:	Kent Becher (KB)
TCEQ:	April Palmie (AP)
USACE:	Aaron Williams (AW) and Richard Smith (RS)
AEC:	Andrew Maly (AM)
Bhate:	Kim Nemmers (KN) and Dustin McNeil –in person and Mark Stapleton (MS) on the phone
APTIM:	William (Bill) Foss (BF)- in person and Susan Watson (SW) and Praveen Srivastav (PS) on the phone
USFWS:	Paul Bruckwicki (PB)

Action Items

Army

- RMZ stated that the draft enforceable schedule will be discussed after the MMM between the Army and the Regulators. RMZ discussed possible site visit dates for the Five Year Review (FYR) that is being completed under New England United States Army Corps of Engineers (USACE). AP was to check the possible dates of the week of 14 or 21 May 2018.

Bhate Environmental Associates (Bhate)/APTIM

- KN led the discussion about the groundwater treatment plant (GWTP) discharge protocol. KN stated that only the discharge criteria for perchlorate discharge to the INF pond was added to the revised protocol at this time due to changes planned for the ion exchange columns. AW stated that the Army is having a mechanical review completed and has asked AECOM to address how the ion exchange vessels were installed in parallel instead of in series. RMZ stated that the protocol is being followed for discharge to Harrison Bayou. RMZ explained that the fluidized bed reactor (FBR) is supposed to treat the water to below 17 micrograms per liter, but has not been working properly so the ion exchange vessels were installed. If the FBR is operating optimally, the need for the ion exchange vessels could be minimized.

Environmental Protection Agency (EPA)

- KB discussed the surface water sampling completed.

Schedule Review

RMZ reiterated that there would be brief meeting with the Regulators following the MMM to discuss the enforceable schedule further.

Defense Environmental Restoration Program (DERP) Performance Based Remediation (PBR) Update

KN asked everyone to refer to the Document and Issues Tracking Table dated April 19, 2018.

- **Task 1** (Project Management)

- Installation Wide Work Plan (IWWP) - The IWWP was discussed as awaiting EPA review of the standard operating procedures (SOPs). RM stated that his concern with the new SOP was placing the soil cuttings into the drilled hole and whether that was possible. BF stated that bentonite is typically used but that drill cuttings are emplaced into the hole if shallow and borehole diameter is large enough to allow. AP stated that she had checked with others at Texas Commission on Environmental Quality (TCEQ) and that this process was acceptable but suggested that the text be revised to state as appropriate based upon site conditions. RM stated that he would provide specific comments on the SOP.

- **Task 2** (LHAAP-02 Semi-Annual Groundwater Monitoring Report) – KN stated that the next groundwater sampling event is being completed prior to the end of April 2018.
- **Task 3** (LHAAP-03 Record of Decision [ROD] and Explanation of Significant Difference [ESD]) – PS stated that the ROD and ESD were issued to regulators. AP asked if it was possible to receive the ROD and ESD at the same time for signature. RMZ stated that we just have to remember to do this and hold the ROD until the ESD catches up. Everyone agreed that it was possible to have both documents ready for signature at the same time.
- **Task 4** (LHAAP-04 Remedial Design [RD]/Remedial Action Work Plan [RAWP]) – PS stated that the RD/RAWP is still delayed awaiting further input and contract modification from the Army.
- **Task 5** (LHAAP-12 Annual Remedial Action – Operation [RA-O] Report) – The LHAAP-12 Annual RA-O Report is on schedule and is being prepared.
- **Task 6** (LHAAP-16 RAWP) – PS stated that the RAWP is prepared and resolution of regulator comments with the Army is underway.
- **Task 7** (LHAAP-17 Pre-Design Investigation [PDI] Report) – SW stated that the PDI Report was submitted for Army review on April 16. The PDI Report will not include the results from a new monitoring well planned to be installed in the shallow aquifer, but the PDI report does discuss installation of the well. AW confirmed with SW that the RD for LHAAP-17 would include the additional well installation information and sampling results from the well and the remaining soil area. PS stated that the shallow monitoring well was planned to be installed during the current LHAAP-16 drilling mobilization. BF provided handouts explaining that the depth interval for the existing shallow monitoring well 17WW12 is too shallow and may not be representative of the shallow zone in the remainder of the site. BF stated that the plan is to install the new shallow well in the sand lens at approximately 16-26 feet below ground surface, which corresponds to other shallow wells at LHAAP-17.
- **Task 9** (LHAAP-37) – Groundwater sampling at LHAAP-37 is planned for May 2018.
- **Task 10** (LHAAP-46) – PS addressed RM’s comments regarding the gauging and sampling of wells after 2-inches or more of rainfall. PS stated that the Bhate/APTIM team will gauge previously dry wells after 2-inches of rain and asked if the sample had to be collected in all cases. PS stated that the sample collected with only a few inches of water may not be a viable sample because there will not be enough water to purge the well prior to sampling. RM stated that the consultant needed to determine if sampling the well was going to result in an acceptable sample. RMZ stated that the depth of the screen in the monitoring well needed to be known and indicated on the well sample forms to determine if the water level was in the sump below the screen or in the screen interval. AP stated that it needs to be documented if water is encountered within the sump. RM confirmed that if there is sufficient water, then a sample was required. If there was not sufficient water, documentation should be completed that no sample was collected. RMZ stated that HDR,

Inc. did not find water in the wells that were dry in 2010 at LHAAP-47 when they checked them in late March. It was agreed that Bhate/APTIM will gauge dry wells after at least 2-inches of rain and collect samples if sufficient water is present in the screen interval of the well to allow purging or low flow sampling for sample collection.

- **Task 11** (LHAAP-50 RA-O Reports) – PS explained that the Annual RA-O Report for LHAAP-50 comment responses are currently with the Army for review. The next groundwater sampling event is scheduled for May 2018.
- **Task 12** (LHAAP-58 ESD and RA-O Report) – KN discussed that the ESD was provided for Regulatory review. AP stated that she was awaiting signature. AP asked if KN had received her comments on the LHAAP-58 Year 3 RA-O Report. KN stated that she had not. AP indicated that she thought she had emailed stating that TCEQ did not have any further comments. KN and AP agreed to double-check emails regarding the LHAAP-58 Year 3 RA-O Report. Note: KN verified that email was received from AP on March 23, 2018 that accepted the responses to comments for the TCEQ,
  KN stated the Remedial Action Completion Report (RACR) for the injections was being prepared and that the RACR would only include the actual field implementation of the RAWP. KN stated that the June 2018 performance sampling would be presented in the next Annual RA-O Report.
- **Task 13** (LHAAP-67) – PS stated that the next sampling event is scheduled for May 2018.
- **Tasks 14 and 15** (Military Munitions Response Program [MMRP] Sites' RD) – KN explained that the land use notifications for the MMRP sites were being recorded with the county later that day. RMZ clarified that the RACR was not finalized to which KN concurred. The Final RACR will include the recordation. RMZ stated that an Environmental Condition of Property (ECP) is being prepared and then reviewed by legal for the MMRP sites and two other sites.
- **Task 16 (GWTP) -** KN explained that the 4th Quarter Report 2017 for the GWTP is under Army review and the 1st Quarter 2018 Report is being prepared. RM asked if KN had received his comments on the 3rd Quarter Report 2017. KN stated that she did not remember seeing them. AW stated that he would look for the comments.
- **Administrative Record (AR) -** SW discussed that the AR was close to being ready to post as it was in the final review. AP asked if after this initial update if the AR was going to be updated quarterly to which SW concurred that it would. AP discussed file sizes in the AR and the difficulty downloading the files. RM stated that he would determine if Level 4 data packages are required. RMZ stated that font size appears to be the issue and that "nice" fonts are not necessary. KN explained that hidden information gets added the more a document is used as a template so you need to do a document inspection and clear that out before creating the Adobe file. AP asked that letters not include a hyperlink to RMZ's email. SW stated that she will review file sizes prior to finalizing this AR upload.

Discharge SOP Discussion

KN presented a request to minimize the data collected prior to discharging to Harrison Bayou based upon the low flow discharged from the GWTP and/or INF Pond. KN explained that a conservative creek level on the staff would be marked and a camera installed to be able to verify flow and acceptability of the continuing discharge. KN explained how the system works day-by-day. The group discussed that the system operates more as a batch system than a continuous flow system. RMZ stated that a graph would be helpful, and KB suggested a stage discharge relationship graph. MS stated that safety is a reason for implementing this optimization due to individuals going out alone in an area with spotty cell service over the weekends. MS also explained that the equilibriums tank held enough water to allow the treatment plan to run for two to three days with the water pumped into the tank based upon the maximum discharge of 50,000 gallons per day.

Field Work in April and May 2018

- PS stated that groundwater sampling was planned for LHAAP-37, LHAAP-50 and LHAAP-67 in May.
- PS stated that Bhate/APTIM cleared brush at LHAAP-16 during April 2-13 and mobilization for monitoring well installation occurred on April 16. Field work is expected to continue through the rest of April. RMZ noted that Bhate was unable to access the locations for two new wells (i.e. 16WW57 and 16WW58) across Harrison Bayou from Site 16 due to wet conditions. She discussed the meeting earlier with United States Fish and Wildlife Service (USFWS) regarding access issues and concerns for the two monitoring wells. Erik Duerkop, with USFWS, pointed out that the area is inside the Ramsar wetland. RMZ stated that it is important to have the wells installed and samples collected prior to the injections. AW/RS stated that it is important to have the data from the two wells prior to injections so it can be established if any contamination detected in these wells across Harrison Bayou was present prior to injections or was caused by injections pushing contamination out. RMZ stated that damage to this area needs to be minimized. Therefore, the wells will now be installed in the summer when the area dries up, as requested by Bhate. The injections will be completed after the wells are installed and baseline samples are collected. PS/BF stated that the remaining wells were currently being installed and would continue to be installed for the next couple of weeks. AP asked the status of the Underground Injection Control (UIC) information. SW stated that the UIC was under Army review and should be released early the following week. AP stated that it was not a rush due to the delay in the remedy and was asking for informational purposes.
- RM requested that an email be provided once actual dates are identified for field work in the future.

Review Validated Data –

KN provided the validated data package and discussed the baseline groundwater results for Site LHAAP-58 Western Plume. KN pointed out that naturally occurring Dehalococcoides (DHC) and Dehalobacter (DHB) were present in some portion of the aquifer which is a good sign for the treatment. KN also stated that the goal of defining the downgradient extent of the western plume appears to have been accomplished based upon the results.

Schedule Next Managers' Meeting

The May 2018 MMM will be held on May 17, 2018 via conference call at 10:00 AM CDT.

Adjourned at 12:10 PM CDT.

ACRONYM LIST

AEC	United States Army Environmental Command
AM	Andrew Maly
AP	April Palmie
AR	Administrative Record
AW	Aaron Williams
BF	William (Bill) Foss
Bhate	Bhate Environmental Associates, Inc.
BRAC	Base Realignment and Closure

CD	Compact disc
CDT	Central Daylight Time
DERP	Defense Environmental Restoration Program
DHB	Dehalobacter
DHC	Dehalococcoides
ECP	Environmental Condition of Property
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FBR	Fluidized bed reactor
FYR	Five Year Review
GWTP	Ground Water Treatment Plant
IWWP	Installation Wide Work Plan
KB	Kent Becher
KN	Kim Nemmers
LHAAP	Longhorn Army Ammunition Plant
MMM	Monthly Managers' Meeting
MMRP	Military Munitions Response Program
MS	Mark Stapleton
PB	Paul Bruckwicki
PBR	Performance-Based Remediation
PDI	Pre-Design Investigation
PS	Praveen Srivastav
RAB	Restoration Advisory Board
RACR	Remedial Action Completion Report
RA-O	remedial action – operation
RAWP	Remedial Action Work Plan
RD	Remedial Design
ROD	Record of Decision
RM	Rich Mayer
RMZ	Rose M. Zeiler
RS	Rick Smith
SOP	Standard Operating Procedure
SW	Susan Watson
TCEQ	Texas Commission on Environmental Quality
UIC	Underground Injection Control
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

LHAAP Validated Data Packages for April 2018 Monthly Manager's Meeting

LHAAP Site	Sampling Event and Analytical Method
LHAAP-46	*Year 4, February 2018 RA(O) Groundwater Sampling* VOC (8260)
LHAAP-50	*February 2018 Surface Water Sampling* Perchlorate (6850)
LHAAP-58	*Baseline Event Sampling – March 2018* Alkalinity (310.2/SM2320B) Phosphorus (365.4) Anions (9056) Metals (6020A) VOC (8260C) Total Organic Carbon (415.1) Metabolic Acids (HPLC-METACIDS) Dechlorinating Bacteria Dissolved Gases (RSK-175) Ferrous Iron (SM3500FE) Sulfide (376.1)
GWTP Effluent	*Weekly Perchlorate Sampling – February 2018* Perchlorate (6850)
GWTP Effluent	*Weekly, Bi-Weekly, and Monthly Sampling – February 2018* Ammonia (350.3) Ortho-Phosphate (365.3) Organic Carbon (415.1) VOC (8260C) Metals (6020A) Hexavalent Chromium (7196A) 1,4-Dioxane (8270D-SIM) Anions (9056)
GWTP Influent	*Monthly Sampling – February 2018* Metals (6020A) Perchlorate (6850) Hexavalent Chromium (7196A)
GWTP Quarterly	*Influent and Effluent – February 2018* Oil and Grease (1664A) Perchlorate (6850) Metals (6020A) 1,4-Dioxane (8270D-SIM) Chemical Oxygen Demand (410.4) VOC (8260C) Anions (9056)

LHAAP Validated Data Packages for April 2018 Monthly Manager's Meeting

LHAAP Site	Sampling Event and Analytical Method
LHAAP Surface Water	*Quarterly Perchlorate Sampling - March 2018* Perchlorate (6850)
GWTP Air	*Quarterly Air Sampling - March 2018* Volatiles (TO-15)
GWTP Effluent	*Weekly Perchlorate Sampling – March 2018* Perchlorate (6850)
GWTP Effluent	*Weekly, Bi-Weekly, and Monthly Sampling – March 2018* Ammonia (350.3) Ortho-Phosphate (365.3) Organic Carbon (415.1) VOC (8260C) Metals (6020A) Hexavalent Chromium (7196A) 1,4-Dioxane (8270D-SIM) Anions (9056)
GWTP Influent	*Monthly Sampling – March 2018* Metals (6020A) Perchlorate (6850) Hexavalent Chromium (7196A)
INF Pond	*March 2018* Perchlorate (6850)

LHAAP-46 Year 4, February 2018 RA(O) Groundwater Sampling

		Location Code	46WW02		46WW03		46WW05				46WW06		46WW07	
		Sample ID	46WW02-022018		46WW03-022618		46WW05-022618		46WW05-022618-FD		46WW06-022618		46WW07-022318	
		Sample Date	2/20/2018		2/26/2018		2/26/2018		2/26/2018		2/26/2018		2/23/2018	
		Location Description:	Site 46 - Central, inside site boundary. Intermediate Zone.		Site 46 - Central, inside site boundary.		Site 46 - N, inside site boundary. Intermediate Zone.		Site 46 - N, inside site boundary. Intermediate Zone.		Site 46 - W, inside site boundary. Intermediate Zone.		Site 46 - N, inside site boundary. Intermediate Zone.	
Parameter	Units	2017 RES-GW MCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Volatiles														
1,1-Dichloroethene	µg/L	7	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70	0.52	J	< 0.5	U	< 0.5	U	0.62	J	< 0.5	U	< 0.5	U
Trichloroethene	µg/L	5	21		< 0.5	U	14		14		< 0.5	U	< 0.5	U
Vinyl chloride	µg/L	2	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue Highlighting Indicates concentrations above the MCL

J - Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected: The analyte was analyzed for, but not detected.

MCL - Maximum Contaminant Limit

ug/L - micrograms per liter

LHAAP-46 Year 4, February 2018 RA(O) Groundwater Sampling

		Location Code	46WW08				46WW09		46WW11		46WW16		LHSMW19		LHSMW25	
		Sample ID	46WW08-022318		46WW08-022318-FD		46WW09-022218		46WW11-022018		46WW16-022218		LHSMW19-022018		LHSMW25-022218	
		Sample Date	2/23/2018		2/23/2018		2/22/2018		2/20/2018		2/22/2018		2/20/2018		2/22/2018	
		Location Description:	Site 46 - NNW, inside site boundary. Intermediate Zone.		Site 46 - NNW, inside site boundary. Intermediate Zone.		Site 46 - Central, within site boundary. Intermediate Zone.		Site 46 - Central, within site boundary.		Site 46 - N, within site boundary. Intermediate Zone.		Site 46 - Central, within site boundary.		Site 46 - E, within site boundary. Intermediate zone.	
Parameter	Units	2017 RES-GW MCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Volatiles																
1,1-Dichloroethene	µg/L	7	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Trichloroethene	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	18		< 0.5	U	2.4		< 0.5	U
Vinyl chloride	µg/L	2	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue Highlighting Indicates concentrations above the MCL

J - Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected: The analyte was analyzed for, but not detected.

MCL - Maximum Contaminant Limit

ug/L - micrograms per liter

LHAAP-50 February 2018 Surface Water Sampling

		Location Code	GPW-1		GPW-1A	
		Sample ID	GPW1-022118		GPW1A-022118	
		Sample Date	2/21/2018		2/21/2018	
		Location Description:	Goose Prairie Creek - Grab Sample, Collected Off a Bridge On the North Side of LHAAP-50		Goose Prairie Creek - Grab Sample, Collected North of Culvert at NW Intersection of Crockett Avenue and 51st	
Parameter	Units	2017 RES-GW PCL	Result	Val Qual	Result	Val Qual
PERCHLORATE	µg/L	17	1.2	J	6.3	

Notes:

Blue Highlighting Indicates concentrations above the PCL

J - Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

PCL - Texas Risk Reduction Program (TRRP) Tier 1 Residential Groundwater Protective Concentration Level

ug/L - micrograms per liter

LHAAP-58 Remedial Action Operation Validated Data - March 2018

Location ID: Sample Date:	Units	MCL/MSC	35AWW06_030818 3/8/18	35AWW06_030818_a 3/8/18	35AWW11-030718 3/7/18	35AWW19_030818 3/8/18	35AWW20-030718 3/7/18	35AWW23_030818 3/8/18	35AWW24_030818 3/8/18	LHSMW07-030718 3/7/18
Location Description			Site 58 - SW, outside the site boundary.	Site 58 - SW, outside the site boundary. Duplicate	Site 58 - SE, inside site boundary.	Site 58 - SSW, outside site boundary.	Site 58 - SW, inside site boundary, between Building 716 and 113.	Site 58 -Shallow, New Wells South of Avenue G in center of Western Plume	Site 58 -Shallow, Downgradient Western Plume well	Site 58 - SW, outside site boundary.
Alkalinity (310.2/SM2320B)										
Alkalinity, Total	mg/L	NV	**666**	**663**	**446**	**159**	**848**	**608**	**66.5**	**757**
Phosphorus (365.3)										
Phosphorus	mg/L	NV	< 0.0500 U	< 0.0500 U	< 0.0250 U	**0.129**	< 0.0250 U	**0.153**	**0.0240 J**	< 0.0250 U
Total Organic Carbon (415.1)										
Total Organic Carbon	mg/L	NV	**1.89**	**2.32**	**5.28**	**2.51**	**14.5**	**3.31**	**1.45**	**6.67**
Metals (6020A)										
Total Iron	mg/L	NV	**0.249**	**0.196 J**	**0.445**	**1.52**	**0.660**	**0.619**	**0.475**	**0.417**
Total Manganese	mg/L	14	**0.236 J**	**0.226**	**0.383**	**0.546**	**1.34**	**0.502**	**0.369**	**0.119**
Dissolved Iron	mg/L	NV	**0.0954 J**	**0.0904 J**	**0.0143 J**	**0.304**	**0.463**	< 0.200 U	**0.0358 J**	**0.0325 J**
Dissolved Manganese	mg/L	14	**0.194**	**0.187**	**0.393**	**0.490**	**1.55**	**0.482**	**0.374**	**0.137**
Volatile Organic Compounds (8260C)										
1,1,1,2-Tetrachloroethane	µg/L	110	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,1,1-Trichloroethane	µg/L	200	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,1,2,2-Tetrachloroethane	µg/L	14	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,1,2-Trichloroethane	µg/L	5	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**64**	< 1.0 U	< 1.0 U	**3.6**
1,1-Dichloroethane	µg/L	10000	< 1.0 U	< 1.0	< 1.0 U	< 1.0 U	310	8.1	< 1.0 U	**51**
1,1-Dichloroethene	µg/L	7	**2.6**	**2.6**	**10**	**9.0**	**2300**	**13**	< 1.0 U	**370**
1,1-Dichloropropene	µg/L	2.9	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2,3-Trichlorobenzene	µg/L	310	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2,3-Trichloropropane	µg/L	0.0041	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2,4-Trichlorobenzene	µg/L	70	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2,4-Trimethylbenzene	µg/L	5100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2-Dibromo-3-chloropropane	µg/L	0.2	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2-Dibromoethane	µg/L	0.05	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2-Dichlorobenzene	µg/L	600	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 UJ	9.9	< 1.0 U	< 1.0 U	< 1.0 U
1,2-Dichloroethane	µg/L	5	< 1.0 U	< 1.0 U	< 1.0 U	**1.9**	**14**	< 1.0 U	< 1.0 U	**2.0**
1,2-Dichloropropane	µg/L	5	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,3,5-Trimethylbenzene	µg/L	5100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,3-Dichlorobenzene	µg/L	3100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 UJ	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,3-Dichloropropane	µg/L	29	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 UJ	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,4-Dichlorobenzene	µg/L	75	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 UJ	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
2,2-Dichloropropane	µg/L	42	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
2-Butanone	µg/L	61000	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 10 U	< 2.0 U	< 2.0 U	< 2.0 U
2-Chlorotoluene	µg/L	2000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
2-Hexanone	µg/L	6100	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 10 U	< 2.0 U	< 2.0 U	< 2.0 U
4-Chlorotoluene	µg/L	2000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
4-Isopropyltoluene	µg/L	10000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
4-Methyl-2-pentanone	µg/L	8200	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 10 U	< 2.0 U	< 2.0 U	< 2.0 U
Acetone	µg/L	92000	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 10 U	< 2.0 U	< 2.0 U	< 2.0 U
Benzene	µg/L	5	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**5.2**	< 1.0 U	< 1.0 U	**0.63 J**

LHAAP-58 Remedial Action Operation Validated Data - March 2018

Location ID: / Sample Date:	Units	MCL/MSC	35AWW06_030818 3/8/18	35AWW06_030818_a 3/8/18	35AWW11-030718 3/7/18	35AWW19_030818 3/8/18	35AWW20-030718 3/7/18	35AWW23_030818 3/8/18	35AWW24_030818 3/8/18	LHSMW07-030718 3/7/18
Location Description			Site 58 - SW, outside the site boundary.	Site 58 - SW, outside the site boundary. Duplicate	Site 58 - SE, inside site boundary.	Site 58 - SSW, outside site boundary.	Site 58 - SW, inside site boundary, between Building 716 and 113.	Site 58 -Shallow, New Wells South of Avenue G in center of Western Plume	Site 58 -Shallow, Downgradient Western Plume well	Site 58 - SW, outside site boundary.
Bromobenzene	µg/L	2000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 UJ	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Bromochloromethane	µg/L	4100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Bromodichloromethane	µg/L	4.6	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Bromoform	µg/L	36	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Bromomethane	µg/L	140	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Carbon disulfide	µg/L	10000	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 10 U	< 2.0 U	< 2.0 U	< 2.0 U
Carbon tetrachloride	µg/L	5	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Chlorobenzene	µg/L	100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Chloroethane	µg/L	41000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Chloroform	µg/L	1000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Chloromethane	µg/L	220	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
cis-1,2-Dichloroethene	µg/L	70	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**76**	**21**	< 1.0 U	**11**
cis-1,3-Dichloropropene	µg/L	5.3	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Dibromochloromethane	µg/L	34	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Dibromomethane	µg/L	380	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Dichlorodifluoromethane	µg/L	20000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Ethylbenzene	µg/L	700	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Hexachlorobutadiene	µg/L	20	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Isopropylbenzene	µg/L	1000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
m,p-Xylene	µg/L	10000	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 10 U	< 2.0 U	< 2.0 U	< 2.0 U
Methylene chloride	µg/L	5	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 UJ	< 10 U	< 2.0 U	< 2.0 U	< 2.0 U
Naphthalene	µg/L	2000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
n-Butylbenzene	µg/L	4100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
n-Propylbenzene	µg/L	4100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
o-Xylene	µg/L	10000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
sec-Butylbenzene	µg/L	4100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Styrene	µg/L	100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
tert-Butylbenzene	µg/L	4100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Tetrachloroethene	µg/L	5	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Toluene	µg/L	1000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 UJ	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
trans-1,2-Dichloroethene	µg/L	100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
trans-1,3-Dichloropropene	µg/L	29	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Trichloroethene	µg/L	5	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**330**	**27**	< 1.0 U	**34**
Trichlorofluoromethane	µg/L	31000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Vinyl chloride		2	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**110**	**3.1**	< 1.0 U	**5.0**
Metabolic Acids (HPLC-METACIDS)										
Acetic Acid	mg/L	NV	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U
Butyric Acid	mg/L	NV	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Lactic Acid	mg/L	NV	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Propionic Acid	mg/L	51	< 1.0 UJ	< 1.0 UJ	< 1.0 UJ	< 1.0 UJ	< 1.0 UJ	< 1.0 UJ	< 1.0 UJ	< 1.0 UJ
Pyruvic Acid	mg/L	NV	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U	< 0.10 U

LHAAP-58 Remedial Action Operation Validated Data - March 2018

Location ID: Sample Date:	Units	MCL/MSC	35AWW06_030818 3/8/18	35AWW06_030818_a 3/8/18	35AWW11-030718 3/7/18	35AWW19_030818 3/8/18	35AWW20-030718 3/7/18	35AWW23_030818 3/8/18	35AWW24_030818 3/8/18	LHSMW07-030718 3/7/18
Location Description			Site 58 - SW, outside the site boundary.	Site 58 - SW, outside the site boundary. Duplicate	Site 58 - SE, inside site boundary.	Site 58 - SSW, outside site boundary.	Site 58 - SW, inside site boundary, between Building 716 and 113.	Site 58 -Shallow, New Wells South of Avenue G in center of Western Plume	Site 58 -Shallow, Downgradient Western Plume well	Site 58 - SW, outside site boundary.
Anions (9056A)										
Chloride	mg/L	NV	**1000**	**957**	**2,530**	**1430**	**1,510**	**487**	**119**	**2,420**
Nitrate	mg/L	10	< 0.100 U	< 0.100 U	< 0.0500 U	< 0.100 U	< 0.0500 U	**1.20**	**0.110**	< 0.0500 U
Nitrite	mg/L	1	**4.12**	**3.56**	**14.6**	**5.58**	**6.90**	**2.29**	**0.213**	**11.7**
Sulfate	mg/L	NV	**1480**	**1460**	**1,260**	**1220**	**1,840**	**761**	**85.7**	**2,700**
Dissolved Gases (RSK-175)										
Carbon Dioxide	µg/L	NV	**500,000 J**	**310,000 J**	**360,000**	**97,000**	**370,000**	**500,000**	**290,000**	**350,000**
Ethane	µg/L	NV	< 0.60 U	< 0.60 U	< 0.47 U	< 0.60 U	< 0.47 U	< 0.60 U	< 0.60 U	< 0.47 U
Ethene	µg/L	NV	< 1.0 U	< 1.0 U	**0.38 J**	< 1.0 U	< 0.55 U	< 1.0 U	< 1.0 U	< 0.55 U
Methane	µg/L	NV	< 1.3 U	< 1.3 U	**16**	< 1.3 U	< 1.3 U	< 1.3 U	< 1.3 U	**3**
Ferrous Iron (SM3500Fe)										
Ferrous Iron	mg/L	NV	**0.08 J**	**0.12 J**	**0.10 J**	**1.10 J**	**0.69 J**	**0.13 J**	**0.33 J**	**0.07 J**
Sulfide (376.1)										
Sulfide	mg/L	NV	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Dechlorinating Bacteria										
BAV1 Vinyl Chloride Reductase	cells/mL	NV	< 0.5 U	< 0.5 U	< 0.5 U	< 1.2 U	< 0.5 U	< 0.5 U	< 2.0 U	< 0.5 U
Dehalobacter spp.	cells/mL	NV	**291**	**218**	< 5.0 U	< 11.9 U	**1120**	< 4.8 U	**79.9**	< 4.8 U
Dehalococoides	cells/mL	NV	**1.4**	**1.5**	**0.6**	**0.4 J**	**5.5**	< 0.5 U	< 2.0 U	**11.8**
tceA Reductase	cells/mL	NV	**0.1 J**	< 0.5 U	< 0.5 U	< 1.2 U	< 0.5 U	< 0.5 U	< 2.0 U	< 0.5 U
Vinyl Chloride Reductase	cells/mL	NV	< 0.5 U	< 0.5 U	< 0.5 U	< 1.2 U	< 0.5 U	< 0.5 U	< 2.0 U	< 0.5 U

Blue Highlighting Indicates concentrations above the MCL/MSC

MCL/MSC - Maximum Contaminant Limit/Medium-Specific Concentrations

NA - Not Analyzed

µg/L - micrograms per liter

mg/L - milligrams per liter

J - Estimated: Between the method detection limit and reporting limit and/or due to discrepancies in meeting certain analyte-specific quality control criteria.

UJ - The analyte was not detected; however, the result is estimated due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected: The analyte was analyzed for, but not detected.

NV - No Value

00881427

GWTP Weekly/Effluent Perchlorate Sampling - February 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_020718 2/7/18	LH18/24-SP650-021418 2/14/18	LH18/24-SP650-021418 2/14/18	LH18/24-SP650_022118_BIX 2/21/18	LH18/24-SP650_022118_AIX 2/21/18	LH18/24-SP650-022818 2/28/18	LH18/24-SP650-022818 2/28/18
Location Description			**Collected after ion exchange vessels**			**Collected from a spigot on the discharge of effluent TK-650.**	**Collected after ion exchange vessels**	**Collected from a spigot on the discharge of effluent TK-650.**	
			Weekly	Monthly EFF	Weekly	Weekly	Weekly	Weekly	Quarterly Eff
Perchlorate (6850)									
Perchlorate	µg/L	589	< 4.0 UJ	< 4.0 U	< 4.0 U	**81**	< 4.0 U	**73**	71

µg/L - micrograms per liter

U- Undetected: The analyte was analyzed for, but not detected.

UJ - estimated non detected due to QC discrepancies

GWTP Weekly Sampling - February 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_020718 2/7/18	LH18/24-SP650-021418 2/14/18	LH18/24-SP650_022118 2/21/18	LH18/24-SP650-022818 2/28/18
Location Description			**GWTP–Collected from a spigot on the discharge of effluent TK-650. Sampled Weekly.**			
Ammonia as N (350.3)						
Ammonia as N	mg/L	NV	**8.4**	**10**	**11**	**12**
Ortho-Phosphate (365.3)						
Ortho-Phosphate	mg/L	NV	**3.02**	**2.83**	**2.12**	**3.16**
Organic Carbon (415.1)						
Total Organic Carbon (TOC)	mg/L	NV	**24.4**	**23.3**	**28.2**	**31.2**

mg/L - milligrams per liter

NV - No Value

GWTP Bi-Weekly Sampling - February 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_020718 2/7/18	LH18/24-SP650_022118 2/21/18
Location Description			GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Biweekly.	
Volatile Organic Compounds (8260C)				
1,1,1-Trichloroethane	µg/L	7,230	< 1.0 U	< 1.0 U
1,1,2-Trichloroethane	µg/L	216.9	< 1.0 U	< 1.0 U
1,1-Dichloroethane	µg/L	14,032	< 1.0 U	< 1.0 U
1,1-Dichloroethene	µg/L	253	< 1.0 U	< 1.0 U
1,2-Dichloroethane	µg/L	181	< 1.0 U	< 1.0 U
1,2-Dichloropropane	µg/L	5	< 1.0 U	< 1.0 U
Acetone	µg/L	2,395	< 2.0 U	< 2.0 U
Benzene	µg/L	181	< 1.0 U	< 1.0 U
Carbon tetrachloride	µg/L	181	< 1.0 U	< 1.0 U
Chlorobenzene	µg/L	47,180	< 1.0 U	< 1.0 U
Chloroform	µg/L	3,615	< 1.0 U	< 1.0 U
Ethylbenzene	µg/L	57,025	< 1.0 U	< 1.0 U
m,p-Xylene	µg/L	83.6	< 2.0 U	< 2.0 U
Methylene chloride	µg/L	1,699	< 2.0 U	< 2.0 U
o-Xylene	µg/L	83.6	< 1.0 U	< 1.0 U
Styrene	µg/L	5,987	< 1.0 U	< 1.0 U
Tetrachloroethene	µg/L	180.7	< 1.0 U	< 1.0 U
Toluene	µg/L	4,189	< 1.0 U	< 1.0 U
Trichloroethene	µg/L	181	< 1.0 U	< 1.0 U
Vinyl chloride	µg/L	72	< 1.0 U	< 1.0 U
Anions (9056)				
Chloride	mg/L	NV	**603**	**582**
Sulfate	mg/L	NV	**83.3**	**55.9**

µg/L - micrograms per liter

mg/L - milligrams per liter

U- Undetected: The analyte was analyzed for, but not detected.

NV - No Value

GWTP Monthly Effluent Sampling - February 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650-021418 2/14/18
Location Description			**GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Quarterly.**
Volatile Organic Compounds (8260C)			
1,1,1-Trichloroethane	µg/L	7,230	< 1.0 U
1,1,2-Trichloroethane	µg/L	216.9	< 1.0 U
1,1-Dichloroethane	µg/L	14,032	< 1.0 U
1,1-Dichloroethene	µg/L	253	< 1.0 U
1,2-Dichloroethane	µg/L	181	< 1.0 U
1,2-Dichloropropane	µg/L	5	< 1.0 U
Acetone	µg/L	2,395	< 2.0 U
Benzene	µg/L	181	< 1.0 U
Carbon tetrachloride	µg/L	181	< 1.0 U
Chlorobenzene	µg/L	47,180	< 1.0 U
Chloroform	µg/L	3,615	< 1.0 U
Ethylbenzene	µg/L	57,025	< 1.0 U
m,p-Xylene	µg/L	83.6	< 2.0 U
Methylene chloride	µg/L	1,699	< 2.0 U
o-Xylene	µg/L	83.6	< 1.0 U
Styrene	µg/L	5,987	< 1.0 U
Tetrachloroethene	µg/L	180.7	< 1.0 U
Toluene	µg/L	4,189	< 1.0 U
Trichloroethene	µg/L	181	< 1.0 U
Vinyl chloride	µg/L	72	< 1.0 U
Metals (6020A)			
Barium	mg/L	2	**0.205**
Lead	mg/L	0.0046	< 0.00200 U
Selenium	mg/L	0.012	< 0.00200 U
Silver	mg/L	0.003	< 0.00200 U
Hexavalent Chromium (7196A)			
Hexavalent Chromium	mg/L	0.1244	< 0.0100 U
Semi-Volatile Organic Compounds (8270D SIM)			
1,4-Dioxane	µg/L	134.2	**5.3**

µg/L - micrograms per liter

mg/L - milligrams per liter

U- Undetected: The analyte was analyzed for, but not detected.

GWTP Monthly Influent Sampling - February 2018

Location ID: Sample Date:	Units	LH18/24-SP140_021418 2/14/18
Location Description		**GWTP – Collected from a spigot on the influent to TK-140. Sampled Monthly.**
Metals (6020A)		
Selenium	mg/L	**0.00130 J**
Silver	mg/L	< 0.00200 U
Hexavalent Chromium (7196A)		
Hexavalent Chromium	mg/L	< 0.0100 U
Perchlorate (6850)		
Perchlorate	µg/L	**16,000**

mg/L - milligrams per liter

µg/L - micrograms per liter

U- Undetected: The analyte was analyzed for, but not detected.

J - estimated value between the limit of quantitation and the detection limit

GWTP Quarterly Effluent Sampling - February 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_022818 2/28/18
Location Description			**GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Quarterly.**
Oil and Grease (1664A)			
Oil & Grease	mg/L	15	**3.54**
Chemical Oxygen Demand (410.4)			
Chemical Oxygen Demand	mg/L	200	**86**
Volatile Organic Compounds (8260C)			
1,1,1-Trichloroethane	µg/L	7,230	< 1.0 U
1,1,2-Trichloroethane	µg/L	216.9	< 1.0 U
1,1-Dichloroethane	µg/L	14,032	< 1.0 U
1,1-Dichloroethene	µg/L	253	< 1.0 U
1,2-Dichloroethane	µg/L	181	**0.76 J**
1,2-Dichloropropane	µg/L	5	< 1.0 U
Acetone	µg/L	2,395	< 2.0 U
Benzene	µg/L	181	< 1.0 U
Carbon tetrachloride	µg/L	181	< 1.0 U
Chlorobenzene	µg/L	47,180	< 1.0 U
Chloroform	µg/L	3,615	< 1.0 U
Ethylbenzene	µg/L	57,025	< 1.0 U
m,p-Xylene	µg/L	83.6	< 2.0 U
Methylene chloride	µg/L	1,699	< 2.0 U
o-Xylene	µg/L	83.6	< 1.0 U
Styrene	µg/L	5,987	< 1.0 U
Tetrachloroethene	µg/L	180.7	< 1.0 U
Toluene	µg/L	4,189	< 1.0 U
Trichloroethene	µg/L	181	**2.4**
Vinyl chloride		72	< 1.0 U
Metals (6020A)			
Aluminum	mg/L	1.644	0.0108 UB
Antimony	mg/L	NV	**0.000532 J**
Arsenic	mg/L	0.722	**0.000931 J**
Barium	mg/L	2	**0.155**
Beryllium	mg/L	NV	< 0.00200 U
Cadmium	mg/L	0.0034	< 0.00200 U
Calcium	mg/L	NV	**15.3**
Chromium	mg/L	0.752	**0.00669**
Cobalt	mg/L	11.495	**0.00266 J**
Iron	mg/L	2.395	**0.140 J**
Lead	mg/L	0.0046	< 0.00200 U

GWTP Quarterly Effluent Sampling - February 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_022818 2/28/18
Location Description			GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Quarterly.
Magnesium	mg/L	NV	**28.3**
Manganese	mg/L	15.494	**0.0579**
Nickel	mg/L	0.184	**0.0121**
Potassium	mg/L	NV	**1.93**
Selenium	mg/L	0.012	**0.00149 J**
Silver	mg/L	0.003	< 0.00200 U
Sodium	mg/L	NV	**483**
Thallium	mg/L	NV	< 0.00200 U
Vanadium	mg/L	3.592	< 0.00500 U
Zinc	mg/L	0.31	**0.0357**
Mercury	mg/L	NV	< 0.000200 U
Anions (9056)			
Chloride	mg/L	NV	**531**
Sulfate	mg/L	NV	**182**
Semi-Volatile Organic Compounds (8270D SIM)			
1,4-Dioxane	µg/L	134.2	**13**

µg/L - micrograms per liter

mg/L - milligrams per liter

J - estimated value between the limit of quantitation and the detection limit

UB - considered non-detect due to blank contamination

NV - No Value

U- Undetected: The analyte was analyzed for, but not detected.

GWTP Quarterly Influent Sampling - February 2018

Location ID: Sample Date:	Units	LH18/24-SP140_022818 2/28/18
Location Description		GWTP – Collected from a spigot on the influent to TK-140. Sampled Quarterly.
Oil and Grease (1664A)		
Oil & Grease	mg/L	< 2.00 U
Chemical Oxygen Demand (410.4)		
Chemical Oxygen Demand	mg/L	**24.0**
Perchlorate (6850)		
Perchlorate	µg/L	**5,400**
Volatile Organic Compounds (8260C)		
1,1,1,2-Tetrachloroethane	µg/L	< 10 U
1,1,1-Trichloroethane	µg/L	< 10 U
1,1,2,2-Tetrachloroethane	µg/L	< 10 U
1,1,2-Trichloroethane	µg/L	< 10 U
1,1-Dichloroethane	µg/L	< 10 U
1,1-Dichloroethene	µg/L	< 10 U
1,1-Dichloropropene	µg/L	< 10 U
1,2,3-Trichlorobenzene	µg/L	< 10 U
1,2,3-Trichloropropane	µg/L	< 10 U
1,2,4-Trichlorobenzene	µg/L	< 10 U
1,2,4-Trimethylbenzene	µg/L	< 10 U
1,2-Dibromo-3-chloropropane	µg/L	< 10 U
1,2-Dibromoethane	µg/L	< 10 U
1,2-Dichlorobenzene	µg/L	< 10 U
1,2-Dichloroethane	µg/L	**32**
1,2-Dichloropropane	µg/L	< 10 U
1,3,5-Trimethylbenzene	µg/L	< 10 U
1,3-Dichlorobenzene	µg/L	< 10 U
1,3-Dichloropropane	µg/L	< 10 U
1,4-Dichlorobenzene	µg/L	< 10 U
2,2-Dichloropropane	µg/L	< 10 U
2-Butanone	µg/L	< 20 U
2-Chlorotoluene	µg/L	< 10 U
2-Hexanone	µg/L	< 20 U
4-Chlorotoluene	µg/L	< 10 U
4-Isopropyltoluene	µg/L	< 10 U
4-Methyl-2-pentanone	µg/L	< 20 U
Acetone	µg/L	< 20 U
Benzene	µg/L	< 10 U
Bromobenzene	µg/L	< 10 U
Bromochloromethane	µg/L	< 10 U
Bromodichloromethane	µg/L	< 10 U

GWTP Quarterly Influent Sampling - February 2018

Location ID: Sample Date:	Units	LH18/24-SP140_022818 2/28/18
Location Description		**GWTP – Collected from a spigot on the influent to TK-140. Sampled Quarterly.**
Bromoform	µg/L	< 10 U
Bromomethane	µg/L	< 10 U
Carbon disulfide	µg/L	< 20 U
Carbon tetrachloride	µg/L	< 10 U
Chlorobenzene	µg/L	< 10 U
Chloroethane	µg/L	< 10 U
Chloroform	µg/L	< 10 U
Chloromethane	µg/L	< 10 U
cis-1,2-Dichloroethene	µg/L	**3,600**
cis-1,3-Dichloropropene	µg/L	< 10 U
Dibromochloromethane	µg/L	< 10 U
Dibromomethane	µg/L	< 10 U
Dichlorodifluoromethane	µg/L	< 10 U
Ethylbenzene	µg/L	< 10 U
Hexachlorobutadiene	µg/L	< 10 U
Isopropylbenzene	µg/L	< 10 U
m,p-Xylene	µg/L	< 20 U
Methylene chloride	µg/L	**27**
Naphthalene	µg/L	< 10 U
n-Butylbenzene	µg/L	< 10 U
n-Propylbenzene	µg/L	< 10 U
o-Xylene	µg/L	< 10 U
sec-Butylbenzene	µg/L	< 10 U
Styrene	µg/L	< 10 U
tert-Butylbenzene	µg/L	< 10 U
Tetrachloroethene	µg/L	< 10 U
Toluene	µg/L	< 10 U
trans-1,2-Dichloroethene	µg/L	< 10 U
trans-1,3-Dichloropropene	µg/L	< 10 U
Trichloroethene	µg/L	**7,200**
Trichlorofluoromethane	µg/L	< 10 U
Vinyl chloride	µg/L	**51**
Metals (6020A)		
Aluminum	mg/L	**0.0417**
Antimony	mg/L	< 0.00200 U
Arsenic	mg/L	**0.000956 J**
Barium	mg/L	**0.104**
Beryllium	mg/L	< 0.00200 U
Cadmium	mg/L	< 0.00200 U

GWTP Quarterly Influent Sampling - February 2018

Location ID: Sample Date:	Units	LH18/24-SP140_022818 2/28/18
Location Description		**GWTP – Collected from a spigot on the influent to TK-140. Sampled Quarterly.**
Calcium	mg/L	**140**
Chromium	mg/L	**0.00189 J**
Cobalt	mg/L	**0.00502**
Iron	mg/L	**0.479**
Lead	mg/L	**0.000854 J**
Magnesium	mg/L	**106**
Manganese	mg/L	**0.199**
Nickel	mg/L	**0.00727**
Potassium	mg/L	**1.64**
Selenium	mg/L	**0.00283**
Silver	mg/L	< 0.00200 U
Sodium	mg/L	**720**
Thallium	mg/L	< 0.00200 U
Vanadium	mg/L	< 0.00500 U
Zinc	mg/L	**0.0503**
Mercury	mg/L	< 0.000200 U
Anions (9056)		
Chloride	mg/L	**790**
Sulfate	mg/L	**1,260**
Semi-Volatile Organic Compounds (8270D SIM)		
1,4-Dioxane	µg/L	**7.1**

µg/L - micrograms per liter

mg/L - milligrams per liter

J - estimated value between the limit of quantitation and the detection limit

U- Undetected: The analyte was analyzed for, but not detected.

LHAAP-Quarterly Surface Water Sampling - March 2018

Location ID: Sample Date:	Units	PCL	HBW7_030618 3/6/18	HBW7_030618_a 3/6/18 Duplicate	HBW10_030618 3/6/18	HBW1_030618 3/6/18	GPW1_030618 3/6/18	GPW3_030618 3/6/18
Perchlorate (6850)			Harrison Bayou				Goose Prairie Creek	
Perchlorate	µg/L	17	< 4.0 U	< 4.0 U	< 4.0 U	< 4.0 U	< 4.0 U	< 4.0 U

PCL – Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level

µg/L - micrograms per liter

U - Undetected: The analyte was analyzed for, but not detected.

GWTP Air Sampling - March 2018

Location ID: Sample Date:	Units	LH18/24-AIR_030518_GWTP 3/5/18	LH18/24-AIR_030518_Stripper 3/5/18	LH18/24-AIR_030518_Stripper-Dup 3/5/18	LH18/24-AIR_030518_Downwind_North 3/5/18
Volatile Organic Compounds (TO-15)					
1,1,1-Trichloroethane	UG/M3	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	UG/M3	ND	ND	ND	ND
1,1,2-Trichloroethane	UG/M3	ND	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	UG/M3	**3.1**	**8000**	**8200**	**16**
1,1-Dichloroethane	UG/M3	ND	ND	ND	ND
1,1-Dichloroethene	UG/M3	ND	**140**	**130**	ND
1,2,4-Trichlorobenzene	UG/M3	ND	ND	ND	ND
1,2,4-Trimethylbenzene	UG/M3	ND	ND	ND	ND
1,2-Dibromo 3-Chloropropane	UG/M3	ND	ND	ND	ND
1,2-Dibromoethane	UG/M3	ND	ND	ND	ND
1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	UG/M3	ND	ND	ND	ND
1,2-Dichlorobenzene	UG/M3	ND	ND	ND	ND
1,2-Dichloroethane	UG/M3	ND	**190**	**210**	ND
1,2-Dichloropropane	UG/M3	ND	ND	ND	ND
1,3,5-Trimethylbenzene	UG/M3	ND	ND	ND	ND
1,3-Butadiene	UG/M3	ND	ND	ND	ND
1,3-Dichlorobenzene	UG/M3	ND	ND	ND	ND
1,4-Dichlorobenzene	UG/M3	ND	ND	ND	ND
1,4-Dioxane	UG/M3	ND	ND	ND	ND
2-Butanone (MEK)	UG/M3	ND	ND	ND	ND
2-Hexanone	UG/M3	ND	ND	ND	ND
2-Propanol (Isopropyl Alcohol)	UG/M3	ND	ND	ND	ND
3-Chloro-1-propene (Allyl Chloride)	UG/M3	ND	ND	ND	ND
4-Ethyltoluene	UG/M3	ND	ND	ND	ND
4-Methyl-2-pentanone	UG/M3	ND	ND	ND	ND
Acetone	UG/M3	**33**	ND	ND	ND
Acetonitrile	UG/M3	**1.1**	ND	ND	ND
Acrolein	UG/M3	ND	ND	ND	ND
Acrylonitrile	UG/M3	ND	ND	ND	ND
alpha-Pinene	UG/M3	ND	ND	ND	**0.63**
Benzene	UG/M3	**1.1**	ND	ND	ND
Benzyl Chloride	UG/M3	ND	ND	ND	ND
Bromodichloromethane	UG/M3	ND	ND	ND	ND
Bromoform	UG/M3	ND	ND	ND	ND
Bromomethane	UG/M3	ND	ND	ND	ND
Carbon Disulfide	UG/M3	ND	ND	ND	ND
Carbon Tetrachloride	UG/M3	ND	ND	ND	ND
Chlorobenzene	UG/M3	ND	ND	ND	ND
Chloroethane	UG/M3	ND	ND	ND	ND
Chloroform	UG/M3	ND	ND	ND	ND
Chloromethane	UG/M3	ND	ND	ND	ND
cis-1,2-Dichloroethene	UG/M3	**0.77**	**9100**	**9500**	ND
cis-1,3-Dichloropropene	UG/M3	ND	ND	ND	ND
Cumene	UG/M3	ND	ND	ND	ND
Cyclohexane	UG/M3	ND	ND	ND	ND
Dibromochloromethane	UG/M3	ND	ND	ND	ND
Dichlorodifluoromethane (CFC 12)	UG/M3	**5.5**	ND	ND	**2.5**
Dichloromethane (Methylene Chloride)	UG/M3	ND	**910**	**920**	ND
d-Limonene	UG/M3	**2.7**	ND	ND	ND
Ethanol	UG/M3	**54**	ND	ND	**6.8**
Ethyl Acetate	UG/M3	**2.2**	ND	ND	**12**
Ethylbenzene	UG/M3	**ND**	ND	ND	ND
Hexachlorobutadiene	UG/M3	ND	ND	ND	ND
m,p-Xylenes	UG/M3	**1.9**	ND	ND	ND

GWTP Air Sampling - March 2018

Location ID: Sample Date:	Units	LH18/24-AIR_030518_GWTP 3/5/18	LH18/24-AIR_030518_Stripper 3/5/18	LH18/24-AIR_030518_Stripper-Dup 3/5/18	LH18/24-AIR_030518_Downwind_North 3/5/18
Volatile Organic Compounds (TO-15)					
Methyl Methacrylate	UG/M3	ND	ND	ND	ND
Methyl tert-Butyl Ether	UG/M3	ND	ND	ND	ND
Naphthalene	UG/M3	ND	ND	ND	ND
n-Butyl Acetate	UG/M3	ND	ND	ND	ND
n-Heptane	UG/M3	**0.92**	ND	ND	ND
n-Hexane	UG/M3	**2.2**	ND	ND	ND
n-Nonane	UG/M3	ND	ND	ND	ND
n-Octane	UG/M3	ND	ND	ND	ND
n-Propylbenzene	UG/M3	ND	ND	ND	ND
o-Xylene	UG/M3	ND	ND	ND	ND
Propene	UG/M3	**0.84**	ND	ND	ND
Styrene	UG/M3	ND	ND	ND	ND
Tetrachloroethene	UG/M3	ND	ND	ND	ND
Tetrahydrofuran (THF)	UG/M3	**5.7**	ND	ND	ND
Toluene	UG/M3	**4.3**	ND	ND	**0.9**
trans-1,2-Dichloroethene	UG/M3	ND	ND	ND	ND
trans-1,3-Dichloropropene	UG/M3	ND	ND	ND	ND
Trichloroethene	UG/M3	**2.8**	**26000 D**	**27000 D**	ND
Trichlorofluoromethane	UG/M3	**2.8**	ND	ND	**1.3**
Vinyl Acetate	UG/M3	ND	ND	ND	ND
Vinyl Chloride	UG/M3	ND	**110**	**110**	ND

D - dilution

UG/M3 - micrograms per cubic meter

ND - Non detect

GWTP Weekly/Effluent Perchlorate Sampling - March 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_030718 3/7/18	LH18/24-SP650_031418 3/14/18	LH18/24-SP650_031418 3/14/18	LH18/24-SP650_032118 3/21/18	LH18/24-SP650_032818 3/28/18
Location Description			Collected from a spigot on the discharge of effluent TK-650.			Collected before ion exchange vessels	Collected after ion exchange vessels
			Weekly	Weekly	Monthly EFF	Weekly	Weekly
Perchlorate (6850)							
Perchlorate	µg/L	589	57	130	130	500	< 4.0 U

µg/L - micrograms per liter

U- Undetected: The analyte was analyzed for, but not detected.

GWTP Weekly Sampling - March 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_030718 3/7/18	LH18/24-SP650_031418 3/14/18	LH18/24-SP650_032118 3/21/18	LH18/24-SP650_032818 3/28/18
Location Description			**GWTP–Collected from a spigot on the discharge of effluent TK-650. Sampled Weekly.**			
Ammonia as N (350.3)						
Ammonia as N	mg/L	NV	**10**	**16**	**14**	**14**
Ortho-Phosphate (365.3)						
Ortho-Phosphate	mg/L	NV	**3**	**2.37**	**3.5**	**1.79**
Organic Carbon (415.1)						
Total Organic Carbon (TOC)	mg/L	NV	**31.1**	**24.3**	**25.5**	**21.4**

mg/L - milligrams per liter

NV - No Value

GWTP Bi-Weekly Sampling - March 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_030718 3/7/18	LH18/24-SP650_032118 3/21/18
Location Description			GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Biweekly.	
Volatile Organic Compounds (8260C)				
1,1,1-Trichloroethane	µg/L	7,230	< 1.0 U	< 1.0 U
1,1,2-Trichloroethane	µg/L	216.9	< 1.0 U	< 1.0 U
1,1-Dichloroethane	µg/L	14,032	< 1.0 U	< 1.0 U
1,1-Dichloroethene	µg/L	253	< 1.0 U	< 1.0 U
1,2-Dichloroethane	µg/L	181	**0.72 J**	< 1.0 U
1,2-Dichloropropane	µg/L	5	< 1.0 U	< 1.0 U
Acetone	µg/L	2,395	< 2.0 U	< 2.0 U
Benzene	µg/L	181	< 1.0 U	< 1.0 U
Carbon tetrachloride	µg/L	181	< 1.0 U	< 1.0 U
Chlorobenzene	µg/L	47,180	< 1.0 U	< 1.0 U
Chloroform	µg/L	3,615	< 1.0 U	< 1.0 U
Ethylbenzene	µg/L	57,025	< 1.0 U	< 1.0 U
m,p-Xylene	µg/L	83.6	< 2.0 U	< 2.0 U
Methylene chloride	µg/L	1,699	< 2.0 U	< 2.0 U
o-Xylene	µg/L	83.6	< 1.0 U	< 1.0 U
Styrene	µg/L	5,987	< 1.0 U	< 1.0 U
Tetrachloroethene	µg/L	180.7	< 1.0 U	< 1.0 U
Toluene	µg/L	4,189	< 1.0 U	**0.81 J**
Trichloroethene	µg/L	181	**3.2**	**2.0**
Vinyl chloride	µg/L	72	< 1.0 U	< 1.0 U
Anions (9056)				
Chloride	mg/L	NV	**345**	**312**
Sulfate	mg/L	NV	**113**	**119**

µg/L - micrograms per liter

mg/L - milligrams per liter

U- Undetected: The analyte was analyzed for, but not detected.

NV - No Value

J - estimated value between the limit of quantitation and the detection limit

GWTP Monthly Effluent Sampling - March 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650-031418 3/14/18
Location Description			GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Quarterly.
Volatile Organic Compounds (8260C)			
1,1,1-Trichloroethane	µg/L	7,230	< 1.0 U
1,1,2-Trichloroethane	µg/L	216.9	< 1.0 U
1,1-Dichloroethane	µg/L	14,032	< 1.0 U
1,1-Dichloroethene	µg/L	253	< 1.0 U
1,2-Dichloroethane	µg/L	181	**0.64 J**
1,2-Dichloropropane	µg/L	5	< 1.0 U
Acetone	µg/L	2,395	< 2.0 U
Benzene	µg/L	181	< 1.0 U
Carbon tetrachloride	µg/L	181	< 1.0 U
Chlorobenzene	µg/L	47,180	< 1.0 U
Chloroform	µg/L	3,615	< 1.0 U
Ethylbenzene	µg/L	57,025	< 1.0 U
m,p-Xylene	µg/L	83.6	< 2.0 U
Methylene chloride	µg/L	1,699	< 2.0 U
o-Xylene	µg/L	83.6	< 1.0 U
Styrene	µg/L	5,987	< 1.0 U
Tetrachloroethene	µg/L	180.7	< 1.0 U
Toluene	µg/L	4,189	< 1.0 U
Trichloroethene	µg/L	181	**2.7**
Vinyl chloride	µg/L	72	< 1.0 U
Metals (6020A)			
Barium	mg/L	2	**0.171**
Lead	mg/L	0.0046	< 0.00200 U
Selenium	mg/L	0.012	< 0.00200 U
Silver	mg/L	0.003	< 0.00200 U
Hexavalent Chromium (7196A)			
Hexavalent Chromium	mg/L	0.1244	< 0.0100 U
Semi-Volatile Organic Compounds (8270D SIM)			
1,4-Dioxane	µg/L	134.2	**7.6**

µg/L - micrograms per liter

mg/L - milligrams per liter

U- Undetected: The analyte was analyzed for, but not detected.

J - estimated value between the limit of quantitation and the detection limit

GWTP Monthly Influent Sampling - March 2018

Location ID: Sample Date:	Units	LH18/24-SP140_031418 3/14/18
Location Description		**GWTP – Collected from a spigot on the influent to TK-140. Sampled Monthly.**
Metals (6020A)		
Selenium	mg/L	< 0.00200 U
Silver	mg/L	< 0.00200 U
Hexavalent Chromium (7196A)		
Hexavalent Chromium	mg/L	< 0.0100 U
Perchlorate (6850)		
Perchlorate	μg/L	**7,000**

mg/L - milligrams per liter

μg/L - micrograms per liter

U- Undetected: The analyte was analyzed for, but not detected.

GWTP Influent Perchlorate Sampling - March 2018

Location ID: Sample Date:	Units	INF Pond-Inlet_030718 3/7/18	INF Pond-Outlet_030718 3/7/18
Location Description		**Collected at the inlet to the influent pond**	**Collected at the outlet of the influent pond**
Perchlorate (6850)			
Perchlorate	µg/L	**1.8**	**1.9**

µg/L - micrograms per liter

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

May 9, 2018

DAIM-ODB-LO

Mr. Rich Mayer
US Environmental Protection Agency
Federal Facilities Section R6
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Final Land Use Control Remedial Design/Remedial Action Construction Report LHAAP-001-R-01 and LHAAP-003-R-01, Longhorn Army Ammunition Plant, May 2018

Dear Mr. Mayer,

The above-reference document is being transmitted to you for your records. This document replaces the Draft Final issued on February 1, 2018, which was considered final after 30 days without regulatory comment. This Final document includes the recordation completed on April 19, 2018 and corrections to the List of Attachments and Attachments 3 and 4, as well as corrections and updates to Sections 3.1 and 3.3.2. Response to comments on the Draft version of the document are included within this Final Version.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX
P. Bruckwicki, Caddo Lake NWR, TX
R. Smith, USACE, Tulsa District, OK
A. Williams, USACE, Tulsa District, OK
N. Smith, USAEC, San Antonio, TX
K. Nemmers, Bhate, Lakewood, CO (for project files)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

May 9, 2018

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality Superfund Section, MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Final Land Use Control Remedial Design/Remedial Action Construction Report LHAAP-001-R-01 and LHAAP-003-R-01, Longhorn Army Ammunition Plant, May 2018

Dear Ms. Palmie,

The above-reference document is being transmitted to you for your records. This document replaces the Draft Final issued on February 1, 2018, which was considered final after 30 days without regulatory comment. This Final document includes the recordation completed on April 19, 2018 and corrections to the List of Attachments and Attachments 3 and 4, as well as corrections and updates to Sections 3.1 and 3.3.2. Response to comments on the Draft version of the document are included within this Final Version.

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
P. Bruckwicki, Caddo Lake NWR, TX
R. Smith, USACE, Tulsa District, OK
A. Williams, USACE, Tulsa District, OK
N. Smith, USAEC, San Antonio, TX
K. Nemmers, Bhate, Lakewood, CO (for project files)

00881448

TCEQ and USEPA Review Comments
DRAFT Land Use Control Remedial Design/Remedial Action Construction Report
LHAAP-001-R-01 and LHAAP-003-R-01, Longhorn Army Ammunition Plant December 2017
Review Date: 26 January 2018

SPECIFIC COMMENTS
The following table provides specific comments and identifies the location within the document where each comment applies.

Comment No.	*Location in Document*	*Regulator Comments*	*Respondent (Bhate)[1]*	*Response to Comment (Contractor)*
TCEQ Comments				
1.	Section 3.2.2, Page 3-3	Page 3-3, last bullet should end with 2018 (not 2019).	C	Concur. Sentence will be revised to state: *This update to the Comprehensive LUC Management Plan will be completed during the next annual update which will be in the fourth quarter 2018.*
2.	Section 3.3.4, Page 3-5	Page 3-5, Section 3.3.4, Remove redundant sentence "These actions are taken to reestablish its protectiveness." This is stated in preceding sentence.	X	Concur. The second sentence in this paragraph and presented in the Regulator comment will be removed.
3.	Figure 1-2	Figure 1-1, Remove "and Monitoring Locations" from the title. In the legend, add "(LUC Boundary)" after the existing text for the red line.	C	Concur. Regulator Comment appears to apply to Figure 1-2, which will be revised to state: *LHAAP-001-R and LHAAP-003-R Site Location Map with LUC Boundaries*. The text "(LUC Boundary)" will be added after the existing text for the line that is red.
4.	Appendix C	Appendix C, Exhibits A and B are not legible. All details, including the meets and bounds notes, need to be legible for the record.	C	Concur. Bhate will revise the PDF with copies that are legible.
USEPA Comments				
5.	Appendix C- Page 2	Second Page of Appendix C, second paragraph, the phone number for the Marshall Library is not in service when you dial the number. Is the number transposed?	C	Concur. The area code presented for Marshall Library was typed into the document incorrectly. The area code will be changed to 903.
6.	Section 1.6.2.2	On the Initial Notice of Land Use Controls page (Attachment 1), in the last paragraph, the word Administrative is misspelled.	C	Concur. The term "Adminstrative Record" will be revised to *Administrative Record* in the final sentence within the Initial Notice of Land Use Controls.

Notes:
1) Respondent Concurs (C), Does not concur (D), Takes Exception (E) or Delete (X).
2) Commenter Agrees (A) with response or Does Not Agree (D) with response.

00881449

FINAL
LAND USE CONTROL REMEDIAL DESIGN/ REMEDIAL ACTION CONSTRUCTION REPORT LHAAP-001-R-01 AND LHAAP-003-R-01 LONGHORN ARMY AMMUNITION PLANT

May 2018

Contract Number: W9128F-13-D-0012
Task Order Number: W912BV17F0150

Performance Based Remediation (PBR)
Longhorn Army Ammunition Plant
Karnack, Texas

Prepared For:

Longhorn Army Ammunition Plant
Karnack, Texas

Under Contract To:

U.S. Army Corps of Engineers
Tulsa District
Tulsa, Oklahoma

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TABLE OF CONTENTS

Figures

Attachment

Appendices

ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
BIP	Blow-in-place
CD	Cultural debris
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CTT	Closed, Transferring, and Transferred
DNT	Dinitrotoluene
DoD	Department of Defense
ECP	Environmental Condition of Property
EE/CA	Engineering Evaluation/Cost Analysis
e2M	Engineering-Environmental Management
FFA	Federal Facility Agreement
GW-Ind	Groundwater-Industrial
HMX	1,3,5,7-Tetranitro-1,3,5,7-tetrazocane
IRP	Installation Restoration Program
LHAAP	Longhorn Army Ammunition Plant
LUC	Land use control
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
MC	Munitions constituent
MCL	Maximum Contaminant Level
MD	Munitions debris
MEC	Munitions and Explosives of Concern
mm	Millimeter
MMRP	Military Munitions Response Program
MOA	Memorandum of Agreement
MPPEH	Material potentially presenting explosive hazard
MRS	Munitions response site
MSC	Medium Specific Concentration
NCP	National Contingency Plan
NFA	No Further Action
NPL	National Priorities List
OB/OD	Open burn/open detonation
O&M	Operation and maintenance
PCL	Protective Concentration Level
RACR	Remedial Action Completion Report
RAO	Remedial action objective
RD	Remedial design
RDX	1,3,5-Trinitro-1,3,5-triazinane
ROD	Record of Decision

SARA	Superfund Amendments and Reauthorization Act
§	Section
SI	Site Inspection
STEP	Solutions to Environmental Problems
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TNT	Trinitrotoluene
TRRP	Texas Risk Reduction Program
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UU/UE	Unlimited Use/Unlimited Exposure
UXO	Unexploded Ordnance
WP	White phosphorus

1 INTRODUCTION

This document presents the land use controls (LUCs) remedial design (RD)/Remedial Action Construction Report (RACR) for the implementation of LUCs associated with the remedy set forth in the Final Longhorn Army Ammunition Plant (LHAAP) Record of Decision (ROD) (United States [U.S.] Army, August 2016) for Military Munitions Response Program (MMRP) sites LHAAP-001-R01 (South Test Area/Bomb Test Area) and LHAAP-003-R01 (Ground Signal Test Area). The ROD and this LUC RD/RACR was prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. The ROD includes a remedial action for limited groundwater monitoring for perchlorate to confirm levels in groundwater are below the Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (PCL). The limited groundwater monitoring is not associated with the LUCs for the sites and thus is not discussed further in this document.

This LUC RD/RACR document was prepared for the U.S. Army under the Worldwide Environmental Remediation Services Contract No. W9128F-13-D-0012 managed by the U.S. Army Corps of Engineers (USACE), Tulsa District.

1.1 Facility Background

The LHAAP is an inactive, government-owned, formerly contractor-operated and maintained industrial facility located in central-east Texas, in the northeastern corner of Harrison County. The facility occupies approximately 1,200 of its former 8,416 acres located between State Highway 43 in Karnack, Texas, and the southwestern shore of Caddo Lake, as shown on **Figure 1-1**. The LHAAP was listed as a National Priorities List (NPL) site on August 9, 1990, due to threatened releases of hazardous substances, pollutants, or contaminants. The U.S. Environmental Protection Agency (USEPA), the Texas Water Commission (now the Texas Commission on Environmental Quality [TCEQ]), and the U.S. Army signed a Federal Facility Agreement (FFA) on December 30, 1991, to address the contamination at LHAAP.

1.2 Munitions Response Sites LHAAP-001-R and LHAAP-003-R Site Descriptions

Munitions response sites (MRSs) LHAAP-001-R (South Test Area/Bomb Test Area), is co-located with Installation Restoration Program (IRP) site LHAAP-27 and is situated in the southern portion of LHAAP and covers an area of approximately 79 acres **(Figure 1-2)**. Site LHAAP-001-R was constructed in 1954 and used for testing photoflash bombs produced at the facility until approximately 1956. During the late 1950s, illuminating signal devices were also demilitarized within pits excavated in the vicinity of the test pad. During the 1960s, leaking production items may have been demilitarized by detonation. Leaking white phosphorus (WP) munitions were supposedly disposed of, although no primary source documentation concerning this effort has been located. A 1984 LHAAP Contamination Survey indicated that the area had been relatively inactive since the early 1960s and no disposal or testing activities have been carried out in this area since this time. LHAAP-001-R was identified as a munitions and explosives of concern (MEC) area based on the visual confirmation of MEC.

Site LHAAP-003-R (Ground Signal Test Area), is co-located with IRP site LHAAP-54 and is situated in the southeastern portion of LHAAP and covers an area of approximately 80 acres **(Figure 1-2)**. Site LHAAP-003-R was used intermittently in April 1963 for aerial and on-ground testing and destruction of a variety of devices, including pyrotechnic signal devices, red phosphorus smoke wedges, infrared flares, illuminating mortar shells and cartridges, button bombs, and various types of explosive simulators. The site was also used intermittently over a 20-year period for testing and burn-out of rocket motors. From late 1988 through 1991, the site was also used for the burn-out of Pershing missile rocket motors. Occasionally, leaking WP munitions were burned at the site as a demilitarization activity. LHAAP-003-R was identified as a MEC area based on the reported presence of MEC.

Previous investigations, including an August 2007 Engineering Evaluation/Cost Analysis (EE/CA), prepared by CAPE, verified the presence of MEC at LHAAP-001-R and LHAAP-003-R, and recommended the removal of MEC, along with the implementation of LUCs to reduce the risk within the sites. Soil samples collected from both sites indicated that no WP was identified at detectable concentrations and no munitions constituents (MC) were present in any pre- or post-detonation soil samples collected

Between August and November 2008, a non-time critical MEC removal action was conducted at both sites and surface clearances were performed. At LHAAP-001-R, a surface clearance of approximately 65 acres and subsurface clearance to the depth of detection in a 14-acre open burn/open detonation (OB/OD) area were performed. A total of 384 MEC/material potentially presenting explosive hazard (MPPEH) items and 14 inert items were located and destroyed and a total of 22,139 pounds of munitions debris and 1,876 pounds of cultural debris (CD) were removed during the course of surface and subsurface clearance. At LHAAP-003-R, a total of 12 MEC/MPPEH items and one inert item were located and destroyed and 6,880 pounds of munitions debris and 5,981 pounds of CD were removed during the course of the surface clearance.

Following the 2008 non-time critical removal action surface clearance activities, LUCs were prepared and constructed for both sites. LUCs were designed and constructed to promote ongoing protection of human safety against potential explosive hazards that may remain at the MMRP sites. The LUCs' performance objectives are to prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds, and to prohibit intrusive activities such as digging or any other activity which could result in explosive safety risks. The recordation notification for the sites, which was filed with Harrison County, include a description of the LUCs (**Appendix C)**. The boundary of the LUCs encloses the site boundaries shown on **Figures 2-7 and 2-8**. The locations of the signs are also shown of **Figures 2-7 and 2-8**. The LUC to prohibit residential land use will remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety. The LUC restricting land use to nonresidential will remain in place until it is demonstrated that the MEC no longer presents a threat to public/ human safety. A LUC to prohibit intrusive subsurface activities, including digging, will remain in place until it is demonstrated that the MEC no longer present an explosive hazard. However, intrusive subsurface activities may occur provided that the Army and the EPA approve such intrusive subsurface activities before they are commenced and provided that they are undertaken by qualified personnel who are trained in explosives safety measures.

LUC boundary maps for LHAAP-001-R and LHAAP-003-R, generated as part of the 2008 LUC implementation, are presented as **Attachments 1 and 3** to this LUC RD/RACR document. The 2008 LUCs included:

- Restriction against intrusive activities, including digging. A legal description survey and plat of the LUC boundaries and locations of MEC warning signs prepared in accordance with 30 Texas Administrative Code (TAC) Section (§) 335.569, Appendix III, for recordation in the Harrison County Clerk's Office.

- Placement of MEC warning signage along the perimeter of LHAAP-001-R and LHAAP-003-R to serve as the physical demarcation of the controlled areas. The signs have visibility from one sign to the next, with a maximum spacing of 100 feet. The signs include warning of the potential presence of MEC, state the restriction against intrusive activities, and provide a contact number. The locations of the signs are shown in **Attachment 1 and 2** as **Figures 2-7 and 2-8**.

- Education program for future refuge visitors, staff, and volunteers. The program includes informational pamphlets and a safety video warning of the potential presence of MEC and presenting examples of MEC that were or may be found at the sites.

The Final ROD for LHAAP-001-R and LHAAP-003-R was issued in August 2016 and documents the final selected remedy for the sites (U.S. Army, August 2016). The ROD found that although the removal actions provided an effective solution for reducing risk of exposure by reducing the potential for any direct contact with MEC or material potentially presenting explosive hazard (MPPEH), there is the potential that some MEC remains. A summary of the LUC remedial action objective (RAO) and the selected remedy for LHAAP-001-R and LHAAP-003-R, identified in the Final ROD, is presented in the following sections.

1.3 Land Use Control Remedial Action Objective

The LUC RAO developed for LHAAP-001-R and LHAAP-003-R, as outlined in the LHAAP-001-R and LHAAP-003-R ROD (U.S. Army, August 2016) is:

- Protection of human health and safety from explosive hazards that may have remained at the sites after the MEC removal action.

1.4 Land Use Control Remedial Action

The LUC remedial action for MEC at LHAAP-001-R and LHAAP-003-R is comprised of the following elements:

- LUC to prohibit residential use.
- LUC to restrict land use to non-residential.
- LUC to restrict intrusive activities (e.g., digging).
- Signage to convey MEC warning.
- Education Program.

The Educational Program materials, including pamphlets and video, were delivered to the U. S. Fish and Wildlife Service (USFWS) in hard copy and electronic form as part of the Site Specific Final Report for the MEC Removal Action report (EODT, 2009). There is no recurring requirement associated with this LUC and it will not be addressed further in this document.

2 SITE CHARACTERISTICS

This section presents a summary of site characteristics for LHAAP-001-R and LHAAP-003-R, which are primarily based on the following historical documents: (1) *Final ROD* (U.S. Army, August 2016), (2) *Engineering Evaluation/Cost Analysis Action Memorandum for Three Munitions Response Sites-South test Area/Bomb Test Area, Static Test Area, and Ground Signal Test Area* (CAPE Environmental, August 2007), and (3) *Draft-Final Remedial Design-LHAAP-16* (AECOM, January 2017).

Site LHAAP-001-R encompasses an area of approximately 79 acres. Site topography slopes gently to the east and surface water runoff generally flows to the southeast toward Harrison Bayou. Groundwater at the site is encountered between 7 feet and 9 feet below ground surface (bgs), and is topographically controlled with a general flow direction to the north.

LHAAP-003-R encompasses an area of approximately 80 acres, located in the watersheds of Saunders Branch and Harrison Bayou. Both Saunders Branch and Harrison Bayou flow into Caddo Lake. Surface water from the site flows toward drainage ditches located alongside a circular dirt road forming on the outer margin of the site. The ditches converge to the northeast and southwest directing surface water to Saunders Branch and Harrison Bayou, respectively. Depth to groundwater at the site averages around 15 feet bgs with seasonal fluctuations.

Neither LHAAP-001-R nor LHAAP-003-R include areas of archeological or historical importance.

2.1 Geology and Hydrogeology

The hydrogeologic environment consists of an alluvial depositional environment with multiple permeable layers consisting primarily of silty and/or clayey sands separated by silty clay and clay layers of widely variable thickness that act as aquitards or leaky aquitards. The permeable zones are separated into shallow, intermediate, and deep zones at each site (sometimes split into "upper and lower" when needed), but the alluvial nature of the environment means that groundwater zones are laterally discontinuous at times and may vary in thickness and permeability laterally and vertically.

Surface water runoff at LHAAP-001-R generally flows to the southeast toward Harrison Bayou. Depth to groundwater ranges between 7 feet and 9 feet bgs and flows in a northerly direction.

Based on previous hydrogeological assessments, the groundwater and surface flow direction at LHAAP-003-R are to the northwest and parallel Saunders Branch and Harrison Bayou. Depth to groundwater averages 15 feet bgs.

2.2 Current and Future Land Use

LHAAP has been an industrial facility since 1942. Production activities and associated waste management activities continued until the facility was determined to be in excess of the U.S. Army's needs in 1997. The plant area has been relatively dormant since that time. LHAAP is surrounded by a fence (except on the border with Caddo Lake), and current access measures at the LHAAP preclude unlimited public access to areas within the fence. The fence now represents the National Wildlife Refuge boundary, which surrounds both MRSs LHAAP-001-R and LHAAP-003-R. Approved access for hunters is limited.

The reasonably anticipated future use of LHAAP-001-R and LHAAP-003-R is as part of a national wildlife refuge. This anticipated future use is based on a Memorandum of Agreement (MOA) (U.S. Army, April 2004) between the USFWS and the U.S. Army. That MOA documents the transfer process of the LHAAP acreage to USFWS to become the Caddo Lake National Wildlife Refuge and will be used to facilitate a future transfer of LHAAP-001-R and LHAAP-003-R. Presently the Caddo Lake National Wildlife Refuge occupies approximately 7,000 acres of the 8,416-acre former installation. In accordance with the National Wildlife Refuge System Administration Act of 1966 and its amendments (16 United States Code [U.S.C.] 668dd), the land will remain as a national wildlife refuge unless there is a change brought about by an act of Congress, or the land is part of an exchange authorized by the Secretary of the Interior.

2.3 Nature and Extent of MEC

MMRP sites LHAAP-001-R and LHAAP-003-R are co-located with Installation Restoration Program (IRP) sites LHAAP-27 and LHAAP-54, respectively.

From 2002 to 2007, investigations related to the MMRP were conducted at LHAAP. As a result of the records review for the U.S. Army Closed, Transferring, and Transferred (CTT) Range/Site Inventory in 2002, the South Test Area/Bomb Test Area and Ground Signal Area were designated as LHAAP-001-R and LHAAP-003-R, respectively (Engineering-Environmental Management [e2M], 2002). For these two MRSs, investigations were conducted to determine the presence or absence of MEC. Details regarding investigations at each site are presented below.

2.3.1 LHAAP-001-R

Between 2002 and 2004, a MMRP Site Inspection (SI) was conducted for LHAAP-001-R to determine the presence or absence of MEC at the site, which may have remained from activities conducted by the Department of Defense (DoD) during operation of the MRS, and may pose a threat to human health and/or the environment (e2M, June 2005).

Results of the historical records review and a visual SI verified MEC presence at the site. Possible source areas for MEC identified during the SI included the following:

- Testing areas associated with the various suspected ordnance types.
- A Demolition Area located within the footprint of LHAAP-001-R. This area was reportedly designed for detonation of dangerous/unserviceable ammunition.
- Spent flares, a 155 millimeter (mm) WP projectile, shrapnel from photoflash bombs, and ordnance related scrap found on the site.

In 2007, an EE/CA was conducted to facilitate a non-time-critical removal action of MEC at the site (CAPE Environmental, August 2007). During this effort, twenty-one MEC and MPPEH items along with 700 pounds of munitions debris (MD) were recovered at the surface or within the top 6 inches of the soil. The items were clustered within an area suspected as being used for OB/OD activities, although the area was never permitted as an OB/OD unit. The suspected OB/OD area is approximately 14 acres in size.

Between August and November 2008, a MEC non-time-critical removal action was conducted and LUCs were developed for the site (EODT, September 2009). Surface clearance of the entire 79 acre site and subsurface clearance to the depth of detection, within a 14-acre area of the site, was performed at LHAAP-001-R. Magnetometer-assisted surface clearance was performed for the entire site, which required site preparations including brush removal. The clearance team worked in grids and established 5-foot sweep lanes within each grid, removing and disposing of all surface MEC and MPPEH, MD, CD, and range-related debris. A total of 90 MEC/MPPEH items were located and destroyed, and a total of 6,742 pounds of MD and 154 pounds of CD were removed during the course of surface clearance. Subsurface MEC removal was conducted for the suspected OB/OD area of approximately 14 acres within LHAAP-001-R. Magnetometers were utilized to detect surface and subsurface anomalies. Each detected anomaly was excavated until the item was located, identified, and a magnetic signature was no longer detected at the location. All MEC/MPPEH encountered were explosively destroyed to verify that no residual explosive hazard existed. A total of 294 MEC/MPPEH items and 14 inert items were located, excavated, and removed and a total of 15,397 pounds of MD and 1,722 pounds of CD were removed during the course of subsurface clearance. MEC items were destroyed using the “blow-in-place” (BIP) method following approved demolition procedures. Debris was consolidated and relocated to the site lay down area. The debris was stored in approved containers, inspected, verified, and certified as free of explosives, and shipped off site for final disposition.

LUCs were designed and constructed for LHAAP-001-R, consistent with recommendations of the EE/CA, which included:

- Restriction against intrusive activities. Title 30 TAC § 335.569, Appendix III requires that the restriction be recorded in the Harrison County Clerk’s Office, with the survey, map, and LUC language.
- Signage at the perimeter of LHAAP-001-R. Signs were installed at the perimeter of the site, serving as the physical demarcation of the controlled areas. The signs have visibility from one

sign to the next with a maximum spacing of 100 feet. The signs include warning of the potential presence of MEC and state the restriction against intrusive activities.

- Education program for future refuge visitors, staff, and volunteers. The program includes informational pamphlets and safety video warning of the potential presence of MEC and presenting examples of MEC that were or may be found at the site.

2.3.2 LHAAP-003-R

Between 2002 and 2004, a MMRP SI was conducted for LHAAP-003-R to determine the presence or absence of MEC at the site, which may have remained from activities conducted by the DoD during operations of the MRS. The SI verified MEC presence at the site (e2M, June 2005). Possible source areas for MEC identified during the SI included: testing areas associated with the various suspected ordnance types; a confirmed mortar impact area on site with numerous unidentified ordnance item shapes on the surface and outside the mortar berm; a site reportedly used for the testing and burnout of Pershing and Sergeant rocket motors; and areas associated with past demilitarization activities. In addition, a Sergeant rocket motor reportedly exploded at the site around 1970 and debris was reportedly placed in the resulting crater and backfilled. It was also reported that occasionally WP munitions were burned at the site. It appears that most of the items tested at this location were statically fired and observed for adequate illumination and burn time and not launched by a weapons system.

In 2007, an EE/CA was conducted to facilitate a non-time-critical removal action of MEC at the site (CAPE Environmental, August 2007). During this effort, fourteen MEC and MPPEH items along with 513 pounds of MD were recovered at the surface or within the top 6 inches of the soil. The items were clustered within the former Mortar Test Area.

Between August and November 2008, a MEC removal action was conducted and LUCs were developed for the site. Magnetometer-assisted surface clearance was performed at LHAAP-003-R for the entire site of approximately 80 acres, and site preparations included brush removal. The clearance team worked in grids and established 5-foot sweep lanes within each grid, removing and disposing of all surface MEC and MPPEH, MD, CD, and range related debris. Twelve MEC/MPPEH items and one inert item were located and destroyed and 6,880 pounds of MD and 5,981 pounds of CD were removed during the course of surface clearance. All MEC items were destroyed using the BIP method following approved demolition procedures. All debris was consolidated and relocated to the site lay down area. The debris was stored in approved containers, inspected, verified and certified as free of explosives, and shipped off site for final disposition.

LUCs were designed and constructed for LHAAP-003-R consistent with the recommendations of the EE/CA, which included:

- Restriction against intrusive activities. Title 30 TAC § 335.569, Appendix III requires that the restriction be recorded in the Harrison County Clerk's Office, with the survey, map, and LUC language.
- Signage at the perimeter of LHAAP-003-R. Signs were installed at the perimeter of the site, serving as the physical demarcation of the controlled areas. The signs have visibility from one sign to the next with a maximum spacing of 100 feet. The signs include warning of the potential presence of MEC and state the restriction against intrusive activities.
- Education program for future refuge visitors, staff, and volunteers. The program includes informational pamphlets and safety video warning of the potential presence of MEC and presenting examples of MEC that were or may be found at the site.

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3 LAND USE CONTROL REMEDIAL DESIGN/REMEDIAL ACTION CONSTRUCTION

The remedial action objective for LHAAP-001-R and LHAAP-003-R is protection of human health and safety from explosive hazards that may have remained at the sites after the MEC removal action. The duration for the LUCs specified in the MEC ROD for this purpose must remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety.

This section describes the LUC RD/RAC for LHAAP-001-R and LHAAP-003-R. Per the Final ROD, the LUCs' performance objectives are to:

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, child care facilities, and playgrounds.
- Restrict land use to nonresidential
- Prohibit intrusive activities such as digging or any other activity which could result in explosive safety risk.
- Maintain existing MEC warning signs at the perimeter of each site to physically demarcate controlled areas.

The implementation, maintenance, and inspection requirements associated with each of the performance objectives that comprise this LUC RD/RAC are described below. The actions taken to implement the LUC objectives during the remedial action phase, as well as ongoing maintenance, monitoring, and reporting requirements are presented in Section 3.1 below. Upon regulatory review and concurrence with the final LUC RD/RACR, it will be distributed as part of the Comprehensive LUC Management Plan.

For portions of LHAAP-001-R and LHAAP-003-R subject to LUCs that are not owned by the Army, the Army will monitor and report on the implementation, maintenance, and enforcement of LUCs, and coordinate with federal, state, and local governments and owners and occupants of properties subject to LUCs. The Army remains responsible for ensuring that the remedy remains protective of human health and safety.

3.1 LUC Implementation (Completed)

The actions required to implement the LUCs for LHAAP-001-R and LHAAP-003-R are described below. An initial notice of LUCs, was completed on December 8, 2016 (**Attachments 1 and 2**), within 90 days of ROD signature as required. The notice of LUCs including the final LUC boundary maps and description of the LUCs were completed on May 9, 2018 (**Attachments 3 and 4**). The preliminary LUC boundaries presented in the initial notice are considered the final LUC boundaries presented in the notice of final LUCs and are presented on **Figure 1-2.** The following actions were undertaken to implement LUCs for LHAAP-001-R and LHAAP-003-R:

- Finalize the boundaries of the LUCs as part of the remedial action (completed). The preliminary LUC boundaries are considered the final LUC boundaries, as referenced on **Figure 1-2**.
- Survey the LUC boundaries (completed). The boundaries were finalized based on USEPA and TCEQ concurrence, and the LUC boundaries were surveyed by a State of Texas licensed surveyor. A legal description of the surveyed area accompanies the survey plat.
- Record the LUCs in Harrison County. The LUC plats and legal descriptions and LUC restriction language was recorded in the Harrison County Courthouse in accordance with Title 30 TAC §335.566 on April 19, 2018 (**Appendix C**).
- Provide notice of LUCs with finalization of the RD/RACR (completed).
    - Prepare the notice of land use restrictions including prohibiting development/use for residential housing, elementary and secondary schools, child care facilities and play grounds; prohibit intrusive activities, and maintenance of existing MEC warning signs along the perimeter of each site to physically demarcate controlled areas. The notice consists of a brief description of the LUCs and a figure depicting the LUC boundaries.
    - Transmit the notice to federal, state, and local governments involved at LHAAP-001-R and LHAAP-003-R and owners and occupants of the property subject to restrictions and LUCs. The notices have been sent to federal, state, and local officials including: State Representatives, the Harrison County Judge, Harrison County Historical Courthouse, the City of Uncertain Mayor, and Caddo Lake and Leigh Water Supply Corporations' Presidents. Notice has also been sent to the Caddo Lake National Wildlife Refuge Manager, as a representative of the USFWS, the future transferee of the property.

3.2 Maintenance and Monitoring

Components of the final remedy at LHAAP-001-R and LHAAP-003-R require repair and maintenance and those activities are described in this section, along with other routine maintenance activities. The following subsections present the maintenance and monitoring requirements of the final remedy.

3.2.1 Maintenance of Existing MEC Warning Signs

MEC warning signs have been installed at the perimeter of LHAAP-001-R and LHAAP-003-R (64 signs at each site), that serve as a physical demarcation of the controlled areas. The signs have visibility from one sign to the next with a maximum spacing of 100 feet. The signs include warning of potential presence of MEC and state the restriction against intrusive activities.

These signs will be visually inspected annually, or as needed, to ensure they remain intact, undamaged, and visible from one sign to the next. Maintenance will be conducted, as needed, and may include the following activities:

- Mowing and brush clearing around MEC warning signs to ensure that they are visible from one sign location to the next sign location.

- Rehanging/affixing MEC warning signs or replacing MEC warning sign(s), if they become damaged or illegible. Figure 3-1 presents an example of the Unexploded Ordnance (UXO) Danger signs that are required. The specifications for sign replacement are found in Appendix N of the MEC Removal Action report (EODT, 2009).

- Repairing existing MEC warning sign posts, which may require the reestablishment of the concrete base or post replacement.

The Inspection and Maintenance Checklist is provided in **Appendix A.** Repairs will also be documented via photographs and field notes.

3.2.2 Administrative Maintenance

Administrative maintenance required to ensure LUCs remain in place and effective include:

- Annual field inspections of LHAAP-001-R and LHAAP-003-R to confirm that no violations of the LUCs have occurred. Documentation of the inspection will be included on the Inspection and Maintenance Checklist (see **Appendix A**).
- Annual certifications that no LUC-restricted activities have been authorized and that LHAAP-001-R and LHAAP-003-R conditions and use are consistent with the LUCs. The Annual LUC Compliance Certification Form is presented in **Appendix B**.
- Periodic transmittal of a LUC Notice to federal, State, and local authorities and to owners and occupants of LHAAP-001-R and LHAAP-003-R. The notice will include the land use restrictions referenced in the ROD, a written description of the LUCs, and a figure depicting the LUC boundaries. The transmittal will coincide with each Five Year Review and will be documented in the report.
- The final LUC RD/RACR will be added to the Comprehensive LUC Management Plan and the plan will be provided to the owner or occupant of LHAAP-001-R and LHAAP-003-R. This update to the Comprehensive LUC Management Plan will be completed during the next annual update, which will be in the fourth quarter of 2018.

The U.S. Army will address LUC problems within its control that are likely to impact remedy integrity and shall address problems as soon as practicable.

3.3 Reporting of LUC Inspection and Monitoring

Beginning with finalization of this RD/RACR and approval of the Inspection and Maintenance forms and the Annual Certification Form, the U.S. Army will undertake inspections and certify continued compliance with the LUC objectives. The U.S. Army, or the transferee after transfer, will retain the LUC Inspection and Certification documents in the project files for incorporation into the Five Year Review reports, and these documents will be made available to USEPA and TCEQ upon request. In addition, should any violations be found during the certification, the U.S. Army will provide to USEPA and TCEQ, along with the document, a separate written explanation indicating the specific violations found and what efforts or measures have or will be taken to correct those violations. The need to continue inspections and certifications will be revisited during each Five Year Review.

3.3.1 Notice of Planned Property Conveyances

Upon transfer of Army-owned property, the Army will provide written notice of the LUCs to the transferee of the potential presence of MEC and any land use restrictions referenced in the ROD. Within 15 days of transfer, the U.S. Army will provide written notice to USEPA and TCEQ of the division of implementation, maintenance, and enforcement responsibilities unless such information has already been provided in the LUC RD/RACR. The notice will describe the mechanism by which the LUC will continue to be implemented, maintained, inspected, reported, and enforced. Upon transfer, such responsibilities may shift to the transferee via appropriate provisions placed in the Environmental Condition of Property (ECP) or other environmental document for transfer. Although the U.S. Army may transfer responsibility for various implementation actions, the U.S. Army will also retain ultimate responsibility for the remedy integrity. This means that the U.S. Army is responsible for addressing substantive violations of the LUC performance objectives that would undermine the U.S. Army's CERCLA remedy. The U.S. Army also will be responsible for incorporating RD information and outlining the transferee's LUC obligations into property transfer documentation. In the event property is transferred out of Federal control, the LUCs relating to property restrictions shall be recorded in the deed and shall be enforceable by the U.S. and the state of Texas.

3.3.2 Opportunity to Review Text of Intended LUCs

The U.S. Army provided a copy of the land use restriction notification to TCEQ for review and approval prior to its recordation in Harrison County. The USEPA also received a copy for review. The U.S. Army will produce an ECP or other environmental document for transfer of LHAAP-001-R and LHAAP-003-R, but before executing transfer, the U.S. Army will provide the USEPA and TCEQ with a copy of the ECP or other environmental document for transfer so that they may have reasonable opportunity, before transfer, to review all LUC-related provisions.

3.3.3 Notification Should Action(s) which Interfere with LUC Effectiveness be Discovered Subsequent to Conveyance

Should the U.S. Army discover, after conveyance of the site, any activity on the property inconsistent with the LUC performance objectives, the U.S. Army shall notify the USEPA and TCEQ within 72 hours of such discovery. Consistent with Section 4.3.4 below, the U.S. Army will then work with the USEPA, TCEQ, and the transferee to correct the problem(s) discovered. This reporting requirement does not preclude the U.S. Army from taking immediate action pursuant to its CERCLA authorities to prevent any perceived risk(s) to human health and safety.

3.3.4 LUC Enforcement

Should the LUC remedy reflected in this LUC RD/RACR fail, the U.S. Army will coordinate with the USEPA and TCEQ to ensure that appropriate actions are taken to reestablish its protectiveness. These actions may range from informal resolutions with the USFWS or its lessee, to the institution of judicial action against non-federal third parties. Alternatively, should the circumstances warrant such, the U.S. Army could choose to exercise its response authorities under CERCLA. Should the U.S. Army become aware that any future owner or user of the property has violated any LUC requirement over which a local agency may have independent jurisdiction, the U.S. Army may notify those agencies of such violation(s) and work cooperatively with them to re-achieve owner/user compliance with the LUC.

3.3.5 Modification or Termination of LUCs

The LUCs shall remain in effect until such time as the U.S. Army and USEPA agree that it has been demonstrated that MEC no longer presents a threat to public/human safety, allowing unrestricted property use. When this occurs, the LUCs will be terminated, as needed. The decision to terminate the LUC will be documented consistent with the National Contingency Plan (NCP) process for post-ROD changes, potentially including an explanation of significant differences or a RACR. If the property has been transferred and a determination by the U.S. Army and USEPA has been made to terminate the LUC, the U.S. Army shall provide to the owner of the property an appropriate release for recordation pertaining to the site and will also timely advise other local stakeholders of the action.

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4 REFERENCES

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EODT. September 2009. *Final Site Specific Report for the MEC Removal Action at the Former Longhorn Army Ammunition Plant, LHAAP-001-R (Site 27) and LHAAP-003-R (Site 54), Karnack, Texas.*

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FIGURES

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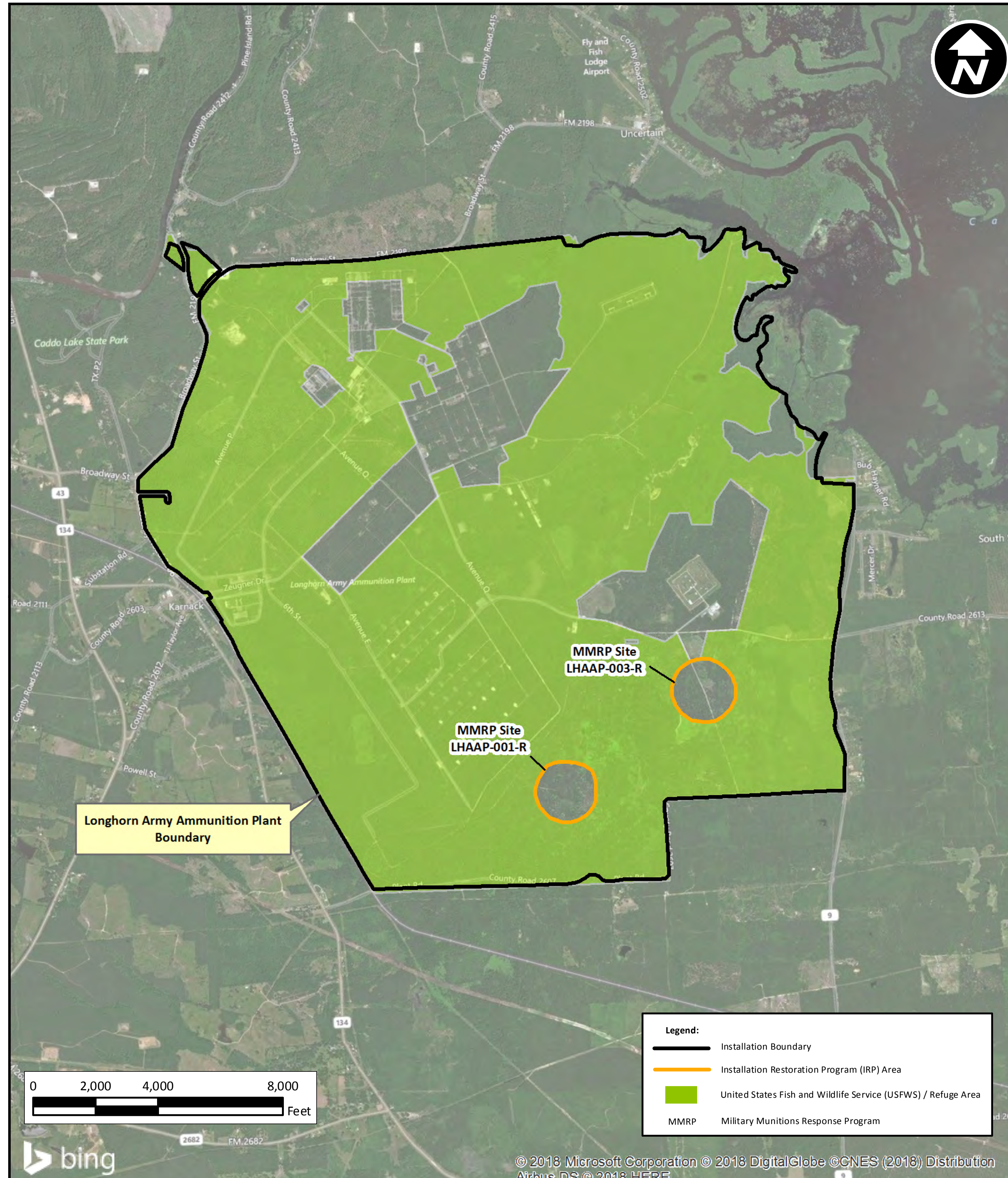


LHAAP Site Map

Figure 1-1

Remedial Design LHAAP-001-R and LHAAP-003-R Group 4
Longhorn Army Ammunition Plant
Karnack, Texas

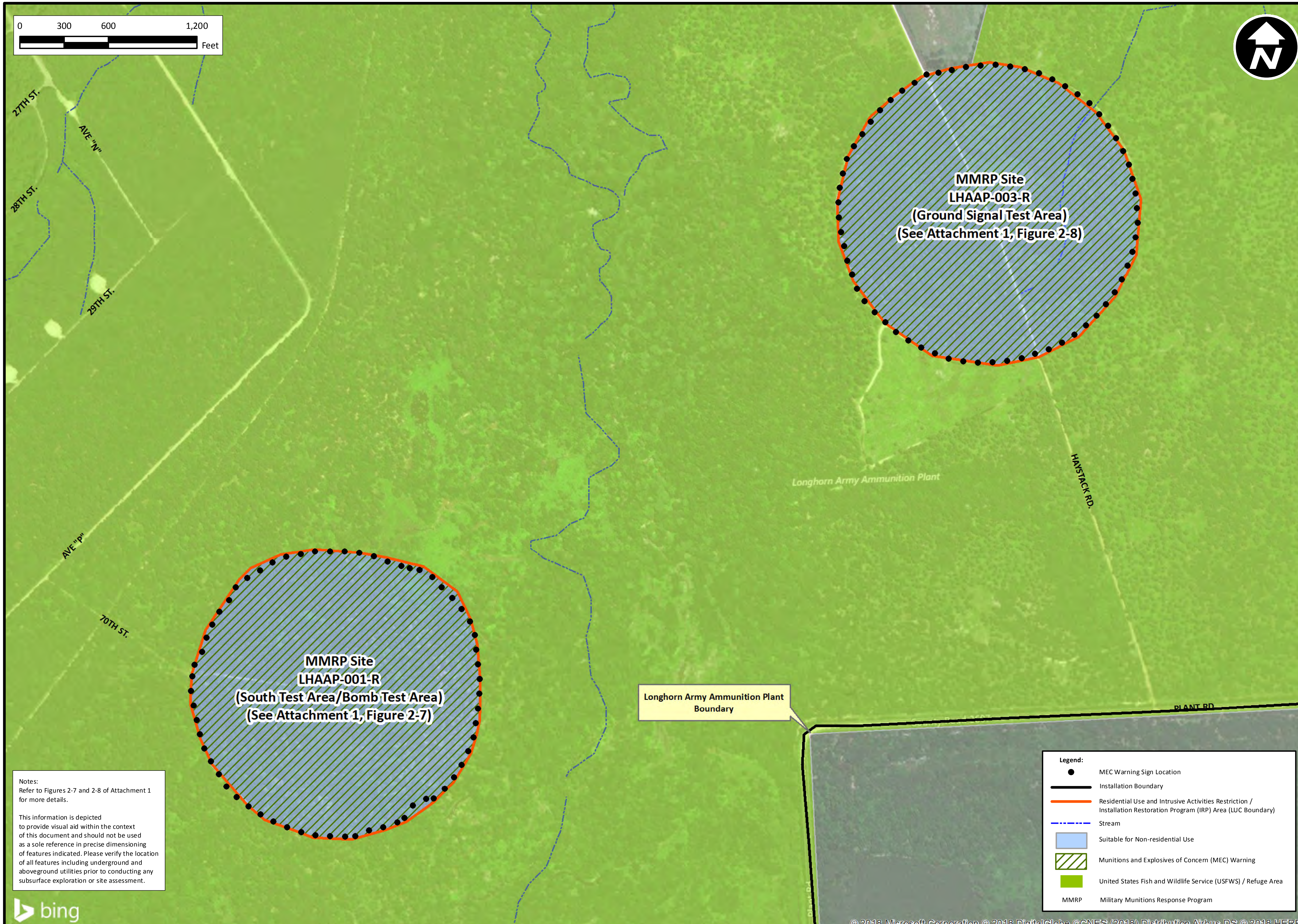
DRAWN BY: MRM

DATE: 1/30/2018

SCALE: As Shown

PROJECT NO: NWO1312.0150

bhate ENVIRONMENT & INFRASTRUCTURE



LHAAP-001-R and LHAAP-003-R Site Location Map with LUC Boundaries

Figure 1-2

Remedial Design LHAAP-001-R and LHAAP-003-R Group 4
Longhorn Army Ammunition Plant
Karnack, Texas

DRAWN BY:	DATE:	SCALE:	PROJECT NO:
MRM	1/31/2018	As Shown	NWO1312.0150

bhate ENVIRONMENT & INFRASTRUCTURE

bhate ENVIRONMENT & INFRASTRUCTURE

Remedial Design LHAAP-001-R and LHAAP-003-R Group 4
Longhorn Army Ammunition Plant
Karnack, Texas

PROJECT NO:	SCALE:	DATE:	DRAWN BY:
NWO1312.0150	As Shown	1/30/2018	MRM

Danger UXO Warning Sign

Figure 3-1

ATTACHMENTS

ATTACHMENT 1

INITIAL NOTICE OF LAND USE CONTROLS INCLUDING 2008 LUC BOUNDARY MAPS FOR LHAAP-001-R AND LHAAP-003-R

Initial Notice of Land Use Controls

LHAAP-001-R, South Test Area/South Bomb Area and
LHAAP-003-R, Ground Signal Test Area
Longhorn Army Ammunition Plant, Karnack Texas

The former Longhorn Army Ammunition Plant (LHAAP) is an inactive government-owned, formerly contractor-operated and maintained Department of Defense facility located in central east Texas in the northeast corner of Harrison County. LHAAP is approximately 14 miles northeast of Marshall, Texas. The facility is approximately 40 miles west of Shreveport, Louisiana. The former U.S. Army installation occupied nearly 8,416 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake and is accessed by State Highways 43 and 134.

LHAAP was placed on the National Priorities List (NPL) on August 9, 1990. Activities to remediate contamination began in 1990. After its listing on the NPL, the U.S. Army, the USEPA, and the Texas Water Commission (currently known as the TCEQ) entered into a CERCLA Section 120 Federal Facilities Agreement (FFA) for remedial activities at LHAAP. The FFA became effective December 30, 1991. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property.

The sites addressed in this Initial Notice of Land Use Controls are LHAAP-001-R and LHAAP-003-R, which are shown on the attached Figures and discussed below.

Land Use Controls (LUCs) are applied at LHAAP-001-R and LHAAP-003-R as part of the final remedy in accordance with the Record of Decision signed September 13, 2016. LUCs are necessary to promote ongoing protection of human safety against potential explosive hazards that may remain at the MMRP sites. The performance objectives are to prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds, and to prohibit intrusive activities such as digging or any other activity which could result in explosive safety risks.

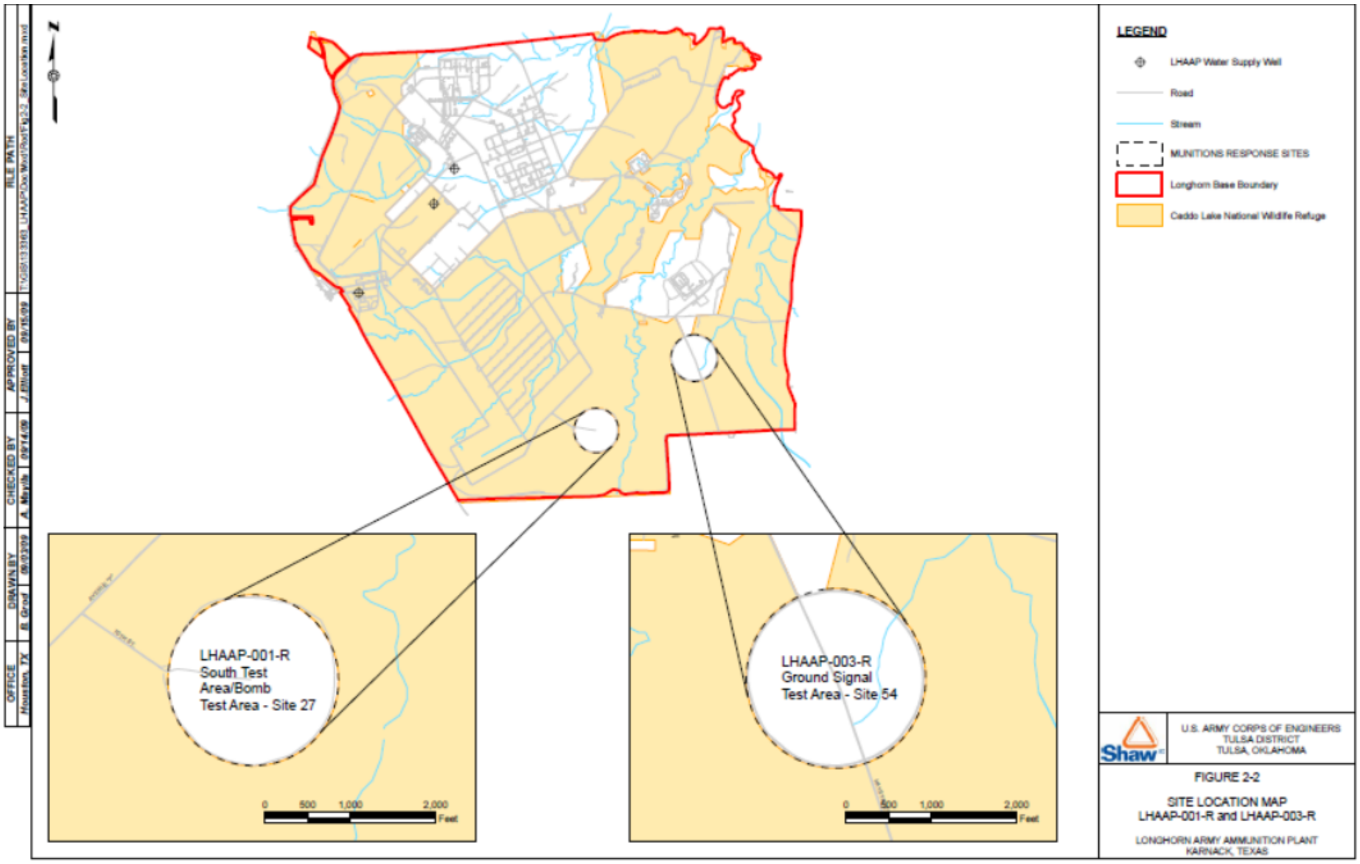
Land Use Controls

- The LUC to prohibit residential land use will remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety.
- The LUC restricting land use to nonresidential will remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety.
- A LUC to prohibit intrusive subsurface activities, including digging, will remain in place until it is demonstrated that the MEC no longer present an explosive hazard. However, intrusive subsurface activities may occur provided that the Army and the EPA approve such intrusive subsurface activities before they are commenced and provided that they are undertaken by qualified personnel who are trained in explosives safety measures.

Further information may be found in the Administrative Record at the Marshall Public Library, at website www.longhornaap.com or by contacting Rose M. Zeiler (479-635-0110 or rose.m.zeiler.civ@mail.mil).

Initial Notice of Land Use Controls

LHAAP-001-R, South Test Area/South Bomb Area and
LHAAP-003-R, Ground Signal Test Area
Longhorn Army Ammunition Plant, Karnack Texas



Initial Notice of Land Use Controls

LHAAP-001-R, South Test Area/South Bomb Area
Longhorn Army Ammunition Plant, Karnack, Texas

DESCRIP	NORTHING	EASTING
SIGN 01	3613016.8	393564.7
SIGN 02	3612986.7	393560.5
SIGN 03	3612956.4	393563.9
SIGN 04	3612926.3	393568.9
SIGN 05	3612896.4	393574.2
SIGN 06	3612866.9	393581.7
SIGN 07	3612839.1	393594.1
SIGN 08	3612812.3	393608.5
SIGN 09	3612785.5	393622.9
SIGN 10	3612762.6	393643.0
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SIGN 13	3612708.3	393716.2
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SIGN 41	3613150.7	394108.5
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SIGN 43	3613195.6	394069.6
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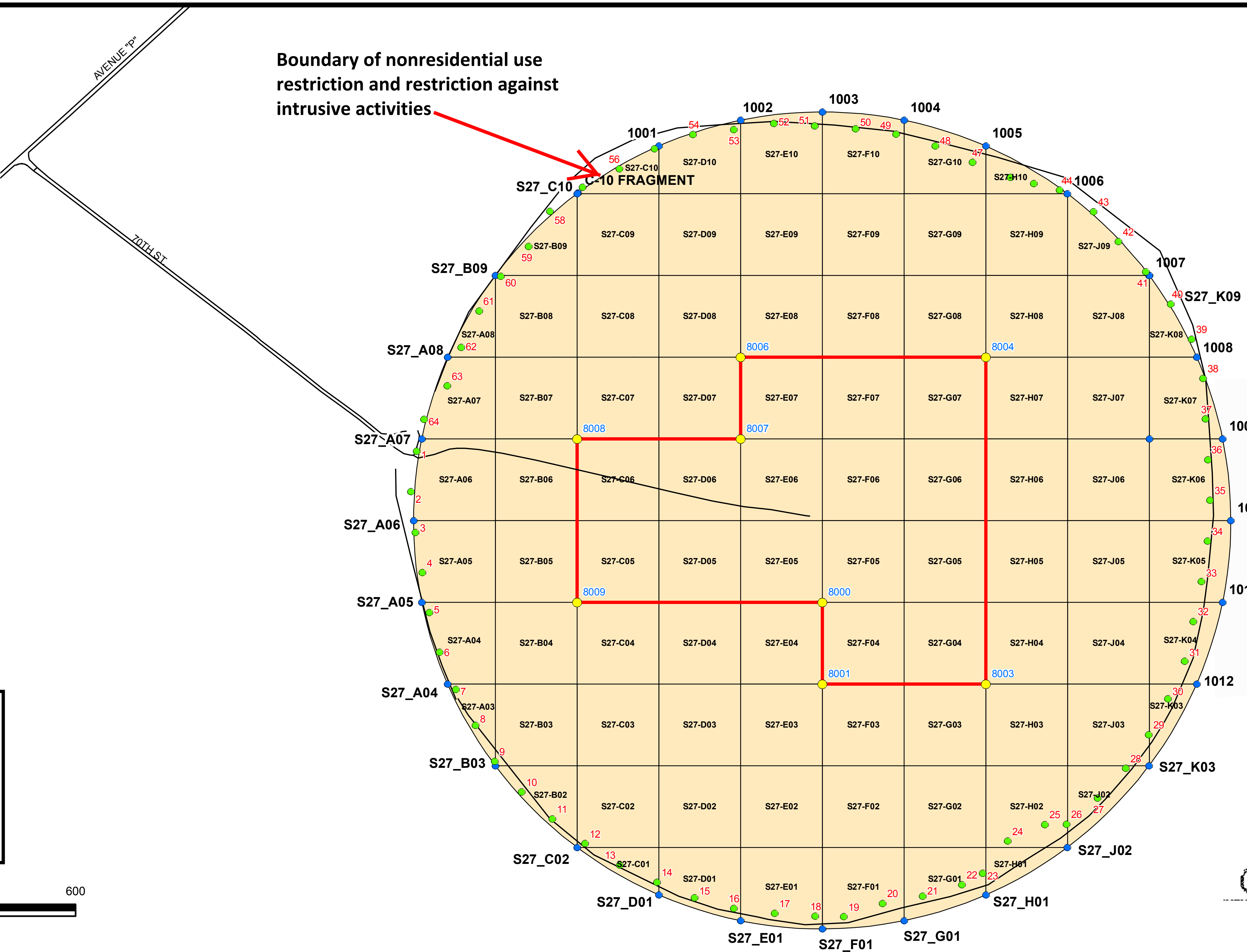

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8007	3613026.1	393806.4
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8009	3612904.2	393684.4

DESCRIP	NORTHING	EASTING
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1004	393928.3	3613263.8
1005	393989.2	3613244.5
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1008	394146.5	3613087.0
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S27_A07	393568.6	3613026.1
S27_A08	393587.9	3613087.1
S27_B03	393623.5	3612782.3
S27_B09	393623.5	3613148.0
S27_C02	393684.6	3612721.3
S27_C10	393684.4	3613209.0
S27_D01	393745.4	3612685.9
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S27_K03	394110.9	3612782.3
S27_K07	394111.2	3613026.1
S27_K09	394111.2	3613147.9

Legend

- OBOD Corners
- UXO Sign
- Boundary Stakes
- Roads
- OBOD
- Investigated Grids

0 150 300 600
Feet

Datum: NAD83 UTM
Monument: Longhorn Army Ammunition Plant
Monument BG-1 with coordinates
NORTHING-3614801.46,
EASTING-395385.09

I, David R. Collins, Registered Professional Land Surveyor No. 1954, do hereby certify that this plat correctly represents the results of a survey made under my supervision August 4 through September 23, 2008.

Principal of the firm: ____________________

SUXOS: ____________________

Initial Notice of Land Use Controls
LHAAP-003-R, Ground Signal Test Area
Longhorn Army Ammunition Plant, Karnack, Texas

N

DESCRIP	NORTH	EAST	DESCRIP	NORTHIN	EASTING
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SIGN 13	3613894.1	394947	1017	395180.3	3614195.0
SIGN 14	3613863.7	394949.6	1018	395241.3	3614203.9
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SIGN 25	3613602.8	395130	1030	395567.2	3613808.1
SIGN 26	3613591	395158.1	1031	395507.7	3613686.2
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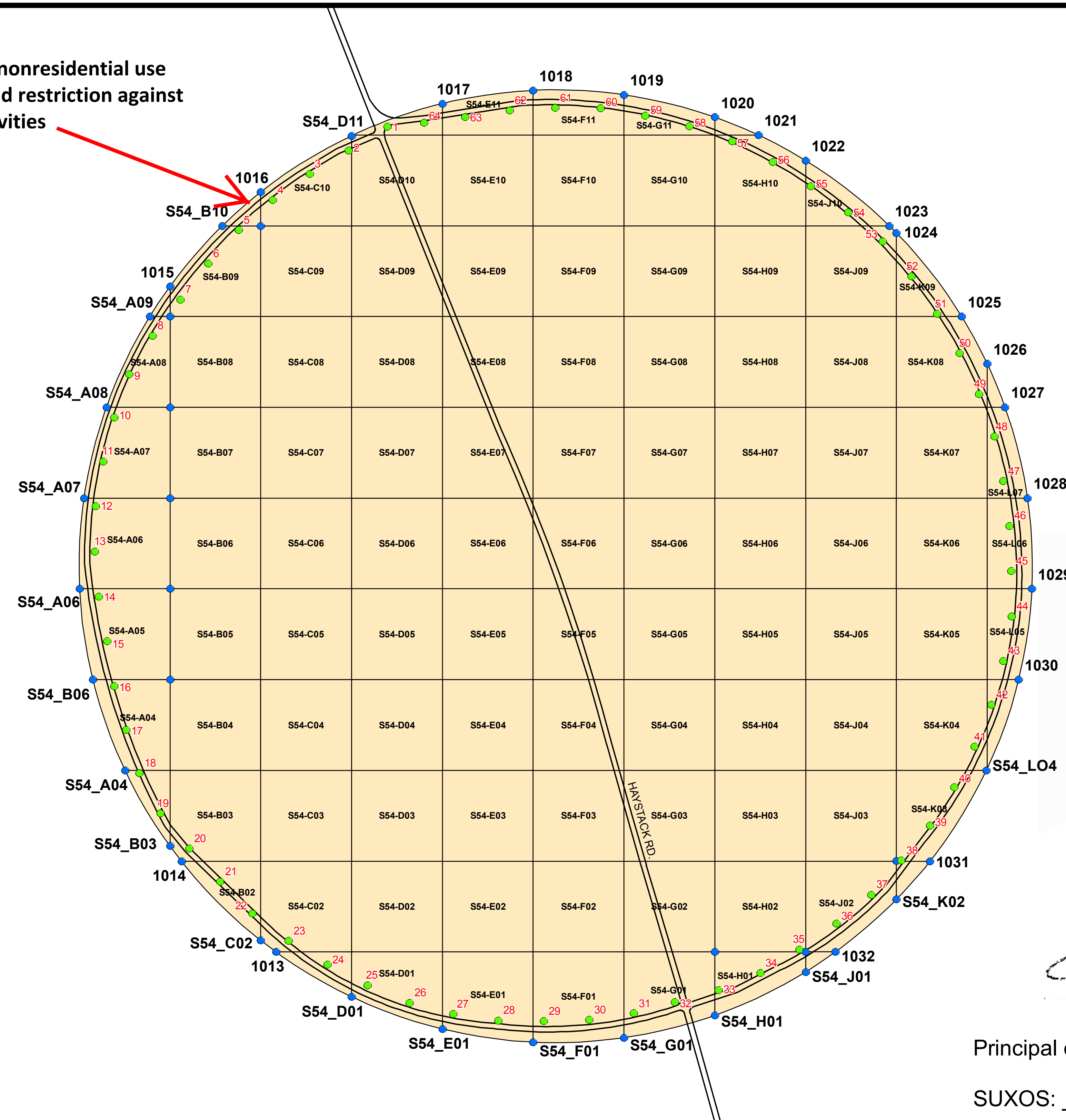
SIGN 41	3613763	395537.5	S54_D01	395119.3	3613595.1
SIGN 42	3613791.2	395548.8	S54_D11	395119.4	3614173.3
SIGN 43	3613820.6	395556.7	S54_E01	395180.3	3613573.5
SIGN 44	3613850.5	395562.3	S54_F01	395241.3	3613564.6
SIGN 45	3613880.9	395562.2	S54_G01	395302.2	3613567.6
SIGN 46	3613911.3	395561	S54_H01	395363.2	3613582.6
SIGN 47	3613941.4	395556.7	S54_H02	395363.1	3613625.2
SIGN 48	3613971.3	395550.8	S54_J01	395424.1	3613611.8
SIGN 49	3613999.9	395540.5	S54_J02	395424.1	3613625.2
SIGN 5	3614110.1	395043.4	S54_K02	395485.1	3613660.5
SIGN 50	3614027.4	395527.5	S54_K03	395485.1	3613686.2
SIGN 51	3614053.7	395512.2	S54_LO4	395545.5	3613747.1
SIGN 52	3614078.9	395495.2			
SIGN 53	3614102.3	395475.8			
SIGN 54	3614122	395452.6			
SIGN 55	3614139.3	395427.5			
SIGN 56	3614155.8	395401.9			
SIGN 57	3614169.5	395374.8			
SIGN 58	3614179.6	395346			
SIGN 59	3614186.8	395316.5			
SIGN 6	3614087.5	395022.9			
SIGN 60	3614191.9	395286.4			
SIGN 61	3614192.1	395255.9			
SIGN 62	3614190.3	395225.5			
SIGN 63	3614185.9	395195.4			
SIGN 64	3614182	395167.9			
SIGN 7	3614063.3	395004.4			
SIGN 8	3614039.1	394985.8			
SIGN 9	3614013.1	394969.9			

Boundary of nonresidential use restriction and restriction against intrusive activities



Legend
- UXO Signs
- Boundary Stakes
- Roads
- Investigated Grids

0 150 300 600

Feet

Datum: NAD83 UTM
Monument: Longhorn Army Ammunition Plant
Monument BG-1 with coordinates
NORTHING-3614801.46,
EASTING-395385.09

STATE OF TEXAS
REGISTERED
DAVID R. COLLINS
1954
PROFESSIONAL
LAND SURVEYOR

I, David R. Collins, Registered Professional Land Surveyor No. 1954, do hereby certify that this plat correctly represents the results of a survey made under my supervision August 4 through September 23, 2008.

Principal of the firm: ______________________________

SUXOS: ______________________________

ATTACHMENT 2

INITIAL NOTICE OF LAND USE CONTROLS FOR FOUR ENVIRONMENTAL SITES AT LONGHORN ARMY AMMUNITION PLANT (LHAAP), KARNACK, TEXAS TRANSMITTAL LETTERS

00881488

December 8, 2016

DAIM-ODB-LO

Senator Ted Cruz
305 S. Broadway, Suite 501
Tyler, TX 75702

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Senator John Cornyn
517 Hart Senate Office Bldg.
Washington, DC 20510

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881490

December 8, 2016

DAIM-ODB-LO

Congressman Louie Gohmert
Congressional District 1
1121 ESE Loop 323, Ste 206
Tyler, TX 75701

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Senator Kevin Eltife
P.O. Box 12068
Capitol Station
Austin, Texas 78711

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881492

December 8, 2016

DAIM-ODB-LO

Representative Chris Paddie
Room E2.412
P.O. Box 2910
Austin, TX 78768

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881493

December 8, 2016

DAIM-ODB-LO

Hugh Taylor - Harrison County Judge
Harrison County Historical Courthouse
#1 Peter Whetstone Square, Room 314
Marshall, TX 75670

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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Sincerely,

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Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

William Hatfield
Harrison County Historical Courthouse
#1 Peter Whetstone Square, Room 307
Marshall, TX 75670

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Sam Canup
P.O Box 277
Uncertain, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881496

December 8, 2016

DAIM-ODB-LO

Erik Duerkop
USFWS - Caddo Lake NWR
15600 State Hwy 134
National Wildlife Refuge
Karnack, Texas 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881497

December 8, 2016

DAIM-ODB-LO

Carl Shelton – President
Liegh Water Supply Corporation Board of Directors
P.O. Box 1408
Marshall, TX 75671

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Paul Fortune – Vice President
Liegh Water Supply Corporation Board of Directors
P.O. Box 1408
Marshall, TX 75671

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881499

December 8, 2016

DAIM-ODB-LO

Jim McCutchens – Secretary/Treasurer
Liegh Water Supply Corporation Board of Directors
P.O. Box 1408
Marshall, TX 75671

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Chris Miller
Liegh Water Supply Corporation Board of Directors
P.O. Box 1408
Marshall, TX 75671

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Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Joe Stephens
Liegh Water Supply Corporation Board of Directors
P.O. Box 1408
Marshall, TX 75671

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Octavia Polk
Liegh Water Supply Corporation Board of Directors
P.O. Box 1408
Marshall, TX 75671

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Rick Sims
Liegh Water Supply Corporation Board of Directors
P.O. Box 1408
Marshall, TX 75671

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881504

December 8, 2016

DAIM-ODB-LO

Brenda Walker
Liegh Water Supply Corporation Board of Directors
P.O. Box 1408
Marshall, TX 75671

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881505

December 8, 2016

DAIM-ODB-LO

Terry Britt – President
Caddo Lake Water Supply Corporation Board of Directors
159 Easy St.
Karnack, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881506

December 8, 2016

DAIM-ODB-LO

Robert Wall – Vice-President
Caddo Lake Water Supply Corporation Board of Directors
2153 Dorough Rd.
Karnack, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881507

December 8, 2016

DAIM-ODB-LO

Joe Oliphant – Secretary Treasurer
Caddo Lake Water Supply Corporation Board of Directors
2451 Blairs Landing Rd.
Karnack, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

The attached information is provided to fulfill a requirement of the ROD by giving notice of the groundwater and soil (surface and subsurface) contamination and any land use restrictions referenced in the ROD within 90 days of ROD signature. The notices are being sent to federal, state and local governments involved at these sites and the owners and occupants of the properties subject to the use restrictions and land use controls.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881508

December 8, 2016

DAIM-ODB-LO

Billy Wall
Caddo Lake Water Supply Corporation Board of Directors
2149 Dorough Rd.
Karnack, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

David Smith
Caddo Lake Water Supply Corporation Board of Directors
449 Cypress Drive
Uncertain, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Jay Webb
Caddo Lake Water Supply Corporation Board of Directors
1027 Cypress Dr.
Uncertain, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881511

December 8, 2016

DAIM-ODB-LO

Ernest Knott
Caddo Lake Water Supply Corporation Board of Directors
195 Mossy Brake Rd.
Uncertain, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

December 8, 2016

DAIM-ODB-LO

Gary Kempf
Caddo Lake Water Supply Corporation Board of Directors
2249 Blairs Landing Rd.
Karnack, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

00881513

December 8, 2016

DAIM-ODB-LO

Russell Wright
Caddo Lake Water Supply Corporation Board of Directors
3057 Dorough Rd.
Karnack, TX 75661

Re: Initial Notice of Land Use Controls for four environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Records of Decision (RODs) for four sites at LHAAP were signed on September 13, 2016. The four sites are: LHAAP-16 Landfill; LHAAP-17 Burning Ground No. 2/Flashing Area Group 2; LHAAP-001-R South Test Area/South Bomb Area; and, LHAAP-003-R Ground Signal Test Area.

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
D. Richmann (Administrative Record)

ATTACHMENT 3

NOTICE OF LAND USE CONTROLS INCLUDING FINAL LUC BOUNDARY MAPS FOR LHAAP-001-R AND LHAAP-003-R

Notice of Land Use Controls

LHAAP-001-R, South Test Area/South Bomb Area and
LHAAP-003-R, Ground Signal Test Area
Longhorn Army Ammunition Plant, Karnack Texas

The former Longhorn Army Ammunition Plant (LHAAP) is an inactive government-owned, formerly contractor-operated and maintained Department of Defense facility located in central east Texas in the northeast corner of Harrison County. LHAAP is approximately 14 miles northeast of Marshall, Texas. The facility is approximately 40 miles west of Shreveport, Louisiana. The former U.S. Army installation occupied nearly 8,416 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake and is accessed by State Highways 43 and 134.

LHAAP was placed on the National Priorities List (NPL) on August 9, 1990. Activities to remediate contamination began in 1990. After its listing on the NPL, the U.S. Army, the USEPA, and the Texas Water Commission (currently known as the TCEQ) entered into a CERCLA Section 120 Federal Facilities Agreement (FFA) for remedial activities at LHAAP. The FFA became effective December 30, 1991. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property.

The sites addressed in this Notice of Land Use Controls are LHAAP-001-R and LHAAP-003-R, which are shown on the attached Figures and discussed below.

Land Use Controls (LUCs) are applied at LHAAP-001-R and LHAAP-003-R as part of the final remedy in accordance with the Record of Decision signed September 13, 2016. LUCs are necessary to promote ongoing protection of human safety against potential explosive hazards that may remain at the MMRP sites. The performance objectives are to prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds, and to prohibit intrusive activities such as digging or any other activity which could result in explosive safety risks.

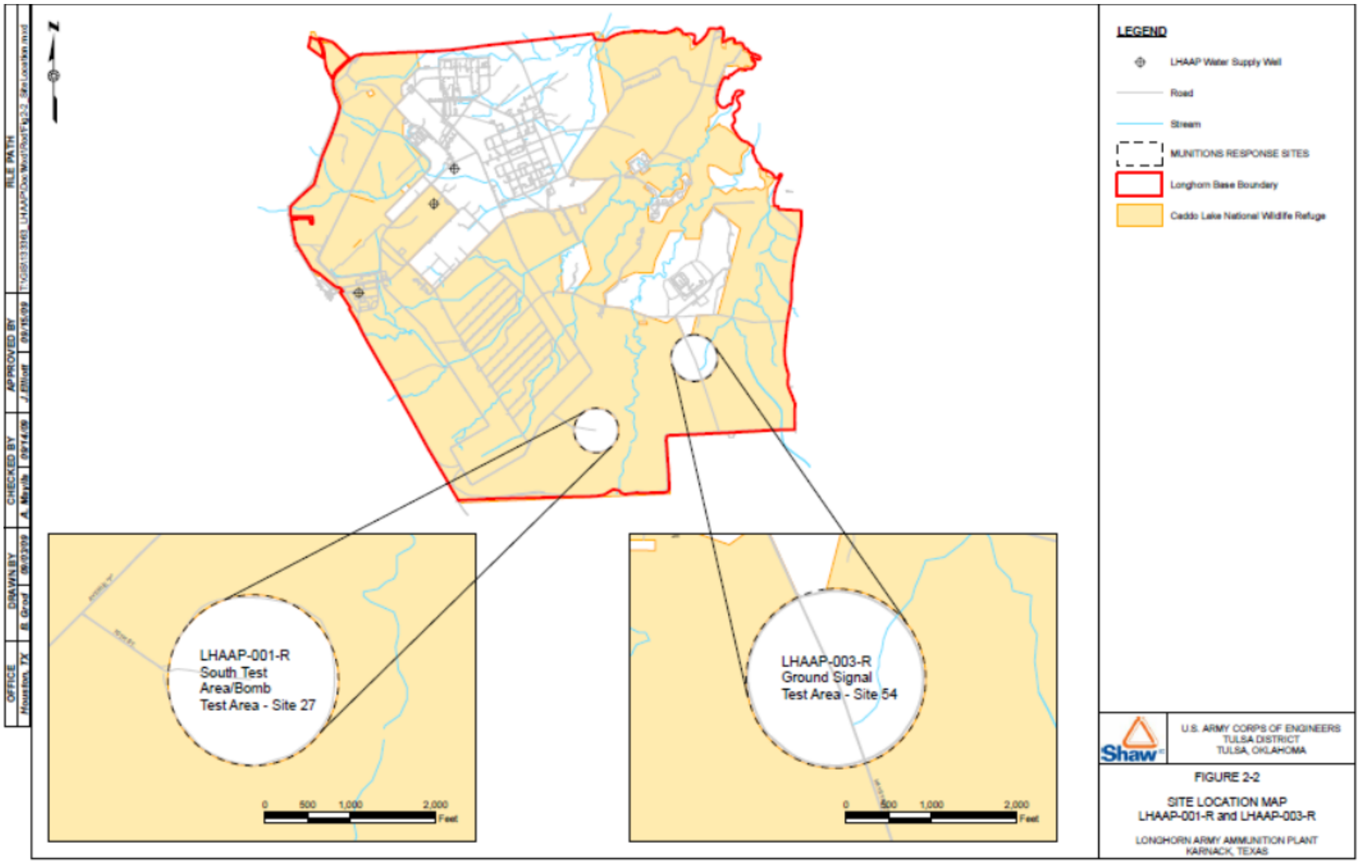
Land Use Controls

- The LUC to prohibit residential land use will remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety.
- The LUC restricting land use to nonresidential will remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety.
- A LUC to prohibit intrusive subsurface activities, including digging, will remain in place until it is demonstrated that the MEC no longer present an explosive hazard. However, intrusive subsurface activities may occur provided that the Army and the EPA approve such intrusive subsurface activities before they are commenced and provided that they are undertaken by qualified personnel who are trained in explosives safety measures.

Further information may be found in the Administrative Record at the Marshall Public Library, at website www.longhornaap.com or by contacting Rose M. Zeiler (479-635-0110 or rose.m.zeiler.civ@mail.mil).

Notice of Land Use Controls

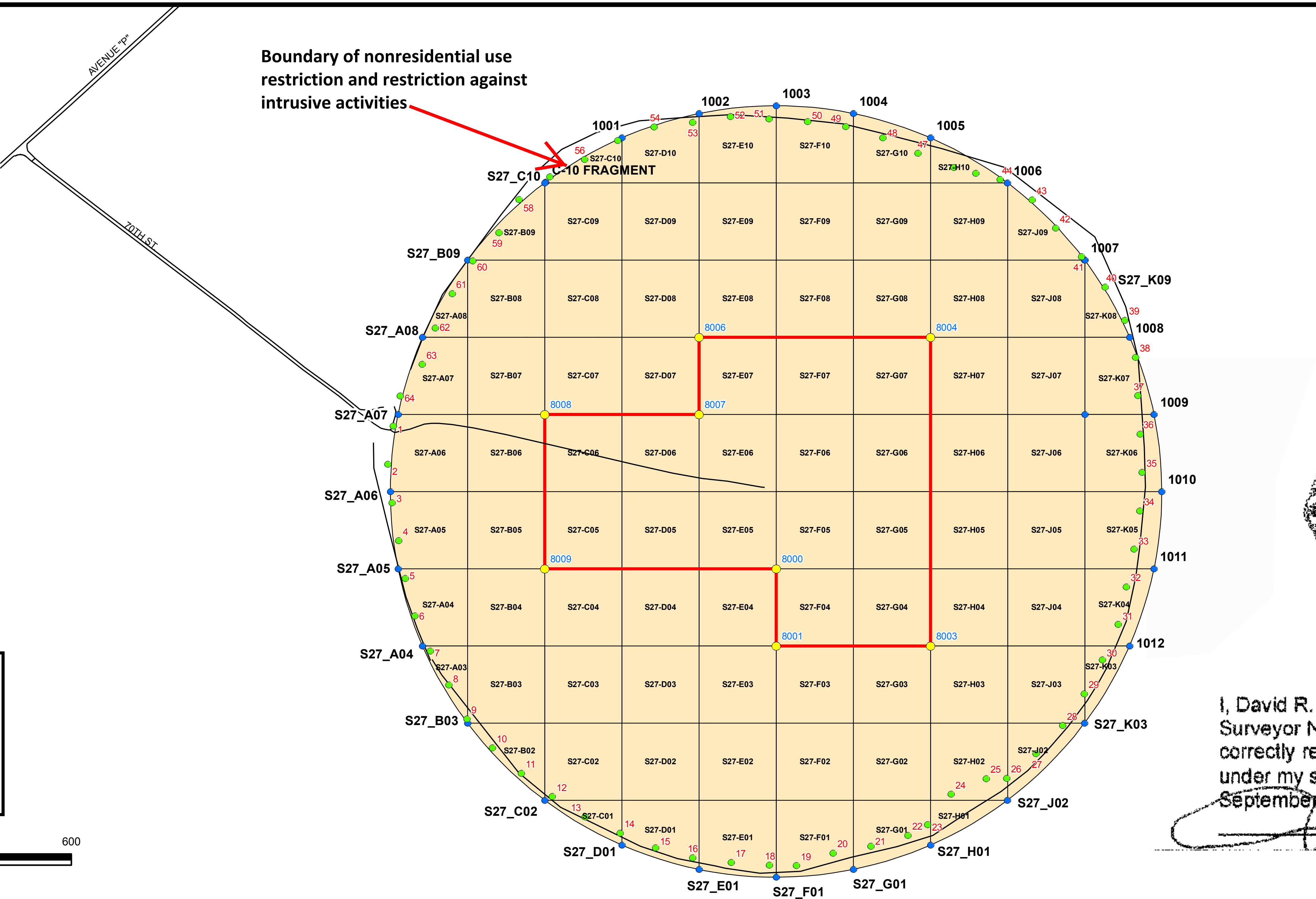
LHAAP-001-R, South Test Area/South Bomb Area and
LHAAP-003-R, Ground Signal Test Area
Longhorn Army Ammunition Plant, Karnack Texas



Notice of Land Use Controls
LHAAP-001-R, South Test Area/South Bomb Area
Longhorn Army Ammunition Plant, Karnack, Texas

N

DESCRIP	NORTHING	EASTING
SIGN 01	3613016.8	393564.7
SIGN 02	3612986.7	393560.5
SIGN 03	3612956.4	393563.9
SIGN 04	3612926.3	393568.9
SIGN 05	3612896.4	393574.2
SIGN 06	3612866.9	393581.7
SIGN 07	3612839.1	393594.1
SIGN 08	3612812.3	393608.5
SIGN 09	3612785.5	393622.9
SIGN 10	3612762.6	393643.0
SIGN 11	3612742.6	393666.0
SIGN 12	3612724.3	393690.2
SIGN 13	3612708.3	393716.2
SIGN 14	3612695.4	393743.8
SIGN 15	3612683.8	393771.9
SIGN 16	3612675.9	393801.4
SIGN 17	3612672.1	393831.6
SIGN 18	3612670.0	393862.0
SIGN 19	3612669.6	393883.3
SIGN 20	3612679.6	393912.1
SIGN 21	3612684.9	393942.1
SIGN 22	3612693.6	393971.2
SIGN 23	3612701.9	393987.0
SIGN 24	3612726.1	394005.4
SIGN 25	3612738.3	394033.3
SIGN 26	3612738.6	394049.3
SIGN 27	3612758.1	394072.6
SIGN 28	3612780.3	394093.6
SIGN 29	3612805.5	394110.5
SIGN 30	3612832.3	394124.9
SIGN 31	3612860.1	394137.3
SIGN 32	3612889.8	394143.8
SIGN 33	3612919.7	394149.8
SIGN 34	3612949.8	394154.5
SIGN 35	3612980.2	394156.4
SIGN 36	3613010.6	394154.7
SIGN 37	3613040.9	394152.8
SIGN 38	3613071.3	394151.2
SIGN 39	3613100.5	394142.6
SIGN 40	3613126.7	394127.2
SIGN 41	3613150.7	394108.5
SIGN 42	3613173.2	394088.0
SIGN 43	3613195.6	394069.6
SIGN 44	3613211.6	394044.1
SIGN 45	3613216.5	394024.9
SIGN 46	3613221.1	394007.6
SIGN 47	3613232.4	393979.3
SIGN 48	3613244.4	393951.4
SIGN 49	3613253.3	393922.2
SIGN 50	3613257.5	393892.0
SIGN 51	3613259.5	393861.7
SIGN 52	3613261.2	393831.2
SIGN 53	3613256.8	393801.1
SIGN 54	3613253.2	393770.8
SIGN 55	3613242.5	393742.2
SIGN 56	3613227.5	393715.8
SIGN 57	3613213.7	393688.6
SIGN 58	3613195.8	393664.0
SIGN 59	3613169.6	393648.3
SIGN 60	3613147.5	393627.4
SIGN 61	3613121.6	393611.4
SIGN 62	3613094.3	393597.9
SIGN 63	3613065.7	393587.4
SIGN 64	3613040.5	393570.2



Legend

- OBOD Corners
- UXO Sign
- Boundary Stakes
- Roads
- OBOD
- Investigated Grids

0 150 300 600
Feet

Datum: NAD83 UTM
Monument: Longhorn Army Ammunition Plant
Monument BG-1 with coordinates
NORTHING-3614801.46,
EASTING-395385.09

DESCRIP	NORTHING	EASTING
8000	3612904.2	393867.3
8001	3612843.2	393867.3
8003	3612843.2	393989.2
8004	3613087.0	393989.2
8006	3613087.1	393806.4
8007	3613026.1	393806.4
8008	3613026.1	393684.4
8009	3612904.2	393684.4

DESCRIP	NORTHING	EASTING
1001	393745.4	3613244.5
1002	393806.4	3613263.8
1003	393867.3	3613269.9
1004	393928.3	3613263.8
1005	393989.2	3613244.5
1006	394050.1	3613209.0
1007	394111.0	3613148.0
1008	394146.5	3613087.0
1009	394165.8	3613026.1
1010	394171.9	3612965.1
1011	394165.8	3612904.2
1012	394146.5	3612843.2
C-10 FRAGMENT	393685.2	3613209.4
S27_A04	393588.0	3612843.2
S27_A05	393568.7	3612904.2
S27_A06	393562.5	3612965.1
S27_A07	393568.6	3613026.1
S27_A08	393587.9	3613087.1
S27_B03	393623.5	3612782.3
S27_B09	393623.5	3613148.0
S27_C02	393684.6	3612721.3
S27_C10	393684.4	3613209.0
S27_D01	393745.4	3612685.9
S27_E01	393806.4	3612666.6
S27_F01	393867.3	3612660.5
S27_G01	393928.3	3612666.7
S27_H01	393989.3	3612686.0
S27_J02	394049.9	3612721.3
S27_K03	394110.9	3612782.3
S27_K07	394111.2	3613026.1
S27_K09	394111.2	3613147.9

STATE OF TEXAS
REGISTERED
DAVID R. COLLINS
1954
PROFESSIONAL LAND SURVEYOR

I, David R. Collins, Registered Professional Land Surveyor No. 1954, do hereby certify that this plat correctly represents the results of a survey made under my supervision August 4 through September 23, 2008.

Principal of the firm: ______________________

SUXOS: ______________________

Notice of Land Use Controls
LHAAP-003-R, Ground Signal Test Area
Longhorn Army Ammunition Plant, Karnack, Texas

DESCRIP	NORTH	EAST	DESCRIP	NORTHIN	EASTING
SIGN 1	3614179.4	395143.2	1013	395068.6	3613625.2
SIGN 10	3613984.2	394959.8	1014	395005.1	3613686.2
SIGN 11	3613954.6	394952.4	1015	394997.4	3614072.1
SIGN 12	3613924.6	394947.4	1016	395058.4	3614135.6
SIGN 13	3613894.1	394947	1017	395180.3	3614195.0
SIGN 14	3613863.7	394949.6	1018	395241.3	3614203.9
SIGN 15	3613833.8	394955.1	1019	395302.2	3614200.9
SIGN 16	3613803.8	394959.8	1020	395363.2	3614185.9
SIGN 17	3613774.4	394967.8	1021	395392.4	3614173.9
SIGN 18	3613745.2	394976.7	1022	395424.1	3614156.7
SIGN 19	3613718.3	394991.2	1023	395480.2	3614112.9
SIGN 2	3614163.4	395117.3	1024	395485.1	3614108.0
SIGN 20	3613694.6	395010.3	1025	395528.9	3614051.9
SIGN 21	3613672.4	395031.1	1026	395546.1	3614020.2
SIGN 22	3613651.1	395052.8	1027	395558.0	3613991.0
SIGN 23	3613632.6	395077	1028	395573.1	3613930.0
SIGN 24	3613616.8	395103.1	1029	395576.0	3613869.1
SIGN 25	3613602.8	395130	1030	395567.2	3613808.1
SIGN 26	3613591	395158.1	1031	395507.7	3613686.2
SIGN 27	3613583.5	395187.6	1032	395444.2	3613625.2
SIGN 28	3613579.1	395217.8	S54_A04	394967.3	3613747.1
SIGN 29	3613578.7	395248.2	S54_A06	394936.8	3613869.1
SIGN 3	3614147.8	395091.2	S54_A07	394939.8	3613930.0
SIGN 30	3613579.6	395278.7	S54_A08	394954.8	3613991.0
SIGN 31	3613584.2	395308.8	S54_A09	394983.9	3614051.9
SIGN 32	3613591.4	395336.3	S54_B03	394997.4	3613696.4
SIGN 33	3613599.5	395365.6	S54_B06	394997.4	3613808.1
SIGN 34	3613611	395393.8	S54_B06	394945.7	3613808.1
SIGN 35	3613626.8	395419.8	S54_B06	394997.4	3613869.1
SIGN 36	3613644.2	395444.8	S54_B07	394997.4	3613930.0
SIGN 37	3613663.6	395468.2	S54_B08	394997.4	3613991.0
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SIGN 40	3613735.9	395523.8	S54_C10	395058.4	3614112.9
SIGN 41	3613763	395537.5	S54_D01	395119.3	3613595.1
SIGN 42	3613791.2	395548.8	S54_D11	395119.4	3614173.3
SIGN 43	3613820.6	395556.7	S54_E01	395180.3	3613573.5
SIGN 44	3613850.5	395562.3	S54_F01	395241.3	3613564.6
SIGN 45	3613880.9	395562.2	S54_G01	395302.2	3613567.6
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SIGN 47	3613941.4	395556.7	S54_H02	395363.1	3613625.2
SIGN 48	3613971.3	395550.8	S54_J01	395424.1	3613611.8
SIGN 49	3613999.9	395540.5	S54_J02	395424.1	3613625.2
SIGN 5	3614110.1	395043.4	S54_K02	395485.1	3613660.5
SIGN 50	3614027.4	395527.5	S54_K03	395485.1	3613686.2
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SIGN 52	3614078.9	395495.2			
SIGN 53	3614102.3	395475.8			
SIGN 54	3614122	395452.6			
SIGN 55	3614139.3	395427.5			
SIGN 56	3614155.8	395401.9			
SIGN 57	3614169.5	395374.8			
SIGN 58	3614179.6	395346			
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SIGN 6	3614087.5	395022.9			
SIGN 60	3614191.9	395286.4			
SIGN 61	3614192.1	395255.9			
SIGN 62	3614190.3	395225.5			
SIGN 63	3614185.9	395195.4			
SIGN 64	3614182	395167.9			
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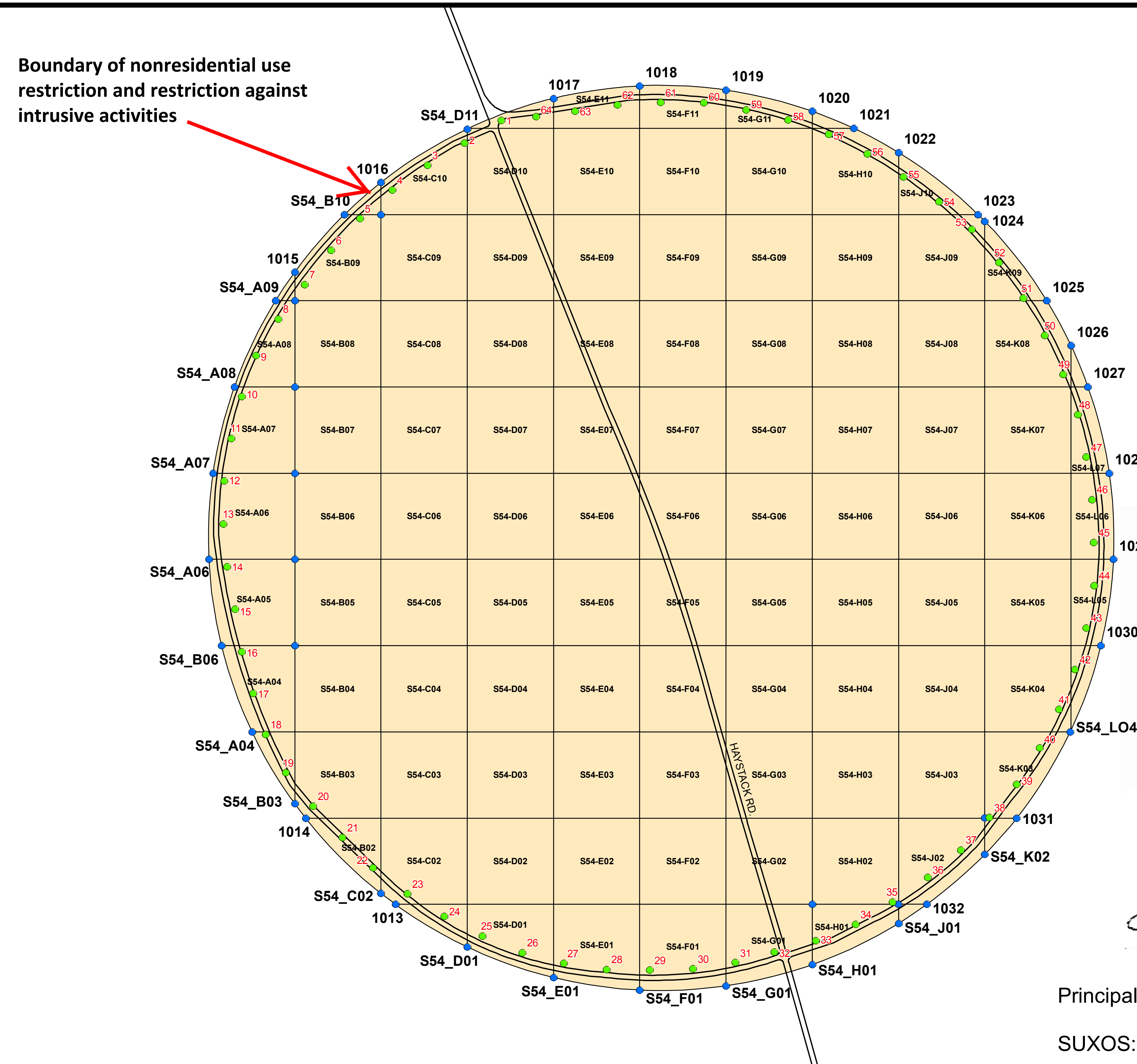
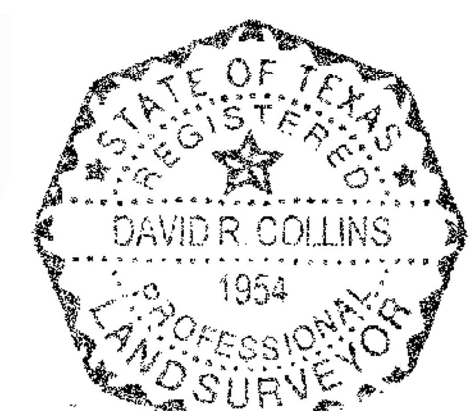
SIGN 9	3614013.1	394969.9			



Legend
- UXO Signs
- Boundary Stakes
- Roads
- Investigated Grids

0 150 300 600
Feet

Datum: NAD83 UTM
Monument: Longhorn Army Ammunition Plant
Monument BG-1 with coordinates
NORTHING-3614801.46,
EASTING-395385.09



I, David R. Collins, Registered Professional Land Surveyor No. 1954, do hereby certify that this plat correctly represents the results of a survey made under my supervision August 4 through September 23, 2008.

Principal of the firm: ______________________________

SUXOS: ______________________________

ATTACHMENT 4

NOTICE OF LAND USE CONTROLS FOR TWO ENVIRONMENTAL SITES AT LONGHORN ARMY AMMUNITION PLANT (LHAAP), KARNACK, TEXAS TRANSMITTAL LETTERS

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May 9, 2018

DAIM-ODB-LO

Senator Ted Cruz
305 S. Broadway, Suite 501
Tyler, TX 75702

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Land Use Control (LUC) Remedial Design (RD)/Remedial Action Construction Report (RACR) for two sites at LHAAP was completed in 2018. The two sites are: LHAAP-001-R South Test Area/South Bomb Area and LHAAP-003-R Ground Signal Test Area.

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The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
Administrative Record

May 9, 2018

DAIM-ODB-LO

Senator John Cornyn
517 Hart Senate Office Bldg.
Washington, DC 20510

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Administrative Record

00881524

May 9, 2018

DAIM-ODB-LO

Congressman Louie Gohmert
Congressional District 1
1121 ESE Loop 323, Ste 206
Tyler, TX 75701

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Land Use Control (LUC) Remedial Design (RD)/Remedial Action Construction Report (RACR) for two sites at LHAAP was completed in 2018. The two sites are: LHAAP-001-R South Test Area/South Bomb Area and LHAAP-003-R Ground Signal Test Area.

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Administrative Record

00881525

May 9, 2018

DAIM-ODB-LO

Senator Kevin Eltife
P.O. Box 12068
Capitol Station
Austin, Texas 78711

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

The final Land Use Control (LUC) Remedial Design (RD)/Remedial Action Construction Report (RACR) for two sites at LHAAP was completed in 2018. The two sites are: LHAAP-001-R South Test Area/South Bomb Area and LHAAP-003-R Ground Signal Test Area.

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Administrative Record

00881526

May 9, 2018

DAIM-ODB-LO

Representative Chris Paddie
Room E2.412
P.O. Box 2910
Austin, TX 78768

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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A. Palmie, TCEQ, Austin, TX
Administrative Record

May 9, 2018

DAIM-ODB-LO

Hugh Taylor - Harrison County Judge
Harrison County Historical Courthouse
#1 Peter Whetstone Square, Room 314
Marshall, TX 75670

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Administrative Record

00881528

May 9, 2018

DAIM-ODB-LO

William Hatfield
Harrison County Historical Courthouse
#1 Peter Whetstone Square, Room 307
Marshall, TX 75670

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Longhorn AAP Site Manager

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A. Palmie, TCEQ, Austin, TX
Administrative Record

May 9, 2018

DAIM-ODB-LO

Sam Canup
P.O Box 277
Uncertain, TX 75661

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
Administrative Record

May 9, 2018

DAIM-ODB-LO

Erik Duerkop
USFWS - Caddo Lake NWR
15600 State Hwy 134
National Wildlife Refuge
Karnack, Texas 75661

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
Administrative Record

00881531

May 9, 2018

DAIM-ODB-LO

Carl Shelton – President
Liegh Water Supply Corporation Board of Directors
P.O. Box 1408
Marshall, TX 75671

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
Administrative Record

00881532

May 9, 2018

DAIM-ODB-LO

Terry Britt – President
Caddo Lake Water Supply Corporation Board of Directors
159 Easy St.
Karnack, TX 75661

Re: Notice of Land Use Controls for two environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

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Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Three Enclosures
Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
A. Palmie, TCEQ, Austin, TX
Administrative Record

APPENDIX A

LTM INSPECTION AND MAINTENANCE CHECKLIST

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LTM Inspection and Maintenance Checklist

General Information	
Project Name	LTM Inspection and Maintenance, LHAAP-001-R and LHAAP-003-R MMRP, Longhorn Army Ammunition Plant, Karnack, TX
Contractor	
Inspector's Name	
Inspector's Title	
Inspector's Signature	
Inspector's Contact Number	
Inspection Date	
Type of Inspection	☐ Quarterly ☐ Semiannual ☐ Annual ☐ Prior to forecast rain ☐ After rain event ☐ Other______________________________

Description		Yes	No	N/A	**Comments** (Attach photos/location sketches)	**Corrective Action** (Attach photos)
A. Perimeter Signage						
A.1	Are there any damaged signs?					
A.2	Are there any missing signs?					
A.3	Are all signs legible?					
A.4	Is perimeter boundary mowed?					

A.5	Are signs visible from one sign to the next sign?					
B. LUC Boundary						
B.1	Is the LUC Boundary identifiable?					
C. Dig and Intrusive Activities restriction						
C.1	Any observed digging activities or similar intrusive activities within the site boundaries?					

Note: Annual compliance inspections shall be conducted no later than March 1 of each year for the previous calendar year and filed onsite.

APPENDIX B

LAND USE CONTROL COMPLIANCE CERTIFICATION FORM

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LAND USE CONTROL COMPLIANCE CERTIFICATION FORM

In accordance with the LUC Plan dated_________________for LHAAP-001-R and LHAAP-003-R, an inspection of the sites was conducted by_________________________on____________.

A summary of land use control mechanisms is as follows:

- Land use restrictions - restrict land use to non-residential.
- Integrity of LUC signage by ensuring signs are present, legible and have visibility from one sign to the next.

A summary of compliance with land use and restriction covenants is as follows:

- The posted signs are properly maintained at LHAAP-001-R and LHAAP-003-R.
- No digging or intrusive activities have taken place within the boundaries identified for LHAAP-001-R and LHAAP-003-R.
- No land use other than non-residential.
- Pamphlets and safety awareness video are being used to educate visitors.

I, the undersigned, do document that the inspections were performed as indicated above, and that the above information is true and correct to the best of my knowledge, information, and belief.

Date: ______________________

Name: ______________________

Signature: ___________________

Completed annual compliance inspections shall be conducted no later than March 1 of each year for the previous calendar year and filed on site.

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APPENDIX C

RECORDATION OF LAND USE CONTROLS FOR LHAAP-001-R AND LHAAP-003-R

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00881543

2018-000004040

*****DO NOT REMOVE THIS PAGE – IT IS A PART OF THIS INSTRUMENT*****

NOTICE

6 Pages

FILED AND RECORDED – OPR	CLERKS NOTES
On: 04/19/2018 02:27 PM	
Document Number: 2018-000004040	
Receipt No: 1804258	
Amount: $ 42.00	
By: Ann Turner, **Deputy**	
Patsy Cox, County Clerk **Harrison County, Texas**	

COUNTY COURT · COUNTY OF HARRISON, TEXAS

STATE OF TEXAS
COUNTY OF HARRISON
I hereby certify that this instrument was filed on the date and time stamped hereon by me and was duly recorded in the Official Public Records of Harrison County, Texas.

Patsy Cox

Patsy Cox, Harrison County Clerk

Record and Return To:

KIM NEMMERS
4085 ASPEN LANE

EVERGREEN, CO 80439

STATE OF TEXAS

HARRISON COUNTY

INDUSTRIAL SOLID WASTE NOTICE OF LAND USE CONTROLS

KNOW ALL MEN BY THESE PRESENTS THAT:
Pursuant to the Rules of the Texas Commission on Environmental Quality (TCEQ) pertaining to Industrial Solid Waste Management, this document is hereby filed in the Public Records of Harrison County, Texas in compliance with the recordation requirements of said rules:

I

The U.S. Army, Department of Defense, has performed a removal of munitions and explosives of concern on the land described herein. Longhorn Army Ammunition Plant (LHAAP) Munition Response Sites (MRSs) LHAAP-001-R (South Test Area/Bomb Test Area) and LHAAP-003-R (Ground Signal Test Area) are former military test areas located in the southern and southeastern portions of LHAAP, respectively. LHAAP was placed on the National Priorities List (NPL) in August 1990. After its listing on the NPL, the U.S. Army, United States Environmental Protection Agency (USEPA) and the TCEQ entered into an agreement under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 120 for remedial activities. The CERCLA Section 120 Agreement, referred to as the Federal Facility Agreement (FFA), became effective on December 30, 1991. MRSs LHAAP-001-R and LHAAP-003-R are co-located with NPL sites LHAAP-27 and LHAAP-54, respectively and are also considered NPL sites. Remedial activities at these sites were performed in accordance with the FFA requirements.

MRS LHAAP-01-R was constructed in 1954 and was used for testing photoflash bombs produced at the facility until approximately 1956. During the late 1950s, illuminating signal devises were also demilitarized within pits excavated in the vicinity of the test pad. During the 1960s, leaking production items may have been demilitarized by detonation. LHAAP-001-R was identified as an MRS based on the visual confirmation of MEC.

MRS LHAAP-003-R was used intermittently in April 1963 for aerial and on-ground testing and destruction of a variety of devices, including pyrotechnic signal devices, red phosphorus smoke wedges, infrared flares, illuminating mortar shells and cartridges, button bombs and various types of explosive simulators. The site was used intermittently over a 20-year period for testing and burn-out of rocket motors. From late 1988 through 1991, the site was used for the burn-out of Pershing missile rocket motors and, occasionally, leaking white phosphorus munitions were burned at the site as a demilitarization activity. LHAAP-003-R was identified as an MRS based on the reported presence of MEC.

Non-time critical removal actions (NTCRAs) for MEC removal were conducted at both sites in 2008. A Final Record of Decision (ROD) for LHAAP-001-R and LHAAP-003-R was issued in August 2016, which documents the final selected remedy for the sites, including the implementation of Land Use Controls (LUCs) designed to promote ongoing protection of human safety against potential explosive hazards that may have remained at the sites following the MEC removal actions. The LUCs' performance objectives are to prohibit residential use, to restrict land use to non-residential, and to prohibit intrusive activities such as digging or any other activity which could result in explosive safety risks.

Further information may be found by examination of the Notice of Registration No. 30990 files, which are available for inspection upon request at TCEQ, Central File Room Customer Service Center, Building E (Room 103. first floor) 12100 Park 35 Circle, Austin, Texas 78753, (512) 239-2900, Monday through Friday 8:00 am to 5:00 pm, or the Administrative Record available at the Marshall Public Library, 300 South Alamo Boulevard, Marshall, Texas 75670, (903) 935-4465, Monday, Tuesday and Thursday 9:30AM – 7:30PM, Wednesday and Friday 9:30AM – 5:30PM, and Saturday 9:30AM – 3:30PM.

The TCEQ requires certain persons to provide recordation in the real property records to notify the public on the conditions of the land and/or the occurrence of remediation. This notification is not a representation or warranty by the TCEQ of the suitability of this land for any purpose.

II

MRS LHAAP-001-R covers an area of approximately 72.14 acre-tract, more or less, located in Harrison County, Texas, near the town of Karnack, being more particularly described with survey plat and metes and bounds established in **Exhibit A**. The entire LHAAP-001-R parcel is within a LUC boundary which is described in **Exhibit A**.

MRS LHAAP-003-R covers an area of approximately 79.53 acre-tract, more or less, located in Harrison County, Texas, near the town of Karnack, being more particularly described with survey plat and metes and bounds established in **Exhibit B**. The entire LHAAP-003-R parcel is within a LUC boundary which is described in **Exhibit B**.

The United States Department of the Army has undertaken careful environmental study of MRSs LHAAP-001-R and LHAAP-003-R and the USEPA and TCEQ concluded that LUCs should remain in place until it is demonstrated that MEC no longer presents an explosive hazard.

Future use of these sites is intended as a national wildlife refuge consistent with industrial or recreational activities and not for residential purposes. The LUCs placed on the property to ensure appropriate future use include:

(1) Use must remain non-residential as described above. For purposes of this certification, residential use includes, but is not limited to, single family or multi-family residences, child care facilities, nursing home or assisted living facilities, and any type of educational purpose for children/young adults in grades kindergarten through 12. This LUC will remain in place until it is demonstrated that the MEC no longer present a threat to human safety/health.

(2) No intrusive activity shall be permitted, which includes digging or any other activity which could result in explosive safety risks, without prior consent. This LUC will remain in place until it is demonstrated that the MEC no longer present an explosive hazard. Intrusive subsurface activities may occur provided that the Army and the EPA approve such intrusive subsurface activities before they are commenced and provided that they are undertaken by qualified personnel who are trained in explosives safety measures.

III

The owner of these sites is the Department of the Army, and its address where more specific information may be obtained is as follows:

ATTN: DAIM-ODB-LO (R. Zeiler)
Post office Box 220
Ratcliff, AR 72951
Or
Assistant Chief of Staff for Installation Management
ATN: DAIM-ODB (T. Lederle)
600 Army Pentagon
Washington, D.C. 20310-0600

Rose M. Zeiler
Rose M. Zeiler
Longhorn AP Site Manager

EXECUTED this the 19th day of April, 2018.

BEFORE ME, on this 19th day of April personally appeared Rose M. Zeiler, of the United States Army, United States Department of Defense, known to me to be the person and agent of said agency whose name is subscribed to the foregoing instrument, and she acknowledged to me that she executed the same for the purposes and in the capacity therein expressed.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, this the 19th day of April, 2018.

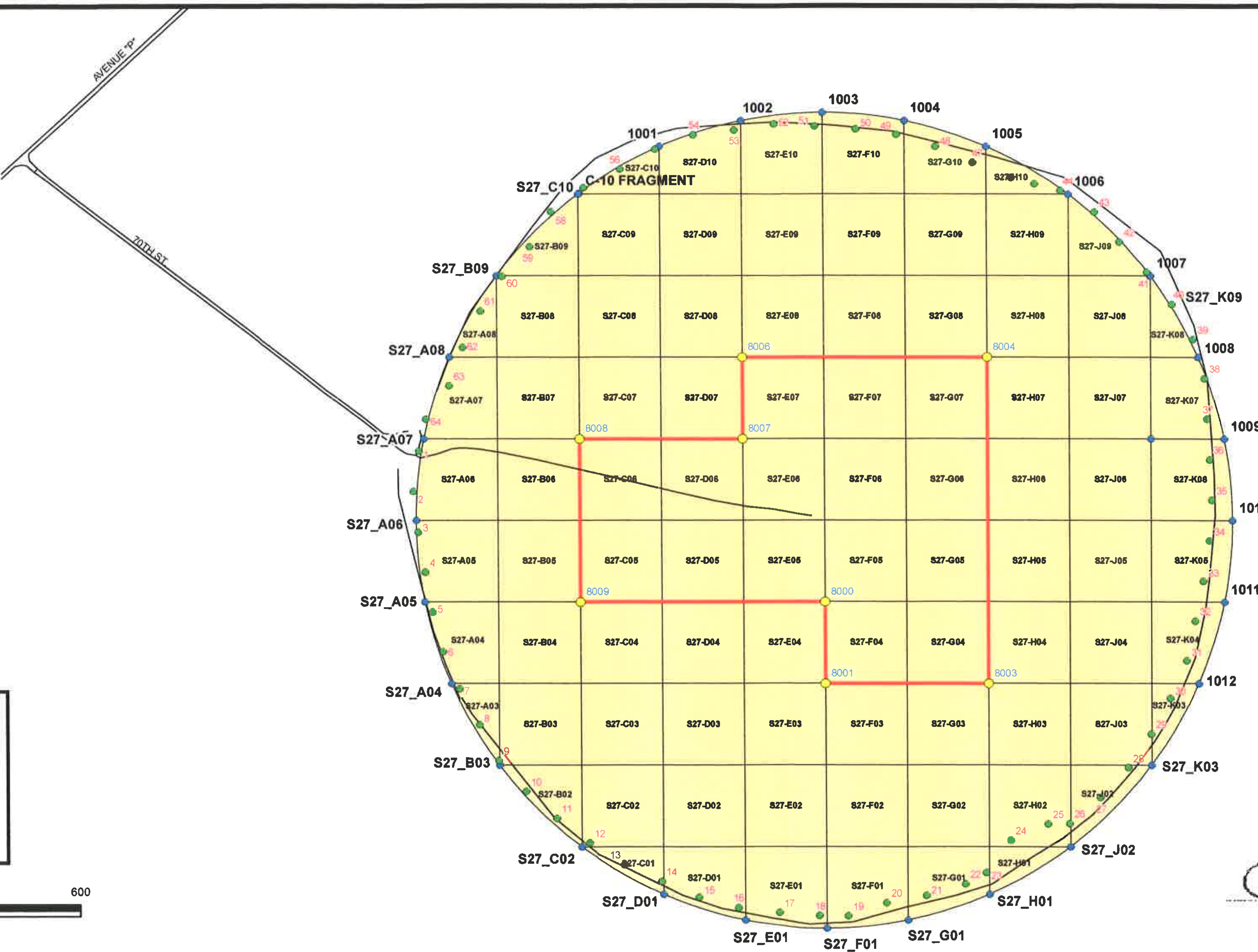
NOTARY PUBLIC STATE OF TEXAS
JENNIFER LESTER
Notary Public State of Texas
COMM. EXP. 1/3/2019
NO. 128484987

Jennifer Lester
Notary Public in and for the State of Texas,
County of Harrison

Exhibit A
LHAAP-001-R, South Test Area/South Bomb Area
Longhorn Army Ammunition Plant, Karnack, Texas

N

DESCRIP	NORTHING	EASTING
SIGN 01	3613016.8	393564.7
SIGN 02	3612986.7	393560.6
SIGN 03	3612956.4	393563.9
SIGN 04	3612926.3	393568.9
SIGN 05	3612896.4	393574.2
SIGN 06	3612866.9	393581.7
SIGN 07	3612839.1	393594.1
SIGN 08	3612812.3	393608.5
SIGN 09	3612785.5	393622.9
SIGN 10	3612762.6	393643.0
SIGN 11	3612742.6	393666.0
SIGN 12	3612724.3	393690.2
SIGN 13	3612708.3	393716.2
SIGN 14	3612695.4	393743.8
SIGN 15	3612683.8	393771.9
SIGN 16	3612675.9	393801.4
SIGN 17	3612672.1	393831.6
SIGN 18	3612670.0	393862.0
SIGN 19	3612669.6	393883.3
SIGN 20	3612679.6	393912.1
SIGN 21	3612684.9	393942.1
SIGN 22	3612693.6	393971.2
SIGN 23	3612701.9	393987.0
SIGN 24	3612726.1	394005.4
SIGN 25	3612736.3	394033.3
SIGN 26	3612738.6	394049.3
SIGN 27	3612758.1	394072.6
SIGN 28	3612780.3	394093.5
SIGN 29	3612805.5	394110.5
SIGN 30	3612832.3	394124.9
SIGN 31	3612860.1	394137.3
SIGN 32	3612889.8	394143.8
SIGN 33	3612919.7	394149.8
SIGN 34	3612949.8	394154.5
SIGN 35	3612980.2	394156.4
SIGN 36	3613010.6	394154.7
SIGN 37	3613040.9	394152.8
SIGN 38	3613071.3	394151.2
SIGN 39	3613100.5	394142.6
SIGN 40	3613126.7	394127.2
SIGN 41	3613150.7	394108.5
SIGN 42	3613173.2	394088.0
SIGN 43	3613195.6	394069.6
SIGN 44	3613211.6	394044.1
SIGN 45	3613216.5	394024.9
SIGN 46	3613221.1	394007.6
SIGN 47	3613232.4	393979.3
SIGN 48	3613244.4	393951.4
SIGN 49	3613253.3	393922.2
SIGN 50	3613257.5	393892.0
SIGN 51	3613259.5	393861.7
SIGN 52	3613261.2	393831.2
SIGN 53	3613256.8	393801.1
SIGN 54	3613253.2	393770.8
SIGN 55	3613242.5	393742.2
SIGN 56	3613227.5	393716.8
SIGN 57	3613213.7	393688.6
SIGN 58	3613195.8	393664.0
SIGN 59	3613169.6	393648.3
SIGN 60	3613147.5	393627.4
SIGN 61	3613121.6	393611.4
SIGN 62	3613094.3	393597.9
SIGN 63	3613065.7	393587.4
SIGN 64	3613040.5	393570.2



DESCRIP	NORTHING	EASTING
8000	3612904.2	393867.3
8001	3612843.2	393867.3
8003	3612843.2	393989.2
8004	3613087.0	393989.2
8006	3613087.1	393806.4
8007	3613026.1	393806.4
8008	3613026.1	393684.4
8009	3612904.2	393684.4

DESCRIP	NORTHING	EASTING
1001	393745.4	3613244.5
1002	393806.4	3613263.8
1003	393867.3	3613269.9
1004	393928.3	3613263.8
1005	393989.2	3613244.5
1006	394050.1	3613209.0
1007	394111.0	3613148.0
1008	394146.5	3613087.0
1009	394165.8	3613026.1
1010	394171.9	3612965.1
1011	394165.8	3612904.2
1012	394146.5	3612843.2
C-10 FRAGMENT	393685.2	3613209.4
S27_A04	393688.0	3612843.2
S27_A05	393568.7	3612904.2
S27_A06	393562.5	3612965.1
S27_A07	393568.6	3613026.1
S27_A08	393587.9	3613087.1
S27_B03	393623.5	3612782.3
S27_B09	393623.5	3613148.0
S27_C02	393684.6	3612721.3
S27_C10	393684.4	3613209.0
S27_D01	393746.4	3612685.9
S27_E01	393806.4	3612666.6
S27_F01	393867.3	3612660.5
S27_G01	393928.3	3612666.7
S27_H01	393989.3	3612686.0
S27_J02	394049.9	3612721.3
S27_K03	394110.9	3612782.3
S27_K07	394111.2	3613026.1
S27_K09	394111.2	3613147.9

Legend

- OBOD Corners
- UXO Sign
- Boundary Stakes
- Roads
- OBOD
- Investigated Grids

0 150 300 600
Feet

STATE OF TEXAS REGISTERED DAVID R COLLINS 1954 PROFESSIONAL LAND SURVEYOR

I, David R. Collins, Registered Professional Land Surveyor No. 1954, do hereby certify that this plat correctly represents the results of a survey made under my supervision August 4 through September 23, 2008.

Datum: NAD83 UTM
Monument: Longhorn Army Ammunition Plant
Monument BG-1 with coordinates
NORTHING-3614801.46,
EASTING-395385.09

Principal of the firm: ____________________

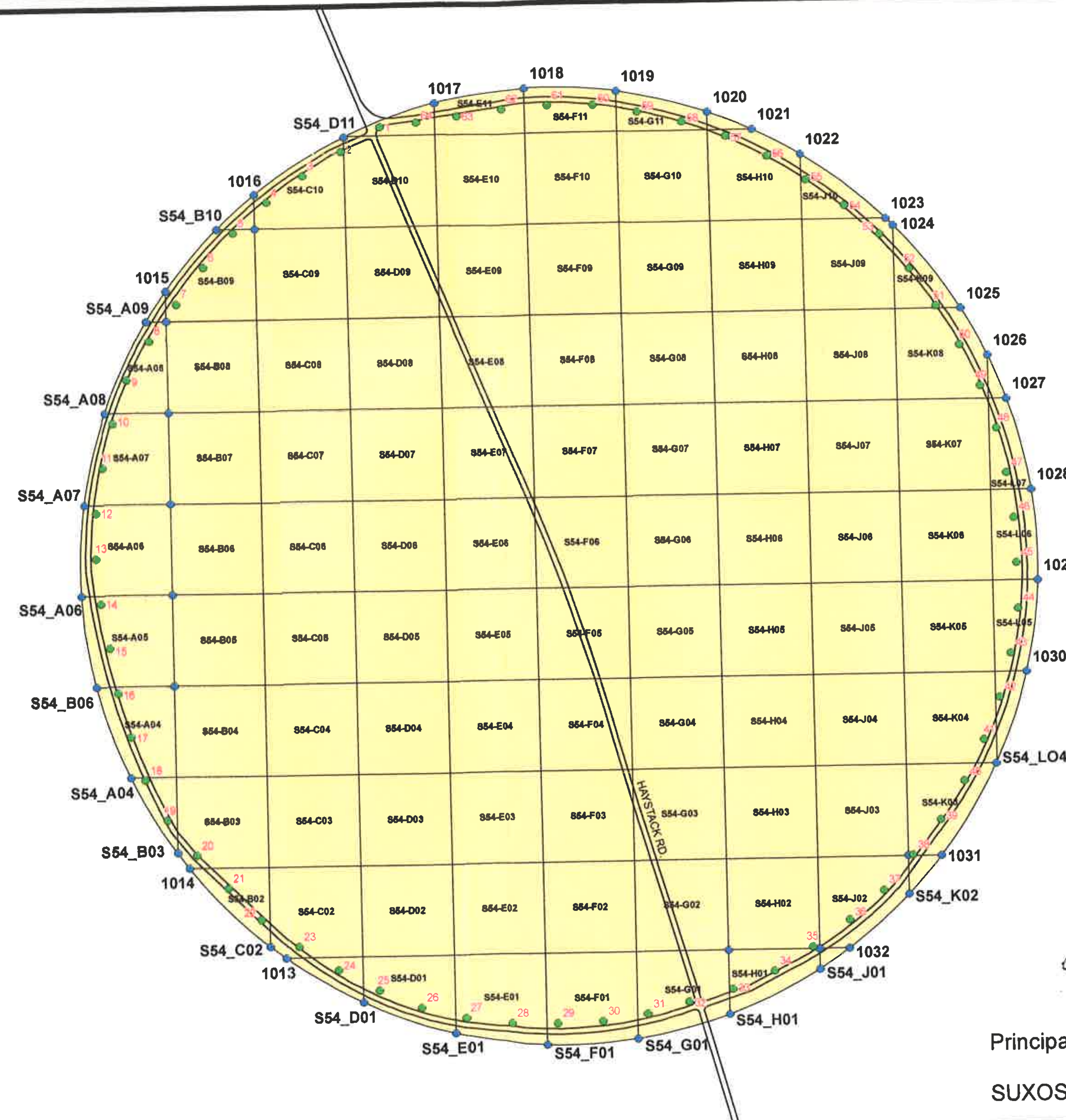
SUXOS: ____________________

Exhibit B
LHAAP-003-R, Ground Signal Test Area
Longhorn Army Ammunition Plant, Karnack, Texas

N

DESCRIP	NORTH	EAST
SIGN 1	3614179.4	395143.2
SIGN 10	3613984.2	394959.8
SIGN 11	3613954.6	394952.4
SIGN 12	3613924.6	394947.4
SIGN 13	3613894.1	394947
SIGN 14	3613863.7	394949.6
SIGN 15	3613833.8	394955.1
SIGN 16	3613803.8	394959.8
SIGN 17	3613774.4	394967.8
SIGN 18	3613745.2	394976.7
SIGN 19	3613718.3	394991.2
SIGN 2	3614163.4	395117.3
SIGN 20	3613694.6	395010.3
SIGN 21	3613672.4	395031.1
SIGN 22	3613651.1	395052.8
SIGN 23	3613632.6	395077
SIGN 24	3613616.8	395103.1
SIGN 25	3613602.8	395130
SIGN 26	3613591	395158.1
SIGN 27	3613583.5	395187.5
SIGN 28	3613579.1	395217.8
SIGN 29	3613578.7	395248.2
SIGN 3	3614147.8	395091.2
SIGN 30	3613579.6	395278.7
SIGN 31	3613584.2	395308.8
SIGN 32	3613591.4	395338.3
SIGN 33	3613599.5	395365.6
SIGN 34	3613611	395393.8
SIGN 35	3613626.8	395419.8
SIGN 36	3613644.2	395444.8
SIGN 37	3613663.6	395468.2
SIGN 38	3613686.5	395488.2
SIGN 39	3613710.2	395507.8
SIGN 4	3614130.2	395066.2
SIGN 40	3613735.9	395523.8
SIGN 41	3613763	395537.5
SIGN 42	3613791.2	395548.8
SIGN 43	3613820.6	395556.7
SIGN 44	3613850.5	395562.3
SIGN 45	3613880.9	395562.2
SIGN 46	3613911.3	395561
SIGN 47	3613941.4	395556.7
SIGN 48	3613971.3	395550.8
SIGN 49	3613999.9	395540.5
SIGN 5	3614110.1	395043.4
SIGN 50	3614027.4	395527.6
SIGN 51	3614053.7	395512.2
SIGN 52	3614076.9	395495.2
SIGN 53	3614102.3	395476.8
SIGN 54	3614122	395452.6
SIGN 55	3614139.3	395427.5
SIGN 56	3614155.8	395401.9
SIGN 57	3614169.5	395374.8
SIGN 58	3614179.6	395346
SIGN 59	3614186.8	395316.5
SIGN 6	3614087.5	395022.9
SIGN 60	3614191.9	395286.4
SIGN 61	3614192.1	395255.9
SIGN 62	3614190.3	395225.5
SIGN 63	3614185.9	395195.4
SIGN 64	3614182	395167.9
SIGN 7	3614063.3	395004.4
SIGN 8	3614039.1	394985.8
SIGN 9	3614013.1	394969.9

DESCRIP	NORTHIN	EASTING
1013	395068.5	3613625.2
1014	395005.1	3613686.2
1015	394997.4	3614072.1
1016	395058.4	3614135.6
1017	395180.3	3614195.0
1018	395241.3	3614203.9
1019	395302.2	3614200.9
1020	395363.2	3614185.9
1021	395392.4	3614173.9
1022	395424.1	3614156.7
1023	395480.2	3614112.9
1024	395485.1	3614108.0
1025	395528.9	3614051.9
1026	395546.1	3614020.2
1027	395558.0	3613991.0
1028	395573.1	3613930.0
1029	395576.0	3613869.1
1030	395567.2	3613808.1
1031	395507.7	3613686.2
1032	395444.2	3613625.2
S54_A04	394967.3	3613747.1
S54_A06	394936.6	3613869.1
S54_A07	394939.8	3613930.0
S54_A08	394954.8	3613991.0
S54_A09	394983.9	3614051.9
S54_B03	394997.4	3613698.4
S54_B05	394997.4	3613808.1
S54_B06	394945.7	3613808.1
S54_B06	394997.4	3613869.1
S54_B07	394997.4	3613930.0
S54_B08	394997.4	3613991.0
S54_B09	394997.4	3614051.9
S54_B10	395032.6	3614112.9
S54_C02	395088.4	3613633.0
S54_C10	395058.4	3614112.9
S54_D01	395119.3	3613596.1
S54_D11	395119.4	3614173.3
S54_E01	395180.3	3613573.5
S54_F01	395241.3	3613564.6
S54_G01	395302.2	3613567.6
S54_H01	395363.2	3613582.6
S54_H02	395363.1	3613625.2
S54_J01	395424.1	3613611.8
S54_J02	395424.1	3613625.2
S54_K02	395485.1	3613660.5
S54_K03	395485.1	3613686.2
S54_LO4	395545.5	3613747.1



Legend
- UXO Signs
- Boundary Stakes
- Roads
- Investigated Grids

0 150 300 600
Feet

Datum: NAD83 UTM
Monument: Longhorn Army Ammunition Plant
Monument BG-1 with coordinates
NORTHING-3614801.46,
EASTING-395385.09

STATE OF TEXAS
REGISTERED
DAVID R COLLINS
1954
PROFESSIONAL
LAND SURVEYOR

I, David R. Collins, Registered Professional Land Surveyor No. 1954, do hereby certify that this plat correctly represents the results of a survey made under my supervision August 4 through September 23, 2008.

Principal of the firm: ____________________

SUXOS: ____________________

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

May 16, 2018

DAIM-ODB-LO

Mr. Rich Mayer
U.S. Environmental Protection Agency
Federal Facilities Section R6
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant Karnack Texas. May 2018

Dear Mr. Mayer,

The above-referenced document is being transmitted to you for your records. Response to comments on the Draft Final version of the document are included within this Final Version.

The document was revised by Bhate Environmental Associates, Inc., (Bhate) on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX
P. Bruckwicki, Caddo Lake NWR, TX
R. Smith, USACE, Tulsa District, OK
A. Williams, USACE, Tulsa District, OK
N. Smith, USAEC, San Antonio, TX
K. Nemmers, Bhate, Lakewood, CO (for project files)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

May 16, 2018

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality Superfund Section, MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant Karnack Texas. May 2018

Dear Ms. Palmie,

The above-referenced document is being transmitted to you for your records. Response to comments on the Draft Final version of the document are included within this Final Version.

The document was revised by Bhate Environmental Associates, Inc., (Bhate) on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
P. Bruckwicki, Caddo Lake NWR, TX
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Responses to Comments on
Draft Final Installation Wide Work Plan (IWWP)
Longhorn Ammunition Plant, Karnack, Texas
15 May 2018

1. Respondent Concurs (C), Does Not Concur (D), Takes Exception (E), or Delete (X).
2. Commenter Agrees (A) with response or Does not Agree (D) with response.

Comment #	Page	Section/ Paragraph	Comment (February 21, 2018)	C,D,E or X[1]	Response (March 15, 2018)	A or D[2]	Comment (April 13, 2018)	C,D,E or X[1]	Response (April 16, 2018)	A or D[2]
Reviewer: April Palmie, TCEQ **Respondent:** Kim Nemmers, Bhate										
1		1, 1-1, last sentence 2nd paragraph	Remove words "Bhate deems"	C	The words "Bhate deems" will be deleted.	A				
2		6, 6-1	Is the *Draft Project Management Plan* part of the administrative record? It has not been shared with regulators. Reference should be to publicly available documents.	C	Reference to the Project Management Plan will be removed.	A				
3		Appendix A, A2.3, 2-2	DPT cores should also be logged. Any competent core should be logged.	C	Reference to DPT coring has been added to first sentence of A2.3. Logging details for competent material has been added to A2.3.	A				
4		Appendix A, A2.3, 2-3	Third bullet on this page ends with a partial sentence.	C	The partial sentence will be removed.	A				
5		Appendix A, A7.3.1.6, 7-4	Include explanation for grouting deep wells.	C	The section will be revised to state "*on both shallow and deep wells.*"	A				
6		Appendix A, A7.3.1.8, 7-4	Most site wells are stick-up, not flush mounts, and this is more suitable for the woody environment.	C	Text within A7.3.8 (previously A7.3.1.8) has been revised to state: *Generally all wells will be installed as aboveground completions. Flush-mount completions will only be done if determined to be appropriate.* Additionally, the order of procedures for surface completions has been switched, placing aboveground completions ahead of flush-mount completions.	A				
7		Appendix A, A7.3.1.8, 7-5	Surface protective posts should be a requirement for all wells at LHAAP. Otherwise prone to damage from equipment and very difficult to find the wells.	C	Text within A7.3.8 (previously A7.3.1.8) has been revised to state: *Four 3- to 4-inch diameter, 5-foot long steel guard posts will be installed on the corner of the concrete pad. These posts will extend at least 2 feet into a concrete footing and at least 3 feet above the ground surface, and be filled with concrete for additional strength.*	A				
8		Appendix A, A9.1, 9-1	Second bullet needs to be split up into two.	C	Information contained in second bullet of A9.1 has been split up into two bullets.	A				
9		Appendix A, A13.2.1, 13-2	Base Identifier revise to "LHAAP 57 = …."	C	Base Identifier has been revised to *LHAAP57.*	A				
10		Appendix A, A14, 14-1	Search here and elsewhere in the document for "ethane, ethane" should be "ethane, ethene"	C	Text of A14 has been revised to *ethene*. Remainder of document searched to confirm that this is the only occurrence.	A				

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11		Appendix A, A16.1.1	4th bullet – TCEQ and EPA should also be notified.	C	Fourth bullet of A16.1.1 has been revised to state: *Give notice to the Texas Commission on Environmental Quality (TCEQ) and USEPA of intent to abandon well.*	A				
12		Appendix A, 17-21	Change formatting to be consistent with Appendix A. This will require extensive rewrites/reformatting. Remove SOP specific table of contents and acronym list. Remove reference to the SOP as an attachment. Remove references to this document (HASP, IWWP, QAPP)	C	Appendix A SOP 17 through SOP 21 have been revised as suggested.	A				
13		Appendix A, SOP 18, General	This is very important SOP which we have discussed as a group quite extensively. Update references to: TCEQ 2012 Surface Water Quality Procedures Manual, Vol. 1: Physical and Chemical Methods (RG-415) USGS also has a great field manual dated 2012 but I don't know the title.	C	Reference to TCEQ Manual has been updated as suggested and as further discussed in USEPA Comment and Response Number 12 below.	A				
14		Appendix A, SOP 18, General	Process should include collecting stream bed profile at least once a year. Staff plate should be checked each time measurements are taken. Condition should be noted in field notes. Velocity should be measured at the midpoint of depth at each one-foot cross section.	C	Note that reference to stream bed profile being conducted on an annual basis will be moved from Section 5.0 in SOP A19 to Appendix A, SOP A19.2. The following text will be added to the new SOP A18.2 (formerly located in Section 5 of Attachment 18) regarding condition of staff plate: *Additionally, the staff plate condition should be noted each time measurements are collected and repairs/cleaning performed as necessary*. As further discussed in Response to EPA comment number 12, the fourth bullet of A18.2 will be revised to state: *Lower the rod with sensor bulb into the water, beginning as close to the bank as possible. Ensure that the sensor bulb is facing upstream and then set at 60-percent (%) of the total depth.* Underlined text has been added to the second sentence of A18.2.1 which now states:	A				

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					Flow readings at the creek should be collected bank to bank, in 1-foot increments <u>*at 60% of the total depth*</u>*, and field data recorded into a task specific spreadsheet developed to calculate the average velocity in the water body being measured.*					
15		Appendix A, SOP 18, Procedures section	Replace last bullet "Verify discharge rate into creek…" with something like Calculate allowable discharge rate. Set discharge rate to be less than the allowable rate.	C	Last bullet of A18.2 has been revised to state: *Calculate the allowable discharge rate and set the discharge rate to be less than the allowable rate.*	A				
16		Appendix A, SOP 19, General	Please carefully review and reference "Protocol for Discharging GWTP Effluent" which is included in the latest GWTP report. This protocol was developed by all parties to the FFA and prior Contractor and should be followed carefully. SOP should use the same process and formulas as the protocol.	C	The following will be added to the end of the first paragraph of SOP A19: "*This SOP is compliant with the Protocol for Discharging GWTP Effluent that was finalized on August 28, 2017, with concurrence from the TCEQ and USEPA.*"	A				
17		Appendix A, SOP 19, Procedures section	Keep the initial formula from Interim ROD and follow with explanation that the formula has been solved to give maximum effluent flow rate. Or something like that. Hereafter, use the formula from "Protocol" which solves for maximum effluent flow rate. Change the internal reference to correct TCEQ guidance document (see Comment 13). Solution example should also use the formula from "Protocol"	C	The following text will be added following the Interim ROD equation: "*Per the Protocol for Discharging GWTP Effluent dated August 28, 2017, the formula within the Interim ROD was solved to give the maximum effluent flow rate. Therefore, this formula will be used to determine the maximum effluent flow rate allowed and is presented as follows:*" Also, references were updated to include the protocol and the TCEQ guidance document discussed in Comment 13.	D	TCEQ guidance reference was not revised.	C	The TCEQ guidance will be updated to: TCEQ. 2012. *Surface Water Quality Procedures Manual, Vol. 1: Physical and Chemical Methods (RG-415).*	
18		Appendix C, QAPP	The Introduction of the IWWP listed 1,4-dioxane, in the last paragraph of page 1-1, as an identified contaminant from past operations. However, no discussion of 1,4-dioxane and/or associated analytical method(s) for 1,4-dioxane is found in the QAPP. This needs to be resolved. Determination of 1,4-dioxane in water at low detection levels is accomplished most often using modified EPA 8270 with liquid-liquid extraction and isotope dilution by capillary column gas chromatography-mass spectrometry (GC-MS). This GC-MS method is optimized for 1,4-dioxane as a single analyte. Modified EPA 8270 can detect method detection levels (MDLs) at 0.23 – 1.0 µg/L. However, if lower concentrations are needed and if groundwater (GW)	C	1,4-Dioxane was added to any reference of semi-volatiles. 1,4-Dioxane was captured with the semi-volatile narrative but was spelled out for clarity. It is also listed in Worksheet 15.	A				

Responses to Comments on
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			turbidity is relatively low, then EPA method 522 is preferred. EPA method 522 can detect 1,4-dioxane concentrations at 0.02 – 0.036 µg/L.							
19		Appendix C, QAPP, Worksheet 11 pg 27	Search here and elsewhere in the document for "ethane, ethane" should be "ethane, ethene"	C	The second "ethane" listed will be changed to "ethene."	A				
20		Appendix C, QAPP, Worksheet 17	Summary of Project Tasks – Should include VOC lab location Laboratory Analysis – Should include 1,4 Dioxane	C	VOC lab location and 1,4-Dioxane have been added.	A				
21		Appendix C, QAPP, Worksheet 18	Sampling Locations and Methods (page 45); Coded in the sample identification is the sample location, sample type, sample date, and QA sample identifier. As defined, the QA sample identifier "-a" indicates the sample is a field duplicate. However, stated in the last paragraph on page 146 of the QAPP field duplicates (FDs) should be sent to the laboratory as blind samples. Therefore, the identifier "-a" indicating the sample is a field duplicate should not be used. I recommend assigning an arbitrary sample identifier and collection time associated with FDs and document the true sample identity and collection time in the field logs.	D	The "a" is the easiest and most convenient way to determine the FD sample for the validating chemist especially if the field logs are not readily accessible from the field crew at the time of sample login/confirmation. Therefore, the "a" designation will be retained. We will delete the sentence stating that field duplicates should be sent as blind samples	A				
22		Appendix C, QAPP, Worksheet 21	SOP A1 – Typo in title	C	The word "Prodcedures" will be corrected to "Procedures."	A				
23		Appendix C, QAPP, Worksheets 22 and 25	The column heading titled "Frequency" in tables 10 and 13 needs more specification for clarity. For example, the first row in Table 10, Field Equipment and Instruments, listed four column headings associated with equipment and instrument *activities* and one column heading, "Frequency", referring to one of the specific activities. For clarity, more detail is needed to associate the intended activity with the correct frequency.	C	Table 10: the Frequency column has been removed since it is redundant. Table 13: the Frequency column has been revised to "Maintenance Frequency" for better clarity.	A				
24		Appendix C, QAPP, Worksheet 23	Table 11 Analytical SOP References; The second row on page 65, Lab SOP Number HS-QS010, is repeated as the fourth row on page 67. Also, the "0" is omitted in a few revision dates. The dates 216 and 217 should be corrected as 2016 and 2017, respectively.	C	The second reference to HS-QS010 has been removed and #216" and "217" have been revised to "2016" and "2017".	A				

Responses to Comments on
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26		Appendix C, QAPP, Attachment 1	[a] Attachment to what? Cover page should reference Worksheet 15. It would be better to place this table after Worksheet 15. [b] Needs 1,4 Dioxane [c] Aqueous - all need column for MCL [d] Pg 11 – Put perchlorate on a page by itself so you can change the column heading. Aqueous should be TRRP Tier 1 Groundwater Residential PCL. The * and note three pages later are confusing.	C, E	[a] Attachment 1 will be revised to say "Analytical Reference Limits – Worksheet 15". [b] 1,4 Dioxane is included in the table on page 13 of 26. [c] MCLs are already included in the screening criteria and will be footnoted for clarity. [d] Perchlorate footnote will be revised to indicate the reference to the TRRP PCL on the same page.	A				
27		Appendix A, SOP 22					A22.4 – Please revise the first sentence. The wastewater is not disposed at the GWTP, it is treated. I do realize this language was in the previous IWWP but it needs to be revised.	C	Sentence will be revised to: *"Wastewater containing contaminants treatable at the GWTP (VOCs, metals, and perchlorate) will be transported and treated at LHAAP's GWTP."*	
			END of TCEQ Comments							

Responses to Comments on
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Reviewer: Richard Mayer, USEPA, Region 6 **Respondent:** Kim Nemmers, Bhate										
1		IWWP, Section 3.6, Task 6	EPA recommends calling sediment either bed sediment or stream sediment, so it does not get confused with suspended sediment. There is always the potential that suspended sediment could be collected at some point in time at the site.	C	The words "stream bed" will be added before the word "sediment" to clarify the sample type.	A				
2		SOP A2.2, Page 2-2, Required Equipment	Please add a tape measure to the list. In addition, the recovery percentage of each core should be included in notes.	C	Tape measure will be added to the Requirement Equipment listed in A2.2. Also, the recovery percentage of each core will be included in the pertinent information listed within item 3 of Section A.2.2 for field personnel to record.	A	In regards to percent recovery, EPA did not see any text in the SOP to document percent recovery, but the logging form does include a percent recovery column. EPA suggests adding a bullet that percent recovery will be documented.	C	Percent recovery will be added to the bullets in Section A2.3.	
3		SOP A5.1.1, Sampling Method	Based on the geology at the site, it is recommended that groundwater sampling (in fine-grained lithology) be conducted the next day to allow water from the "tighter zones" (from the smear effect on the side wall) to enter the sampler bailer.	C	Section A5.1, Procedures will include the following: *As DPT drilling can cause smearing and compaction of the borehole wall in silty and clayey lithologies, the following steps will be taken to allow for accumulation of sufficient volume of groundwater for laboratory analysis.* 1. *Review water levels from adjacent wells.* 2. *Review lithology from acetate liner and from the nearest available boring logs.* 3. *If potential for smearing exists, allow 3 to 4 hours for adequate groundwater breakthrough prior to sampling.* 4. *If groundwater is not observed after 3 to 4 hours, evaluate whether the borehole should remain open for 24 hours prior to abandonment.*	A				
4		SOP A4.1, Required Equipment	Please add tape measure to the list.	C	Tape measure will be listed under Section A4.1, Required Equipment.	A				
5		SOP A7.3.1.6, Bentonite Seal	Please ensure that if pellets are used, they are well hydrated. In recent years, there have been a few wells that were installed at the site where the cement grout had leaked and the pH of the wells were high (10 or higher).	C	Section A7.3.6 (previously A7.3.1.6) will be revised as follows: *Bentonite pellets or volclay grout will be placed above the sand/filter pack to a minimum thickness of 2 feet to provide an adequate seal. Bentonite pellets shall not exceed one-half inch diameter and will be poured into place through the augers. If the bentonite seal is positioned above the water table, the bentonite will be installed in 1-foot lifts with each hydrated with clean, potable water for a minimum of 30 minutes between lifts before proceeding. Augers will be retracted and*	A	EPA recommends using a bentonite slurry when possible, since this seal method is more effective/reliable than pellets.		Noted.	

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					measurements will be made to ensure proper seal placement. After the placement of the final lift, the bentonite seal will be allowed to hydrate an additional two hours before grouting begins. If approved by the onsite geologist or LHAAP Technical Lead, bentonite slurry, such as volclay grout, may be used for seals above the water table.					
6		SOP A7.3.1.8: Surface Completions of Monitoring Wells	The first paragraph mentions most wells will be flush-mount wells. Is this correct? Almost all the wells currently at Longhorn are aboveground. Please clarify.	C	First paragraph will be revised as follows and the following paragraph will be added: *Generally all wells will be installed as aboveground completions. Flush-mount completions will only be done if determined to be appropriate. The procedures for each completion type are described below.* *For <u>aboveground</u> completion, the riser pipe will extend a minimum of 2.5 feet above the ground surface. A steel outer protective casing, equipped with a hinged locking cap, will be installed while the surface pad is being poured. The pad cannot be poured until the grout seal has cured for a minimum of 24 hours. Initially, concrete is poured into the remaining 2 feet or greater of annular space. The protective casing is then pushed at least 2 feet into the concrete. The remainder of the form for the pad will be filled with concrete. The pad will be a minimum of 3' x 3' x 6" and will extend a minimum of 2 inches below grade to prevent under-washing by surface water flow, and will be sloped away from the protective casing in all directions. Concrete should then be added to the space between the well casing and the protective casing until the level of the concrete inside the protective casing is at or above the surface concrete pad. After the concrete has cured, two weep holes will be drilled into the protective casing immediately above the concrete surface. These weep holes will be a minimum of ¼-inch diameter to allow the drainage of water which may accumulate inside the protective casing. Four 3-to 4-inch diameter, 5-foot long steel guard posts will be installed on each corner of the concrete pad. These posts will extend at least 2 feet into a concrete footing and at least 3 feet above the ground surface, and be filled with concrete for additional strength.*	A				
7		SOP A7.3.1.8: Surface Completions of	EPA recommends that bollards are installed for each well when you consider the understory	C	Text will be added as follows and as presented in the previous response to comment 6:	A				

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		Monitoring Wells, Last Paragraph	growth which can make wells hard to see and cold be destroyed or damaged easily.		*Four 3-to 4-inch diameter, 5-foot long steel guard posts will be installed on each corner of the concrete pad. These posts will extend at least 2 feet into a concrete footing and at least 3 feet above the ground surface, and be filled with concrete for additional strength.*					
8		SOP A10, Page 10-3, 3e	ORP also cannot be properly measured using bailer samples.	C	The following will be added to the SOP A10: *Note: Dissolved oxygen and oxidation/reduction potential (ORP) cannot be properly measured utilizing bailer samples because dissolved oxygen and ORP changes rapidly upon exposure to atmospheric conditions.*	A				
9		SOP A11.2.2, Page 11-2	ORP or DO cannot be taken accurately unless thru a flow cell or a surface water metering instrument?	C	The note presented in response to comment 8 above will be added within A11.2.2 also.	A	As a to ensure that there is no confusion to EPA comments, an instream placement of multi-parameter meter can be used to collect dissolved oxygen or ORP in flowing surface water bodies. Using a bailer to collect stream measurements for dissolved oxygen and ORP should be omitted from the IWWP.	C	The following sentence will be removed from Section A11.2.2: ~~*Note: Dissolved oxygen and ORP cannot be properly measured utilizing bailer samples because dissolved oxygen and ORP changes rapidly upon exposure to atmospheric conditions.*~~	
10		SOP A13.2.1, Page 13-2	It may be easier to identify sampling results by the date instead of RA event numbers.	C	Text will be revised to use date versus sampling event number and to match with the UFP-QAPP.	A				
11		SOP A16.1.7, Page 16-4	Should also notify TCEQ and provide them with the required documentation.	C	Item 12 under A16.1.7 will be revised to state: *12. Notify the TCEQ and USEPA of well abandonment, and provide them with the required documentation.*	A				
12		SOP 18	EPA used both the TCEQ and USGS technical guidance for sources for the tools to review this SOP. Based on these technical documents, EPA believes that past and current procedures need to be modified to determine discharge in Harrison Bayou. Listed below are the changes to procedures that would address these issues. a) Depths at 1-foot increments have been collected and the staff plate has been used to determine depths at these sections based on water level elevation. Standard techniques indicate that depth should be collected during each discharge collection event. Depths are needed to determine where to place the velocity meter on the rod and to accurately determine the area within the section. The staff plate could be used to develop a rating curve after multiple measurements over time and then just a reading off the staff plate could give a discharge.	C	a and b) The A18 Standard Operating Procedure will be revised to indicate that the velocity meter will be set at 60% of the total depth when the water is less than 2.5 feet in depth. To be more protective of the environment and to maintain consistency among the measurements, we also propose to collect velocity measurements at the same 60% reading when the depth of water column is greater than 2.5 feet. Depending on the vertical velocity profile in the Harrison Bayou, this will result in a slight under estimation of the discharge within the bayou. This will slightly reduce the effluent volume from the GWTP that can be discharged to Harrison Bayou. Ultimately, this is a more conservative approach and will reduce the overall impacts on an ecologically sensitive area. c) The velocity area method currently in use at LHAAP for determining the Harrison Bayou discharge is still acknowledged as "The most practical method of measuring the discharge of a stream" (Discharge	A	EPA agrees that a .6 meter location even at depths over 1.5 (not 2.5 feet when using the doppler type meters, see pages 21 and 23 USGS, 2010) would most likely be conservative for velocity (see page 21, velocity profile); however, EPA still believes that following the most current USGS methods provides a more accurate reading of discharge. The data collected should be flagged as estimated, since the proper techniques for determining stream discharge are not being used and will bias the discharge to be low. In addition, potential data users in the future may not be fully aware of how this data was calculated and may assume the data was calculated correctly.	C	The following will be added to SOP Section A18.2.1: *"Note that these calculations are estimates."*	

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			Typically, rating curves need to be adjusted over time especially after major events. The staff plate should be checked at least once a year via surveying to make sure it has not moved. The SOP should state that depth at each section. b) The velocity meter needs be set at the proper depth based on the depth. If depth is between .25 and 1.5 ft., the meter should be placed at .6 ft. depth. If the depth is over 1.5 ft., two velocity measurements should be made. One at .2 ft. depth and one at .8 ft. depth. The average of the two point velocities then can be used in the calculation. Please note that the TCEQ guidance is out of date based on changes in technology. TCEQ guidance states that the two-point method should be done at depths greater than 2.5 ft., which would be correct if a AA meter or a sounding weight was used. The new electronic and Doppler meters use the 1.5 depth as the break point. c) Here are the links to both the USGS and TCEQ technical guidance. TCEQ used USGS Ranz, 1992 for their guidance, but the USGS updated their guidance in 2010 that covers multiple techniques (new and old). https://pubs.usgs.gov/tm/tm3-a8/ https://www.tceq.texas.gov/publications/rg/rg-415		Measurements at Gaging Stations, USGS 2010). As such, the Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods, TCEQ 2012, does a very good job detailing how the method should be employed. As a result, we are not proposing any changes to the guidance or reference materials appearing in the A18 Standard Operating Procedure at this time.					
13		QAPP, Worksheet 10, Page 21	The Conceptual Site Model narrative is weak on the Site Geology and Hydrogeology piece and needs to be "beefed up" such as the CSM found in the RAO Reports.	C	The Conceptual Site Model will be revised to state the following under the title of <u>Site Geology and Hydrogeology</u>: *Surface water at LHAAP drains to the northeast into Caddo Lake, part of Big Cypress Bayou, via four drainage systems: Saunder's Branch, Harrison Bayou, Central Creek, and Goose Prairie Creek. Saunder's Branch of Martin's Creek flows onto LHAAP near the southeastern corner of the installation and flows northward into Caddo Lake. Approximately 10 percent of the heavily-wooded eastern section of the former plant footprint is drained by this system. Harrison Bayou enters LHAAP on the southern edge of the installation. The bayou captures approximately 30 percent of the surface drainage of LHAAP and bisects the installation*	A				

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					in a northeasterly direction. Central Creek enters LHAAP on its western edge, just south of the town of Karnack. Approximately 30 percent of the surface drainage from the installation is transported to Caddo Lake via this drainage course. The headwaters of Goose Prairie Creek are located near the northwestern corner of the former plant footprint and consist of one larger creek and several smaller tributaries. Goose Prairie Creek flows across the northern edge of the installation and drains approximately 30 percent of LHAAP. The flows of Central Creek and Goose Prairie Creek are intermittent. The subsurface geology at LHAAP consists of a thin veneer of Quaternary alluvium overlying Tertiary age rocks of the Wilcox and Midway Groups. Underlying these sediments are Cretaceous age rocks of the Navarro and Taylor Groups. The stratigraphic thickness of the uppermost Wilcox Group ranges from a maximum of 350 feet in the northwest corner of LHAAP to approximately 130 to 140 feet along the east side of the facility near Caddo Lake. The Wilcox Group constitutes the majority of the unconsolidated sediments underlying LHAAP. The Wilcox Group consists of interbedded sands, silts, and clays. These sediments were deposited along flood plains and in lakes and swamps on a wide, flat coastal plain traversed by shifting streams. This type of depositional environment resulted in the extreme variability and discontinuity of the sediments observed in the Wilcox Group beneath the site. *As part of the Post-Screening Investigation Report – LHAAP-18/24 (AECOM, December 2013) , the conceptual site model (CSM) was updated to describe the presence of two groundwater zones: the shallow zone is up to a depth of approximately 45 feet below ground surface (Shallow Alluvium Zone) and a deep unit below the shallow zone (Wilcox Formation). Generally the two units are separated by a continuous clay layer which is understood to be present across the entire site with the exception of the area to the west and northwest towards the Harrison Bayou. Based upon this updated CSM, the shallow and shallow/intermediate-screened wells are identified in the Shallow Zone and the intermediate and deep-screened wells are identified in the Wilcox Formation.*					

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					As presented in the Post-Screening Investigation Report (AECOM, December 2013), the shallow alluvium consists of discrete sand channels encapsulated in lower permeability silt/clay floodplain sediments. The thickness of the shallow alluvium is variable, because of the irregular contact with underlying Wilcox Formation. Thickness ranges from 10 to 40 feet. The zone is characterized by potentially complex flow paths, gradients depending on where sandy channel deposits intersect or diverge. In general, the axis of channel deposits trend toward the north and northeast. *A clay unit separating the shallow alluvium from the Wilcox sands occurs at the top of the Wilcox Formation throughout most of the site. However, this clay is missing where fluvial incision has occurred during both the deposition of the shallow Wilcox as well as later incision by the Harrison Bayou. The sands of the Wilcox Formation vary in grain size from medium to fine silty sands. The more homogenous nature (both vertically and horizontally) of the unit is visible on all sections. Additional geologic and hydrogeologic information is included in site-specific reports.*					
14		QAPP, Table 6, Page 47	Is 1,4 dioxane considered a VOC? If not, then 1,4-dioxane needs to be added to known sites such as 18/24, 35A (58), 12 and possibly others.	E	Although 1,4-dioxane is listed as a VOC in SW-846 8260B and the Appendix IX list of compounds, EPA currently has 1,4-dioxane listed as a SVOC the Target Compound List (TCL) SOM02.2, published in 2014. The SW-846 8270 method for 1,4-dioxane will be added to the associated sites in Table 6.	A				
15		QAPP, Worksheet 21, Table 9	SOPs 17 thru 21 need to be added.	C	SOPs 17 through 21 will be added to QAPP Worksheet 21.	A				
16		QAPP Worksheet 22, Table 10	Under the PID instrument, the maintenance activity is none. Is that correct? Please clarify or modify.	C	"None" will be corrected to "*Lamp Replacement, as needed*."	A				
17		QAPP Attachment 1, Reference Limits and Evaluation- Volatiles, Metals, Explosives, Hexavalent Chromium, Semi-Volatiles, Pesticides, PCBs, Dioxins, and 1,4-dioxane	The column for TCEQ GW-Ind (aq)/GWP-Ind (s) MSC should be changed to TCEQ TRRP residential PCLs per the final dispute decision by the EPA Administrator.	C	The TCEQ TRRP residential PCLs for perchlorate, Mn and Ni, per the final dispute resolution, have been listed and footnoted in the Worksheet 15 tables in Attachment 1 (see pages 10 and 13). Footnote will be added to the page where the analyte is listed in the Worksheet 15 table.	A				
18		General	Please include a SOP for collecting geotechnical samples if samples are planned in the future.	E	No geotechnical samples are planned at LHAAP under the current contract. However, should such samples be	A				

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					required, then a SOP for the geotechnical samples will be included in the site-specific work plans.					
19		SPO A22.1					It is fine to fill boreholes that are 2 feet or less with the remaining soil; however, if greater than 2 feet, the borehole should be filled with bentonite slurry or chips.	C	The second bullet in Section A22.1 will be revised to state: •"*Upon completion of the downhole activity (i.e., drilling for subsurface soil sampling), the soil cuttings will be placed back into the borehole from which they were generated, if the borehole is 2 feet deep or less. If greater than 2 feet deep, the borehole will be filled with bentonite chips or slurry.*"	
20		SOP A22.5					It mentions that non-hazardous solids can be place on the ground after analytical results for COCs are below a screening level. What are the screening levels being used for a specific contaminant? For example, if a soil sample analyzed for lead comes back TCLP non-hazardous, but the total concentration was 600 mg/kg, it would be unacceptable to place that soil back onto the ground. Please clarify.	D	SOP A22 is consistent with EPA guidance referenced, which allows nonhazardous IDW to be left within the site of its origin. Sections A22.2 and A22.5 will be modified to provide more clarity.	
			END of EPA Comments							

FINAL
INSTALLATION-WIDE WORK PLAN FOR LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS

May 2018

Contract Number: W9128F-13-D-0012
Task Order Number: W912BV17F0150

Performance Based Remediation (PBR)
Longhorn Army Ammunition Plant
Karnack, Texas

Prepared For:

Longhorn Army Ammunition Plant
Karnack, Texas

Under Contract To:

U.S. Army Corps of Engineers
Tulsa District
Tulsa, Oklahoma

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ACRONYMS AND ABBREVIATIONS

APTIM	APTIM Federal Services, Inc.
ASTM	ASTM International (formerly American Society for Testing and Materials)
Bhate	Bhate Environmental Associates, Inc.
DPT	Direct-push technology
°F	Degrees Fahrenheit
GPS	Global Positioning System
GWTP	Groundwater treatment plant
HASP	Health and Safety Plan
HDPE	High-density polyethylene
INF	Intermediate-Range Nuclear Force
ISB	In-situ bioremediation
IWWP	Installation-Wide Work Plan
Jacobs	Jacobs Engineering Group
LHAAP	Longhorn Army Ammunition Plant
O&M	Operation and maintenance
PPE	Personal protective equipment
PVC	Polyvinyl chloride
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QASP	Quality Assurance Surveillance Plan
QC	Quality control
RA	Remedial Action
RI	Remedial Investigation
SOP	Standard Operating Procedure
SWMU	Solid Waste Management Unit
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TNT	Trinitrotoluene
TO	Task Order
UFP	Uniform Federal Policy
U.S.	United States
U.S. Army	U.S. Department of the Army
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compound

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1 INTRODUCTION

Bhate Environmental Associates, Inc. (Bhate) was contracted by the United States (U.S.) Army Corps of Engineers (USACE), Tulsa District, to perform remediation activities at multiple sites at the Longhorn Army Ammunition Plant (LHAAP) under Worldwide Environmental Remediation Services Contract No. W9128F-13-D-0012, Task Order (TO) W912BV17F0150. Bhate has subcontracted APTIM Federal Services, Inc. (APTIM) to support this task order. Management of work performed under this contract will be performed by the Tulsa District of the USACE. As part of the remediation activities, Bhate, along with APTIM, has been tasked with preparing plans to support field implementation of investigation and remediation activities during the completion of work under this TO. This document and its appendices fill that role.

This Installation-Wide Work Plan (IWWP) provides descriptions of common field activities that are likely to be implemented at one or more sites during Bhate Team's performance of this TO. These descriptions are meant to be generally applicable, and thus eliminate the need for repeatedly describing these activities in site-specific work plans. However, site-specific work plans will be issued as necessary to address:

- The locations and rationale of activities within specific sites
- Significant deviations from the proposed approach
- Modifications of the activities described in this IWWP
- Specialized technologies not described in this IWWP
- Health and safety and quality control (QC) issues associated with modified activities or specialized technologies

LHAAP is an inactive, government-owned, formerly contractor-operated and maintained Department of Defense facility located in central-east Texas. Extensive demolition and salvaging of materials has occurred at LHAAP, but there are still portions of buildings remaining. The entire installation was under the control of the U.S. Department of the Army (U.S. Army) until May 5, 2004, when approximately two thirds of the property was transferred to the U.S. Fish and Wildlife Service (USFWS). Additional property has been transferred to USFWS since then and the property transfer process will continue as remediation and closure activities are completed at additional sites. The U.S. Army Environmental Command has the responsibility for the environmental restoration activities at LHAAP, with the management of the U.S. Army's property provided by the Base Realignment and Closure Office.

The groundwater, surface water, stream bed sediment, and soil at LHAAP have been contaminated by past operations. Studies conducted at LHAAP identified contaminants such as Volatile Organic Compounds (VOCs); heavy metals; perchlorate; dioxins; 1,4-dioxane; and explosives in on-site media. Several areas of contamination are subject to investigation and cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S. Code 9604).

The field activities described in this IWWP are potentially applicable to any of the LHAAP sites addressed by this TO. Those sites are listed in Table 1-1.

Table 1-1. Sites Addressed by the Task Order

Site Name	Brief Description
LHAAP-02	Vacuum Truck Overnight Parking Lot
LHAAP-03	Building 722 Paint Shop
LHAAP-04	Pilot Wastewater Treatment Plant
LHAAP-12	Landfill 12 (Solid Waste Management Unit [SWMU] 12)
LHAAP-16	Old Landfill (SWMU 16)
LHAAP-17	No. 2 Flashing Area/Burning Ground (SWMU 17)
LHAAP-18	Burning Ground/Washout Pond (SWMU 18) *Note: This site is grouped with LHAAP-24*
LHAAP-19	Construction Materials Landfill
LHAAP-24	Former Unlined Evaporation Pond (SWMU 24) *Note: This site is grouped with LHAAP-18*
LHAAP-37	Chemical Laboratory Waste Pad *Note: This site was previously called LHAAP-35B*
LHAAP-46	Plant 2/Pyrotechnic Operation
LHAAP-50	Former Waste Disposal Facility
LHAAP-58	Maintenance Complex *Note: This site was previously called LHAAP-35A*
LHAAP-67	Above Ground Storage Tanks
LHAAP-001-R-01	South Test Area / Bomb Test Area
LHAAP-003-R-01	Ground Signal Test Area

This IWWP is composed of the following sections:

- Section 2, Location, summarizes the facility description, background, and setting of LHAAP.
- Section 3, Common Field Activities, describes field activities such as sampling and excavation that are expected to be implemented at several project sites.
- Section 4, Health and Safety, introduces Bhate's safety culture and the installation-wide Health and Safety Plan (HASP).
- Section 5, Quality Assurance/Quality Control, discusses general quality assurance (QA)/QC processes and introduces the installation-wide Quality Assurance Project Plan (QAPP).
- Section 6, References, presents a listing of the references cited in this document.

This IWWP is supported by a number of installation-wide planning tools. These tools are presented in the following appendices:

- Appendix A - Standard Operating Procedures (SOPs)
- Appendix B - Health and Safety Plan
- Appendix C - Uniform Federal Policy Act - Quality Assurance Project Plan (UFP-QAPP) (Based on the Optimized UFP-QAPP Worksheets, March 2012)

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2 LOCATION

2.1 Site Location

LHAAP is located in central-east Texas in the northeastern corner of Harrison County. The footprint of the former U.S. Army installation occupies 8,416 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake, as shown on **Figure 2-1**. To date, approximately 7,200 acres of the 8,416-acre installation have been transferred to USFWS for management as the Caddo Lake National Wildlife Refuge. The U.S. Army intends to transfer the remaining property to the USFWS after the environmental response is completed.

The nearest cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the southeast. Caddo Lake, a large freshwater lake situated on the Texas-Louisiana border, bounds LHAAP to the north and east.

2.2 History

LHAAP was established in December 1941, near the beginning of World War II, when the U.S. Army issued a contract to build a six-line production facility for manufacturing trinitrotoluene (TNT) (Plant 1 Area). The first flake of TNT was produced in October 1942. LHAAP ultimately produced 414 million pounds of TNT before production was halted in August 1945, near the end of the war, and the facility went on standby status.

In 1952, during the Korean War, the government undertook two new initiatives at LHAAP:

- A partially-constructed facility (Plant 2) was reactivated and refitted for pyrotechnics production. This facility produced 3.4 million pyrotechnic devices (e.g., photoflash bombs, simulators, hand signals, and 40 millimeter tracers) before production was discontinued in April 1956.
- A facility (Plant 3) was designed and built for producing solid-fuel rocket motors for tactical missiles. Actual rocket motor production began in December 1954. The last major propellant-loading activity in Plant 3 occurred in 1980. Over the intervening quarter century, LHAAP manufactured over 50 million pounds of composite propellant and delivered over 200,000 rocket motors.

Production of rocket motors continued to be the primary operation at LHAAP until 1965 when, due to the Vietnam conflict, Plant 2 was reactivated for the production of pyrotechnic and illuminating ammunition. In the years following Vietnam, LHAAP continued to produce flares and other basic pyrotechnic or illuminating items for the U.S. Department of Defense inventory. From September 1988 to May 1991, LHAAP was also used for the static firing and elimination of Pershing I and II rocket motors in compliance with the Intermediate-Range Nuclear Force (INF) Treaty in effect between the U.S. and the former Union of Soviet Socialist Republics.

Various media in certain areas have been contaminated by past industrial operations and waste management practices at LHAAP. Industrial operations involved the use of secondary explosives, rocket motor propellants, and various pyrotechnics, such as illuminating and signal flares and ammunition. Explosives included TNT and black powder. Typical composite propellants were composed of a rubber binder, an oxidizer such as ammonium perchlorate, and a powdered metal fuel such as aluminum. Pyrotechnics were generally composed of an inorganic oxidizer such as sodium nitrate, a metal powder such as magnesium, and a binder. Other materials used in the industrial operations included acids, lubricants, and solvents; particularly trichloroethene and methylene chloride. Waste management included sanitary wastewater treatment, industrial wastewater treatment, holding/evaporation ponds, storm water drainage, sanitary and industrial waste landfills, and demolition/burning grounds. Discharges and releases to surface water, groundwater, and other secondary media have occurred from the historical operations.

LHAAP was placed on the National Priorities List on August 9, 1990. A Federal Facility Agreement among the U.S. Army, the U.S. Environmental Protection Agency, and the Texas Natural Resources Conservation Commission (now the Texas Commission on Environmental Quality [TCEQ]), became effective on December 30, 1991. LHAAP became inactive in July 1997, with the U.S. Army issuing a contract to remove salvageable property a year later. On May 5, 2004, the U.S. Army transferred control of approximately 5,032 acres of land to the USFWS. The Remedial Investigation (RI), Feasibility Study, Remedial Design, Remedial Action (RA) process is continuing at the Group 2 and Group 4 sites with the land still under the U.S. Army's control. Those sites covered by this IWWP are presented on **Figure 2-2**.

2.3 Physical Setting

The LHAAP location is characterized by a mild climate with an average low temperature of 35 degrees Fahrenheit (°F) and an average high of 91 °F. Precipitation averages 46.9 inches per year with a slight peak in the spring. LHAAP is in an area of mixed pine-hardwood forests that cover flat to gently rolling terrain. Most of the terrain at LHAAP has an average slope of 3 percent or less, but slopes as steep as 12 percent can be found in the western and northwestern portions of the installation and along Harrison Bayou.

LHAAP is a part of the Cypress Bayou Basin occurring in the Piney Woods ecological region of Texas. The gentle topography and mild climate support an abundant and diverse plant community with a diversity of habitats. This diversity suggests the potential for a large variety of animal species to inhabit LHAAP. As the buildings have been demolished, more and more of the facility has been left to nature with pine trees growing among concrete remnants. Common mammals found at LHAAP include white-tailed deer, red and gray foxes, rabbits, squirrels, opossums, skunks, armadillos, beavers, and raccoons. In addition to mammals, a total of 334 bird species have been documented as inhabiting Caddo Lake's drainage system and potentially inhabiting LHAAP sometime during the year. A reported 53 different reptile species inhabit the Cypress Bayou Basin.

Surface water at LHAAP drains to the northeast into Caddo Lake, part of Big Cypress Bayou, via four drainage systems: Saunder's Branch, Harrison Bayou, Central Creek, and Goose Prairie Creek. Saunder's Branch of Martin's Creek flows onto LHAAP near the southeastern corner of the installation and flows northward into Caddo Lake. Approximately 10 percent of the heavily-wooded eastern section of the former plant footprint is drained by this system. Harrison Bayou enters LHAAP on the southern edge of the installation. The bayou captures approximately 30 percent of the surface drainage of LHAAP and bisects the installation in a northeasterly direction. Central Creek enters LHAAP on its western edge, just south of the town of Karnack. Approximately 30 percent of the surface drainage from the installation is transported to Caddo Lake via this drainage course. The headwaters of Goose Prairie Creek are located near the northwestern corner of the former plant footprint and consist of one larger creek and several smaller tributaries. Goose Prairie Creek flows across the northern edge of the installation and drains approximately 30 percent of LHAAP. The flows of Central Creek and Goose Prairie Creek are intermittent.

The subsurface geology at LHAAP consists of a thin veneer of Quaternary alluvium overlying Tertiary age rocks of the Wilcox and Midway Groups. Underlying these sediments are Cretaceous age rocks of the Navarro and Taylor Groups.

The stratigraphic thickness of the uppermost Wilcox Group ranges from a maximum of 350 feet in the northwest corner of LHAAP to approximately 130 to 140 feet along the east side of the facility near Caddo Lake. The Wilcox Group constitutes the majority of the unconsolidated sediments underlying LHAAP. The Wilcox Group consists of interbedded sands, silts, and clays. These sediments were deposited along flood plains and in lakes and swamps on a wide, flat coastal plain traversed by shifting streams. This type of depositional environment resulted in the extreme variability and discontinuity of the sediments observed in the Wilcox Group beneath the site.

The unconsolidated sediments of the Wilcox Group generally consist of three sandy, water-bearing zones separated by silty clay layers. The uppermost portion of the Wilcox Group at LHAAP consists of medium plastic sandy silts and clays ranging in thickness from approximately five to 15 feet. These surficial sediments are underlain by the first or "shallow" saturated sand zone, which ranges in thickness from 10 to 20 feet. This sand zone consists of silty fine sand containing some silt and clay lenses and is at first dry to moist and then generally becomes saturated at 15 to 20 feet below ground surface. A 5 to 20-foot thick medium to highly plastic silt and clay layer underlies the shallow saturated sand zone. An intermediate saturated sand zone, consisting of fine to medium silty sand, is then encountered below the silty clay layer at 30 to 50 feet below ground surface. The intermediate saturated sand zone is generally less silty than the shallow saturated sand zone and exhibits higher hydraulic conductivity. A silt to silty clay layer is encountered beneath the intermediate saturated sand zone and ranges in thickness from 5 to 30 feet. Underlying this silt to silty clay layer, a massive homogeneous silty, clayey, fine sand layer is encountered at a depth that continues to the top of the underlying Midway Group (approximately 200 to 300 feet below ground surface).

Because of the high degree of stratigraphic heterogeneity, the level of interconnection between the shallow, intermediate, and deep water-bearing zones in the Wilcox Group deposits at LHAAP is highly variable. The depth to groundwater across the facility ranges from 1 to 70 feet below ground surface, with the typical depth at 12 to 16 feet. The regional groundwater flow direction is generally east-northeast towards Caddo Lake, but varies by site location.

Additional geologic and hydrogeologic information is included in the RI reports (Jacobs Engineering Group [Jacobs], 2001 and 2002).

2.4 Current and Future Land Uses

LHAAP is located near the unincorporated community of Karnack, Texas. Karnack is a rural community with a population of approximately 2,600 people (http://zipcode.org/city/tx/karnack). The incorporated community of Uncertain, Texas, population less than 100 (http://www.city-data.com/city/Uncertain-Texas.html), is a resort area located to the northeast of LHAAP on the edge of Caddo Lake and an access point to Caddo Lake. The industries in the surrounding area consist of agriculture, timber, oil and natural gas production, and recreation.

The majority of the former LHAAP footprint is now under USFWS management as the Caddo Lake National Wildlife Refuge. The remainder is managed by the U.S. Army and continues to undergo environmental investigation and remediation with the ultimate goal of all property being transferred to USFWS for use as a wildlife refuge.

3 COMMON FIELD ACTIVITIES

Planned remediation activities at LHAAP's various sites include several primary common tasks that are described here.

- Task 1 - Mobilization and Site Setup
- Task 2 - Monitoring Well/Compliance Well Installation
- Task 3 - Surveying
- Task 4 - Groundwater Sampling
- Task 5 - Soil Sampling
- Task 6 - Surface Water/Sediment Sampling
- Task 7 - Investigation-Derived Waste Management
- Task 8 - Soil Excavation and Disposal
- Task 9 - Well Abandonment
- Task 10 – In-situ Bioremediation

Additional information regarding these tasks can be found in **Appendix A**, Standard Operating Procedures and **Appendix C**, the Uniform Federal Policy -Quality Assurance Project Plan. The SOPs described in this document are generally consistent with those employed previously at the site.

For use in conjunction with this IWWP, site-specific/project-specific work plans will be generated and used as needed. Those site-specific work plans will define the specific locations where common field activities will be conducted and will describe the implementation of remedial activities including remediation techniques unique to specific sites.

3.1 Task 1 – Mobilization and Site Setup

Prior to the mobilization of subcontractors to LHAAP sites, Bhate will examine work locations for overhead and ground level accessibility. In areas that have excessive vegetation and/or tree growth, a backhoe or other appropriate earth moving equipment will be used to clear the areas to allow equipment access. After coordinating with underground utility locators for utility clearances, drilling locations and areas that require surface soil removal will be located and staked.

Bhate will mobilize appropriate personnel, subcontractors, and equipment necessary to perform specific task(s). A permanent decontamination station is located at the on-site groundwater treatment plant (GWTP) at LHAAP-18/24 and can accommodate large equipment. Temporary decontamination pads will be constructed as needed at approved on-site locations to decontaminate equipment and prevent cross-contamination between sites. Wash water will be contained and transported to the GWTP for disposal when necessary.

3.2 Task 2 – Monitoring Well/Compliance Well Installation

3.2.1 Well Installation

Monitoring and compliance wells will typically be drilled and installed using a hollow stem auger rig. Certain site conditions, including flowing sands, are present at LHAAP and may require wet rotary drilling techniques. Each well will be constructed with flush-joint threaded, schedule 40, polyvinyl chloride (PVC). If necessary, soil samples will be collected continuously using a sampler advanced ahead of the drill bit and is further described in Task 5, below. The soil (or sediment) samples will be described according to ASTM International (ASTM) D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM, 2009), and logged on USACE Engineering Form 1836 (Drilling Log) or equivalent. Additional guidance for well installation is found in SOP A7-Monitoring Well Installation, of **Appendix A**.

The monitoring wells will be installed in the annulus of hollow-stem augers or open hole depending on the drilling methodology. The PVC well screen for each well will be constructed with 0.01 inch slots and will typically be 10 feet in length. A threaded PVC bottom cap will be secured to the bottom of the screen interval. Solid PVC casing will be installed from the top of the screen interval to approximately 3 feet above surface grade. A filter pack consisting of clean silica sand (20 to 40 size) will be placed in the auger-well annulus from the well bottom to approximately 2 feet above the screen interval. A 3-foot thick bentonite seal (pellets or chips) will be placed above the sand filter pack and hydrated with portable water. The annular space from the top of the bentonite seal to the surface will be filled with a bentonite-cement grout. The screen length and sealing criteria may be adjusted on a site-specific basis.

For the wells installed in the deeper groundwater zones, the shallower groundwater zones will be isolated using a suitable diameter, schedule 40 PVC casing. The casing will be installed from near surface grade to the top of the first confining layer. Upon grouting and setting of the isolation casing, drilling will proceed into the deeper zone.

The drilling equipment will be decontaminated prior to the arrival at the site and between wells. Upon completion of drilling activities, the drilling equipment will be decontaminated prior to demobilizing and leaving the installation. Additional guidance on decontamination procedures can be found in SOP A1-Decontamination Procedures, in **Appendix A**. Core samplers will be decontaminated between sampling intervals with a detergent/water solution and multiple rinse stages in clean buckets. The decontamination wastewater and drill cuttings will be placed in appropriate containers (e.g., 55 gallon drums, roll-off bins) and handled as described in Section 3.7 below.

Well surface completions will be constructed for each monitoring/compliance well installed. Surface completion will consist of protective steel casing, with a hinged, lockable lid set in a concrete pad. Concrete-filled steel bollards will be installed at the corners of the concrete pad.

The monitoring wells and surface completions will be installed in general accordance with USACE and State of Texas requirements by a drilling subcontractor licensed in the State of Texas. Monitoring wells shall comply with applicable technical requirements of 16 Texas Administrative Code (TAC) Chapter 76. State of Texas Well Reports will be submitted to the Texas Department of Licensing and Regulation for each well.

3.2.2 Well Development

The newly installed monitoring wells will be developed to remove drilling fines and enhance hydraulic communication between the well and the groundwater zone. The wells will be developed no sooner than 48 hours, and no later than 7 days, after installation (grouting) of the well. Well development will typically be performed by pumping and gentle surging of the screened interval using a rubber-lined surge block. A minimum of three well borehole volumes of water will be removed. The volume of groundwater removed from each well will be calculated from the static water level measurement referenced from the top-of-casing. An electronic interface probe will be used to measure the water levels. As an alternative to pumping, a bottom-filling bailer may be used to remove water from low-yielding wells. Water quality parameters (temperature, hydrogen ion concentration [pH], conductivity, and turbidity) of the development discharge water will be monitored. Development will continue until the water quality parameters have stabilized and the water is visually clear. Detailed well development guidance is provided in SOP A8-Monitoring Well Development, of **Appendix A**.

A Bhate team geologist will supervise well development, and document the development process and measurements on a Well Development Record specific to each well. Downhole development equipment will either be disposed after each use or will be decontaminated prior to and following use at each well location by cleaning in a detergent/water solution and multiple rinse stages in clean buckets. The development and decontamination wastewater will be placed in 55-gallon drums or other appropriate containers and handled as described in Section 3.7.

3.3 Task 3 – Surveying

A professional land surveyor licensed in the State of Texas will survey the locations and elevations of the newly installed monitoring wells. The horizontal coordinates (northing and easing) of the wells will be surveyed to the nearest foot and will be based on the North American Datum of

1983. The vertical elevations of the top of the wells (top-of-casing) will be based on the North American Vertical Datum of 1988 and will be surveyed to the nearest 0.01 feet at a reference point (i.e., groove or marking on the north side of the well casing) used to collect water level measurements as described in SOP A9-Water Level Measurement, of **Appendix A**. The ground surface (top of the actual ground surface) elevation at each well location will be surveyed to the nearest 0.1 foot. To ensure compatibility with pre-existing well elevations, the top-of-casing for one of the existing wells at each site will be surveyed. If discrepancies are noted, the USACE will be consulted for resolution.

For identifying locations of soil confirmation samples and limits of excavation, either land surveying or global positioning system (GPS) equipment may be used. Bhate will coordinate with the USACE prior to the use of GPS.

3.4 Task 4 – Groundwater Sampling

Monitoring wells will be sampled using low-flow techniques or bailers. The volume purge method using a bailer shall be used in lieu of the low-flow method, only if warranted by the site conditions (e.g. exceptionally low recharge rate) and only if specified in the work plan or approved by the project manager or technical lead. Procedures for purging and sampling the monitoring wells with the low-flow method or alternative means are detailed in SOP A10-Low-Stress (Minimal Drawdown) Groundwater Sampling, of **Appendix A**. Analytical parameters and the frequency of sampling will be discussed in the site-specific work plans.

3.5 Task 5 – Soil Sampling

Surface soil is defined as that which exists from the land surface extending approximately 1-foot below ground surface. Surface soil samples may be collected during various investigation or remediation activities.

Subsurface soil samples may be collected during various activities including drilling of soil borings, test pits, or installation of monitoring wells for investigation activities. Soils samples collected during drilling activities will be described in general accordance with ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). If VOC samples are required from the boring and a designated depth interval is defined, the VOC sample will be collected first using a Terra Core™, or equivalent, sampler before conducting any screening activities. If the VOC sample interval is not defined, screening activities of the boring using an organic vapor analyzer will be conducted quickly and the boring resealed to minimize loss of VOCs from the boring. Each boring will be logged on USACE Engineering Form 1836 (Drilling Log) or equivalent. More information regarding lithologic logging can be found in SOP A2-Lithologic Description of Subsurface Samples and Completion of Drill Logs, of **Appendix A**. Where appropriate, soil samples will be screened using an organic vapor analyzer and headspace readings recorded on the boring log. Samples will be collected in accordance with site-specific work plans. More information regarding subsurface soil samples and field screening of soil samples can be found in SOP A3–Headspace Analysis and A4-Subsurface Soil Sampling, of **Appendix A.**

Test pits may be installed at the facility to fulfill specific objectives relating to site investigations or for confirmation purposes. Generally, test pits will be used in order to identify the location of pipelines, the condition of pipelines, and to characterize the surrounding soil to determine if there have been any impacts to the soil during past operations. Additional procedural criteria and sampling protocols will be defined in site-specific work plans covering work where test pitting is a planned activity.

3.6 Task 6 – Surface Water/Sediment Sampling

During various phases of work, surface water and stream bed sediment samples may be collected to satisfy specific requirements as outlined is site-specific work plans. Sampling equipment may be utilized depending on sample objectives and site conditions (e.g., Kemmerer samplers, etc.). Detailed guidance regarding surface water sampling can be found in SOP A11-Surface Water Sampling, of **Appendix A**.

Stream bed sediment samples are usually collected in conjunction with a surface water sample, and as close as possible to the location the surface water sample. As with other media, samples should first be collected from the point suspected to be the least contaminated and later from more contaminated points to minimize the risk of cross-contamination (e.g., collection near a pipe outfall should not be the first sample if several samples are planned for the water body). Detailed guidance regarding stream bed sediment sampling can be found in SOP A12-Sediment Sampling, of **Appendix A**.

3.7 Task 7 – Investigation-Derived Waste Management

Environmental investigation activities can include monitoring well installation, groundwater sampling, soil sampling, surface water/sediment sampling, soil excavation, and well abandonment. Wastes generated while conducting these activities can include soil cuttings, waste water, soil piles, personal protective equipment (PPE), sampling equipment, well materials, and miscellaneous trash. Management of the waste streams is described below.

3.7.1 Drill Cuttings

Drill cuttings may initially be placed in 55-gallon drums or similar containers, or directly placed in a high-density polyethylene (HDPE)-lined roll-off container. Upon completion of each soil boring, drums will be sealed and transported to a staging area. Drill cuttings in drums will be transferred to an HDPE-lined roll-off container if the quantity of drill cuttings is large. Composite samples will be collected from drums or roll-off boxes for characterization before disposal. The procedures for sampling the drill cuttings in drums or roll-offs and handling of investigation-derived waste is described in SOP A1.3-Investigation-Derived Waste Handling, of **Appendix A**.

Following characterization, drill cuttings may be disposed on site if they are determined to be non-hazardous. Typically, cuttings will be transported to a permitted landfill if they are determined to be hazardous or containing listed waste.

3.7.2 Wastewater

Wastewater generated from equipment decontamination, well development, sampling, and purging activities will be stored in 55-gallon drums or larger containers. Containers will be transported to the GWTP at LHAAP-18/24 for disposal by addition to the influent stream of the plant.

3.7.3 Miscellaneous Wastes

Miscellaneous wastes include spent PPE, HDPE sheeting, rags, paper towels, etc. These wastes will not be characterized and will be placed in plastic bags for disposal as municipal solid waste.

3.8 Task 8 – Soil Excavation and Disposal

The limits and plans for excavation will be included in site-specific work plans. Excavating soil as a RA generally consists of preparing the site, excavating the soil, transporting and disposing the soil, collecting confirmation samples, surveying the excavation limits, and backfilling and restoring the site. Documenting the excavation through adequate field records is crucial to successful final reporting of soil excavation as a RA. Excavations for sites under this IWWP are expected to be less than 1 acre in size and are not subject to the storm water pollution prevention requirements of Chapter 26 of the Texas Water Code and TCEQ General Permit TXR15000.

3.8.1 Site Preparation

The Bhate team will inspect the intended excavation area to identify any underground utilities, overhead electrical lines that may restrict removal activities, and electrical poles within or near the excavation that have the potential to become unstable as soil is removed. As necessary, the Bhate team will shut down power, reroute power, remove poles, and/or ensure that the poles are guy-wired for stability. If power must be shut down, the power outage will be coordinated with the GWTP and USFWS operations.

The areas to initially be excavated will be established prior to mobilization of the excavation personnel. Soil analytical results will be used to define the excavation area. A GPS will be used to delineate and mark the excavation area. The potential limits of excavation will then be physically marked with survey stakes, pin flags, paint, or other appropriate marking. Clearing of the vegetation in the excavation area will largely be conducted using conventional equipment. A temporary decontamination station will be constructed onsite.

Direct loading of soil into transport trailers is planned. However, an area will also be designated as a temporary soil staging/stock pile area, cleared, and polyethylene sheeting will be available to prepare a temporary stockpile area if needed.

3.8.2 Excavation and Soil Handling

Initial excavation limits will be established as described above. Vertical excavation will stop if groundwater or bedrock is encountered.

At excavations with sufficient soil analytical results, Bhate may decide to coordinate with the selected disposal facility to evaluate the potential for pre-excavation acceptance of the soil by the facility. Pre-excavation acceptance will allow direct loading of contaminated soil and thus avoid staging and double-handling of material. In these instances, the soil will be removed from the excavation and placed directly in transport trailers or dump trucks for immediate transport to the disposal facility. Licensed transporters will be used to haul the excavated soil to the pre-approved landfill for nonhazardous disposal. The excavated soil may be staged on plastic sheeting adjacent to the excavation while awaiting loading.

For sites not compatible with direct loading operations, excavated soils will typically be staged at the site and sampled for waste characterization and profiling. The process of staging and handling waste soil will depend on expected contaminant concentrations and soil volumes. If it is necessary to excavate clean soil, an attempt will be made to segregate clean soil from soil that is expected to exceed site-specific cleanup levels. The nonhazardous material generated will be placed in stockpiles while awaiting waste characterization analyses. The stockpiles will be placed in a designated contaminated-soil staging area which will be underlain by two layers of 6 millimeter polyethylene. Additional soil will be spread atop the polyethylene to minimize damage from heavy equipment and trucks. Soil in the staging area will be protected from surface water run-on by construction of temporary berms to divert potential run-on away from the area. The soil piles will be covered after each day with polyethylene sheeting to minimize the potential for contaminated dust generation and deposition during windy conditions, and to reduce exposure to rain and run off. As necessary, a site-specific plan addressing appropriate storm water control measures and/or fugitive dust control measures will be established prior to any soil excavation, staging activities, or other RAs involving earthwork in accordance with applicable regulations.

Composite samples will be collected from staged material as required to gain acceptance at specified disposal facilities. Each composite sample will consist of equal parts of five samples collected at evenly spaced locations within the stockpile. The composite sample will be analyzed for constituents and properties according to the selected disposal facility requirements. The fully-characterized excavation stockpile soil will be removed from the site for proper disposal in accordance with state and federal regulations.

No characteristically hazardous waste is expected during the soil excavation for the sites under this IWWP. However, if there are any assumed hazardous soils, they will be staged separately from assumed non-hazardous soils. If the excavated material is expected to be characteristically hazardous waste or if listed hazardous wastes are expected to be present, the soil will be placed in lined containers. The containers will be maintained in a designated staging area at the remediation site while waste characterization samples are analyzed. The containers will be covered by tarps while awaiting disposition.

3.8.3 Verification of Excavation Limits

If predefined excavation limits and a clean excavation boundary were not established using analytical data prior to the excavation, confirmation samples will be collected to verify the clean excavation limits. Confirmation sampling will be conducted concurrently with excavation and will document that the remaining soils beyond the confirmation sample meet established site-specific cleanup levels. After the initial excavation, samples will be collected from the walls and floor of the excavation and tested for the contaminants which the excavation intended to remove. Excavation would continue until concentrations in the soil are less than the site-specific cleanup levels. A five-point composite soil sample will be collected from approximately every 1,000 square feet of the excavation floor area and of each wall of the excavation.

If contaminants are detected above their cleanup levels during the confirmation sampling, the area will be excavated at least one additional foot deeper or sideways. This would continue until confirmation samples demonstrate the contaminants remaining in the soil are below their cleanup level or until groundwater is encountered. Thus, vadose zone soil that is identified as exceeding the cleanup levels would be removed.

The Site Superintendent and/o Site Quality Assurance/Quality Control Specialist, identified in the site-specific work plan, will mark the corners of the completed excavation for subsequent surveying. They will also measure and document the depths of excavation, including any depth variations. More information on surveying can be found in SOP A15-Surveying, of **Appendix A**.

3.8.4 Backfilling and Site Restoration

Once the excavation has been completed, the Bhate team will restore the site and demobilize. As needed, backfill operations would proceed after excavation activities are complete. The excavation areas would be backfilled with fill material that is certified to meet the site-specific cleanup levels. The borrow material may come from on-site if an available source is identified or may be obtained from an approved off-site source. After backfilling is complete, the area will be graded, if necessary, to match the original topography and to ensure positive drainage, and completed with topsoil and reseeded across the excavation area.

3.9 Task 9 – Well Abandonment

Well abandonment will be conducted in accordance with 16 TAC 76.104, as applicable, by a Texas-licensed driller. The abandonment procedures used at a site are dependent upon specific regulatory requirements and generally fall into two different methods: abandonment of the well in place; or complete removal of the well and associated materials from the aquifer. Abandonment in place will typically be used when cross-contamination between water-bearing zones is not a concern. In other circumstances, removal of the well materials will be implemented by over-drilling the well casing. Well abandonment reports and notices required by the Texas Water Development Board and Texas Department of Licensing and Regulation will be submitted upon abandonment.

Several goals should be met while conducting well abandonment activities. These include the prevention of vertical migration of fluids in the borehole and prevention of intermixing of waters from different water-bearing zones. In addition, any physical hazards that may be present, such as an open borehole, should be eliminated after conducting well abandonment procedures. Lastly, well abandonment activities should be conducted in such a way to preserve aquifer properties. Additional guidance is provided in SOP A16-Soil Boring/Monitoring Well Abandonment, of **Appendix A.**

3.10 Task 10 – In-Situ Bioremediation

To inject the in-situ bioremediation (ISB) amendments into the subsurface, direct-push technology (DPT) or injection wells will be used. DPT injections will be limited to the shallow zone groundwater. The use of DPT allows the ISB amendments to be injected into the treatment area and eliminates permanent injection wells, waste soil, future abandonment of injection wells, and post injection operation and maintenance (O&M). For areas requiring injection wells, they will be completed in the required depth interval specified in the site-specific work plan prior to mobilization for injection of amendments. The following subsections outline the minimum requirements for ISB implementation. Each site-specific work plan consider site-specific conditions that may adjust the implementation requiring additional requirements or considerations.

3.10.1 Installation of Injection Wells

Prior to mobilization for injections, any new injections wells will be installed as described in Task 2, Monitoring Well/Compliance Well Installation, with the exception of the well screen slot size, sand, and completion with a threaded connection to connect the injection hoses for injections. If needed, existing injection wells will be modified to accept the injection hose. Additionally, injection wells will not be developed prior to injection. Details of the injection wells will be included in the site-specific work plans.

3.10.2 ISB Amendment Preparation

For ISB treatment using SDC-9™, the first task of the in-situ enhanced bioaugmentation is to create anaerobic water for mixing amendments and their dispersion in the aquifer matrix. This will be accomplished by placing water tanks (rigid or flexible pillow tanks) near the treatment area and filling each one. The water tanks will be filled using a water truck that has been filled from a fire hydrant. To turn the water anaerobic, a carbon source (Emulsified Vegetable Oil or lactate) will be added to each water tank 24 hours before the water is needed for injection. Once the dissolved oxygen is below 1 milligram per liter, the water is considered anaerobic and the SDC-9™ will be added into the water tank. This is expected to occur in approximately 24 hours. To adjust the pH in the groundwater, the appropriate amount of sodium bicarbonate may be added to each water tank. As a contingency, rigid water tanks may be sparged using argon gas to ensure that the anaerobic conditions are established prior to the addition of SDC-9™.

3.10.3 ISB Treatment Application

To perform the ISB injection, three primary components are required: a water source; an injection rig including necessary pumps, hoses, and gauges; and a drill/DPT rig including injection rods. The drill rig will be subcontracted to a Texas licensed driller.

The ISB treatment mixture from the tanks will be injected into the target zone at each point. Multiple points will be injected at one time, typically between 2 and 4, using an injection manifold. The spacing of the injections will be established in the site-specific work plan, and the number and spacing of injection points (DPT points or injection wells) may be altered due to obstacles or restricted areas within the planned target area. Such deviations are expected to be noted in the site-specific technical work plan, but may arise from encounters with unexpected field conditions.

3.11 Other Remediation Tasks

For tasks not otherwise described in this IWWP, site-specific work plans will be issued that will specifically address a site and the scope of work that will be required for that site. Other activities associated with ongoing remedies such as operation, monitoring, and maintenance of the extraction systems and the GWTP are included in the Operations and Maintenance Plan. Remedial actions, including contingency remedies, will have work plans that provide details, including HASP Addendums, for that specific field work.

3.12 Site Restoration and Demobilization

Following completion of remediation activities, Bhate will restore the site and demobilize. Disturbed areas will be graded for proper drainage, if necessary. Revegetation of disturbed areas will be with native vegetation where possible. Equipment and personnel will be demobilized from the project site immediately following completion of field operations. Equipment will be decontaminated before leaving the site.

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4 HEALTH AND SAFETY

The HASP defines and establishes the policies and procedures that protect workers and the public from potential hazards posed by planned project activities during this installation-wide investigation and remediation effort at LHAAP. The HASP incorporates health and safety policies and safe operating procedures for individual project site activities proposed under this contract. These procedures allow work activities to be carried out in a controlled, effective manner, consistent with Bhate policies.

Prior to initiating work at the facility for any site, workers will sign the HASP acknowledgement page to indicate they have read and understood the document. Also, daily safety meetings will be held with all field crew members prior to starting work each day in order to review the day's scope of work, any site conditions expected, and any hazards that need to be addressed or acknowledged. The HASP is provided as **Appendix B**.

Each site-specific work plan will include a HASP Addendum, or similar. That section will address hazards that are not addressed by this IWWP because the hazards are unique to the site or associated with specialized technologies dealt with in the site-specific work plan.

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5 QUALITY ASSURANCE/QUALITY CONTROL

The UFP-QAPP in **Appendix C** provides additional information on QA/QC procedures. This plan identifies personnel, procedures, controls, instructions, tests, verifications, documents, and forms to be used and what type of records to be maintained. The USACE Three-Phase QC process will be used to enforce QA/QC requirements and includes preparatory inspections, initial inspections, and follow-up inspections. The three phases of inspections will target each definable feature of work during execution of project activities.

Bhate will coordinate with the USACE to meet the requirements of the Quality Assurance Surveillance Plan (QASP). The QASP, developed by the USACE, incorporates key QC activities that the USACE will use to assess progress toward milestones as described in the Performance Work Statement.

Each site-specific work plan generated to guide activities not covered in this IWWP will include a section on QC. That section will address QC requirements specific to any specialized technologies that are being applied but not addressed by this IWWP.

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6 REFERENCES

ASTM International (ASTM). 2009. ASTM D2488-09a, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*.

Jacobs Engineering Group (Jacobs). April 2001. *Final Remedial Investigation Report for the Group 2 Sites (Sites 12, 17, 18/24, 29, and 32) at Longhorn Army Ammunition Plant, Karnack, Texas*.

Jacobs. January 2002 *Final Remedial Investigation Report Volume 1: Report for the Group 4 Sites, Sites 35A, 35B, 35C, 46, 47, 48, 50, 60, and Goose Prairie Creek, Longhorn Army Ammunition Plant, Karnack, Texas*.

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FIGURES

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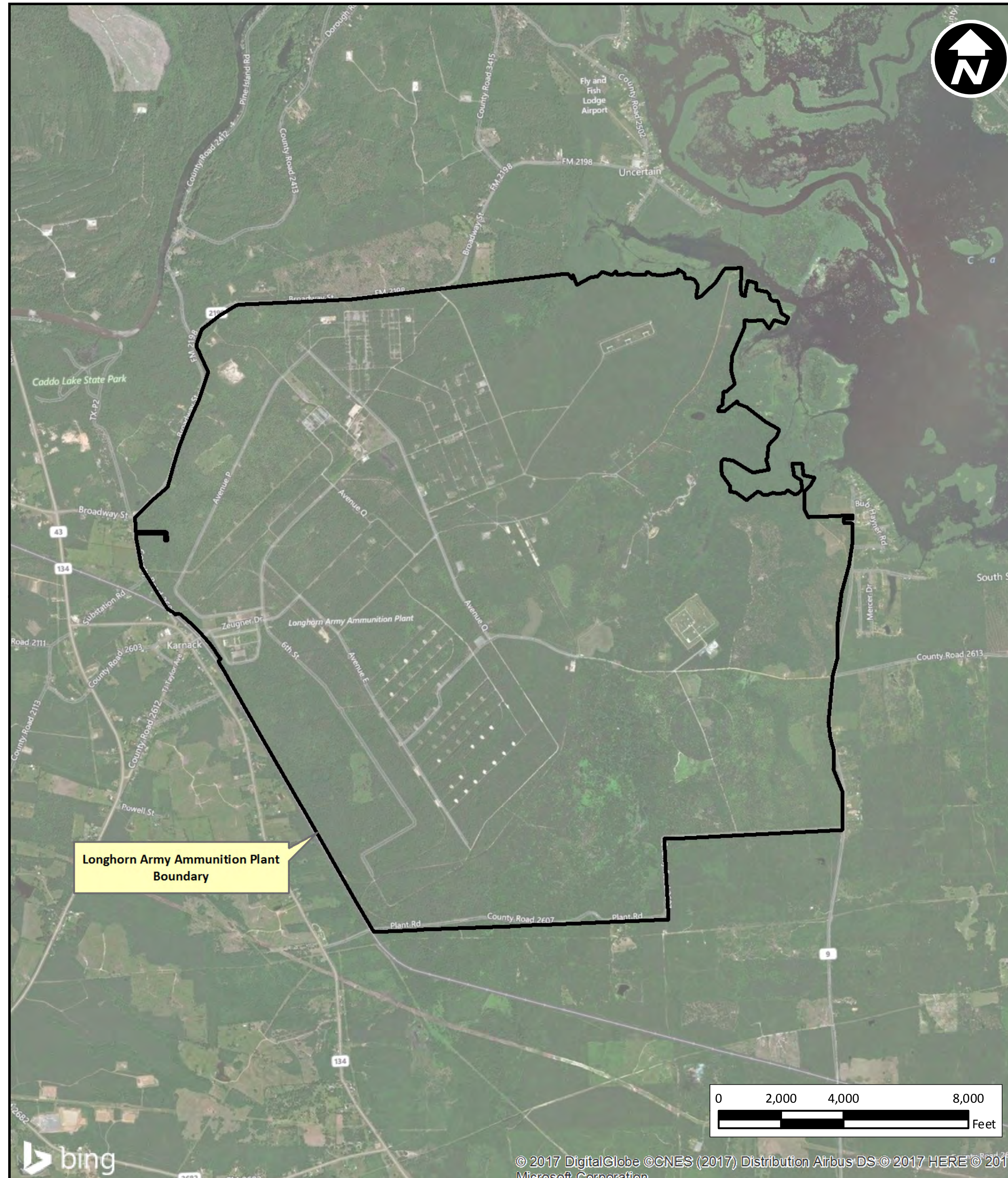


LHAAP Location Map

Figure 2-1

Installation-Wide Work Plan for
Longhorn Army Ammunition Plant
Karnack, Texas

DRAWN BY: MRM

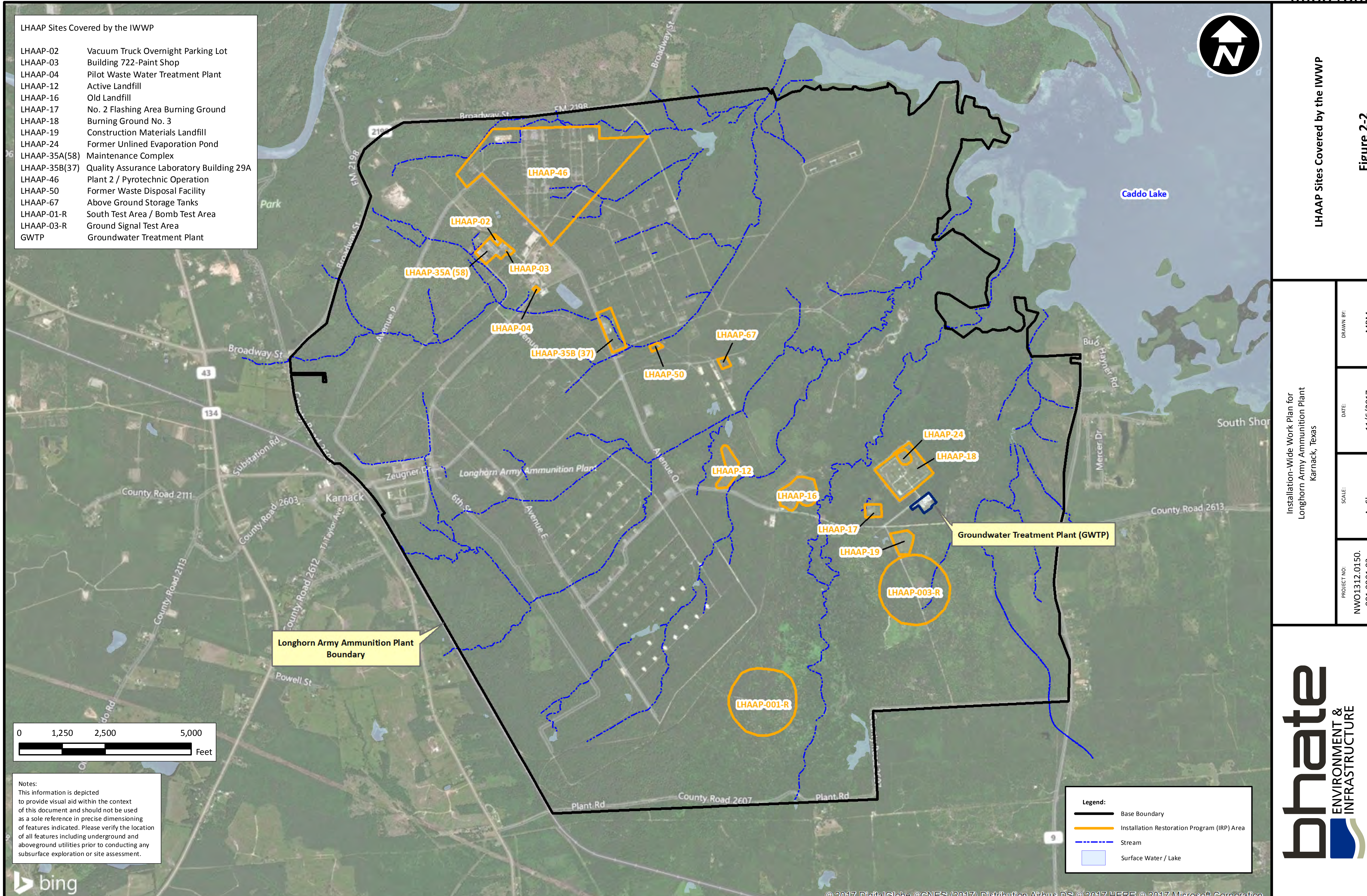
DATE: 11/6/2017

SCALE: As Shown

PROJECT NO: NWO1312.0150.001.0001.03

bhate ENVIRONMENT & INFRASTRUCTURE

00881598



LHAAP Sites Covered by the IWWP
LHAAP-02 Vacuum Truck Overnight Parking Lot
LHAAP-03 Building 722-Paint Shop
LHAAP-04 Pilot Waste Water Treatment Plant
LHAAP-12 Active Landfill
LHAAP-16 Old Landfill
LHAAP-17 No. 2 Flashing Area Burning Ground
LHAAP-18 Burning Ground No. 3
LHAAP-19 Construction Materials Landfill
LHAAP-24 Former Unlined Evaporation Pond
LHAAP-35A(58) Maintenance Complex
LHAAP-35B(37) Quality Assurance Laboratory Building 29A
LHAAP-46 Plant 2 / Pyrotechnic Operation
LHAAP-50 Former Waste Disposal Facility
LHAAP-67 Above Ground Storage Tanks
LHAAP-01-R South Test Area / Bomb Test Area
LHAAP-03-R Ground Signal Test Area
GWTP Groundwater Treatment Plant
LHAAP-46
LHAAP-02
LHAAP-35A (58)
LHAAP-03
LHAAP-04
LHAAP-35B (37)
LHAAP-50
LHAAP-67
LHAAP-12
LHAAP-16
LHAAP-24
LHAAP-18
LHAAP-17
LHAAP-19
LHAAP-003-R
LHAAP-001-R
Groundwater Treatment Plant (GWTP)
Longhorn Army Ammunition Plant Boundary
Longhorn Army Ammunition Plant
Caddo Lake
Karnack
Broadway St
FM 2198
County Road 2111
County Road 2603
County Road 2613
County Road 2607
Plant Rd
Powell St
South Shore
0 1,250 2,500 5,000
Feet
Notes:
This information is depicted to provide visual aid within the context of this document and should not be used as a sole reference in precise dimensioning of features indicated. Please verify the location of all features including underground and aboveground utilities prior to conducting any subsurface exploration or site assessment.
Legend:
Base Boundary
Installation Restoration Program (IRP) Area
Stream
Surface Water / Lake
© 2017 DigitalGlobe ©CNES (2017) Distribution Airbus DS © 2017 HERE © 2017 Microsoft Corporation
bing
Figure 2-2
LHAAP Sites Covered by the IWWP
Installation-Wide Work Plan for Longhorn Army Ammunition Plant Karnack, Texas
DRAWN BY: MRM
DATE: 11/6/2017
SCALE: As Shown
PROJECT NO: NWO1312.0150.001.0001.03
bhate ENVIRONMENT & INFRASTRUCTURE

APPENDIX A

STANDARD OPERATING PROCEDURES

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00881601

STANDARD OPERATING PROCEDURES
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

May 2018

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Table of Contents

SOPs

Tables

Attachments

SOPs

ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials (now ASTM International)
bgs	Below ground surface
°C	Degrees Celsius
Cal EPA	California Environmental Protection Agency
cc	Cubic centimeter
cfs	Cubic feet per second
Cl-	Chloride
DI	De-ionized
DPT	Direct push technology
eV	Electron volts
°F	Fahrenheit
FID	Flame ionization detector
GC	Gas chromatograph
gpg	Grains per gallon
GPS	Global positioning system
GWTP	Groundwater Treatment Plant
HASP	Health and Safety Plan
Hg	Mercury
ID	Identification
IDM	Investigation-derived materials
IPA	Isopropyl alcohol
lb	Pound
LHAAP	Longhorn Army Ammunition Plant
MEK	Methyl ethyl ketone
µg/L	Micrograms per liter
mg/L	Milligrams per liter
mL	Milliliter
mL/min	Milliliters per minute
MS	Matrix Spike

SOPs

mS/cm	Millisiemens per centimeter
MSD	Matrix Spike Duplicate
msl	Mean sea level
mV	Millivolts
NaCl	Sodium chloride
NAVD	National American Vertical Datum
NIOSH	National Institute for Occupational Safety and Health
nm	Nanometer
NTU	Nephelometric turbidity units
OD	Outer diameter
ORP	Oxidation/Reduction Potential
OSHA	Occupational Safety and Health Administration
%	Percent
PID	Photoionization detector
PM	Project Manager
POL	Petroleum, oil, and lubricants
ppb	Parts per billion
PPE	Personal protective equipment
ppm	Parts per million
PVC	Polyvinyl chloride
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RLS	Registered land surveyor
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SI	Site Investigation
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedures
SSHP	Site Safety and Health Plan

TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
U.S.	United States
USCG	U.S. Coast Guard
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
UST	Underground storage tank
VOC	Volatile Organic Compounds

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A1 DECONTAMINATION PROCEDURES

This Standard Operating Procedure (SOP) describes the procedures to be used to decontaminate sampling equipment in the field after use. Decontamination is performed as a quality assurance (QA) measure and safety precaution. It prevents cross-contamination among samples and helps maintain a clean working environment for the safety of all field personnel.

Decontamination is mainly achieved by rinsing with liquids including soap or detergent solutions, tap water, deionized water, and isopropanol. After being cleaned, equipment is allowed to air dry. If time constraints will not allow for complete air drying, the equipment should be rinsed with copious amounts of analyte-free water. Equipment may then be reused immediately. Steam cleaning should be used whenever visible contamination exists on large machinery/vehicles.

One of the primary responsibilities of the Site Supervisor is to assure that proper decontamination procedures are followed. The Site Supervisor is also responsible for ensuring that all waste materials produced as a result of the cleaning procedures are stored or disposed of properly. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and to ensure that contaminants are not negligently introduced into the environment.

A1.1 Required Equipment

The following is a list of supplies which will be needed in order to properly decontaminate equipment:

- Scrub brushes
- Buckets or wash tubs
- Paper towels
- Liquinox® or Alconox® detergent
- Potable water
- Deionized water
- Spray bottles (if needed)
- Appropriate personal protective equipment (PPE) (minimally safety glasses and nitrile gloves)
- Waste storage containers (plastic buckets with lid, carboys, etc.)
- Logbook

A1.2 Procedures

Review the site specific plans/addendums to determine if any QA samples will be required prior to deploying to the field. After arriving in the field, personnel should:

1. Assemble containers and equipment for decontamination; and

2. Decontaminate all equipment before use if not previously decontaminated under controlled conditions.

Once a piece of equipment has been used, it must be decontaminated before it can be reused. If the protective wrapping on a piece of pre-cleaned equipment has been torn, or if there is any question about its cleanliness, the equipment should be considered contaminated and undergo the full decontamination procedures before it is used.

Adequate supplies of rinsing liquids and all materials should be available. Equipment cleaning should be performed in the same level of protective clothing required for sampling activities unless a different level of protection is specified in the Site Safety and Health Plan (SSHP).

The procedure for all field decontamination of equipment follows:

1. Remove any solid particles from the equipment or material by brushing and then rinsing with available tap water. For drilling equipment, steam cleaning is necessary. The purpose of the initial step is to remove gross contamination.
2. Wash equipment with a brush and a phosphate-free detergent solution.
3. Rinse with tap water.
4. For organic contaminants, an optional rinse with isopropanol may be necessary to dissolve and remove coatings of organic contaminants.
5. Rinse thoroughly with potable water.
6. Double rinse with deionized water.
7. Allow equipment to air dry thoroughly.
8. If the equipment must be reused before the isopropanol evaporates, it should be rinsed thoroughly with copious amounts of deionized water.
9. Unless the equipment is going to be used immediately, it must be wrapped in new aluminum foil, shiny side out, to keep it clean until needed. For large bulky equipment, new plastic sheeting can be substituted for the aluminum foil.

The alcohol rinse should be omitted for any equipment such as plastic well sounding tapes, polyvinyl chloride (PVC) slugs, etc. Solvents should not be used on any type of non-Teflon plastic equipment which will contact an environmental sample or be introduced into a monitoring well.

If cleaned under controlled conditions at a warehouse or laboratory, wrapped in aluminum foil for protection, and then brought to the field, the equipment must not be used if the aluminum foil is torn. Under these circumstances, the equipment should be considered to be contaminated and must be decontaminated before use. If this pre-cleaned equipment is not used, it must be decontaminated under controlled conditions before return to the equipment stock for reuse at another site. This requirement applies even if the aluminum foil is not torn. This requirement can be waived if, after being decontaminated under controlled conditions and wrapped in aluminum foil, the equipment is heat sealed in plastic. In this case, if the equipment is not used, the plastic can be rinsed with water and the equipment can be returned to equipment stock.

Decontamination under controlled conditions is by procedures which are slightly different from the aforementioned procedures. The differences are listed below:

- The phosphate-free detergent solution should be hot;
- The tap water rinse should be with hot water;
- For glass and Teflon sampling equipment, a rinse with at least a 10 percent nitric acid solution should be added after the tap water rinse step; and
- An additional tap water rinse should be added after the dilute acid rinse.

The decontamination of drilling, hydrocone, and direct push technology (DPT) equipment will be performed as follows:

1. Drilling rig engine and power head as well as the DPT will be steam cleaned and rinsed with tap water prior to arrival on-site.
2. Drill equipment will be decontaminated between each sampling site as discussed above.
3. The DPT probes will be disassembled and steam cleaned.

Before leaving the field, personnel should:

1. Decontaminate as much sampling equipment as possible and properly dispose of expendable items that cannot be decontaminated. Heavily contaminated equipment should not be returned to the office or warehouse but should at least be field cleaned (e.g., detergent wash and tap water rinse) before it is returned. Proper disposal may involve on-site draining of liquids and solids into approved containers for subsequent disposal. Expensive items like machinery may require a more advanced analysis of decontamination options.
2. Prepare the final decontamination blank sample; document it according to SOP A13, Sample Control and Documentation; and ship it to the analytical laboratory.
3. Store containers of solutions produced during decontamination in a secure area.

Dispose of any soiled materials as designated in the project work plan.

After returning to the office, personnel should:

1. Deliver original logbooks to the Site Supervisor for technical review. The Site Supervisor will review and transmit these items to the Project Manager (copies to the sites).
2. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.
3. Contact the analytical laboratory to ensure that the sample arrives safely and instructions for analyses are clearly understood.
4. After receiving the result of the laboratory analyses, arrange for the disposal of wastes generated during the investigation.

A1.3 Investigation-Derived Materials Handling

Investigation-derived materials (IDM) soil cuttings, groundwater, and rinse water generated during soil and groundwater sampling will be containerized and stored at a secure location. Containers will be labeled to indicate contents. See SOP A22 for further handling and management of IDM.

A1.4 References

National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), United States (U.S.) Coast Guard (USCG), and U.S. Environmental Protection Agency (USEPA). 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*.

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM)*.

A2 LITHOLOGIC DESCRIPTION OF SUBSURFACE SAMPLES AND COMPLETION OF DRILL LOGS

This SOP will provide instructions for describing subsurface materials encountered during hollow stem augering, hand augering, and other drilling activities and will describe how to clearly document the events and findings of the drilling activity.

The drilling log is used for describing unconsolidated materials encountered in the subsurface. To achieve uniformity and clarity, the Site Supervisor will adhere to the following standards in describing and presenting geological data. A drilling log is intended for use in the field during drilling, sampling, and or logging process for soil borings and monitoring wells. The purpose of the log is to clearly document the events and findings of the drilling activity. All pertinent data related to boring/drilling operations will be concisely recorded by a qualified, experienced geologist or geotechnical engineer as objectively as possible.

A2.1 Office and Field Preparation

Before leaving the office to begin field activities, personnel should:

1. Review the project work plan and associated documentation for a specific operation and obtain all information related to the purpose and intent of the field program. This documentation may include but is not limited to:
   - The scope of work described in the project work plan;
   - Previous reports related to the site;
   - Reports related to the area;
   - Site maps;
   - Area maps;
   - Access agreements;
   - The drilling subcontractor's work plan if drilling has not yet been performed;
   - Copies of all drilling logs if the boreholes have been completed;
   - Data collection and equipment checklists; and
   - Associated SOPs.
2. Contact facility/installation/site staff, members of the community (in coordination with facility/installation/site staff), and subcontractors before work is initiated. During the initial contact, permission to enter private property or security areas should be obtained. Field personnel are expected to maintain a good working relationship with the client, community, and subcontractors.
3. Obtain and test all equipment needed for the task.
4. Obtain a logbook to record/document all observations concerning pre-operation drill rig inspections, drilling operations, soil or rock core loggings.
5. Obtain a sufficient number of the appropriate data collection forms such as drilling logs, etc.

A2.2 Required Equipment

The following is a list of supplies which will be needed in order to describe subsurface materials.

- Plastic sheeting
- Paper towels
- Plastic bags and/or glass jars with aluminum foil
- Tape measure
- Munsell® Color Chart
- Appropriate PPE (minimally safety glasses and nitrile gloves)
- Logbook
- PID (if applicable for headspace analysis)

Upon arriving in the field, but before the start of site operations, personnel should:

1. Decontaminate all sampling equipment before taking the first sample and between sampling intervals.
2. Have a sufficient number of blank log forms.
3. Record all pertinent information (date, site, ID number, and location) in the logbook or the appropriate data form. Note field conditions, recovery percentage of each core, unusual circumstances, and weather conditions.
4. Permanently attach a soil sample identification label to each sample container.

A2.3 Sample Logging Procedure

Whenever a sample is collected during DPT coring or hollow stem augering, drilling logs will be completed. All relevant information blanks in the log heading and log body will be completed. Borings should be logged at a scale of one inch equals one foot unless otherwise approved by the U.S. Army Geologist.

Each and every material type encountered will be described in column C of the log. Material types are to be logged directly from samples and indirectly interpolated using professional judgment, drill cuttings, drill action, etc., between sampling intervals. Unconsolidated materials will be described as outlined below:

- Descriptive Unified Soil Classification System (USCS) in accordance with ASTM International (ASTM) D 2488-84;
- Consistency of cohesive materials or apparent density of non-cohesive materials;
- Moisture content assessment, e.g., moist, wet, saturated, etc.;
- Color based on the Munsell® Color Chart;
- Percent recovery;
- Bedding, plasticity, sorting, organic materials, macrostructures, or grading; and

- Depositional type (alluvium, till, loess, etc.). Deposit names will follow the name of the primary grain size.

Competent (rock) materials will be described in accordance with ASTM C294 and as outlined below:

- Rock type;
- Relative hardness;
- Density;
- Texture;
- Color based on the Munsell® Color Chart;
- Weathering;
- Bedding;
- Fractures, joints, bedding planes, and cavities, including any filling material and weather open or closed;
- Rock Quality Designation; and
- Other descriptive features (fossils, pits, crystals, etc.).

Stratigraphic/lithologic changes will be identified by a solid horizontal line at the appropriate scale depth on the log which corresponds to measured borehole depths at which changes occur. Gradational transitions, changes identified from cuttings or methods other than direct observation and measurement will be identified by a horizontal dashed line at the appropriate scale depth based on the best judgment of the logger. Entries into other columns will be as follows:

- At the top of the column, an acronym/abbreviation for the field screening instrument (PID, flame ionization detector [FID], etc.) type and detection level in parts per million (ppm) for the field screening device employed under ambient conditions. In the column, present the screening results from a sample interval.
- Depth at which a sample was collected and the designated sample number.
- Other information relevant to the investigation including any special drilling or sampling problems/resolutions; odors; borehole/sample diameters; depths at which drilling, sampling methods, or equipment changed; along with total depth of penetration.

Logs will identify the depth at which water is first encountered, the depth to water at the completion of drilling, and the stabilized depth to water. The absence of water in borings will also be indicated. Stabilized water level data will include time allowed for levels to stabilize. The bottom of the hole will be clearly identified on the logs with the notation "Bottom of Hole". Completed borehole logs will be submitted to the U.S. Army Project Manager (PM) within 5 calendar days of completion of the boring or as required under specific contract requirements; these logs will not contain any surveyed data. Copies of the field logs will be included in the draft and final project reports; hand written logs may be provided in draft documents and final documents may include typed boring logs (Attachment A2.5.1).

Before leaving the field, personnel should:

1. Decontaminate as much sampling equipment as possible and properly dispose of expendable items that cannot be decontaminated. Heavily contaminated equipment should not be returned to the office or warehouse but should at least be field cleaned (detergent wash and tap water rinse) before it is returned. Proper disposal may involve on-site draining of liquids and solids into approved containers for subsequent disposal. Expensive items like machinery may require a more advanced analysis of decontamination options.
2. Ensure that all equipment is accounted for.
3. Make sure all borehole locations are properly staked and the location ID is readily visible on the location stake.
4. Review data collection forms for completeness.
5. Dispose of any soiled materials as designated in the project work plan.

After returning to the office, personnel should:

1. Deliver original forms and logbooks to the Project Manager for technical review. The Project Manager will review and file the information for later presentation within applicable reporting documents.
2. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

A2.4 Reference

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM)*.

A2.5 Attachments

A2.5.1 Drilling Log

The form is provided as an attachment in this SOP.

ATTACHMENT A2.5.1
DRILLING LOG

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00881623

HTW DRILLING LOG

HTW DRILLING LOG							HOLE NO.
1. COMPANY NAME			2. DRILLING CONTRACTOR				SHEET OF SHEETS
3. PROJECT				4. LOCATION			
5. NAME OF DRILLER				6. MANUFACTURER'S DESIGNATION OF DRILL			
7. SIZES & TYPES OF DRILLING & SAMPLING EQUIPMENT				8. HOLE LOCATION North East			
				9. SURFACE ELEVATION (ft. NGVD)			
				10. DATE STARTED		11. DATE COMPLETED	
12. OVERBURDEN THICKNESS				15. DEPTH GROUNDWATER ENCOUNTERED			
13. DEPTH DRILLED INTO ROCK				16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED			
14. TOTAL DEPTH OF HOLE				17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)			
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED		19. TOTAL NUMBER OF CORE BOXES			
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE REC %	
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR			

% REC. a	DEPTH b	DESCRIPTION OF MATERIALS c	Field Screening Results d	Geotech Sample or Core Box No. e	Analytical Sample No. f	Blow Counts g	REMARKS h
	0						
	1						
	2						
	3						
	4						
	5						

PROJECT

HOLE NO.

% REC.

00881624

HTW DRILLING LOG

HOLE NO.		
PROJECT	INSPECTOR	SHEET OF SHEETS

% REC. a	DEPTH b	DESCRIPTION OF MATERIALS c	Field Screening Results d	Geotech Sample or Core Box No. e	Analytical Sample No. f	Blow Counts g	REMARKS h

00881625

HTW DRILLING LOG

PROJECT			INSPECTOR				HOLE NO. / SHEET OF SHEETS
% REC. a	DEPTH b	DESCRIPTION OF MATERIALS c	Field Screening Results d	Geotech Sample or Core Box No. e	Analytical Sample No. f	Blow Counts g	REMARKS h

PROJECT HOLE NO.

A3 HEADSPACE ANALYSIS

This SOP should be used if headspace analysis is required based on project work plans. This method is used to screen water, soil, and sediment samples for total organic vapor concentration. High ambient humidity causes erratic responses (usually low). Available lamps include 9.5 electron volts (eV), 10.2 eV, and 11.7 eV. The 9.5 eV lamp detects aromatics and large molecules. The 10.2 eV lamp detects the above compounds plus vinyl chloride, methyl ethyl ketone (MEK), trichloroethene (TCE), and other two to four carbon compounds. The 11.7 eV lamp detects the above compounds plus halocarbons, methanol, and other single carbon compounds. The detection limit is 100 micrograms per liter (µg/L) for most volatile organics. The linear operating range for most compounds is 100 to 60,000 µg/L. The useful range extends to 200,000 µg/L.

The PID should be calibrated every morning according to the manufacturer's specification before the start of field activities. If field personnel suspect a malfunction, the PID should be recalibrated and noted in the field logbook.

A3.1 Required Equipment

- Ziploc® bags (or equivalent) or clean glass jars
- Aluminum foil (if using glass jars)
- PID Calibration gases as applicable to the PID

A3.2 Procedures

Note that headspace samples (soil) should be collected for each interval after the laboratory sample is collected. In many cases, results of the headspace analysis will determine which samples should be retained for submittal to the laboratory per the site specific sampling plan.

The following describes the use of glass containers (soil and water).

1. Calibrate PID in accordance with the manufacturer's specifications.
2. Label glass jar with the sample number.
3. Fill the container half full with soil (or 75% with water) and cover with aluminum foil and the cap.
4. Wait approximately 30 minutes to allow the sample and headspace within the jar to equilibrate.
5. Analyze the headspace in the container using a PID by removing the cap and inserting the PID wand through the foil to maintain a seal.

The following describes the use of Ziploc® bags (soil only).

1. Calibrate PID in accordance with the manufacturer's specifications.
2. Label Ziploc® bag with the sample number.
3. Place soil in Ziploc® bag until bag is approximately one-half full. Shake Ziploc® bag to homogenize sample.

4. Wait at least 5 minutes to allow soil vapors to equilibrate. In cold weather, place samples in a warm environment; in hot weather, keep samples out of direct sun.
5. Place PID wand into Ziploc® bag, being careful not to contact soil with the PID probe.
6. Record highest sustained reading in field log form and/or in logbook.

A3.3 Reference

Coel-Roback, B. September 13, 2004. *Risk Reduction and Environmental Stewardship-Environmental Characterization and Remediation Standard Operating Procedure for Headspace Vapor Screening with a Photoionization Detector.* Los Alamos National Laboratory.

A3.4 Attachments

A3.4.1 Calibration Form

The form is provided as an attachment in this SOP.

A3.4.2 Headspace Analysis Form

The form is provided as an attachment in this SOP.

ATTACHMENT A3.4.1
CALIBRATION FORM

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Field Instrument Calibration Records

SITE NAME: Page _______ of________

INSTRUMENT (MAKE/MODEL#)_______________________ **INSTRUMENT #**__________________________

PARAMETER:

☐ TEMPERATURE ☐ CONDUCTIVITY ☐ pH

☐ TURBIDITY ☐ ORP ☐ DO ☐ OTHER

STANDARDS: **[Specify the type(S) of standards used for calibration, the provenance of the standards and the standard values.]**

Standard A

Standard B

Standard C

DATE (DD/MM/YY)	TIME (hr:min)	STD (A, B,C)	STD VALUE	INSTRUMENT RESPONSE	DEV	CALIBRATED (YES, NO)	INSTRUMENT ID#	SAMPLER INITIALS

ATTACHMENT A3.4.2
HEADSPACE ANALYSIS FORM

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Headspace Analysis Log Form

Page _______ of________

Site Name:	**Location:**
Date:	**Project No:**
Client:	
Measured by:	

Headspace Monitoring Instrument: **OVA** **H·Nµ**

Brief Description of Sample Preparation Method:

Sample No	Sample Interval	Depth feet below ground surface	Time		Headspace Reading (ppm)	Description
			Collection	Analysis		

A4 SUBSURFACE SOIL SAMPLING

This SOP contains specific details about the procedures and equipment necessary to properly collect soil samples to aid in the delineation of potential migration pathways of subsurface contaminants. Refer to the project work plan which covers the specific type of environmental investigation you are conducting and for the purpose and types of samples which must be collected.

Soil samples will be collected during the installation of soil borings and/or monitoring wells. Split-spoon samplers or hand augers will be used to collect all soil samples. A drill rig equipped with a 140-pound (lb) drop hammer will be used for split-spoon sample collection in unconsolidated soils. Hollow stem auger drilling is the preferred method of drilling, however, other methods may be acceptable. Sampling will be performed as specified in the project plans [e.g., continuously from ground surface to water table using a standard split spoon sampler or hand auger]. In general, sampling events should be sequenced to work from the least contaminated locations to the more highly contaminated locations to prevent cross-contaminating samples.

All split-spoon sampling will be performed through a flight of hollow stem augers using 3-inch outer diameter (OD), 24-inch split-spoon samplers driven in accordance with ASTM D-1586-84. Split-spoon samples will be collected continuously at 2-foot intervals down to the groundwater-soil interface. If other methods of drilling are used, refer to the project plans for more detail on the collection of soils.

A4.1 Required Equipment

- Stainless steel sample mixing dishes, if applicable
- Sample containers per the project plans
- Tape measure
- Stainless steel sampling spoons, if applicable
- Sampling equipment decontamination supplies
- Logbooks and appropriate field forms (drilling logs, chain of custody forms, etc.)
- Sample tags/labels and sample shipping supplies

A4.2 Procedures

Before leaving the office to begin field activities, personnel should:

1. Review the project work plan and associated documentation for a specific operation and obtain all information related to the purpose and intent of the field program. This documentation may include but is not limited to:
   - The scope of work described in the project work plan;
   - Previous reports related to the site;
   - Reports related to the area;
   - Site maps;

- Area maps;
- Access agreements;
- The drilling subcontractor's work plan;
- Data collection and equipment checklists; and
- Associated SOPs.

2. Contact facility/installation/site staff, members of the community (in coordination with facility/installation/site staff), and subcontractors before work is initiated. During the initial contact, permission to enter private property or security areas should be obtained. Field personnel are expected to maintain a good working relationship with the client, community, and subcontractors.
3. Obtain and test all equipment needed for the task.
4. Obtain a logbook and record observations concerning pre-operation drill rig inspections, drilling operations, and soil or rock core loggings.
5. Obtain a sufficient number of data collection forms.

Upon arriving in the field, but before the start of site operations, personnel should:

1. Verify that the appropriate supplies for soil sample collection activities are present on-site;
2. Verify that the drill rig is equipped with a 140-lb drop hammer and sufficient hollow-stem augers to drill to the depths required by the site-specific work plan;
3. Verify that sufficient numbers of split-spoon, or hand auger samplers are decontaminated and available for sampling; and
4. Verify that sufficient containers (e.g., drums, roll-off containers) are present on-site to store all excess sample materials obtained from split-spoons or bucket augers.

A4.2.1 Hand (Manual) Auger Soil Sampling

When collecting soil samples with a hand auger, the sample location surface is to be cleared of grasses, concrete, asphalt, or other cover, and a decontaminated stainless-steel hand auger bucket with extension and handle is to be used to auger to the top of the desired sampling depth by hand rotating the auger clockwise. Another pre-cleaned auger bucket should then be used to obtain a sample from the desired sampling depth. Once the auger has been driven a full 12 inches into the sampling depth, it will be withdrawn, and the upper 3 inches, representing material that has fallen from above or has been scraped from the sides of the auger hole, is to be discarded.

Place the sample in the appropriate container, label it, and store it on ice in a cooler. Sample collection procedures are detailed in sections of this SOP.

Note the sample ID number, depth from which sample was taken, and analyses requested in the field logbook and on the appropriate forms. Complete the field logbook entry and soil boring log.

A4.2.2 Split-Spoon Soil Sampling

During split-spoon sampling, the locations to be sampled should be surveyed and staked or marked, and the sample location surface should be cleared of grasses, concrete, asphalt, or other cover. To prepare the location for drilling, plastic sheeting should be spread over and around the vicinity to be sampled. Once drilling begins, the borehole will be advanced to the desired depth. A decontaminated split-spoon sampler should then be screwed onto the center rod and driven into the ground with the drill rig hammer. The center rod will then be marked in 6-inch increments and a 140-lb hammer falling 30 inches will be used to drive the spoon as specified by the ASTM Method D-1586. Driving will cease when the full length of the spoon has been driven into the ground, or when it hits refusal.

The split-spoon sampler will be unscrewed from the center rod and placed on a plastic or foil covered surface. The sampler should be carefully opened to minimize disturbance. The upper 3 inches of soil in the sampler should be assumed to represent material that has fallen from above or has been scraped from the sides of the auger hole; therefore, this portion is not representative of the sampling interval and is to be discarded. Describe the sample in detail on the boring log form per SOP A2. After sampling, advance the borehole to the next sampling depth and collect samples as described above.

A4.2.3 Soil Sample Collection

Hermetically sealed samples should be collected from each sample interval using pre-cleaned sample containers provided by a subcontracted laboratory or manufacturer (e.g., TerraCore). All containers will be glass and will come equipped with pre-cleaned Teflon-lined lids or septa. Soil samples should be collected prior to obtaining headspace samples in order to reduce volatilization, when applicable. Upon completion of the boring, the headspace analysis can be used to determine which samples to retain for submittal to the laboratory. The samples not selected for laboratory analysis should be discarded per the laboratory instructions.

Samples should be collected per the manufacturers' direction (i.e. Encore® samplers, TerraCore samplers, etc.). The sample containers will then be packed in coolers with ice at 4 degrees Celsius (°C) to minimize volatilization or biodegradation of contaminants. If delivery to the laboratory within 48 hours (volatile analyses) is not possible, samples may be frozen in the field and shipped on ice. Non-volatile soil samples will be placed in appropriate sample containers and each container will be secured immediately with a Teflon-lined lid.

Each sample will be tagged for identification. The outside of each container will be cleaned with a damp paper towel. The container will be placed in a plastic bag and sealed before being placed in an iced sample cooler. Samples will then be shipped or delivered to the analytical laboratory within the appropriate hold time of the sample. If samples are held overnight, the coolers must be held and properly stored (sufficient ice) in a secured location under the supervision of the sampler.

SOPs

After the completion of field operations and before returning to the office, personnel should:

1. Ensure that all equipment is accounted for, decontaminated (See SOP A1, Decontamination Procedures), and ready for shipment back the office or rental facility.
2. Restore the site to the pre-sampling conditions as specified in the project work plan. Restoration can include repair of damage to the land surface (tire ruts) or private property (fences) as well as restoration anticipated at the time the project work plan was prepared (e.g., re-vegetation or bore-hole abandonment).
3. Complete any remaining documentation. This can consist of, but is not limited to:
   - Recording any restoration work in the logbook.
   - Recording any uncompleted work in the logbook. This additional recording may include soil samples which could not be collected and/or damage that could not be repaired.
   - Completing logbook entries, verifying the accuracy of entries, and signing/initialing any pages for which this was not done during field activities. If any of this signing/initialing is done at the end of field activities, the date it is performed should also be noted by each new entry.
   - Reviewing data collection forms for completeness.

Immediately after returning to the office, personnel should:

1. Deliver original forms and logbooks to the Project Manager for technical review. The Project Manager will review and file the information for later presentation within applicable reporting documents.
2. Inventory equipment and supplies.
3. Repair or replace all broken or damaged equipment.
4. Replace expendable items.
5. Return equipment to the equipment manager and report incidents of malfunction or damage.

A4.3 References

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM)*.

USEPA. 2002. *Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples.*

A5 DIRECT-PUSH GROUNDWATER SAMPLING

This SOP outlines the methods used during direct-push groundwater sampling. Note that metals cannot be sampled via grab samples from DPT bore holes nor temporary wells due to the likelihood of biased results that are not representative of the groundwater. This approach is useful and relatively cost-effective (compared to well installation and sampling) for defining the extent of subsurface contamination and in optimizing the placement of monitoring wells, soil borings, and other sampling points.

DPT groundwater sampling is conducted by driving a groundwater sampling probe into the surficial aquifer and collecting groundwater samples. This method reduces the number of monitoring wells required for plume delineation and though it cannot entirely replace soil sampling and monitoring well installation, it will reduce the ultimate number of wells required for delineating the contaminant plume prior to permanent well placement. In general, sampling events should be sequenced to work from the least contaminated locations to the more highly contaminated locations to prevent cross-contaminating samples.

The DPT method greatly reduces:

- Personnel exposure to potentially hazardous substances;
- The amount of waste soils and water which are generated; and
- The amount of volatilization of compounds from the soil and groundwater into the atmosphere.

A5.1 Procedures

The DPT groundwater sampler is designed to collect water samples without monitoring well installation. After the drill is pushed to the desired sampling depth, the sampling screen is exposed. Water enters the sample chamber under natural hydrostatic pressure. The sample is collected using a small-diameter bailer, or alternative method selected by the Project Manager. If polyethylene tubing is used for sample collection, clean unused tubing will be used for each sample collected. As DPT drilling can cause smearing and compaction of the borehole wall in silty and clayey lithologies, the following steps will be taken to allow for accumulation of sufficient volume of groundwater for laboratory analysis.

1. Review water levels from adjacent wells.
2. Review lithology from acetate liner and from the nearest available boring logs.
3. If potential for smearing exists, allow 3 to 4 hours for adequate groundwater breakthrough prior to sampling.
4. If groundwater is not observed after 3 to 4 hours, evaluate whether the borehole should remain open for 24 hours prior to abandonment.

Following sample collection, the samples will be placed in appropriate laboratory-provided containers and preserved in a manner in conformance with USEPA protocols. The samples will be immediately placed on ice prior to shipment to the laboratory.

A5.1.1 Decontamination

Groundwater probes, detachable drive points, probe connectors, and adapters will be decontaminated with a Liquinox® and tap water wash and a final rinse of distilled water. To avoid contaminating probes, points, etc. with target compounds, no volatile organic solvents will be used in the decontamination procedure.

A5.1.2 Post-Operation

A5.1.2.1 Field

Before leaving the field for return to the office, personnel should:

1. Decontaminate all sampling equipment which has come into contact with contaminated soil or wastes (see SOP A1, Decontamination Procedures).
2. Make sure all survey locations are staked and the location ID is readily visible on the location stake or collect real-time global positioning system (GPS) coordinates while in the field.
3. Record all observations and notes concerning any uncompleted work in the logbook.
4. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.
5. Review data collection forms for completeness.

A5.1.2.2 Office

After returning to the office, personnel should:

1. Deliver original forms and logbooks to the Project Manager for technical review. The Project Manager will review and file the information for later presentation within applicable reporting documents.
2. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

A5.2 References

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).*

A6 FIELD GC SCREENING FOR VOLATILE ORGANIC COMPOUNDS

It is not anticipated that field gas chromatograph (GC) screening for Volatile Organic Compounds (VOCs) will be performed at the Installation. Any site-specific plans requiring this technique will be modified accordingly to include applicable SOPs related to this technique.

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A7 MONITORING WELL INSTALLATION

This SOP contains specific details about the procedures and equipment necessary to properly install and develop monitoring wells to allow for collection of groundwater samples representative of the aquifer being sampled. Refer to the project work plan (e.g. Remedial Investigation [RI]/Feasibility Study [FS] Work Plan, Site Investigation [SI] Work Plan, Underground Storage Tank [UST] Investigation Work Plan, etc.) which covers the specific type of environmental investigation being conducted for the purpose and types of monitoring wells to be installed.

Monitoring wells will be installed to assess the extent of potential groundwater contamination. All monitoring wells will be constructed in a manner that complies with all applicable federal, state, and local regulations. The number of monitoring wells to be installed during an assessment will be discussed in a site-specific scope of work.

Attachment A7.6.1 contains schematics (monitoring well construction logs) of the types of monitoring wells that might be completed during groundwater contamination investigations. Monitoring well construction logs will be used to record data regarding the construction of each well including the project name, well identification, type of screen and casing material, slot size of screen, elevation of screened interval (in reference to North American Vertical Datum (NAVD), depth of installation (to + 0.1 feet), type of end plug, date of installation, well diameter, surface elevation (in reference to mean sea level [msl]), name of geologist and driller responsible for installation, materials and thickness of filter pack and annular sealant, surface seal construction, type of protective casing and cap, and groundwater elevation in the well (+ 0.1 feet in reference to msl). Monitoring well construction logs will be completed following well construction and elevation surveys.

A7.1 Required Equipment

- Logbooks
- Well schematic sheets
- Weighted tapes
- Appropriate PPE (hard hat, nitrile gloves, ear protection, etc.)
- Safety equipment

A7.2 Preparation Activities

Before leaving the office to begin field activities, personnel should:

1. Review the project work plan and associated documentation for a specific operation and obtain all information related to the purpose and intent of the field program. This documentation may include but is not limited to:
    - The scope of work described in the project work plan;
    - Previous reports related to the site;
    - Reports related to the area;
    - Site maps;

- Area maps;
- Access agreements;
- The drilling subcontractor's work plan if drilling has not yet been performed;
- Copies of all drilling logs if the boreholes have been completed;
- Data collection and equipment checklists; and
- Associated SOPs.

2. Contact facility/installation/site staff, members of the community (in coordination with facility/installation/site staff), and subcontractors before work is initiated. During the initial contact, permission to enter private property or security areas should be obtained. Field personnel are expected to maintain a good working relationship with the client, community, and subcontractors.
3. Obtain and test all equipment needed for the task.
4. Obtain a logbook to record/document all observations concerning pre-operation drill rig inspections, drilling operations, soil or rock core loggings.
5. Obtain a sufficient number of the appropriate data collection forms such as drilling logs, etc.

Upon arriving in the field, but before the start of site activities, personnel should:

1. Verify that the appropriate supplies for monitoring well installation, as specified in the drill specifications of the drilling contract are present on-site; and
2. Verify that sufficient containers (drums, roll-off containers, etc.) are present on-site to containerize all of the monitoring well development water.

A7.3 Field Procedures

Each well installed will be constructed of a Schedule 40 PVC 2-inch or 4-inch slotted or continuous wrapped screen attached to a PVC riser. All screen and casing will be flush-threaded. For the wells installed in deeper groundwater zones (i.e. intermediate or deep zones), shallower groundwater zones will be isolated using Schedule 40 PVC isolation casings. In shallow well installations, the top of the well screen will be placed above the top of the water table to allow for seasonal fluctuations. Screen length and well depth will be determined prior to or during an assessment and discussed in a site-specific scope of work that must be approved before monitoring well installation activities commence.

A7.3.1 Drilling Equipment and Materials

Hollow-stem auger is the preferred drilling method, however other methods are acceptable and will be described in project plans. The hollow stem auger method performs well in unconsolidated sediments, allows the rig to operate without the use of drilling fluids, and permits ease of collection for relatively undisturbed formation samples. For the depths and geology involved, this drilling method will provide fast and efficient performance. The hollow-stem auger rig will use 5-foot sections of at least 8-inch OD and 6.25-inch inner diameter hollow-stem auger flight. In borings that will receive monitoring wells, the boring diameter will be such that there will be at least 2 inches of annular space between the formation exposed at the boring wall and the outside diameter of the centered well casing. In areas of flowing or heaving sands, plugs may be required on the center of the auger bit to facilitate placement of the well screen.

A7.3.2 Drilling Procedures

The exact location and depth of wells for each site will be determined in project plans. Soil samples will be collected continuously from the ground surface to the top of the water table at each site for the purpose of describing subsurface geology. During completion of soil borings or monitoring wells, drill cuttings from the water table to total depth of boring will be logged. All borehole lithological descriptions will be made by the geologist on site and recorded on the borehole lithologic form.

The total depths of each well and the screened interval will be determined in project plans or decided by the Site Supervisor on a site-by-site basis. The depths and construction of each well will depend on the geology and groundwater conditions encountered during drilling. All cuttings produced from drilling activities will be managed as specified in the project plans.

A7.3.3 Well Installation

For shallow wells, upon reaching a depth of approximately 10 feet below the water table, each well will be installed to provide representative water samples from the uppermost water bearing zone. At a minimum, a 2-inch annular space must remain after placement of the screen and casing. Before placement of the screen and casing, the borehole depth should be verified with a weighted surveyor tape. For shallow wells, the length of the screen will be installed above and below the water table to allow for water table fluctuation and to collect a light non-aqueous phase layer, if present. For deeper wells, screens will be set at predetermined depths to monitor groundwater conditions within the interval screened.

In areas with heaving sands, a plug may be placed in the bit of the auger to prevent sand from tilling in around the screen and permit well completion at the target depth. After sufficient sand is placed inside the casing to stabilize the hole, the plug is knocked out of the auger bit so that the augers can be pulled as the filter pack is placed around the screen.

A7.3.4 Well Screen and Casing

The screened intervals for monitoring wells will consist of 2-inch or 4-inch, Schedule 40 PVC factory slotted screens. The screen slot size will be selected by the Site Supervisor based on the anticipated lithology. The screened section will be joined to a 2-inch or 4-inch diameter, Schedule 40 PVC, flush threaded casing. The casing will extend from the top of the screen to at least ground surface. The material lengths selected will be based on site-specific groundwater conditions encountered (a 10-foot screen is recommended). The screen will be capped with a threaded PVC cap or plug at the bottom, and all connections will be flush jointed and threaded and use O-ring seals.

Since all well screen and casing materials will be centered in the borehole through the use of the hollow-stem auger drilling method, centralizers will not be necessary for the alignment of shallow wells. However, centralizers may be necessary if the well is not installed through a hollow-stem auger. Monitoring wells must pass a plumbness test; on deeper monitoring wells, centralizers may be necessary to insure plumbness, especially with 2-inch pipes.

No solvent PVC or other glue will be used in the construction of the wells.

A7.3.5 Filter Pack

A sand filter pack will be placed into the annulus between the well casing and the augers (or borehole wall) until the sand pack is approximately 2 feet above the top of the screen. While the sand is being placed, checks for well alignment will be made to ensure that the well is centered in the borehole. The augers will be slowly removed as the sand pack is being placed. This will continue until the bottom of the lead auger is just above the top of the sand pack. The pack will consist of washed and bagged rounded sand with a grain size distribution selected by the project plans (or Project Manager), based on the anticipated lithology. The filter pack will be surged for 5 to 10 minutes after placement. The depth from ground surface to the top of the sand pack will be measured and additional sand added as necessary and surging repeated before placing the bentonite seal.

A7.3.6 Bentonite Seal

Bentonite pellets or volclay grout will be placed above the sand/filter pack to a minimum thickness of 2 feet to provide an adequate seal. Bentonite pellets shall not exceed one-half inch diameter and will be poured into place through the augers. If the bentonite seal is positioned above the water table, the bentonite will be installed in 1-foot lifts with each hydrated with clean, potable water for a minimum of 30 minutes between lifts before proceeding. Augers will be retracted and measurements will be made to ensure proper seal placement. After the placement of the final lift, the bentonite seal will be allowed to hydrate an additional 2 hours before grouting begins. If approved by the onsite geologist or LHAAP Technical Lead, bentonite slurry, such as volclay grout, may be used for seals above the water table.

A7.3.7 Grout Mixture

Neat cement or volclay grout will be emplaced via tremie pipe from above the top of the bentonite seal to land surface on both shallow and deep wells. Cement grout shall consist of a mixture of not more than 7 gallons of water and 3 pounds of powdered bentonite to each 94-pound sack of Portland Cement (ASTM C 150) (~3% bentonite). A tremie pipe will be used to install the grout. The tremie pipe shall be plugged at the bottom and perforated or slotted on the sides to prevent grout from penetrating the bentonite seal. Grouting procedures will continue through auger retraction until undiluted grout flows from the boring at the ground surface. Final grout level will be approximately 2 feet bgs. The remainder of the annular space will be filled with concrete during the installation of the protective casing and surface pad.

A7.3.8 Surface Completions of Monitoring Wells

Generally all wells will be installed as aboveground completions. Flush-mount completions will only be done if determined to be appropriate. The procedures for each completion type are described below.

For aboveground completion, the riser pipe will extend a minimum of 2.5 feet above the ground surface. A steel outer protective casing, equipped with a hinged locking cap, will be installed while the surface pad is being poured. The pad cannot be poured until the grout seal has cured for a minimum of 24 hours. Initially, concrete is poured into the remaining 2 feet or greater of annular space. The protective casing is then pushed at least 2 feet into the concrete. The remainder of the form for the pad will be filled with concrete. The pad will be a minimum of 3' x 3' x 6" and will extend a minimum of 2 inches below grade to prevent under-washing by surface water flow, and will be sloped away from the protective casing in all directions. Concrete should then be added to the space between the well casing and the protective casing until the level of the concrete inside the protective casing is at or above the surface concrete pad. After the concrete has cured, two weep holes will be drilled into the protective casing immediately above the concrete surface. These weep holes will be a minimum of ¼-inch diameter to allow the drainage of water which may accumulate inside the protective casing. Four 3-to 4-inch diameter, 5-foot long steel guard posts will be installed on each corner of the concrete pad. These posts will extend at least 2 feet into a concrete footing and at least 3 feet above the ground surface, and be filled with concrete for additional strength.

For flush-mount wells, each well will be equipped with a locking cap and an outer protective flush-mount casing. The casing for all wells will be set approximately 1 to 2 inches below the ground surface to allow for installation of the flush-mount security casing. The flush-mount casing will be set in a cement pad (approximately 2.5 x 2.5 feet) with a 1 to 2 inch upward slope above ground surface to ensure that surface water flows away from the well. The pad will not be poured until the grout seal has cured for at least 24 hours.

Temporary, secure, and watertight caps will be provided for incomplete wells or open boreholes anytime active construction or development operations are halted. Upon completion, wells will be equipped with keyed-alike locks to match other monitoring wells at the installation.

A7.4 Post-Operation

A7.4.1 Field

After the completion of field operations and before returning to the office, personnel should:

1. Ensure that all equipment is accounted for, decontaminated (See SOP A1, Decontamination Procedures), and ready for shipment.
2. Restore the site to the pre-well installation conditions as specified in the project work plan. Restoration may include repair of damage to the land surface (tire ruts) or private property (fences), as well as restoration anticipated at the time the project work plan was prepared (for example, re-vegetation or borehole abandonment).
3. Complete any remaining documentation. This may consist of, but is not limited to:
   - Recording any restoration work in the logbook.
   - Recording any uncompleted work in the logbook. This additional recording may include drilling that could not be performed, wells that could not be installed, and/or damage that could not be repaired.

- Completing logbook entries, verifying the accuracy of entries, and signing/initialing any pages for which this was not done during field activities. If any of this signing/initialing is done at the end of field activities, the date it is performed should also be noted by each new entry.
- Reviewing data collection forms for completeness.

A7.4.2 Office

Immediately after returning to the office, personnel should:

1. Deliver original forms and logbooks to the Project Manager for technical review. The Project Manager will review and file the information for later presentation within applicable reporting documents.
2. Inventory equipment and supplies.
3. Repair or replace all broken or damaged equipment.
4. Replace expendable items.
5. Return equipment to the equipment manager and report incidents of malfunction or damage.

A7.5 References

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).*

A7.6 Attachments

A7.6.1 Well Construction Diagram

The form is provided as an attachment in this SOP.

ATTACHMENT A7.6.1
WELL CONSTRUCTION DIAGRAM

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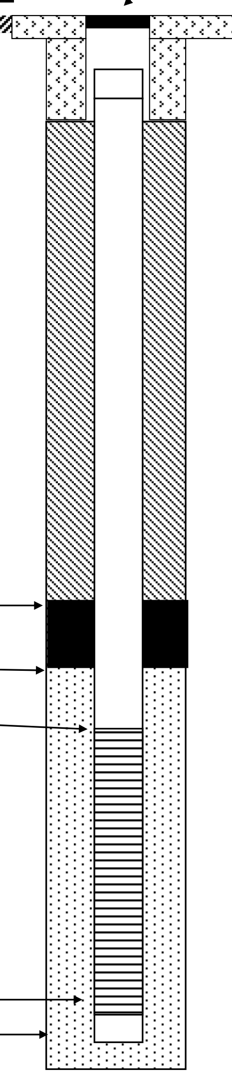
WELL CONSTRUCTION DIAGRAM (Flush Mount)

SITE: ____________________ **WELL/BORING ID:** ____________________
PROJECT NAME: ____________________ **DRILLING METHOD:** ____________________
PROJECT NO.: ____________________ **DATE(S):** ____________________
DRILLING CONTRACTOR: ____________________ **SURVEYOR:** ____________________
DRILLER: ____________________ **NORTHING:** ____________________
SCIENTIST: ____________________ **EASTING:** ____________________

NOT TO SCALE

Ground Surface Elevation (NAVD 88): ____________

Existing Surface



Casing Elevation (NAVD 88): ____________

Borehole Diameter (in): ____________
Well Casing Diameter (in): ____________

Top of Bentonite Seal: ____________

Top of Filter Pack: ____________

Top of Screen: ____________

DEPTH TO WATER
During Drilling: ____________
Date ____________

Post Development: ____________
Date ____________

Bottom of Screen: ____________
Bottom of Well: ____________

Borehole Depth: ____________

PROTECTIVE CASING
Type: ____________
Dimensions: ____________
Length: ____________

SURFACE PAD
Dimensions: ____________
Type: ____________

WELL CASING (RISER)
Manufacturer: ____________
Type/Material: ____________
Diameter (in): ____________
Connection: ____________

WELL SCREEN
Manufacturer: ____________
Type/Material: ____________
Slot Size (in): ____________
Slot Type: ____________
Connection: ____________

ANNULAR SEAL
Type: ____________
Manufacturer: ____________
Mud Scale: ____________
Installation: ____________

BENTONITE SEAL
Manufacturer: ____________
Product Name: ____________
Size: ____________
Installation: ____________

PRIMARY FILTER PACK
Manufacturer: ____________
Product Name: ____________
Size: ____________
Installation: ____________

END CAP
Type: ____________
Length: ____________

BACKFILL MATERIAL
Type: ____________
Volume:

Comments:

A8 MONITORING WELL DEVELOPMENT

The purpose of developing new monitoring wells is to remove the residual materials that may have been introduced during well installation and that may remain in the wells after installation has been completed. Development is also done to try to re-establish the natural hydraulic flow conditions of the formation, disturbed by well construction, in the immediate vicinity of the well and to facilitate hydraulic communication between the screened formation and the monitoring well.

Monitoring well development removes the fines from the well or aquifer formation near the screen and corrects damage that occurs during drilling. All well installation procedures create a skin on the borehole wall. Over pumping and surging are the primary methods used for developing monitoring wells. These methods are discussed below.

Over pumping involves pumping the well down as low as possible and allowing it to refill. The increased velocities created by refilling remove fines. Surging involves raising and lowering a surge or swab block inside the well. The resulting motion of the water removes the borehole skin and fines from the formation. The fines and water must occasionally be removed from the well with a sand bailer to prevent sand locking of the surge block. The rubber seals on the surge block are the same diameter as the inside of the well or 1/2 inch smaller if surging is conducted inside the screened interval. A 3-foot stroke is typical.

A Grundfos Redi-flo 2 or equivalent pump, which is a submersible variable-speed electric pump, is used to evacuate the remainder of the required volumes. Repeated cycles of surging, hand-pumping, and submersible pumping may be required to meet water quality criteria to complete well development.

For shallow wells and where small volumes of development water are anticipated, hand-powered inertial pumps alone may be adequate for well development. Alternate pumps may be used under the direction of the Project Manager and U.S. Army Project Geologist.

A8.1 Equipment Required

- pH Meter
- Temperature meter
- Specific conductance meter
- Turbidity meter
- Tap and Distilled or Deionized water
- Stopwatch
- Water level measurement probe
- Plastic sheeting
- 5-gallon buckets and carboys
- Clear bottle
- Pump and associated tubing

- Generator or alternate power source
- Nitrile gloves
- Safety Glasses
- Well Development Form

A8.2 Procedures

Before leaving the office to begin field activities, personnel should:

1. Review the Work Plan and relevant SOPs.
2. Coordinate schedules/actions with Installation personnel.
3. Obtain appropriate permission for property access.
4. Assemble the equipment and supplies listed in Section A8.1. Ensure the proper operation of all sampling equipment.
5. If samples are to be collected for analyses, notify the laboratory of sample types, the number of samples, and the approximate arrival date. In addition, contact the carrier that will transport samples to obtain information on regulations and specifications.
6. Ensure that the water treatment system is operational (if applicable) and make transport arrangements so that drums, on-site poly tanks, or a mobile tank are available to collect development water. This may include the purchase of fabric filters and new activated carbon canisters.
7. Obtain a logbook.
8. Obtain a sufficient number of the Well Development Forms.

After arriving in the field to begin field activities, personnel should:

1. Decontaminate all equipment before developing each well according to SOP A1, Decontamination Procedures, unless dedicated pumps and tubing are being used.
2. Assemble containers for the temporary storage of water produced during well development. The containers must be structurally sound, compatible with anticipated contaminants, and field manageable. Truck-mounted tanks may be required.
3. If treatment of development water is required, ensure that the Water Conditioning System is operational within the parameters required. This may include inspection of the holding tank, pump, piping, fabric filters, carbon canister, and associated piping. Ensure that the effluent line is inserted into the Installation sanitary sewer connection.

The following are general procedures for developing a groundwater monitoring well.

Wells should be developed within 7 days after construction, but no sooner than 24 hours after grouting is completed. The well must be developed without the use of dispersing agents, acids, or explosives. The well may be developed prior to placing the annular seal providing borehole stability can be maintained throughout the development and seal placement activities. This should be considered if significant settlement of the filter pack during development is anticipated. The objectives of well development are to: (a) assure that groundwater enters the well screen freely, thus yielding a representative groundwater sample and an accurate water level measurement, b) remove all water that may have been introduced during drilling and well installation, c) remove very fine-grained sediment in the filter pack and nearby formation so that groundwater samples are not highly turbid and so that silting of the well does not occur.

Development will consist of mechanical surging and bailing until little or no sediment enters the well. If not specified in the site specific section of the work plan or directed by the U.S. Army Geologist, well development shall continue for a minimum of 2 hours. Sediment that enters the well during this process shall be removed. At the end of that time, the well shall be continuously pumped using an electric submersible, pneumatic drive positive displacement, or bladder pump. Temperature, pH, specific conductivity, turbidity, and water level shall be monitored during pumping (at least one reading per well casing volume after the well water becomes visibly less turbid). Pumping shall continue until these parameters have stabilized (less than 0.2 pH units or a 10 percent change for the other parameters between four consecutive readings) and the water is clear and below 20 nephelometric turbidity units (NTU). If these parameters have not stabilized after 4 hours of continuous pumping, then the Project Manager and/or U.S. Army shall be contacted for further direction.

If the addition of water is required to facilitate surging and bailing, only formation water from that well shall be used. If this is not practical due to tightness of the formation then only bailing shall be done. In all cases, the utmost care shall be taken not to collapse well screens during development activities and at least as much water as was introduced during drilling shall be removed from each well.

If required, containerize all water produced by development in contaminated areas or areas suspected of contamination. This is done by pumping development water from the well into drums or on-site poly tanks. When the volume in the mobile tank reaches approximately ¾ capacity, the development water should be transferred into the stationary holding tank for conditioning prior to disposal. This transfer should be entered into the Water Log-in Sheet.

Well development will be documented by collecting at least 500 milliliters (mL) of the last water withdrawn from the well during development in a clear glass jar, labeling, and immediately photographing it. The photograph shall be a suitably backlit (white background is recommended), close-up that shows the clarity of the water. Fines remaining in the water shall not be allowed to settle out prior to taking the photograph.

Part of well development should be the washing of the entire well cap and interior of the well casing above the water table using only water from that well. The result of this operation should be a well casing free of extraneous materials (grout, bentonite, sand, etc.). This washing should be conducted during development, not after development is completed. This washing should not be performed where free phase contaminants (i.e. petroleum products) are present.

Note the final color, clarity, and odor of the water. Measure and record the final pH, temperature, and specific conductance of the water. Complete the appropriate data entry requirements on the Monitoring Well Construction Diagram form to document well development.

The data entry requirements are:

1. Name of project and site, well ID number, and dates.
2. Date, time, and elevation of the static water level and bottom of well before development.
3. Method used for development, to include equipment, size, type, and make of bailer and/or pump used during development.
4. Time spent developing the well by each method, to include the typical pumping rate if a pump was used in development.
5. Volume and physical character of water removed, to include changes during development in clarity, color, particulates, and odor.
6. Volume and source of any water added to the well, and chemical analyses of the added water.
7. Volume and physical character of sediment removed, to include changes during development in color and odor.
8. Clarity of water before, during, and after development, and depth of any sediment which settles to the bottom of the jar containing the last one liter of water withdrawn from the well during development.
9. Total depth of well and the static water level immediately after development.
10. Readings of pH, specific conductance, temperature, and turbidity taken before, during, and after development.
11. Names and job title of individuals developing well.
12. Name and/or description of the disposal facility for waters removed during development.

After the completion of field activities and before returning to the office, personnel should:

1. Ensure that all equipment is accounted for, decontaminated (see SOP A1, Decontamination Procedures), and ready for shipment.
2. Restore the site to the pre-development conditions.
3. Make sure all monitoring well locations are properly staked, the location ID tag is readily visible on the protective casing, and the lock is secured.
4. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.
5. Review data collection forms for completeness.

Immediately after returning to the office, personnel should:

1. Enter the well development activities on the Daily Quality Control Report. Facsimiles of this report, along with the completed Well Development Log, will be transmitted to the U.S. Army Project Geologist on a daily basis or as required.
2. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

3. If samples have been collected for analysis, contact the laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

A8.3 References

Driscoll, Fletcher G. 1986. *Groundwater and Wells*. Johnson Filtration Systems, Inc., St. Paul, Minnesota.

Gass, Tyler E. 1986. *Monitoring Well Development.* Water Well Journal. Vol. 40, No. 1, pp. 52-55.

Schalla, Ronald, and Robert W. Landick. 1986. *A New Valved and Air-Vented Surge Plunger for Developing Small-Diameter Monitoring Wells.* Ground Water Monitoring Review. Vol. 6, No. 2, pp. 77-80.

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).*

A8.4 Attachments

A8.4.1 Well Development Log (Form)

The Well Development Log is provided as an attachment in this SOP.

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ATTACHMENT A8.4.1
WELL DEVELOPMENT LOG

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WELL DEVELOPMENT LOG

PROJECT:			**WELL ID:**
Performed By:	**Signature:**	**Completion Date:**	**Development Date:**
Water Level **Initial:** **Final:**		**Develop Method:**	**Total Vol. Dev:**
Weather:	**Screen Interval:**	Top:	Bottom:
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole			**Total Depth:** **Initial:** **Final:**

Time	Cum Volume (Liters)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (^{o}C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		

Remarks

A9 WATER LEVEL MEASUREMENT

This SOP will describe the general procedures followed when measuring the water levels in monitoring wells. These measurements are used to generate potentiometric surface maps and to augment Installation-wide groundwater modeling efforts. The water table is subject to fluctuation due to recharge from surface precipitation events. The time for infiltration to impact the phreatic surface is dependent upon several factors, including amount of precipitation, surface slope, surface covering material (i.e. pavement or grass), and subsurface soil type in the vadose zone. Due to this variability, measurements should not be taken until the water table surface has stabilized following a recharge event. At sites with shallow groundwater, measurements should be taken a minimum of 48 hours after a significant precipitation has occurred. For the purposes of gathering modeling or groundwater elevation data, measurements at different locations should be taken within a 24-hour period.

When Installation-wide data is gathered, it is sometimes necessary to employ several teams to complete water level measurements in the 24-hour period. When this is done, the measuring devices will be calibrated so that water level measurements can be corrected for minor differences in tape length. When measurements are taken, the actual reading on the instrument will be recorded. Calibration corrections will be made at a later time. This procedure will reduce errors introduced by faulty corrections in the field.

A registered land surveyor (RLS) has established the elevations of the top-of-casing points. These elevations are referenced to msl, specifically to the NAVD of 1988. All water level and total depth measurements will be taken with reference to the top-of-casing points, to an accuracy of 0.01 feet.

Water level measurements will be taken before and after well development and groundwater sampling activities and recorded on the relevant log sheets. A tabulated list of water surface elevations will be included in the Draft and Final reports.

A9.1 Equipment Required

- Site map showing well locations
- Oil/water interface probe
- Electronic water level probe
- Weighted nylon tape graduated in 0.01 feet
- Plastic sheeting
- Decontamination solutions
- Keys to well locks
- Non-water-soluble black ink pens

A9.2 Procedures

Before leaving the office to begin field activities, personnel should:

SOPs

1. Review the Work Plan, SSHP, and relevant SOPs.
2. Determine if the site requires use of protective clothing and equipment.
3. Coordinate schedules/actions with the Installation staff.
4. Obtain appropriate permission for property access.
5. Assemble necessary equipment and supplies listed in A9.1 and any required protective equipment.
6. Obtain a logbook.
7. Record results of equipment check in the logbook.
8. Obtain a sufficient number of the appropriate data collection forms (see attachments to this SOP).
9. Consult the project plans and Project Chemist for a current list of location IDs and sample numbers used in the completion of forms and sample documentation.

After arriving in the field to begin field activities, personnel should:

1. Locate monitoring wells to be measured and check wells for proper ID tag.
2. Obtain keys for well locks from the Groundwater Treatment Plant Operator or responsible party.
3. Decontaminate all equipment before taking the first measurement and between measurement intervals.

   When taking a number of water level measurements, it is preferable to start at those wells that are the least contaminated and proceed to those wells that are the most contaminated.

4. Calibrate measuring instruments, if using more than one. Calibration procedures are:
   1) Compare all instruments to a steel tape to determine which instrument is most nearly accurate. This will be the reference instrument. Record this information in logbook.
   2) Measure a clean well with the reference instrument. Record this measurement in logbook.
   3) Measure the same well with each instrument. Record each measurement.
   4) Subtract each measurement from the reference measurement. The difference will be the correction for each instrument. Record the correction for each measurement.

Whenever a water level is measured, enter a description of the sampling location and record of the measured value onto the Groundwater Level Data form or the Groundwater Level and Free Product Thickness Data form. Use the latter form when a petroleum, oil, and lubricants (POL) product is floating on the static water in the well. The following is a description of how to collect a water level measurement.

1. Check well for proper ID tag and record access in the logbook.
2. Unlock the well cover and remove the PVC cap.
3. Inspect well, noting any deterioration, damage, or apparent tampering. Notify the U.S. Army Project Manager if any repairs are necessary.

4. Before each measurement, decontaminate the water-level and oil/water interface probes as outlined in SOP A1.
5. Lower the oil/water interface probe into the well to check for floating product. If POL is present, record the thickness and water level on the Groundwater Level and Free-Product Thickness Data form and note POL presence in Field Log.
6. If POL is not detected, lower the electronic probe into the well until water is encountered and note the depth on the calibrated tape relative to the surveyed reference point. This measurement should be made to the nearest 0.01.
7. Repeat the water-level measurement until two consecutive measurements agree within 0.01 foot. All readings will be documented within the logbook to verify these SOPs are followed as outlined.
8. Sound the total depth of the well by lowering the probe to the bottom of the well. If an oil/water interface probe is used to measure total depth of the well, adjust to account for the extra length on the indicator tip past the sensor.
9. Record the depth to water and adjusted total well depth on the appropriate form or field logbook. The screen interval will be provided prior to collection of field data (groundwater measurements, sampling, etc.) to verify whether sedimentation has occurred and to determine if water level is above or below the bottom of the screen interval.
10. Decontaminate probe and the entire length of the water-level indicator which entered the well.
11. Cap and lock the well if no more activities will occur.

After the completion of field activities and before returning to the office, personnel should:

1. Ensure that all equipment is accounted for and decontaminated.
2. Restore site to pre-measurement conditions as specified in work plan.
3. Make sure the monitoring well ID tag is properly affixed and visible.
4. Complete logbook entries, verify the accuracy of the entries, and sign/initial all pages.
5. Review data forms for completeness.

Immediately after returning to the office, personnel should:

1. Perform tape calibration adjustments to measurements, if necessary.
2. Convert all water level measurements to msl elevations.
3. Deliver original forms, logbooks, and list of adjusted and converted elevations to Project Manager or designee for technical review.
4. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items.

A9.3 References

USEPA. September 1986. [Resource Conservation and Recovery Act] *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document.*

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).*

A9.4 Attachments

A9.4.1 Groundwater Level Data Form

The Groundwater Level Data Form is provided as an attachment in this SOP.

A9.4.2 Groundwater Level and Free Product Thickness Data Form

The Groundwater Level and Free Product Thickness Data Form is provided as an attachment in this SOP.

ATTACHMENT A9.4.1
GROUNDWATER LEVEL DATA FORM

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GROUNDWATER LEVEL DATA FORM

Date:

Location ID	Log Time	Depth to Water (ft)	Screen Interval (ft)	Total Depth (ft)	Comments

Note: Groundwater level measaurements should be collected and recorded until two consecutive readings are within 0.01 feet (ft).

ATTACHMENT A9.4.2
GROUNDWATER LEVEL AND FREE PRODUCT THICKNESS DATA FORM

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GROUNDWATER LEVEL AND NAPL THICKNESS FORM

Date:

Location ID	Log Time	Depth to Water (ft)	Depth to NAPL (ft)	Total Well Depth (ft)	Screen Interval (ft)	Comments

A10 LOW-STRESS (MINIMAL DRAWDOWN) GROUNDWATER SAMPLING

This SOP will describe a low-stress (minimal drawdown) procedure for groundwater sampling. It is to be used in conjunction with approved procedures. The primary objective of low-stress purging and sampling is to consistently collect representative groundwater samples without altering water chemistry. Low-stress purging and sampling techniques help to reduce high turbidity levels that may adversely affect sample quality, which commonly occurs with conventional techniques that use bailers or high-speed pumps.

In general, sampling events should be sequenced to work from the least contaminated locations to the more highly contaminated locations to prevent cross-contaminating samples.

A10.1 Procedures

A10.1.1 Well Purging

A well must be purged with a pump prior to sampling to assure that true formation water is sampled instead of stagnant casing water. Suitable pumps for low-flow (minimal drawdown) purging and sampling include bladder pumps, electrical submersible pumps, and gas driven pumps. Bladder pumps are preferred when VOCs are to be sampled. Follow the specific guidance on equipment selection that is provided in each project-specific work plan.

A10.1.1.1 Specific Requirements for Low-Flow Sampling

The pump must have an easily adjustable flow rate that is sustainable at flows as low as 0.1 liter/minute (L/min). The flow rate is adjusted by the combined use of the pump's frequency control box and hydraulic head differences caused by raising and lowering the tubing height above ground.

Teflon tubing is preferred for sampling VOCs, but polyethylene tubing is acceptable for single use.

The disposable polyethylene tubing, which is discarded after its initial use, also decreases the possibility of cross contamination between wells. Sampling devices such as bailers and lift foot-valve samplers that cause repeated sediment disturbance and mixing of stagnant water in the casing with dynamic water in the screened interval are unacceptable.

To minimize sediment disturbance and water mixing, the pump will be slowly lowered through the water column to screen midpoint (or slightly above) for wells screened below the water table and to at least 2 feet below the water table for wells screened at the water table interface. In addition, the pump and water level meter will be placed in the well as far in advance as possible, will be placed at least 2 feet from the bottom of the well, and will not touch the bottom. If a measurement of sediment thickness in the well sump is needed, it will be taken after the well has been sampled.

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize. Monitor and record water level and pumping rate every 3 to 5 minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1 to 0.5 L/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first 15 minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" as pump flow adjustments are made. Purge volume calculations should use stabilized drawdown value, not the initial drawdown. Do not allow the water level to drop below the intake level (if the static water level is above the well screen, avoid lowering the water level meter below the screen). The final purge volume must be greater than the stabilized drawdown volume plus the evacuation tubing volume.

Wells with low recharge rates may require the use of special pumps capable of attaining higher pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate is slower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

Water quality indicator parameters will be measured every 3 to 5 minutes by instruments contained in an in-line flow-through cell attached to the pump. Purging will be considered complete when parameters stabilize for at least three consecutive readings within the following limits: 1 °C for temperature, ± 0.1 pH, ± 0.01 millisiemens per centimeter (mS/cm) for conductivity, ± 10 millivolts (mV) or 10% (whichever is less) for redox potential, ± 10% turbidity, and ± 10% dissolved oxygen. An attempt will be made to purge until turbidity drops below 10 NTU, but this is not a requirement. Removal of a specific volume of water is also not required, provided all water quality parameters are stable as noted above. A monitoring well sample form is included as Attachment A10.3.1.

Wells should not be dewatered or purged dry, which can cause aeration as groundwater cascades back into the well. Water table wells with slow recharge that results in significant drawdown (greater than 4 inches) while purging at the lowest possible rate will be pumped at a rate of 100 milliliters per minute (mL/min) for a minimum of 1 hour, unless drawdown exceeds 2 feet, then allowed to recharge to the static water level and sampled. It will not be necessary at this point to achieve stabilization of the water quality indicator parameters. If a drawdown of >2 feet occurs in a water table well, purging will be stopped to allow the well to recover before sampling. For wells screened below the water table, a greater drawdown during purging may be acceptable, at the discretion of the Project Geologist. The Project Manager will be notified if any wells produce less than 100 mL/min to discuss alternate sampling strategies.

During subsequent low stress sampling events, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s).

A10.1.1.2 Specific Requirements for Volume Purge and Sampling Using a Bailer or Submersible Pump

The following procedures shall be applicable to the volume purge of a well. The volume purge method shall be used only under special circumstances. Prior approval from the LHAAP Technical Lead or the Project Manager shall be obtained and documented on the sample collection form before using this method.

1. Prepare and decontaminate equipment as per decontamination SOP.
2. Measure the static water level and the total well depth with an electric water level indicator.
3. If purging well with a bailer:
   a. Use Teflon® bailers if the bailers are to be decontaminated between wells and re-used, or other disposable bailers.
   b. Use disposable twine with the bailer. Do not decontaminate and reuse plastic twine. Only Teflon® covered steel cable may be decontaminated and reused at another well.
   c. To start purging, gently lower and raise the bailer in the water column until the bailer is full. Remove bailer from well and discharge to designated containment. Repeat, until a sufficient volume of water has been purged from the well.
   d. Record water quality parameters at least twice for each well volume evacuated. Due to the turbidity that can be generated during purging with a bailer, any silt or other particulates present in the purged water may need to settle prior to collecting a turbidity reading.

   Note: Dissolved oxygen and oxidation/reduction potential (ORP) cannot be properly measured utilizing bailer samples because dissolved oxygen and ORP changes rapidly upon exposure to atmospheric conditions.
4. If purging with a submersible pump:
   a. Lower the pump gently to the bottom of the well.
   b. Complete power connections and begin purging.
   c. Record water quality parameters at least twice for each well volume evacuated.
   d. Purge until at least three well volumes have been evacuated and the well parameters have stabilized or the well is bailed dry. Proceed with sample collection once parameter stabilization and low turbidity values have been achieved. If the well is bailed dry, wait until adequate water is available in the well and proceed with sample collection.
5. Collect the samples in the analyte order provided in the applicable work plan or per the direction of the Project Manager.
6. If collecting a field-filtered sample for metals (i.e., turbidity is equal to or greater than 10 NTU), use an inline disposable filter. For each filtered sample submitted to the laboratory for metals analysis, a corresponding raw (unfiltered) water sample must also be submitted to analysis. Alternatively, send an unpreserved (no nitric acid added) sample to the laboratory. The sample will be filtered in the laboratory before analysis. This should be

designated on the chain of custody and recorded on the Monitoring Well Sample Collection Form.

7. If collecting a field-filtered sample for perchlorate, use a disposable 0.2 micron syringe filter with a disposal syringe (5 cubic centimeter [cc] to 20 cc) to remove perchlorate-digesting bacteria. Multiple syringe draws will be required to prepare the required 125 mL of sample for analysis. Field filtration of the sample should be noted on the Monitoring Well Sample Collection Form.
8. Record all pertinent information on the Monitoring Well Sample Collection Form, identifying the sampling method used (i.e., volume purge and sample with a bailer) in the "Comments" field. Any fields in the form not applicable to the method used shall be marked "NA."

A10.1.2 Volume Purge Method

The method involves purging a fixed number of well volumes using a bailer or pump. Purging of groundwater from the well casing is continued until a minimum of three well volumes have been removed and the water quality parameters have stabilized. This method shall be used in lieu of the low-flow method, only if warranted by the site conditions (e.g., exceptionally low recharge rate). A bailer may be used for collecting required sample volume of groundwater from a well that goes dry even at the slowest achievable pumping rate. In such a case, the well is pumped dry and the sample is collected with a bailer within 24 hours. This method shall be used only if specified in the work plan or approved by the Project Manager or Technical Lead.

The low-flow purge and sample method shall be used as a default method for collecting groundwater samples for chemical analysis. The use of the second method will be restricted only to special circumstances, either as specified in the work plan or if warranted by site conditions. If site conditions warrant the use of the second method, prior approval from the Project Manager or Technical Lead is required. This information shall in turn be passed on to the U.S. Army Technical Manager prior to the acceptance of the change in SOP.

A10.1.3 Sample Collection

Groundwater samples will be collected no sooner than 24 hours after completion of well development using pumping and/or surging methods. Wells developed using more stressful methods such as air-lifting or flushing will be allowed to equilibrate for at least 72 hours prior to sample collection. All samples will be collected from the pump system unless federal, state, or local regulations or guidance stipulate other methodology. After water quality indicator parameters stabilize, groundwater samples will be collected immediately. However, in-line monitoring equipment must be removed prior to sample collection. During sample collection, the pumping rate will remain the same or lower than the purging rate to minimize aeration, bubble formation, or turbulent filling of sample bottles.

During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, connector (Teflon or stainless steel) or valve to constrict sampling end of tubing; (2) insert small diameter Teflon tubing into water filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing; (3) collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample and record new drawdown, flow rate, and new indicator field parameter values.

If excessive drawdown is noted using the lowest possible pump rate, then the low-flow method is not applicable. In such a case, the well will be pumped dry once and a sample will be collected with a bailer as soon as adequate quantity of water for samples is available, but within 24 hours of well evacuation.

A10.2 References

Puls, W.P. and M.J. Barcelona. April 1996. *USEPA Groundwater Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.*

U.S. Army Corps of Engineers. February 1, 2001. *Requirements for the Preparation of Sampling and Analysis Plans.* EM200-1-3.

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).*

USEPA, Region 1. January 19, 2010. *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.* Revision Number 3.

A10.3 Attachments

A10.3.1 Monitoring Well Sample Collection Form

The form is provided as an attachment in this SOP.

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ATTACHMENT A10.3.1
MONITORING WELL SAMPLE COLLECTION FORM

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Monitoring Well Sample Collection Form

Page 1 of

LOCATION	Site:			Location ID:					Date:	
	Project Name:			Project No./Phase:					Recorded By:	
EQUIPMENT	Pump Type/ID#:			Water Quality Meter/ID#:					PID Reading:	
	Water Level Indicator Type/ID#:			Other Equipment/ID#:					Decon Method:	Liquinox
	Tubing Type/Diameter (in):			Other Equipment/ID#:					PPE Level:	D
WELL INFO	(A) Initial Depth to Water (ft BTOC):			Casing Type: PVC			Diam. (in)		Weather:	
	(B) Total Well Depth (ft BTOC):			Screen Interval: XX-XX			Well Depth: XXX.XX		Sample Depth:	
	Well Cover Type:			Screen Length (lin ft): XX			Well Type:		Deviations:	
	Depth Class:			Screen Info	Type:	PVC	Size:			

TIME (24 Hr)	Water Level (BTOC)	Cumulative Volume Removed (mL)	Pumping Rate (mL/min)	Temp (°C)	pH (SU)	ORP (mv)	Cond. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Remarks (odor, clarity, etc.)

	No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
Signature:	3-40ml	VOAs	VOCs 8260	HCL	N	8260B	
Sample Time							
Sample Identification							
0.00							

Conversions		**Stabilization Criteria (MUST HAVE THREE CONSECUTIVE READINGS WITHIN THESE PARAMETERS)**						**Well Condition:**	
1 L = 0.26 gals	2" casing = 0.16 gallons/linear foot	**Temp**	+/- 1	**Cond**	+/- 0.01	**Turb**	+/- 10% &/or <10	**Ferrous Iron Reading=**	
1 gal = 3.79 L		**pH**	+/- 0.1	**DO**	+/- 10%	**ORP**	+/- 10 or 10% (the lesser)	**Alkalinity Reading =**	

Monitoring Well Sample Collection Form

LOCATION	Site: 0.00	Location ID: 0.00	Date:
	Project Name: 0.00	Project No./Phase: 0.00	Recorded By:

DATE (mmddyy)	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (mL)	Pumping Rate (mLpm)	Temp (C)	pH (SU)	Cond. (mS/cm)	DO (mg/l)	Turbidity (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)

A11 SURFACE WATER SAMPLING

This SOP is applicable to the collection of representative liquid samples, both aqueous and non-aqueous from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth, as well as samples collected from the surface. These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure or other procedure limitations. In all instances, the ultimate procedures employed should be documented and associated with the final report.

In general, sampling events should be sequenced to work from the least contaminated locations to the more highly contaminated locations to prevent cross-contaminating samples.

Sampling situations vary widely, therefore, no universal sampling procedure can be recommended. However, sampling of both aqueous and non-aqueous liquids from the above mentioned sources is generally accomplished through the use of one of the following samplers or techniques:

- Kemmerer bottle
- Bacon bomb sampler
- Dip sampler
- Direct method

These sampling techniques will allow for the collection of representative samples from the majority of surface waters and impoundments encountered. For surface water samples, a Kemmerer bottle will be used to collect samples from near the river bed.

A11.1 Equipment Required

Equipment needed for collection of surface water samples may include (depending on technique chosen):

- Kemmerer bottles
- Bacon bomb sampler
- Dip sampler
- Line and messengers
- Sample bottles/preservatives
- Ziploc bags
- Ice
- Coolers
- Chain of Custody records, custody seals
- Field data sheets
- Decontamination equipment

- Maps/plot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera
- Logbook/waterproof pen
- Sample bottle labels

A11.2 Procedures

A11.2.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.
2. Obtain the necessary sampling and monitoring equipment.
3. Decontaminate or pre-clean equipment, and ensure that it is in working order.
4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.
5. Use stakes, flagging, or buoys to identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. If collecting sediment samples, this procedure may disturb the bottom.

A11.2.2 Representative Sampling Considerations

In order to collect a representative sample, the hydrology and morphology of a stream or impoundment should be determined prior to sampling. This will aid in determining the presence of phases or layers in lagoons, or impoundments, flow patterns in streams, and appropriate sample locations and depths.

Water quality data should be collected to determine if stratification is present. Measurements of dissolved oxygen, pH, and temperature can indicate if strata exist which would affect analytical results. Measurements should be collected at one-meter intervals from the substrate to the surface using the appropriate instrument (i.e., a Hydrolab or equivalent).

Water quality measurements such as dissolved oxygen, pH, temperature, conductivity, and ORP can assist in the interpretation of analytical data and the selection of sampling sites and depths when surface water samples are collected.

Generally, the deciding factors in the selection of a sampling device for sampling liquids in streams, rivers, lakes, ponds, lagoons, and surface impoundments are:

- Will the sample be collected from shore or from a boat?
- What is the desired depth at which you wish to collect the sample?
- What is the overall depth and flow direction of river or stream?

- What type of sample will be collected (i.e., water or lagoon liquids)?

The appropriate sampling device must be of a proper composition. Selection of samplers constructed of glass, stainless steel, PVC, or PFTE (Teflon) should be based upon the analyses to be performed.

A11.2.3 Sample Collection

A11.2.3.1 Kemmerer Bottle

A Kemmerer bottle may be used in most situations where site access is from a boat or structure such as a bridge or pier, and where samples at depth are required. Sampling procedures are as follows:

1. Use a properly decontaminated Kemmerer bottle. Set the sampling device so that the sampling end pieces (upper and lower stoppers) are pulled away from the sampling tube (body), allowing the substance to be sampled to pass through this tube.
2. Lower the pre-set sampling device to the predetermined depth. Avoid bottom disturbance.
3. When the Kemmerer bottle is at the required depth, send down the messenger, closing the sampling device.
4. Retrieve the sampler and discharge from the bottom drain the first 10 to 20 mL to clear any potential contamination of the valve. Transfer the sample to the appropriate sample container.

A11.2.3.2 Bacon Bomb Sampler

A bacon bomb sampler may be used in situations similar to those outlined for the Kemmerer bottle. Sampling procedures are as follows:

1. Lower the bacon bomb sampler carefully to the desired depth, allowing the line for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut. This will allow the sampler to fill.
2. Release the trigger line and retrieve the sampler.
3. Transfer the sample to the appropriate sample container by pulling up on the trigger.

A11.2.3.3 Dip Sampler

A dip sampler is useful in situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access is limited. The long handle on such a device allows access from a discrete location. Sampling procedures are as follows:

1. Assemble the device in accordance with the manufacturer's instructions.
2. Extend the device to the sample location and collect the sample by dipping the sampler into the substance.
3. Retrieve the sampler and transfer the sample to the appropriate sample container.

A11.2.3.4 Direct Method

For streams, rivers, lakes, and other surface waters, the direct method may be used to collect water samples from the surface directly into the sample bottle. This method is not to be used for sampling lagoons or other impoundments where contact with contaminants is a concern. Use adequate protective clothing, and access the sampling station by appropriate means. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface avoiding surface debris and the boat wake. When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

A11.2.4 Sample Preservation, Containers, Handling, and Storage

Once samples have been collected, the following procedures should be followed:

1. Transfer the sample(s) into suitable, labeled sample containers.
2. Preserve the sample if appropriate, or use pre-preserved sample bottles. Do not overfill bottles, if they are pre-preserved.
3. Cap the container, place in a Ziploc plastic bag and cool to 4 °C.
4. Record all pertinent data in the site logbook and on field data sheets.
5. Complete the chain of custody record.
6. Attach custody seals to cooler prior to shipment.
7. Decontaminate all sampling equipment prior to the collection of additional samples with that sampling device.

A11.3 References

U.S. Geological Survey. 1977. *National Handbook or Recommended Methods for Water Data Acquisition.* (Chapter Updates available).

USEPA. December 1984. *Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition*. EPA-600/4-84-076.

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).*

A12 SEDIMENT SAMPLING

This SOP is applicable to the collection of representative stream bed sediment samples. Analysis of stream bed sediment may be biological, chemical, or physical in nature and may be used to determine the following:

- Toxicity
- Biological availability and effects of contaminants
- Benthic biota
- Extent and magnitude of contamination
- Contaminant migration pathways and source
- Fate of contaminants
- Grain size distribution

The methodologies discussed in this SOP are applicable to the sampling of sediment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. However, if modifications occur, they should be documented in a site or personal logbook and discussed in reports summarizing field activities and analytical results. For the purposes of this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, and impoundments; or flowing, as in rivers and streams.

Stream bed sediment samples may be collected using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion of the sediment profile required (surface vs. subsurface), the type of sample required (disturbed vs. undisturbed), contaminants present, and sediment type. For stream bed sediment sampling at the Installation, a Ponar dredge will be used to sample sediment beneath deep water and a modified suction tube auger will be used to collect sediment beneath shallow water, although other devices are also discussed in this SOP for completeness. Following collection, sediment is transferred from the sampling device to a sample container of appropriate size and construction for the analyses requested. If composite sampling techniques are employed, multiple grabs are placed into a container constructed of inert material, homogenized, and transferred to sample containers appropriate for the analyses requested. The homogenization procedure should not be used if sample analysis includes volatile organics; in this case, sediment, or multiple grabs of sediment, should be transferred directly from the sample collection device or homogenization container to the sample container.

In general, sampling events should be sequenced to work from the least contaminated locations to the more highly contaminated locations to prevent cross-contaminating samples.

A12.1 Equipment Required

Equipment needed for collection of sediment samples may include:

- Maps/plot plan

- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera
- Stainless steel, plastic, or other appropriate composition bucket
- 4-ounce, 8-ounce, and 1-quart wide mouth jars with Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels
- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spade or shovel
- Spatula
- Scoop
- Trowel
- Bucket auger
- Tube auger
- Extension rods
- Sediment coring device (tube, drive head, eggshell check value, nosecone, acetate tube, extension rods, "T" handle)
- Ponar dredge
- Ekman dredge
- Nylon rope or steel cable
- Messenger device

A12.2 Procedures

A12.2.1 Preparation

1. Determine the objective(s) and extent of the sampling effort. The sampling methods to be employed, and the types and amounts of equipment and supplies required will be a function of site characteristics and objectives of the study.
2. Obtain the necessary sampling and monitoring equipment.
3. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.

4. Decontaminate or pre-clean equipment, and ensure that it is in working order.
5. Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors including flow regime, basin morphology, sediment characteristics, depth of overlying aqueous layer, contaminant source, and extent and nature of contamination should be considered when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

A12.2.2 Sample Collection

Selection of a sampling device is most often contingent upon: (1) the depth of water at the sampling location, and (2) the physical characteristics of the sediment to be sampled. The following procedures may be used.

A12.2.2.1 Sampling Surface Sediment with a Trowel or Scoop from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to 6 inches in depth and a shallow aqueous layer is considered to range from 0 to 12 inches in depth.

Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with tools such as spades, shovels, trowels, and scoops. Although this method can be used to collect both unconsolidated and consolidated sediment, it is limited somewhat by the depth and movement of the aqueous layer. Deep and rapidly flowing water render this method less accurate than others discussed below. However, representative samples can be collected with this procedure in shallow sluggish water provided care is demonstrated by the sample team member. A stainless steel or plastic sampling implement will suffice in most applications. Care should be exercised to avoid the use of devices plated with chrome or other materials (plating is particularly common with garden trowels). The following procedure will be used to collect sediment with a scoop, shovel, or trowel:

1. Using a decontaminated sampling implement, remove the desired thickness and volume of sediment from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.
3. Surface water should be decanted from the sample or homogenization container prior to sealing or transfer; care should be taken to retain the fine sediment fraction during this procedure.

A12.2.2.2 Sampling Surface Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to 6 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of bucket auger or tube auger, a series of extensions, and a "T" handle. The use of additional extensions in conjunction with a bucket auger can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. However, sample handling and manipulation increases in difficulty with increasing depth of water. The bucket auger or tube auger is driven into the sediment and used to extract a core. The various depths represented by the core are homogenized or a sub-sample of the core is taken from the appropriate depth.

The following procedure will be used to collect sediment samples with a bucket auger or tube auger:

1. An acetate core liner may be inserted into the bucket auger or tube auger prior to sampling if characteristics of the sediments or water body warrant. By using this technique, an intact core can be extracted.
2. Attach the auger head to the required length of extensions, and then attach the "T" handle to the upper extension.
3. Clear the area to be sampled of any surface debris.
4. Insert the bucket auger or tube auger into the sediment at a 0 to 20 degree angle from vertical. This orientation minimizes spillage of the sample from the sampler upon extraction from the sediment and water.
5. Rotate the auger to cut a core of sediment.
6. Slowly withdraw the auger; if using a tube auger, make sure that the slot is facing upward.
7. Transfer the sample or a specified aliquot of sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.

A12.2.2.3 Sampling Deep Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, deep sediment is considered to range from 6 to greater than 18 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches. Collection of deep sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a bucket auger, a tube auger, a series of extensions and a "T" handle. The use of additional extensions increase the depth of water from which sediment can be collected from 24 inches to 5 feet or more. However, water clarity must be high enough to permit the sampler to directly observe the sampling operation. In addition, sample handling and manipulation increases in difficulty with increasing depth of water. The bucket auger is used to bore a hole to the upper range of the desired sampling depth and then withdrawn. The tube auger is then lowered down the borehole, and driven into the sediment to the lower range of the desired sampling depth. The tube is then withdrawn and the sample recovered from the tube. This method can be used to collect firmly consolidated sediments, but is somewhat limited by the depth of the aqueous layer, and the integrity of the initial borehole.

The following procedure will be used to collect deep sediment samples with a bucket auger and a tube auger:

1. Attach the bucket auger bit to the required various depths.
2. Clear the area to be sampled of any surface debris.

3. Begin augering, periodically removing any accumulated sediment (i.e., cuttings) from the auger bucket. Cuttings should be disposed of in drums or roll-off containers.
4. After reaching the upper range of the desired depth, slowly and carefully remove the bucket auger from the boring.
5. Attach the tube auger bit to the required lengths of extensions, then attach the "T" handle to the upper extension.
6. Carefully lower the tube auger down borehole using care to avoid making contact with the borehole sides and, thus, cross contaminating the sample. Gradually force the tube auger into sediment to the lower range of the desired sampling depth. Hammering of the tube auger to facilitate coring should be avoided as the vibrations may cause the boring walls to collapse.
7. Remove the tube auger from the borehole, again taking care to avoid making contact with the borehole sides and, thus, cross contaminating the sample.
8. Discard the top of the core (approximately 1 inch); as this represents material collected by the tube auger before penetration to the layer of concern.
9. Transfer the sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.

A12.2.2.4 Sampling Surface Sediment with an Ekman or Ponar Dredge from Beneath a Shallow or Deep Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to 6 inches in depth. Collection of surface sediment can be accomplished with a system consisting of a remotely activated device (dredge) and a deployment system. This technique consists of lowering a sampling device (dredge) to the surface of the sediment by use of a rope, cable, or extended handle. The mechanism is activated, and the device entraps sediment in spring loaded or lever operated jaws. An Ekman dredge is a lightweight sediment sampling device with spring activated jaws. It is used to collect moderately consolidated, fine textured sediment. The following procedure will be used for collecting sediment with an Ekman dredge:

1. Attach a sturdy nylon rope or stainless steel cable through the hole on the top of the bracket, or secure the extension handle to the bracket with machine bolts.
2. Attach springs to both sides of the jaws. Fix the jaws so that they are in open position by placing trip cables over the release studs. Ensure that the hinged doors on the dredge top are free to open.
3. Lower the sampler to a point 4 to 6 inches above the sediment surface.
4. Drop the sampler to the sediment.
5. Trigger the jaw release mechanism by lowering a messenger down the line, or by depressing the button on the upper end of the extension handle.
6. Raise the sampler and slowly decant any free liquid through the top of the sampler. Care should be taken to retain the fine sediment fraction during this procedure.

7. Open the dredge jaws and transfer the sample into a stainless steel, plastic, or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment grabs until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

A Ponar dredge is a heavyweight sediment sampling device with weighted jaws that are lever or spring activated. It is used to collect consolidated fine to coarse textured sediment. The following procedure will be used for collecting sediment with a Ponar dredge:

1. Attach a sturdy nylon rope or steel cable to the ring provided on top of the dredge.
2. Arrange the Ponar dredge with the jaws in the open position, setting the trip bar so the sampler remains open when lifted from the top. If the dredge is so equipped, place the spring loaded pin into the aligned holes in the trip bar.
3. Slowly lower the sampler to a point approximately 2 inches above the sediment.
4. Drop the sampler to the sediment. Slack on the line will release the trip bar or spring loaded pin; pull up sharply on the line closing the dredge.
5. Raise the dredge to the surface and slowly decant any free liquid through the screens on top of the dredge. Care should be taken to retain the fine sediment fraction during this operation.
6. Open the dredge and transfer the sediment to a stainless steel, plastic, or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenized and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

A12.2.2.5 Sampling Subsurface Sediment with a Coring Device from Beneath a Shallow Aqueous Layer

For purposes of this method, subsurface sediment is considered to range from 6 to 24 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of subsurface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a tube sampler, acetate tube, eggshell check valve, nosecone, extensions, and "T" handle, or drive head. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. This sampler may be used with either a drive hammer for firm sediment, or a "T" handle for soft sediment. However, sample handling and manipulation increases in difficulty with increasing depth of water.

The following procedure describes the use of a sample coring device used to collect subsurface sediments.

1. Assemble the coring device by inserting the acetate core into the sampling tube.
2. Insert the "egg shell" check valve into the lower end of the sampling tube with the convex surface positioned inside the acetate core.
3. Screw the nosecone onto the lower end of the sampling tube, securing the acetate tube and eggshell check valve.
4. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.
5. Place the sampler in a perpendicular position on the sediment to be sampled.
6. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. After the desired depth is reached, rotate the sampler to shear off the core at the bottom. Slowly withdraw the sampler from the sediment and proceed to Step 15.
7. If the drive hammer is selected, insert the tapered handle (drive head) of the drive hammer through the drive head.
8. Drive the sampler into the sediment to the desired depth.
9. Record the length of the tube that penetrated the sample material, and the number of blows required to obtain this depth.
10. Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.
11. Rotate the sampler to shear off the core at the bottom.
12. Lower the sampler handle (hammer) until it just clears the two ear-like protrusions on the drive head, and rotate about 90 degrees.
13. Slowly withdraw the sampler from the sediment. If the drive head was used, pull the hammer upwards and dislodge the sampler from the sediment.
14. Carefully remove the coring device from the water.
15. Unscrew the nosecone and remove the eggshell check valve.
16. Slide the acetate core out of the sampler tube. Decant surface water, using care to retain the fine sediment fraction. If head space is present in the upper end, a hacksaw may be used to shear the acetate tube off at the sediment surface. The acetate core may then be capped at both ends. Indicate on the acetate tube the appropriate orientation of the sediment core using a waterproof marker. The sample may be used in this fashion, or the contents transferred to a sample or homogenization container.
17. Open the acetate tube and transfer the sediment to a stainless steel, plastic, or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

A12.3 Sample Preservation, Containers, Handling, and Storage

1. Chemical preservation of solids is generally not recommended. Cooling to 4 °C is usually the best approach, supplemented by the appropriate holding time for the analyses requested.
2. Wide mouth glass containers with Teflon lined caps are used for sediment samples. The sample volume is a function of the analytical requirements and will be specified in the Work Plan.
3. If analysis of sediment from a discrete depth or location is desired, sediment is transferred directly from the sampling device to a labeled sample container(s) of appropriate size and construction for the analyses requested. Transfer is accomplished with a stainless steel or plastic lab spoon or equivalent.
4. If composite sampling techniques or multiple grabs are employed, equal portions of sediment from each location are deposited into a stainless steel, plastic, or other appropriate composition (e.g., Teflon) containers. The sediment is homogenized thoroughly to obtain a composite representative of the area sampled. The composite sediment sample is transferred to a labeled container(s) of appropriate size and construction for the analyses requested. Transfer of sediment is accomplished with a stainless steel or plastic lab spoon or equivalent. Samples for volatile organic analysis must be transferred directly from the sample collection device or pooled from multiple areas in the homogenization container prior to mixing. This is done to minimize loss of contaminant due to volatilization during homogenization.
5. All sampling devices should be decontaminated, and then wrapped in aluminum foil. The sampling device should remain in this wrapping until it is needed. Each sampling device should be used for only one sample. Disposable sampling devices for sediment are generally impractical due to cost and the large number of sediment samples which may be required. Sampling devices should be cleaned in the field using the decontamination procedure described in SOP A1.

A12.4 References

Barth, D.S. and B.J. Mason. 1984. *Soil Sampling Quality Assurance User's Guide*. EPA-600/4-84-043.

deVera, E.R., B.P. Simmons, R.D. Stephens, and D.L. Storm. January 1980. *USEPA Samplers and Sampling Procedures for Hazardous Waste Streams*. EPA-600/2-80-018.

Mason, B.J. July 1992. *Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies.* EPA/600/R-92/128.

USEPA. December 1984. *Characterization of Hazardous Waste Sites- A Methods Manual: Volume II. Available Sampling Methods, Second Edition*. EPA-600/4-84-076.

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A13 SAMPLE CONTROL AND DOCUMENTATION

This SOP contains specific details concerning sample control and identification, data recording, and chain of custody documentation. Refer to the project work plan (e.g., RI/FS Work Plan, SI Work Plan, UST Investigation Work Plan, etc.) which covers the specific type of environmental investigation you are conducting for the type of samples to be collected and the destination of the collected samples.

Sample control and documentation are necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, correspondence, sample labels or tags, chain of custody forms, photographs, and analytical records. Indelible black ink must be used in recording all data.

All Quality Control (QC) numbered logbooks are to be bound with consecutively numbered pages. Indelible black ink is used for recording all data. Logbook pages and data should never be removed. To change an incorrect entry, the individual shall draw a line through the entry, write the change above or adjacent to the entry, and date and initial the change. If anyone other than the person to whom the logbook is assigned makes an entry, that person shall date and sign the entry.

All pertinent information concerning sampling activity (e.g., date, site, ID number, and location) shall be recorded in the logbook. Field conditions, weather conditions, and any unusual circumstances should also be recorded. Notes should be as descriptive and inclusive as possible. A person reading the entries should be able to reconstruct the sampling situation from the recorded information. Language should be objective, factual, and free of comments of a personal nature and inappropriate terminology.

A13.1 Equipment Required

- Logbooks
- Chain-of-custody forms
- Soil and water sample identification labels and seals
- Indelible black pens
- Digital camera
- Data forms

A13.2 Procedures

Before leaving the office to begin field operations, personnel should:

1. Review the project work plan and appropriate SOPs.
2. Coordinate schedules/actions with the facility/installation/site staff.
3. Obtain appropriate permission for property access.
4. Assemble the equipment and supplies listed in Section A13.1. Ensure proper operation of all sampling equipment.

5. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.
6. Contact the carrier that will transport samples to obtain information on regulations and specifications.
7. Obtain a logbook
8. Record results of the equipment check in the appropriate logbook.
9. Obtain a sufficient number of the appropriate data collection forms.

Preparation for field activities requires organizing sample bottles, labels, and documentation in an orderly, systematic manner to ensure consistency and traceability of all data. The following activities should be completed before a sample is collected:

1. Record all pertinent information (e.g., date, site, number, and location) in the logbook. Note field conditions, unusual circumstances, and weather conditions.
2. Fill out information on the sample identification label and attach the label to a sample bottle.
3. Complete initial information required on data collection forms.

During field operations which involve the collection of any types of samples, the following support activities must be performed.

A13.2.1 Sample Identification

A numbering system must be developed for each environmental investigation to identify each well; boring location; and samples taken during water, sediment, and soil sampling programs. This numbering system must provide a tracking procedure to allow data retrieval and ensure that sample identifiers are not duplicated. The most important aspect of any sample numbering system which is developed is ensuring the uniqueness of an individual sample number. Such a sample numbering system is described below. A listing of the sample identification numbers will be maintained by the project data administrator and the field supervisor will ensure that it is universally applied to samples collected during a given project.

Each sample collected will be identified on the sample label and chain-of-custody records. Sample documentation, handling, and shipping will be in accordance with the SOPs. Sample collection information inclusive of the container type and quantity for the groundwater samples to be collected is discussed in Worksheet #19 of the Uniform Federal Policy-Quality Assurance Project Plan. The field duplicate samples will appear in sequence with the regular samples. An explanation of the sample ID nomenclature for the samples is as follows:

Installation Identifier and Site Number: LHAAP57 = Longhorn Army Ammunition Plant Site 57

Sample Location: MW534 = Monitoring well 534

Sample Date: 031218 = March 12, 2018

QA sample identifiers: a = field duplicate, c = trip blank, MS = matrix spike, MSD = matrix spike duplicate

For example:

Monitoring Well Sample: 57WW534-031218

A13.2.2 Completing the Logbook

Personnel should enter all information pertinent to a field activity in a bound logbook with consecutively numbered pages. If the information is not included on a data collection form, entries in the logbook should include, at a minimum, the following:

- Date and time of entry
- Purpose of sampling
- Name and address of field contact
- Site identification
- Type of process producing waste (if known)
- Type of waste (sludge or wastewater)
- Description of sample waste components and concentrations
- Sample identifier and size of sample taken
- Description of sampling point
- Sample collection date and time
- Collector's sample identification number(s) and/or name
- References to the sampling site (e.g., maps or photographs)
- Field observations and sampling locations
- Associated field measurements
- Method of sample collection, preservation techniques, and any deviations or anomalies noted
- Transfer of a logbook to individuals designated for specific tasks of the project
- Any uncompleted work

Because sampling situations vary, notes are to be as descriptive and inclusive as possible so that a person reading the entries would be able to reconstruct the sampling situation from the recorded information. Entries should include language that is objective, factual, and free of comments of a personal nature or any other inappropriate terminology. If anyone other than the person to whom the logbook was assigned makes an entry, this person should date and sign the entry. Logbook pages should never be removed. Mistakes should be corrected with a single line through the mistake; the new information added above the line or adjacent to the change, and the change should be initialed and dated.

A13.2.3 Taking Photographs

Photographs provide the most accurate record of the field worker's observations. They can be significant during future inspections, informal meetings, and hearings. A photograph must be documented to be a valid representation of an existing situation. For each photograph taken as part of the official record of site conditions, the items listed below should be recorded in the logbook and on the back of each processed photograph, or as part of the digital information captured by the camera.

- Date and time
- Name and identification number of site
- General direction faced and description of the subject
- Location at the site

Photographs of each site may be taken before and after the field investigation to document site restoration. Remarks regarding the content of a photograph could jeopardize its value as legal evidence. Therefore, comments should be limited to the photograph's location. Photographs should be taken with a perspective similar to that afforded by the naked eye. Telephoto or wide-angle shots cannot be used in enforcement proceedings.

In addition to the information recorded in the logbook and on the backs of the photographs, certain information should be entered on a site plan or field sketch. A circle should be drawn on the plan which indicates the position of the photographer. The sequential number of the photograph (roll number-photo number) should be entered in the circle. A line with an arrowhead should extend from the circle in the direction the photographer was facing. The absence of a line/arrowhead indicates that the photographer was facing down at that location. The transfer of this information to a drawing in the final report will greatly will aid the reader of any report containing the photographs in visualizing what the photograph is depicting.

A13.2.4 Completing Sample Labels/Seals

All samples should be sealed immediately after collection. The samples should then be labeled by one of the methods described below. All labeling must be done with indelible black ink.

Soil and water sample identification labels or tags may be used to identify sample containers and may be filled out before collection to minimize the handling of the sample containers. Sample Label and Custody Seals (attached), provides examples of a common sample label and seal which may be used while directions (attached) give instructions for completing this label and seal. These labels are examples only. Other labels or seals may be substituted as long as they contain, at a minimum, the information listed on the examples.

The use of an etching tool to mark sample containers in the field, rather than immediately applying a sample label or tag may be appropriate. This avoids possible label contamination problems and subsequent decontamination difficulties. When etching is used, the data intended for the sample label should be recorded in the logbook. Following decontamination of the sample containers, the information is transcribed onto the label and seal which are then attached to the decontaminated and dry sample containers. The custody seal is to be attached to the sample container in a manner such that if the sample container is opened and/or tempered with, that it will be evident by the condition of the seal (e.g., it will be torn or broken).

A13.2.5 Collecting and Inventorying Samples

A minimum number of persons should be involved in collecting and handling samples. As samples are collected, data collection forms should be completed with the date, time, and the sample collector(s) signature or initials. The liquid level in all containers should be marked with waterproof black ink. This requirement is not necessary for completely filled VOC septum vials. The marking of the liquid level indicates to the laboratory if the sample container may have leaked, been tampered with, or spilled hazardous materials. The chain-of-custody form (see Attachment) is used to inventory all samples collected in the field. Instructions for completing the form are contained in the Data Form Completion (attached).

A13.2.6 Chain of Custody

A13.2.6.1 Objectives

The primary objective of the chain of custody procedure is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and introduction as evidence a sample is in someone's custody when one of the criteria listed below has been satisfied:

- The sample is in one's actual possession;
- The sample is in one's view after being in one's physical possession;
- The sample is in one's physical possession and is then locked up so that no one can tamper with it; or
- The sample is kept in a secured area that is restricted to authorized personnel.

A13.2.6.2 Completing the Chain of Custody Form

Chain of custody forms will be filled out and will accompany every sample shipping container. All personnel involved with sample handling and transfer will be trained in the importance of the chain of custody process and each field sampler involved in the field investigations will be experienced with the procedures for properly and completely filling out a chain of custody form.

The chain of custody process will be initiated upon sample collection. The field sampler that signs the chain of custody form will be responsible for the samples until they are transferred to the custody of a laboratory or another custodian. Each chain of custody form will be filled out in indelible black ink. Any errors will be crossed out with a single line, initialed, and dated by the field sampler filling out the form. Once the form has been completed, all remaining field sample number spaces will be crossed through to prevent unauthorized addition of sample information. All sampling location information must be augmented by referenced information in the field logbook and on field boring logs.

A13.2.6.3 Transfer of Custody and Shipment

As sample custody is transferred, the persons both relinquishing and receiving the samples will sign, date, and note the time on the form. Minimizing the number of custodians in the chain of possession will reduce the number of custody records. Common couriers involved in shipping processes will not sign the chain of custody forms; only field samplers and laboratory personnel will be involved in sample custody. An example of the type of chain-of-custody form that will be used by contractor personnel performing field sampling operations is attached. Each chain of custody form will include the name and address of the facility, the name and address of the contracting firm conducting the sampling, each sample number included in the shipping container, the signature of the sample collector, the date and time of collection, the sample media, the sample location (borehole or well number), the number and type of containers included for each sample, requested analytical method(s), signatures of all persons involved in sample custody, and dates and times of possession.

The method of shipment, courier name, and airbill number will be entered in the first "received by" block of the chain of custody form for each shipment of samples. Each shipment of samples will be accompanied by a chain of custody record (possibly multiple forms). Chain of custody forms will be sealed in plastic bags and taped to the inside of the closure of the shipping container after the field custodian has detached the appropriate copy of the form(s). For shipments consisting of multiple shipping containers, a plastic bag containing a chain of custody record will be taped to the inside of the closure of each shipping container. Each shipping container will be marked with a unique identifier, which will also be recorded on the chain of custody form accompanying that container. Each airbill number will be recorded in the field sampling logbook and a copy of all airbills will be retained as part of the permanent chain of custody record documentation. The original chain of custody form(s) will accompany the sample shipment to the laboratory.

Upon receipt at the analytical laboratory, the laboratory sample custodian will check the temperature of the samples and note it on the laboratory sample receiving form. Custody is not technically transferred to the laboratory until the sample custodian for the laboratory signs the chain of custody record. The laboratory will keep a copy of the chain of custody record in their files, and the original will be returned with the analytical results from the laboratory.

A13.2.7 Post Operation

A13.2.7.1 Field

Before leaving the field, personnel should:

1. Verify that all sample bottles have been correctly identified and labels have all necessary information (e.g., location, time, and date).
2. Cross-check filled sample bottles in possession against those recorded in the logbook. Maintain custody of filled sample bottles by keeping them in actual possession, within view, locked or sealed up to prevent tampering, or transferring them to a secure area.
3. Prepare samples for transport.
4. Record data and any uncompleted work in the logbook.
5. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.
6. Document samples on the chain-of-custody form (see Attachment A13.4.2).
7. Review data collection forms for completeness.

A13.2.7.2 Office

After returning to the office; personnel should:

1. Deliver original forms and logbooks to the Project Manager for technical review. The Project Manager will review and file the information for later presentation within applicable reporting documents.
2. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.
3. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

A13.3 References

USEPA. September 1986. *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document.*

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).*

A13.4 Attachments

A13.4.1 Example Sample Label and Custody Seal

The examples are provided as an attachment in this SOP.

A13.4.2 Example Chain-of-Custody Form

The examples are provided as an attachment in this SOP.

A13.4.3 Chain-of-Custody Form Completion

The completion instructions are provided as an attachment in this SOP.

A13.4.4 Data Form Completion

The completion instructions are provided as an attachment in this SOP.

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ATTACHMENT A13.4.1
EXAMPLE SAMPLE LABEL AND CUSTODY SEAL

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Example Sample Label

Project:	
Project Number:	
Client:	
Location ID:	
Preservative:	
Sampler:	
Date/Time:	
Analysis Requested:	

Example Custody Seal

CUSTODY SEAL

DATE ______________________________

SIGNATURE ______________________________

ATTACHMENT A13.4.2
EXAMPLE CHAIN-OF-CUSTODY FORM

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Page: ____

Project No: ____

COC Number(1): ____

LIMS Number: ____

Chain of Custody and Analytical Request

Facility/Base I.D.:								Sample Analysis Requested (5)									Quality Assurance Samples (6)			
Project/Site Name:																				
Client Name:																				
Collected by:																				
Field Sample ID (30 Characters Max)	ERPIMS LOCID (15 Characters Max)	Date Collected (dd-mmm-yyyy)	Time Collected (Military) (hhmm)	Sample Depth (beginning - ending)	SA Code (2)	Sample Number (3)	Sample Matrix (4)	Number of containers									Ambient Blank Lot Control Number	Equipment Blank Lot Control Number	Trip Blank Lot Control Number	Cooler ID
				-																
				-																
				-																
				-																
				-																
				-																
				-																
				-																
				-																

COMMENTS: PO # XXXXX, EDR Required, Level IV

Custody Transfers Prior to Receipt by Laboratory

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1.____			1.____		
2.____			2.____		
3.____			3.____		

Sample Delivery Details / Laboratory Receipt

Delivered Directly to Lab:	____	Shipped No.:	____
Method of Shipment:	____	Airbill Number:	____
Analytical Lab:	____	Delivery Location:	____
Lab Recipient:		Delivery Date/Time:	

1.) Chain of Custody Number = date collected + custody number (e.g. 09-02-1999-01)

2.) Sample Type (SA) Codes: N = Normal Sample, TB = Trip Blank (-c) Sample, FD = Field Duplicate (-a) Samples, FR = Field Replicate (-b) Samples, EB = Equipment Blank (-d) Samples, MS = Matrix Spike, SD = Matrix Spike Duplicate, AB = Ambient Blank (-e)

3.) Sample Number: Unique sample number collected from a particular location per day. (e.g. Groundwater sample collected from MW-1 on 10/10/99 = 01, if sampled again on 10/10/99 = 02, etc.)

4.) Matrix Codes: GS = Soil Gas, WG = Groundwater, WS = Surface Water, SO = Soil, SE = Sediment, SL = Sludge, SS = Surface Soil Samples, WQ = Aqueous Blank Samples (trip, equipment, ambient, etc), SQ = Soil Blanks

5.) Sample Analysis Requested: Analytical method requested and number of containers provided for each.

6.) Quality assurance samples are assigned by date (ddmmyy) and the sample number associated with the sample (01, 02, etc) (e.g. Equipment blank collected in association with MW-1 on 10/10/99 will be designated 10109901 in the Equipment Blank Lot Control

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ATTACHMENT A13.4.3
CHAIN-OF-CUSTODY FORM COMPLETION

A chain of custody form must accompany each cooler of samples shipped from the site. The following bullets explain each of the data fields on the chain of custody form:

- Project Name/Location- Enter the name of the project and the geographical location of the facility/site.
- Remarks - Enter any remarks pertaining to the project or to a group of samples.
- Cooler ID- Unique identifier for each cooler of samples shipped to facilitate tracking, trip blank assignment, and analytical flagging associated with sample storage temperature.
- Field Sample I.D. - Enter the sample identifier
- Date- Enter the sample collection date in the format DD-MMM-YYYY
- Time- Enter the sample collection time in military format (HHMM).
- Preservatives- indicate the preservatives added to the sample, if any.
- Sample Type/matrix- Enter the indicated sample matrix codes.
- Number of Containers- Enter the total number of containers collected for the individual sample.
- Analyses- Check columns for the parameter grouping {s) for which analysis is requested.
- Remarks- Enter any remarks specific to that sample, such as unusually high levels of contamination, MS/MSD analyses requested, etc.
- Relinquished By/Date-Time/Received By- Enter the printed names, signatures, and date and time in these blocks each time the custody of the sample changes hands.

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ATTACHMENT A13.4.4
DATA FORM COMPLETION

All data forms will be completed using an indelible black ink pen (not a felt tip pen). Make an entry in each blank. Where there is no data entry, the following will be entered: "UNK" for unknown, "NA" for not applicable, or "NO" for not done. If any procedure was not performed as prescribed, the reason for the change or omission on the form will be provided. To change an entry, the person making the change will draw a single line through mistake, add the correct information above it or adjacent to it, and initial the change.

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A14 NATURAL ATTENUATION FIELD TEST KIT

The purpose of sampling for natural attenuation parameters is to determine the effectiveness of remedies in place and to determine, if any additional treatments are required. Monitoring natural attenuation parameter concentrations in groundwater will demonstrate the continued absence of an exposure pathway.

The project work plans contain details about the method, materials, and equipment to be used to monitor for natural attenuation parameters. Several natural attenuation groundwater parameters can be measured at the site: ferrous iron (Iron II), alkalinity, chloride, sulfate, manganese, total organic carbon, methane, ethane, ethene, pH, dissolved oxygen, ORP, and temperature. Of these parameters, iron II and alkalinity are to be collected by the use of a field test kit and will be addressed in this SOP. The remaining parameters will either be analyzed by a laboratory or collected at the well head with a water quality meter.

A14.1 Equipment Required

A14.1.1 Iron II

- Kitchen timer (digital)
- Clippers or scissors
- Color Comparator
- Color disc
- Ferrous iron reagent powder pillows, 25 mL
- Vial with 2, 5, 10, 15, 20, and 25-mL measuring marks
- Plastic viewing tube
- Water, deionized

A14.1.2 Alkalinity

- Clippers or scissors
- Alkalinity reagent set
- Glass mixing bottle
- Bromcresol Green-Methyl Red powder pillows
- Plastic measuring tube (5.83 mL)
- Phenolphthalein powder pillows
- Sulfuric Acid standard solution, 0.035 N

A14.2 Procedures

The following are general procedures for analyzing groundwater samples using iron II and alkalinity using Hach® field test kits.

A14.2.1 Sampling and Storage

A sample of groundwater from the well to be tested should be collected in a 500-mL or larger glass or plastic bottle, leaving no headspace. The sample bottle should be tightly capped and labeled. Excessive agitation and prolonged exposure to air should be avoided. Collection of this sample bottle should occur after the normal analytical suite is collected, and should be placed on ice with the remainder of the suite of analyte bottles. Samples should be analyzed as soon as possible after collection but can be stored at least 24 hours by cooling to 4 °C or below. The sample should be warmed to room temperature before analyzing.

A14.2.2 Iron II (Ferrous) Test Kit Procedure

The 1, 10 phenanthroline indicator in the Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the ferrous iron concentration. Ferric iron does not react. The ferric iron (Fe3+) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test, if available. The following is a description of the analyzing ferrous iron.

1. Fill a viewing tube to the first (5-mL) line with sample water. This is the blank. Place this tube in the top left opening of the color comparator.
2. Fill the measuring vial to the 25-mL mark with sample water. Add the contents of one Ferrous Iron Reagent Powder Pillow to the measuring vial.
3. Swirl to mix. An orange color will develop, if ferrous iron is present. Allow three minutes for full color development.
4. Fill another viewing tube to the first (5-mL) mark with the prepared sample. Place the second tube in the top right opening of the color comparator.
5. Hold the comparator up to a light source such as the sky, a window or a lamp. Look through the openings in front. Rotate the color disc until the color matches in the two openings. Read the milligrams per liter (mg/L) ferrous iron concentration in the scale window.

A14.2.3 Alkalinity Test Kit Procedure

The 5 to 100 mg/L range of Hach® Alkalinity test kit should adequate to determine concentrations of alkalinity in groundwater.

The sample is titrated with sulfuric acid to a colorimetric end point corresponding to a specific pH. Phenolphthalein alkalinity is determined by titration to a pH of 8.3, as evidenced by the color change of phenolphthalein indicator, and indicates the total hydroxide and one half the carbonate present. Total alkalinity (methyl orange) is determined by titration to a pH between 3.7 and 5.1, and includes all carbonate, bicarbonate, and hydroxide.

A14.2.3.1 To Determine Alkalinity (as $CaC0_3$)

1. Fill the mixing bottle to the 23-mL mark with the sample water. Add the contents of one Phenolphthalein Indicator Powder Pillow.
2. Swirl to mix. If the sample remains colorless, the phenolphthalein alkalinity is zero. In this case, proceed to Step 4.

3. If the sample turns pink, add Sulfuric Acid Standard Solution one drop at a time. Count each drop. Swirl the mixing bottle after each drop is added. Add drops until the sample turns colorless.
4. Multiply by 5 the number of drops of titrant used. This is the mg/L of phenolphthalein alkalinity as calcium carbonate ($CaC0_3$).

A14.2.3.2 To Determine Total Alkalinity (Hydroxide, Carbonate, and Bicarbonate alkalinity)

1. Add the contents of one Bromcresol Green-Methyl Red Indicator Powder Pillow to the mixing bottle. Swirl to mix.
2. Add Sulfuric Acid Standard Solution one drop at a time. Count each drop. Swirl the mixing bottle after each drop is added. Add drops until the sample turns pink.
3. Multiply by 5 the total number of drops of titrant used in both steps 4 and 8. This is the total mg/L of methyl orange alkalinity as $CaC0_3$.
4. Total alkalinity primarily includes hydroxide, carbonate, and bicarbonate alkalinities. The concentration of these types in a sample may be determined when the phenolphthalein and total alkalinities are known (see Table A14-1).

Table A14-1. Determination of Alkalinities

Row Number	**Result of Titrations**	**Hydroxide Alkalinity is equal to:**	**Carbonate Alkalinity is equal to:**	**Bicarbonate Alkalinity is equal to:**
1	Phenolphthalein Alkalinity = 0	0	0	Total Alkalinity
2	Phenolphthalein Alkalinity = Total Alkalinity	Total Alkalinity	0	0
3	2x Phenolphthalein Alkalinity < Total Alkalinity	0	2x the Phenolphthalein Alkalinity	Total Alkalinity – [2x the Phenolphthalein Alkalinity]
4	2x Phenolphthalein Alkalinity = Total Alkalinity	0	Total Alkalinity	0
5	2x Phenolphthalein Alkalinity > Total Alkalinity	[2x the Phenolphthalein Alkalinity] - Total Alkalinity	2x the difference between Total and Phenolphthalein Alkalinity	0

To use this table, follow these steps:

a) Does the phenolphthalein alkalinity equal zero? If yes, use Row 1.
b) Does the phenolphthalein alkalinity equal total alkalinity? If yes, use Row 2.
c) Multiply the phenolphthalein alkalinity by 2.
d) Select Row 3, 4 or 5 based on comparing the result of Step "c" with the total alkalinity.
e) Perform the required calculations if any.
f) Check your results. The sum of the three alkalinity types will equal the total alkalinity.

A14.3 Measuring Hints and General Test Information

Suggested measuring procedures and general test information are supplied by Hach® (www.hach.com). For both procedures, it is recommended that all labware be washed between tests. Clean with a non-abrasive detergent or a solvent such as isopropyl alcohol (IPA). Use a soft cloth for wiping or drying. Do not use paper towels or tissue on plastic tubes as this may scratch them. Rinse with clean water (preferably deionized water). Procedures specific to each test, and are outlined below.

A14.3.1 Iron II

1. Rinse all viewing tubes thoroughly with the sample water before testing.
2. Use clippers or scissors to open plastic powder pillows.
3. For critical testing, reagent accuracy should be checked with each new lot of reagents. Prepare a ferrous iron stock solution (100 mg/L Fe) by dissolving 0.702 grams of ferrous ammonium sulfate, hexahydrate, in 1 liter deionized water. Dilute 5.00 mL of this solution to 100 mL with deionized water to make a 5.0 mg/L standard solution. Prepare this immediately before use. Follow the ferrous iron test instructions using this solution instead of a water sample, to confirm a color comparison match of 5.0 mg/L.

A14.3.2 Alkalinity

1. When titrating, count each drop of titrant. Hold the dropper vertically. Swirl the mixing bottle after each drop is added. [Note: Results can be expressed in grains per gallon (gpg) by dividing the mg/L result by 17.1.]
2. To open PermaChem Powder Pillows:
   1) Tap the bottom of the pillow on a hard surface.
   2) Tear open the pillow along the dashed line.
   3) Open the pillow and form a spout by squeezing the side edges.
   4) Pour the contents into the sample.

It is strongly recommended that, for optimum test results, reagent accuracy be checked with each new lot of reagents. Follow the instructions included with the standard solution to test for reagent accuracy.

A14.4 Completing the Logbook

Personnel should enter all information pertinent to field kit testing in a bound logbook with consecutively numbered pages. If the information is not included on a data collection form, entries in the logbook should include, at a minimum, the following:

- Name of person performing field kit test;
- Date and time of entry in logbook;
- Sample collection;
- Groundwater sample ID number of associated analytical groundwater sample set;
- Field test kit results; and

- Any remarks related to condition of sample (i.e. unusual color, turbidity, odor).

If any reagent accuracy testing is performed; those results should be recorded as well.

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A15 SURVEYING

This section describes the requirements for land surveying performed as a part of environmental projects. While not specifying the exact methods employed, it does summarize the required results and degree of accuracy.

For an accurate spatial presentation of the results of the investigations performed at the Installation, it is necessary to determine the exact locations of sampling points, monitoring wells, and other associated physical features. The locations are determined by measuring horizontal coordinates and vertical elevations. To facilitate this, a registered land surveyor (RLS) will be subcontracted to perform this work. This RLS will be registered with the State in which the work is to be performed.

The coordinates of the required objects will be established to the closest one foot and referenced to the State Plane Coordinate System. A ground elevation to the closest 0.10 foot will be established for ground surfaces. Water level reference points, such as top of well casings and stream gauges, shall be established to the closest 0.01 feet. All elevations shall be referenced to NAVD of 1988. All positions and coordinates of all permanent points within the control traverse will be shown.

The results of this surveying work will be supplied as drawings which carry the RLS stamp of the surveying subcontractor. It is assumed that documentation will be done by the RLS according to appropriate and relevant state laws and standards of the industry.

A15.1 Procedures

A15.1.1 Preparation

- Review the Work Plan, SSHP, and relevant SOPs.
- A surveying subcontractor will be selected and RLS certification will be verified.
- Provide maps or other documents to RLS to ensure that all pertinent locations are identified.
- Contact the RLS to ensure any other concerns are addressed.
- Arrange Installation access for the RLS.
- Coordinate schedules/actions with Installation personnel. This may include arranging access to restricted areas.
- Provide RLS with location identification codes.
- Ensure intent of RLS to comply with Work Plan, SSHP, and relevant SOPs.
- Locate any objects or locations that RLS may have questions about.
- All sampling locations shall be staked to facilitate subsequent surveying.

A15.1.2 Monitoring Well Surveying

- Coordinates of each monitoring well will be established to closest one foot using the Texas North Central 4202 Coordinate System.

- Elevation of ground surface will be established to the closest 0.10 foot, using NAVD) of 1983.
- Elevation of well riser will be established to the closest 0.01-foot, using NAVD of 1983.

A15.1.3 Soil Borings/Sampling Points

- Coordinates of soil borings will be established to the closest one foot using State Plane Coordinate System.
- Elevation of ground surface will be established to the closest 1.0 foot, using NAVD of 1983.

A15.1.4 Physical Features

- Verify aboveground and, where possible, underground physical features to the nearest foot. Verification will be with previous mapping.
- Locate the features as described in the bullet above if features have not been previously located.
- Place permanent control monuments in accessible locations within the limits of the Installation if existing permanent monuments are not located within 1,000 feet of a site. One set of monuments is allowable for adjacent sites. These monuments will be set no closer than 500 feet to each other.

A15.1.5 Documentation

Surveying procedures and measurements will be documented by the RLS according to appropriate and relevant state laws and standards of the industry.

- The RLS will plot location, identification, coordinates, and elevations of the wells, sample sites, and monuments on maps with a scale large enough to show their locations with reference to other structures at the individual sites.
- The RLS will provide a tabulated list of the monitoring wells, sample locations, and monuments. This list will consist of:
  - The designation of the well, sample location, or monument,
  - X and Y coordinates, and
  - All of the required elevations.

A16 SOIL BORING/MONITORING WELL ABANDONMENT

The purpose of this SOP is to describe the methods used to prevent migration of contaminants from the ground surface to the water table or between aquifers when it is necessary to abandon a soil boring or monitoring well.

Unplugged or improperly plugged or abandoned borings and wells pose a threat to groundwater. These wells serve as a pathway for surface pollutants to infiltrate into the subsurface and present an opportunity for various qualities of water to mix. The objectives of an abandonment procedure are to eliminate physical hazards, prevent groundwater contamination, conserve aquifer yield and hydrostatic head, and prevent intermixing of subsurface water (USEPA, 1975; American Water Works Association, 1984). The purpose of sealing an abandoned boring or well is to prevent any further disturbance to the pre-existing hydrologic conditions that exist within the subsurface. The plug should prevent vertical movement within the borehole and confine the water to the original zone of occurrence.

The SOP for monitoring well abandonment will be to attempt to remove the well casing, filter pack, and plug by pulling the casing with appropriate equipment, and then filling the hole with grout as outlined in 16 Texas Administrative Code, Chapter 76.104. This section requires all wells shall be plugged or capped with following specifications: (1) all removable casings shall be removed from the well; (2) any existing surface completion shall be removed; (3) the entire well pressure grouted via a tremie pipe with cement or bentonite grout, with the top 2 feet filled with cement.

The SOP for soil boring abandonment will be to place bentonite chips or grout in the borehole. Bentonite chips will be hydrated with clean potable water. The grout will be placed in one continuous operation from the bottom of the hole up.

A16.1 Procedures

The following are general procedures for removal of well casing and placement of grout. When a borehole is to be abandoned, the sections pertaining to removal of protective casing, over drilling, and well casing removal may be disregarded.

A16.1.1 Preparation

- Review the Work Plan, SSHP, and relevant SOPs.
- Determine well location and if well has been surveyed.
- If well has not been surveyed, arrange for surveying.
- Give notice to the Texas Commission on Environmental Quality (TCEQ) and USEPA of intent to abandon well.
- Notify drilling subcontractor, ensure that driller is familiar with abandonment procedures, and ensure that driller can provide the required grout mixture.
- If well is a flush-mount, make arrangements for cutting of concrete or asphalt.

- Ensure that a qualified geologist or hydrogeologist will be overseeing field drilling and abandonment procedures.
- Coordinate schedules/actions with Installation personnel. This may include arranging access to restricted areas.
- Obtain field logbook.
- Ensure that driller has provided proper containers for waste that will be generated during abandonment activities.

A16.1.2 Depth Measurement

1. Remove lock and open well.
2. Measure total depth of well as described in SOP A9, Water Level Measurement.
3. Record measurement in logbook.

A16.1.3 Removal of Concrete Pad and Protective Casing

1. Break concrete pad with a sledge hammer or jackhammer. Wear a minimum of level D safety equipment during this operation. If the well completion is a flush-mount, it may be necessary to use a concrete saw or other equipment to remove pavement material around the well cover.
2. Place waste material in a drum or another container for proper disposal.
3. Remove protective casing and posts.

A16.1.4 Casing Removal

An attempt will be made to remove well casing using the procedure below:

1. Grasp the casing with a pipe dog and raise the casing with the cable winch on the drill rig. Other methods may be employed, depending on available equipment.
2. Break down the casing and decontaminate if necessary. Dispose of as disposable equipment.

The hole (if casing is removed) or the monitoring well (if casing cannot be removed) will be grouted according to the procedure below.

A16.1.5 Grouting

Grout shall consist of a minimum 9.1 pounds per gallon weight (16 Texas Administrative Code 76.104).

1. Calculate the volume of grout required using the following equation:

$$V = D * H * 7.2/4$$

   where V is the volume of grout required, D is the diameter of the borehole, and H is the previously measured depth of the well.

2. Place the grout from the bottom of the hole up in one continuous operation using the tremie method. The end of the tremie tube shall remain submerged in the grout at all times.
3. Continue grout placement until grout is approximately 2 feet bgs.
4. Allow grout to cure for a minimum of 24 hours.
5. Fill the top 2 feet of the hole with cement

A16.1.6 Site Cleanup

1. Place all waste material generated, including broken concrete, well casing, filter pack, grout plug, etc., in drums or roll-off containers for disposal.
2. Place clean fill soil level with the existing ground surface in the borehole and post holes.
3. If the well is located in a paved area, place appropriate pavement and finish to match the surrounding pavement material.

A16.1.7 Documentation and Clean up

1. Inspect the site to ensure it has been returned to the condition prior to field work within 10 working days.
2. Photograph the site to document that site has been returned to the condition prior to field work.
3. Ensure proper disposal of waste materials.
4. Return well lock and identification tag to Installation personnel.
5. Record the date, start time, finish time, personnel present, drilling equipment, grout materials used, and environmental conditions in the field logbook.
6. Record initial depth measurements in field log.
7. Include a description of all procedures followed, including drilling, casing removal, and grout placement.
8. Include a description of the grout mixture and total volume placed.
9. Record cleanup procedures and any uncompleted work in the logbook.
10. Complete log entries, verify the accuracy of entries, and sign/initial all pages.
11. Drilling contractor to file well abandonment reports with the Texas Well Report Submission and Retrieval System maintained by the Texas Water Development Board.
12. Notify the TCEQ and USEPA of well abandonment, and provide them with the required documentation.
13. Submit copies of well abandonment reports in draft and final reports.

A16.2 References

Aller, L., et al. March 1991. *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.*

SOPs

American Water Works Association. 1984. *Appendix I: Abandonment of Test Holes, Partially Completed Wells, and Completed Wells.*

Driscoll, Fletcher G. 1986. *Groundwater and Wells.* Johnson Filtration Systems, Inc., St. Paul, Minnesota.

16 Texas Administrative Code 76.104. Technical Requirements – Standards for Capping and Plugging of Wells and Plugging Wells that Penetrate Injurious Water Zones, Effective April 1, 2018.

USEPA. 1975. *Manual of Water Well Construction Practices*. EPA-570/9-75-001.

USEPA, Region 4, Athens, Georgia. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).*

A17 CHLORIDE ANALYSIS USING TITRATION STRIPS

The purpose of this SOP is to establish guidelines and procedures for using Titration Strips (titrators) when recording quantitative concentrations of chloride in process water at the groundwater treatment plant (GWTP) located at the Longhorn Army Ammunition Plant (LHAAP) in Karnack, Texas. The procedures and equipment requirements contained in this SOP are subject to modification based upon project specific requirements and site conditions.

The procedures in this SOP have been modified from multiple guidance documents listed in the reference section to reflect the typical field conditions encountered at LHAAP. The procedures are subject to change if unusual or unanticipated field conditions are encountered; however, all deviations must be approved by one of the following: the LHAAP Technical Lead or the LHAAP Project Manager, before implementation.

Titrators are disposable devices for measuring chloride (sodium chloride [NaCl] or chloride [Cl-]) in aqueous solutions. Consult the manufacturer's Instruction Manual for testing requirements and calibration table conversions to ppm chloride ion.

A17.1 Procedures

Titrators consist of a thin, chemically inert plastic sheath. Laminated within the sheath is a strip impregnated with a reagent. When titrators are placed in a test solution, fluid rises up the titrator by capillary action. The reagent reacts with the chloride ion in the solution and produces a white column in the strip. The height of this column is proportional to the total chloride concentration. The results are read by observing the number on the strip where the column peaks and then using the accompanying calibration table to convert the reading to ppm chloride ion.

The approximate titration range is 0.0005% NaCl (30 ppm Cl) to 1.0% NaCl (6,000 ppm Cl). Normal dilution procedures allow testing to 10% NaCl (60,000 ppm Cl). Additional dilutions may be made to test higher levels.

A17.1.1 Preparation

Titrators should be stored in a dry storage area and replaced prior to the expiration date or every 2 years. Each titrator must be checked for damage or dampness prior to each reading. Damaged titrators shall be discarded to prevent future use.

A17.1.2 Process for the Use of Titrator

Procedures for using titrators are as follows:

- The sample to be tested will be collected from the sample valve located on TK-630.
- Fill the sample cup to the 60 mL mark.
- Conduct analysis within the Plant office in the testing area near the sink using a Hach kit.
- Remove a titrator from the bottle and replace the bottle's cap immediately.

- Insert the lower end of the titrator into the sample cup. Do not allow the yellow line located at the top of the titrator to become submerged in the water sample.
- Allow the water sample to saturate the wick of the titrator completely. Reaction is complete when the yellow string turns dark. This process will take 5 to 10 minutes.
- The strip will turn white based on the concentration level of chloride. Document where the tip of the white chloride peak falls on the numbered conversion scale. This represents the unit value.
  - Refer to the table on the strip bottle to convert into a chloride concentration and record results in the Plant logbook.
  - If the unit is below 1.0 milligrams per liter (mg/L), report the chloride concentration as <24 mg/L.
- Test strips may be disposed as general refuse.

NOTE: Filtration of the sample solution may be needed to prevent obstruction of the strip.

A17.1.3 Recording Results

The Plant logbook should be used to document the date, time, and location of each reading and should reference the model name of the strip being used.

Readings measured that are subsequently found to be outside of normal readings should be retested to obtain accurate and reliable data.

A18 WATER DEPTH AND VELOCITY MEASUREMENTS

The purpose of this SOP is to establish guidelines and procedures for using a velocity flow meter (i.e., Flo-Mate or similar) to measure the velocity and depth in a conductive liquid, such as water, at the LHAAP in Karnack, Texas. The procedures and equipment requirements contained in this SOP are subject to modification based upon project specific requirements and site conditions.

The procedures in this SOP have been modified from multiple guidance documents listed in the reference section to reflect the typical field conditions encountered at LHAAP. The procedures are subject to change if unusual or unanticipated field conditions are encountered; however, all deviations must be approved by one of the following: the LHAAP Technical Lead or the LHAAP Project Manager before implementation.

A18.1 Equipment and Materials

- Flo-Mate Velocity Meter (calibrate prior to use and record calibration data in logbook)
- Cable
- Weight Hanger
- Sliding Rod
- Depth Gauge
- Sensor Mount
- Weight
- Sensor
- Notebook or handheld tape recorder
- Instruction manual

A18.2 Procedures

The Flo-Mate uses an electromagnetic sensor to record velocity of liquid flowing in one direction and presents the data on a digital display in feet per second or meters per second. All instrument probes must be calibrated prior to being used to measure water depth and flow velocity. Calibration must be checked if any anomalous readings are obtained. Consult the manufacturer's Instructions manual for additional calibration requirements and procedures. Additionally, the staff plate condition should be noted each time measurements are collected and repairs/cleaning performed as necessary.

The procedures for using a Flo-Mate Velocity Meter to measure surface water velocity are described below:

- Transport the Flo-Mate Velocity Meter to Harrison Bayou.
- Record in the notebook or on the handheld recorder the date, time, weather conditions, and individuals conducting the activities.
- Slide the bulb sensor (wire side up) down the weight hanger (rod), which is located on the walkway of the bridge, to position the sensor approximately 1-foot above the end of the

rod. Tighten the set screw to securely fasten the sensor bulb to the weight hanger at the desired length.

- Lower the rod with sensor bulb into the water, beginning as close to the bank as possible. Ensure that the sensor bulb is facing upstream and then set at 60-percent (%) of the total depth. Take preventive measures to ensure personnel safety for the full duration of the work. Assess the edge of the river/creek bank for cohesive stability and slippery surfaces prior to any work being done.
- Allow the flow meter readings to stabilize on the meter, and document the readings in the field logbook after each consecutive reading.
- Repeat this procedure at 1-foot intervals from bank to bank and mark measurement increments from the bank across the bridge with number.
- Upon completion of the work, return the Flo-Mate Velocity Meter to the office.
- Complete calculations using field readings to determine creek flow.
- Collect 150 mL of sample water prior to discharge from TK-630 for sulfate and chloride test. An SOP is available for this testing procedure.
- Calculate the allowable discharge rate and set the discharge rate to be less than the allowable rate.

A18.2.1 Recording Results

The site logbook should be used to document the time, location, depth, and weather conditions of each reading, and should reference the model number of the specific flow meter being used.

Flow readings at the creek should be collected from bank to bank, in 1-foot increments at 60% of the total depth, and field data recorded into a task specific spreadsheet developed to calculate the average velocity in the water body being measured. Note that these calculations are estimates.

Instruments measuring readings that are subsequently confirmed to be outside of normal readings will be sent to the manufacturer for recalibration and/or repairs.

A18.3 References

TCEQ. 2012. *Surface Water Quality Procedures Manual, Vol. 1: Physical and Chemical Methods (RG-415)*.

A19 DISCHARGING TREATED GROUNDWATER INTO HARRISON BAYOU

The purpose of this SOP is to establish guidelines and procedures for data collection requirements prior to discharging treated groundwater into Harrison Bayou at the LHAAP in Karnack, Texas. The procedures and equipment requirements contained in this SOP are subject to modification based upon project specific requirements and site conditions. This SOP is compliant with the Protocol for Discharging GWTP Effluent that was finalized on August 28, 2017, with concurrence from the TCEQ and USEPA.

The procedures in this SOP have been modified from multiple guidance documents listed in the reference section to reflect the typical field conditions encountered at LHAAP. The procedures are subject to change if unusual or unanticipated field conditions are encountered; however, all deviations must be approved by one of the following: the LHAAP Technical Lead or the LHAAP Project Manager before implementation.

The premise of this work is the interim Record of Decision (ROD), which requires collection of the following data:

- Flow measurements in Harrison Bayou; and
- Sulfate and chloride concentrations in the treated groundwater.

A19.1 Procedures

The effluent concentrations (C_E) for chloride and sulfate are determined at the on-site laboratory and the allowable discharge rate (Q_E) is calculated for both chloride and sulfate and the smaller value is used. The steps are as follows:

- Collect a treated water sample from TK-560 tank.
- Measure the chloride concentration following SOP A17, Chloride Analysis Using Titration Strips.
- Measure the depth of water and measure flow velocity at 1-foot intervals from bank to bank in Harrison Bayou at a specified location (e.g., along the handrail location) following SOP A18, Water Depth and Velocity Measurements.
- Measure the sulfate concentration following SOP A20, Sulfate Analysis Using Hach DR 3900.
- Input water depth, velocity measurements, sulfate concentration, and chloride concentration into the interactive GWTP outfall calculation spreadsheet (maintained at the GWTP) to determine an estimate of allowable discharge flow rate of treated effluent.

The interim ROD provides the following information related to data collection:

SOPs

Note: Discharge limits for chloride and sulfate are to be based on discharge rates using the following formula:

$$C_C > \frac{Q_S C_A + Q_E C_E}{Q_E + Q_S}$$

Where:

C_A = Chloride/sulfate (ambient), 10,000 µg/L (value obtained from State of Texas Water Quality Inventory)

C_C = Chloride/sulfate criteria, 100,000 µg/L for chloride and 50,000 µg/L for sulfate (values obtained from State of Texas Water Quality Inventory)

C_E = Effluent Concentration (discharge limit) in µg/L

Q_E = Treated Groundwater Discharge Rate in cubic feet per second (cfs). The groundwater pumping and treatment rate shall be adjusted as necessary in order to meet the required effluent concentration C_E.

Q_S = Flow rate in the receiving stream, Harrison Bayou, in cfs. This flow rate shall be measured at a constant location no less than 100 feet upstream from the point of discharge of treated groundwater. Measurements will be taken daily in Harrison Bayou in accordance with Texas Natural Resource Conservation Commission's Water Quality Monitoring Manual, August 1994.

Example: For a discharge rate of 250,000 gallons per day, or 0.39 cfs, and a flow rate in the receiving stream of 4 cfs, the discharge limit for chloride would be:

$$100{,}000 = \frac{(4.0)(10{,}000) + (0.39)(CE)}{0.39 + 4.0}$$

C_E = 1,023,000 µg/L

Per the Protocol for Discharging to the GWTP Effluent dated August 28, 2017, the formula within the Interim ROD was solved to give the maximum effluent flow rate. Therefore, this formula will be used to determine the maximum effluent flow rate allowed and is presented as follows:

$$Q_E \leq \frac{Q_S (C_C - C_A)}{(C_E - C_C)}$$

Where:
Q_E = GWTP effluent flow
Q_S = Harrison Bayou flow (see SOP A18)
C_C = Criteria concentration (100 mg/L for chloride, 50 mg/L for sulfate)
C_A = Ambient concentration – 10 mg/L
C_E = Chloride or sulfate concentration in the GWTP effluent (see SOP A20)

The allowable GWTP effluent flow will be the lower of the calculated values, obtained from the measured concentrations of chloride and sulfate in the discharge stream. For each day that the GWTP effluent is discharge to Harrison Bayou, the measured Harrison Bayou flow, the allowable effluent flow, and the actual effluent flow are recorded.

A19.2 Recording Results

The GWTP outfall flow rate (in Harrison Bayou) is to be calculated for documentation that the discharge rate is acceptable. In addition, the effluent chloride and sulfate concentrations are to be recorded, including the sample ID, date, and time of sample collection.

Field data shall be recorded to calculate the average velocity in Harrison Bayou. As part of this calculation, the depth to the bottom of the stream bed cross section will be evaluated on an annual basis so that calculation adjustments can be made, if needed.

All field documentation shall be stored on-site for the minimum duration of 5 years.

A19.3 References

U.S. Army, August 28, 2017. *Protocol for Discharging GWTP Effluent Longhorn Army Ammunition Plant, Karnack, TX*.

TCEQ. 2012. *Surface Water Quality Procedures Manual, Vol. 1: Physical and Chemical Methods (RG-415)*.

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A20 SULFATE ANALYSIS USING HACH DR 3900

The purpose of this SOP is to establish guidelines and procedures for using the Hach DR 3900 (powder pillows test) instrument for sulfate analysis at the GWTP located at the LHAAP in Karnack, Texas. The procedures and equipment requirements contained in this SOP are subject to modification based upon project specific requirements and site conditions.

The procedures in this SOP have been modified from multiple guidance documents listed in the reference section to reflect the typical field conditions encountered at LHAAP. The procedures are subject to change if unusual or unanticipated field conditions are encountered; however, all deviations must be approved by one of the following: the LHAAP Technical Lead or the LHAAP Project Manager before implementation.

This procedure is equivalent to USEPA Method 375.4 for wastewater. Consult the manufacturer's Instruction Manual for testing requirements and troubleshooting instrument failures.

A20.1 Equipment and Materials

The user should read the entire SOP prior to unpacking, setting up, or operating this equipment. Below is a list of supplies and equipment used to calibrate and run samples for the determination of sulfate concentration in water:

- Reagent powder pillows
- Sample cells
- Sulfate standard solution 1,000 mg/L
- Seven 100 mL Class A volumetric flasks
- One 10 mL TenSette pipet and tips

The reagent powder pillows (SulfaVer 4) contain barium chloride. Refer to the Material Safety Data Sheet for safe handling and first aid precautions.

A20.2 Equipment Handling

Follow the below equipment handling procedures for proper instrument operation, and to ensure long service life:

- Place the instrument firmly on an even surface. Do not push any objects under the instrument.
- The ambient temperature must be 10 to 40 °C.
- The relative humidity should be less than 80 percent. Moisture should not condense on the instrument.
- Leave at least a 15 centimeter clearance at the top and on all sides for air circulation to avoid overheating of electrical parts.
- Do not operate or store the instrument in dusty, humid, or wet locations.

A20.3 Calibration

Calibration is recommended for the SulfaVer 4 method for the best accuracy. Complete the following steps to enter a new calibration curve in the instrument. Perform this procedure for each new lot of reagent.

1. Prepare seven calibration standards (10, 20, 30, 40, 50, 60, and 70 mg/L sulfate) as follows. Use the TenSette pipet to add 1, 2, 3, 4, 5, 6, and 7 mL of the 1,000 mg/L sulfate standard solution to seven different 100 mL Class A volumetric flasks.
2. Dilute each flask to the mark with de-ionized (DI) water, and mix thoroughly.
3. Use each standard solution in place of the sample and follow the SulfaVer 4 powder pillow procedure as noted below.

A20.4 Procedures

The Hach DR 3900 instrument is a visible spectrophotometer with a wavelength range of 320 to 1,100 nanometers (nm) and is used to analyze sulfate concentrations in liquid solutions. Below are the procedures for analyzing wastewater at the Longhorn GWTP using the Hach DR 3900. Each sample is analyzed at the Longhorn GWTP on-site laboratory.

A20.4.1 Prior to Test

- Prior to beginning a test, adjust the standard curve.
- Measure a reagent blank value for each new lot of reagent.
- Complete the test procedure and use DI water in place of a sample.
- Subtract the reagent blank value from the final results or complete a reagent blank, adjust.
- Filter samples that have large amounts of color or turbidity with a funnel and filter paper.

A20.4.2 Sample Testing

- Collect a water sample from the TK-650 effluent tank in a clean plastic or glass container. The sample needs to be at room temperature before analysis. If the sample cannot be tested, then it can be stored for up to 28 days at 4°C (39 degrees Fahrenheit [°F]) or below.
- Turn the DR 3900 on and select stored programs. Scroll down to program 680 Sulfate and push select.
- Remove the three SulfaVer 4 powder pillows from the Hach packet.
- Using the 5-mL pipette and glass beaker, dilute the sample 4:1 (e.g., 20 mL of DI water and 5-mL of sample).
- Using the 5 mL pipette, fill one 10-mL cell with 10 mL of DI water and one SulfaVer 4 powder pillow and shake well. Then fill the other two 10-mL cells with 10-mL of diluted sample and one SulfaVer 4 powder pillow per cell and shake well.
- Wipe all three cells clean with a paper towel.

- Insert the blank (DI water and powder pillow) into the instrument and press the timer and select 5 minutes.
- After the 5 minute timer is finished, press zero to zero the instrument.
- Remove the blank from instrument and insert the first sample and press read. Take the reading and multiply by 4 (to account for dilution of 4:1) and record the value in the site logbook.
- Remove the first sample cell from the instrument and insert the duplicate sample cell into the instrument and press read. Take that reading and multiply by 4 and record that number in the sample log.
- Rinse all three cells with DI water when finished.
- Turn the DR 3900 off.

A20.4.3 Recording Results

The site logbook should be used to document the date, time, sample ID, and steps taken for each reading and should reference the model name of the instrument used.

Sample measurements that are subsequently found to be outside of normal readings should be retested to obtain accurate and reliable data. If abnormal results are repeated, recalibrate the instrument and run the test again.

All field documentation shall be stored for the minimum duration of 5 years.

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A21 AIR SAMPLING

This SOP provides methods to be used for the monitoring and collection of air samples (ambient air or effluent gas) for the purpose of evaluating the ambient air concentrations and concentrations in the air stripper effluent air. The SOP specifically provides methods for air monitoring, ambient air sampling, and effluent gas sampling at the GWTP at Burning Ground Number 3, located at LHAAP in Karnack, Texas.

The effluent air sampling will be conducted consistent with the procedures described in the USEPA Environmental Response Team SOP #2008 entitled General Air Sampling Guidelines (1994) as well as air sampling best practices.

The procedures and equipment requirements contained in this SOP are subject to modification based upon project specific requirements and site conditions. The procedures in this SOP have been modified from multiple guidance documents listed in the reference section to reflect the typical field conditions encountered at LHAAP. The procedures are subject to change if unusual or unanticipated field conditions are encountered; however, all deviations must be approved by either the LHAAP Technical Lead or the LHAAP Project Manager before implementation. This information shall in turn be passed on to the Technical Manager prior to the acceptance of the change in SOP.

A21.1 Equipment and Supplies

- General equipment and supplies
    - Field notebook and field log forms
    - Chain of custody records
    - Sample labels
    - Custody seals
    - Tool box with hand tools
    - Monitoring instruments and sample canisters with appropriate fittings to connect to the effluent air stripper soil gas probe assembly when sampling
    - PID and calibration gas
    - Sample shipping containers and materials
    - A copy of the site-specific HASP
- Air Sampling Apparatus and Materials
    - Summa® canister – electropolished, evacuated, and wrapped for shipping
    - Connecting tubing - stainless steel tubing (straight and splitter) and valves
    - Shipping container – suitable for protection of canister during shipping
    - Wrenches and screw drivers of various sizes (clean and free of contaminants)
    - Negative pressure gauge (clean and free of contaminants) – typically installed on the canister to check canister pressure

A21.2 Procedures

The monitoring program includes the monitored constituents, meteorological monitoring, air monitoring and methods, and QA/QC. The contaminant of concern is VOCs; therefore, the monitoring program will focus on monitoring VOCs during groundwater treatment.

A21.2.1 Air Monitoring

Air monitoring of the sampling line and immediate vicinity may be conducted in order to evaluate the presence or absence of VOCs using a PID.

A PID screening procedure of the effluent line should be used to monitor for the presence of VOCs in the effluent line and/or surroundings prior to sampling.

Sampling equipment for PID screening include a PID (Mini-Rae 3000, 11.7-eV lamp) or equivalent for VOC monitoring. The PID should detect combustible organic compounds such as chlorinated VOCs. The detection limit for the PID is 0.1 ppm, with a range of 0 to 10,000 ppm. The PID should detect all organic compounds with an ionization potential below 11.7 eV; however, it cannot distinguish between one VOC and another (e.g., methylene chloride and benzene). The PID should be checked and calibrated according to the manufacturer's directions prior to use. An excerpt from the current February 2016 Mini-Rae User's Guide, outlining the two-point calibration procedure, is presented in Attachment A.

Standard procedures supplied from the manufacturer should be followed for PID screening. Data collected during monitoring events should be documented and evaluated in conjunction with information obtained from samples collected using Summa® canisters and analyzed by the laboratory.

A21.2.2 Effluent Air Sampling

Effluent air samples are collected from a sampling port located in the effluent line before the air is released into the atmosphere. Evacuated, polished, 6-liter Summa® canisters that meet all the requirements specified for USEPA Method TO-15/Selective Ion Monitoring (SIM) should be used to collect air samples.

A21.2.3 Collecting Samples Using Summa® Canisters

Clean sampling protocols must be followed at all times when handing and collecting samples. This requires care in the shipping, storage, and use of all sampling equipment. Personnel that perform the sampling must maintain appropriate cleanliness: no smoking, eating, or drinking; perfumes; or deodorants, and clean over garments are required (not dry cleaned).

Prior to the collection of air samples, the following parameters should be measured in the effluent line and recorded on the appropriate form: VOCs (using a PID).

The stagnant air present in the effluent line and the sampling train must be removed to ensure that the collected sample is representative of VOC concentrations in the effluent air. Information about the effluent line length and inner diameter should be used to calculate the "dead volume" of air in the effluent line. It is recommended to purge a minimum of three volumes of the effluent line. If the effluent line is under sufficient positive pressure, the line can be purged by opening the sampling port valve and allowing a free flow of air out of the effluent and sampling train lines. This is an acceptable procedure because the concentrations of VOCs are such that no explosive atmospheres would be created. Purge volume is typically determined to be sufficient when the PID reading in the purge line reaches an asymptotic steady concentration, indicating that the VOC concentrations in the purge line are the same as the VOC concentrations in the air stripper effluent. The maximum PID reading and the steady PID reading should be noted in the field logbook.

All connections, fittings, sampling port valve, etc., should be checked for physical integrity prior to purging. Visibly damaged equipment will not be used during sampling.

A21.2.4 Sampling System Leak Check

Leakage of atmospheric air into the sampling system during sampling can compromise sample integrity and dilute measured soil vapor hydrocarbon concentrations ("false negative") or allow the entrance of ambient air contaminants into the sampling system ("false positive").

The Summa® canister should be inspected for physical integrity prior use. Summa® canister vacuum pressure indicated on the laboratory's evacuation tag can be compared with measured vacuums to determine possible leakage during transportation. Canisters with potential leakage will not be used. The recommended vacuum pressure for air sampling using a Summa® canister ranges from -30 to -28 inches of mercury (Hg). If the pressure in the canister is less than -28 inches of Hg, it may be an indication the canister integrity has been compromised. The canister use should be discontinued. The canister ID, initial vacuum, and all other pertinent information related to the sampling effort will be recorded in the field notes.

A21.2.5 Sampling Procedures

Once the above listed topics have been addressed, and after making certain that all connections between the Summa® canister and all other portions of the sampling system are tight, the effluent air sampling will commence by opening the sampling port valve and the canister valve.

Air stack effluent air samples will be obtained by slowly opening the valve to evacuate canister vacuum and slowly bringing it to equilibrium with the source. A low flow rate of air from the effluent line to the canister is preferable to reduce the possibility of leakage of ambient air into the sampling equipment. A flow controller provided by the laboratory will maintain a uniform flow rate throughout the duration of the sampling. The vacuum pressure change on the canister gauge should be monitored several times during the course of the sampling period to ensure the canister is filling at the desired rate.

Ambient air samples at the GWTP and downwind are also collected using Summa® canisters. These canisters are laboratory-equipped with flow regulators to collect air samples over a defined period of time: 8-hour composite sample for the GWTP ambient air sample and 24-hour composite sample for the downwind ambient air sample. A flow controller provided by the laboratory will maintain a uniform flow rate throughout the duration of the sampling. The most common range of flow rates in mL/min for given time intervals is provided in the Table located in Section A21.4.

The sampling will be considered complete when the vacuum in the canister has decreased to -5 inches of Hg. After sampling is complete, all sample information should be written on the label supplied with the canister or affix a label on the canister label tag. Do not affix any labels to the canister body.

A21.3 Data Collection and Quality Control

Proper data collection and QC will ensure that data are representative, defensible, and readily accepted by all stakeholders. The analytical method chosen for the analysis, the use of replicate and other QC samples, and proper documentation of the air monitoring/sampling activities will ensure that data meet the expectations of all parties involved.

A21.3.1 Analytical Method

Unless otherwise specified in the project Work Plan, samples should be analyzed for VOCs by USEPA Method TO-15 or an equivalent method. The minimum detection limit for the analysis should be at least one part per billion (ppb) (1 to 7 micrograms per cubic meter depending on the molecular weight for each compound). All samples collected should be analyzed using an USEPA-certified laboratory.

A21.3.2 Leak Testing

Leakage of atmospheric air into the sampling equipment during sampling can compromise sample integrity and dilute measured soil vapor hydrocarbon concentrations, possibly to the point that the concentration is below the method detection level (i.e., a “false negative”). Contaminants in ambient air can also enter the sampling system and be detected in the sample from a non-contaminated sampling probe (i.e., a “false positive”). Air leakage can occur in the sampling system through loose fittings in the sampling equipment.

Ambient air sampling using Summa® canisters do not require leak testing because the sample collected is obtained directly from ambient air. Sampling the GWTP effluent stack air is conducting using an air sampling port which is slightly under positive pressure such that when the sampling port valve is opened, a release of air stack air occurs into the atmosphere. Before the sample is collected, the air sampling line is purged by allowing the stack air to flow through the sampling line. Purging is complete when the PID reading of the air sampling line reaches a steady state condition, representing the concentration of VOCs in the air stack effluent stream. When this condition is established, a Summa® canister sampling line is connected to the air stripper air effluent line to collect the air sample. The Summa® canister valve is then opened to collect the sample. Because the stripper air sampling line is under positive pressure, introduction of ambient air into the line or the Summa® canister is not possible.

A21.3.3 Quality Assurance/Quality Control

Unless otherwise specified in the project Work Plan, QA/QC samples should be collected to ensure that data is representative, defensible, and readily accepted by all parties. QA/QC samples should include: duplicate samples (one for every 10 samples) and method blanks (one for every 10 samples). No field blanks or trip blanks will be included in the QA/QC program.

Field duplicate samples should be collected at the site during sampling activities. Duplicate samples should be obtained each sampling day or event, or from a minimum of 10% of the samples obtained. A duplicate sample is obtained by use of a splitter affixed upgradient of the flow controller, with separate sampling tubes connected to two individual Summa® canisters. Due to use of the splitter and simultaneous filling of the canisters, the sampling time required to obtain a duplicate sample could be doubled.

All Summa® canisters shall be certified 100% clean by GC/mass spectrometer analysis by the laboratory before being used in the field. Certification of cleaning and evacuation should be noted by field personnel prior to collection of the samples. Site name, sample location, number, and date should be recorded on a chain of custody form and on a blank tag attached to the canister.

Once samples are collected they should be stored according to the method protocol (at ambient temperature) and delivered to the analytical laboratory as soon as possible. Samples should not exceed recommended holding times prior to being processed by the laboratory. Sample holding times for canisters is variable and may range from 72 hours (California Environmental Protection Agency [Cal EPA], 2003) to 14 days (USEPA, 1999). Laboratory procedures for sample accession and chain of custody should be followed.

A21.3.4 Recording Results

Calibration and inspection of equipment (e.g., PID) should be performed prior to the start of the monitoring/sampling events. All instrumentation should be operated in accordance with operating instructions as supplied by the manufacturer and laboratory, unless otherwise specified in the Work Plan. Equipment checkout and calibration activities must occur prior to site sampling and must be documented.

Field logbooks and/or log sheets and any other soil gas measurement documentation shall be placed in the project files and retained for at least 2 years following the data date.

A21.3.5 Health and Safety Considerations

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the Health and Safety Plan (HASP). Note that effluent air sampling typically requires Level D PPE unless there is a potential for airborne exposures to site contaminants. Section 9.f, Respiratory Protection and PPE Plan, of the HASP (Bhate, January 2018) presents the PPE and respiratory protection requirements.

Health and safety hazards include, but are not limited to, the following:

- Hazardous materials (exposure and/or release)
- High noise levels
- Eye hazards
- Air quality (i.e., chemical, dust, explosive conditions)
- Uneven walking/working surfaces and potential for trips and slips
- Pinch points
- Loose clothing

- Overhead hazards
- Hand hazards

A21.4 Flow Rate Table

The Summa® canisters that shall be used for air sampling will be 6 liter canisters.

Sampling Interval (hrs)	0.5	1	2	4	8	12	24
6 L Canister Flow Rate (mL/min)	167	83.3	41.7	20.8	11.5	7.6	3.5

A21.5 References

Cal EPA, 2003. *Advisory – Active Soil Gas Investigation*. Jointly issued by the Regional Water Quality Control Board, Los Angeles Region, and the Department of Toxic Substances Control.

RAE Systems, February 2016. *MiniRAE 3000 Users Guide, Revision F*.

USEPA, November 1994. *General Air Sampling Guideline.* SOP#: 2008, Revision 0.0. www.ert.org/products/2008.pdf. United States Environmental Protection Agency, Environmental Response Team.

USEPA, 1999. *Volatile Organic Compounds (VOCs) in Air (Ambient Air/Soil Vapor/Stack Gas) Samples Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry EPA Method TO-15 (January 1999)*. Table 1A. Summary of Holding Times and Preservation for Volatile Organic Compounds (VOCs) in Air.

A21.6 Attachments

A21.6.1 Calibration of MiniRAE 3000 Photoionization Detector

The calibration procedures are provided as an attachment in this SOP.

ATTACHMENT A21.6.1
CALIBRATION OF MINIRAE 3000 PHOTOIONIZATION DETECTOR

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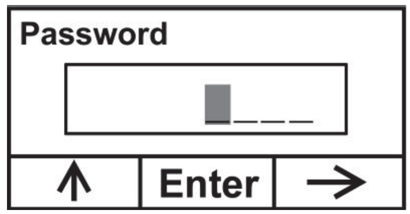
MiniRAE 3000
User's Guide

RAE SYSTEMS
by Honeywell

Rev. F
February 2016
P/N 059-4020-000

Entering Calibration

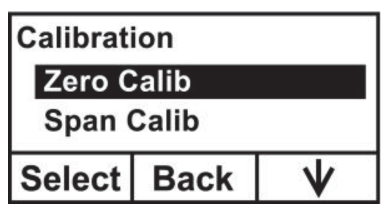
1. Press and hold [MODE] and [N/-] until you see the Password screen.



2. In Basic User Level, you do not need a password to perform calibrations. Instead of inputting a password, enter calibration by pressing [MODE].

   Note: If you inadvertently press [Y/+] and change any of the numbers, simply press [MODE] and you will be directed to the calibration menu.

The Calibration screen is now visible with Zero Calibration highlighted.



These are your options:

- Press [Y/+] to select the highlighted calibration (Zero Calib or Span Calib).
- Press [MODE] to exit calibration and return to the main display and resume measurement.
- Press [N/-] to toggle the highlighted calibration type.

Zero (Fresh Air) Calibration

This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the instrument to a "fresh" air source such as from a cylinder or Tedlar bag (optional accessory). The "fresh" air is clean, dry air without organic impurities and an oxygen value of 20.9%. If such an air cylinder is not available, any clean ambient air without detectable contaminants or a charcoal filter can be used.

At the Zero Calibration menu, you can proceed to perform a Zero calibration or bypass Zero calibration and perform a Span calibration. You may also go back to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.

If you have pressed [Y/+] to enter Zero calibration, then you will see this message:

Please apply zero gas...		
Start	**Quit**	

1. Turn on your Zero calibration gas.
2. Press [Y/+] to start calibration.

   Note: At this point, you may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu, highlighted for Span calibration.

3. Zero calibration starts a 30-second countdown and displays this message:

Zeroing...

During the zeroing process, the instrument performs the Zero calibration automatically and does not require any action on your part.

Note: To abort the zeroing process at any time and proceed to Span calibration, press [N/-] at any time while zeroing is being performed. You will see a confirmation message that says "Zero aborted!" and then the Span calibration menu appears.

When Zero calibration is complete, you see this message:

Zeroing is done!
Reading = 0.0 ppm

The instrument will then show the Calibration menu on its display, with Span Calib highlighted.

Span Calibration

This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:

C. Gas = Isobutene		
Span = 100 ppm		
Please apply gas 1...		
Start	Quit	

1. Turn on your span calibration gas.
2. Press [Y/+] to initiate calibration.

Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will abort the span calibration and take you directly to the Calibration menu for Zero calibration.

3. Span calibration starts and displays this message:

Calibrating...

During the Span calibration process, there is a 30-second countdown and the instrument performs the Span calibration automatically. It requires no actions on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu appears. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you see a message similar to this (the value is an example only):

Span 1 is done!
Reading = 100.0 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Two-Point Calibration In Basic User Level

When you are done performing calibrations, press [MODE], which corresponds with "Back" on the display. You will see the following message:

Updating settings…

The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

A22 INVESTIGATION DERIVED MATERIALS

The LHAAP is conducting investigation activities that generate potential waste materials. These potential waste materials typically consist of environmental media (drill cuttings, monitoring well purge water, and development water) and project-related trash (spent PPE and other inert materials such as plastic, rope, tape, paper, etc. that are generated during well installation and sampling activities and associated site activities. When accumulated, the waste materials must be managed to ensure compliance with applicable regulatory requirements.

A22.1 Initial Handling Requirements

Environmental media will be managed in an effort to minimize exposure to human health and the environment and in accordance with the USEPA Guidance (USEPA, April 1992). Typically, the media will be generated as a result of drilling soil test borings and constructing and sampling groundwater monitoring wells. In instances where soil test borings are advanced, either for the sole purpose of retrieving soil samples or to allow for the retrieval of a groundwater sample via a hydropunch or similar sampling device, including obtaining a sample from an open borehole, the following handling protocols for investigation-derived soil will be used:

- The soil cuttings will be placed adjacent to the borehole on plastic or other suitable material capable of precluding contact with the ground surface.
- The cuttings will be covered daily or during rainfall events to prevent contact with moisture.
- Upon completion of the downhole activity (i.e., drilling for subsurface soil sampling), the soil cuttings will be placed back into the borehole from which they were generated, if the borehole is 2 feet deep or less. If greater than 2 feet deep, the borehole will be filled with bentonite chips or slurry.
- Replaced cuttings will be compacted to the extent practical and a 1- by 1-foot by three inch thick grout cap will be placed over the top of the borehole to prevent vertical migration of surface water.

In cases where a soil test boring is advanced for the purposes of installing a groundwater monitoring well, the environmental media accumulated will be containerized to allow for characterization upon generation and situated at a designated staging area or near the point of generation. As solids are generated, they will first be placed into 55-gallon drums, or other approved containers including roll-off boxes, until they are sampled to determine if offsite disposal is necessary. Pending further characterization, solids may be bulked into larger approved containers situated within the work area. Liquids may be bulked upon generation unless directed otherwise.

After each container (i.e., drum, roll-off box, etc.) has been filled, the container and lid, if appropriate, will be labeled indicating a description of the media (i.e., soil, purge water, decon water, PPE), origin of media (i.e., sample identification such as boring or well), date the media was placed in the container, site identification (i.e., LHAAP-##), date container was sealed and sampled, and any other pertinent information (i.e., hazardous versus nonhazardous). The containers may be labeled using a paint pen or other indelible marker that will not fade when exposed to weather. A record of the number of containers and their contents will be completed at each generation site and will be included in the logbook before leaving each site.

At the end of each day and/or field activity, the containers will be sealed or covered in such a way to prevent the introduction of rain water or surface run-off.

A centralized staging area will be assigned for each site prior to initiation of any site work. Unless directed otherwise, the staging area will be located within the boundaries of the site where field work will take place. The containers will be moved from their original filling location to the staging area within 5 days of filling. In the event that conditions indicate the potential for reactive wastes, special handling and storage precautions will be utilized. The integrity of containers will be monitored weekly. Waste may be transported between sites when required or in preparation for disposal activities.

A22.2 Characterization of Environmental Media

The characterization of environmental media will be determined by a two-step process.

First, the materials will be characterized using analytical data obtained during the activity from which the materials were generated previously. As stated, it is anticipated that specific generation activities will include soil test borings, monitoring well installations, and monitoring well purge and development actions. Water obtained from specific monitoring well sampling points (i.e., purge and development water) will be characterized using groundwater sampling data taken from the specific well site from which the water was obtained. Analytical data obtained from a particular borehole reflecting soil contaminant levels will be used to characterize solids generated from that borehole. Other solids such as rock and other environmental media generated during field activities will be evaluated based on the analytical results of the soil and water sampled at the specific location where the solids were generated. Analytical results from both soils and water will be used to characterize decon water. When appropriate, analytical data will be extrapolated to reflect toxicity characteristic leaching procedure (TCLP) values if the material is 100% solids (i.e., 20x divisor rule for soils per Section 1.2 of the Method 1311 TCLP). Generator's knowledge may be used to evaluate the media potential for corrosivity, ignitability, and reactivity.

Second, if analytical results indicate contaminant levels below 75 percent of TCLP values, no additional analytical testing will be performed, and the media will be considered nonhazardous. When analytical results indicate that elevated contaminant levels (i.e., more than 75 percent of TCLP) are present, additional TCLP analyses will be performed. If previous analytical data are not available, samples will be collected and analyzed for site contaminants of concern (COCs). If soil COCs are not available for a site or drilling activity for monitoring well installation occurs outside the site boundary, groundwater COCs may be adopted for use as COCs for drill cuttings. Analytical results from the soil samples will be handled using the 20x rule. Composite samples will be taken for each type of media generated (i.e., soil, water) and for each specific generation location (i.e., monitoring well, soil boring, etc.). Samples will be taken directly from the containers. Where multiple numbers of containers are generated for a particular media and generation site, the samples will be taken to ensure that the volume of soil from which one composite sample is prepared is equivalent to no more than the volume contained by 20, 55-gallon drums. Generator knowledge may be used to minimize the volume of analytical tests required to adequately characterize the media. Hazardous versus nonhazardous determinations will be made utilizing those parameters outlined in the Texas Administrative Code and/or 40 Code of Federal Regulations, Part 261. All sampling and analytical testing protocols will be consistent with TCEQ/USEPA requirements and methodologies.

A22.3 Management and Disposition

U.S. Department of Transportation approved labels will be used if transportation outside of LHAAP boundaries is required or anticipated. Waste materials may also be bulked on site (within the staging area), with like waste streams possessing compatible non-reacting characteristics. Hazardous and nonhazardous materials will be segregated. In addition, liquids and solids will be separated.

A22.4 Wastewater

Wastewater containing contaminants treatable at the GWTP (VOCs, metals, and perchlorate) will be transported and treated at LHAAP's GWTP. Wastewater containing contaminants not treatable at the GWTP will be disposed offsite after proper characterization.

A22.5 Nonhazardous Solids

Soil cuttings and rock will be staged within the confines of the site from which they were generated. After offsite laboratory analyses are finalized and depending upon site conditions, cuttings determined to be nonhazardous will be removed from containers and replaced "at or near" the location from which they were derived. "At or near" infers a media will be placed as near to its point of origin as is practical. Examples would be placing monitoring well cuttings around the monitoring well from which they originated as opposed to within it. However, when not practical, the media may be centrally located within the confines of the originating site in an area of minimal traffic and where the media could be managed in a manner protective of human health and the environment.

A22.6 Hazardous Solids

For management and disposition purposes, the hazardous solids will be broken into two major categories: those exhibiting hazardous characteristics and those containing listed hazardous waste.

Solids exhibiting hazardous characteristics or that contain a listed hazardous waste will be stored upon generation "at or near" the point of generation within the site of origin or bulked in anticipation of disposal activities at a centralized location at LHAAP. Secondary containment will not be required for the storage of hazardous solids as long as the containers are secure and monitored routinely for releases.

The disposition of solids possessing hazardous characteristics will be determined on a case-by-case basis depending on specific contaminants, concentrations, and site conditions.

In the event that on site treatment of hazardous solids is not available, the media will be disposed off-site in accordance with state and federal requirements in a permitted disposal facility, as required.

A22.7 Trash

Trash includes nonhazardous solids such as spent PPE, plastic sheeting, rope, and unused monitoring well construction materials generated during field activities. These materials will be placed into dumpsters or roll-offs for disposal at a permitted solid waste disposal facility.

A22.8 References

USEPA, April 1992, *Guide to Management of Investigative-Derived Wastes*, Office of Solid Waste and Emergency Response, Publication 9345.3-03FS.

USEPA, December 28, 1992, *Management of Contaminated Media*, Region IV EPA, Guidance Number TSC-92-02.

USEPA, 1991, *Management of lnvestigative-Derived Wastes During Site Inspections*, Office of Research and Development, Publication, EPA/540/G-91/009, May 1991.

APPENDIX B

HEALTH AND SAFETY PLAN

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FINAL
HEALTH AND SAFETY PLAN
FOR LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

May 2018

Prepared For:

ON THE LINE

Longhorn Army Ammunition Plant
Karnack, Texas

Under Contract To:

U.S. Army Corps of Engineers
Tulsa District
Tulsa, Oklahoma

Contract Number: W9128F-13-D-0012
Task Order Number: W912BV17F0150

Prepared By:

bhate
ENVIRONMENT &
INFRASTRUCTURE

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Attachments

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LIST OF ACRONYMS

§	Section
ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
APTIM	APTIM Federal Services, LLC
BBP	Blood Borne Pathogen
Bhate	Bhate Environmental Associates, Inc.
°C	Degrees Celsius
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
COR	Contracting Officer's Representative
CP	Competent Person
CPEA	Certified Professional Environmental Auditor
CPR	Cardiopulmonary Resuscitation
CSP	Certified Safety Professional
DPT	Direct Push Technology (Geoprobe)
EM	Engineering Manual
EMR	Experience Modification Rate
°F	Degrees Fahrenheit
ft^2	Square feet
GFCI	Ground fault circuit interrupter
GWTP	Groundwater treatment plant
HASP	Health and Safety Plan
HAZCOM-GHS	Hazard Communication-Global Harmonization System
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEC	Hazardous Energy Control
HSM	Health and Safety Manager
IWWP	Installation-Wide Work Plan
LHAAP	Longhorn Army Ammunition Plant
MHS	Masters of Health Sciences
MSDS	Material Safety Data Sheet
NFPA	National Fire Protection Association

NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PBR	Performance-Based Remediation
PE	Professional Engineer
PFAS	Personal fall arrest system
PPE	Personal protective equipment
QP	Qualified Person
REM	Registered Environmental Manager
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SPF	Sun protection factor
SSHO	Site Safety and Health Officer
TLV	Threshold Limit Value
TNT	2,4,6-Trinitrotoluene
U.S.	United States
USACE	U.S. Army Corp of Engineers
USFWS	U.S. Fish and Wildlife Service

1 SIGNATURE SHEET

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

COMMITMENT TO IMPLEMENT THIS HEALTH AND SAFETY PLAN/ACCIDENT PREVENTION PLAN		
Health and Safety Manager: Sally S. Smith, CIH, CSP, CHMM, CPEA *Bhate Director of Health and Safety* 205-918-4022 Office 205-983-4150 Cell	Sally S. Smith Signature	5/15/18 Date
Program Manager: Frank Gardner, P.G. 720-463-3903 Office 303-386-6454 Cell	Signature	5/16/18 Date
Project Manager: Kim Nemmers, P.E. 720-463-3909 Office 303-550-9239 Cell	Signature	5/16/18 Date
Site Safety and Health Officer: Scott Beesinger 903-679-3448 Office 903-930-6193 Cell	Scott Beesinger Signature	5/15/18 Date

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2 PROJECT BACKGROUND AND SCOPE

This Health and Safety Plan (HASP) is the document that defines the health and safety requirements for field activities to be conducted at the site. This document is required by the U.S. Army Corps of Engineers (USACE) *Safety and Health Requirements Manual*, Engineering Manual (EM) 385-1-1 (2014), and addresses applicable requirements of Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) Parts 1910 and 1926, and the *Bhate Corporate Health and Safety Plan* (Corporate HASP). All Bhate personnel and subcontractor personnel working at the site will be briefed on the information contained in this HASP and will follow the procedures established within this HASP.

This HASP, which conforms to the USACE Safety Manual EM 385-1-1 (2014) Accident Prevention Plan (APP) Outline, provides health and safety requirements applicable to the site-specific field operations. All activities performed by Bhate and their subcontractors at the site will be conducted in accordance with this HASP.

2.a Contractor

Bhate Environmental Associates, Inc. (Bhate) has been retained by the USACE, Tulsa District, in Tulsa, Oklahoma, under W9128F-13-D-0012 Task Order W912BV17F0150, to perform remediation activities at multiple sites at the Longhorn Army Ammunition Plant (LHAAP), hereafter referred to as the “Installation”. This Task Order is specifically to execute performance based environmental remediation activities at LHAAP in Karnack, Texas in order to achieve performance objectives to support progress toward Site Closeout or Response Complete, as applicable, at 14 Installation Restoration Program sites and two Military Munitions Response Program sites. This HASP conforms to the USACE Safety Manual EM385-1-1 (2014) and provides the health and safety policies and procedures that will be used during execution of the awarded Scope of Work.

2.b Contract Number

The contract number is W9128F-13-D-0012, Task Order W912BV17F0150.

2.c Project Name

The project name is Performance-Based Remediation (PBR) at LHAAP.

2.d Project Description and Background

The 8,416-acre LHAAP installation is located in central-east Texas between State Highway 43 and Caddo Lake in Karnack, Harrison County, Texas, approximately 14 miles northeast of Marshall, Texas, and approximately 40 miles northwest of Shreveport, Louisiana. The site is in a rural area and operated from 1942 to 1997, historically manufacturing 2,4,6-trinitrotoluene (TNT), rocket motors, and various pyrotechnic items. LHAAP is an inactive, government-owned, formerly contractor-operated and maintained Department of Defense facility. Extensive demolition and salvaging of materials has occurred at LHAAP, but there are still portions of buildings remaining. The entire installation was under the control of the United States Department of the Army (U.S. Army) until May 5, 2004, when approximately two thirds of the property was transferred to the U.S. Fish and Wildlife Service (USFWS). Additional property has been transferred to the USFWS since then and the property transfer process will continue as remediation and characterization activities are completed at additional sites. The U.S. Army Environmental Center has the responsibility for the environmental restoration activities at LHAAP, with the management of the U.S. Army's property provided by the Base Realignment and Closure Office.

The groundwater, surface water, sediment, and soil at LHAAP have been contaminated by past operations. Studies conducted at LHAAP identified contaminants such as Volatile Organic Compounds, heavy metals, perchlorate, and explosives in on-site media. Several areas of contamination are subject to investigation and cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S. Code 9604).

2.d.1 Tasks Requiring AHAs

Activity Hazard Analyses (AHAs) identify potential safety, health, and environmental hazards, and provide for the protection of personnel, the community, and the environment. Because conditions may be constantly changing during the course of a project, supervisors must be aware of conditions that may harm site personnel, the community, or the environment. The Project Manager and Site Safety and Health Officer (SSHO) must monitor these changing conditions and discuss them with the Corporate Health and Safety Manager (HSM). The HSM will write or approve addenda to modify the AHAs. AHAs are provided in **Attachment 1** of this HASP.

The PBR Task Order includes operations and maintenance of the groundwater treatment plant (GWTP) as well as planned remediation activities at LHAAP's various sites. The following list includes the primary common tasks that are described in the Installation-Wide Work Plan (IWWP) and for which AHAs have been developed.

- Task 1 Monitoring Well/Compliance Well Installation
- Task 2 Surveying
- Task 3 Groundwater Sampling
- Task 4 Soil Sampling
- Task 5 Surface Water/Sediment Sampling
- Task 6 Investigation-Derived Waste Management
- Task 7 Soil Excavation and Disposal
- Task 8 Well Abandonment
- Task 9 GWTP Operation and Maintenance

The Bhate Project Manager will not allow fieldwork to begin at the site until this HASP has been accepted by the USACE and reviewed with all field personnel in the safety orientation session. Before work area entry, all Bhate personnel will attend a site-specific briefing session, to be conducted by the SSHO, on the potential site hazards and specific requirements of this HASP.

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3 CORPORATE HEALTH AND SAFETY POLICY STATEMENT

3.a Safety and Health Expectations, Incentive Programs, and Compliance

As stated in Bhate's Corporate Health and Policy Statement, "Bhate management is committed to achieving positive health and safety results while maintaining high standards for production and quality. Protection of personnel, controlling liability, managing risk, and compliance with applicable federal, State, and local regulations are project responsibilities. In order to succeed at the goals of the Corporate Health and Safety Policy Statement, Bhate has developed this HASP and Bhate's Corporate HASP, which will provide employees with health and safety policies, an overview of programs, and Standard Operating Procedures (SOPs) to promote consistency and uniformity throughout all of Bhate's operations."

For this project, as well as any project Bhate conducts, the goal is zero incidents. By achieving zero incidents, Bhate ensures that there will be no work related injury or illnesses, spills resulting in deleterious effects to the environment, or cases of property damage. Zero incidents are achieved through proper work planning, personnel tasking, and proper execution of the work. A safety incentive program will not be implemented for this project. It is expected that each Bhate employee will be accountable for their actions and responsible for fulfilling their duties in a safe manner. Bhate will refer to their Disciplinary Action for Personnel Safety Violations procedure to enforce non-compliance with safety directions, as needed.

The Safety and Health Forms that may be used for this project are included in **Attachment 2**.

3.b Safety Commitment - Corporate Health and Safety Policy Statement

Bhate is committed to achieving positive health and safety results while maintaining high standards for production and quality. Bhate believes in protecting the health and safety of our employees, clients, and community members impacted by our work. Bhate believes all jobs are important and proper planning is critical to the safe execution of work.

In order to achieve our goals of zero incidents and providing quality services, our work activities are guided by the following:

- The Bhate Principals will provide a safe workplace for their employees with safe work methods and adequate technical resources.
- Health and safety must be an integral part of Bhate's business operations; and therefore, must be an equal priority in every business decision and operation.
- Every job can and will be done safely.

- The safety of the employee will not be endangered to meet the requirements of production, service, or quality.
- All employees have a responsibility to comply with the health and safety policies, procedures, and work practices, which may constitute a condition of employment.

Every Bhate employee is accountable for their actions and is responsible for fulfilling their duties in a safe manner.

3.c Project Safety Coordination

The health and safety requirements described in this HASP will apply to all field activities conducted at the site. Bhate will be responsible for overall health and safety of project employees. Bhate will enforce the requirements of this HASP for site personnel. Bhate's subcontractors will be required to comply with the requirements of this HASP. Subcontractors will also be responsible for site safety related to, or affected by, their operations. If any subcontractor activities are not listed in the hazard identification and control section of this HASP, then an addendum describing those hazards and controls will be prepared by the subcontractor and reviewed by Bhate.

A fully trained and experienced SSHO, or approved alternate, will be continually on site during field activities to implement and enforce the health and safety procedures outlined in this HASP. The Bhate HSM will be responsible for the development, implementation, and oversight of the project health and safety program as presented in this HASP.

Before work area entry, all site personnel and visitors must attend a site-specific safety and health briefing session, to be conducted by the SSHO. The briefing will cover potential site hazards and specific requirements of this HASP. The SSHO will also conduct daily safety briefings with all on-site personnel to cover planned activities with associated hazards and controls required.

The overall responsibility for the health and safety of all project personnel lies with the Project Manager. If there is any question whether an unplanned occurrence on site may compromise health and safety, the SSHO has the authority to interrupt operations and to remove all personnel from the area. If work is stopped due to any health or safety concern, immediate attention will be given by health and safety personnel, working in cooperation with the Project Manager, to identify and correct the cause of concern as quickly as possible. Any such incident will be fully documented by the SSHO in a report to the HSM and Project Manager.

For emergency developments on the site, communications begin with the SSHO. The SSHO will report all safety and/or health related incidents to the HSM and the Project Manager. The SSHO will contact others if additional assistance is needed.

4 RESPONSIBILITIES AND LINES OF AUTHORITY

4.a Statement of Ultimate Responsibility

Bhate is ultimately responsible for the implementation of its Safety and Occupational Health Program and this HASP. Adherence to USACE EM 385-1-1 (2014) will be maintained.

Bhate has maintained an average Total Recordable Case Frequency Rate of 0.23 over the past 5 years. Over the last 3 years, Bhate's Experience Modification Rate (EMR) has not exceeded 0.80, which is below our industry's average. **Attachment 3** contains Bhate's OSHA 300A Annual Summaries for Reporting Years 2014, 2015, and 2016 and EMR Letter dated March 9, 2017.

4.b Responsible Personnel

Table 4-1 summarizes the operational and health and safety responsibilities of key persons. The project team members have safety and health-related responsibilities for the activities covered by this HASP. The SSHO (and alternate) are required to have a 30-hour Construction Safety Training certificate.

Table 4-1. Project Team Members with Project Health and Safety Responsibilities

Title	Name	Telephone
Corporate Health and Safety Manager	Sally S. Smith, MHS, CIH, CSP, CHMM, CPEA	(205) 918-4022 (205) 983-4150 cell
Project Manager	Kimberly Nemmers, PE	(303) 550-9239
Site Supervisor/SSHO	Scott Beesinger	(903) 930-6193
Sampler and GWTP Operator	Ken Moore	(315) 464-9976
Remediation Subcontractor – APTIM Federal Services, LLC Health, Safety, and Environmental Manager II	David L. Mummert, CIH	(419) 429-5509 (419) 348-1544 cell
Notes: MHS – Masters of Health Sciences, CIH – Certified Industrial Hygienist, CSP – Certified Safety Professional, CHMM – Certified Hazardous Materials Manager, CPEA - Certified Professional Environmental Auditor, PE – Professional Engineer		

4.c Competent Personnel

In accordance with EM-385 01.A.14.b.3, the names of the Competent Person(s) (CP) and Qualified Person(s) (QP) required for a particular activity (e.g., excavation, electrical work, fall protection, or other activities as specified by OSHA and EM-385 are identified in **Table 4-2** and **Attachment 4** of this HASP. Copies of certificates are kept on file at the GWTP and with the HSM.

4.d Presence of Competent Personnel

No work requiring an OSHA CP will be conducted on site unless a designated OSHA CP for the specific task being performed is present.

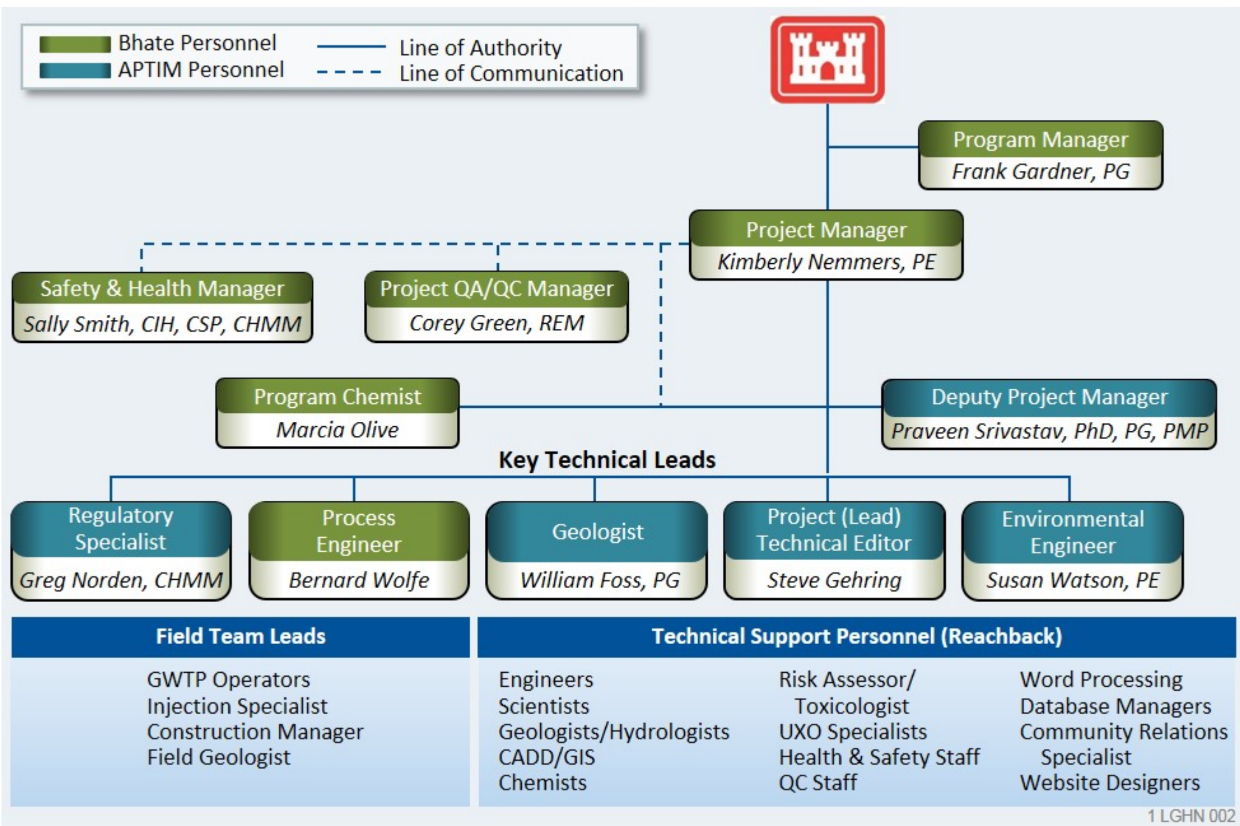
4.e Pre-task Safety and Health Analysis

The SSHO will review the requirements for pre-task safety and health analysis as documented in the AHAs with the employees and the subcontractors' employees during each preparatory meeting.

4.f Lines of Authority

The lines of authority are illustrated in the organization chart below.

Figure 4-1. Organization Chart



4.f.1 Health and Safety Manager

The HSM, a CIH, will assist with the development, implementation, and oversight of Bhate's Corporate HASP and this HASP. This HASP will be reviewed and signed and dated by the HSM prior to initiation of field activities.

The HSM maintains records of personnel training and certifications and is the first point of contact with Bhate Corporate Management in the event of an accident or incident at the site.

4.f.2 Site Safety and Health Officer

The SSHO will be on site at all times while work is in progress. The SSHO will functionally report to the Project Manager, with secondary reporting requirements to the Bhate HSM. The SSHO has delegated authority from the HSM and respective corporate management to stop work and enforce this HASP.

The SSHO is responsible for all aspects of site health and safety. He has the authority and responsibility for stopping site work should activities jeopardize the health and safety of workers or the public. If practical, the Project Manager and HSM should be consulted before any operation is interrupted. Additional responsibilities of the SSHO include:

- Provide site orientation safety training for all personnel actively involved in project field work.
- Conduct daily safety briefings.
- Inspect health and safety equipment daily.
- Select protective equipment and clothing in accordance with this HASP.
- Confirm worker's suitability for performance of activities.
- Coordinate the project safety and health program with the USACE.
- Monitor workers for adverse effects of hazardous contaminants.
- Inspect the work areas to ensure compliance with the safety and health requirements for the tasks to be completed and identify hazards.
- Coordinate medical care, as needed.
- Maintain daily exposure data (i.e., man-hours worked, documentation of incidents/injuries).
- Enforce the requirements of this HASP.

The SSHO will take the following action(s), as appropriate, and in accordance with this HASP:

- Report all safety and/or health related incidents to the HSM and the Bhate Project Manager;
- Order the immediate shut-down of field activities in case of medical emergency or unsafe practice; and

- Restrict visitors from areas of potential exposure to harmful substances or hazardous conditions.

The SSHO will maintain a log or binders to document all activities related to safety and health. The log or binders will include daily safety meeting topics, training given, inspection results, first aid administered, visits of outside personnel, environmental monitoring, and documentation of all activities or incidents of a health and safety nature.

4.f.3 Project Manager

The Project Manager is the senior Bhate representative for the project. The Project Manager reports directly to Bhate corporate management and site contacts. The Project Manager is committed to the overall success of the project, including performance of all site work in accordance with this HASP. The Project Manager is responsible for the preparation, organization, and review of the HASP and is responsible for the selection, assignment, and conduct of site personnel. The Project Manager coordinates field activities with appropriate site contacts, serves as liaison with the facility, and coordinates preparation of the project deliverables. The Project Manager has overall responsibility for the health and safety of Bhate personnel and Bhate subcontractors working on site. The Site Supervisor implements the approved project IWWP at the Installation as designated by the Project Manager.

4.g Noncompliance

All Bhate personnel are required to comply with designated health and safety procedures as defined in the Bhate Corporate HASP procedures, and/or specific project requirements. All field personnel are required to comply with this HASP and its Attachments. Failure to comply with safety rules and procedures will result in disciplinary action.

Disciplinary action for safety violations will follow a three-step process:

- Initial violation – a verbal warning is issued indicating the infraction, explanation of the possible outcomes of the infraction, and steps to prevent recurrence.
- Second violation – a written reprimand is issued and entered into the employee's personnel file.
- Third violation – employee is terminated and documentation of the infraction and reason for termination is included in the personnel file.

During each step of the process, the employee will be informed of the successive step in the disciplinary action procedure. Additionally, at each step of the procedure the employee will receive retraining at their supervisor's discretion.

Some discretion is permitted in the procedure. In some instances, infractions can be different violations with similar principles. For example, failure to wear proper personal protective equipment (PPE) on one day and failure to use a seatbelt in a vehicle another day. Both of these infractions can be characterized as a failure to follow procedure.

If disputes arise in the administration of a disciplinary action for a safety violation, a Principal will render a final decision.

Some situations, due to the severity of the violation may warrant immediate suspension and/or termination, including but not limited to:

- Willful violation of the HASP, procedures, and/or specific project requirements permitting an imminent danger situation.
- Withholding chemical information regarding a project and allowing personnel to work in such scenarios.
- Working continuously under suspended loads.
- Failure to use appropriate fall protection when required.
- Working in confined spaces without following the appropriate entry procedures.

As noted previously, discretion is permitted in implementing this procedure.

All disciplinary action is to be instituted upon witnessing and/or being informed of the infraction. The employee is to be reviewed and held accountable relative to bonuses, raises, and/or promotions during their annual review. The employee will be evaluated for improvement during the employee's subsequent annual review at which time written reprimands will be removed from the personnel file.

4.h Manager and Supervisor Accountability

Bhate management (Program Managers and Project Managers) ensure that all company activities are executed in accordance with the Bhate Corporate HASP, procedures, and applicable regulations. Their annual performance evaluation includes elements of safety conformance and implementation of the Bhate Corporate HASP and field HASPs.

The Site Supervisor has the responsibility to integrate loss control principles into all operations and to ensure that:

- All projects are implemented in compliance with all applicable health and safety laws, regulations, and program requirements.
- HASPs are developed, approved, and implemented in accordance with Bhate requirements. For projects that do not require a HASP, the requirements of the Bhate Corporate HASP shall be enforced.
- Bhate personnel and subcontractors (as applicable) understand the requirements of the project HASPs and each individual understands his/her responsibility for plan implementation.
- Personnel have all required training and are capable of performing all assigned tasks.

- Facilities and equipment meet Bhate expectations and government regulations.
- Work rules are enforced.
- Inspections and incident investigations are conducted per program requirements.
- Effective corrective actions are implemented in a timely manner following inspections, audits, incident investigations, etc.
- Clients are notified using Bhate incident reporting procedures.
- Appropriate disciplinary action is implemented when necessary.
- Promptly address safety problems or issues that employees bring to their attention and involve technical resource personnel as necessary.
- Provide positive feedback (either verbal or written) to employees who exhibit safe behaviors.

When unsafe behaviors are noticed, managers should:

- Stop work immediately.
- Discuss the behavior with the employee(s), including the possible consequences of such unsafe behavior.
- Document the observations and results of the discussion with the employee for inclusion in the project and/or personnel files.
- Report the behavior should it result in an incident and investigate the root cause in accordance with the Incident Reporting and Investigation Procedure.
- Instruct employees on appropriate safe behaviors.
- When necessary, schedule retraining for employees who appear unfamiliar with safety procedures. Training may be conducted by the manager, qualified peer employees, or other resources as necessary.

5 SUBCONTRACTORS AND SUPPLIERS

5.a Subcontractor Coordination/Control

The anticipated subcontractor(s) and their responsibilities on the Bhate team will include:

- Remediation subcontractor – APTIM Federal Services, LLC (APTIM)
- Laboratory for analysis of air, soil, groundwater, and surface water samples
- Waste transportation of investigation-derived waste and filter press cake from GWTP

5.b Safety Responsibilities for Subcontractors

Bhate will be responsible for the overall health and safety of both contractor and subcontractor(s) employees used for field activities. Bhate will enforce the requirements of this HASP for project personnel. Bhate's subcontractor(s) will be required to comply with the requirements of this HASP, the OSHA standards contained in Title 29 of CFR Parts 1910 and 1926 and EM 385-1-1 (2014), when applicable. The subcontractor(s) will also be responsible for site safety related to, or affected by, their operations and actions.

Each subcontractor employee is responsible for his own safety as well as the safety of those around him. Employees will use all equipment provided in a safe and responsible manner as directed by the SSHO. When an activity requires an OSHA CP to be present (e.g., scaffolding, trenching, excavation, etc.), the task will not be performed until the designated competent person(s) is present at the location of the activity.

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6 TRAINING

6.a Safety Indoctrination

Training for all site personnel will be consistent with requirements in 29 CFR Parts 1926 and 1910, and EM 385-1-1 (2014), when applicable. Site-specific training concerning site hazards, general health and safety procedures, and the contents of the HASP and the AHAs will be performed by the SSHO for all Bhate onsite project personnel and subcontractor employees before field work can commence. This will consist of a review of the specific hazards of concern, risks, symptoms of exposure, and an overview of the HASP to include safety procedures and emergency contacts. The relevant AHAs will be covered in a safety meeting as each phase of work commences.

6.b Training Requirements

All personnel performing supervisory duties should have received appropriate OSHA and USACE safety training. Required worker training is indicated in **Table 6-1**.

Table 6-1. Required Worker Training and Site-Specific Training

Required Worker Training	Site-specific Training Requirements
OSHA Hazard Communication-Global Harmonization System (HAZCOM-GHS) training (all workers on site) OSHA 30-hour for Construction – SSHO only 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Training and current 8-hour Refresher – Both GWTP operators (they are also the air, soil, groundwater, and surface water samplers) First Aid/Cardiopulmonary Resuscitation (CPR)/Bloodborne Pathogens (BBPs) – SSHO and the GWTP operator. Competent Person - Electrical – Designated Subcontractor, as needed Competent Person – Confined Space Entry Monitoring -Designated Subcontractor, as needed	All personnel working on site shall attend site-specific orientation/ training prior to starting on site project work. This training will be facilitated by the SSHO, as needed. The site-specific orientation/training will provide at a minimum an overview of the project, anticipated hazards, control measures, and emergency response procedures as explained in this HASP.

All on-site personnel (including supervisors) will attend tailgate safety briefings each morning prior to beginning fieldwork. The daily safety meetings will be facilitated by the SSHO. Employees will be instructed on the requirements of the HASP and any additional safety or health concerns and discuss the proposed activities scheduled for the day. Any employee not present at the scheduled daily safety meeting shall be thoroughly briefed by the SSHO prior to starting work for the day.

Special emphasis will be placed on potential inclement weather conditions and emergency procedures to follow in the event of an accident or illness. A thorough review of the potential hazards, the protective measures to be taken to avoid those hazards, the proper use of any PPE to be used, and the contents of the HASP will be conducted.

Attendance at daily safety briefings, any site-specific training, and an employee endorsement of the provisions of the HASP will be maintained by the SSHO.

6.c Periodic Training

In addition to the training required in **Table 6-1** and the daily safety meeting, periodic training will be given by the SSHO when there is a need to promptly address safety problems or issues that employees bring to their attention, or discovered during site walk-around inspections. When necessary, the SSHO will schedule retraining for employees who appear unfamiliar with safety procedures. Training may be conducted by the manager, qualified peer employees, or other resources as necessary. Periodic training would occur when effective corrective actions are implemented in a timely manner following inspections, audits, incident investigations, etc.

The corporate health and safety program requires continuous improvement for supervisors and employees and encourages increased safety knowledge and proactive behavior through a series of safety messages and communications, online training, “read and sign” Powerpoint training, and review of safety procedures.

6.d Emergency Response Training

For this scope of work, Bhate will rely on the local emergency services to respond to emergency situations. The SSHO will verify the means to summon emergency rescue, firefighting, and medical services. Maps and addresses of the nearest hospital and emergency contact numbers will be posted on a central job board.

Take-shelter and evacuation procedures will be established and covered with all subcontractors during the safety orientation by the SSHO and posted on a central job board.

7 SAFETY AND HEALTH INSPECTIONS

7.a Internal Safety and Health Inspections

The SSHO will conduct daily informal safety and health inspections of the active field work areas. The inspection will cover workplace conditions, physical area safety, and employee work practices. The SSHO will document any deficiencies and corrective actions on the *Discrepancy Tracking* form. A copy of the tracking log will be mounted on or be adjacent to the bulletin board or a notice on the bulletin board will state the location where it may be accessed by all workers upon request. It will be updated as needed.

The SSHO will be responsible for ensuring all deficiencies noted are corrected immediately. If deficiencies cannot be corrected immediately, appropriate temporary countermeasures will be implemented that will ensure safety until more permanent countermeasures can be put in place.

7.b External Safety and Health Inspections

External Safety and Health Inspections are not anticipated for this work. If OSHA safety inspectors request access to the work site, they will be briefed on safety procedures and proper PPE before accessing the work areas. Bhate will cooperate with regulatory safety inspectors.

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8 ACCIDENT REPORTING

8.a Exposure Data

All man-hours worked, by Bhate and subcontractors, will be generated monthly. At the conclusion of the field work, the man-hours will be tallied, summarized, and available for submission to the USACE as requested.

8.b Accident Investigations, Reports, and Logs

The SSHO is responsible for compiling any incident reports and incident investigations as necessary and submitting them to the HSM and the Contractor Officer's Representative (COR) by the end of the day of the occurrence and/or no later than 24 hours following the occurrence.

Bhate will thoroughly investigate an incident or accident and submit the findings along with the appropriate corrective action(s) to the COR and Contracting Officer as soon as possible, but no later than 5 working days following the incident. Except for rescue and emergency measures, efforts will be made to not disturb the incident scene until it has been released by the investigating official. Bhate will implement corrective actions as soon as reasonably possible.

8.c Notification of Major Accidents

In the event of a major accident or injury, immediate notification will be made by the SSHO to the local fire or emergency department and Installation Office to initiate incident response.

The following require immediate notification to the USACE:

- A fatal injury;
- A permanent total disability;
- A permanent partial disability;
- The in-patient hospitalization of one or more people resulting from a single occurrence;
- An employee's amputation or an employee's loss of an eye, as a result of a work-related incident; or
- Property damage of $200,000 or more.

Additionally, the HSM and the COR for USACE will also be notified immediately (after notifying first responders and after taking initial life-saving or first aid measures) of any major accident or injury. The SSHO shall make additional notification to Bhate management in accordance with the *Bhate Incident Report* procedure.

Bhate's HSM will complete the Accident Investigation Report form (ENG 3394 version 2), as needed, in addition to Bhate's *Incident Report Form* and *Incident Investigation Form*.

Updates will be given by the SSHO to the USACE on a weekly basis summarizing accidents, injuries, concerns, or other safety related issues for the prior work week.

9 PLANS REQUIRED BY THE SAFETY MANUAL

9.a Layout Plans

See the IWWP for the site location figures.

9.b Emergency Response Plans

Reference Section 9.kk of this HASP for details regarding Spill Prevention and Control.

The Supervisor/SSHO and the Site Operator are certified in First Aid, CPR, and BBP awareness. At least one of them will be continuously present during site operations to provide those services as required for Bhate and subcontractor employees. The Site Supervisor/SSHO will possess a basic first aid kit suitable for use by the work crew that meets the minimum fill requirements of American National Standards Institute (ANSI) Z308.1-2003. A portable eyewash station will also be available on site and will be periodically inspected by the Supervisor/SSHO. At the GWTP, there are five emergency showers with eyewashes and there is also one fixed eyewash station attached to the faucet in the GWTP office. They will also be inspected by the Supervisor/SSHO. The Supervisor/SSHO will also maintain a cellular telephone to summon emergency services.

This project includes multiple sites that are listed in the IWWP. **Table 9-1** lists the nearest medical facility (primary responder). The SSHO shall contact the nearest medical center to notify them of the locations of work and types of activities to be performed on site to verify their ability to respond to potential emergency situations. In the event of a medical emergency, use of ambulance services and medical facilities will be determined by the first responders.

Medical facilities are identified in the Table below.

Table 9-1. Medical Facility Information

Facility	Address	Phone Number
See Figure 9-1 Christus Good Shepherd Medical Center (Trauma Center)	811 South Washington Avenue Marshall, Texas 75670	(903) 927-6000
See Figure 9-2 Christus Good Shepherd Occupational Medical Clinic (Non-Trauma Center)	614 South Grove Street Marshall, Texas 75670 (Open only M-F, 8:00 am– 5:00 pm)	(903) 927-6240
Willis-Knighton Work Kare – North (Non-emergency clinic used by APTIM [subcontractor])	2724 Greenwood Road Shreveport, Louisiana 71109	(318) 212-4750

Facility	Address	Phone Number
Longview Occupational Medicine (Non-emergency clinic used by APTIM [subcontractor])	3202 N. Fourth Street, #100 Longview, Texas 75605	(903) 757-0577

The map and directions to the nearest hospital and non-emergency clinic are included as **Figures 9-1 and 9-2**. The remediation subcontractor, APTIM, will use one of the following clinics for non-emergency medical care – Willis-Knighton or Longview Occupational Medicine in accordance with their corporate safety plan.

An emergency situation requiring response is considered to exist if:

- Any member of the field crew is injured in an accident or experiences or exhibits any adverse effects or symptoms of chemical exposure, or heat stress.
- Safety monitoring indicates site conditions are more hazardous than anticipated and cannot be controlled or that an immediate danger to life or health exists.

The SSHO or the other designated First Aid/CPR trained person will administer appropriate first-aid treatment, including CPR, in emergency situations as needed. The SSHO or designee will call 911, as needed. The following general emergency procedures will be carried out in the event of an injury:

1. Notify the SSHO of the incident.
2. If the victim can be moved safely, remove him from the work area to a safe location.
3. Administer first aid.
4. If medical assistance or ambulance is needed, call onsite 911.
5. If ambulance is not needed, but further medical evaluation is needed, transport the victim to the local medical facility (**Figures 9-1** and **9-2**).
6. Immediately notify the HSM and USACE COR and Contracting Officer of the incident and describe the emergency response actions taken.

9.b.1 Emergency Contacts

In the event of an emergency, local sources of assistance can be used. Prior to the commencement of the work, the SSHO will familiarize the field team with the location of the closest medical facility. Phone numbers and facilities for emergency use are provided for the work site in **Table 9-2**.

After initial contacts have been made and the situation has stabilized, notify the SSHO, Project Manager, USACE COR, and HSM, as appropriate.

Table 9-2. Emergency Contact Information

Name	Title	Telephone Number	Mobile Phone
Aaron Williams	USACE Technical Lead	(918) 679-4915	(918) 629-7925
Rose Zeiler, PhD	LHAAP Site Manager	(479) 635-0110	(479) 209-2422
Kim Nemmers	Project Manager	(720) 463-3909	(303) 550-9239
Scott Beesinger	Site Supervisor/SSHO	(903) 679-3448	(903) 930-6193
Kenny Moore	Site Operator	(903) 679-3448	(318) 463-9976
Sally S. Smith, CIH	Bhate HSM	(205) 918-4000	(205) 983-4150
David Mummert, CIH	APTIM HSM	(419) 429-5509	(419) 348-1544
Organization / Agency			
Name			**Telephone Number**
LHAAP Police Department/Non Emergency			911 or (903) 935-4525
LHAAP Fire Department			911 or (903) 935-4580
State Police			911
Ambulance Service ***(Emergency Medical Technician will determine appropriate hospital for treatment)***			911
Hospital: Christus Good Shepherd Medical Center (open 24 hours) 811 South Washington Avenue Marshall, Texas 75670 See Figure 9-1 for Hospital Map and Directions			(903) 927-6000
Non-Emergency Clinic: Christus Good Shepherd Occupational Medical Clinic 614 South Grove Street Marshall, Texas 75670 Note – only open M - F - 8 am – 5 pm See Figure 9-2 for Clinic Map and Directions			(903) 927-6240
Poison Control Center			(800) 222-1222
Pollution Emergency			(800) 292-4706
National Response Center			(800) 424-8802
Public Utilities			
Name			**Telephone Number**
Common Ground Alliance Nationwide *Call Before You Dig*			811

9.b.2 Directions to Designated Hospital and Clinic

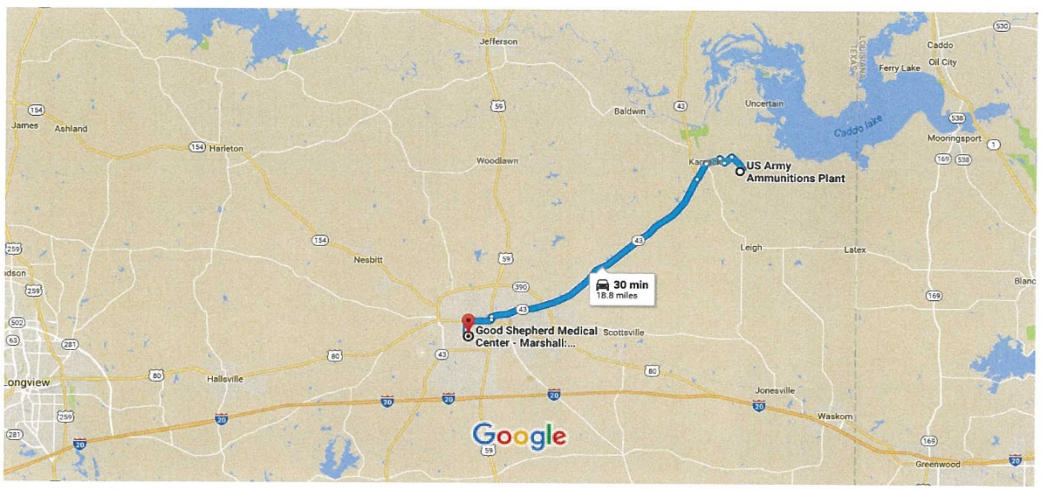
The nearest hospital from LHAAP is in Marshall, Texas, and is a trauma center opened 24 hours, seven days a week. The non-emergency clinic is also in Marshall and is only open Monday through Friday from 8 am to 5 pm. See Figures 9-1 and 9-2 for a map and specific directions from the installation.

Figure 9-1. Trauma Center Map and Route Directions

Christus Good Shepherd Medical Center (open 24 hours)
811 South Washington Avenue
Marshall, Texas 75670
Phone (903) 927-6000

Google Maps US Army Ammunitions Plant to Good Shepherd Medical Center - Marshall: Emergency Room — Drive 18.8 miles, 30 min

Longhorn (LHAAP)



Map data ©2017 Google 2 mi

US Army Ammunitions Plant
15600 FM 134, Karnack, TX 75661

Take Avenue N, Zeugner Dr and TX-449 Spur S to TX-43 S — 10 min (3.5 mi)

1. Head northeast on 25th St toward Avenue N — 0.2 mi
2. Turn left onto Avenue N — 0.8 mi
3. Turn left onto 18th St — 0.5 mi
4. Turn right at the 1st cross street onto Avenue E — 0.3 mi
5. Turn left onto Zeugner Dr — 0.7 mi
6. Continue onto Kay St — 348 ft
7. Continue onto TX-449 Spur S — 0.9 mi

Follow TX-43 S to N Grove St in Marshall

17 min (14.3 mi)

8. Turn left onto TX-43 S

12.9 mi

9. Use any lane to turn left onto E End Blvd N

0.2 mi

10. Turn right onto E Grand Ave

1.3 mi

Continue on N Grove St to your destination

3 min (1.0 mi)

11. Turn left onto N Grove St

0.4 mi

12. Turn right onto S Grove St

92 ft

13. Turn left to stay on S Grove St

0.3 mi

14. Slight left onto Bomar St

390 ft

15. Turn left at the 1st cross street onto University Ave

449 ft

16. Turn left onto Lindsey Dr

89 ft

17. Slight right
Destination will be on the right

180 ft

Good Shepherd Medical Center - Marshall: Emergency Room

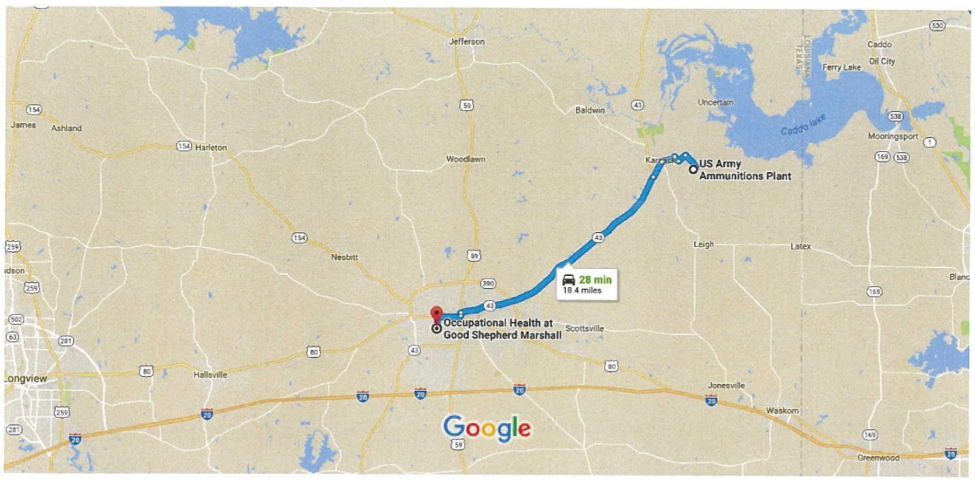
811 S Washington Ave, Marshall, TX 75670

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Figure 9-2. Non-Emergency Clinic Map and Route Directions

Christus Good Shepherd Occupational Medical Clinic
614 South Grove Street
Marshall, Texas 75670
Phone (903) 927-6240
(open M-F, 8 am – 5 pm)

Google Maps — US Army Ammunitions Plant to Occupational Health at Good Shepherd Marshall — Drive 18.4 miles, 28 min



Map data ©2017 Google 2 mi

US Army Ammunitions Plant
15600 FM 134, Karnack, TX 75661

Take Avenue N, Zeugner Dr and TX-449 Spur S to TX-43 S

10 min (3.5 mi)

1. Head northeast on 25th St toward Avenue N — 0.2 mi
2. Turn left onto Avenue N — 0.8 mi
3. Turn left onto 18th St — 0.5 mi
4. Turn right at the 1st cross street onto Avenue E — 0.3 mi
5. Turn left onto Zeugner Dr — 0.7 mi
6. Continue onto Kay St — 348 ft
7. Continue onto TX-449 Spur S — 0.9 mi

Follow TX-43 S to N Grove St in Marshall

17 min (14.3 mi)

8. Turn left onto TX-43 S

12.9 mi

9. Use any lane to turn left onto E End Blvd N

0.2 mi

10. Turn right onto E Grand Ave

1.3 mi

Drive to S Grove St

2 min (0.6 mi)

11. Turn left onto N Grove St

0.4 mi

12. Turn right onto S Grove St

92 ft

13. Turn left to stay on S Grove St
Destination will be on the left

0.1 mi

Occupational Health at Good Shepherd Marshall

614 S Grove St, Marshall, TX 75670

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

9.b.3 Procedures for Evacuation of the Work Area

In the event that a member of the field crew is injured or experiences any adverse effects or symptoms of possible exposure (chemical or physical) while on site, the entire field crew will immediately halt work and act according to the instructions provided by the SSHO. The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated will result in the evacuation of the field team and reevaluation of the hazard and the level of protection required. If an emergency situation develops which requires evacuation of the work area, the evacuation procedures in **Table 9-3** shall be followed.

Table 9-3. Evacuation Procedures

Evacuation Step	Methods and Comments
1. Notify affected workers	Use of site communication methods as applicable
2. Evacuate to safe location	Assemble at the rally point determined by Bhate and Installation
3. Assemble and account for workers	SSHO shall account for personnel using the Daily Safety Meeting Log
4. Notify Fire and Emergency Services	Notification as needed
5. Complete incident report	Follow the Incident Reporting and Investigation procedure

Table 9-4 summarizes potential emergency situations and response actions that are applicable for the project.

Table 9-4. Potential Emergency Situations

In Case of	Response Actions
Injury or illness	Treat injury with applicable First Aid. All work related injuries beyond first aid will result in notification of Emergency Services and notification of the employee supervisor. Any employee requiring advanced medical treatment will be accompanied by a knowledgeable company employee that can answer potential questions on job duties and hazards. Make notifications in accordance with the Incident Reporting and Investigation procedure.
Chemical exposure	First Aid shall be provided such as but not limited to: move victim to fresh air, remove contaminated clothing, flush affected skin with water, and seek medical attention.
Fire or explosion	Notify emergency services immediately. All personnel shall evacuate the immediate area of the fire and move to an upwind location. Personnel shall not engage in firefighting activities (use of fire extinguisher) unless trained to do so and only in the incipient stages of fire.
Adverse weather	Tornados, hurricanes, lightning, or other threatening weather conditions will result in an immediate shut down of operations and evacuation of personnel. Lightning proximity will be determined by measuring the time interval between the visually observed lightning flash and the subsequent sound of thunder. An interval less than 30 seconds will prompt the shutdown. Operations will be shut down for the period of the storm passing plus an additional 30 minutes.

In Case of	Response Actions
Material spill or release	Vehicles and equipment will be maintained and inspected so as to prevent fluid leaks. Should any vehicle fluid leaks occur, the equipment will be taken out of service to make necessary repairs. Spills or leaks of hazardous materials, wastes, and other deleterious materials (i.e., oil filled transformers) will be contained adequately and will be cleaned up immediately upon detection. Project personnel will be trained in spill prevention and cleanup and a sufficient quantity of spill kits will be readily available at all times. In the event of a significant spill, the waste will be handled and properly disposed in an authorized waste management facility. Notification will be made in accordance with the Incident Reporting and Investigation Procedure.

9.c Alcohol and Drug Abuse Plan

Bhate expects its employees and its subcontractors' employees to submit to a 5-panel drug screen and a breath alcohol test within 24 hours of any work incident/accident, which includes injury, illness, property damage, spills and releases, in accordance with state regulations for the state where the incident occurred (i.e., Texas). Bhate has a substance abuse prevention program explained in its Employee Manual in Section 3.11 and is administered under the direction of the Human Resources Manager. Section 3.11 is enforceable onsite and reads as follows:

3.11 Substance Abuse

"The Company is committed to the highest standards of integrity and professionalism in its work, and to the safety of its employees. For this reason, the Company does not condone abuse of alcohol or use of illegal drugs by employees. Illegal drugs include but are not limited to LSD, cocaine, crack, heroin, opiates, marijuana, or prescription or over-the-counter drugs used illegally. The term does not include proper use of a prescribed medication. The use or possession of illegal drugs, on or off duty, is inconsistent with law-abiding behavior and a potential threat to the safety of others and work efficiency. Further, possession or consumption of alcoholic beverages on company premises or while working, or being under the influence of alcohol while at work, is also a threat to employee safety and work efficiency.

Employees may be subject to discharge, even for a first offense, if the Company concludes that they are guilty of the following:

The use or unauthorized possession of alcohol on premises and/or Company worksite;

The on premises use (except for the proper use of prescribed drugs), manufacture, distribution, dispensing, possession, sale, soliciting, or purchase of any illegal drug or other controlled substance on Company premises or while working;

Testing positive for the presence of illegal drugs in the body;

Testing or behavior indicating the employee is under the influence of alcohol while at work or performing Company business;

Failing to properly notify the Company as to taking a legal drug the employee has reason to believe may create a safety risk to the employee or others;

The failure to report to the Company within five days any conviction (including guilty or nolo contendere plea) for a criminal drug offense in the workplace;

The conviction (including guilty or nolo contendere plea) of any criminal drug offense in the workplace;

The failure or refusal to consent to drug or alcohol testing, including, but not limited to, execution of appropriate authorizations to test, if so directed;

The attempt to alter, falsify, or interfere with a drug or alcohol test;

Failure to cooperate with a search for illegal drugs or alcohol.

Knowledge of employees using, transferring, purchasing, or in possession of illegal drugs or controlled substances (unless legally prescribed) while working will immediately be called to the attention of the Human Resources Director. Failure to do so may result in discipline, including discharge.

Employees will not be disciplined for the proper use of a prescribed medication. However, any employee who has reason to believe that use of a prescribed drug or even an over-the-counter drug may present a safety risk to himself/herself or others must report such drug use to their supervisor in writing in advance of beginning work so that the Company can determine work-related consequences. The employee may be removed from working a job when, in the judgment of the supervisor, the employee's performance while taking the medication presents a direct threat to the health or safety of the employee or others.

The Company may conduct searches for illegal drugs or alcohol on Company property, on worksites, and/or Company vehicles when management, at its sole discretion, determines there is reasonable suspicion to believe that illegal drugs or alcohol are present. At a Principal's discretion, they may contact local law enforcement agencies to ask them to assist in the search. Those searches may include an employee's personal property, including, but not limited to the employee's vehicle, clothing, cooler, purse, parcels, and similar items.

Employees who believe they may have a substance abuse problem are encouraged to seek assistance. An employee's decision to seek assistance will not be used as the basis for disciplinary action. However, it is the responsibility of the employee to seek assistance before alcohol or drug use leads to conduct that results in disciplinary action. An employee's request to seek treatment will not be a defense to discipline imposed for prior misconduct. The Company may require an employee who is participating in a treatment program to undergo periodic testing at its discretion. Moreover, an employee seeking voluntary assistance, like any other employee, still must comply with all Company policies, and still may be disciplined or terminated for any noncompliance. Testing is not a necessary prerequisite to discipline or discharge if it is otherwise determined that this policy was violated.

3.11.1 Drug Screening

Employees may be required to take drug or alcohol tests;

When the employee is involved in a job related incident, which did or could have resulted in injury or property damage.

When the Company has reasonable suspicion to believe the employee is under the influence of drugs or alcohol. Employees may also be required to submit to random tests for illegal drugs.

An employee may also be disqualified from receiving employee benefits if the employee is discharged for the use of illegal drugs, or for refusal to submit to a test for illegal drugs or for alteration of a test specimen."

3.11.2 Work Related Accident - To Your Person, Others, or a Vehicle

Under Texas law, workers who are injured at the workplace or in the course of employment may be tested for drugs and alcohol, and if impaired, may not be paid benefits under the Texas Worker's Compensation laws if the injury is a result of an accident caused by drug and/or alcohol impairment.

The refusal to take tests for drugs and/or alcohol after an accident will forfeit your rights to recover benefits under the Texas Worker's Compensation Act.

End of policy.

9.d Site Sanitation Plan

For this scope of work, the sanitation facilities will be provided by the installation. The GWTP has restroom facilities and running potable water. Bottled water will be provided when there is not potable water available.

Bhate will ensure any waste (common trash) generated during the performance of the work activities will be collected and disposed of properly. Housekeeping will be maintained continuously during the project.

9.e Access and Haul Road Plan

Bhate will coordinate with the local staff at each location to establish defined routes as necessary for material handling and movement around the site. Where necessary, Bhate will employ spotters to guide heavy equipment operators and vehicles transporting materials in tight work areas. A general traffic pattern for the site will be established and will be communicated in advance to field personnel.

9.f Respiratory Protection and PPE Plan

The use of respiratory protection is not expected to be required except for during mixing of grout. However, if respirators are required, proof of medical clearance and fit testing will be provided to the USACE for all on-site personnel prior to use for those who wear respirators more than 30 days per year. **Table 9-5** lists the minimum PPE that will be required for the various activities within the scope of the project.

Table 9-5. Personal Protective Equipment by General Activity (Not by Task)

Activity	Head/Face	Foot	Hands	Respiratory	Clothing [3, 4]
Mobilization / Demobilization	Hard Hat (for overhead hazards), Safety Glasses[1] with rigid side shields	Steel toed safety boots	Leather gloves as needed	None	Minimum of long pants and shirts with a minimum 4-inch sleeve
General site labor	Hard Hat, Safety Glasses with rigid side shields, Face shield for grinding, Hearing Protection as needed	Steel toed safety boots	Leather gloves as needed	None Anticipated	Minimum of long pants and shirts with a minimum 4-inch sleeve, ANSI Class II Reflective Safety vests
Equipment Operation/ Monitoring Well Installation and Decommissioning	Hard Hat[2], Safety Glasses[1] with rigid side shields Hearing protection when working with noisy equipment (open cab) or tools Goggles for dusty conditions Goggles and face shield when injecting Portland cement slurry	Steel toed boots	Leather gloves as needed Nitrile or rubber gloves when handling fuels, wet grout, or other materials	Disposable N95 respirator if mixing grout containing silica	Minimum of long pants and shirts with a minimum 4-inch sleeve ANSI Class II reflective safety vests when working around heavy equipment or traffic areas
Soil, Surface Water, Air, or Groundwater Sampling	Hard Hat, Safety Glasses[1] with rigid side shields Hearing protection when working with noisy equipment (open cab) or tools	Steel toed boots	Leather gloves as needed Nitrile or rubber gloves when sampling	None	Minimum of long pants and shirts with a minimum 4-inch sleeve ANSI Class II reflective safety vests when working around heavy equipment or traffic areas, Protective coveralls (Tyvek-like or rain gear)

Activity	Head/Face	Foot	Hands	Respiratory	Clothing [3, 4]
Fuels Recovery, If a spill occurs	Hard Hat, Safety Glasses[1] with rigid side shields Hearing protection when working with noisy equipment, motors or tools	Steel toed boots	Leather gloves as needed Nitrile or rubber gloves when contact with fuels	None	Minimum of long pants and shirts with a minimum 4-inch sleeve ANSI Class II reflective safety vests when working around heavy equipment or traffic areas, Protective coveralls (Cotton –non-static producing)
Excavation	Hard Hat[2], Safety Glasses[1] with rigid side shields Hearing protection when working with noisy equipment (open cab) or tools Goggles for dusty conditions	Steel toed boots	Leather gloves as needed Nitrile or rubber gloves when handling fuels, wet grout, or other materials	Disposable N95 respirator if mixing grout containing silica	Minimum of long pants and shirts with a minimum 4-inch sleeve ANSI Class II reflective safety vests when working around heavy equipment or traffic areas
Injection of injectate using direct push technology (DPT)	Hard Hat[2], Safety Glasses[1] with rigid side shields Hearing protection when working with noisy equipment or tools Goggles for dusty or liquid conditions Goggles and face shield when injecting Portland cement slurry	Steel toed boots, disposable over bootie, as needed	Leather gloves as needed Nitrile or rubber gloves when handling injection materials, wet grout, or other materials	None	Minimum of long pants and shirts with a minimum 4-inch sleeve ANSI Class II reflective safety vests when working around heavy equipment or traffic areas, Protective coveralls (Tyvek-like or rain gear)

Notes:
1 Safety Glasses with rigid side shields approved by ANSI Z-87 required at all times.
2 Hard hats are not required inside fully enclosed equipment cabs.
3 Disposable PPE (i.e. Tyvek coveralls, boot covers, chemical resistant gloves, etc.) may be used for the purpose of maintaining cleanliness.
4 Additional PPE may be included in the AHAs.
5 A portable hand/face wash station will be provided.

As indicated in **Table 9-5**, respiratory protection is not expected to be required during the project activities. If needed, respirators will be specified according to the hazard. All personnel who may be required to wear a respirator during any phase of site activities must comply with the requirements of the Bhate Respiratory Protection Program. A qualified person will be assigned as respiratory protection manager for the project as necessary. If respiratory protection is required, facial hair (beards, long sideburns, or mustaches) which may interfere with a satisfactory fit of a respirator mask is not allowed on any person who may be required to wear a respirator.

The PPE specified in **Table 9-5** must be worn by all site personnel. This includes hard hats, steel toe work boots, and safety glasses with rigid side shields, which must be worn at all times in active work areas.

9.g Health Hazard Control Program

This HASP serves as the health hazard control program for this scope of work.

If work is stopped due to any health and safety concern, immediate attention should be given by health and safety personnel working in cooperation with the Project Manager to identify and correct the cause of concern as quickly as possible. Any such incident should be fully documented by the SSHO in a report to the HSM and Project Manager. In the event of a work stoppage, the Project Manager must be notified as soon as possible and kept apprised of progress in resolving the incident until normal operations are resumed.

9.h Hazard Communication Program

9.h.1 Chemical Hazard Communication

During the course of the project, fuels, lubricants, etc., are some of the anticipated hazardous materials that will be brought on-site by Bhate or their subcontractors for use during this scope of work. A Safety Data Sheet (SDS)/Material Safety Data Sheet (MSDS) will be obtained for all materials and reviewed with all affected employees prior to use. A copy of the SDS/MSDS will also be submitted to the Bhate HSM. All containers will be properly labeled and kept closed when not in use.

A SDS/MSDS for all chemicals brought on site must be submitted to the SSHO and the HSM. A copy of all SDSs/MSDSs must be kept on site as well as in the Corporate Office. All employees on site must review the SDS/MSDS for all chemicals used. New SDSs/MSDSs will be reviewed during the daily safety briefing conducted by the SSHO. All containers must be labeled at a minimum with the identity of the chemical contents and the associated hazards. The National Fire Protection Association (NFPA) diamond label will be used for all temporary or transfer containers used on site. The appropriate rating will be filled in for each hazard category based on the SDS/MSDS:

Red = Fire Hazards
Blue = Health Hazards
Yellow = Reactivity Hazards
White = other hazards (i.e. water reactive or oxidizer)

All subcontractors are responsible for submitting a SDS/MSDS for all chemical products brought on site.

The types of hazardous chemicals (as defined in 29 CFR Section [§]1910.1200) that may be brought and used on site are identified below in **Table 9-6**. The use of these materials shall be in accordance with their intended use. A hazardous material includes any material defined as hazardous under the latest version of Federal Standard No. 313. A project specific chemical inventory and file of applicable SDSs/MSDSs will be maintained by the SSHO at the project sites.

Table 9-6. Sample Chemical Identification

Chemical Name	Amount	Location	Purpose
Assorted fuels, lubricants, coolants, etc., necessary for equipment operation	Quantities limited to immediate use requirements of onsite equipment	On site vehicles and equipment	Equipment servicing and operation
Grout and bentonite	Quantities limited to immediate use requirements	At monitoring wells	May be needed during monitoring well activities
GWTP Chemicals	Quantities limited to immediate use requirements	At GWTP	May be needed for treatment and treatment plant maintenance
Injection compound, if needed	To be determined	To be determined	Injecting using DPT

9h.2 Communication Tools

Cellular telephones will be available to contact emergency services as required. Refer to the Corporate HASP and Section 9.b of this HASP for emergency situations and appropriate actions and contacts. Site communication amongst employees will be a combination of audio, equipment/air horns, and/or line of sight hand communications. Some common hand communication signals include the following:

- Hand gripping throat: Can’t breath
- Grip partner’s wrist or both hands at waist: Leave area immediately
- Hands on top of head: Need assistance
- Thumbs up: OK, I’m all right, I understand
- Thumbs down: No, negative

Cellular telephone use is not permitted while operating equipment.

9.i Heat/Cold Stress Monitoring Plan

9.i.1 Heat Stress

The prime objective of heat stress management is the prevention of heat stroke, which is life-threatening and the most serious of the heat-related disorders. Personnel will be made aware that heat stress can occur during periods of elevated ambient temperatures. This hazard significantly increases with moderate to heavy workloads and when impermeable protective clothing is in use. Personnel will be informed regarding the various forms of heat stress (e.g., heat cramps, heat exhaustion, and heat stroke) and the signs and symptoms of exposure. Initial symptoms of heat cramps and heat exhaustion are cramps, faintness, dizziness or disorientation, and pale, clammy skin. Heat stroke is an extremely serious medical emergency with sudden onset and symptoms that include dilated pupils, dry and hot skin, loss of consciousness, and/or convulsions. Heat stroke can be fatal if not promptly and properly treated.

At the beginning of the fieldwork, site safety training and discussions will focus on the heat stress monitoring plan. Training components will include:

- Knowledge of the hazards of heat stress
- Recognition of predisposing factors, danger signs, and symptoms
- Awareness of first-aid procedures for heat stroke
- Employee responsibilities in avoiding heat stress
- Dangers of using drugs and alcohol in hot work environments
- Use of protective clothing and equipment, and
- Discussion of environmental and medical surveillance programs.

During the daily tailgate safety meetings, the SSHO will discuss the anticipated high temperature for the day with all personnel to be onsite. Tasks to be performed during the day will be scheduled such that heavier-load work will be accomplished during the cooler parts of the day, or so that work-rest breaks may be incorporated into the work schedule. A wet-bulb globe thermometer will be used onsite as needed.

Work-Load Assessment

Work-Load Assessment is categorized by caloric expenditure for each job position. Under conditions of high temperature (greater than 75 degrees Fahrenheit [°F]) and medium or heavy work-load, the SSHO will determine the work-load category of each job using the "Screening Criteria for Threshold Limit Values and Action Limit for Heat Stress Exposure".

9.i.2 Heat Stress Monitoring

A monitoring program for heat stress in accordance with the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limits Values (TLV) Booklet for Heat Stress will be implemented for work in elevated ambient temperatures (greater than 70°F) and personnel wearing impermeable protective garments or work requiring the use of a respirator. Initial phases of work activity are closely monitored to identify personnel who are more susceptible to heat exposure or who may have other risk factors such as elevated alcohol/drug use or cardiovascular disease. A wet-bulb globe thermometer will be used onsite as needed. Workers are responsible for observing each other and themselves for development of heat stress symptoms.

Controls

Below is a summary of controls that may be used during fieldwork.

Skin Protection and Clothing Selection – Where employees are exposed to solar radiation for short periods and there is the potential for sunburn or exposure for prolonged periods where long-term exposure could lead to health effects such as skin cancer, employees will be provided sunscreen with a sun protection factor (SPF) appropriate for their skin type and exposure, at a minimum of SPF 15. Sunscreens will be used only in accordance with the manufacturer's recommendations. Lightweight, breathable reflective clothing will also be recommended to be worn by field personnel.

Fluid Replacement – Personnel will be encouraged to drink generous amounts of water and electrolyte replacement fluids (even if not thirsty) to prevent dehydration. Cool water or any cool liquid (except alcoholic beverages) will be made available to workers to encourage them to drink small amounts frequently, e.g., one cup every 20 minutes.

Sunshield or Other Shelter – Adequate shelter will be provided if determined necessary to protect personnel from direct sun exposure.

Wetted Clothing – Wetted clothing is a simple and inexpensive personal cooling technique that is particularly effective when reflective or other impermeable protective clothing is worn. A suggested method involves wetting a terry cloth towel with cold water and placing it on the back of the neck.

9.i.3 Cold Stress

Since prolonged exposure to cold air, or to immersion in cold water, at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided. Adequate insulating dry clothing to maintain core temperatures above 36 degrees Celsius (°C) (96.8 °F) must be provided to employees working in air temperatures below 4 °C (40 °F). Wind chill cooling rate and the cooling power of air are critical factors. Employees working under these conditions will use the work/warm-up schedule specified by the SSHO. Personnel will be made aware of the signs and symptoms of cold stress during daily safety meetings and will review the cold stress plan during review of the related AHA.

Employees who become immersed in water or whose clothing becomes wet will immediately change into dry clothing/blankets and be treated for hypothermia. Blankets will be included as part of the first aid equipment on such activities, and employees will ensure they have a change of clothing.

Cold weather sheltering and clothing will be provided as follows:

- If wind chill is a factor at a work location, the cooling effect of the wind will be reduced by shielding the work area or requiring employees to wear an outer windbreak layer garment.
- Extremities, ears, toes, and nose will be protected from extreme cold by proper clothing such as hats, gloves, masks, etc. Employees whose clothing may become wet will wear an outer layer of clothing that is impermeable to water.
- Outer garments will provide for ventilation to prevent wetting of inner clothing by sweat.
- If clothing is wet, the employee will change into dry clothes before entering a cold environment.
- Employees will change socks and removable felt insoles at regular daily intervals or will use vapor barrier boots.
- Due to the added danger of cold injury due to evaporative cooling, employees handling evaporative liquid (such as gasoline, alcohol, or cleaning fluids) at air temperatures below 40 °F (4 °C) will take precautions to avoid soaking of clothing or contact with skin.
- Eyewear providing protection against ultraviolet light, glare, and blowing ice crystals will be provided to employees in snow and/or ice-covered terrain.

If employees express a concern about their ability to work in a cold environment, they will provide medical documentation on their ability to work in cold weather (30 °F [-1 °C] or below). If medical documentation is provided that shows they are suffering from diseases or taking medication that interferes with normal body temperature regulation or reduces tolerance to work in cold environments, they will be excluded from the cold weather tasks.

Localized injuries resulting from cold are included in the generic term “frostbite.”

9.j Crystalline Silica Monitoring Plan (Assessment)

In accordance with EM 385-1-1 Section 06.N.10 - *Itinerant Work*, the job tasks where there is a potential for crystalline silica exposure are during temporary work. The employees or the subcontractor’s employees are at temporary worksites away from their primary worksite so they shall have available N95 respiratory protection as a minimum, protective clothing, portable engineering controls, and provisions for personal hygiene and sanitation. Training for employees shall be provided to protect them as well as others from airborne silica dust exposure. See Attachment 5 for the Crystalline Silica Monitoring Plan.

9.k Night Operations Lighting Plan

Bhate does not expect to work during night or early morning hours. Per OSHA §1926.56(a), a minimum of 5 foot candles will be set up should night operations need to be performed. Hours work is performed is dependent on time of year, daylight savings time, etc. General work hours are from 7:00 am to 5:00 pm.

9.l Fire Prevention Plan

Accumulation of flammable materials will be monitored and overseen by the SSHO or the CP appointed by the SSHO adhering to OSHA standards.

Equipment and systems which are potential ignition sources shall be monitored and overseen by the SSHO or the CP appointed by the SSHO.

Housekeeping will be done on a daily basis and overseen by the SSHO. Materials will be disposed of in containers designated for this use.

Anticipated fire ignition sources would include matches or lighters for personal smoking use and sparks from saws, grinders, and other power tools. Smoking is discouraged and will only be allowed in locations outside the work area designated by the SSHO on personal break time. Any spark or flame producing activity on-site will require a hot work permit issued by the local contact and approved by the SSHO. Flammable and combustible materials will be kept at a distance of at least 50 feet from any spark producing activity. Based on moderate hazard levels, one fire extinguisher rated 2A-10BC will be positioned for every 3,000 square feet (ft^2) of floor space on each level if indoors and no further than 75 feet from any work area.

Bhate will complete its Hot Work Permit form (see **Attachment 2**) before commencing hot work. No burning, grinding, chipping, or other operation which produces heat, sparks, or ignition sources are to be performed without a hot work permit. Bhate or its subcontractor will provide a fire watch in the immediate area with a fire extinguisher for all hot work activities. The fire watch employee must be present during all hot work and for a period of 1 hour after the hot work is completed.

9.m Hazardous Energy Control Plan

All temporary power sources used will be equipped with ground fault circuit interrupters (GFCI).

The intended use of this Hazardous Energy Control (HEC) Plan is to safeguard all personnel working on this project from all potential forms of hazardous energy. Hazardous energy is defined as electrical, mechanical, hydraulic, pneumatic, chemical, thermal, gravitational, or any other form of energy that could cause injury due to the unintended motion energizing, start-up, or release of such stored or residual energy in machinery, equipment, piping, pipelines, or process systems.

In order to coordinate and communicate the HEC activities, safety meetings specific to the tasks being accomplished will be conducted by the SSHO with all personnel about the potential impacts and requirements of this Plan. This Plan will be on site and available at all times to all employees.

Bhate will fully coordinate all control activities with the USACE throughout the planning and implementation of these activities. Each shall inform the other of their HEC plans and procedures, ensure that their own personnel understand and comply with rules and restrictions of the procedures agreed upon to be used for the job, and ensure that their employees affected by the hazardous energy control activity are notified when the procedural steps outlined in the HEC plan are to be initiated.

To document the applicability of Lockout/Tagout or the appropriate alternative safety procedure, the Lockout/Tagout Permit form will be completed including each piece of equipment (or generally for multiple machines) and maintenance tasks, the required energy isolation and lockout point or alternative procedure which is applicable.

Before work is begun, the person in charge will ascertain by inquiry, by direct observation, or by instruments, whether any part of an electric power circuit (exposed or concealed) is located such that the performance of work could bring any person, tool, or machine into physical or electrical contact with it.

The following alternatives to Lockout/Tagout may be employed, as appropriate:

a) Extension tools or procedures that eliminate exposure to hazardous machinery movement when the equipment must be in operation during servicing are provided and available and employees are trained and familiar with these practices.
b) Unplugging an electrical power cord or completely separating equipment from its energy source and releasing all stored energy, if the craftsman/operator has exclusive control (observation) of the plug or other connection equipment and /or a locking or disabling safety device is affixed to the plug or other connecting equipment.

The following procedural steps for shutting down, isolating, blocking, and securing machines or equipment to control hazardous energy shall be implemented in the order indicated.

a) The person responsible for the lockout/tagout shall notify other affected employees.
b) An authorized employee shall identify the type of energy source and how to control the energy.
c) An authorized employee shall initiate the shutdown procedure if the machinery is running.
d) The energy isolating devices (s) will be deactivated.
e) Lockout of the energy isolating devices with assigned individual locks and tagging to notify other employees shall be affixed to the lockout point.
f) Stored energy shall be released by grounding, bleeding, blocking etc.
g) A log shall be maintained of all lockout/tagout including the date and time on and the date and time off, the affected machinery and purpose of the lockout as well as the name and phone number of the person responsible.

h) Upon completion of the lockout/tagout job, procedures to restore equipment to service shall be used, including notifying affected employees and safe startup methods shall be implemented. Before the last lock or tag is removed, the authorized person shall check to ensure that all tools have been removed from the work area and the system is completely assembled. As each employee completes their work task, they shall remove their own lock or tag. All employees are to be clear of the equipment. All employees who work in the area are notified that the lockout/tagout is being removed. The supervisor shall then be advised that the equipment is ready to be put back in service.

Any personal grounds needed for grounding equipment shall be placed only by a certified electrician. A written notice of the date the ground was set and who set the ground shall be included in the daily report. The ground shall only be removed by the person who placed it.

Testing to verify effective de-energization and the effectiveness of isolation and lockout/tagout devices shall be conducted through the use of calibrated voltmeters set to the correct voltage. Before starting work on locked out equipment, authorized employees must know that the equipment has been de-energized by showing that the main disconnect switch or circuit breaker can't be moved to the on position, by pushing buttons or other normal operating control(s) and/or by other test to make sure that the equipment will not operate. Other energy isolating devices include but are not limited to: a manually operated electrical circuit breaker; a disconnect switch; a line valve; a block or similar device that block or isolates energy.

In the event that responsibility for a lockout needs to be transferred, the following procedures will apply:

a) Transfers when both responsible parties are present shall be accomplished by the removal of the current lock and tag and replacement by the transferred lock. The transferee shall complete and affix a tag or sign to the lockout.
b) Transfers which cannot be accomplished with both responsible parties present shall be accomplished through an intermediary, who will affix his lock and tag to the lockout point during the interim period.

GFCI will be used on all electrical tools, extension cords, equipment, and temporary power.

Only construction grade hard duty extension cords will be used. Cords will be protected from damage and/or standing water at all times.

All electrical tools, cords, and equipment shall be inspected daily for damage. Damaged tools, cords, or equipment will be tagged and taken out of service immediately.

"Plug in hand" procedure with the device unplugged and the plug under exclusive control of the operator will be followed when changing bits, saw blades, or other attachments on powered hand tools. Lockout/tagout procedures will be followed where the operator cannot maintain exclusive control of the plug and/or where a guard or other safety device must be removed/disconnected.

All equipment shall be covered by a safe clearance (or lockout/tagout procedures) and all energy sources shall be controlled before performing service or maintenance on equipment in which the unexpected energizing, startup, or release of stored energy could occur and cause any of the following: personal injury, property damage, loss of content, loss of protection, loss of capacity, or harm to the environment.

9.m.1 Work Near Power Lines

Prior to any work near power lines, power will be disconnected and verified. If power cannot be disconnected, the minimum safety requirements will be followed per EM385-1-1 Section 11.F.04. See **Table 9-7** below.

Table 9-7. Minimum Clearance from Energized Overhead Electric Lines

Minimum Clearance from Energized Overhead Electric Lines

Voltage (nominal, kV, alternating current)	Minimum clearance distance
Up to 50	10 ft (3 m)
51 – 200	15 ft (4.6 m)
201 – 350	20 ft (6 m)
351 – 500	25 ft (7.6 m)
501 – 750	35 ft (10.7 m)
751 – 1000	45 ft (13.7 m)
Over 1,000	(As established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution)

Note: All dimensions are distances from live part to equipment and components at any potential reach.

Source: EM385-1-1 (2014) Table 11-1, page 11-15.

9.n Contingency Plan for Severe Weather

In the event of adverse weather such as tornados, hurricanes, lightning, or other threatening weather conditions, the SSHO will shut down all work activities and personnel will be required to evacuate or seek shelter, as directed by the National Weather Service (or as appropriate). Personnel will assemble at the rally point determined by Bhate and the USACE COR and then go to the safe shelter. The SSHO will monitor National Weather Service announcements/ warnings/advisories to keep up with weather conditions during the project.

Site operations will be curtailed and all field employees will shelter in project vehicles or trailers if the time interval between lightning flashes and the subsequent thunder is 10 seconds or less. Site work may resume when lightning and thunder is no longer detected or after 30 minutes have passed from the last detection of lightning and thunder that is greater than a 10 second interval. Tornado warnings issued for the work site area shall result in a stoppage of work for the duration of the warning. Sustained winds in excess of 35 miles per hour shall result in a stoppage of work. Personnel may not return to the site after a hurricane until allowed by the Installation.

Bhate personnel will adhere to severe weather plans and rally points, as required by the local area authorities.

9.o Site Specific Fall Protection and Prevention Plan

The scope of work for this project may include performing tasks at elevation during maintenance of the GWTP.

The purpose of this plan is to prevent injuries due to falls from elevated work surfaces and to comply with OSHA fall protection standards in 29 CFR Part 1926, Subpart M and Section 21 of EM385-1-1. All work from greater than 6 feet in elevation on an unprotected ledge will require the use of fall protection (e.g., full body harness, lanyard, sling, lifeline, etc.), except ladders. Ladders less than 20 feet tall do not require workers to wear a personal fall arrest system (PFAS). Ladders have to be secured. Employees shall only be allowed to work on walking/working surfaces which have the strength and integrity to support employees safely. <u>This HASP will need to be amended if employees have to perform tasks where they could fall 6 feet and the need for guard rails, safety nets, or PFAS would be required. Currently, site personnel are not trained in fall protection and prevention so the task/activity would not be performed until training is completed or the task would be completed by a trained subcontractor.</u>

9.p Excavation and Trenching Plan

The excavation tasks are not anticipated to exceed 4 feet deep so a plan is not necessary. Should additional site investigations determine that the depth of removal is greater than 4 feet, then an addendum to this HASP will be prepared.

9.q Site Safety and Health Plan for HTRW Work (HAZWOPER)

Separate site-specific safety and health plans will be prepared and submitted for review by the COR for specific remediation tasks.

9.r Confined Space

In the event that a confined space is encountered, permit required confined space procedures will comply with the applicable OSHA regulation, and a Confined Space program will be submitted for approval. The SSHO will be responsible for issuing and approving the confined space permit if one is required. The SSHO will contact the USACE COR before a confined space permit is issued. The subcontractor will have to provide the name of and proof of CP for monitoring the air before entry and proof of confined space entry training for employees.

9.s Spill Prevention and Control

9.s.1 General Measures

- To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR Parts 110, 117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.
- SSHO is the designated responsible person to oversee and enforce control measures.
- Spills should be covered and protected from stormwater run-on during rainfall to the extent that it doesn't compromise cleanup activities.
- Do not bury or wash spills with water.
- Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provision in applicable best management practices.
- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water appropriately.
- Place proper storage, cleanup, and minor water spillage and do not allow it to discharge into drain facilities or watercourses.
- Place proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open conspicuous, and accessible location.
- Keep waste storage areas clean, well-organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

9.s.2 Cleanup

- Clean up leaks and spills immediately.
- Use a rag for small spills on paved surface, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used clean up materials are also hazardous and must be disposed of as hazardous waste.

- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly.

9.s.3 Minor Spills

Minor spills typically involve small quantities of oil, gasoline, paint, etc., which can be controlled by the first responder at the discovery of the spill.

- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Absorbent materials should be promptly removed and disposed of properly.
- Follow the practice below for a minor spill:
  - Contain the spread of the spill.
  - Recover spilled materials.
  - Clean the contaminated area and properly dispose of contaminated materials.

9.s.4 Semi-Significant Spills

Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities. Spills should be cleaned up immediately:

- Contain spread of the spill.
- Notify the project foreman immediately.
- If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and /or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
- If the spill occurs in dirt areas immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated spill.
- If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

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10 RISK MANAGEMENT PROCESSES

10.a Task Hazard(s) Summary

The potential health and safety hazards of this project are summarized below in **Table 10-1**. The potential for encountering these hazards is ranked (high, moderate, or low) based on the work to be performed and the hazard control measures to be used.

Table 10-1. Task Hazards Summary

Summary	Hazard potential [High, Moderate, or Low]	Description of potential hazards
_√_Safety (i.e. Walking and working surfaces, heavy equipment, traffic, falls, excavations, power and hand tools, materials handling, hoisting and rigging, electrical safety, etc.)	Moderate	Uneven walking and working surfaces Slips, trips, and falls Materials handling Heavy equipment operation Falling or dropped objects Electrical
_√_Utilities	Moderate	-Dig Safe will not be able to locate the abandoned utilities at many of the sites Underground and overhead utilities may be present All utilities shall be disconnected by qualified technicians prior to the initiation of any excavation activities
_√_Chemical	Moderate	Gasoline (fuel for equipment) Diesel (fuel for equipment) Lubricants (i.e. oil or grease) Chemicals for GWTP operations and maintenance Injectate and mixing chemicals, if PBR activity needed
_√_Physical (i.e. Heat, cold, noise)	Moderate	Thermal stressors (variable weather anticipated) Sun exposure Noise from heavy equipment
_√_Biological (i.e. Plants, animals, insects, spiders, ticks)	Moderate	Insect stings and bites Poisonous animals and plants Snakes

10.b Hazard Control Measures

All site personnel must attend the Daily Safety Briefing, sign-in daily for emergency accountability, and follow Bhate's Incident Reporting and Investigation procedures. The Supervisor/SSHO, and all subcontractor supervision are responsible to perform daily proactive inspections to maintain hazard controls as stated in the relevant AHAs for the various project activities.

Coordination with the Installation representatives is a mandatory requirement for performing the work at this site. Bhate will be responsible for coordinating site access for subcontractors.

Bhate will use any existing fencing to restrict access to unauthorized personnel. Temporary project fencing (or a substitute acceptable to Installation) shall be provided for areas of active use by members of the public, including those areas in close proximity to family housing areas and/or school facilities.

Bhate will establish defined routes for material handling and equipment movement around the site. A general traffic pattern for the site will be established and will be communicated in advance to field personnel. Unauthorized vehicle access into the site will be controlled. If applicable, Bhate will coordinate any required roadway closures with the Installation officials.

11 REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH), *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*.

Bhate. *Corporate Health and Safety Plan for Construction*.

Bhate. *Corporate Employee Manual*.

USACE. *EM 385-1-1, Safety and Health Requirements Manual,* November 2014.

U.S. Department of Labor, Title 29 Code of Federal Regulations Part 1910.

U.S. Department of Labor, Title 29 Code of Federal Regulations Part 1926.

U.S. Department of Health and Human Services, National Institute of Occupational Safety and Health (NIOSH), *Pocket Guide to Chemical Hazards*, 2008.

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ATTACHMENT 1
ACTIVITY HAZARD ANALYSES (AHAS) AND TABLE OF POTENTIAL CHEMICALS OF CONCERN

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Activity Hazard Analysis (AHA) – 01

<table>
<tr><td colspan="2">Task: General Site Activities</td><td colspan="2">Bhate Project Number: NWO1312.0150.001.0001.03</td></tr>
<tr><td colspan="2" rowspan="2">Minimum Personal Protective Equipment (PPE): Level D PPE (Long pants, shirts with minimum 4” sleeve, steel toe boots, safety glasses, hard hat for overhead hazards, leather work gloves, and hearing protection, as required)</td><td colspan="2">Location: Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas</td></tr>
<tr><td>Analysis Approved by:
Sally S. Smith, CIH, CSP, CHMM, CPEA</td><td>Date: May 2018</td></tr>
</table>

Activity	Potential Hazards	Recommended Controls
Mobilization/Demobilization and Site Preparation Hazards associated with Mobilization/Demobilization and Site Preparation are applicable throughout the project Note: Each workday shall begin with a mandatory daily safety meeting for all on-site workers	Slips, trips, or falls on walking and working surfaces	• Determine the best access route prior to transporting equipment and tools • Continuously inspect the work area for slip, trip, and fall hazards • Pay attention; ensure safe and secure footing • Maintain clean work areas by following good housekeeping procedures • Be alert for uneven and variable terrain • Wear slip resistant footwear when walking/working on slippery surfaces or slopes • Fall protection is required for all work > 6 feet in elevation • All ladders must be free of damage and/or defects and used according to manufacturer’s instructions
	Site Traffic	• Be aware of potential vehicle traffic while on site • Follow posted warnings and rules for travel around site
	Eye injury	• Use approved safety glasses with rigid side shields
	Overhead hazards	• Personnel will be required to wear hard hats that meet American National Standards Institute (ANSI) Standard Z89.1 in all areas with overhead hazards
	Cuts, punctures, and abrasions	• Wear leather work gloves when handling materials or using tools
	Dropped objects	• Steel toe boots meeting ANSI Standard Z41 will be worn
	Electrical	• All power will be equipped with Ground Fault Circuit Interrupter (GFCI) • All cords and power tools will be inspected prior to use looking for frays, missing ground prongs or other damage; all damaged equipment or cords will be tagged and taken out of service • All power tools must be grounded or double insulated • All cords used must be construction / hard use grade and must be protected from damage

AHA – 01 (continued)

Activity	Potential Hazards	Recommended Controls
Mobilization/Demobilization and Site Preparation (continued)	Thermal Stressors (i.e. heat or cold stress)	• Employees will have appropriate clothing for variable weather • Use of long sleeves or application of sunscreen with a high sun protection factor (SPF) on exposed skin encouraged • Employees will take breaks and drink plenty of fluids, as necessary, to prevent heat stress • To prevent cold stress employees will take appropriate warming breaks in pre-designated areas, whole body protection will be worn, employees will be provided warm sweet drinks and soups to facilitate warming and maintain proper hydration, workers shall change into dry clothing should their clothing get wet
	Back Injury from Materials Handling	• Use proper lifting techniques • Loads greater than 50 pounds require assistance (team lift) or mechanical equipment • Prior to lifting, check the load for jagged or sharp edges • Avoid torso twisting motions while handling or moving loads
	Inclement weather (Thunderstorms and tornadoes)	• Halt activities immediately and take cover during thunderstorm or tornado warnings, shelter in a building if possible, stay away from windows • If outdoors, stay close to the ground • Listen to radio or television announcements for pending weather information • Do not try to outrun a tornado on foot or in a vehicle
	Biological hazards (spiders, snakes, plants, etc.)	• Workers will inspect the work area carefully and avoid placing hands and feet into concealed areas • Look in direction of travel for biological hazards to avoid
Clearing and Grubbing (as needed)	Heavy equipment operation and hand tool hazards	• Use of bush-hog, bulldozer, track hoe by experienced operator only. • Inspect heavy equipment before each use and complete Equipment Checklist • Hand tools (i.e. saws or pruning shears) shall be used over power tools, as feasible • Tools shall be inspected prior to use; damaged tools (frayed wiring, missing ground prong, damaged casing or handle) shall be tagged "damaged – do not use" and taken out of service. • Use leather work gloves for hand protection against scratches and sticks; however, gloves must be removed if using a tool with a rotating bit such as a drill where the glove could get caught while in operation

AHA – 01 (continued)

Activity	Potential Hazards	Recommended Controls
Clearing and Grubbing (continued)	Slips, trips, and falls	• Practice good housekeeping and clear loose brush away from work area • Look before stepping to ensure adequate footing
	Noise	• Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 Decibels "A-weighting scale" (dBA) (ear muffs or plugs) • The Site Safety and Health Officer (SSHO) will determine the need for hearing protection • All equipment will be equipped with manufacturer's required mufflers
	Heavy equipment operation	• Maintain awareness of vehicle movement in work area and exercise caution when approaching heavy equipment • Equipment will be equipped with functioning back-up alarms, signal lamps, and alerting horns • Operators are required to use seat belts • Only qualified operators are permitted to operate equipment • All personnel working around moving equipment will be required to wear highly visible safety vests • All equipment will be inspected prior to use on a daily basis • All broken or damaged parts will be replaced immediately • Signs, barricades, flagmen, and/or other traffic control devices will be used to control traffic as necessary • Buckets and attachments shall be placed on the ground if operator not at controls or if ground personnel approach
Silt Fence Installation, as needed	Biological hazards (spiders, snakes, plants, etc.)	• Workers will inspect the work area carefully and avoid biological hazards • Look in direction of travel for biological hazards to avoid
	Hand tool hazards	• Hand tools (hammers, shovels) shall be inspected for defects prior to use • Use leather work gloves for hand protection against scratches, sticks, and splinters • Use proper tools for the work

AHA – 01 (continued)

Activity	Potential Hazards	Recommended Controls
Silt Fence Installation, as needed (continued)	Back Injury from Materials Handling	• Install silt fence in manageable sections • Use proper lifting techniques • Loads greater than 50 pounds require assistance (team lifting) or mechanical equipment • Prior to lifting, check the load for jagged or sharp edges • Avoid torso twisting motions while handling or moving loads
Excavation, as needed	Heavy equipment operation	• Maintain awareness of vehicle movement in work area and exercise caution when approaching heavy equipment • Equipment will be equipped with functioning back-up alarms, signal lamps, and alerting horns • Operators are required to use seat belts • Equipment must be inspected prior to use daily. An inspection checklist will be completed for each piece of equipment used. Broken or damaged parts will be replaced immediately. • Only qualified operators are permitted to operate equipment • All personnel to wear highly visible yellow or orange safety vests while working around moving equipment • Signs, barricades, and/or other traffic control devices will be used, as necessary • Buckets and attachments shall be placed on the ground if operator not at controls or if ground personnel approach • An exclusion zone shall be delineated around the excavation areas
	Noise	• Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs) • The SSHO will determine the need for hearing protection • All equipment will be equipped with manufacturer's required mufflers

AHA – 01 (continued)

<table>
<tr><th>Activity</th><th>Potential Hazards</th><th>Recommended Controls</th></tr>
<tr><td rowspan="2">Excavation, as needed (continued)</td><td>Overhead/buried utilities</td><td>

Area of excavation should be delineated and a utility locate performed prior to any excavation
Overhead utilities should be considered live until determined otherwise
Work activity adjacent to overhead electric power lines will not be initiated until a survey has been conducted to ascertain the safe clearance distance from energized lines. Please refer to the U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM 385-1-1, 2014) for a complete description of procedures required when working at a location adjacent to overhead power lines. The minimum required clearance distances from energized overhead electric lines are provided below.

Minimum Clearance from Energized Overhead Electric Lines
<table>
<tr><th>Nominal System Voltage</th><th>Minimum Rated Clearance</th></tr>
<tr><td>0 to 50 kV</td><td>3 m (10 ft)</td></tr>
<tr><td>51 to 200 kV</td><td>4.6 m (15 ft)</td></tr>
<tr><td>201 to 350 kV</td><td>6 m (20 ft)</td></tr>
<tr><td>351 to 500 kV</td><td>7.6 m (25 ft)</td></tr>
<tr><td>501 to 650 kV</td><td>9.1 m (30 ft)</td></tr>
<tr><td>651 to 800 kV</td><td>10.7 m (35 ft)</td></tr>
<tr><td>801 to 950 kV</td><td>12.2 m (40 ft)</td></tr>
<tr><td>951 to 1100 kV</td><td>13.7 m (45 ft)</td></tr>
<tr><td colspan="2">Note: kV = Kilovolts, m = Meter, ft = feet</td></tr>
</table>
</td></tr>
<tr><td>Excavation Safety</td><td>

Ensure equipment is placed so as to not contribute to a cave-in situation
No personnel will be allowed to enter excavations greater than 4 feet bgs unless the excavation has been properly inspected, shoring and means of egress installed as necessary, all heavy equipment has been moved away from the affected edges, and any spoils have been removed from the edge
Do not place spoil piles closer than 2 feet from the edge of the excavation
Open excavations shall be protected with minimum Class III perimeter protection

</td></tr>
</table>

AHA – 01 (continued)

Activity	Potential Hazards	Recommended Controls
Excavation, as needed (continued)	Electrical	• Ensure GFCI are used in all outdoor environments and in any areas subject to moisture • Ensure all cords are in good repair. Do not attempt to repair a cord with tape; discard damaged cords immediately. Ensure ground prong is in place and insulation is not damaged on all extension cords/equipment. • Keep cords and electrical tools out of traffic areas where they may be damaged and out of water • Prohibit work on new and existing energized (hot) electrical circuits until all power is shut off and a positive Lockout/Tagout System is in place. ONLY TRAINED ELECTRICIANS ARE PERMITTEED TO WORK ON ELECTRICAL CIRCUITRY. • VIOLATION OF A LOCKOUT TAGOUT REQUIREMENT CAN RESULT IN IMMEDIATE REMOVAL FROM THE JOB SITE AND POSSIBLE TERMINATION FROM THE COMPANY AND/OR BAN ON FUTURE BUISNESS FOR SUBCONTRACTOS

	Unexploded ordnance (UXO) or Munitions and Explosives of Concern (MEC)	• Although not anticipated, as with any military base, the potential exists to encounter UXO; all employees will be instructed on safe procedures to be followed including the following:
		  • Under no circumstances will any Bhate employee or subcontractor employee (other than a UXO Technician) attempt to move or otherwise handle any UXO/MEC or suspected UXO/MEC item.
		  • Collection of “souvenirs” is prohibited, whether rendered safe or not.
		  • If you did not put it there, don’t pick it up! If you cannot recognize the item as a tool, don’t pick it up! Notify a Base UXO technician to inspect the item.
		  • If UXO/MEC items are encountered during heavy equipment operations, work shall be stopped and the item(s) investigated by a Base UXO technician. Work shall not resume until the item has been secured or deemed not an UXO/MEC item.
		  • After the potential encounter with UXO/MEC, the heavy equipment used will be inspected to determine if any UXO/MEC materials had lodged in the tracks, tires, bucket, and other extensions of the equipment.
		  • Three R’s: Recognize, Retreat and Report
		    • Recognize: Don’t touch it.
		    • Retreat: 300 feet
		    • Report to Site Supervisor or UXO Safety Supervisor

AHA – 01 (continued)

Safety Equipment Used	Inspection Requirements	Training Requirements
Level D PPE First Aid Kit Fire Extinguisher Eyewash Use of bush-hog, bulldozer, track hoe, etc. when have to "clear and grub"	Informal daily work area inspections and formal weekly safety inspections to be conducted by the SSHO Inspect heavy equipment before using and complete Equipment Checklist form	Site personnel have read and understand the HASP Site personnel possess all of the required training as specified in the HASP Site personnel received site-specific safety indoctrination SSHO and one other field employee will have Cardiopulmonary Resuscitation (CPR) and First Aid training

AHA – 02

Task: Groundwater sampling	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves. As needed - chemical impervious gloves [nitrile inner and outer], and hearing protection with a noise reduction rating >26).	**Location:** LHAAP, Karnack, Texas	
	Analysis Approved by: Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazards	Recommended Controls
Groundwater sampling Note: Each workday shall begin with a mandatory daily safety meeting even though there may be only one worker onsite. Keeping a safety focus is important.	Slips, trips, or falls on walking and working surfaces	• Determine the best access route prior to transporting equipment and tools • Continuously inspect the work area for slip, trip, and fall hazards • Pay attention; ensure safe and secure footing • Maintain clean work areas by following good housekeeping procedures • Be alert for uneven and variable terrain • Wear slip resistant footwear when walking/working on slippery surfaces or slopes • Provide adequate lighting in all work areas
	Site Traffic	• Be aware of potential vehicle traffic while on site • Follow posted warnings and rules for travel around site • All onsite personnel must wear highly reflective orange or yellow safety vests in traffic areas and/or when working around heavy equipment
	Eye injury	• Use approved safety glasses with rigid side shields
	Overhead hazards	• Personnel will be required to wear hard hats that meet ANSI Standard Z89.1 in all areas with overhead hazards
	Cuts, punctures, and abrasions	• Wear leather work gloves when handling materials or using tools
	Dropped objects	• Steel-toe safety boots meeting ANSI Standard Z41 will be worn
	Thermal Stressors (i.e. heat stress and/or cold stress)	• Employees will have appropriate clothing for variable weather • Use of long sleeves or application of sunscreen with a high SPF on exposed skin encouraged • Employees will take breaks and drink plenty of fluids, as necessary, to prevent heat and/or cold stress

AHA-02 (continued)

Activity	Potential Hazards	Recommended Controls
Groundwater sampling (continued)	Back Injury from Materials Handling	• Inspect travel route prior to lifting/movement of heavy loads • Use proper lifting techniques, bending with the knees, not the back • Avoid torso twisting motions while handling or moving loads • Site personnel will be instructed on proper lifting techniques – bend with the knees and not with the back; avoid twisting at the waist, use your feet to turn • Loads greater than 50 pounds require assistance or mechanical equipment • Mechanical devices should be used to reduce manual handling of materials • Team lifting should be used if mechanical devices are not available • Prior to lifting, check the load for jagged or sharp edges
	Inclement weather (Thunderstorms and tornadoes)	• Halt activities immediately and take cover during thunderstorm or tornado warnings, shelter in a building if possible, stay away from windows • Implement a 30-minute stand down during lightning events • If outdoors, stay close to the ground • Listen to radio or television announcements for pending weather information • Do not try to outrun a tornado on foot or in a vehicle
	Biological hazards (spiders, snakes, etc.)	• Workers will inspect the work area carefully and avoid placing hands and feet into concealed areas • Look in direction of travel for biological hazards to avoid • Wear insect repellant as needed
	Electrical Hazards (Extension cords, Electrical Equipment, Temporary lighting, Building electricity) If necessary	• Equipment must be inspected prior to use and must be in good condition • The use of extension cords or other portable electrical connections or devices that are not rated for use in wet environments is strictly prohibited • Only ground fault circuit interrupter (GFCI) outlets may be used at source of power • Ensure cords are protected and run out of travel pathways • Ensure breaker boxes, electrical boxes, junction boxes, outlets, have covers in place. Ensure there are no openings where someone can come in contact with live electricals; all knockout holes are covered with proper plugs. • Do not use metal or other conductive ladders around electrical hazards

AHA-02 (continued)

Activity	Potential Hazards	Recommended Controls
Groundwater sampling (continued)	Exposure to soil and/or water contaminants	• To the extent feasible, limit contact with subsurface contaminants • Wear chemical resistant gloves (nitrile inner and outer) when handling groundwater samples • Wash hands and face prior to eating or drinking after handling potentially contaminated materials
	Spills/Fire	• Fuel cans will be National Fire Protection Association (NFPA) approved and equipped with pouring spout or funnel • Have absorbent materials available to control possible spills or leaks. • Smoking and open flames are not permitted in fueling/greasing areas or in the work area • All heavy equipment will be equipped with a ABC type fire extinguishers which will be inspected weekly and documented • Keep fire extinguishers easy to see and reach in case of an emergency • Store gasoline and other flammable liquids in a safety can with flame arrestor outdoors or in an approved flammable cabinet • Don't store LP gas tanks inside buildings • Keep temporary heaters at least 50 feet away from any LP gas container or any other flammable/combustible material • Ensure that leaks or spills of flammable or combustible materials are cleaned up promptly • Oily or solvent soaked rags must be disposed of in a metal self-closing safety can and must be emptied and properly disposed of on a daily basis
	Noise	• Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs) • The SSHO will determine the need for hearing protection • All equipment will be equipped with manufacturer's required mufflers
Equipment Used	**Inspection Requirements**	**Training Requirements**
Modified Level D PPE First Aid Kit with Eyewash Fire Extinguisher Groundwater pump and tubing Water quality instruments Laboratory-provided sampling containers	Informal daily work area inspections to be conducted by the SSHO Weekly inspection of first aid kit and eye wash Inspect all equipment before use	Site personnel received site specific safety indoctrination Site personnel have read and understand the HASP Site personnel possess all of the required training as specified in this HASP The SSHO will have CPR and First Aid training

AHA - 03

Task: Operation and Maintenance of Groundwater Treatment Plant (GWTP)	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.	**Location:** LHAAP, Karnack, Texas **Analysis Approved by:** Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazards	Recommended Controls
Operation and maintenance of GWTP [Note: Hazards and recommended controls from AHA-01 General Site Activities apply as well] Each workday shall begin with a mandatory daily safety meeting even though there may be only one worker onsite. Keeping a safety focus is important.	Noise	• Use hearing protection when working in the immediate vicinity of the noisy motors.
	Slips, Trips, and Falls	• Be aware of surroundings. • Clearly mark aboveground pipes so they are visible or fence off area containing aboveground pipes.
	Insect bites (spiders, snakes, insects)	• Wear DEET (or equivalent) insect repellant while working outside. • Wear long sleeves and pants to minimize exposure to spiders, snakes and insects. • Be aware of surroundings. • Inspect treatment system containers of potential entry points (fans, filters, louvers) for insects to enter and build nests (i.e. wasps) and ensure those entry points are secure, have no damage or openings to the outdoors, and have the correct slot size to prevent insect intrusion. • Wear leather gloves if needed to protect hands from spider/insect bites.
	Contact with moving/rotating machinery	• Moving Parts: **Lock Out/Tag Out Required** • Disable control and power switches before maintaining, servicing, or repairing the system. • Before starting work, disconnect the blower. • Ensure all fasteners are secure. • Tighten hardware and keep all guards in position over fans, impellers, or other moving parts. • Be sure to verify zero energy prior to repairing or performing maintenance to system.
	Fall from unstable ladder	• Inspect ladder before use and ensure it is in good condition (dispose of dangerous or defective ladders). • Secure ladder footing when in use. • Use care when ascending and descending the ladder- do not rush. • Maintain 3 points of contact while using the ladder.

AHA-03 (continued)

Activity	Potential Hazards	Recommended Controls
Operation and maintenance of GWTP (Continued)	Cold stress and heat stress	• Employees will have appropriate clothing for variable weather. • Workers will be trained in the recognition of cold stress and appropriate actions to take. • Workers will watch others for signs and symptoms of cold stress (shivering, numbness, sluggishness). • Take breaks in heated shelters to prevent cold stress. • Drink warm liquids to reduce the susceptibility to cold stress. • Remove outer layer of clothing and loosen other layers to promote evaporation of perspiration upon entering shelter to prevent heat stress. • Use of long sleeves or application of sunscreen with a high SPF on exposed skin encouraged. • Employees will take breaks and drink plenty of fluids, as necessary, to prevent heat and/or cold stress.
	Injury from hand tool use	• Inspect all tools before each use. Tag and remove defective tools from service. • Personnel will be familiar in the proper use of hand and power tools. • All power tools will be energized through a GFCI. • Use the appropriate tool for the job. • Wear proper PPE (safety glasses with side shields, safety/insulated boots and work/insulated gloves and hard hat, when overhead hazards)
	Impact with pressurized lines Shock from electrical lines	• Electrical and Pressurized Lines: **Lock Out/Tag Out Required** • Turn OFF electrical power before touching or removing any electrical components. • Keep areas around the blower clean and dry. • Be sure to verify zero energy prior to repairing or performing maintenance to system. • Use appropriate rubber gloves when working on equipment or transmission lines. • Have a person qualified in first aid for electrical shock present at all times when working on electrical equipment. • No one is permitted to work on unprotected energized electrical systems >50 volts without an energized work permit, flash analysis, determination of approach boundaries, PPE, and NFPA 70E training. • If energized electrical work is determined to be necessary, a separate energized electrical work AHA will be required.

AHA-03 (continued)

Activity	Potential Hazards	Recommended Controls
Operation and Maintenance of GWTP (continued)	Exposure to contaminants	• Wear personal protective equipment to reduce potential exposure to contaminants. See Table of Potential Contaminants of Concern in Attachment 1 of the HASP.
Use of PVC glue and primer	Inhalation of Volatile Organic Compounds (VOCs)	• Use glue or primer in open air to minimize exposure. • All containers shall be properly stored and labeled. • Review the MSDS/SDS and complete the chemical-specific hazard communication training. • Follow recommended controls on MSDS/SDS, including any recommended PPE. • NOTE 1: If glues or primers are needed to be used in a small space or other area without good ventilation, modification to this AHA will be submitted to the HSM. • NOTE 2: No confined space entry activities allowed in the project without prior discussion with HSM and revision to the HASP.
Equipment Used	**Inspection Requirements**	**Training Requirements**
Modified Level D PPE First Aid Kit with Eyewash Fire Extinguisher Assorted hand and power tools Ladder PVC glue and primer	Inspect PPE before use Informal daily work area inspections to be conducted by the SSHO Inspect tools and equipment before use	User of tools and ladder should be competent and qualified as determined by supervisor. 40-hour Initial HAZWOPER training, current 8-hour refresher training Training on the HASP Hazard communication training in accordance with the HASP (maintain MSDSs/SDSs for PVC glue/primer in centrally located area) Lockout/Tagout training for authorized workers: General electrical training.

AHA – 04

Task: Management of Investigative Derived Waste (IDW)	**Bhate Project Number:** NWO1312.0150.001.0001.03		
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.	**Location:** LHAAP, Karnack, Texas **Analysis Approved by:** Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018	

Activity	Potential Hazard(s)	Control Measures
Management of IDW [NOTE: The hazards and control measures presented in AHA-01 are applicable to all phases of the project]	Slips, trips, or falls on walking and working surfaces	• Be alert for uneven terrain and steep slopes • Keep work area free of dirt, grease, slippery materials, debris, and tools; practice good housekeeping • Provide adequate lighting in all work areas • Keep all stairways and walkways clear of debris/tools to prevent trips
	Potential for non-work personnel to be injured or contaminated (during staging of roll-off boxes and when waste haulers remove roll-off boxes)	• In areas where traffic control is required, all traffic control devices and methodologies will comply with the U.S. Department of Transportation (DOT) Manual on Uniform Traffic Control Devices (MUTCD, http://mutcd.fhwa.dot.gov) including the use of appropriate roadway markings, highly visible safety vests, and flagmen as needed. • Be aware of potential vehicle traffic while on site • Follow posted warnings and rules for travel around site • All onsite personnel must wear highly reflective ANSI Class 2 safety vests in traffic areas and/or when working around heavy equipment
	Exposure to high noise from heavy equipment and power tools	• Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs) • SSHO will determine the need for hearing protection • All equipment will be equipped with manufacturer's required mufflers
	Eye injury	• Use ANSI approved safety glasses with rigid side shields
	Overhead hazards	• Personnel will be required to wear hard hats that meet ANSI Standard Z89.1 in any areas with overhead hazards
	Dropped objects	• Steel toe boots meeting ANSI Standard Z41 shall be worn

AHA – 04 (continued)

Activity	Potential Hazard(s)	Control Measures
Management of IDW (continued) [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Inclement weather (Thunderstorms and tornadoes)	• Halt activities immediately and take cover during thunderstorm or tornado warnings, shelter in a building if possible, stay away from windows • If outdoors, stay close to the ground • Listen to radio or television announcements for pending weather information • Do not try to outrun a tornado on foot or in a vehicle
	Biological hazards (spiders, snakes, ticks etc.)	• Workers will inspect the work area carefully and avoid placing hands and feet into concealed areas • Look in direction of travel for biological hazards to avoid • Wear insect repellant as needed
	Thermal Stressors and other hazards (i.e. heat stress, cold stress)	• Employees will have appropriate clothing for variable weather • Wear long sleeves and long pants and sunscreen with a high sun protection factor (SPF) on exposed skin • Employees will take breaks and drink plenty of fluids, as necessary, to prevent heat stress alternating between water and Gatorade-type drinks • Take periodic warming breaks and drink warm sweet liquids when working in cold weather • Protect skin from becoming wet in cold weather; replace clothing that becomes wet as soon as possible • Wear insect repellant as needed • Refer to the Bhate Corporate HASP for detailed information on heat and cold stress
	Overhead/buried utilities	• Conduct a utility locate to identify the location of underground utilities in locations where drilling activities will occur • Overhead utilities should be considered live until determined otherwise • Maintain a minimum distance of > 25 feet from overhead utilities • All underground utilities must be clearly marked before beginning work • No intrusive work shall be conducted within a 4 foot "Buffer Zone" of any underground utility marking

AHA – 04 (continued)

Activity	Potential Hazard(s)	Control Measures
Management of IDW (continued) [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Spills/Fire	• Fuel cans will be NFPA approved and equipped with pouring spout or funnel • Spill and absorbent materials will be readily available • Smoking and open flames are not permitted in fueling/greasing areas or in the work area • All heavy equipment will be equipped with a ABC type fire extinguishers which will be inspected weekly and documented • Provide fire extinguishers near all welding, soldering, or other sources of ignition • Keep fire extinguishers easy to see and reach in case of an emergency • Store gasoline and other flammable liquids in a safety can with flame arrestor outdoors or in an approved flammable cabinet • Ensure that leaks or spills of flammable or combustible materials are cleaned up promptly • Oily or solvent soaked rags must be disposed of in a metal self-closing safety can and must be emptied and properly disposed of on a daily basis
	Sharp objects, if encountered	• All exposed sharp objects that could cut or impale someone must be protected (i.e. rebar caps - mushroom type is not acceptable for impalement protection) • All exposed nails must be bent over or removed; all loose nails must be kept off the ground • Wear leather or Kevlar gloves while handling sharp objects to prevent lacerations
	Electrical, when used	• Ensure ground fault circuit interrupters (GFCI) are used in all outdoor environments, in any areas subject to moisture, and for all temporary power • Ensure all cords and electrical tools are in good repair. Do not attempt to repair a cord with tape; discard damaged cords immediately. Ensure ground prong is in place and insulation is not damaged on all extension cords/equipment. • Ensure breaker boxes, electrical boxes, junction boxes, outlets, have covers in place. Ensure there are no openings where someone can come in contact with live electricals; all knockout holes are covered with proper plugs. • Keep cords and electrical tools out of traffic areas where they may be damaged • Prohibit work on new and existing energized (hot) electrical circuits until all power is shut off and a positive Lockout/Tagout System is in place. ONLY TRAINED ELECTRICIANS ARE PERMITTED TO WORK ON ELECTRICAL CIRCUITRY. • VIOLATION OF A LOCKOUT/TAGOUT REQUIREMENT CAN RESULT IN IMMEDIATE REMOVAL FROM THE JOB SITE AND TERMINATION FROM THE COMPANY AND/OR BAN ON FUTURE BUSINESS FOR SUBCONTRACTORS

AHA – 04 (continued)

Activity	Potential Hazard(s)	Control Measures
Management of IDW (continued) [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Ergonomics	• Avoid awkward postures • Avoid repetitive motions; switch hands and take rest breaks to give your affected body parts time to rest • Avoid excessive contact stress; provide padding if contact with a fixed object is prolonged such as the floor or a wall
	Vehicular traffic in work area and heavy equipment operation	• Wear ANSI Class II reflective traffic vest and cordon off work area • Maintain awareness of vehicle movement in work area and exercise caution when approaching heavy equipment exercise caution when approaching heavy equipment • Equipment will be equipped with functioning back-up alarms, signal lamps, lights, and alerting horns • Operators are required to use seat belts at all times • Only qualified / licensed operators will operate mobile equipment • All equipment must be inspected using the appropriate forms prior to use on each day of use
	Exposure to potential contaminants during management of IDW	• Wear appropriate PPE including chemical resistant gloves (nitrile inner and neoprene outer) and Tyvek coveralls to minimize potential contact with soil or groundwater, as appropriate • Conduct work activities in a manner that minimizes potential contact with soil or groundwater • Collect all PPE and disposable sampling equipment and place in properly labeled DOT container for proper disposal • Wash hands and face prior to eating, drinking, or smoking

Equipment Used	Inspection Requirements	Training Requirements
Level D PPE Fire Extinguishers First Aid Kits Eyewash	Employees inspect their own PPE. Weekly inspections will be performed on fire extinguishers. Weekly inspections will be performed on first aid kits and eyewash. Informal daily inspections are to be conducted by the SSHO. Formal weekly safety inspections are to be conducted and documented on field inspection form by the SSHO.	Personnel have read and understand the HASP, hospital route map, SDSs and AHAs At least two designated individuals onsite will have current CPR and First Aid training

AHA – 05

Task: Soil sampling and boring abandonment	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.	**Location:** LHAAP, Karnack, Texas **Analysis Approved by:** Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazard(s)	Control Measures
Soil sampling and boring abandonment [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Overhead/buried utilities (continued)	• For other overhead or in-workplace utilities, workers must be instructed to use care in working under or around utilities to avoid hot surfaces, pressurized gases or air, leaking pipelines, and discharging steam or hot liquids, and must work to prevent accidental contact or damage. • Overhead utilities should be considered live until determined otherwise • All underground utilities must be clearly marked before beginning work • No borings shall be made within a 4 foot "Buffer Zone" of any utility marking
	Exposure to contaminants	• To the extent feasible, limit contact with subsurface materials • Wear chemical resistant gloves (nitrile inner and outer) when handling soil samples • SSHO shall conduct breathing zone monitoring for volatile organic compounds (VOCs) with a photoionization detector (PID)/flame ionization detector (FID) if any odors or visible soil staining are encountered (SSHO may require an upgrade in PPE or modification to work based on monitoring results) • Wash hands and face prior to eating, drinking, or smoking after handling potentially contaminated materials
	Spills/residue material	• Have absorbent materials available to control possible spills or leaks
	Electrical Hazards (Extension cords, electrical equipment, temporary lighting, if encountered)	• Equipment must be inspected prior to use and must be in good condition • The use of extension cords or other portable electrical connections or devices that are not rated for use in wet environments is strictly prohibited • Only ground fault circuit interrupter outlets may be used
	Noise	• Drill Rig operation may result in high noise levels • Appropriate hearing protection with a NRR >26 shall be worn while operating the drill rig
	Pinch points	• Use appropriate PPE (leather gloves) when handling tools

AHA-05 (continued)

Activity	Potential Hazard(s)	Control Measures
Soil sampling and boring abandonment [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Cut hazards	• Use care when handling glassware • Do not reach "blindly" into sample container cooler
	Dust	• Use wet methods to prevent dust generation
Preparing shipping container after sampling	Heavy lifting (heavy from ice in sample shipping containers)	• Do not overload shipping containers with ice and with samples • Use proper lifting techniques • Wear disposable gloves to avoid contact

Equipment Used	Inspection Requirements	Training Requirements
Modified Level D PPE (Level C, if SSHO determines needed) First Aid Kits Eyewash Fire Extinguishers Direct Push Technology (DPT) drill rig	Employees inspect their own PPE. Weekly inspections will be performed on fire extinguishers. Weekly inspections will be performed on first aid kits and eyewash. Informal daily inspections are to be conducted by the SSHO. Formal weekly safety inspections are to be conducted and documented on field inspection form by the SSHO.	Personnel have read and understand the HASP, hospital route map, SDSs, and AHAs At least two designated individuals onsite will have current CPR and First Aid training Operator of the DPT rig must be trained and experienced

AHA – 06

<table>
<tr><td colspan="2">Task: Monitoring Well Installation</td><td colspan="2">Bhate Project Number: NWO1312.0150.001.0001.03</td></tr>
<tr><td colspan="2" rowspan="2">Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.</td><td colspan="2">Location: LHAAP, Karnack, Texas</td></tr>
<tr><td>Analysis Approved by:
Sally S. Smith, CIH, CSP, CHMM, CPEA</td><td>Date: May 2018</td></tr>
</table>

Activity	Potential Hazard(s)	Control Measures
Monitoring Well Installation [Note: Hazards and recommended controls from AHA-01 - Mobilization/ Demobilization/Site Preparation apply to these activities too]	Drill Rig Hazards	• Drill rig is to be operated and maintained by qualified operators • A Drill Rig Inspection Checklist (in Attachment 2 of the HASP) should be completed to ensure that the rig is operating properly (the inspection will include fittings, cables, pins, connections, lubrication points, controls, emergency stops, etc.) • To the extent possible, the terrain should be level and the condition of the ground such that unexpected movement of the rig is unlikely • Stabilize the rig prior to boring in accordance with manufacturer's recommendations • Wear required PPE (hard hat, safety glasses, work gloves, ear muffs or plugs, steel toe work boots), ensure loose clothing is secured • Maintain good housekeeping on and around drill rig • Keep hands, fingers, and other body parts clear of all moving machinery; ensure machine guards are in place while in operation
	Exposure to contaminants	• To the extent feasible, limit contact with subsurface materials • Wear chemical resistant gloves (nitrile inner and outer) when handling soil and groundwater samples • SSHO will conduct breathing zone monitoring for volatile organic compounds (VOCs) with a photoionization detector (PID)/flame ionization detector (FID) if any odors or visible soil staining are encountered (SSHO may require an upgrade in PPE or modification to work based on monitoring results) • Wash hands and face prior to eating, drinking, or smoking after handling potentially contaminated materials
	Noise	• Drill Rig operation may result in high noise levels • Appropriate hearing protection with a NRR >26 will be worn while operating the drill rig

AHA-06 (continued)

<table>
<tr><th>Activity</th><th>Potential Hazard(s)</th><th>Control Measures</th></tr>
<tr>
<td>Monitoring Well Installation (continued)

(NOTE: Hazards and recommended controls from AHA -01 -Mobilization/ Demobilization/Site Preparation apply)</td>
<td>Overhead/buried utilities
Overhead/buried utilities (continued)</td>
<td>

Work activity adjacent to overhead electric power lines will not be initiated until a survey has been conducted to ascertain the safe clearance distance from energized lines.
Refer to the U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM 385-1-1, 2014) for a complete description of procedures required when working at a location adjacent to overhead power lines.
The minimum required clearance distances from energized overhead electric lines are provided below.

<table>
<tr><th>Nominal System Voltage</th><th>Minimum Rated Clearance</th></tr>
<tr><td>0 to 50 kilovolts (kV)</td><td>10 feet (ft) (3 meters [m])</td></tr>
<tr><td>51 to 200 kV</td><td>15 ft (4.6 m)</td></tr>
<tr><td>201 to 350 kV</td><td>20 ft (6 m)</td></tr>
<tr><td>351 to 500 kV</td><td>25 ft) (7.6 m)</td></tr>
<tr><td>501 to 650 kV</td><td>30 ft (9.1 m)</td></tr>
<tr><td>651 to 800 kV</td><td>35 ft (10.7 m)</td></tr>
<tr><td>801 to 950 kV</td><td>40 ft (12.2 m)</td></tr>
<tr><td>951 to 1,100 kV</td><td>45 ft (13.7 m)</td></tr>
</table>

For other overhead or in-workplace utilities, workers must be instructed to use care in working under or around utilities to avoid hot surfaces, pressurized gases or air, leaking pipelines, and discharging steam or hot liquids, and must work to prevent accidental contact or damage.
Overhead utilities should be considered live until determined otherwise
All underground utilities must be clearly marked before beginning work
No borings will be made within a 4 foot “Buffer Zone” of any utility marking

</td>
</tr>
</table>

AHA - 06 (continued)

Activity	Potential Hazards	Recommended Controls
Monitoring Well Installation (continued)	Spills/residue material	• Have absorbent materials available to control possible spills or leaks
	Heavy lifting (sample shipping containers)	• Use proper lifting techniques
	Electrical Hazards (Extension cords, electrical equipment, temporary lighting, if encountered)	• Equipment must be inspected prior to use and must be in good condition • The use of extension cords or other portable electrical connections or devices that are not rated for use in wet environments is strictly prohibited • Only ground fault circuit interrupter outlets may be used
	Pinch points	• Utilize appropriate PPE (leather gloves) when handling well casings and tools
	Dust	• Use care when filling bore holes and using materials (sand, bentonite, Portland cement) to prevent dust generation • Position body in an upwind location from materials while mixing and pouring • Use wet methods to prevent dust generation
	Cut hazards	• Use care when handling glassware • Do not reach "blindly" into sample container cooler
Safety Equipment Used	**Inspection Requirements**	**Training Requirements**
Modified Level D PPE (upgrades to level C with respiratory protection worn, only as needed) First Aid Kit and Eyewash Fire Extinguisher Environmental Air Monitoring Equipment	Informal daily work area inspections to be conducted by the SSHO Formal weekly safety inspections will be conducted and documented. Weekly inspection of first aid kit and eye wash. Perform Calibrations in accordance with equipment manual	Site personnel received site specific safety indoctrination before starting site activities Site personnel have read and understand the HASP Site personnel possess all of the required training as specified in the HASP Only experienced personnel will operate equipment The SSHO and at least one more person onsite will have CPR and First Aid, and Blood borne Pathogens training

AHA – 07

Task: Excavation/Backfill/Site Restoration		**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.		**Location:** LHAAP, Karnack, Texas	
		Analysis Approved by: Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazard(s)	Control Measures
Excavations/Backfill/Site Restoration, as needed	Excavation and trenching hazards include but are not limited to Cave-in, equipment pinch point/crushing hazards, atmospheric hazards, engulfment, utilities, etc.	• Keep workers away from digging equipment and never allow workers in an excavation when equipment is in use. • Keep workers from getting between equipment in use and other obstacles and machinery that can cause crushing hazards. • Keep equipment and the excavated dirt back >2 feet from the edge of the excavation. • Have a competent person conduct daily inspections and correct any hazards before workers enter a trench or excavation. Soils analysis and inspections must be documented on the appropriate forms on a daily basis. • Provide workers a way to get into and out of a trench or excavation > 4 feet deep such as ladders and ramps. They must be within 25 feet of the worker. • For excavations and utility trenches over 5 feet deep where employees must enter, use shoring, shields (trench boxes), benching, or slope back the sides. Unless soil analysis has been completed, the earth's slope must be at least 1½ feet horizontal to 1 foot vertical (34°). • Keep water out of trenches with a pump or drainage system, and inspect the area for soil movement and potential cave-ins. • Keep drivers in the cab and workers away from dump trucks when dirt and other debris are being loaded into them. Don't allow workers under any load and train them to stay clear of the backs of vehicles. • Air monitoring must be conducted prior to entering a trench >4 feet deep; oxygen levels must be between 19.5 and 23.5 % oxygen; lower explosion limit must be less than <10%; Carbon Monoxide levels must be less than < 25 ppm. • Inspect the trench regularly for changes in the stability of the earth (water, cracks, vibrations, spoils pile). Stop work if any potential for cave-in develops and fix the problem before work starts again. • All trenches must be properly barricade (safety fencing) and marked ("Danger – Open Pit" or "Danger – Open Trench"). • Travel pathways should be a minimum of 6 feet from an open excavation or trench and the possibility of needing • Arrange for overhead lighting if night work is anticipated and use lighting systems for visibility and hazard identification at night as necessary. • Provide lighting for hazard identification to prevent pedestrians and vehicles from entering work area at night or when unattended.

AHA-07 (continued)

Safety Equipment Used	Inspection Requirements	Training Requirements
Modified Level D PPE (upgrades to level C with respiratory protection worn, only as needed) First Aid Kit and Eyewash Fire Extinguisher	Informal daily work area inspections to be conducted by the SSHO Formal weekly safety inspections will be conducted and documented. Weekly inspection of first aid kit and eye wash.	Site personnel received site specific safety indoctrination before starting site activities Site personnel have read and understand the HASP Site personnel possess all of the required training as specified in the HASP Only experienced personnel will operate equipment The SSHO and at least one more person onsite will have CPR and First Aid and Bloodborne Pathogens training When needed, employees involved in excavation work will have appropriate OSHA 29 CFR Part 1926 Subpart P training and a competent person will be present

Attachment 1 - Table 1. Properties of the Primary Contaminants of Concern

Contaminant	PEL (ppm)	TLV	Route(s) of Exposure	Signs and Symptoms of Exposure – Acute	Signs and Symptoms of Exposure - Chronic	Target Organs	IP (eV)	Specific Gravity (g/mL)	VP (mm Hg)	Flash Point (°F)	LEL %	UEL %
Tetrachloroethylene/ Perchloroethylene (PCE) CAS # 127-18-4	100 C 200	50	Inhalation, ingestion, skin and/or eye contact	Irritation of eyes, skin, nose, and throat, respiratory system, nausea, Flush face, neck, dizziness	Liver damage (potential occupational carcinogen)	Eyes, skin, respiratory system, liver, kidneys, central nervous system	9.32	1.62	14	NA	NA	NA
Trichloroethylene (TCE) CAS # 79-01-6	100 C 200	50 270 (STEL)	Inhalation, ingestion, skin and/or eye contact	Irritation of eyes, skin, headache, lassitude (weakness, exhaustion), dizziness, tremors	Liver damage (potential occupational carcinogen)	Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system	9.45	1.46	58	?	8	10.5
1,2-Dichloroethylene (DCE) CAS # 540-59-0	200	Removed 1994	Inhalation Ingestion Contact	Irritation of respiratory system, nausea, headaches	Cancer, jaundice, weight loss, eye damage, anemia	Eyes, skin, respiratory system	NA	1.24	87	55	6.2	15.9
1,2-Dichloroethane (1,2-DCA) (CAS # 75-34-3)	50 ppm	10 ppm	Inhalation Ingestion Contact	Irritation of respiratory system, nausea, headaches	Cancer, jaundice, weight loss, eye damage, anemia	Eyes, skin, respiratory system	NA	1.24	87	55	6.2	15.9
Benzene CAS # 71-43-2	1 ppm	0.5 ppm	Inhalation Ingestion Contact Absorption	Irritation of eyes, skin, nose, and throat, headache, dizziness, nausea, staggered gait, fatigue	Cancer (leukemia), adverse reproductive effects (female fertility, birth defects)	Eyes, skin, respiratory system, blood, central nervous system, bone marrow	9.24	0.88	75	12	1.2	7.8
Ethylbenzene CAS # 100-41-4	1,000	1,000 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation of eyes, skin, nose; headache, drowsiness, lassitude (weakness, exhaustion), narcosis; cough; liver damage; anemia; reproductive, teratogenic effects	Irritation of eyes, skin, nose; headache, drowsiness, lassitude (weakness, exhaustion), narcosis; cough; liver damage; anemia; reproductive, teratogenic effects	Eyes, skin, respiratory system, central nervous system, liver, blood, reproductive system	10.47	0.79	44	55	3.3	19.0

Contaminant	PEL (ppm)	TLV	Route(s) of Exposure	Signs and Symptoms of Exposure – Acute	Signs and Symptoms of Exposure - Chronic	Target Organs	IP (eV)	Specific Gravity (g/mL)	VP (mm Hg)	Flash Point (°F)	LEL %	UEL %
Vinyl Chloride	5 ppm	1 ppm	Contact Ingestion Inhalation	Blisters, eye irritation, nausea, difficulty breathing, and headaches	Cancer, blood disorders, liver and kidney damage	Eyes, skin, bone marrow, kidneys, central nervous system	NA	0.91	2515.6	-108	3.6	33
1,2-Dichloropropane [Synonym is Propylene dichloride] (CAS # 78-87-5)	75 ppm OSHA Table Z-1	10 ppm	Inhalation Contact	Dermal irritation, Irritation of upper respiratory system	Irritation of upper respiratory system	Skin, upper respiratory system	NA	1.156	49.6 - 54	59	3.4	14.5
Portland cement	Total Dust 15 mg/m^3 Respirable Fraction 5 mg/m^3	10 mg/m^3 5 mg/m^3	Inhalation Ingestion Contact	Irritation of eyes, skin, nose; cough; expectoration	Suspect cancer (lung); Exertional dyspnea, wheeze, chronic bronchitis; dermatitis	Eyes, skin, respiratory system	NA	NA	0	NA	NA	NA
No. 2 Diesel Fuel	5 mg/m^3 as mineral oil	100 mg/m^3 as total hydro-carbon vapor	Inhalation Skin absorption Ingestion Skin and/or eye contact	Irritation of eyes	Potential carcinogen, ACGIH A3 carcinogen, skin tumors in animals; Skin irritation when prolonged contact	Eyes, skin, respiratory system, central nervous system, liver, kidneys	NA	0.81-0.88	0.40	>125 ^{0}F (>152 ^{0}C)	0.3	10.0
Gasoline	NA	300 ppm	Inhalation Skin absorption Ingestion Skin and/or eye contact	Irritation of eyes, skin, mucous membrane; dermatitis; headache, lassitude (weakness, exhaustion), blurred vision, dizziness, slurred speech, confusion, convulsions; chemical pneumonitis (aspiration liquid); possible liver, kidney damage [potential occupational carcinogen]	Potential carcinogen	Eyes, skin, respiratory system, central nervous system, liver, kidneys	NA	0.72	38	-45	1.4	7.6

[See Notes on next page.]

Notes:

PEL	= Permissible Exposure Limit	LEL	=	Lower Explosive Limit
TLV	= Threshold Limit Value	UEL	=	Upper Explosive Limit
°F	= Degrees Fahrenheit	%	=	Percent
IP	= Ionization Potential	ppm	=	Parts per million
eV	= Electron volt	mg/m^3	=	Milligrams per cubic meter of air
VP	= Vapor Pressure	CAS	=	Chemical Abstract Service
mm Hg	= Millimeters of mercury	NA	=	Not Applicable
g/mL	= Grams per milliliter	STEL	=	Short term exposure limit
?	= Unknown	OSHA	=	Occupational Safety and Health Administration
ACGIH	= American Conference of Governmental Industrial Hygienists	C	=	+ Ceiling

Media centre

Zika virus

Fact sheet
Updated 18 March 2016

Key facts

- Zika virus disease is caused by a virus transmitted by *Aedes* mosquitoes.
- People with Zika virus disease usually have symptoms that can include mild fever, skin rashes, conjunctivitis, muscle and joint pain, malaise or headache. These symptoms normally last for 2-7 days.
- There is no specific treatment or vaccine currently available.
- The best form of prevention is protection against mosquito bites.
- The virus is known to circulate in Africa, the Americas, Asia and the Pacific.

Introduction

Zika virus is an emerging mosquito-borne virus that was first identified in Uganda in 1947 in rhesus monkeys through a monitoring network of sylvatic yellow fever. It was subsequently identified in humans in 1952 in Uganda and the United Republic of Tanzania. Outbreaks of Zika virus disease have been recorded in Africa, the Americas, Asia and the Pacific.

- Genre: Flavivirus
- Vector: *Aedes* mosquitoes (which usually bite during the morning and late afternoon/evening hours)
- Reservoir: Unknown
-
-
-

Signs and Symptoms

The incubation period (the time from exposure to symptoms) of Zika virus disease is not clear, but is likely to be a few days. The symptoms are similar to other arbovirus infections such as dengue, and include fever, skin rashes, conjunctivitis, muscle and joint pain, malaise, and headache. These symptoms are usually mild and last for 2-7 days.

Potential complications of Zika virus disease

During large outbreaks in French Polynesia and Brazil in 2013 and 2015 respectively, national health authorities reported potential neurological and auto-immune complications of Zika virus disease. Recently in Brazil, local health authorities have observed an increase in Guillain-Barré syndrome which coincided with Zika virus infections in the general public, as well as an increase in babies born with microcephaly in northeast Brazil. Agencies investigating the Zika outbreaks are finding an increasing body of evidence about the link between Zika virus and microcephaly. However, more investigation is needed to better understand the relationship between microcephaly in babies and the Zika virus. Other potential causes are also being investigated.

Transmission

Zika virus is transmitted to people through the bite of an infected mosquito from the *Aedes* genus, mainly *Aedes aegypti* in tropical regions. This is the same mosquito that transmits dengue, chikungunya and yellow fever. However, sexual transmission of Zika virus has been described in 2 cases, and the presence of the Zika virus in semen in 1 additional case.

Zika virus disease outbreaks were reported for the first time from the Pacific in 2007 and 2013 (Yap and French Polynesia, respectively), and in 2015 from the Americas (Brazil and Colombia) and Africa (Cabo Verde). In addition, more than 13 countries in the Americas have reported sporadic Zika virus infections indicating rapid geographic expansion of Zika virus.

Diagnosis

Infection with Zika virus may be suspected based on symptoms and recent history (e.g. residence or travel to an area where Zika virus is known to be present). Zika virus diagnosis can only be confirmed by laboratory testing for the presence of Zika virus RNA in the blood or other body fluids, such as urine or saliva.

Prevention

Mosquitoes and their breeding sites pose a significant risk factor for Zika virus infection. Prevention and control relies on reducing mosquitoes through source reduction (removal and modification of breeding sites) and reducing contact between mosquitoes and people.

This can be done by using insect repellent regularly; wearing clothes (preferably light-coloured) that cover as much of the body as possible; using physical barriers such as window screens, closed doors and windows; and if needed, additional personal protection, such as sleeping under mosquito nets during the day. It is extremely important to empty, clean or cover containers regularly that can store water, such as buckets, drums, pots etc. Other mosquito breeding sites should be cleaned or removed including flower pots, used tyres and roof gutters. Communities must support the efforts of the local government to reduce the density of mosquitoes in their locality.

Repellents should contain DEET (N, N-diethyl-3-methylbenzamide), IR3535 (3-[N-acetyl-N-butyl]-aminopropionic acid ethyl ester) or icaridin (1-piperidinecarboxylic acid, 2-(2-hydroxyethyl)-1-methylpropylester). Product label instructions should be strictly followed. Special attention and help should be given to those who may not be able to protect themselves adequately, such as young children, the sick or elderly.

During outbreaks, health authorities may advise that spraying of insecticides be carried out. Insecticides recommended by the WHO Pesticide Evaluation Scheme may also be used as larvicides to treat relatively large water containers.

Travellers should take the basic precautions described above to protect themselves from mosquito bites.

Treatment

Zika virus disease is usually relatively mild and requires no specific treatment. People sick with Zika virus should get plenty of rest, drink enough fluids, and treat pain and fever with common medicines. If symptoms worsen, they should seek medical care and advice. There is currently no vaccine available.

WHO response

WHO is supporting countries to control Zika virus disease through:

- Define and prioritize research into Zika virus disease by convening experts and partners.
- Enhance surveillance of Zika virus and potential complications.
- Strengthen capacity in risk communication to help countries meet their commitments under the International Health Regulations.
- Provide training on clinical management, diagnosis and vector control including through a number of WHO Collaborating Centres.
- Strengthen the capacity of laboratories to detect the virus.
- Support health authorities to implement vector control strategies aimed at reducing *Aedes* mosquito populations such as providing larvicide to treat still water sites that cannot be treated in other ways, such as cleaning, emptying, and covering them.
- Prepare recommendations for clinical care and follow-up of people with Zika virus, in collaboration with experts and other health agencies.

Zika virus/complications »

This page links all WHO information to its response on the Public Health Emergency of International Concern.

Zika virus fact sheet

- Portuguese
- Arabic
- Chinese
- French
- Russian
- Spanish

Related links

Zika virus disease

- Zika virus fact sheet in Portuguese
- Zika virus Q&A
- More on Zika virus

Microcephaly

- Microcephaly key facts
- Q&A: Women, Microcephaly and Zika virus (English version)
- Q&A: Women, Microcephaly and Zika virus (Portuguese version)
- More on Microcephaly

Guillain–Barré syndrome

- Guillain–Barré syndrome fact sheet
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Related

- **Zika virus disease**
- **Dispelling rumours around Zika and microcephaly**

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- **IHR Emergency Committee regarding Ebola**

Zika virus disease: Questions and answers

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Latest Ebola outbreak over in Liberia; West Africa is at zero, but new flare-ups are likely to occur

Commission on Ending Childhood Obesity

Middle East respiratory syndrome coronavirus (MERS-CoV) – Saudi Arabia

00881858

Mosquito Bite Prevention (United States)

Not all mosquitoes are the same. Different mosquitoes spread different viruses and bite at different times of the day.

Type of Mosquito	Viruses spread	Biting habits
Aedes aegypti, *Aedes albopictus*	Chikungunya, Dengue, Zika	Primarily daytime, but can also bite at night
Culex species	West Nile	Evening to morning

Protect yourself and your family from mosquito bites

Use insect repellent

Use an Environmental Protection Agency (EPA)-registered insect repellent with one of the following active ingredients. When used as directed, EPA-registered insect repellents are proven safe and effective, even for pregnant and breastfeeding women.

Active ingredient Higher percentages of active ingredient provide longer protection	**Some brand name examples***
DEET	Off!, Cutter, Sawyer, Ultrathon
Picaridin, also known as **KBR 3023, Bayrepel**, and **icaridin**	Cutter Advanced, Skin So Soft Bug Guard Plus, Autan (outside the United States)
Oil of lemon eucalyptus (OLE) or **para-menthane-diol** (PMD)	Repel
IR3535	Skin So Soft Bug Guard Plus Expedition, SkinSmart

* Insect repellent brand names are provided for your information only. The Centers for Disease Control and Prevention and the U.S. Department of Health and Human Services cannot recommend or endorse any name brand products.

00881859

Protect yourself and your family from mosquito bites *(continued)*

- Always follow the product label instructions.
- Reapply insect repellent every few hours, depending on which product and strength you choose.
  - » Do not spray repellent on the skin under clothing.
  - » If you are also using sunscreen, apply sunscreen first and insect repellent second.

Natural insect repellents (repellents not registered with EPA)

- The effectiveness of non-EPA registered insect repellents, including some natural repellents, is not known.
- To protect yourself against diseases like chikungunya, dengue, and Zika, CDC and EPA recommend using an EPA-registered insect repellent.
- When used as directed, EPA-registered insect repellents are proven safe and effective.
- For more information: www2.epa.gov/insect-repellents

If you have a baby or child

- Always follow instructions when applying insect repellent to children.
- Do not use insect repellent on babies younger than 2 months of age.
- Dress your child in clothing that covers arms and legs, or
- Cover crib, stroller, and baby carrier with mosquito netting.
- Do not apply insect repellent onto a child's hands, eyes, mouth, and cut or irritated skin.
  - » Adults: Spray insect repellent onto your hands and then apply to a child's face.
- Do not use products containing oil of lemon eucalyptus (OLE) or para-menthane-diol (PMD) on children under 3 years of age.

Treat clothing and gear

- Treat items such as boots, pants, socks, and tents with permethrin or purchase permethrin-treated clothing and gear.
  - » Permethrin-treated clothing will protect you after multiple washings. See product information to find out how long the protection will last.
  - » If treating items yourself, follow the product instructions.
  - » Do not use permethrin products directly on skin.

Mosquito-proof your home

- Use screens on windows and doors. Repair holes in screens to keep mosquitoes outside.
- Use air conditioning when available.
- Keep mosquitoes from laying eggs in and near standing water.
  - » Once a week, empty and scrub, turn over, cover, or throw out items that hold water, such as tires, buckets, planters, toys, pools, birdbaths, flowerpots, or trash containers. Check inside and outside your home.

ATTACHMENT 2
USACE ENG FORM 3394 ACCIDENT INVESTIGATION REPORT, BHATE HEALTH AND SAFETY FORMS, AND BHATE INCIDENT PROCEDURES AND POLICY

00881861

(For Safety Staff only)	REPORT NO.	EROC CODE	UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT (For Use of this Form See Help Menu and USACE Suppl to AR 385-40)	REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)

1. ACCIDENT CLASSIFICATION

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE	MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER		☐	

2. PERSONAL DATA

a. Name *(Last, First, MI)*	b. AGE	c. SEX ☐ MALE ☐ FEMALE	d. SOCIAL SECURITY NUMBER	e. GRADE

f. JOB SERIES/TITLE	g. DUTY STATUS AT TIME OF ACCIDENT	h. EMPLOYMENT STATUS AT TIME OF ACCIDENT
	☐ ON DUTY ☐ TDY ☐ OFF DUTY	☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER ☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL ☐ TEMPORARY ☐ STUDENT ☐ OTHER *(Specify)* ______

3. GENERAL INFORMATION

a. DATE OF ACCIDENT *(month/day/year)*	b. TIME OF ACCIDENT *(Military time)* hrs	c. EXACT LOCATION OF ACCIDENT	d. CONTRACTOR'S NAME (1) PRIME: (2) SUBCONTRACTOR:

e. CONTRACT NUMBER	f. TYPE OF CONTRACT	g. HAZARDOUS/TOXIC WASTE ACTIVITY
______ ☐ CIVIL WORKS ☐ MILITARY ☐ OTHER *(Specify)* ______	☐ CONSTRUCTION ☐ SERVICE ☐ A/E ☐ DREDGE ☐ OTHER *(Specify)* ______	☐ SUPERFUND ☐ DERP ☐ IRP ☐ OTHER *(Specify)* ______

4. CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see help menu)*

a. CONSTRUCTION ACTIVITY	(CODE) #	b. TYPE OF CONSTRUCTION EQUIPMENT	(CODE) #

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see help menu)*

a. SEVERITY OF ILLNESS/INJURY (CODE) #	b. ESTIMATED DAYS LOST	c. ESTIMATED DAYS HOSPIT-ALIZED	d. ESTIMATED DAYS RESTRICTED DUTY

e. BODY PART AFFECTED	g. TYPE AND SOURCE OF INJURY/ILLNESS
PRIMARY ______ (CODE) #	TYPE ______ (CODE) #
SECONDARY ______ (CODE) #	SOURCE ______ (CODE) #
f. NATURE OF ILLNESS/INJURY ______ (CODE) #	

6. PUBLIC FATALITY *(Fill in line and correspondence code number in box - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT (CODE) #	b. PERSONAL FLOATATION DEVICE USED? ☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE	b. TYPE OF COLLISION	c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
☐ PICKUP/VAN ☐ AUTOMOBILE	☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END	(1) FRONT SEAT			
☐ TRUCK ☐ OTHER *(Specify)* ______	☐ BROADSIDE ☐ ROLL OVER ☐ BACKING ☐ OTHER *(Specify)* ______	(2) REAR SEAT			

8. PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM	b. OWNERSHIP	c. $ AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and correspondence code number in box from list - see help menu)*

a. TYPE OF VESSEL/FLOATING PLANT (CODE) #	b. TYPE OF COLLISION/MISHAP (CODE) #

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

11. CAUSAL FACTOR(S) *(Read Instruction Before Completing)*

a. (Explain YES answers in item 13)

	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐

a. *(CONTINUED)*

	YES	NO
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident	☐	☐

b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES *(If yes, attach a copy.)* ☐ NO

12. TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING.	c. DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB	(Month) (Day) (Year)

13. **FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES** *(See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)*

a. DIRECT CAUSE

b. INDIRECT CAUSE(S)

14. ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).

DESCRIBE FULLY:

15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.

a. BEGINNING (Month/Day/Year)	b. ANTICIPATED COMPLETION (Month/Day/Year)

c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT	d. DATE *(Mo/Da/Yr)*	e. ORGANIZATION IDENTIFIER *(Div, Br, Sect)*	f. OFFICE SYMBOL
CORPS ____________ CONTRACTOR ____________			

16. MANAGEMENT REVIEW *(1st)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17. MANAGEMENT REVIEW *(2nd - Chief Operations, Construction, Engineering, etc.)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18. SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS

SIGNATURE	TITLE	DATE

19. COMMAND APPROVAL

COMMENTS

COMMANDER SIGNATURE	DATE

*U.S. GOVERNMENT PRINTING OFFICE: 1993-0-791-757

10. **ACCIDENT DESCRIPTION** *(Continuation)*

13a. **DIRECT CAUSE** *(Continuation)*

13b.	INDIRECT CAUSES *(Continuation)*

14.	ACTION(S) TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE(S) *(Continuation)*

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GENERAL. Complete a separate report for each person who was *injured, caused,* or *contributed* to the accident (excluding uninjured personnel and witnesses). Use of this form for reporting USACE employee first-aid type injuries not submitted to the Office of Workers' Compensation Programs (OWCP) shall be at the descretion of the FOA commander. Please type or print legibly. Appropriate items shall be marked with an "X" in box(es). If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16. and 17.

INSTRUCTIONS FOR SECTION 1— ACCIDENT CLASSIFICATION. *(Mark All Boxes That Are Applicable.)*

a. GOVERNMENT. Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.

(1) INJURY/ILLNESS/FATALITY—Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of OWCP Forms CA-1 (injury), CA-2 (illness), or CA-6 (fatality) to OWCP; mark if accident resulted in military personnel lost-time or fatal injury or illness.

($2,000 or more) (2) PROPERTY DAMAGE—Mark the appropriate box if accident resulted in any damage of $~~1~~2000 or more to government property (including motor vehicles). also see ER 385-1-99 for new classes of accidents.

(3) VEHICLE INVOLVED—Mark if accident involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY—Mark if the accident involved an in-house USACE diving activity.

b. CONTRACTOR.

(1) INJURY/ILLNESS/FATALITY—Mark if accident resulted in any contractor lost-time injury/illness or fatality.

($2,000 or more) (2) PROPERTY DAMAGE—Mark the appropriate box if accident resulted in any damage of $~~1~~2000 or more to contractor property (including motor vehicles). also see ER 385-1-99 for classes of accidents

(3) VEHICLE INVOLVED—Mark if accident involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY—Mark if the accident involved a USACE Contractor diving activity.

c. PUBLIC.

(1) INJURY/ILLNESS/FATALITY—Mark if accident resulted in public fatality or permanent total disability. (The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander).

(2) VOID SPACE—Make no entry.

(3) VEHICLE INVOLVED—Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" is marked.

(4) VOID SPACE—Make no entry.

INSTRUCTIONS FOR SECTION 2—PERSONAL DATA

a. NAME—(MANDATORY FOR GOVERNMENT ACCIDENTS. OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER FOR CONTRACTOR AND PUBLIC ACCIDENTS). Enter last name, first name, middle initial of person involved.

b. AGE—Enter age.

c. SEX—Mark appropriate box.

d. SOCIAL SECURITY NUMBER—(FOR GOVERNMENT PERSONNEL ONLY) Enter the social security number (or other personal identification number if no social security number issued).

e. GRADE—(FOR GOVERNMENT PERSONNEL ONLY) Enter pay grade. Example: O-6; E-7; WG-8; WS-12; GS-11; etc.

f. JOB SERIES/TITLE—For *government civilian employees* enter the pay plan, full series number, and job title, e.g. GS-0810/Civil Engineer. For *military personnel* enter the primary military occupational specialty (PMOS), e.g., 15A30 or 11G50. For *contractor employees* enter the job title assigned to the injured person, e.g. carpenter, laborer, surveyor, etc.,

g. DUTY STATUS—Mark the appropriate box.

(1) ON DUTY—Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.

(2) TDY - Person was on official business, away from the duty station and with travel orders at time of accident. Line-of-duty investigation required.

(3) OFF DUTY - Person was not on official business at time of accident

h. EMPLOYMENT STATUS—(FOR GOVERNMENT PERSONNEL ONLY) Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3—GENERAL INFORMATION

a. DATE OF ACCIDENT—Enter the month, day, and year of accident.

b. TIME OF ACCIDENT—Enter the local time of accident in military time. Example: 1430 hrs (not 2:30 p.m.).

c. EXACT LOCATION OF ACCIDENT—Enter facts needed to locate the accident scene. (installation/project name, building number, street, direction and distance from closest landmark, etc.,).

d. CONTRACTOR NAME

(1) PRIME—Enter the exact name (title of firm) of the prime contractor.

(2) SUBCONTRACTOR—Enter the name of any subcontractor involved in the accident.

e. CONTRACT NUMBER—Mark the appropriate box to identify if contract is civil works, military, or other: if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.

f. TYPE OF CONTRACT—Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.

g. HAZARDOUS/TOXIC WASTE ACTIVITY (HTW)—Mark the box to identify the HTW activity being performed at the time of the accident. For Superfund, DERP, and Installation Restoration Program (IRP) HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site (FUDS) activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4—CONSTRUCTION ACTIVITIES

a. CONSTRUCTION ACTIVITY—Select the *most appropriate* construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

1. MOBILIZATION	14. ELECTRICAL
2. SITE PREPARATION	15. SCAFFOLDING/ACCESS
3. EXCAVATION/TRENCHING	16. MECHANICAL
4. GRADING (EARTHWORK)	17. PAINTING
5. PIPING/UTILITIES	18. EQUIPMENT/MAINTENANCE
6. FOUNDATION	19. TUNNELING
7. FORMING	20. WAREHOUSING/STORAGE
8. CONCRETE PLACEMENT	21. PAVING
9. STEEL ERECTION	22. FENCING
10. ROOFING	23. SIGNING
11. FRAMING	24. LANDSCAPING/IRRIGATION
12. MASONRY	25. INSULATION
13. CARPENTRY	26. DEMOLITION

b. TYPE OF CONSTRUCTION EQUIPMENT—Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24, "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

1. GRADER
2. DRAGLINE
3. CRANE (ON VESSEL/BARGE)
4. CRANE (TRACKED)
5. CRANE (RUBBER TIRE)
6. CRANE (VEHICLE MOUNTED)
7. CRANE (TOWER)
8. SHOVEL
9. SCRAPER
10. PUMP TRUCK (CONCRETE)
11. TRUCK (CONCRETE/TRANSIT MIXER)
12. DUMP TRUCK (HIGHWAY)
13. DUMP TRUCK (OFF HIGHWAY)
14. TRUCK (OTHER)
15. FORKLIFT
16. BACKHOE
17. FRONT-END LOADER
18. PILE DRIVER
19. TRACTOR (UTILITY)
20. MANLIFT
21. DOZER
22. DRILL RIG
23. COMPACTOR/VIBRATORY ROLLER
24. OTHER

INSTRUCTIONS FOR SECTION 5—INJURY/ILLNESS INFORMATION

a. SEVERITY OF INJURY / ILLNESS - Reference para 2-10 of USACE Suppl 1 to AR 385-40 and enter code and description from list below.

NOI	NO INJURY
FAT	FATALITY
PTL	PERMANENT TOTAL DISABILITY
PPR	PERMANENT PARTIAL DISABILITY
LWD	LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK
NLW	RECORDABLE CASE WITHOUT LOST WORKDAYS
RFA	RECORDABLE FIRST AID CASE
NRI	NON-RECORDABLE INJURY

b. ESTIMATED DAYS LOST—Enter the estimated number of workdays the person will lose from work.

c. ESTIMATED DAYS HOSPITALIZED—Enter the estimated number of workdays the person will be hospitalized.

d. ESTIMATED DAYS RESTRICTED DUTY—Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.

e. BODY PART AFFECTED—Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box.

GENERAL BODY AREA	CODE	BODY PART NAME
ARM/WRIST	AB	ARM AND WRIST
	AS	ARM OR WRIST
TRUNK, EXTERNAL MUSCULATURE	B1	SINGLE BREAST
	B2	BOTH BREASTS
	B3	SINGLE TESTICLE
	B4	BOTH TESTICLES
	BA	ABDOMEN
	BC	CHEST
	BL	LOWER BACK
	BP	PENIS
	BS	SIDE
	BU	UPPER BACK
	BW	WAIST
	BZ	TRUNK OTHER
HEAD, INTERNAL	C1	SINGLE EAR INTERNAL
	C2	BOTH EARS INTERNAL
	C3	SINGLE EYE INTERNAL
	C4	BOTH EYES INTERNAL
	CB	BRAIN
	CC	CRANIAL BONES
	CD	TEETH
	CJ	JAW
	CL	THROAT, LARYNX
	CM	MOUTH
	CN	NOSE
	CR	THROAT, OTHER
	CT	TONGUE
	CZ	HEAD OTHER INTERNAL
ELBOW	EB	BOTH ELBOWS
	ES	SINGLE ELBOW
FINGER	F1	FIRST FINGER
	F2	BOTH FIRST FINGERS
	F3	SECOND FINGER
	F4	BOTH SECOND FINGERS
	F5	THIRD FINGER
	F6	BOTH THIRD FINGERS
	F7	FOURTH FINGER
	F8	BOTH FOURTH FINGERS
TOE	G1	GREAT TOE
	G2	BOTH GREAT TOES
	G3	TOE OTHER
	G4	TOES OTHER
HEAD, EXTERNAL	H1	EYE EXTERNAL
	H2	BOTH EYES EXTERNAL
	H3	EAR EXTERNAL
	H4	BOTH EARS EXTERNAL
	HC	CHIN
	HF	FACE
	HK	NECK/THROAT
	HM	MOUTH/LIPS
	HN	NOSE
	HS	SCALP
KNEE	KB	BOTH KNEES
	KS	KNEE
LEG, HIP, ANKLE, BUTTOCK	LB	BOTH LEGS/HIPS/ ANKLES/BUTTOCKS
	LS	SINGLE LEG/HIP ANKLE/BUTTOCK
HAND	MB	BOTH HANDS
	MS	SINGLE HAND
FOOT	PB	BOTH FEET
	PS	SINGLE FOOT
TRUNK, BONES	R1	SINGLE COLLAR BONE
	R2	BOTH COLLAR BONES
	R3	SHOULDER BLADE
	R4	BOTH SHOULDER BLADES
	RB	RIB
	RS	STERNUM (BREAST BONE)
	RV	VERTEBRAE (SPINE; DISC)
	RZ	TRUNK BONES OTHER
SHOULDER	SB	BOTH SHOULDERS
	SS	SINGLE SHOULDER
THUMB	TB	BOTH THUMBS
	TS	SINGLE THUMB
TRUNK, INTERNAL ORGANS	V1	LUNG, SINGLE
	V2	LUNGS, BOTH
	V3	KIDNEY, SINGLE
	V4	KIDNEYS, BOTH
	VH	HEART
	VL	LIVER
	VR	REPRODUCTIVE ORGANS
	VS	STOMACH
	VV	INTESTINES
	VZ	TRUNK, INTERNAL; OTHER

f. NATURE OF INJURY/ILLNESS - Select the most appropriate nature of injury / illness from the list below. This nature of injury / illness shall correspond to the primary body part selected in 5e, above. Enter the nature of injury / illness name on the line and place the corresponding CODE letters in the box provided.

* The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
*TRAUMATIC INJURY OR DISABILITY	TA	AMPUTATION
	TB	BACK STRAIN
	TC	CONTUSION; BRUISE; ABRASION
	TD	DISLOCATION
	TF	FRACTURE
	TH	HERNIA
	TK	CONCUSSION
	TL	LACERATION, CUT
	TP	PUNCTURE
	TS	STRAIN, MULTIPLE
	TU	BURN, SCALD, SUNBURN
	TI	TRAUMATIC SKIN DISEASES/ CONDITIONS INCLUDING DERMATITIS
	TR	TRAUMATIC RESPIRATORY DISEASE
	TQ	TRAUMATIC FOOD POISONING
	TW	TRAUMATIC TUBERCULOSIS
	TX	TRAUMATIC VIROLOGICAL/ INFECTIVE/PARASITIC DISEASE
	T1	TRAUMATIC CEREBRAL VASCULAR CONDITION/STROKE
	T2	TRAUMATIC HEARING LOSS
	T3	TRAUMATIC HEART CONDITION
	T4	TRAUMATIC MENTAL DISORDER; STRESS; NERVOUS CONDITION
	T8	TRAUMATIC INJURY — OTHER (EXCEPT DISEASE, ILLNESS)

**A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins, poisons, fumes, etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes, an occupational illness/disease or disability is any reported condition which does not meet the definition of traumatic injury or disability as described above.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
**NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY		
RESPIRATORY DISEASE	RA	ASBESTOSIS
	RB	BRONCHITIS
	RE	EMPHYSEMA
	RP	PNEUMOCONIOSIS
	RS	SILICOSIS
	R9	RESPIRATORY DISEASE, OTHER
VIROLOGICAL, INFECTIVE & PARASITIC DISEASES	VB	BRUCELLOSIS
	VC	COCCIDIOMYCOSIS
	VF	FOOD POISONING
	VH	HEPATITIS
	VM	MALARIA
	VS	STAPHYLOCOCCUS
	VT	TUBERCULOSIS
	V9	VIROLOGICAL/INFECTIVE/ PARASITIC—OTHER
DISABILITY, OCCUPATIONAL	DA	ARTHRITIS, BURSITIS
	DB	BACK STRAIN, BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION; STROKE
	DD	ENDEMIC DISEASE (OTHER THAN CODE TYPES R&S)
	DE	EFFECT OF ENVIRONMENTAL CONDITION
	DH	HEARING LOSS
	DK	HEART CONDITION
	DM	MENTAL DISORDER, EMOTIONAL STRESS NERVOUS CONDITION
	DR	RADIATION
	DS	STRAIN, MULTIPLE
	DU	ULCER
	DV	OTHER VASCULAR CONDITIONS
	D9	DISABILITY, OTHER
SKIN DISEASE OR CONDITION	SB	BIOLOGICAL
	SC	CHEMICAL
	S9	DERMATITIS, UNCLASSIFIED

g. TYPE AND SOURCE OF INJURY/ILLNESS (CAUSE) - Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the initiating source of the incident (see example 1, below). Examples:

(1) An employee tripped on carpet and struck his head on a desk.
TYPE: 210 (fell on same level) SOURCE: 0110 (walking/working surface)

NOTE: This example would NOT be coded 120 (struck against) and 0140 (furniture).

(2) A Park Ranger contracted dermatitis from contact with poison ivy/ oak.
TYPE: 510 (contact) SOURCE: 0920 (plant)

(3) A lock and dam mechanic punctured his finger with a metal sliver while grinding a turbine blade.
TYPE: 410 (punctured by) SOURCE: 0830 (metal)

(4) An employee was driving a government vehicle when it was struck by another vehicle..
TYPE: 800 (traveling in) SOURCE: 0421 (government-owned vehicle, as driver)

NOTE: The Type Code 800, "Traveling In" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality, but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	TYPE OF INJURY NAME
	STRUCK
0110	STRUCK BY
0111	STRUCK BY FALLING OBJECT
0120	STRUCK AGAINST
	FELL, SLIPPED, TRIPPED
0210	FELL ON SAME LEVEL
0220	FELL ON DIFFERENT LEVEL
0230	SLIPPED, TRIPPED (NO FALL)
	CAUGHT
0310	CAUGHT ON
0320	CAUGHT IN
0330	CAUGHT BETWEEN
	PUNCTURED, LACERATED
0410	PUNCTURED BY
0420	CUT BY
0430	STUNG BY
0440	BITTEN BY
	CONTACTED
0510	CONTACTED WITH (INJURED PERSON MOVING)
0520	CONTACTED BY (OBJECT WAS MOVING)
	EXERTED
0610	LIFTED, STRAINED BY (SINGLE ACTION)
0620	STRESSED BY (REPEATED ACTION)
	EXPOSED
0710	INHALED
0720	INGESTED
0730	ABSORBED
0740	EXPOSED TO
0800	TRAVELING IN

CODE	SOURCE OF INJURY NAME
0100	BUILDING OR WORKING AREA
0110	WALKING/WORKING SURFACE (FLOOR, STREET, SIDEWALKS, ETC)
0120	STAIRS, STEPS
0130	LADDER
0140	FURNITURE, FURNISHINGS, OFFICE EQUIPMENT
0150	BOILER, PRESSURE VESSEL
0160	EQUIPMENT LAYOUT (ERGONOMIC)
0170	WINDOWS, DOORS
0180	ELECTRICITY

CODE	SOURCE OF INJURY NAME
0200	ENVIRONMENTAL CONDITION
0210	TEMPERATURE EXTREME (INDOOR)
0220	WEATHER (ICE, RAIN, HEAT, ETC.)
0230	FIRE, FLAME, SMOKE (NOT TOBACCO)
0240	NOISE
0250	RADIATION
0260	LIGHT
0270	VENTILATION
0271	TOBACCO SMOKE
0280	STRESS (EMOTIONAL)
0290	CONFINED SPACE
0300	MACHINE OR TOOL
0310	HAND TOOL (POWERED: SAW, GRINDER, ETC.)
0320	HAND TOOL (NONPOWERED)
0330	MECHANICAL POWER TRANSMISSION APPARATUS
0340	GUARD, SHIELD (FIXED, MOVEABLE, INTERLOCK)
0350	VIDEO DISPLAY TERMINAL
0360	PUMP, COMPRESSOR, AIR PRESSURE TOOL
0370	HEATING EQUIPMENT
0380	WELDING EQUIPMENT
0400	VEHICLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE
0421	DRIVER OF GOVERNMENT VEHICLE
0422	PASSENGER OF GOVERNMENT VEHICLE
0430	COMMON CARRIER (AIRLINE, BUS, ETC.)
0440	AIRCRAFT (NOT COMMERCIAL)
0450	BOAT, SHIP, BARGE
0500	MATERIAL HANDLING EQUIPMENT
0510	EARTHMOVER (TRACTOR, BACKHOE, ETC.)
0520	CONVEYOR (FOR MATERIAL AND EQUIPMENT)
0530	ELEVATOR, ESCALATOR, PERSONNEL HOIST
0540	HOIST, SLING CHAIN, JACK
0550	CRANE
0551	FORKLIFT
0560	HANDTRUCK, DOLLY
0600	DUST, VAPOR, ETC.
0610	DUST (SILICA, COAL, ETC.)
0620	FIBERS
0621	ASBESTOS
0630	GASES
0631	CARBON MONOXIDE
0640	MIST, STEAM, VAPOR, FUME
0641	WELDING FUMES
0650	PARTICLES (UNIDENTIFIED)
0700	CHEMICAL, PLASTIC, ETC.
0711	DRY CHEMICAL—CORROSIVE
0712	DRY CHEMICAL—TOXIC
0713	DRY CHEMICAL—EXPLOSIVE
0714	DRY CHEMICAL—FLAMMABLE
0721	LIQUID CHEMICAL—CORROSIVE
0722	LIQUID CHEMICAL—TOXIC
0723	LIQUID CHEMICAL—EXPLOSIVE
0724	LIQUID CHEMICAL—FLAMMABLE
0730	PLASTIC
0740	WATER
0750	MEDICINE
0800	INANIMATE OBJECT
0810	BOX, BARREL, ETC.
0820	PAPER
0830	METAL ITEM, MINERAL
0831	NEEDLE
0840	GLASS
0850	SCRAP, TRASH
0860	WOOD
0870	FOOD
0880	CLOTHING, APPAREL, SHOES
0900	ANIMATE OBJECT
0911	DOG
0912	OTHER ANIMAL
0920	PLANT
0930	INSECT
0940	HUMAN (VIOLENCE)
0950	HUMAN (COMMUNICABLE DISEASE)
0960	BACTERIA, VIRUS (NOT HUMAN CONTACT)

CODE	SOURCE OF INJURY NAME
1000	PERSONAL PROTECTIVE EQUIPMENT
1010	PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES
1020	RESPIRATOR, MASK
1021	DIVING EQUIPMENT
1030	SAFETY BELT, HARNESS
1040	PARACHUTE

INSTRUCTIONS FOR SECTION 6 — PUBLIC FATALITY

a. ACTIVITY AT TIME OF ACCIDENT—Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the *most* appropriate primary activity area (water related, non-water related or other activity), the code number for "Other", and write in the activity being performed at the time of the accident.

WATER RELATED RECREATION

1. Sailing
2. Boating—powered
3. Boating—unpowered
4. Water skiing
5. Fishing from boat
6. Fishing from bank dock or pier
7. Fishing while wading
8. Swimming/supervised area
9. Swimming/designated area
10. Swimming/other area
11. Underwater activities (skin diving, scuba, etc.)
12. Wading
13. Attempted rescue
14. Hunting from boat
15. Other

NON-WATER RELATED RECREATION

16. Hiking and walking
17. Climbing (general)
18. Camping/picnicking authorized area
19. Camping/picnicking unauthorized area
20. Guided tours
21. Hunting
22. Playground equipment
23. Sports/summer (baseball, football, etc.)
24. Sports/winter (skiing, sledding, snowmobiling etc.)
25. Cycling (bicycle, motorcycle, scooter)
26. Gliding
27. Parachuting
28. Other non-water related

OTHER ACTIVITIES

29. Unlawful acts (fights, riots, vandalism, etc.)
30. Food preparation/serving
31. Food consumption
32. Housekeeping
33. Sleeping
34. Pedestrian struck by vehicle
35. Pedestrian other acts
36. Suicide
37. "Other" activities

b. PERSONAL FLOTATION DEVICE USED—If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7—MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE—Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

b. TYPE OF COLLISION—Mark appropriate box.

c. SEAT BELT—Mark appropriate box.

INSTRUCTIONS FOR SECTION 8—PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM—Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number (NSN) whenever applicable.

b. OWNERSHIP—Enter ownership for each item listed. (Enter one of the following: *USACE; OTHER GOVERNMENT; CONTRACTOR; PRIVATE)*

c. $ AMOUNT OF DAMAGE—Enter the total estimated dollar amount of damage (parts and labor), if any.

INSTRUCTIONS FOR SECTION 9—VESSEL/ FLOATING PLANT ACCIDENT

a. TYPE OF VESSEL/FLOATING PLANT—Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below, enter item number for "OTHER" and write in specific type of vessel/ floating plant.

VESSEL/FLOATING PLANTS

1. ROW BOAT	7. DREDGE/DIPPER
2. SAIL BOAT	8. DREDGE/CLAMSHELL, BUCKET
3. MOTOR BOAT	9. DREDGE/PIPE LINE
4. BARGE	10. DREDGE/DUST PAN
5. DREDGE/HOPPER	11. TUG BOAT
6. DREDGE/SIDE CASTING	12. OTHER

b. COLLISION/MISHAP—Select from the list below the object(s) that contributed to the accident or were damaged in the accident.

COLLISION/MISHAP

1. COLLISION W/OTHER VESSEL	7. HAULAGE UNIT
2. UPPER GUIDE WALL	8. BREAKING TOW
3. UPPER LOCK GATES	9. TOW BREAKING UP
4. LOCK WALL	10. SWEPT DOWN ON DAM
5. LOWER LOCK GATES	11. BUOY/DOLPHIN/CELL
6. LOWER GUIDE WALL	12. WHARF OR DOCK
	13. OTHER

INSTRUCTIONS FOR SECTION 10—ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT—Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role(s) in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11—CAUSAL FACTORS

a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

(1) DESIGN—Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?

(2) INSPECTION/MAINTENANCE—Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?

(3) PERSON'S PHYSICAL CONDITION—Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?

(4) OPERATING PROCEDURES—Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?

(5) JOB PRACTICES—Were any of the provisions of the Safety and Health Requirements Manual (EM 385-1-1) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (including EM 385-1-1) fail to adequately address the task or work process? Would better job practices improve the safety of the task?

(6) HUMAN FACTORS—Was the person under undue stress (either internal or external to the job)? Did the task tend toward overloading the capabilities of the person; i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

(7) ENVIRONMENTAL FACTORS—Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

(8) CHEMICAL AND PHYSICAL AGENT FACTORS—Did exposure to chemical agents (either single shift exposure or long-term exposure) such as dusts, fibers (asbestos, etc.), silica, gases (carbon monoxide, chlorine, etc.), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by-products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (UV radiation created during welding, etc.) contribute to the accident/incident?

(9) OFFICE FACTORS—Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?

(10) SUPPORT FACTORS—Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (in terms of employee skills, number of workers, and adequate supervision) available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc?

(11) PERSONAL PROTECTIVE EQUIPMENT—Did the person fail to use appropriate personal protective equipment (gloves, eye protection, hard-toed shoes, respirator, etc.) for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?

(12) DRUGS/ALCOHOL—Is there any reason to believe the person's mental or physical capabilities, judgement, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

b. WRITTEN JOB/ACTIVITY HAZARD ANALYSIS—Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. *If one was performed, attach a copy of the analysis to the report.*

INSTRUCTIONS FOR SECTION 12—TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?—For the purpose of this section "trained" means the person has been provided the necessary information (either formal and/or on-the-job (OJT) training) to competently perform the activity/task in a safe and healthful manner.

b. TYPE OF TRAINING—Mark the appropriate box that best indicates the type of training; (classroom or on-the-job) that the injured person received before the accident happened.

c. DATE OF MOST RECENT TRAINING—Enter the month, day, and year of the last *formal* training completed that covered the activity-task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13—CAUSES

a. DIRECT CAUSES—The direct cause is that single factor which most directly lead to the accident. See examples below.

b. INDIRECT CAUSES—Indirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13:

a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.
Direct cause: failure to provide fall protection at elevation.
Indirect causes: failure to enforce USACE safety requirements; improper training/motivation of employee (possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. (note USACE vehicle was in proper/safe working condition).
Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.
Indirect cause: Failure of employee to pay attention to driving (defensive driving).

INSTRUCTIONS FOR SECTION 14—ACTION TO ELIMINATE CAUSE(S)

DESCRIPTION—Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15—DATES FOR ACTION

a. BEGIN DATE—Enter the date when the corrective action(s) identified in Section 14 will begin.

b. COMPLETE DATE—Enter the date when the corrective action(s) identified in Section 14 will be completed.

c. TITLE AND SIGNATURE—Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE Supervisor shall also sign the report. Upon entering the information required in 15.d, 15.e and 15.f below, the responsible USACE supervisor shall forward the report for management review as indicated in Section 16.

d. DATE SIGNED—Enter the month, day, and year that the report was signed by the responsible supervisor.

e. ORGANIZATION NAME—For GOVERNMENT employee accidents enter the USACE organization name (Division, Branch, Section, etc.) of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15.c. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

f. OFFICE SYMBOL—Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15.e.

INSTRUCTIONS FOR SECTION 16—MANAGEMENT REVIEW (1st)

1ST REVIEW—Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15.c shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt, the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief (2nd review) for review and comment.

INSTRUCTIONS FOR SECTION 17—MANAGEMENT REVIEW (2nd)

2ND REVIEW—The FOA Staff Chief (i.e., FOA Chief of Construction, Operations, Engineering, Planning, etc.) shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18—SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW—The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc, are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19—COMMAND APPROVAL

4TH REVIEW—The FOA Commander shall (to include the person designated Acting Commander in his absence) review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.

EXHIBIT A

Minimum Safety Requirements for Subcontractors

Subcontractor is required to supply their employees with the proper personal protective equipment as required

- ANSI approved hard hats must be worn while in the work area
- ANSI approved safety glasses with rigid side shields must be worn while in the work area
- Substantial/sturdy work boots are required while on site. Sandals, tennis shoes, or any other soft cloth, nylon, and/or low cut shoes are NOT permitted. Steel toe shoes and/or foot guards may be required for trades or any activities that could present an impact or compression hazard to the foot (i.e. steel erectors, masonry, work that involves lifting, rolling, material handling, jack hammering, compacting, pile driving, drilling, or any other activity that is otherwise indicated on the Site Safety and Health Plan (SSHP)).
- Work gloves (leather, Kevlar, or other) must be worn while handling sharp or abrasive objects.
- Long pants are required. Nylon warm-up suits are NOT permitted on the job site.
- Work shirts with at least 4" sleeves are required. Sleeveless and tank top shirts are NOT permitted.
- Hearing protection, respiratory protection, and other personal protective equipment shall be worn when required.
- All employees shall wear full body safety harnesses when working 6 feet or more above the ground on any unprotected ledge or platform. The lanyard shall be secured 100% of the time and shall allow a max fall distance of 6 feet. Safety harnesses shall also be worn while working out of extensible and articulating boom platforms or suspended scaffolds. All employees required to use fall protection equipment shall have received appropriate training by the subcontractor.
- All hand, power tools, and any associated parts such as electrical cords, air lines, etc. shall be maintained in a safe condition and inspected monthly. Damaged tools must be tagged and taken out of service until repairs can be made. Electrical cords may not be spliced and taped back together. Ground fault circuit interrupters shall be used for temporary power, generators > 5000 watts, & in all moist areas. All electrical work, installation, and wire capacities shall be in accordance with the pertinent provisions of the NEC, ANSI, and OSHA; All temporary power panels shall have covers installed at all times. All open or exposed breaker spaces shall be adequately covered and labeled.
  Knockout plugs shall be replaced immediately.
- Compressed gas cylinders shall be secured and stored in an appropriate area in an upright position at all times; Oxygen and acetylene cylinders or other combustible materials shall be separated by distance of >20 feet or by a non combustible barrier 5 feet high with a ½ hour fire rating; anti-flash back valves are required on oxygen/acetylene.
- All scaffolds will be erected, used, and dismantled under the supervision of a trained, competent person designated by the subcontractor. Scaffolds must be inspected + tagged by the sub's competent person prior to each work shift.
- All cranes and derricks shall be certified by a competent person designated by the subcontractor as being in safe operating condition prior to use with documentation daily onsite and inspected monthly thereafter; all rigging equipment will be inspected prior to use and monthly by a competent person designated by the subcontractor; the swing radius of the crane counterweight shall be barricaded; personnel are not permitted to walk under

loads while being lifted and loads are not permitted to be swung over personnel; all equipment will not be operated within 25 feet of any overhead utilities; critical lifts (lifts that require more than one crane, over 75% of the manufacturer's recommended lift capacity) must be approved by Bhate Corporate Health and Safety.

- All equipment and motor vehicles must be inspected with documentation prior to use daily and monthly inspections must be conducted by the subcontractor; defective equipment or vehicles will be repaired or taken out of service immediately; all mobile equipment will be equipped with roll-over protection and seat belts to be worn at all times while in operation; all operators of construction equipment must be certified by a competent person designated by the subcontractor; all equipment will not be operated within 25 feet of any overhead utilities; all mobile equipment onsite must have a functioning back-up alarm where equipped by the manufacturer; if a piece of equipment was not equipped with a back-up alarm, the horn shall be used prior to and during backing.
- Bhate shall issue a lockout and tag (LOTO) procedure if the subcontractor does not have their own, and when there are multiple subcontractors participating in the LOTO process.
- The use of damaged ladders is prohibited; metal ladders are not to be used where electrical hazards exist; ladders shall extend 36" above landing and be secured to prevent displacement.
- Floor and wall openings shall be guarded by a standard guardrail and toe board, or adequately covered and labeled.
- Stairs with four or more risers must have railings installed.
- The subcontractor must notify the Bhate Superintendent prior to conducting any excavation activity; underground utilities must be identified prior to performing excavations by calling 811 (one call utility locate service); no excavations can occur within a 4 foot "buffer zone" of any underground utility; excavations must be inspected daily with documentation by a competent person and after each rainfall and/or any other hazard increasing occurrence to determine their safety; all excavations four feet or more in depth shall be tested at least daily to determine that the atmosphere within the excavation is safe if there is reason to believe an atmospheric hazard exists; all banks/excavations five feet or more shall be sloped to the angle of repose (i.e. Type A soil = 53 degrees from horizontal; Type B soil = 45 degrees; and Type C soil = 34 degrees), shall be shielded, or shall be adequately shored; the protection system used for the excavation shall be determined by classifying the soil by a competent person designated by the subcontractor; excavations > 20 feet are not permitted without the assistance of a PE; ladders or steps shall be provided for all trenches 4 feet or more in depth and shall be located to require no more than 25 feet of lateral travel before having access or egress; excavated or loose materials must be kept at least 2 feet from the edge of the excavation; all trenches and excavations shall be properly marked and barricaded.
- Steel erection shall not commence until approval is obtained by Bhate; all personnel performing steel erection must be trained in fall protection, and any specialized training for connectors for employees working in the controlled decking zone.
- As applicable all subcontractors shall have a confined space program submitted to and approved by Bhate including entry procedures to be used when employees are required to

EXHIBIT A

Minimum Safety Requirements for Subcontractors

work in confined spaces. All affected employees must be properly trained. Atmospheric testing must be conducted prior to entry and hazards must be communicated with affected individuals. Bhate shall be notified prior to any confined space work.

- The subcontractor is responsible for supplying the necessary equipment and calibration gases to conduct atmospheric testing for their affected employees as required by OSHA and/or the SSHP.
- Housekeeping must be maintained by the subcontractor while working on site. Bhate must be notified of any hazardous material brought on site with MSDS provided by the subcontractor and/or of any hazardous waste generated at the site. The subcontractor is responsible for storage of their hazardous waste and proper disposal. Documentation of proper disposal must be submitted to Bhate.
- All protruding nail, tie rods and wires shall be removed from foundations or boards as soon as forms are stripped. Nails shall be bent over if not removed. All protruding rebar must have cap impalement protectors in place.
- No open fires of scrap lumber or any other material are permitted; smoking is only allowed in pre-designated areas.
- Subcontractor(s) will abide by the Bhate APP at all times.

- No alcohol or illegal substances are allowed on site. Drug testing will be required of any employee for reasonable cause of suspicious behavior or activity including accidents or incidents.
- All injuries, accidents, near misses, chemical spills, fires, property damage, or other incidents must be reported immediately to Bhate.
- Prior to any demolition project an engineering survey must be completed and used to evaluate the hazards; all affected utilities must be disconnected by the utility companies; provisions must be made for prompt medical attention in the event of an emergency; a fire prevention and protection plan must be developed and implemented.
- The subcontractor must designate a competent person as their safety representative who will be responsible for conducting weekly safety meetings, daily inspections of the work areas, formal weekly inspections, as well as all aforementioned monthly inspections. Documentation of all inspections must be maintained and made available.
- The subcontractor must submit a copy of all written safety programs that covers the subcontractor's activities to Bhate prior to start of work for approval; the subcontractor is responsible for ensuring all affected employees have all required health and safety training to perform the assigned tasks.

This list includes some highlighted components of the health and safety rules while working onsite and is not all inclusive. Subcontractors are expected to comply with all applicable regulations to include but not limited to OSHA, EPA, DOT, site specific safety, and local and state regulations. Only through a written request detailing to Bhate Corporate Health and Safety may any subcontractor requirement be downgraded either based on a lack of hazard or a situation where the requirement increases the hazard.

DEFICIENCY TRACKING						
Item #	Date Deficiency Identified	Description of Deficiency	Name of Person Responsible for Corrective Action	Projected Resolution Date	Date Actually Resolved	Description of Resolution
1						
2						
3						
4						
5						
6						
7						
8						

Confined Space Entry Permit

Permit Valid for one shift only. All Permit copies to remain at project site until completion of the project.

Project Location (Address, City, State, Site Description):	**Date:**	**Time:**	**Project Number:**

Supervisor on Duty:	**Supervisor Phone Number:**	**Purpose of Entry:**

Communication Procedures:
Rescue Procedures and Phone Numbers:

Requirements Completed					
	Date	**Time**		**Date**	**Time**
Breathing Apparatus			Line(s) Broken-Capped Blank		
Emergency Escape/Fall Retrieval Equipment			Lighting (Explosive Proof)		
Full Body Harness w/ "D" Ring			Fire Extinguishers		
Lifelines			Secure Area (Post and Flag)		
Protective Clothing			Ventilation		
Respiratory Protection			Purge-Flush and Vent		
Standby Safety Personnel					

Note: For items that do not apply, enter N/A in the blank.

Instrumentation
Manufacturer:
Model:
Serial #:
Date of Last Factory Calibration:

Pre-Entry Calibration Data		
Date and Time		
Gas Type	**Concentration**	**Instrument Reading**

Post-Entry Calibration Data		
Date and Time		
Gas Type	**Concentration**	**Instrument Reading**

bhate
ENVIRONMENT
INFRASTRUCTURE

Confined Space Entry Permit

Air Monitoring Record Monitoring Results At Least Every ¼ Hour							
Parameters	**Permissible Entry Level**	**Times**					
Percent Oxygen	**19.5% - 22.0%**						
Lower Flammable Level	**< 10%**						

Entry Participants		
Name	**Signature**	**Duty (Supervisor, Entrant, Attendant)**

Remarks:

Entry Authorization Supervisor has reviewed the permit and verified the confined space conditions	
Supervisor Signature:	**Date/Time:**

Confined Space Pre-Entry Briefing Checklist

Project Location (Address, City, State, Site Description):	Date:	Time:	Project Number:
Checklist Completed By:	**Attendee(s):**		

- ☐ Hazard Communication (including the signs, symptoms, and modalities of chemical overexposure)
- ☐ Physical hazards present
- ☐ All hazard controls
- ☐ Acceptable entry conditions
- ☐ Emergency procedures
- ☐ Rescue procedures
- ☐ Duties of entrants and attendants during routine and emergency operations
- ☐ Frequency and Types of Monitoring
- ☐ Communications system backup to be used
- ☐ Review of work to be accomplished during entry
- ☐ Decontamination procedures (if necessary)
- ☐ PPE disposal
- ☐ Potential emergencies that may occur outside the confined space

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ENVIRONMENT
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Construction Equipment Inspection Checklist

Project Name:	**Date /Time:** **S M T W Th F S (Please circle the day)**
Type of Inspection: **Incoming ____** **Outgoing ____** **(Please check the inspection type)** **Daily ____**	**Equipment Make/Description:** **Equipment Model Number:** **Equipment ID/Plate Number:**
Inspected By: (Name and Signature):	

Equipment	Acceptable	Not Acceptable	NA	Comments and Actions Taken
Operation/Owners Manual				
Brakes				
Brake Lights				
Reverse Signal Alarm				
Horn/Air Horn				
Tires/Tracks				
Steering				
Seat Belt				
Operating Controls				
Fire Extinguisher				
Lights				
Defroster				
Mirrors				
Instruments				
Coupling Devices				
Bed/Cargo Area				
Tailgate and Latch				
Tarps/covers				
Windshield/Window Glass				
Windshield Wipers				
Mudflaps/Rock Guards				
Exhaust Systems				
Hitches and Safety Cables				
Hydraulic Lines and Air Hoses				
Engine Oil				
Hydraulic Fluid				
Rollover Equipment				
Cleanliness				

Comments:

bhate ENVIRONMENT INFRASTRUCTURE

DAILY SITE SAFETY MEETING

Project: ______________________ **Date:** __________

Project/Phase Number: ______________________ **Time:** __________

Meeting Conducted By: ______________________ ______________________

Print Name *Signature*

1. AWARENESS (e.g., special EHS concerns, pollution prevention, recent incidents, etc.):

2. OTHER ISSUES (HASP changes, new AHAs, attendee comments, etc.):

3. DISCUSSION OF DAILY ACTIVITIES/TASKS AND SAFETY MEASURES TO BE USED:

4. ATTENDEES (Print Name):

1.	2.
3.	4.
5.	6.
7.	8.
9.	10.
11.	12.
13.	14.
15.	16.
17.	18.
19.	20.
21.	22.
23.	24.
25.	26.
27.	28.
29.	30.

This Site Safety Meeting Log documents the safety briefing conducted in accordance with 29 CFR 1910.120 *Hazardous Waste Operations and Emergency Response* as well as other applicable regulatory requirements. Personnel who perform work operations onsite are required to attend each safety briefing and acknowledge receipt of such briefings daily.

Excavation Soils Analysis Form
(To Be Completed by a "Competent Person")

This checklist must be completed when soil analysis is made to determine the soil type(s) present in the excavation. A separate analysis must be performed on each layer of soil in excavation walls or if the length of the excavation is in different soil types.

Project Location (Address, City, State, Site Description):	**Date:**	**Time:**	**Project Number:**
	Weather Conditions:		
Competent Person:	**Excavation Dimensions:**		
	Depth	**Width**	**Length**
Location Where Soil Sample Obtained:			

Visual Observations				
Particle type:	______ Fine Grained (cohesive)	______ Course grained (sand or gravel)		
Water conditions:	____ Wet	______ Dry	______ Surface water present	____ Submerged

Previously disturbed soils?	_____Yes	_____No
Underground utilities?	_____Yes	_____No
Layered soils?	_____Yes	_____No
Layered soil dipping into excavation?	_____Yes	_____No
Excavation exposed to vibrations?	_____Yes	_____No
Crack-like openings or spallings observed?	_____Yes	_____No
Conditions that may create a hazardous atmosphere? If yes, identify condition and source in comments.	_____Yes	_____No
Surface encumbrances?	_____Yes	_____No
Work to be performed near public vehicular traffic?	_____Yes	_____No
Possible confined space exposure?	_____Yes	_____No

Excavation Soils Analysis Form

Manual Tests		
Plasticity:	_____Cohesive	_____Non-cohesive
Dry Strength:	_____Granular (crumbles easily)	_____Cohesive (broken with difficulty)

NOTE: The following unconfined compressive strength tests should be performed on undisturbed soils.

Thumb Test (used to estimate unconfined compressive strength of cohesive soil)

Test performed:_____Yes _____No

_____Type A (soil indented by thumb with very great effort)
_____Type B (soil indented by thumb with some effort)
_____Type C (soil easily penetrated several inches by thumb with little or no effort). If soil is submerged, seeping water, subjected to surface water, runoff, exposed to wetting.

Penetrometer or Shearvane (used to estimate unconfined compressive strength of cohesive soils)

Test performed:_____Yes _____No

_____Type A (soil with unconfined compressive strength of 1.5 tons per square foot (tsf)or greater)
_____Type B (soil with unconfined compressive strength of 0.5 tsf to 1.5 tsf)
_____Type C (soil with unconfined compressive strength of 1.5 tsf or less). If soil is submerged, seeping water, subjected to surface water, runoff, exposed to wetting.

Wet Shaking Test (used to determined percentage of granular and cohesive materials).
Compare results to soil textural classification chart to determine soil type.

Test performed:_____Yes _____No

_____Type A (clay, silty clay, sandy clay, clay loam, and in some cases silty clay, loam and sandy clay loam)
_____Type B (angular gravel [similar to crushed rock], silt, silt loam, sandy loam, silty clay loam and sandy clay loam)
_____Type C (granular soil including gravel, sand, and loamy sand)
_____% granular _____% cohesive _____% silt

NOTE: Although OSHA will accept the above tests in most cases, some states will not. Check your state safety requirements for trenching regulations.

Soil Classification		
_____Type A	**_____Type B**	**_____Type C**

Selection of Protective System		
_____Sloping, Specify angle:_____	**_____Aluminum Hydraulic Shoring**	**_____Timber Shoring**

Comments

bhate ENVIRONMENT INFRASTRUCTURE

FIELD SSHP REVIEW SHEET

I have been trained in the contents of the Site Specific Safety and Health Plan (SSHP) and have been advised of the locations of copies available for review. I will comply with the provisions contained therein.

Print Name and Sign Name:	Your Company and Date:

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Hazardous Chemical Inventory List

Facility Location (Address, City, State, Site Description):	Date Inventory Prepared:	
Individual Preparing List:	Phone Number:	Page ____of____

Name of Chemical/Product	Manufacturer	Location

00881885

Hot Work Permit

Project Location (Address, City, State, Site Description):	Permit Issuance Date:	Permit Issuance Time:	Project Number:
	Permit Expiration Date:	Permit Expiration Time:	
Describe the Hot Work to be completed:			

Safety Zone for work established by (check all that apply)				
____ Cones	____ Caution Tape	_____ Natural Barrier	_____ Welding Screen	_____ Building
Other, explain:				

Safety Equipment (check all that apply)			
____ Respirator	____ Welders Mask	_____ Burning Goggles	_____ Face Shield
Other, explain:			

Safety Requirements		
Fire Extinguisher properly rated	_____Yes	_____No
Fire watch present	_____Yes	_____No
Combustibles covered or removed within 50 feet	_____Yes	_____No
Work area clean	_____Yes	_____No
Cables, hose lines, regulators, cylinders, electric sources checked	_____Yes	_____No
Are special fire protection procedures being implemented? If so, explain		

Air Monitoring Requirements, as specified by the SSHO							
Instrumentation	Background	Times					
FID/PID							
Oxygen Level							
Combustible Gas Indicator							

Hot Work Authorization	
Supervisor Signature:	Date/Time:
SSHO Signature:	Date/Time:
Fire Watch Signature:	Date/Time:

00881886

INCIDENT INVESTIGATION

Bhate Report No: ______________________

1. GENERAL INFORMATION				
COMPANY:	**DATE OF INCIDENT:**	**DATE OF INVESTIGATION REPORT:**		
INCIDENT COST:	ESTIMATED: $	ACTUAL: $		
OSHA RECORDABLE: ❒ YES ❒ NO	# RESTRICTED DAYS:	# DAYS AWAY FROM WORK:		
WAS THE ACTIVITY ADDRESSED IN AN AHA?:	❒ YES (Attach a copy)	❒ NO		
2. CAUSE ANALYSIS				
IMMEDIATE CAUSES – WHAT ACTIONS AND CONDITIONS CONTRIBUTED TO THIS EVENT? (SEE EXAMPLES NEXT PAGE)				
BASIC CAUSES - WHAT SPECIFIC PERSONAL OR JOB FACTORS CONTRIBUTED TO THIS EVENT? (SEE EXAMPLES NEXT PAGE)				
3. ACTION PLAN				
REMEDIAL ACTIONS - WHAT HAS BEEN AND/OR SHOULD BE DONE TO CONTROL THE CAUSES LISTED? INCLUDE MANAGEMENT PROGRAMS (SEE ATTACHED LIST) FOR CONTROL OF INCIDENTS IF APPLICABLE.				
ACTION	PERSON RESPONSIBLE	TARGET DATE	DATE COMPLETE	VERIFIED BY
4. PERSONNEL PERFORMING INVESTIGATION				
NAME: (PRINT)	SIGN:	DATE:		
NAME: (PRINT)	SIGN:	DATE:		
NAME: (PRINT)	SIGN:	DATE:		
5. MANAGEMENT REVIEW				
Project Manager (PRINT)	SIGN:	DATE:		
COMMENTS:				
Bhate Health and Safety Manager (PRINT)	SIGN:	DATE:		
COMMENTS:				

NOTE: Attach additional information as necessary. Site Manager to forward copy of Investigation Report to the Bhate Health and Safety Manager as soon as possible, but no later than 72 hours after the incident.

INCIDENT INVESTIGATION (Continued)

EXAMPLES OF IMMEDIATE CAUSES	
SUBSTANDARD ACTIONS	SUBSTANDARD CONDITIONS
1. Operating Equipment without Authority	1. Inadequate Guards or Barriers
2. Failure to Warn	2. Inadequate or Improper Protective Equipment
3. Failure to Secure	3. Defective Tools, Equipment, or Materials
4. Operating at Improper Speed	4. Congestion or Restricted Action
5. Making Safety Devices Inoperable	5. Inadequate Warning System
6. Using Defective Equipment	6. Fire and Explosion Hazards
7. Failure to Use PPE Properly	7. Poor Housekeeping/Disorder
8. Improper Loading	8. Noise Exposure
9. Improper Placement	9. Exposure to Radiation/Hazardous Materials
10. Improper Lifting	10. Exposure to Temperature Extremes
11. Improper Position for Task	11. Inadequate Illumination
12. Servicing Equipment in Operation	12. Inadequate Ventilation
13. Horseplay	13. Hazardous Environmental Conditions
14. Under Influence of Alcohol/Drugs	
15. Using Equipment Improperly	
16. Failure to Follow Procedure	

EXAMPLES OF BASIC CAUSES	
PERSONAL FACTORS	JOB FACTORS
1. Inadequate Physical/Physiological Capability	1. Inadequate Leadership/Supervision
2. Inadequate Mental/Psychological Capability Knowledge	2. Inadequate Engineering
3. Physical or Psychological Stress	3. Inadequate Purchasing
4. Mental or Psychological Stress	4. Inadequate Maintenance
5. Lack of Knowledge	5. Inadequate Tools/Equipment
6. Lack of Skill	6. Inadequate Work Standards
7. Improper Motivation	7. Excessive Wear and Tear
	8. Abuse or Misuse

MANAGEMENT PROGRAMS FOR CONTROL OF INCIDENTS	
1. Leadership and Administration	10. Health Control
2. Management Training	11. Program Audits
3. Planned Inspections and Maintenance	12. Engineering and Change Management
4. Task Analysis and Procedures	13. Personal Communications
5. Task Observation	14. Group Communications
6. Emergency Preparedness	15. General Promotion/Awareness
7. Rules and Work Permits	16. Hiring and Placement
8. Accident/Incident Analysis	17. Purchasing Controls
9. Personal Protective Equipment	18. Off-the-Job Safety

NOTIFICATION REMINDER
Fatalities or hospitalization (admittance) of three or more individuals requires notification to OSHA within 8 hours. Contact the Bhate Operations Manager to make the notification. If unavailable, the senior operations person on site should make the notification.

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INCIDENT INVESTIGATION INSTRUCTIONS

Report No.: This is the same as the incident report number assigned by the Bhate Health and Safety Manager

Date of Investigation Report: This date should be within 72 hours of the incident. In cases where the investigation is not completed until a later date, submit the incomplete report within the 72 hours, and a revised report should be submitted when the missing information is obtained.

Incident Cost: For all vehicle/equipment or property damage cases, an estimated or actual loss value must be entered. If an estimated value is entered, the report must be revised when the actual costs are known.

OSHA Recordable: This section should be completed in consultation with the Health and Safety Manager.

No. of Restricted Days: This relates to days of restricted work activity, not restrictions on motion or physical capability. If the employee is capable of doing his normal job the day after the injury and thereafter, there are no restricted days, even if the physician indicates a physical restriction. It does not include the day of the injury.

No. of Days Away from Work: The number of days after the day of the injury that the employee was scheduled to work but could not due to an occupational injury. If the treating physician releases an employee to return to work, but the employee chooses not to come to work, do not count those days. In this case the Health and Safety Manager should be consulted.

Cause Analysis

Immediate Causes: Determine the immediate causes, using the examples on page 2 of the Incident Investigation form. If one or more of the examples fits the circumstance, use those words in the cause description. However, do not confine your cause determination to the guide words.

Basic Causes: Like the Immediate Causes, use the guide words in the attachment whenever appropriate and explain. For example, improper motivation may be because the correct way takes more time or effort; short cutting standard procedure is tolerated or positively reinforced; or the person thinks there is no personal benefit to always doing the job correctly.

Remedial Actions: Include all actions taken or those that should be taken to prevent recurrence. Be sure that actions address the causes. For example, training (safety meetings) may be a necessary response for lack of knowledge, but may be inadequate for improper motivation. If completion dates are not verified prior to submitting the report, a revised report must be submitted or verification of closeout noted on the original report.

Personnel Performing Investigation: The primary investigator is the Supervisor in charge of the work where the incident occurred. Others participating in the investigation should also sign the report.

Management Review: The Bhate Project Manager and the Bhate Health and Safety Manager must sign the report indicating their satisfaction with the thoroughness of the investigation and the report, and their concurrence that the action items address the identified causes.

bhate ENVIRONMENT INFRASTRUCTURE

INCIDENT REPORT

Date of Report: ____________________ **Bhate Report No:** __________________
(To be assigned by the HSM)

TYPE OF INCIDENT (check all that apply)

❒ INJURY/ILLNESS ❒ VEHICLE DAMAGE ❒ HIGH LOSS POTENTIAL (NEAR MISS) ❒ FIRE
❒ SPILL/RELEASE ❒ PROPERTY LOSS/DAMAGE ❒ PERMIT OR EQUIV. EXCEEDANCE ❒ OTHER

GENERAL INFORMATION

PROJECT: TASK:

COMPANY OR SUBCONTRACTOR NAME(S):

DATE OF INCIDENT: DAY OF WEEK: MILITARY TIME:

SUPERVISOR ON DUTY: PHONE: SUPV ON SCENE? ❒ YES ❒ NO

LOCATION OF INCIDENT:

WEATHER/LIGHTING CONDITIONS:

DESCRIBE WHAT HAPPENED (step by step, use additional pages if necessary)

1. What was the employee doing, or what was happening, just before the incident occurred? Describe the activity, as well as the equipment, tools, or materials in use. *Be specific, e.g. "climbing a ladder while carrying tools" or "driving westbound on Main St."*

2. What happened? What was the contact or event and how did it occur? e.g. "When the ladder slipped on the wet floor, employee fell 20 feet" or "was distracted by bee, swerved off right side of road and struck the stop sign"

IMMEDIATE CORRECTIVE ACTIONS (use additional pages if necessary)

AFFECTED EMPLOYEE INFORMATION (Include injured person or employees whose activities resulted in incident) ❒N/A

NAME: ❒ MALE ❒ FEMALE COMPANY:

HOME ADDRESS:

SOCIAL SECURITY OR EMPLOYEE #: HOME PHONE #:

JOB CLASSIFICATION: YEARS IN JOB CLASSIFICATION:

TIME EMPLOYEE BEGAN WORK: DATE OF HIRE: AGE:

DID INCIDENT RELATE TO ROUTINE TASK FOR JOB CLASSIFICATION?: ❒ YES ❒ NO

INJURY/ILLNESS INFORMATION ❒N/A

NATURE OF INJURY OR ILLNESS (Body part affected and how it was affected, e.g. strained back):

OBJECT/EQUIPMENT/SUBSTANCE CAUSING HARM:

FIRST AID PROVIDED: ❒ YES ❒ NO IF YES, WHERE: ❒ ON SITE ❒ OFF SITE

IF YES, WHO PROVIDED FIRST AID?:

WILL THE INJURY/ILLNESS RESULT IN: ❒ RESTRICTED DUTY ❒ LOST TIME ❒ UNKNOWN

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INCIDENT REPORT (Continued)

TREATMENT OR EVALUATION INFORMATION (Attach Provider's Report/Statement) ❐ N/A

WAS TREATMENT OR EVALUATION PROVIDED? ❐ YES ❐ NO ❐ FIRST AID ❐ EVALUATION ❐ MEDICAL TREATMENT

IF YES, WHERE? ❐ ON SITE ❐ DR'S OFFICE ❐ HOSPITAL ❐ OTHER:

NAME OF PERSON(S) PROVIDING TREATMENT OR EVALUATION:

ADDRESS WHERE TREATMENT OR EVALUATION WAS PROVIDED:

TYPE OF TREATMENT OR EVALUATION:

PROPERTY LOSS OR DAMAGE INFORMATION ❐ N/A

PROPERTY OR VEHICLE INVOLVED:

DESCRIPTION OF LOSS OR DAMAGE: ESTIMATED $ LOST:

SPILL OR RELEASE INFORMATION ❐ N/A

SUBSTANCE SPILLED OR RELEASED: FROM WHERE: TO WHERE:

ESTIMATED QUANTITY/DURATION:

REPORTABLE QUANTITY (RQ): RQ EXCEEDED? ❐ YES ❐ NO

RELEASED TO WATERS OF STATE? ❐ YES ❐ NO CERCLA HAZARDOUS SUBSTANCE? ❐ YES ❐ NO

RESPONSE ACTIONS TAKEN:

PERMIT OR EQUIVALENT EXCEEDANCE ❐ N/A

TYPE OF PERMIT: PERMIT #:

DATE OF EXCEEDANCE: DATE FIRST KNOWLEDGE OF EXCEEDANCE:

PERMITTED LEVEL OR CRITERIA (e.g., Water quality, Air Quality):

EXCEEDANCE LEVEL OR CRITERIA: EXCEEDANCE DURATION:

RESPONSE ACTIONS TAKEN:

PERSONS PREPARING REPORT (Employee and Supervisor to Complete Report)

EMPLOYEE'S NAME (PRINT): SIGN: DATE:

EMPLOYEE'S NAME (PRINT): SIGN: DATE:

SUPERVISOR'S NAME (PRINT): SIGN: DATE:

PERSONNEL NOTIFIED (check all that apply)

ORGANIZATION	NAME(S)	DATE/TIME
❐ Bhate Site Safety and Health Officer		
❐ Bhate Site Manager		
❐ Site Emergency Services		
❐ Other Organizations Notified		

RECEIVED BY Bhate Health and Safety Manager Date:

bhate ENVIRONMENT INFRASTRUCTURE

INCIDENT REPORT INSTRUCTIONS

General: The incident report (2 pages) must be completed within 24 hours of the incident. If any information is unknown, it can be provided later as the information is available. Complete all applicable sections of the form. If a section does not apply, indicate this by using "N/A". Names, dates, and signatures should be complete.

Type of Incident: Check all that apply. A Near Miss (High Loss Potential) incident is one that does not result in loss, but under slightly different circumstances, could have resulted in an OSHA Recordable injury, spill, release, permit exceedance, fire, or vehicle/property damage in excess of $500. All Near Miss (High Loss Potential) incidents are to be investigated.

General Information

Project/Task: Give the Project Name and task being performed.

Supervisor on Duty: The Supervisor on Duty responsible for the work effort involving the incident.

Location of Incident: The specific location on the project (a street address or facility building numbers)

Weather/Lighting Conditions: Temperature, precipitation, approximate wind speed and direction, lighting conditions, cloud cover, relative humidity. This information may be included in the description section, and must be given in detail whenever it is a factor in the cause or impact, e.g., spill, release, heat stress, windblown material.

Describe What Happened: This section must be completed in sufficient detail to describe the events and conditions leading up to and resulting from the incident. Try to answer the questions who, what, where, when, and how. This information is then used to determine why (cause). Provide details such as work objective, procedure being used, body position, and PPE. Include diagrams or sketches for all incidents involving vehicles/equipment and other incidents where they aid in providing detail or perspective. Consider attaching photographs.

Immediate Corrective Actions

List what corrective actions were taken immediately as a result of the incident such as containing spills, first aid, temporary barriers, work stoppage, and similar actions.

Affected Employee Information

Employee: Direct hire, whether professional, administrative, or craft; full-time or part-time; permanent or temporary and/or Subcontractor employee.

Hours Worked on Shift Prior to the Incident: Only include the amount of time the employee worked that shift or day prior to the incident.

Years with the Company: Give the number of years employed with the current company in years and/or months.

Injury/Illness Information

Nature of Injury or Illness: Give a brief description of the body part affected and type of injury or illness, as applicable.

First Aid Provided: First Aid is any treatment that does not have to be provided by a health care professional. A clinic may provide first aid depending on the severity of the injury.

Will the Injury Result In: Do not delay the report if this information is unknown.

Medical Treatment Information

Was Medical Treatment Provided? Medical treatment is that treatment that must be provided by a licensed medical practitioner.

Type of Treatment: This information is important in determining OSHA recordability. Attach a copy of the treating professional's statement/work release.

Property Loss or Damage Information

Property or Vehicle Involved: For vehicles, indicate VIN and vehicle ownership.

Description of Loss or Damage: Be specific as to the identity of damaged part, location, and extent.

Estimated $ Lost: Estimate the monetary amount of loss or damage.

Spill or Release Information

Substance Spilled or Released: For pure substances, list materials by common name/chemical. For wastes, indicate waste code. For mixtures or contaminated media, provide contaminant name, CAS No., concentration.

RQ Exceeded? Specify the Reportable Quantity for the material.

Response Action Taken: Describe the mitigation efforts, as well as any reports made, beyond initial notification.

Permit or Equivalent Exceedance

Type of Permit: List name of permit or equivalent including the agency name where applicable (e.g., NPDES, NESHAP, etc.).

Date of Exceedance: Specify date exceedance occurred (e.g., date discharge in excess of permit limits occurred).

Date First Knowledge of Exceedance: Specify date when first knew there was an exceedance (i.e., date analytical received). This date may be different from the date of the exceedance listed above.

Permitted Level or Criteria: List discharge or emission limit or narrative criteria specified in the permit.

Exceedance Level or Criteria: Specify an actual discharge/emission limit or narrative criterion which was exceeded.

Exceedance Duration: Specify time frame by date and hours (using military time) during which exceedance occurred.

See "**Spill or Release Information**" (above) for description of remaining questions.

Persons Preparing Report

Employee's Name: The affected employee described on page 1 should review the report and sign here, as well as any other employees witnessing or involved in the incident.

Supervisor's Name: The Supervisor must review and sign the report indicating agreement. The Supervisor should be involved in conducting the investigation.

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INFRASTRUCTURE

Air Monitoring Data Sheet
(Integrated Air Monitoring)

Project Location (Address, City, State, Site Description):	Page ____ of_____	Date:	Project Number:
	Weather Conditions:		

Employee Name:	Employee Number:	Job Title/Job Classification:	Sample Type:	
			Personal	
			Area	
			Blank	

Personal Protective Equipment Used:

Notes, Job Description, Task description, Ventilation, Controls, etc.:

Analyte	Sample Media	Analytical Method	Exposure Limit (i.e. PEL, TLV)

Calibration Method	
Bubble	Base Unit No.
	Cell Unit No.
Precision Rotameter	Unit No.
Notes: (elevation and/or elevation changes)	

Pre-Sample Calibration Data	
Date and Time	
	Flow Rate
Trial 1	
Trial 2	
Trial 3	
Average	

Post-Sample Calibration Data	
Date and Time	
	Flow Rate
Trial 1	
Trial 2	
Trial 3	
Average	

Sample Data				
Sample No.				
Pump No.				
Start Time				
Stop Time				
Total Time (min.)				
Flow Rate				
Total Volume (L)				
Sample Quantity				
Concentration				
8-Hour TWA				

Data Review		
Sampler:	Sampler Signature:	Date:
Data Reviewed by:	Reviewer Signature:	Date:

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Lockout/Tagout Permit

Section A			
Project Location (Address, City, State, Site Description):	**Date:**	**Time:**	**Project Number:**
Equipment Description and Location:	**Reason for Lockout/Tagout:**		
Lockout Locations:	**Supervisor on Duty:**	**Authorized Employee:**	

Section B	
Requestor:	
Notifier:	
Shut Down By:	
Isolator:	
Verifier:	
Approved By:	

Section C			Section D				Section E		
Device Description	**Location**	**Isolation Position**	**Applied By**	**Lock #**	**Date**	**Time**	**Removed By**	**Date**	**Time**

Special Instructions for Removal or Releasing Stored Energy:

bhate ENVIRONMENT INFRASTRUCTURE

Air Monitoring Data Sheet (Real-Time Air Monitoring)

Project Location (Address, City, State, Site Description):	Page ____ of_____	Date:	Project Number:
	Weather Conditions:		
Notes, Task description, Ventilation, Controls, Employees Present (Y/N), Suspected contaminants, etc.:			

Instrumentation
Manufacturer:
Model:
Serial #:
Detector Tube:

Pre-Sample Calibration Data		
Date and Time:		
Gas Type	Concentration	Instrument Reading

Post-Sample Calibration Data		
Date and Time:		
Gas Type	Concentration	Instrument Reading

Monitoring Data			
Location	Time	Results (ppm, mg/M^3, %, etc.)	Observations

Data Review		
Sampler:	Sampler Signature:	Date:
Data Reviewed by:	Reviewer Signature:	Date:

Site Health and Safety Inspection Form

Project Location (Address, City, State, Site Description):	**Date:**	**Project Number:**
Type of Inspection: ☐ **Weekly** ☐ **Monthly**		
Tasks or Activities Observed:		

Personnel Participating in Inspection:

Name	Organization	Name	Organization

General Workplace Conditions:

Category	Observations (N/A if Not Applicable)	Action required - Yes or No
Walking/Working Surfaces		
Aisles and Passageways		
Platforms/Scaffolding		
Ladders		
Stairs		
Exits/Egress		
Roadways		
Excavations/Trenches		
Ventilation		
Lighting		
Noise Exposure		
Ergonomics		
Potable Water		
Sanitation Facilities		
Temperature Extremes		

Hazardous Materials Use & Storage:

Category	Observations (N/A if Not Applicable)	Action required - Yes or No
MSDSs Available		
Material Labeling		
Storage Conditions		
Storage Containers Condition		
Chemical Storage Compatibility		
Compressed Gas Storage & Use		
Waste Storage/Disposal		

bhate ENVIRONMENT INFRASTRUCTURE

Site Health and Safety Inspection Form

Motor Vehicles & Power Equipment:

Category	Observations (N/A if Not Applicable)	Action required - Yes or No
Seatbelts & Back-up Alarms		
Dozer Equipment		
Scraper Equipment		
Road Grader Equipment		
Water Trucks		
Front End Loader/Backhoe Equipment		
Cranes/ Hoists & Rigging		
Forklifts		
Other Heavy Equipment		
Loads Secure on Vehicles		
Wheels Chocked		

Hazard Controls:

Category	Observations (N/A if Not Applicable)	Action required - Yes or No
General Site Controls		
Work Zone Delineation		
Lockout/Tagout Systems		
Accident Prevention Signs and Tags		
Barricades		
Hole Covers		
Electrical Grounding & GFCI Use		

Emergency Systems:

Category	Observations (N/A if Not Applicable)	Action required - Yes or No
Emergency Instructions/Postings		
Fire Protection		
Eye Wash and Showers		
First Aid Kits/Stations		
Emergency Rescue Equipment		

Personal Protective Equipment:

Category	Observations (N/A if Not Applicable)	Action required - Yes or No
Eye Protection		
Ear Protection		
Respiratory Protection		
Head Protection		
Hand Protection		
Foot Protection		
Body Protection		
Fall Protection		

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Hand/Power Tools and Power Systems:

Category	Observations (N/A if Not Applicable)	Action required - Yes or No
Hand Tools Condition		
Portable Power Tools Condition		
Welding/Burning Equipment		
Power Tools Guarding		
Electrical Power Generator		
Pneumatic Power Generator		

Remediation Waste Management:

Category	Observations (N/A if Not Applicable)	Action required - Yes or No
Waste Properly Categorized		
Cross Contamination Minimized		
Storage Containers in Good Condition		
Waste Storage Location		
Staging/Stockpiling of Soil/Debris		
Decontamination Water		

Environmental Controls:

Category	Observations (N/A if Not Applicable)	Action required - Yes or No
Dust Control		
Odor Control		
Oil and Spill Prevention		
Stormwater/Erosion Control Activities		

Other Health and Safety Related Conditions or Work Practices

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INFRASTRUCTURE

Site Health and Safety Inspection Form

Project Location (Address, City, State, Site Description):	Date:	Project Number:

Type of Inspection: ☐ Weekly ☐ Monthly

Summary and Recommendations

Hazard Classification*	Findings and Recommended Corrective Action	Date Corrected	Corrected or Verified by

*Classify as Major or Minor – Major findings indicate that a potential or imminent hazard to people, property, or the environment exists

bhate ENVIRONMENT INFRASTRUCTURE

Noise Survey Data Sheet

Project Location (Address, City, State, Site Description):	Page ____ of_____	Date:	Project Number:

Instrumentation	Model	Serial No.	Microphone	Date of Last Factory Calibration
Calibrator				
Sound Level Meter				

Calibration	Date/Time	Calibration Level (dB)	
		94 dB	114 dB
Pre-survey			
Post-survey			
Note adjustments as needed:			

SLM Settings		
	Pre-set	Actual
Threshold (dB)	80	
Weighting	A-scale	
Response (Fast/Slow)	Slow	
Criterion (dB)	90	
Exchange Rate (dB)	5	

Diagram, Notes, Equipment, Distances, Exceedances, etc.:

↑ N

Sound Level Data								
Location (indicate on diagram 1, 2, etc.)								
Distance (feet)								
SPL (dBA)								

Octave Band Analysis								
Frequency	Hz	Hz	Hz	Hz	Hz	Hz	Hz	Hz
SPL (dBA)								

Data Review		
Surveyor:	Surveyor Signature:	Date:
Data Reviewed by:	Reviewer Signature:	Date:

bhate ENVIRONMENT INFRASTRUCTURE

Noise Dosimetry Data Sheet

Project Location (Address, City, State, Site Description):	Page ____ of_____	Date:	Project Number:

Employee Name:	Employee Number:	Job Title/Job Classification:	HPDs? Yes ☐ No ☐ Type: Muff or Plug NRR:

Instrumentation	Model	Serial No.	Microphone	Date of Last Factory Calibration
Calibrator			NA	
Sound Level Meter				

Calibration	Date/Time	Calibration Level (dB)	
		94 dB	114 dB
Pre-survey			
Post-survey			

Note adjustments as needed:

SLM Settings	Pre-set	Actual
Threshold (dB)	80	
Weighting	A-scale	
Response (Fast/Slow)	Slow	
Criterion (dB)	90	
Exchange Rate (dB)	5	

Noise Monitoring Data

Start Time	Stop Time	Total Time	Dose %	Proj. Dose %	TWA	L_{EQ} (dB)	L_{MAX} (dB)	Max L_{PEAK} (dB)

Notes, Job description, Task description, Exceedances, etc:

Data Review

Surveyor:	Surveyor Signature:	Date:
Data Reviewed by:	Reviewer Signature:	Date:

bhate ENVIRONMENT INFRASTRUCTURE

Daily Excavation Inspection Checklist
(To Be Completed by a "Competent Person")

Project Location (Address, City, State, Site Description):	**Date:**	**Time:**	**Project Number:**
	Weather Conditions:		

Competent Person:	**Soils Type:**	**Soil Classification**	
		Type A	
	Excavation Dimensions: Depth: Width: Length:	**Type B**	
		Type C	
Type of Protective System Used:			

General Inspection of Job Site	**Yes**	**No**	**Not Applicable (N/A)**
Surface encumbrances removed or supported			
Employees protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation			
Hard hats worn by all employees			
Spoils, materials, and equipment set back at least 2 feet from the edge of the excavation			
Barriers provided at all remotely located excavations, wells, pits, shafts, etc.			
Walkways and bridges over excavations 4 feet or more in depth are equipped with standard guardrails			
Warning vests or other highly visible clothing provided and worn by all employees exposed to public vehicular traffic			
Warning system established and utilized when mobile equipment is operated near the edge of the excavation			
Employees prohibited from working on the faces of sloped or benched excavations above other employees			
Utilities			
Utility companies contacted and/or utilities located			
Exact location of utilities marked when approaching the utilities			
Underground installations protected, supported or removed when excavation is open			
Means of Access and Egress			
Lateral travel to means of egress no greater than 25 feet in excavations 4 feet or more in depth			
Ladders used in excavations secured and extended 3 feet above the edge of the trench			
Structural ramps used by employees designed by a competent person			
Structural ramps used for equipment designed by a registered professional engineer (RPE)			
Ramps constructed of materials of uniform thickness, cleated together on the bottom, equipped with a no-slip surface			
Employees protected from cave-ins when entering or exiting the excavation			

bhate ENVIRONMENT INFRASTRUCTURE

Daily Excavation Inspection Checklist

Wet Conditions	Yes	No	Not Applicable (N/A)
Precautions taken to protect employees from the accumulation of water			
Water removal equipment monitored by a competent person			
Surface water or runoff diverted or controlled to prevent accumulation in the excavation			
Inspections made after every rainstorm or other hazard increasing occurrence			
Hazardous Atmospheres			
Atmosphere within the excavation tested when there is a possibility of an oxygen deficiency, combustible or other harmful contaminant exposing employees to a hazard			
Ventilation			
Testing conducted often to ensure that the atmosphere remains safe			
Emergency equipment, such as breathing apparatus, safety harness and line, and basket stretcher readily available where hazardous atmospheres could or do exist			
Safety harness and life line used and individually attended when entering deep confined excavations			
Support Systems			
Materials and/or equipment for support systems selected based on soil analysis, trench depth, and expected loads			
Materials and equipment used for protective systems inspected and in good condition			
Materials and equipment not in good condition have been removed from service			
Damaged materials and equipment used for protective systems inspected by a RPE after repairs and before being placed back into service			
Protective systems installed without exposing employees to the hazards of cave-ins, collapses or from being struck by materials or equipment			
Members of support system securely fastened to prevent failure			
Support systems provided to insure stability of adjacent structures, buildings, roadways, sidewalks, walls, etc.			
Excavations below the level of the base or footing approved by an RPE			
Removal of support systems progresses from the bottom and members are released slowly as to note any indication of possible failure			
Backfilling progresses with removal of support system			
Excavation of material to a level no greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth			
Shield system placed to prevent lateral movement			
Employees are prohibited from remaining in shield system during vertical movement			

Comments

ATTACHMENT 3
OSHA 300A SUMMARY LOGS AND EXPERIENCE MODIFICATION RATES

WillisTowersWatson

Telephone: 1-205-871-3300
Fax: 1-205-871-0602
Website: www.willistowerswatson.com

Direct Line: 1-205-868-0383
Direct Fax: 1-205-871-0602
Email: colleen.davis@willistowerswatson.com

March 9, 2017

Mr. Doug Sanders
Bhate Environmental Associates, Inc.
1608 13th Avenue, South
Birmingham, AL 35205

Re: Experience Modification Factor – Other States

Dear Doug:

This is to confirm your Experience Modification Factors for States other than Alabama have been as follows:

2005	.85
2006	.82
2007	.80
2008	.77
2009	.77
2010	.76
2011	.80
2012	.83
2013	.84
2014	.80
2015	.77
2016	1.00 (premium no longer qualifies for experience mod)
2017	1.00 (premium no longer qualifies for experience mod)

If you have any questions, please feel free to contact me.

Sincerely,

Colleen Davis

Colleen Davis, CIC
Sr. Client Services Specialist

Willis of Alabama, Inc.
2101 Sixth Avenue, Suite 725
Birmingham, AL 35203

OSHA's Form 300A (Rev. 01/2004)
Summary of Work-Related Injuries and Illnesses

Year 2016

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	0	0	0
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
0	0
(K)	(L)

Injury and Illness Types

Total number of...
(M)

(1) Injury	0	(4) Poisoning	0
(2) Skin Disorder	0	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	0

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

Public reporting burden for this collection of information is estimated to average 58 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

Establishment information

Your establishment name: Bhate Environmental Associates Inc.

Street: 1608 13th Avenue South Suite 300

City: Birmingham State: Alabama Zip: 35205

Industry description (e.g., Manufacture of motor truck trailers): Construction and Environmental Management Services

Standard Industrial Classification (SIC), if known (e.g., SIC 3715): ____

OR North American Industrial Classification (NAICS), if known (e.g., 336212): 5 6 2 9 1 0

Employment information

Annual average number of employees: 105

Total hours worked by all employees last year: 192,480

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

[signature]
Company executive

CEO
Title

(205) 918-4000
Phone

31 January 2017
Date

00881906

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 2015

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	0	0	0
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
0	0
(K)	(L)

Injury and Illness Types

Total number of...
(M)

(1) Injury	0	(4) Poisoning	0
(2) Skin Disorder	0	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	0

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

Public reporting burden for this collection of information is estimated to average 58 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

Establishment information

Your establishment name: Bhate Environmental Associates Inc

Street: 1608 13th Avenue South Suite 300

City: Birmingham State: Alabama Zip: 35205

Industry description (e.g., Manufacture of motor truck trailers): Construction and Environmental Management Services

Standard Industrial Classification (SIC), if known (e.g., SIC 3715): ___

OR North American Industrial Classification (NAICS), if known (e.g., 336212): 5 6 2 9 1 0

Employment information

Annual average number of employees: 87

Total hours worked by all employees last year: 192,576

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company executive: [signature] Title: CEO

Phone: (205) 918-4000 Date: 29-Jan-16

OSHA's Form 300A (Rev. 01/2004)
Summary of Work-Related Injuries and Illnesses

Year 2014

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	0	0	0
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
0	0
(K)	(L)

Injury and Illness Types

Total number of...
(M)

(1) Injury	0	(4) Poisoning	0
(2) Skin Disorder	0	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	0

Establishment information

Your establishment name: Bhate Environmental Associates Inc.

Street: 1608 13th Avenue South Suite 300

City: Birmingham State: Alabama Zip: 35205

Industry description (e.g., Manufacture of motor truck trailers): Construction and Environmental Management Services

Standard Industrial Classification (SIC), if known (e.g., SIC 3715): __ __ __ __

OR North American Industrial Classification (NAICS), if known (e.g., 336212): 5 6 2 9 1 0

Employment information

Annual average number of employees: 85

Total hours worked by all employees last year: 144,081

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

[signature] — Company executive

CEO — Title

(205) 918-4000 — Phone

30 January 2015 — Date

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

ATTACHMENT 4
TRAINING CERTIFICATES AND PROOF OF OSHA COMPETENCY FROM SUBCONTRACTORS

Name	Job Duty	Training Certificates [1]
Scott Beesinger	Supervisor/SSHO	40-hour HAZWOPER, current 8-hour HAZWOPER Refresher, 30-hour OSHA Construction Safety, CPR/First Aid/AED/BBP training
Kenny Moore	Site Operator	CPR/First Aid/AED/BBP
Sally S. Smith	Health and Safety Manager	40-hour HAZWOPER, current 8-hour HAZWOPER Refresher, 30-hour OSHA Construction Safety, CPR/First Aid/AED/BBP training

NOTE 1: COPIES OF TRAINING CERTIFICATES ARE KEPT ON FILE AT THE GWTP AND WITH THE HSM.

ATTACHMENT 5
CRYSTALLINE SILICA MONITORING PLAN

Bhate's Crystalline Silica Evaluation (Written Exposure Control Plan)

This written exposure control plan for crystalline silica, as required by 29 Code of Federal Regulations (CFR) Section (§)1926.1153, will be used at field projects to control employee exposures to respirable crystalline silica.

1. Employee airborne exposure to crystalline silica shall not exceed the 8-hour time weighted average (TWA) occupational exposure level (OEL) of 50 micrograms per cubic meter (µg/m^3).
2. Employees shall be trained on the hazards of silica, the controls required to control the potential exposure, any sampling results, and work practices to lower their exposure.
3. Both the exposure control methods listed in the Occupation Safety and Health Administration's (OSHA's) Silica Standard, Table 1 - Specified Exposure Control Methods When Working With Materials Containing Crystalline Silica, and the alternative exposure control methods identified in 29 CFR §1926.1153 will be used at field projects.
4. Each project whose scope of work requires performing tasks from Bhate's temporary work operations listed below in item # 5, will have a designated *Silica Competent Person,* which means an individual who is capable of identifying existing and foreseeable respirable crystalline silica hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The competent person must have the knowledge and ability necessary to fulfill the responsibilities set forth in paragraph (g) of the OSHA silica standard.
5. There are **temporary work operations** in the field that could present occupational exposures of personnel to crystalline silica. These temporary work operations by Bhate employees or subcontractor employees include, but are not limited to the following:
   - Mixing grout with Portland cement and bentonite
   - Cutting asphalt and concrete pavement before well installations
   - Concrete demolition
   - Excavation of pavement, rock, and soil
   - Material blending and stabilization:
     - Apply Portland Cement to soils and sediments
     - Mix cement, soils, and sediments with Wirtgen Soil Mixer
     - Compact concrete at site with roller
6. "For each employee engaged in a task identified on Table 1 [of 29 CFR §1926.1153], the employer shall fully and properly implement the engineering controls, work practices, and respiratory protection specified for the task on Table 1, unless the employer assesses and limits the exposure of the employee to respirable crystalline silica in accordance with

paragraph (d) of the OSHA Silica Standard." [from 12 CFR §1926.1153(c)(1)]

7. Where an employee performs more than one task on Table 1 during the course of a shift, and the total duration of all tasks combined is more than 4 hours, the required respiratory protection for each task is the respiratory protection specified for more than 4 hours per shift. If the total duration of all tasks on Table 1 combined is less than 4 hours, the required respiratory protection for each task is the respiratory protection specified for less than 4 hours per shift.

Table 1 from 29 CFR §1926.1153(c)(1) is provided below.

Table 1—Specified Exposure Control Methods When Working With Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	>4 hours/shift
(i) Stationary masonry saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions	None	None
(ii) Handheld power saws (any blade diameter)	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.		
	-When used outdoors	None	APF 10
	-When used indoors or in an enclosed area	APF 10	APF 10

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF) ≤ 4 hours/shift	>4 hours/shift
(iii) Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less)	For tasks performed outdoors only: Use saw equipped with commercially available dust collection system.	None	None
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.		
	Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency.		
(iv) Walk-behind saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade.		
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions:		
	-When used outdoors	None	None
	-When used indoors or in an enclosed area	APF 10	APF 10
(v) Drivable saws	For tasks performed outdoors only:		
	Use saw equipped with integrated water delivery system that continuously feeds water to the blade.	None	None
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.		
(vi) Rig-mounted core saws or drills	Use tool equipped with integrated water delivery system that supplies water to cutting surface.	None	None
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.		

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF) ≤ 4 hours/shift	>4 hours/shift
(vii) Handheld and stand-mounted drills (including impact and rotary hammer drills)	Use drill equipped with commercially available shroud or cowling with dust collection system.	None	None
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.		
	Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.		
	Use a HEPA-filtered vacuum when cleaning holes.		
(viii) Dowel drilling rigs for concrete	For tasks performed outdoors only:		
	Use shroud around drill bit with a dust collection system. Dust collector must have a filter with 99% or greater efficiency and a filter-cleaning mechanism.	APF 10	APF 10
	Use a HEPA-filtered vacuum when cleaning holes.		
(ix) Vehicle-mounted drilling rigs for rock and concrete	Use dust collection system with close capture hood or shroud around drill bit with a low-flow water spray to wet the dust at the discharge point from the dust collector.	None	None
	OR		
	Operate from within an enclosed cab and use water for dust suppression on drill bit.	None	None

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF) ≤ 4 hours/shift	>4 hours/shift
(x) Jackhammers and handheld powered chipping tools	Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.		
	-When used outdoors.	None	APF 10
	-When used indoors or in an enclosed area.	APF 10	APF 10
	OR Use tool equipped with commercially available shroud and dust collection system.		
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.		
	Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.		
	-When used outdoors.	None	APF 10
	-When used indoors or in an enclosed area.	APF 10	APF 10
(xi) Handheld grinders for mortar removal (i.e., tuckpointing)	Use grinder equipped with commercially available shroud and dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	APF 10	APF 25
	Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.		

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF) ≤ 4 hours/shift	>4 hours/shift
(xii) Handheld grinders for uses other than mortar removal	For tasks performed outdoors only: Use grinder equipped with integrated water delivery system that continuously feeds water to the grinding surface Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. OR Use grinder equipped with commercially available shroud and dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	None	None
	-When used outdoors	None	None
	-When used indoors or in an enclosed area	None	APF 10
(xiii) Walk-behind milling machines and floor grinders	Use machine equipped with integrated water delivery system that continuously feeds water to the cutting surface. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. OR	None	None

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF) ≤ 4 hours/shift	>4 hours/shift
	Use machine equipped with dust collection system recommended by the manufacturer. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide the air flow recommended by the manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. When used indoors or in an enclosed area, use a HEPA-filtered vacuum to remove loose dust in between passes.	None	None
(xiv) Small drivable milling machines (less than half-lane)	Use a machine equipped with supplemental water sprays designed to suppress dust. Water must be combined with a surfactant. Operate and maintain machine to minimize dust emissions.	None	None
(xv) Large drivable milling machines (half-lane and larger)	For cuts of any depth on asphalt only: Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. Operate and maintain machine to minimize dust emissions. For cuts of four inches in depth or less on any substrate:	None	None

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF) ≤ 4 hours/shift	>4 hours/shift
	Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. Operate and maintain machine to minimize dust emissions. OR	None	None
	Use a machine equipped with supplemental water spray designed to suppress dust. Water must be combined with a surfactant. Operate and maintain machine to minimize dust emissions.	None	None
(xvi) Crushing machines	Use equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (e.g., hoppers, conveyers, sieves/sizing or vibrating components, and discharge points) Operate and maintain machine in accordance with manufacturer's instructions to minimize dust emissions. Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote control station.	None	None

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF) ≤ 4 hours/shift	>4 hours/shift
(xvii) Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	Operate equipment from within an enclosed cab.	None	None
	When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None
(xviii) Heavy equipment and utility vehicles for tasks such as grading and excavating but not including: demolishing, abrading, or fracturing silica-containing materials	Apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None
	OR		
	When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab.	None	None

APPENDIX C

BASE-WIDE UNIFORM FEDERAL POLICY-QUALITY ASSURANCE PROJECT PLAN

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00881921

FINAL
BASEWIDE UNIFORM FEDERAL POLICY - QUALITY ASSURANCE PROJECT PLAN
LONGHORN ARMY AMMUNITION PLANT

May 2018

Prepared For:

Longhorn Army Ammunition Plant
Karnack, Texas

Under Contract To:

U.S. Army Corps of Engineers
Tulsa District
Tulsa, Oklahoma

Contract Number: W9128F-13-D-0012
Task Order Number: W912BV17F0150

Prepared By:

1608 13th Avenue South, Suite 300
Birmingham, Alabama 35205
1-800-806-4001 • www.bhate.com

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TABLE OF CONTENTS

Figures

Tables

Attachment

ACRONYMS AND ABBREVIATIONS

>	Greater than
<	Less than
%	Percent
§	Section
A2LA	American Association of Laboratory Accreditation
AA	Atomic Absorption
ABI	Applied Biosystems
AEC	Army Environmental Command
ALS	ALS Environmental
APTIM	APTIM Federal Services, Inc.
ASTM	ASTM International (formerly American Society for Testing and Materials)
BERA	Baseline Ecological Risk Assessment
BFB	4-Bromofluorobenzene
Bhate	Bhate Environmental Associates, Inc.
BRAC	Base Realignment and Closure
°C	Degree Celsius
CA	Corrective Action
CCB	Continuing Calibration Blank
CCV	Continuing calibration verification
CD	Compact disc
CERCLA	Comprehensive Environmental Response Compensation Liability Act
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
CL	Control limit
CLO_4	Perchlorate
CLP	Contract Laboratory Program
CO_2	Carbon dioxide
COC	Contaminant of Concern
COD	Chemical Oxygen Demand
COR	Contracting Officer's Representative
CPEA	Certified Professional Environmental Auditor
CPR	Cardiopulmonary Resuscitation
CSM	Conceptual Site Model
CSP	Certified Safety Professional
%D	Percent Difference
DDT	Dichlorodiphenyltrichloroethane
DHB	Dehalobacter
DHC	Dehalococcoides
DIS	Dissolved
DL	Detection limit
DoD	Department of Defense
DoE	Department of Energy
DOT	Department of Transportation
DQCR	Data Quality Control Report
DQI	Data quality indicators
DQO	Data quality objective
ECD	Electron Capture Detector
EDD	Electronic data deliverable
EICP	Extracted Ion Current Profile
EISB	Enhanced in-situ bioremediation
ELAP	Environmental Laboratory Accreditation Program
e-mail	Electronic mail
ESD	Explanation of Significant Difference
EXT	Extraction
FD	Field duplicate
FFA	Federal Facility Agreement
FID	Flame Ionization Detector
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information System

GPS	Global Positioning System
GW	Groundwater
GWTP	Groundwater Treatment Plant
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	Hydrochloric acid
HDPE	High-Density Polyethylene
HNO_3	Nitric acid
HPLC	High Performance Liquid Chromatography
H_3PO_4	Phosphoric acid
HS or HE	Houston
HSM	Health and Safety Manager
H_2SO_4	Sulfuric acid
HRMS	High Resolution Mass Spectroscopy
IC	Ion Chromatography
ICAL	Initial calibration
ICPMS	Inductively Coupled Plasma Mass Spectrometer
ICS-A/B	Interference Check Solution A or B
ICS	Interference Check Sample
ICV	Initial calibration verification
INF	Intermediate-Range Nuclear Forces
IS	Internal standard
ISB	In-situ bioremediation
IWWP	Installation-Wide Work Plan
KO	Contracting Officer
LC-MS	Liquid Chromatography-Mass Spectroscopy
LCL	Lower confidence limit
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LIMS	Laboratory Information Management System
LHAAP	Longhorn Army Ammunition Plant
LL	Low-level
LOD	Limit of detection
LODV	Limit of Detection Verification
LOQ	Limit of quantitation
LUC	Land use control
MCL	Maximum Contaminant Level
MCT	Matrix conductivity threshold
MDL	Method detection limit
MEE	Methane, ethane, ethene
MET	Metals
mg	Milligram
MI	Microbial Insights
mL	Milliliter
MMRP	Military Munitions Response Program
MNA	Monitored natural attenuation
MPC	Measurement performance criteria
MRL	Method Reporting Limit
MS	Matrix spike
MSC	Medium Specific Concentrations
MSD	Matrix spike duplicate
MSSV	Mass Spectroscopy Semi-Volatiles
MSV	Mass Spectroscopy Volatiles
μm	Micrometers
MW	Monitoring Well
NA	Not applicable or not available
NaOH	Sodium Hydroxide
NIST	National Institute of Standards and Technology
No.	Number
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
PARCCS	Precision, accuracy, representativeness, comparability, completeness, and sensitivity

PBR	Performance Based Remediation
PCB	Polychlorinated Biphenyl
PCL	Protective Concentration Levels
PDF	Portable document format
PDI	Pre-Design Investigation
PDS	Post-digestion spike
PE	(Registered) Professional Engineer
PG	(Registered) Professional Geologist
pH	Potential of hydrogen
PhD	Doctor of Philosophy
PID	Photoionization detector
PM	Project Manager
PMP	Project Management Professional
POC	Point of Contact
PPE	Personal protective equipment
PQO	Project quality objective
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
qPCR	Quantitative Polymerase Chain Reaction
QS	Quality Systems
r	Correlation Coefficient
R	Revision
r^2	Coefficient of determination
%R	Percent Recovery
RA-O	Remedial action operation
RC	Response Complete
RCRA	Resource Conservation and Recovery Act
REM	Registered Environmental Manager
RF	Response factor
RL	Reporting limit
ROD	Record of Decision
RPD	Relative percent difference
RRS	Risk Reduction Standard
RRT	Relative retention time
RSD	Relative standard deviation
RT	Retention time
SDG	Sample delivery group
SIM	Selected ion monitoring
SM	Standard Method
SOP	Standard Operating Procedure
SPE	Solid Phase Extraction
SSHO	Site Safety and Health Officer
SV	Semi-Volatiles
SW	Solid Waste
TAC	Texas Administrative Code
TAL	Target analyte list
TCD	Thermal Conductivity Detector
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
TNT	2,4,6-Trinitrotoluene
TOC	Total Organic Carbon
TRRP	Texas Risk Reduction Program
UCL	Upper confidence limit
UFP	Uniform Federal Policy
U.S.	United States
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UV	Ultraviolet
V	Volatiles
VFA	Volatile Fatty Acid
VOA	Volatile organic analyte
VOC	Volatile Organic Compound
WC	Wet Chemistry

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WORKSHEETS 1 AND 2 - TITLE AND APPROVAL PAGE

Project Name and Site Location:	Longhorn Army Ammunition Plant (LHAAP) Performance-Based Remediation (PBR) in Karnack, Texas
Contract Number:	W9128F-13-D-0012; Task Order: W912BV17F0150
Document Title:	LHAAP Base-wide Uniform Federal Policy Act (UFP)-Quality Assurance Project Plan (QAPP)
Lead Organization:	United States (U.S.) Army
Lead Regulatory Organization:	U.S. Army
Contractor's Contact Information:	Bhate Environmental Associates, Inc. (Bhate) 1608 13th Avenue South, Suite 300 Birmingham, Alabama 35205
Identify Regulatory Program:	Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980
List organizational partners (stakeholders) and connection with lead organization:	Texas Commission on Environmental Quality (TCEQ), U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS)
List dates and titles of work plan documents written for previous site work, if applicable:	Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant Karnack, Texas (AECOM, July 2014)
Preparation Date:	May 2018

Approvals

This UFP-QAPP has been reviewed and approved by the following persons.

Investigative Organization's Project Manager:

Kimberly Nemmers, PE

Organization: Bhate Environmental Associates, Inc.

Investigative Organization's Project Quality Assurance/Quality Control (QA/QC) Manager:

Corey Green

Organization: Bhate Environmental Associates, Inc.

Installation Point of Contact (POC):

Rose Zeiler, PhD

Organization: Army Base Realignment and Closure (BRAC)

Project Engineer

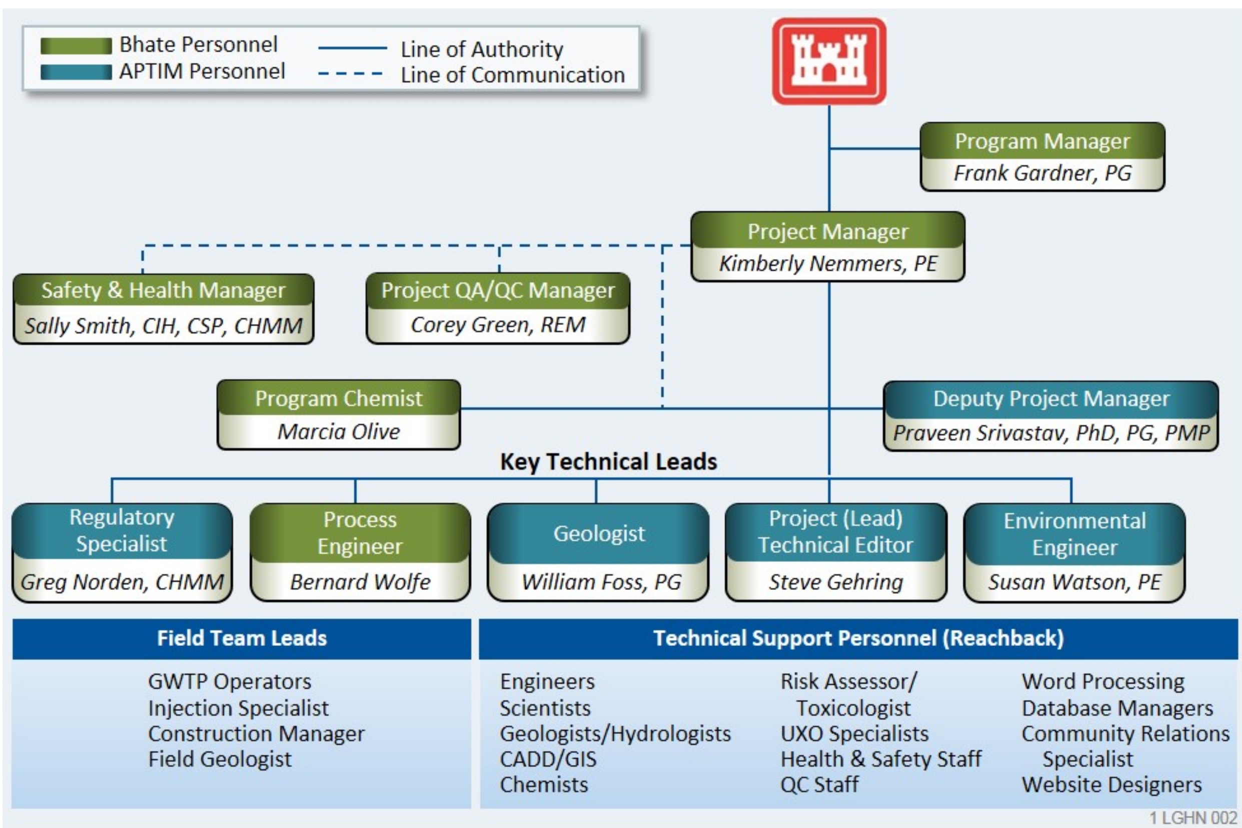
Aaron Williams

Organization: U.S. Army Corps of Engineers (USACE)-Tulsa

WORKSHEETS 3 AND 5 – PROJECT ORGANIZATION AND DOCUMENT DISTRIBUTION

This worksheet identifies reporting relationships between key and support personnel involved in the project, including the lead organization and all contractor and subcontractor organizations. This organization is specific to typical LHAAP activities such as operations and maintenance (O&M) of the groundwater treatment plant (GWTP) and sampling of various media (soil, groundwater, air, and surface water) for Remedial Action - Operation at various sites. Implementation of remedial actions at sites will be presented in a site-specific work plan that includes an addendum to the Health and Safety Plan (HASP) contained in Appendix B of the Installation-Wide Work Plan (IWWP). **Figure 1** presents the LHAAP PBR Organization Chart. Document distribution information follows the Organization Chart.

Figure 1. Organization Chart



The following lists the entities who will receive copies of the approved UFP-QAPP, subsequent UFP-QAPP revisions, addenda, and amendments.

Document Title: *LHAAP Base-wide UFP-QAPP*

Contract Number: W9128F-13-D-0012; Task Order: W912BV17F0150

Recipient	Title	Organization	Hard Copy	Electronic Copies
Rick Smith	Project Manager	USACE - Tulsa	None	None
Aaron Williams	Project Engineer	USACE - Tulsa	None	One
Rose Zeiler	BRAC Installation Manager	BRAC - LHAAP	One	One
Nicholas Smith	Army Environmental Command (AEC), Environmental Restoration Manager	USACE	None	One
April Palmie	Remedial Project Manager	TCEQ	One	One
Richard Mayer, PG	Remedial Project Manager	USEPA – Region 6	One	One
Paul Bruckwicki	Refuge Biologist	USFWS	None	None
Eric Duerkop	Deputy Refuge Manager	USFWS	None	None

WORKSHEETS 4, 7, AND 8 – PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

Table 1. Personnel Qualifications and Sign-off

Project Personnel	Project Title and Role	Education and Experience	Specialized Training and Certifications	Signature and Date
Prime Contractor				
Kim Nemmers	LHAAP PBR Task Order Project Manager (PM) - Responsible for management of PBR Contract including monthly reporting, scheduling, invoicing, and achievement of proposed performance objectives on or ahead of schedule	Bachelor of Science, Civil Engineering (1998), Purdue University Master of Science, Environmental Engineering (2002), Illinois Institute of Technology 19 years of PM experience 14 years of environmental remediation and field operations management	Professional Engineer (PE), Illinois	
Bernard Wolfe	Process Engineer	Bachelor of Science, Civil and Environmental Engineering (1998), University of Alabama at Birmingham Bachelor of Arts, Philosophy (1986), Millsaps College (Jackson, Mississippi) 17 years of experience on construction, demolition, engineering, and environmental restoration projects	Engineer-in-Training 40-Hour Hazardous Waste Operator Emergency Response (HAZWOPER) Training American Red Cross First Aid & Cardiopulmonary Resuscitation (CPR) 30-hour Occupational Safety and Health Administration (OSHA) Site Supervisor Training Confined Space Entrant Supervisor Training Construction Quality Management for Contractors	

Project Personnel	Project Title and Role	Education and Experience	Specialized Training and Certifications	Signature and Date
Marcia Olive	Project Chemist	Bachelor of Science, Chemistry (1995), University of Colorado, Colorado Springs 16 years of experience on Department of Defense (DoD) (U.S. Army, USACE, U.S. Navy, U.S. Air Force), Department of Energy (DoE), and Superfund projects as a Project Chemist		
Corey Green	Project QA/QC Manager	Master of Science, Environmental Systems Engineering (1993), Clemson University Bachelor of Science, Chemistry (1991), University of South Carolina 20 years of experience in report and plan preparation for environmental investigations, compliance, and remediation 15 years of experience performing QC reviews of project deliverables	Registered Environmental Manager (REM) Asbestos Inspector	
Sally Smith	Health and Safety Manager (HSM)	Master of Health Science, Industrial Hygiene and Environmental Health Engineering (2001), Johns Hopkins University Master of Public Health, Occupational Epidemiology (1976), University of Illinois Bachelor of Science, Biochemistry (1974), University of Illinois 32 years of health and safety experience 22 years of Resource Conservation and Recovery Act (RCRA) and Superfund experience for federal environmental remediation and construction projects	Certified Industrial Hygienist (CIH) Certified Safety Professional (CSP) Certified Hazardous Materials Manager (CHMM) Certified Professional Environmental Auditor (CPEA) Construction Safety and Health Supervisor	

Project Personnel	Project Title and Role	Education and Experience	Specialized Training and Certifications	Signature and Date
Subcontractor: APTIM Federal Services (APTIM) – Teaming Partner				
Greg Norden	Regulatory Specialist	Master of Science, Environmental Management (1994), University of Findlay, Ohio Bachelor of Science, Public Administration (1990), Cedarville College, Ohio 27 years of experience ensuring regulatory compliance for Hazardous, Toxic, and Radioactive Waste sites and managing transport and disposal of radioactive and hazardous waste projects	CHMM Department of Transportation (DOT) Hazardous Materials Training OSHA 40-hour HAZWOPER and Annual 8-hour Refreshers DOT Hazardous Materials Transportation 40-hour RCRA Seminar for 40 CFR Part 262 – Standards Applicable to Generators of Hazardous Waste 40-hour RCRA Seminar for Land Disposal Restriction requirements of 40 CFR Part 268	
Susan Watson	Environmental Engineer	Bachelor of Science, Mechanical Engineering (1979), University of Oklahoma 30 years of experience on environmental compliance and remediation projects primarily on DoE or DoD projects Over 20 years of experience managing technical aspects of remediation of contaminated sites in Texas	PE, Texas OSHA 40-hour HAZWOPER and Annual 8-hour Refreshers	

Project Personnel	Project Title and Role	Education and Experience	Specialized Training and Certifications	Signature and Date
William "Bill" Foss	Geologist	Bachelor of Science, Geology (1993), Texas A&M University 24 years of experience as a Professional Geologist (PG) performing environmental consulting services nationwide, with over 13 years on DoD installations Over 23 years of experience investigating sites, evaluating hydrogeology, and performing remediation in East Texas geological settings very similar to and including those found at LHAAP 19 years of experience evaluating biological remediation and natural attenuation of sites in Texas	PG, Texas OSHA 40-hour HAZWOPER and Annual 8-hour Refreshers OSHA Site Supervisor Training TCEQ Texas Risk Reduction Program (TRRP) Training	
Steve Gehring	Project (Lead) Technical Editor	PhD, Music History and Theory (2011), Stony Brook University Master of Arts, Music History and Literature (1999), University of Denver Bachelor of Arts, Music (1984), University of Northern Colorado 10+ years of experience as a technical editor 5 years of experience as company Technical Publications Disciple Lead		

Project Personnel	Project Title and Role	Education and Experience	Specialized Training and Certifications	Signature and Date
Praveen Srivastav	Deputy Project Manager	PhD, Geology (1993), University of Rochester Master of Science, Geology (1988), University of Rochester Master of Science, Applied Geology (1985), Indian Institute of Technology Bachelor of Science, Applied Geology (1983), Delhi University 20 years of experience managing environmental assessment and remediation at DoD and DoE sites 20 years of experience as Project Manager for 10 USACE task orders including work at LHAAP and 2 Air Force Civil Engineer Center task orders	Certified Project Management Professional (PMP) PG, Texas OSHA Health & Safety Supervisor Training OSHA 40-hour HAZWOPER and Annual 8-hour Refreshers	
Subcontractors Supporting Laboratory Services				
Sonia West	ALS Environmental (ALS), Project Manager	Sam Houston State University, 1984-85 11 years of experience as Project Manager		

Note: Approvals can be received via electronic mail or similar such that actual signature of this UFP-QAPP is not required.

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Manpower Requirements

Project management, scheduling, and technical support will be based in Bhate's Lakewood, Colorado, office. Personnel resumes are available through Bhate's human resources department for Bhate personnel.

Project Management and Field Supervision

The Bhate project management approach is to work closely with the client to accomplish project objectives and ensure continuous client satisfaction with the project. Therefore, the Bhate PM will have overall responsibility for project schedule, costs, and resources. Resource requirements will be addressed with full support of Bhate staff prior to mobilization and on a regular basis during the course of work.

Project controls personnel will be assigned to assist with daily cost tracking and equipment/materials procurement. The project controls personnel will work closely with the PM with regard to project costs and planning.

Personnel - Duties and Responsibilities

Overall Responsibilities

Bhate will accomplish the following:

- Initiate and maintain a thorough and proactive safety program throughout the entire project.
- If a conflict, error, or discrepancy is found in contract documents, obtain a written interpretation or clarification from the Army Contracting Officer (KO) before proceeding with the task(s) in question; with the Army Contracting Officer's Representative (COR), PM, and Project Engineer copied on such correspondence.
- Notify the Army KO and COR in writing or by electronic mail (e-mail) of any potential change to site conditions.
- Assign a PM for the life of the project (with prior written notice provided to the Army before any necessary changes in Bhate supervision are executed).
- Maintain at the site copies, as appropriate, of any site-specific work plans, the Basewide IWWP (including this UFP-QAPP and HASP), specifications, addenda, written amendments, change orders, work directive changes, field test records, field orders, and written interpretations and clarifications.
- Manage all resources to meet the project schedule in a cost-effective manner.
- Effectively communicate project-related information to the USACE, AEC, and LHAAP BRAC PM.

Responsibilities of the Project Management Team

The Bhate PM will have day-to-day responsibility for technical, schedule, and budget issues. The Site Supervisor, GWTP operator(s) and other support personnel (as needed) will support the PM in the field. For routine media sampling and O&M of the GWTP, the Site Supervisor will also serve as the Site Safety and Health Officer (SSHO) and will assume on-site QC responsibilities. Individual responsibilities are described further in the following sections.

Project Manager

The PM (Kimberly Nemmers, PE) is in charge of the overall project and has full authority for project coordination and direction. The PM will also communicate directly with the COR. The PM will:

- Interpret and plan the overall work effort.
- Review and approve submittals (including Daily Quality Control Reports [DQCRs]).
- Define resource needs and secure staff and equipment commitments.
- Monitor subcontractor performance, schedules, budgets, and invoices.
- Develop, review, and meet work schedule and budget objectives.
- Ensure technical adequacy of field, laboratory, and data management activities.
- Attend meetings with the Army, LHAAP, TCEQ, and USEPA personnel as required.

To carry out these functions, the PM will have the authority to:

- Determine staff and subcontractor priorities.
- Allocate additional personnel, as needed.
- Establish work budgets and schedules with milestones.
- Approve subcontractor work and invoices.
- Review and approve invoices.

Site Supervisor

The Site Supervisor is responsible for the performance of the field activities in accordance with the Work Plan and other project plans and specifications, including preparation of DQCRs. The Site Supervisor will also act as the SSHO and will be in charge of site QA/QC. The Site Supervisor is also the GWTP Operator and is supported by a second GWTP Operator. The Site Supervisor will:

- Implement day-to-day activities required by the HASP (Appendix B in the IWWP).
- Coordinate field activities at the site, as directed by the PM.
- Oversee sampling activities and ensure that pre-investigation requirements are completed.
- Manage day-to-day administrative and procurement activities at the site.
- Oversee GWTP operations and advise the PM for potential issues and repair needs.
- Monitor work progress and schedule, and advise the PM of variances.
- Ensure compliance of all site work tasks with governing State and Federal regulations pertinent to the work. Has stop work authority.

- Assist in preparation of work progress schedules and project reports.
- Compile daily logs for submittal to the PM.
- Attend work progress meetings.
- Report any proposed significant project changes to the PM in a timely manner to allow review and approval prior to incorporating the changed condition.

Health and Safety Manager

The HSM (Sally Smith, CIH, CSP, CHMM, CPEA) will be responsible for the development, implementation, oversight, and enforcement of the Basewide HASP. The HSM will:

- Sign and date the Basewide HASP, prior to submittal.
- Be available for emergencies.
- Provide onsite consultation to the SSHO as needed to ensure the Basewide HASP is fully implemented.
- Coordinate any modifications to the Basewide HASP with the SSHO and the COR.
- Provide continued support for upgrading/downgrading the level of personal protection.
- Be responsible for evaluating data and recommending changes to engineering controls, work practices, and personal protective equipment (PPE).
- Review accident reports and results of daily inspections. Has stop work authority.

Site Safety and Health Officer

The Site Supervisor will also act as the SSHO for GWTP O&M and routine media sampling and are responsible for implementing the HASP to satisfy federal, State, and local regulations and ensuring that the plan is consistent with site conditions. The SSHO will be responsible for the enforcement of the Basewide HASP during those times that the HSM is absent from the site. The SSHO may take actions independent of the project group to stop the project, if required, to address safety concerns. The SSHO is responsible for conformance of all site work with requirements and procedures identified in the Basewide HASP. To oversee the day-to-day implementation of the Basewide HASP, the SSHO will:

- Approve PPE and safety procedures specified in the Basewide HASP.
- Oversee the maintenance and use of field equipment.
- Designate appropriate personal protection levels, including upgrades.
- Provide guidance to the project staff to maintain compliance of all site work with Federal and State regulations.
- Be "first at the scene" for emergencies and be responsible for notifying the HSM and the PM. The SSHO is also responsible for preparing an *Incident Report Form* related to any emergency.

Project Chemist

The Project Chemist (Marcia Olive) will be responsible for the QA/QC of analytical data generated during project activities in accordance with this UFP-QAPP and site-specific UFP-QAPPs. In addition, the Project Chemist will provide necessary oversight and guidance for the subcontracted laboratory through various QA/QC activities, including data review/validation and systems and performance auditing. The Project Chemist will:

- Coordinate with the Site Supervisor on field sampling and shipment.
- Verify the receipt of samples with the subcontracted laboratories.
- Coordinate with the subcontracted laboratories on laboratory QA/QC matters.
- Resolve all QC problems with the subcontracted laboratories and report them to the PM.
- Review all chemical analytical data for compliance with QC requirements and technical accuracy.
- Ensure all the analytical data packages are validated against project requirements.

Subcontractors

The selection of qualified subcontractors will be in accordance with Bhate procurement procedures. Subcontractors will be supervised by the Site Supervisor/SSHO to verify the operator qualifications and use of properly operating equipment. The Site Supervisor will also direct the activities of the subcontractors, including work stoppage and/or taking appropriate emergency actions. The PM is responsible for overall subcontractor performance.

An individual with each respective subcontractor will serve to manage each task. They will have the responsibility for planning, supervising, conducting, and delivering work for the assigned tasks.

Routine Training and Certification Requirements

This section outlines the training and certification required to complete the activities in the UFP-QAPP. The following sections describe the requirements for contractor and subcontractor personnel working onsite.

Field Work Training

Field team members will be adequately trained in field methods and sampling procedures outlined in this plan and the Standard Operating Procedures (SOPs) which are provided in Appendix A of the IWWP. Specifically, field team members will have training in the following activities:

- Monitoring Well Installation
- Monitoring Well Development
- Waste Management (including investigation-derived waste)
- Water, Air and Soil Sampling and sample handling, packaging, and shipping

- Surveying monitoring wells
- Well abandonment

Training will be provided by the Site Supervisor, who are required to have a minimum of 3 years of direct field experience with sampling, sample handling, packaging and shipping, field equipment operation, and handling of hazardous and non-hazardous waste. Subcontractor personnel may require additional training to operate heavy equipment. This training is not provided by the Site Supervisor and will be the responsibility of the subcontractor.

Health and Safety Training

Bhate and subcontractor personnel who work at hazardous waste project sites are required to meet the OSHA training requirements defined in Title 29 Code of Federal Regulations (29 CFR Section [§]1910.120 (e)). These requirements are:

- 40 hours of formal off-site instruction;
- A minimum of 3 days of actual on-site field experience under the supervision of a trained and experienced field supervisor; and
- 8 hours of annual refresher training.

Field personnel who directly supervise employees engaged in hazardous waste operations also receive at least 8 additional hours of specialized supervisor training. The supervisor training covers the Basewide HASP requirements, training requirements, PPE requirements, spill containment program, and health-hazard monitoring procedures and techniques. At least one member of every field team will maintain current certification in the American Red Cross "Multimedia First Aid" and "CPR Modular" or equivalent. **Table 2** outlines special personnel training requirements.

Table 2. Special Personnel Training Requirements

Specialized Training - Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Location of Training Records/Certificates
40-hour OSHA HAZWOPER Training and 8-hour Refresher	Varies	Varies	All field personnel	Available upon request
8-hour OSHA Site Supervisor	Varies	Varies	All field personnel	Available upon request
First Aid/CPR	Varies	Varies	At least one field team member	Available upon request
Biological Hazards	Varies	Varies	All field personnel	Available upon request
Electrical Safety	Varies	Varies	All field personnel	Available upon request
Fall Protection	Varies	Varies	All field personnel	Available upon request
Hazard Communication	Varies	Varies	All field personnel	Available upon request
Respiratory Protection	Varies	Varies	All field personnel	Available upon request
Driver Awareness	Varies	Varies	All field personnel	Available upon request
DOT Level 1	Varies	Varies	At least one field team member	Available upon request

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WORKSHEET 6 – COMMUNICATION PATHWAYS

Communication Drivers	Responsible Entity	Name	Contact Information	Procedure (Timing, Pathways, Documentation, etc.)
Manage all contract phases	Bhate PM	Kim Nemmers	knemmers@bhate.com 303-550-9239	All project information will be copied to the USACE PM. The Bhate PM will notify the USACE PM of field related problems by phone or email by close of business the day of the event if possible and no later than noon Central Daylight/Standard Time the following day.
Regulatory agency interface	USACE PM/ Installation POC/ PBR PM	Rick Smith Rose Zeiler Kim Nemmers	Richard.P.Smith@usace.army.mil 918-669-4956 rose.m.zeiler.civ@mail.mil 479-635-0110 knemmers@bhate.com 303-550-9239	Monthly Managers Meetings will be held with Regulators, USACE, LHAAP personnel, and the Bhate Team. Additional coordination and communication with regulatory agencies will be completed by the LHAAP POC or by the Bhate PM with USACE PM approval. Regulatory interactions will be documented.
Laboratory QC Variances	Project Chemist	Marcia Olive	molive@bhate.com 720-463-3905	The laboratory will be required to repeat the determination of the limit of detection (LOD) if there are significant changes to the method or instrumentation prior to analysis of the first sample. The limit of quantitation (LOQ) will be verified quarterly; if the method is modified or major changes are made to the instrumentation, the LOQ will be verified and reported.
Analytical corrective action	Project Chemist	Marcia Olive	molive@bhate.com 720-463-3905	Determines the need for corrective action for analytical issues; reviews data and technical deliverables as needed; provides feedback to Bhate PM on technical deliverables within 10 days of receipt.
Data Verification Issues	Project Chemist	Marcia Olive	molive@bhate.com 720-463-3905	Confirms that scientifically sound data is used in making project decisions via a three step data review (Worksheets 34 and 37).

Communication Drivers	Responsible Entity	Name	Contact Information	Procedure (Timing, Pathways, Documentation, etc.)
Data Validation Issues	Project Chemist	Marcia Olive	molive@bhate.com 720-463-3905	Evaluate whether the collected data comply with project requirements by comparing the data collected with criteria established based on data quality objectives (DQOs). Coordinate with contracted laboratory as needed.
Data Review Corrective Action	Project Chemist	Marcia Olive	molive@bhate.com 720-463-3905	If corrective action is deemed necessary, review supporting raw data to verify accuracy.
Health and Safety issues	HSM	Sally Smith	ssmith@bhate.com 205-983-4150	The onsite SSHO will verbally report any issue to the HSM and notify the U.S. Army COR verbally, at a minimum. A Bhate incident form must be completed within 24 hours by the SSHO and submitted to the HSM for review and approval. Within 5 days of the incident, the HSM will complete the Bhate incident investigation form.

WORKSHEET 9 – PROJECT SCOPING SESSION PARTICIPANTS SHEET

No specific scoping session was held for this UFP-QAPP.

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WORKSHEET 10 – CONCEPTUAL SITE MODEL

This worksheet describes the Conceptual Site Model (CSM). The CSM integrates existing information and working assumptions about the physical site conditions; the nature, occurrence, and distribution of chemicals; fate and transport processes; and potential exposures to human and ecological receptors. The CSM is based on the current understanding of site history and conditions.

LHAAP is located in central-east Texas in the northeastern corner of Harrison County. The former U.S. Army installation occupies 8,416 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake. The nearest cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the southeast. Caddo Lake, a large freshwater lake situated on the Texas-Louisiana border, bounds LHAAP to the north and east.

LHAAP became inactive and excess to the U.S. Army's needs in July 1997. Between 1998 and 2000, the Government liquidated all personal property and specific installed property. In 1999, the U.S. Army demolished several structurally unsafe buildings. The BRAC Division received administrative control of LHAAP in October 2002. The AEC is responsible funding the Installation Restoration Program and MMRP at LHAAP. BRAC is responsible for administration and execution of the restoration program at LHAAP. The USFWS requested all of LHAAP during the federal screening for Government property disposal. In April 2004, a Memorandum of Agreement was executed between the U.S. Army and USFWS providing the terms and conditions for transfer of LHAAP property to USFWS. To date, approximately 7,000 of the 8,416-acre installation have been transferred to USFWS.

Remediation and remedial action operation (RA-O) activities are planned under this project for sites LHAAP-03, LHAAP-04, LHAAP-12, LHAAP-16, LHAAP-17, LHAAP-19, LHAAP-37, LHAAP-46, LHAAP-50, LHAAP-58, LHAAP-67, LHAAP-001-R-01, LHAAP-003-R-01, LHAAP-18/24, and the GWTP. Surface water sampling will be completed in accordance with the 1999 Dispute Resolution and in accordance with site-specific remedial action work plans. Land use controls (LUCs) will be maintained and mowing performed at LHAAP-12, LHAAP-16, LHAAP-19, LHAAP-001-R-01, and LHAAP-003-R-01. Well systems will be maintained and operated at each of the active LHAAP sites including LHAAP-02, -04, -12, -16, -17, -18/24, -37, -46, -50, -58, -67 and -001-R. In addition, LUCs are maintained at all of the sites under this task order, and the LUC Management Plan is updated annually. The GWTP at Site LHAAP-18/24 and the Intermediate-Range Nuclear Forces Pond (referred to as the INF Pond) will be Operated and Maintained.

Summary of Previous Investigations and Remedial Actions

Site specific work-plans will outline previous investigation and remedial actions, as necessary.

Site Geology and Hydrogeology

Surface water at LHAAP drains to the northeast into Caddo Lake, part of Big Cypress Bayou, via four drainage systems: Saunder's Branch, Harrison Bayou, Central Creek, and Goose Prairie Creek. Saunder's Branch of Martin's Creek flows onto LHAAP near the southeastern corner of the installation and flows northward into Caddo Lake. Approximately 10 percent of the heavily-wooded eastern section of the former plant footprint is drained by this system. Harrison Bayou enters LHAAP on the southern edge of the installation. The bayou captures approximately 30 percent of the surface drainage of LHAAP and bisects the installation in a northeasterly direction. Central Creek enters LHAAP on its western edge, just south of the town of Karnack. Approximately 30 percent of the surface drainage from the installation is transported to Caddo Lake via this drainage course. The headwaters of Goose Prairie Creek are located near the northwestern corner of the former plant footprint and consist of one larger creek and several smaller tributaries. Goose Prairie Creek flows across the northern edge of the installation and drains approximately 30 percent of LHAAP. The flows of Central Creek and Goose Prairie Creek are intermittent.

The subsurface geology at LHAAP consists of a thin veneer of Quaternary alluvium overlying Tertiary age rocks of the Wilcox and Midway Groups. Underlying these sediments are Cretaceous age rocks of the Navarro and Taylor Groups. The stratigraphic thickness of the uppermost Wilcox Group ranges from a maximum of 350 feet in the northwest corner of LHAAP to approximately 130 to 140 feet along the east side of the facility near Caddo Lake. The Wilcox Group constitutes the majority of the unconsolidated sediments underlying LHAAP. The Wilcox Group consists of interbedded sands, silts, and clays. These sediments were deposited along flood plains and in lakes and swamps on a wide, flat coastal plain traversed by shifting streams. This type of depositional environment resulted in the extreme variability and discontinuity of the sediments observed in the Wilcox Group beneath the site.

As part of the Post-Screening Investigation Report – LHAAP-18/24 (AECOM,March 2013), the CSM was updated to describe the presence of two groundwater zones: the shallow zone is up to a depth of approximately 45 feet below ground surface (Shallow Alluvium Zone) and a deep unit below the shallow zone (Wilcox Formation). Generally the two units are separated by a continuous clay layer which is understood to be present across the entire site with the exception of the area to the west and northwest towards the Harrison Bayou. Based upon this updated CSM, the shallow and shallow/intermediate-screened wells are identified in the Shallow Zone and the intermediate and deep-screened wells are identified in the Wilcox Formation.

As presented in the Post-Screening Investigation Report (AECOM, December 2013), the shallow alluvium consists of discrete sand channels encapsulated in lower permeability silt/clay floodplain sediments. The thickness of the shallow alluvium is variable, because of the irregular contact with underlying Wilcox Formation. Thickness ranges from 10 to 40 feet. The zone is characterized by potentially complex flow paths, gradients depending on where sandy channel deposits intersect or diverge. In general, the axis of channel deposits trend toward the north and northeast.

A clay unit separating the shallow alluvium from the Wilcox sands occurs at the top of the Wilcox Formation throughout most of the site. However, this clay is missing where fluvial incision has occurred during both the deposition of the shallow Wilcox as well as later incision by the Harrison

Bayou. The sands of the Wilcox Formation vary in grain size from medium to fine silty sands. The more homogenous nature (both vertically and horizontally) of the unit is visible on all sections.

Additional geologic and hydrogeologic information is included in site-specific reports.

Chemicals of Potential Concern and Regulatory Environment

Various media in certain areas have been contaminated by past industrial operations and waste management practices at LHAAP. Industrial operations involved the use of secondary explosives, rocket motor propellants, and various pyrotechnics, such as illuminating and signal flares and ammunition. Explosives included 2,4,6-trinitrotoluene (TNT) and black powder. Typical composite propellants were composed of a rubber binder, an oxidizer such as ammonium perchlorate, and a powdered metal fuel such as aluminum. Pyrotechnics were generally composed of an inorganic oxidizer such as sodium nitrate, a metal powder such as magnesium, and a binder. Other materials used in the industrial operations included acids, lubricants, and solvents; particularly trichloroethene (TCE) and methylene chloride. Waste management included sanitary wastewater treatment, industrial wastewater treatment, holding/evaporation ponds, storm water drainage, sanitary and industrial waste landfills, and demolition/burning grounds. Discharges and releases to surface water, groundwater, and other secondary media have occurred from the historical operations.

LHAAP's anticipated future use is as a wildlife refuge, and human health risk was evaluated for a hypothetical future maintenance worker use. LHAAP is grandfathered under the Texas Risk Reduction Standard (RRS), 30 Texas Administrative Code (TAC) Chapter 335, but the cleanup levels for the contaminants of concern (COCs) in groundwater are a mix of federal and State programs.

The soil cleanup levels for human health are based on RRS number (No.) 2 Industrial Medium Specific Concentrations (MSCs) from 30 TAC Chapter 335. For inorganic compounds, if the LHAAP site-specific background concentrations (Shaw Environment and Infrastructure, July 2004) are greater than the MSCs, then the background values become the cleanup levels. Based upon site-specific receptors, soil cleanup levels for ecological receptors may be applicable as per the Baseline Ecological Risk Assessment (BERA, Shaw Environment and Infrastructure, November 2007).

For sites LHAAP-16, LHAAP-17, LHAAP-001-R-001, and LHAAP-003-R-001, groundwater (GW) cleanup level for perchlorate is the TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL) per the October 2014 USEPA dispute resolution letter (USEPA, 2014). Even though not included in the dispute resolution letter, the TRRP Tier 1 Groundwater Residential PCL for perchlorate also applies as the cleanup level for sites LHAAP-04 and LHAAP-50. Similarly, the PCL is the cleanup levels for manganese and nickel at Site LHAAP-16. The groundwater cleanup levels for all other COCs in groundwater are the federally promulgated Maximum Contaminant Levels (MCLs), unless MCLs are not available. If an MCL is not available for a chemical, with specified exceptions, the Texas Risk Reduction Rule (RRR) Groundwater Industrial (GW-Ind) MSC are applied. For inorganic compounds, if the LHAAP site-specific background concentration (Shaw Environment and Infrastructure, 2007) is greater than the MSC, then the background level is used as the cleanup level.

WORKSHEET 11 – PROJECT AND DATA QUALITY OBJECTIVES

The LHAAP DQOs were developed using the USEPA seven-step process (USEPA, February 2006). The Table below summarizes the DQOs.

Table 3. Data Quality Objectives

1	Problem Statement	Previous investigations and remedial actions have been, and continue to be, performed by the U.S. Army and its contractors. The results indicate that environmental media have been impacted by releases from past operations and that there are several groundwater plumes at various locations at the site containing predominantly chlorinated solvents (e.g., TCE and daughter products), perchlorate, and explosives constituents (often co-mingled). The classes of contaminants are perchlorate and chlorinated solvents for soil and water. Each activity has different sampling frequencies and analytical parameters depending on the site.
2	Identify the Goals	The data will be used to determine the concentrations of contaminants at multiple sites to evaluate remedy effectiveness, determine effluent discharge locations, and meet CERCLA and Federal Facility Agreement (FFA) requirements.
3	Inputs to the Decision	**LHAAP-02, LHAAP-001-R-01, and LHAAP-003-R-01** • Have the site-specific contaminants in groundwater achieved cleanup levels to attain response complete (RC)? **LHAAP-03** • What is the extent of arsenic and lead soil contamination? • Has soil been removed to achieve RC? **LHAAP-04** • What is the vertical and horizontal extent of perchlorate contaminated groundwater? • Any changes to plume prior to and during implementation of in-situ bioremediation (ISB)? • Is the plume stable during ISB? • Are there any potentially toxic and/or mobile transformation products? • Is the plume(s) expanding? • Has there been any unacceptable impact to downgradient receptors? **LHAAP-16** • Any changes to plume prior to and during implementation of ISB)? • Is the plume stable during ISB? • Are there any potentially toxic and/or mobile transformation products? • Is the plume(s) expanding? • Has there been any unacceptable impact to downgradient receptors? **LHAAP-18/24 and GWTP** • Is the GWTP effectively treating groundwater? • Where can processed water be discharged based upon the perchlorate protocol? • What is the extent of Volatile Organic Compounds (VOCs) and perchlorate contamination in the water bearing zones both inside and outside the containment area? • Is there a vertical gradient between water-bearing zones both inside and outside the containment area?

		• Is there evidence of natural attenuation of TCE, methylene chloride, and perchlorate? **LHAAP-17** • What is the vertical and horizontal extent of vadose zone soil contamination above cleanup levels? • What is the vertical and horizontal extent of groundwater contamination? • Is natural attenuation of chlorinated solvents occurring? **LHAAP-12, LHAAP-37, LHAAP-46, LHAAP-50, LHAAP-67** • Is natural attenuation occurring according to expectations? • Are there any changes in the environmental conditions (e.g., geochemical, hydrogeologic, etc.) that may reduce the efficacy of any of the natural attenuation processes? • Are there any potentially toxic and/or mobile transformation products? • Is the plume(s) expanding? • Has there been any unacceptable impact to downgradient receptors? • Are there any new releases of contaminants to the environment that could impact effectiveness of the natural attenuation remedy? • Has there been attainment of the remediation objectives? **LHAAP-58** • Any changes to plume prior to and during implementation of ISB? • Is the plume stable during ISB? • Are there any potentially toxic and/or mobile transformation products? • Is the plume(s) expanding? • Has there been any unacceptable impact to downgradient receptors? • Has enhanced in-situ bioremediation (EISB) effectively addressed groundwater contamination and are contamination levels trending toward the clean-up objective? **Creek (Surface Water) Sampling** • Are remedial actions continuing to limit contaminants from reaching surface water via overland flow or from groundwater influent?
4	Study Area Boundaries	Remedial activities are planned under this project for sites LHAAP-03, LHAAP-04, LHAAP-12, LHAAP-16, LHAAP-17, LHAAP-18/24 and the GWTP, surface water sampling within LHAAP boundaries, LHAAP-19, LHAAP-37, LHAAP-46, LHAAP-50, LHAAP-58, LHAAP-67, LHAAP-001-R-01, and LHAAP-003-R-01. A CERCLA 121(c) Five-Year Review will be completed for all sites in with Remedy in Place or RC.
5	Analytical Approach	Samples will be collected from existing or newly installed site wells. Based on creek water levels, surface water samples may be collected at various creeks. Air samples will be collected at the GWTP. Soil will be sampled at various locations. Samples will be sent for off-site analyses of some or all of the following: Dioxins by method 8290A, pesticides/PCBs by Methods 8081B/8082A, total and dissolved target analyte list (TAL) metals by Solid Waste (SW)-846 Methods 6020A/7470A/7471B; perchlorate by SW-846 Method 6850; the standard list of high explosives by SW-846 Method 8330A; VOCs by SW-846 Method 8260C; semi-volatiles including 1,4-dioxane by SW-846 Method 8270D Low-level (LL) or Selected ion monitoring (SIM); anions (chloride, sulfate, nitrate, nitrite) by SW-846 Method 9056A; Oil & Grease by Method 1664A; Volatile Fatty Acids by High Performance Liquid Chromatography (HPLC)-METACIDS; Hexavalent Chromium by Method 7196A; monitored natural attenuation (MNA) parameters (including some combination of the following: Total Organic Carbon (TOC); ammonia; total phosphorus; ortho-phosphate;

		alkalinity; Chemical Oxygen Demand (COD); sulfide; ferrous iron; methane, ethane, ethene, carbon dioxide[MEE/CO2]); and microbial analysis, as needed. Air samples will be analyzed for VOCs by TO-15. In addition, a Trimble Global Positioning System (GPS) unit will be used to map the locations of newly installed monitoring wells and aid in finding existing monitoring wells.
6	Acceptable Limits on Decision Error	Analytical data needs to be compliant with Worksheets 19/30, 20, 25, 26/27, and 28 as this data will be used to support the performance objectives outlined in the Performance Work Statement.

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WORKSHEET 12 – MEASUREMENT PERFORMANCE DATA

This worksheet documents the quantitative measurement performance criteria (MPC) in terms of precision, bias, and sensitivity for both field and laboratory measurements and is used as guidance for selecting appropriate techniques and analytical methods. In conjunction with Worksheet 11, these MPCs ensure data will satisfy the project quality objectives (PQOs) and DQOs. MPCs should be determined for each matrix and analytical group.

MPC were established for each analytical parameter. Refer to the following worksheets for the required information in this worksheet:

- Worksheet 15 (Reference Limits and Evaluation) for data quality indicators (DQIs) consisting of precision and accuracy;
- Worksheet 24 (Analytical Instrument Calibration);
- Worksheet 28 (Laboratory Quality Control Sample Summary);
- Worksheet 36 (Data Validation Procedures - Validation Summary) for data review and validation process; and
- Worksheet 37 (Data Usability Assessment) for precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS).

The quality of the data to be collected for this project will be verified using appropriate MPCs established for both sampling procedures and analytical methods. The criteria will relate to the DQIs in the table below. The MPCs follow those defined in the DoD *Quality Systems Manual for Environmental Laboratories*, Version 5.1 (DoD, January 2017). The sampling procedures and the quality of the laboratory results will be evaluated for compliance with the project-specific DQOs through a review of overall PARCCS, in accordance with procedures described in Worksheet 37 (Data Usability Assessment).

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Table 4. Quantitative Measurement Performance Criteria

QC Sample	Analytical Group/SOP	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error*
Trip Blank	Aqueous/Solid Volatiles SW8260C/SOP HS-MSV001 R11.2	One per cooler containing VOC samples	Overall accuracy/bias (Contamination)	No target analyte ≥ LOQ; with the exception of common field/ laboratory contaminants	S
MS/MSD		One per 20 samples per matrix	Accuracy/Precision	See Worksheet 15	S&A
LCS/LCSD		At least one per analytical batch	Accuracy/Precision	See Worksheet 15	A
Cooler Temperature Indicator		One per cooler	Accuracy/Representative	Between 0 and 6 degrees Celsius (°C)	S
Field Duplicates		One per 10 samples per matrix	Precision	RPD ≤ 30% (water) RPD ≤ 50% (soil)	S & A
Equipment/Rinsate Blanks (as required)		At least one per day	Bias/Contamination	No target analytes ≥ LOQ; with the exception of common field/ laboratory contaminants	S
Data Completeness Check		NA	Data Completeness	95% Overall	S & A
Field Duplicates	Aqueous/Solid Metals SW6020A-SW3010A/ SW3050B, SW7470A/ 7471B SOP HS-MET003 R8.6, HS-MET001 R11.1, HS-MET002 R9.0, HS-MET004 R12.0, HS-MET005 R9.3	One per 10 samples per matrix	Overall Precision	RPD ≤ 30% (water) RPD ≤ 50% (soil)	S & A
LCS/LCSD		At least one per analytical batch	Analytical Accuracy/ Precision	See Worksheet 15	A
MS/MSD		One per 20 sample matrix	Analytical Accuracy/Bias (matrix interference)	See Worksheet 15	S & A
Equipment Blanks (as required)		At least one per day	Overall Accuracy/Bias (contamination)	No target analytes ≥ LOQ	S
Data Completeness		NA	Data Completeness	95% Overall	S & A
Cooler Temperature Indicator	Aqueous/Solid	One per cooler	Accuracy/Representative	Between 0 and 6°C	S

QC Sample	Analytical Group/SOP	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error*
Field Duplicates	Anions SW9056A/SOP IC001 R9.1 Perchlorate 6850/SOP LC-MS-CLO4 R10.0 Explosives SW8330A/SOP HS-HPLC003 R5.1, HS-EXT013 R4.0, HS-EXT014 R5.0	One per 10 samples per matrix	Precision	RPD ≤ 30%	S & A
LCS/LCSD		At least one per analytical batch	Analytical Accuracy/ Precision	See Worksheet 15	A
MS/MSD		One per 20 sample matrix	Analytical Accuracy/Bias (matrix interference)	See Worksheet 15	S & A
Equipment/Rinsate Blanks (as required)		At least one per day	Bias/Contamination	No target analytes ≥ LOQ	S
Data Completeness Check		NA	Data Completeness	95% Overall	S & A
Field Duplicates	Aqueous/Solid Hexavalent Chromium SW846 7196A-3060A/ SOP HS-WC008 R7.2, HS-WC009 R6.1 Semi-volatiles SW8270D (SIM)-SW3510C/SW3541/ SOPs HS-MSSV003 R6.0, HS-MSSV006 R1.0, HS-EXT001 R11.1, HS-EXT002 R10.3 TOC USEPA 415.1/ SW9060A/SOP HS-WC021 R6.2/HS-WC022 R5.0	One per 10 samples per matrix	Precision	RPD ≤ 50 %	S & A
LCS/LCSD		At least one per analytical batch	Precision/Accuracy/Bias	See Worksheet 15	S
MS/MSD		One per 20 samples per matrix	Accuracy/Bias	See Worksheet 15	S&A
Equipment/Rinsate Blanks (as required)		At least one per day	Bias/Contamination	No target analytes ≥ LOQ	S
Data Completeness Check		Not Applicable	Data Completeness	95% Overall	S & A
Cooler Temperature Indicator		One per cooler	Accuracy/Representative	Between 0 and 6°C	S

QC Sample	Analytical Group/SOP	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error*
Field Duplicates	Aqueous Alkalinity SM2320B/SOP HS-WC001 R8.2 Oil & Grease USEPA 1664A/SOP WC-036 R4.2 COD USEPA 410.4/SOP HS-WC025 R3.4 Total Phosphorous/ Ortho-Phosphate SM4500-P/SOP HS-WC015 R7.0 Ammonia SM4500NH3B F/SOP HS-WC026 R5.0 Sulfide SM4500S2F/SOP HS-WC018 R7.0 Ferrous iron SM3500 Fe B/GEN-3500 R5.0 MEE+Co2 RSK-175/SOP VOA-DISGAS R16.0 Volatile Fatty Acids HPLC-METACIDS R5.0	One per 10 samples per matrix	Precision	RPD ≤ 30%	S & A
LCS/LCSD		At least one per analytical batch	Analytical Accuracy/ Precision	See Worksheet 15	A
MS/MSD (if applicable)		One per 20 samples per matrix	Accuracy/Bias	See Worksheet 15	S&A
Data Completeness Check		NA	Data Completeness	95% Overall	S & A

QC Sample	Analytical Group/SOP	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error*
Field Duplicates	Air Volatiles SOP VOA-TO-15	One per 10 samples per matrix	Precision	RPD ≤ 30%	S & A
LCS/LCSD		At least one per analytical batch	Analytical Accuracy/ Precision	See Worksheet 15	A
Data Completeness Check		Not Applicable	Data Completeness	95% Overall	S & A
Field Duplicates	Solid Pesticides/PCBs SW846 8081B/ 8082A/SOP HS-GCECD001 R8.3, HS-GCECD002 R10.1, HS-EXT002 R10.3 Dioxins SW8290A/SOPs HE-HRMS001 R0.1, HE-EXT002 R0.2	One per 10 samples per matrix	Precision	RPD ≤ 50 %	S & A
LCS/LCSD		At least one per analytical batch	Precision/Accuracy/Bias	See Worksheet 15	S
MS/MSD		One per 20 samples per matrix	Accuracy/Bias	See Worksheet 15	S&A
Equipment/Rinsate Blanks (as required)		At least one per day	Bias/Contamination	No target analytes ≥ LOQ	S
Data Completeness Check		Not Applicable	Data Completeness	95% Overall	S & A

Notes: *Sampling (S), Analytical (A) or both (S&A)
RPD – relative percent difference; MSV – Mass Spectroscopy Volatiles; MSSV – Mass Spectroscopy Semi-Volatiles; MET - Metals; IC – Ion Chromatography; EXT – Extraction; HS or HE – Houston; WC – Wet Chemistry; LC-MS – Liquid Chromatography-Mass Spectroscopy; R – Revision; VOA – Volatile Organic Analyte; DIS – dissolved; MS – Matrix Spike; MSD – Matrix Spike Duplicate; CLO4 – perchlorate; NA – Not applicable; LCS – Laboratory control sample; LCSD – Laboratory control sample duplicate, HRMS – High Resolution Mass Spectroscopy; PCBs - Polychlorinated Biphenyls; ECD – Electron Capture Detector

WORKSHEET 13 – SECONDARY DATA CRITERIA AND LIMITATIONS

Secondary data refer to historical data and background information previously collected at the site. The source(s) of the data, date of collection, planned uses, and limitations of the secondary data are summarized in the following table.

Table 5. Secondary Data Criteria Limitations

Secondary Data	Date of Collection	Source	How Data Will Be Used	Limitations on Data Use
Groundwater and surface water data	Varies by sites	Laboratory electronic data deliverables (EDDs)	Verifies compliance with RODs	None

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WORKSHEETS 14 AND 16 – PROJECT TASKS AND SCHEDULE

Individual site field work tasks and schedule are provided to the LHAAP team as field work is scoped.

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WORKSHEET 15 – REFERENCE LIMITS AND EVALUATION

This worksheet includes laboratory quality control data for each matrix and analytical method. The goal is that the laboratory and method can provide accurate data at the detection limits. The planning process identified target analytes and reference limits on which detection limits are based. Reference limits for ALS and applicable screening objectives are located in Attachment 1.

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WORKSHEET 17 – SAMPLING DESIGN AND RATIONALE

This worksheet describes the sampling design/field investigation activities and basis for its selection. The field activities will be conducted in accordance with the field SOPs listed in Worksheet 21. **Site-specific sampling approaches and associated rationale will be developed in site-specific work plans, as the approach may vary from site to site.** Surface water monitoring will be conducted to provide ongoing assessment for detection of any movement of contaminants. The number of samples and the analytical parameters planned are summarized in Worksheet 18 (Sampling Locations and Methods).

Physical Boundaries for the Area Under Study

LHAAP is located in central-east Texas in the northeastern corner of Harrison County. The footprint of the former U.S. Army installation occupies 8,416 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake.

Summary of Project Tasks

Groundwater samples will be collected from each existing monitoring well, and monitoring wells installed during the duration of the project; along with soil samples from various sites to determine the concentrations of metals, the standard list of high explosives, VOCs, and/or perchlorate in site groundwater and soil. Samples will be sent offsite for analysis to ALS. Groundwater and soil samples will also potentially include some or all of the following analyses, varying from site to site: VOCs, total and dissolved TAL metals; pesticides/PCBs, dioxins, semi-volatiles including 1,4-dioxane; MNA parameters; and hexavalent chromium by ALS located in Houston, Texas. Perchlorate and air samples will be analyzed by ALS located in Salt Lake City, Utah. Methane, ethane, ethene and carbon dioxide be analyzed by ALS located in Simi Valley, California. Ferrous Iron and volatile fatty acids will be analyzed by ALS located in Rochester, New York. Samples for dehalococcoides and functional gene analysis will be sent to Microbial Insights (MI) in Knoxville, Tennessee. Field duplicate samples, MS/MSDs, trip blanks, and equipment blanks (when necessary) will also be collected as QC samples.

Sampling at LHAAP includes multiple sites with differing sampling designs and rationales, and will be conducted over a period of several years. Please refer to the most current site-specific documents (e.g., work plans and addendums) for specifics of sampling design and rationale at each LHAAP site. See the **IWWP Figure 2-2** for LHAAP site locations.

Laboratory Analysis

The samples collected for characterization, evaluation of remedies, RA-O, and compliance activities will be analyzed as follows:

- VOCs by USEPA Method 8260C
- TAL Metals by USEPA Method 6020A/7470A/7471B
- Alkalinity by SM2320B

- Nitrate, nitrite, chloride, and sulfate by USEPA 9056A
- Sulfide by Method SM4500 S2F
- TOC by Method EPA 415.1/SW9060A
- Total Phosphorus/Ortho-phosphate by Method SM4500 P
- Methane, ethane, ethene, carbon dioxide by Method RSK-175
- Ferrous iron by Method SM3500 FeB
- Semi-Volatiles (including 1,4-Dioxane) by Method 8720D/8270 D LL or SIM
- COD by USEPA Method 410.4
- Dehalobacter (DHB)/Dehalococcoides (DHC) ethogenes by Quantitative Polymerase Chain Reaction (qPCR) Method
- Volatiles in Air by Method TO-15
- Volatile Fatty Acids (VFA) by Method HPLC-METACIDS
- Explosives by Method 8330A
- Perchlorate by Method 6850
- Hexavalent Chromium by Method 7196A
- Ammonia by Method SM4500 NH3 B F
- Oil & Grease by Method 1664A
- Pesticides/PCBs by Methods 8081B/8082A
- Dioxins by Method SW8290A

ALS will perform all laboratory analyses in accordance with the analytical methods and this UFP-QAPP. ALS has a current DoD Environmental Laboratory Accreditation Program (ELAP) certification for all required methods. Data validation will be completed as defined in Worksheet 36, compliant with the DoD Quality Systems Manual, Version 5.1 (DoD, January 2017).

Data Management

A three-step data review process (consisting of verification, validation, and usability assessment) will be used to examine the collected data so that only scientifically-sound data of known and documented quality are used in making environmental decisions. Worksheets 34 (Data Verification and Validation Inputs) through 37 (Data Usability Assessment) describe the process and criteria in detail.

Analytical data obtained during the project will be validated by the Project Chemist according to the specifications provided in Worksheet 36 (Data Validation Procedures).

Stage III data validation will be performed, by the validating chemist, on 100% of the Level IV analytical data provided by the laboratory. If any problems arise, a Stage IV validation of the chromatograms and spot checks of calculated results will be performed. The review and evaluation will be performed according to the guidelines of the *USEPA Contract Laboratory Program* [CLP] *National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA, January 2017), *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (USEPA, January 2017), and the QC criteria specified in this document.

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WORKSHEET 18 – SAMPLING LOCATIONS AND METHODS

The sample nomenclature for groundwater samples collected will be as follows:

SiteXXX-MW02_0518-x

- Site alpha numeric identifier: SiteXXXXX = Site XXXX
- Sample type identifier: MW = monitoring well number
- Sample date: May 2018
- x = Reserved for the following QA sample identifiers:

-a = field duplicate	-d = equipment blanks	MS = matrix spike
-b = field replicate	-c = trip blank	SD = matrix spike duplicate

Field duplicates (FDs) will be collected at frequency of 10 percent, MS/MSD samples will be collected at a frequency of 5 percent, equipment blanks will be collected at least once per day (for non-dedicated equipment), and a trip blank will be included with each shipped cooler containing field samples selected for VOC analysis.

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Table 6. Sample Locations and Sampling SOP Requirements

Sampling Location	Matrix	Analytical Group	Estimated Number of Primary Samples	Sampling SOP Reference	Rationale for Sampling Location
LHAAP-02	Aqueous	Metals	1	See Worksheet 21	See Worksheet 17
LHAAP-03	Solid	Metals, waste characterization	To be determined	See Worksheet 21	See Worksheet 17
LHAAP-04	Aqueous	Perchlorate	10	See Worksheet 21	See Worksheet 17
LHAAP-12	Aqueous	VOCs; 1,4-Dioxane	13	See Worksheet 21	See Worksheet 17
LHAAP-16	Aqueous	VOCs, perchlorate	8	See Worksheet 21	See Worksheet 17
LHAAP-17	Aqueous	VOCs, perchlorate	To be determined	See Worksheet 21	See Worksheet 17
LHAAP-17	Solid	VOCs, Explosives, perchlorate, dioxins, barium, waste characterization	To be determined	See Worksheet 21	See Worksheet 17
LHAAP-58	Aqueous	VOCs; MNA; VFA; Arsenic; DHB/DHC; 1,4-Dioxane	24	See Worksheet 21	See Worksheet 17
LHAAP-001-R-01	Aqueous	Perchlorate	6	See Worksheet 21	See Worksheet 17
GWTP	Aqueous, Air	Various	1-2 per event	See Worksheet 21	See Worksheet 17
LHAAP-18/24	Aqueous	VOCs, perchlorate, metals	95	See Worksheet 21	See Worksheet 17
Surface water sampling	Aqueous	Perchlorate	5	See Worksheet 21	See Worksheet 17
LHAAP-37	Aqueous	VOCs, MNA	26	See Worksheet 21	See Worksheet 17
LHAAP-46	Aqueous	VOCs, MNA	24	See Worksheet 21	See Worksheet 17
LHAAP-50	Aqueous	VOCs, MNA, perchlorate	22	See Worksheet 21	See Worksheet 17

Waste characterization may include: VOCs, SVOCs, Pesticides, PCBs, metals

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WORKSHEETS 19 AND 30 – SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

This worksheet summarizes the laboratory delivery information and the analytical methods for each sampling matrix, including the required sample volume, containers, preservation, and holding time requirements. Further information on the analytical SOPs is provided in Worksheet 23 (Analytical SOP References).

Table 7. Laboratory Delivery Information

Laboratory:	ALS Environmental
Laboratory Contact, Title:	Sonia West, Project Manager
Laboratory Address	10450 Stancliff Road Houston, TX 77099
Laboratory Telephone Numbers:	Main: 281-530-5656 PM Direct: 281-575-2132 Fax: 281-530-5887
Certification:	DoD ELAP
Accreditation Expiration:	12/2018
Sample Delivery Method:	FedEx Overnight services
Data Deliverable:	14 Calendar Days for results/21 days for Level IV

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Table 8. Sample Containers, Preservation, and Hold Times

Matrix	Analytical Group	Method/SOP	Container	Sample Volume	Preservation	Analytical Holding Time
Aqueous	VOCs	SW8260C/SOP HS-MSV001 R11.2	3 X 40-mL glass volatile vials	*5* mL	HCl to pH <2; Cool to 0 – 6 °C; no headspace	14 days to analysis
Aqueous	Perchlorate	6850/SOP HS-LC-MS-CLO4 R10.0	1 X 125 mL HDPE	100 mL	Filtration (0.2 µm), Cool to 0 – 6 °C	28 days to analysis
Aqueous	Explosives	SW8330A/SOP HS-HPLC003 R5.1, HS-EXT013 R4.0	2 X 1-liter glass amber bottles	1,000 mL	Cool to 0 – 6 °C	7 days until extraction/ 40 days extraction to analysis
Aqueous	Metals (Total and Dissolved)	SW6020A/SW3010A, SW7470A/SOP HS-MET003 R8.6, HS-MET002 R9.0, HS-MET004 R12.0	1 X 60-mL HDPE	10 mL for ICPMS/10 mL for mercury	Cool to 0 – 6 °C; HNO_3 to pH <2	180 days ICPMS, 28 days mercury
Aqueous	Ammonia	SM4500NH3 B F/SOP HS-WC026 R5.0	1 X 250-mL HDPE	100 mL	Cool to 0 – 6 °C, H_2SO_4 to pH <2	28 days
Aqueous	Total Phosphorus	SM4500-P/SOP HS-WC015 R7.0	1 X 250-mL HDPE	100 mL	Cool to 0 – 6 °C, H_2SO_4 to pH <2	28 days
Aqueous	Ortho-phosphate	SM4500-P/SOP HS-WC015 R7.0	1 X 250-mL HDPE	100 mL	Filtration (0.45 µm), Cool to 0 – 6 °C	48 hours to analysis
Aqueous	TOC	EPA 415.1/SW9060A/SOP HS-WC021 R6.2	Amber VOA 40-mL	*5* ml	Cool to 0 – 6 °C, H_2SO_4 to pH <2	28 days
Aqueous	Hexavalent Chromium	SW846 7196A/SOP HS-WC008 R7.2	1 X 250-mL plastic	100 mL	Cool to 0 – 6 °C	24 hours to analysis Notify of all shipments. Ship for receipt Monday – Friday.

Matrix	Analytical Group	Method/SOP	Container	Sample Volume	Preservation	Analytical Holding Time
Aqueous	Anions	SW9056A/SOP IC001 R9.1	1 X 250-mL HDPE	5 mL	Cool to 0 – 6 °C	48 hours for nitrate and nitrite 28 days for all others
Aqueous	Alkalinity	SM2320B/SOP HS-WC001 R8.2	1 X 250-mL HDPE	50 ml	Cool to 0 – 6 °C	14 days
Aqueous	Oil and Grease	USEPA 1664A/SOP WC-036 R4.2	1 X 250-mL glass	250 mL	H_2SO_4 to pH <2, Cool to 0 – 6 °C	28 days
Aqueous	COD	USEPA 410.4/ SOP HS-WC025 R3.4	1 X 60-mL plastic	5 ml	H_2SO_4 to pH <2, Cool to 0 – 6 °C	28 days
Aqueous	Sulfide	SM4500S2F/SOP HS-WC018 R7.0	1 X 500-mL HDPE	250mL	Cool to 0 – 6 °C, Zinc Acetate/ NaOH to pH > 12	7 days
Aqueous	Semi-volatiles (including 1,4-dioxane)	SW8270D (SIM)-SW3510C/SOPs HS-MSSV006 R1.0/HS-MSSV003 R6.0/HS-EXT001 R11.1	2 X 1-L amber glass	1000 mL	Cool to ≤ 6 °C	7 days to extraction 40 days to analysis
Aqueous	Ferrous Iron	SM 3500 Fe B/GEN-3500 R5.0	1 X 250-mL plastic	100 mL	Cool to 0 – 6 °C	24 hours
Aqueous	VFA	HPLC-METACIDS	2 X 40-mL glass vial	10 mL	H_3PO_4 to pH < 2 Cool to 0 – 6 °C	28 days
Aqueous	MEE	RSK-175	3 X 40-mL VOA vial - Glass with Teflon-lined lid	40mL Vials	No headspace; pH adjusted at time of collection to <2 with 1:1 HCl; Cool to 4°C ± 2°C	No criteria (14 Days -Laboratory Recommended)

Matrix	Analytical Group	Method/SOP	Container	Sample Volume	Preservation	Analytical Holding Time
Aqueous	CO_2	RSK-175	3 X 40-mL VOA vial - Glass with Teflon-lined lid	40mL Vials	No headspace; no acid preservative, Cool to 4°C ± 2°C	No criteria (7 Days - Laboratory Recommended)
GW and Surface Water	DHC and DHB	DHC ethogenes/qPCR/MI-SOP qPCR	1 X 1-L poly	cells/ml	Cool to 0 – 6 °C	24 - 48 hours
Solid	VOCs	SW8260C/SOP HS-MSV001 R11.2	3 X 40-mL terracores	5 grams (g)	Sodium bisulfate/ methanol, Cool to 0 – 6 °C; or preferred empty vials with stir bar/methanol, freeze – 7 °C	48 hours from sampling to preservation 14 days to analysis
Solid	Perchlorate	6850/SOP LC-MS-CLO4 R10.0	1 X 4-ounce glass	2 g	Cool to 0 – 6 °C, Store with headspace	28 days
Solid	Explosives	SW8330A/SOP HS-HPLC003 R5.1, HS-EXT014 R5.0	1 X 4-ounce glass	IO g	Cool to 0 – 6 °C	14 days until extraction/ 40 days extraction to analysis
Solid	Metals	SW6020A-SW3050B, SW7471B/SOP HS-MET003 R8.6, HS-MET001 R11.1, HS-MET005 R9.3	1 X 4-ounce glass	0.5 g/ 0.3 g mercury	Cool to 0 – 6 °C	180 days metals, 28 days mercury
Solid	Total Organic Carbon	9060A/HS-WC022 R5.0	1 X 2-ounce glass	1 g	Cool to 0 – 6 °C	14 days
Solid	Hexavalent Chromium	SW846 7196A-3060A/SOP HS-WC008 R7.2, HS-WC009 R6.1	1 X 4-ounce glass	2.5 g	Cool to 0 – 6 °C	30 days to digest, Digestate 7 days to analyze

Matrix	Analytical Group	Method/SOP	Container	Sample Volume	Preservation	Analytical Holding Time
Solid	Anions	SW9056A/SOP HS-IC001 R9.1	1 X 4-ounce glass	5 g	Cool to 0 – 6 °C	28 days to leaching, 48 hours to analysis for nitrate and nitrite 28 days to analysis for all others
Solid	Semi-volatiles (including 1,4-dioxane)	SW8270D (SIM)-SW3541/SOP HS-MSSV003 R6.0/HS-MSSV006 R1.0/ HS-EXT001 R11.1/HS-EXT002 R10.3	1 X 4-ounce glass	15 g	Cool to 0 – 6 °C	14 days until extraction/ 40 days extraction to analysis
Solid	Pesticides/ PCBs	SW846 8081B/8082A/ SOP HS-GCECD001 R8.3, HS-GCECD002 R10.1, HS-EXT002 R10.3	1 X 8-ounce glass	30 g	Cool to 0 – 6 °C	14 days until extraction/ 40 days extraction to analysis
Solid	Dioxins	SW8290A/SOPs HE-HRMS001 R0.1, HE-EXT002 R0.2	1 X 4-ounce glass	10 g	Cool to 0 – 6 °C	1 year until extraction/ 40 days extraction to analysis
Air	Volatiles	VOA-TO-15	6-L Summa canister	NA	NA	30 days

Notes: mL - milliliters; HCl - Hydrochloric acid; HDPE - High-Density Polyethylene; HNO_3 - Nitric Acid; H_2SO_4 – Sulfuric acid; H_3PO_4 – Phosphoric acid; ICPMS – Inductively Coupled Plasma Mass Spectrometer; pH – Potential of hydrogen, µm – micrometers, NaOH – Sodium hydroxide, SIM- Selective Ion Monitoring, HR – High Resolution

WORKSHEET 20 – FIELD QUALITY CONTROL SAMPLE SUMMARY

This worksheet summarizes the field QC samples to be collected from the site.

Field Duplicate

A FD is an additional sample collected at the same time from the same location as the normal sample. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner. These samples are used to assess precision of the entire data collection activity, including sampling, analysis, and site heterogeneity.

Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and are treated in an identical manner during storage, transportation, and analysis. The samples may be either co-located samples or sub samples of a single sample collection. The sample containers are assigned a unique identification number in the field. Specific locations should be designated for collection of FD samples before the beginning of sample collection. The standard collection frequency for duplicate samples is 1 for every 10 normal samples.

Equipment Blanks

An equipment blank, sometimes referred to as a rinsate blank, is a sample of ASTM International (ASTM, formerly American Society for Testing and Materials) Type II reagent grade water poured through the sampling device and collected in a sample container for analysis. The results from these blanks are used to assess the effectiveness of equipment decontamination procedures. Equipment blanks will be collected, when appropriate, once per day, immediately after the equipment has been decontaminated. Collection of equipment blanks is only required in the case of non-dedicated sampling equipment. The blank will be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

Matrix Spike/Matrix Spike Duplicate

A MS/MSD sample is used to document the bias of a method due to sample matrix. The MS/MSD samples are aliquots spiked with a known mass and concentration of specific analytes. The spiking occurs before sample preparation and analysis at the laboratory. To allow the analytical laboratory to run MS/MSD analyses, three aliquots of a single sample will be collected in the field to provide sufficient sample volume. The MS/MSD will be designated on the chain-of-custody form. The laboratory may spike additional samples to meet laboratory spike frequencies which are typically analyzed at a rate of approximately every 20 samples collected.

Trip Blanks

Trip blanks are used to assess the potential introduction of contaminants to sample containers during the field collection event, including transportation and storage procedures. The trip blank consists of a VOA sample vial filled in the laboratory with ASTM Type II reagent-grade water, transported to the sampling site, handled like an environmental sample (without being opened), and returned to the laboratory for analysis. Trip blanks will be used only when aqueous samples for VOCs are taken. One trip blank will accompany each cooler of aqueous samples sent to the laboratory for analysis of VOCs.

WORKSHEET 21 – PROJECT SAMPLING STANDARD OPERATING PROCEDURE REFERENCES

The field SOPs, associated with the project sampling (including, but not limited to, sample collection and sample handling and custody), are listed in the following table. The referenced field SOPs are provided in Appendix A of the IWWP.

Table 9. Sampling SOP References

Reference Number	Title	Originating Organization	Equipment Type	Modified for Project Work (as discussed in Worksheet 17)? (X if yes)
Bhate SOP-A1	Decontamination Procedures	Bhate	Various	N
Bhate SOP-A2	Lithologic Description of Subsurface Samples and Completion of Drill Logs	Bhate	Log book	N
Bhate SOP-A3	Headspace Analysis	Bhate	Photoionization Detector (PID) or Flame Ionization Detector (FID)	N
Bhate SOP-A4	Subsurface Soil Sampling	Bhate	Various	N
Bhate SOP-A5	Direct-Push Groundwater Sampling	Bhate	Direct push technology groundwater sampler	N
Bhate SOP-A7	Monitoring Well Installation	Bhate	Various	N
Bhate SOP-A8	Monitoring Well Development	Bhate	Peristaltic pump, water quality parameter instrument, turbidity meter	N
Bhate SOP-A9	Water Level Measurement	Bhate	Water level probe	N
Bhate SOP-A10	Low-Stress (Minimal Drawdown) Groundwater Sampling	Bhate	Various	N
Bhate SOP-A11	Surface Water Sampling	Bhate	Various	N
Bhate SOP-A12	Sediment Sampling	Bhate	Various	N
Bhate SOP-A13	Sample Control and Documentation	Bhate	Logbooks, chain of custody forms	N

Reference Number	Title	Originating Organization	Equipment Type	Modified for Project Work (as discussed in Worksheet 17)? (X if yes)
Bhate SOP-A14	Natural Attenuation Field Test Kit	Bhate	Various	N
Bhate SOP-A15	Surveying	Bhate	GPS	N
Bhate SOP-A16	Soil Boring/Monitoring Well Abandonment	Bhate	Not applicable	N
Bhate SOP-A17	Chloride Analysis Using Titration Strips	Bhate	Titrator	N
Bhate SOP-A18	Water Depth and Velocity Measurements	Bhate	Various	N
Bhate SOP-A19	Discharging Treated Groundwater into Harrison Bayou	Bhate	None	N
Bhate SOP-A20	Sulfate Analysis Using Hach DR 3900	Bhate	Various	N
Bhate SOP-A21	Air Sampling	Bhate	Summa® canister, PID	N

WORKSHEET 22 – FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

This worksheet lists the field equipment and instruments to be used during the field investigation, requiring calibration, maintenance, testing, or inspection.

Field equipment and instruments to be used are identified on the following table.

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Table 10. Field Equipment and Instruments

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Acceptance Criteria	Corrective Action	Responsible Person
PID	Before each use per manufacturer's specifications	Lamp Replacement, as needed	Analyze reference standard as per manufacturer's specifications	PID functioning properly	See manufacturer's specifications	Repeat calibration	Field Personnel
Water quality parameter instrument	Before each use per manufacturer's specifications	Monthly	Analyze reference standard (pH, specific conductance, dissolved oxygen, oxidation-reduction potential) per manufacturer's specifications	Probes and sensors intact and free of debris	See manufacturer's specifications	Repeat calibration	Field Personnel
Turbidimeter	Before each use per manufacturer's specifications	Monthly	Analyze reference standard as per manufacturer's specifications	Optical readers free of debris	See manufacturer's specifications	Repeat calibration	Field Personnel

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WORKSHEET 23 – ANALYTICAL STANDARD OPERATING PROCEDURE REFERENCES

The laboratory SOP references identified in the table below were provided by ALS in Houston, Texas. Note that the laboratory SOPs have not been modified specifically for this project and may not reflect the exact requirements of this document. The laboratory SOPs are supplemented by internal communication systems within the laboratory to disseminate the project requirements to technical staff. Laboratory SOPs are available upon request.

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Table 11. Analytical SOP References

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and/or Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
HS-MSV001	VOCs - GC/MS Soil & Water - SW8260C - USEPA 624 R11.2, 09/24/2017	Definitive	GC/MS - Aqueous/ Solid	Purge & Trap Sample Concentrator, GC/MS	ALS	N
HS-QS010	Container Sub-sampling-volatile organics, SW5035A R3.2, 08/15/2017	Preparation	Organic Solid	Balance	ALS	N
HS-MET001	Hot Block Digest for Solids/Soil – SW3050B R11.1, 03/30/2017	Preparation	Metals Preparation - Solid	Hot Block	ALS	N
HS-MET002	Hot Block Digestion of Aqueous Samples – SW3010A - E200.8 R9.0, 02/15/2017	Preparation	Metals Preparation - Aqueous	Hot Block	ALS	N
HS-MET003	ICP-MS Analysis by 6020A and 200.8 R8.6, 06/30/2017	Definitive	Metals Analysis	ICPMS	ALS	N
HS-MET004	Mercury Prep/Analysis - Aqueous - SW7470A - E245.1 R12.0, 01/31/2017	Definitive	Metals Analysis	Cold Vapor AA	ALS	N
HS-MET005	Mercury Prep/Analysis - Solids/ Soil - SW7471B R9.3, 04/24/2017	Definitive	Metals Analysis	Cold Vapor AA	ALS	N
HS-IC001	Anions by Ion Chromatography, SW9056A/SW9056/EPA300.0 R9.1, 06/30/2017	Definitive	General Chemistry-Solid/Aqueous	Ion Chromatogram	ALS	N
HS-WC018	Sulfide, SM 4500-S2F (21st) R7.0, 09/30/2016	Definitive	General Chemistry - Aqueous	Titrimetric	ALS	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and/or Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
HS-WC001	Total Alkalinity by SM2320B/WC001 R8.2, 12/28/2016	Definitive	General Chemistry - Aqueous	ManTec Auto Titrimetric	ALS	N
HS-WC025	COD, Hach 8000 USEPA 410.4, colorimetric WC025 R3.4, 04/25/2017	Definitive	General Chemistry - Aqueous	Spectrophotometer	ALS	N
HS-WC015	Total Phosphorus by SM 4500P R7.0, 09/30/2016	Definitive	General Chemistry - Aqueous	Spectrophotometer	ALS	N
HS-WC008	Chrome VI Analysis, SW 7196A/ 3500-Cr B R7.2, 12/28/2016	Definitive	General Chemistry - Aqueous	Spectrophotometer	ALS	N
HS-WC009	Chrome VI - Preparation of Soils, SW 3060A R6.1, 09/15/2017	Preparation	Hexavalent Chromium Preparation - Solid	Hot Block	ALS	N
HS-WC026	Ammonia as N, Colorimetric, SM4500-NH3 B F R5.0, 08/31/2017	Definitive	General Chemistry Aqueous	Spectrophotometer	ALS	N
HS-MSSV003	Low Level Semi-Volatile Organic Compounds by GC/MS - 8270D R6.0, 09/24/2017	Definitive	GC/MS - Aqueous/ Solid	GC/MS	ALS	N
HS-MSSV006	Polynuclear Aromatics Hydrocarbons by GC/MS Selective Ion Monitoring by Method 8270D R1.0, 02/28/2017	Definitive	GC/MS - Aqueous/ Solid	GC/MS	ALS	N
HS-EXT001	Separatory Funnel Extraction of Aqueous Samples R11.1, 06/15/2017	Preparation	Organic - Aqueous	NA	ALS	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and/or Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
HS-EXT002	Automated Soxhlet Extraction of Solids & Soils By 3541, Waste Dilution by 3580A and Acid Cleanup by 3665A R10.3, 08/15/2017	Preparation	Organic - Solid	Automated Soxhlet	ALS	N
HS-WC021	Total Organic Carbon, Aqueous SM5310 B&C/9060A/USEPA 415.1, R6.2, 12/28/2016	Definitive	General Chemistry - Aqueous	TOC Spectrometer	ALS	N
HS-WC022	Total Organic Carbon, Soils R5.0, 09/30/2016	Definitive	General Chemistry - Solid	TOC Analyzer	ALS	N
LC-MS-CLO4 (ALS Salt Lake City)	The Determination of Perchlorate in Water, Soil and Biota by Liquid Chromatography, R 10.0, 11/06/2015	Definitive	LC/MS - Water/Soil	LC/MS	ALS Salt Lake City	N
HS-EXT013	Extraction of Explosives (salting out) - Waters by 8330A, R4.0, 07/07/2017	Preparation	Explosive - Aqueous	NA	ALS	N
HS-EXT014	Extraction of Explosives from Soils by 8330A, R5.0, 03/21/2017	Preparation	Explosive - Solid	NA	ALS	N
HS-HPLC003	Explosives by HPLC, R5.1, 09/05/2017	Definitive	Explosive – Solid/Aqueous	HPLC	ALS	N
HS-WC036	Oil and Grease, SPE - USEPA 1664A, R4.2, 03/29/2017	Definitive	General Chemistry - Aqueous	Gravimetric	ALS	N
VOA-DISGAS	Dissolved Gas Analysis in Aqueous Samples using a Headspace Equilibration Technique; R16.0, 12/17/2016	Definitive	Aqueous	GC/FID MEE, GC/TCD CO_2	ALS Simi Valley	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and/or Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
GEN-3500	Ferrous Iron by Phenanthroline Colorimetry, R5.0, 08/11/2014	Definitive	Water	Spectrophotometer	ALS Rochester	N
HPLC-METACIDS	Analysis of Water Samples for Metabolic Acids by HPLC, R5.0, 09/02/2013, Reviewed 01/17/2017	Definitive	Waters	HPLC	ALS Rochester	N
VOA TO-15	Determination of Volatile Organic Compounds in Air Samples Collected in Specially Prepared Canisters and Gas Collection Bags and Analyzed by GC/MS, R24, 06/03/2017	Definitive	Air	GC/MS	ALS Salt Lake City	N
MI-SOP qPCR	qPCR - Quantitative Polymerase Chain Reaction	Definitive	Aqueous	ABI 7300	Microbial Insights Inc. 10515 Research Drive Knoxville, TN 37932	N
HS-HRMS001	Analysis of Polychlorinated Dibenzo-P-Dioxins and Polychlorinated Dibenzofurans By High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS), R0.1	Definitive	Water & Solid	GC/MS	ALS	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and/or Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
HE-EXT002	Soxhlet Extraction of Solid/Tissue/Air Samples for analysis of PCB and PCDD/F Compounds By High Resolution Mass Spectrometry, R0.2	Definitive	Solid	NA	ALS	N
HS-GCECD001	Organochlorine Pesticides by GCECD – 8081B, R8.3	Definitive	Water/Soil	GCECD	ALS	N
HS-GCECD002	PCBs by GCECD – 8082, R10.1	Definitive	Water/Soil	GCECD	ALS	N

Notes: GC/MS - Gas Chromatography/Mass Spectroscopy; TCD – Thermal Conductivity Detector; AA – Atomic Absorption; SPE – Solid Phase Extraction; ABI – Applied Biosystems; QS – Quality Systems

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WORKSHEET 24 – ANALYTICAL INSTRUMENT CALIBRATION

To confirm that the analytical methods and the selected instrumentation meet the project requirements, each analytical instrument will be calibrated according to the procedures outlined in Worksheet 28 (Laboratory Quality Control Sample Summary) and the following table.

Specific analytical method SOP references are provided in Worksheet 23 (Analytical Standard Operating Procedure References). Full method QA/QC tables are provided for ease of use to the Bhate Project Chemist and the laboratory. This information provides documentation on corrective actions, flagging criteria for laboratory services and expectations for analytical services, and meets the requirements outlined in Worksheet 28 (Laboratory Quality Control Sample Summary) and reflects the requirements of the DoD Quality Systems Manual, Version 5.1 (DoD, January 2017).

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Table 12. Summary of Calibration and Quality Control Procedures for All Methods

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS - VOA (SW846 8260C)	Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-MSV001 R11.2
GC/MS - VOA	ICAL - for all analytes a minimum of five points must be used for linear regression, six points for second order regression.	ICAL prior to sample analysis.	Each analyte must meet one of the three options below: Option 1: RSD for each analyte $\leq$15%; Option 2: linear – least squares regression correlation coefficient (r) $\geq$ 0.995; Option 3: non-linear – $r^2 \geq$ 0.99 (must use 6 points at minimum).	Correct problem then repeat ICAL. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-MSV001 R11.2
GC/MS - VOA	Second Source Calibration Verification (ICV)	Once after each ICAL	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-MSV001 R11.2
GC/MS - VOA	Retention time window position establishment	Once after each ICAL for each analyte and surrogate.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA	Analyst/ Supervisor	HS-MSV001 R11.2
GC/MS - VOA	Evaluation of relative retention times (RRT)	With each sample	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-MSV001 R11.2

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS - VOA	CCV	Daily prior to sample analysis for 12-hour analysis period.	All reported analytes and surrogates within ±20% of true value.	If %D > +20% and sample result is < LOQ, request client approval to qualify and narrate. If %D < -20%, correct problem then rerun CCV. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and explain in the case narrative.	Analyst/ Supervisor	HS-MSV001 R11.2
GC/MS - VOA	CCV Ending	End of sample analysis for 12-hour analysis period.	All reported analytes and surrogates within ±50% for end of analytical batch CCV.	If %D > +50% and sample result is < LOQ, request client approval to qualify and narrate. If %D < -50%, correct problem then rerun sample; if sample should fail on second, report both and narrate.	Analyst/ Supervisor	HS-MSV001 R11.2
GC/MS - VOA	Internal Standards (ISs) – samples and QC samples.	All samples and QC samples.	Retention time ±30 seconds from retention time of the CCV. EICP area within –50% to +100% of CCV.	Reanalyze sample to confirm IS failure due to matrix, and describe in lab narrative.	Analyst/ Supervisor	HS-MSV001 R11.2

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HPLC (SW8330A)	ICAL	Upon instrument receipt, for major instrument changes, or when CCV does not meet criteria.	Minimum 5 point ICAL for all target analytes (6 points for non-linear) % relative standard deviation (%RSD) <15%; or Linear regression r^2 >0.990 (r>0.995); or Non-linear regression $r^2 \geq$ 0.990 (6 points for non-linear)	Repeat calibration if criteria are not met	Analyst/ Supervisor	HPLC003 R5.1
HPLC (SW8330A)	ICAL Verification	After calibration	%D < 20% all analytes	Evaluate, repeat, if still failing, recalibrate.	Analyst/ Supervisor	HPLC003 R5.1
HPLC (SW8330A)	Continuing Calibration	Daily, after every 10 field samples and at end of run	%D ≤ 20%	If %D > +20% and sample result is < LOQ, request client approval to qualify and narrate. If %D < -20%, correct problem then rerun samples after successful CCV. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and explain in the case narrative.	Analyst/ Supervisor	HPLC003 R5.1
HPLC/MS Perchlorate (6850)	Tuning	Prior to ICAL	Must contain the analytes of interest and meet SOP criteria.	Re-tune and/or clean source	Analyst/ Supervisor	LC-MS-CLO4 R10.0 (ALS Salt Lake City)

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HPLC/MS Perchlorate (6850)	ICAL	Upon instrument receipt, for major instrument changes, or when CCV does not meet criteria.	Minimum 5 point ICAL for all analytes (6 points for non-linear) % RSD <20%; or Linear regression r^2 >0.990 (r>0.995); or Non-linear regression $r^2 \geq$ 0.990 (6 points for non-linear) Concentration at Y-intercept must be <LOD	Repeat calibration if criteria is not met	Analyst/ Supervisor	LC-MS-CLO4 R10.0 (ALS Salt Lake City)
HPLC/MS Perchlorate (6850)	ICV	After calibration	%D ≤ 15%	Evaluate, repeat, if still failing, recalibrate.	Analyst/ Supervisor	LC-MS-CLO4 R10.0 (ALS Salt Lake City)
HPLC/MS Perchlorate (6850)	Limit of detection verification (LODV)	Prior to samples and at the end of the analysis sequence. Can be analyzed after every 10 field samples.	%D ≤ 50%	If %D is high and sample result is <LOQ, qualify/ narrate with project approval. If %D is low or project approval not received, reanalyze all samples since last successful LODV.	Analyst/ Supervisor	LC-MS-CLO4 R10.0 (ALS Salt Lake City)
HPLC/MS Perchlorate (6850)	Continuing Calibration	Prior to samples then after every 10 field samples.	%D ≤ 15%	If %D > +15% and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 15%, correct problem then rerun sample in new sequence. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, Apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and	Analyst/ Supervisor	LC-MS-CLO4 R10.0 (ALS Salt Lake City)

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
				explain in the case narrative.		
ICPMS (SW6020A)	Linear dynamic range or high-level check standard	Every 6 months	Within ±10% of true value.	NA	Analyst/ Supervisor	HS-MET003 R8.3
ICPMS (SW6020A)	Mass spectrometry tuning sample.	Prior to initial calibration and calibration verification.	Meet criteria for both SW6020A and USEPA 624	Retune instrument then reanalyze tuning solution.	Analyst/ Supervisor	HS-MET003 R8.3
ICPMS (SW6020A)	ICAL - minimum three standards and a calibration blank for all analytes	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, $r \geq 0.995$ ($r^2 > 0.990$)	Correct problem, then repeat ICAL. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-MET003 R8.3
ICPMS (SW6020A)	Second Source Calibration Verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes(s) within ±10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-MET003 R8.3
ICPMS (SW6020A)	CCV	After every 10 field samples and at the end of the analysis sequence.	Within ± 10% of true value.	If %D > +10% and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 10%, correct problem then rerun CCV. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and	Analyst/ Supervisor	HS-MET003 R8.3

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
				explain in the case narrative.		
ICPMS (SW6020A)	ICV - second source	Daily, after initial calibration and after every recalibration	Within ±20% of true value	Correct problem, then reanalyze. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-MET003 R8.3
ICPMS (SW6020A)	Low-level calibration check standard	Daily, after initial calibration and after every recalibration	Within ±20% of true value	Correct problem, then reanalyze. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-MET003 R8.3
ICPMS (SW6020A)	Calibration verification (CCV-Instrument Check Standard)	After every 10 samples and at the end of the analysis sequence.	All analyte(s) within ±10% of expected value.	Correct problem then repeat calibration and reanalyze all samples since last successful CCV.	Analyst/ Supervisor	HS-MET003 R8.3
ICPMS (SW6020A)	Calibration Blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed. Apply B-flag to all results for specific analyte(s) in all samples associated with the blank.	Analyst/ Supervisor	HS-MET003 R8.3
ICPMS (SW6020A)	Interference check solutions (ICS-A and ICS-B)	At the beginning of each daily analytical run and after every 12 hour period thereafter as the run continues	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD ICS-B: Within 20% of true value	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples. If corrective action fails, Q qualify all associated analyte results.	Analyst/ Supervisor	HS-MET003 R8.3
Cold vapor atomic absorption spectroscopy (SW7470A/7471B)	ICAL	Beginning of each day or if QC exceeds criteria	Minimum 5 point ICAL and a calibration blank linear regression $r^2 > 0.990$ ($r > 0.995$)	Recalibrate and/or perform instrument maintenance	Analyst/ Supervisor	HS-MET004 R12.0/MS-MET005 R9.3

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Cold vapor atomic absorption spectroscopy (SW7470A/7471B)	Second Source Calibration Verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes(s) within ±10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-MET004 R12.0/MS-MET005 R9.3
Cold vapor atomic absorption spectroscopy (SW7470A/7471B)	CCV	After every 10 field samples and at the end of the analysis sequence.	Within ± 10% of true value.	If %D > +20% and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 20%, correct problem then rerun CCV. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and explain in the case narrative.	Analyst/ Supervisor	HS-MET004 R12.0/MS-MET005 R9.3
Cold vapor atomic absorption spectroscopy (SW7470A/7471B)	Continuing Calibration blank (CCB).	Run after each CCV or as needed.	CCB	Correct problem, and then reanalyze calibration blank and all samples associated with blank.	Analyst/ Supervisor	HS-MET004 R12.0/MS-MET005 R9.3
Ammonia (SM4500NH3)	ICAL	Every 3 months minimally	Minimum 5 point ICAL and a calibration blank linear regression $r^2 > 0.990$ ($r \geq 0.995$)	Recalibrate and/or perform instrument maintenance	Analyst/ Supervisor	HS-WC026 R5.0
Ammonia (SM4500NH3)	ICV	After calibration	%D $\leq$ 10% all analytes	Evaluate, repeat, if still failing, recalibrate.	Analyst/ Supervisor	HS-WC026 R5.0
Ammonia (SM4500NH3)	Continuing Calibration	Daily, after every 10 field samples and at end of run	%D $\leq$ 10% all analytes	If %D > +10% and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 10%,	Analyst/ Supervisor	HS-WC026 R5.0

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
				correct problem then rerun sample in new sequence. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and explain in the case narrative.		
Total Phosphorous and Ortho-phosphate (SM4500-P)	ICAL	Every 3 months minimally.	Minimum 5 point ICAL and a calibration blank linear regression $r^2 > 0.990$ ($r \geq 0.995$)	Recalibrate and/or perform instrument maintenance	Analyst/ Supervisor	HS-WC015 R7.0
Total Phosphorous and Ortho-phosphate (SM4500-P)	ICV	After calibration	%D $\leq$ 10% all analytes	Evaluate, repeat, if still failing, recalibrate.	Analyst/ Supervisor	HS-WC015 R7.0
Total Phosphorous and Ortho-phosphate (SM4500-P)	Continuing Calibration	Daily, after every 10 field samples and at end of run	%D $\leq$ 10% all analytes	If %D > +10% and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 10%, correct problem then rerun sample in new sequence. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and	Analyst/ Supervisor	HS-WC015 R7.0

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
				explain in the case narrative.		
TOC analyzer (SW9060)	ICAL	Prior to sample analysis or instrument change, when instrument does not meet method criteria	Linear regression r^2 > 0.990 (r > 0.995)	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	HS-WC021 R6.2/HS-WC022 R5.0
TOC analyzer (SW9060)	Second Source Calibration Verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes(s) within ± 15% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-WC021 R6.2/HS-WC022 R5.0
TOC analyzer (SW9060)	CCV	After every 10 field samples and at the end of the analysis sequence.	Within ± 15% of true value	If %D > +15% (+30%) and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 15% (-30%), correct problem then rerun samples. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and explain in the case narrative.	Analyst/ Supervisor	HS-WC021 R6.2/HS-WC022 R5.0
Hexavalent Chromium (7196A)	ICAL	Every 3 months or as required when ICV exceeds limits. Minimum 5 standards and a calibration blank.	Linear fit with a correlation coefficient (r) of ≥0.995 (r^2>0.990)	Correct problem, then repeat ICAL. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-WC008 R7.2/HS-WC009 R6.1

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Hexavalent Chromium (7196A)	Second Source Calibration Verification (ICV)	Alternate source standard to be analyzed after every calibration curve and at the beginning of every analytical sequence.	Value of second source for all analytes(s) within ±10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate.	Analyst/ Supervisor	HS-WC008 R7.2/HS-WC009 R6.1
Hexavalent Chromium (7196A)	CCV	After every 10 samples and at the end of the analytical sequence	Within ± 10% of true value.	If %D > +10% and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 10%, correct problem then rerun samples. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and explain in the case narrative.	Analyst/ Supervisor	HS-WC008 R7.2/HS-WC009 R6.1
Common Anions (SW9056A)	ICAL	Beginning of each day or if QC exceeds criteria	Minimum 5 point ICAL and a calibration blank linear regression $r^2 > 0.990$ ($r \geq 0.995$)	Recalibrate and/or perform instrument maintenance	Analyst/ Supervisor	HS-IC001 R9.1
Common Anions (SW9056A)	ICV	After calibration	%D ≤ 10% all analytes	Evaluate, repeat, if still failing, recalibrate.	Analyst/ Supervisor	HS-IC001 R9.1
Common Anions (SW9056A)	Continuing Calibration	Daily, after every 10 field samples and at end of run	%D ≤ 10% all analytes	If %D > +10% and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 10%, correct problem then rerun samples. If CCC fails on second attempt, repeat	Analyst/ Supervisor	HS-IC001 R9.1

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
				ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and explain in the case narrative.		
Alkalinity (SW2320B)	Calibration	Daily ICAL prior to sample analysis	4 ± 0.05 pH units, 7 ± 0.05 pH units, 10 ± 0.10 pH units	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	HS-WC001 R8.2
Alkalinity (SW2320B)	pH CCV	Every 10 after samples and at end of analysis.	± 0.20 pH units for check	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	HS-WC001 R8.2
Alkalinity (SW2320B)	Alkalinity CCV	Every 10 after samples and at end of analysis.	± 10% of true value	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	HS-WC001 R8.2
Oil and Grease (1664A)	Calibration/ICV/ CCV	NA	NA	NA	Analyst/ Supervisor	HS-WC036 R4.2
Oil and Grease (1664A)	Balance Check	Before and at end of analysis.	2 mg and 1,000 mg at ±10% of true weight	Correct problem and rerun samples. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples.	Analyst/ Supervisor	HS-WC036 R4.2

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
COD (410.4)	ICV	Before analysis	%D < 10% all analytes	Prepare fresh standard. Spec has building calibration. If fails on second attempt using new standards check with instrument manufacturer. (Built in curve on Spec)	Analyst/ Supervisor	HS-WC025 R3.4
COD (410.4)	Continuing Calibration	Daily, after every 10 field samples and at end of run	%D ≤ 10% all analytes	If %D > +10% and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 10%, correct problem then rerun all samples. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and explain in the case narrative.	Analyst/ Supervisor	HS-WC025 R3.4
Sulfide (SM4500S2F)	Calibration/ICV/ CCV	NA	NA	NA	Analyst/ Supervisor	HS-WC018 R7.0
GC/MS (8270D LL and SIM)	Tuning	Prior to ICAL and at the beginning of each 12 hour period	Must meet the ion abundance criteria required by the method.	Manual tuning; replacement of the ion source or filament. Rerun affected samples.	Analyst/ Supervisor	HS-MSSV003 R6.0/MSSV006 R1.0/HS-EXT001 R11.1/HS-EXT002 R10.3
GC/MS (8270D LL and SIM)	Breakdown Check (DDT only)	At the beginning of each 12-hour analytical sequence.	The degradation must be ≤20% for DDT to verify inertness of the injection port	Retune instrument and verify	Analyst/ Supervisor	HS-MSSV003 R6.0/MSSV006 R1.0/HS-EXT001 R11.1/HS-EXT002 R10.3

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (8270D LL and SIM)	Retention Time (RT) Window Width	Determined at method development and after significant instrument maintenance	Internal Standards: ±0.5 min. Analytes: ±0.06 RRT Units	Perform a 72 hour RT Study as detailed in SW8000C. Follow method guidance on resetting RT windows.	Analyst/ Supervisor	HS-MSSV003 R6.0/MSSV006 R1.0/HS-EXT001 R11.1/HS-EXT002 R10.3
GC/MS (8270D LL and SIM)	ICAL	Prior to sample analysis (minimum 5-point)	Average RF ≥ 0.05; -Option 1: RSD for each analyte ≤ 15%. -Option 2: linear least squares regression r ≥ 0.995 (r^2>0.990). -Option 3: non-linear regression coefficient of determination r^2 ≥ 0.99.	Correct problem then repeat ICAL	Analyst/ Supervisor	HS-MSSV003 R6.0/MSSV006 R1.0/HS-EXT001 R11.1/HS-EXT002 R10.3
GC/MS (8270D LL and SIM)	ICV	After each ICAL	All analytes within ± 20% of the expected value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst/ Supervisor	HS-MSSV003 R6.0/MSSV006 R1.0/HS-EXT001 R11.1/HS-EXT002 R10.3
GC/MS (8270D LL and SIM)	CCV	Daily prior to sample analysis for 12-hour analysis period	RF ≥ 0.05; % difference/drift for target analytes ≤ 20%	If %D > +20% and sample result is < LOQ, request client approval to qualify and narrate. If %D < - 20%, correct problem then rerun CCV. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, apply qualifier to all results for the specific analyte(s) in all samples since last acceptable CCV and explain in the case	Analyst/ Supervisor	HS-MSSV003 R6.0/MSSV006 R1.0/HS-EXT001 R11.1/HS-EXT002 R10.3

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
				narrative.		
GC/MS (8270D LL and SIM)	Calibration verification (CCV) – closing for DoD projects.	At the close of an analytical sequence.	All reported analytes within 50% of true value	Correct problem then repeat analytical sequence.	Analyst/ Supervisor	HS-MSSV003 R6.0/MSSV006 R1.0/HS-EXT001 R11.1/HS-EXT002 R10.3
GC/MS (8270D LL and SIM)	Retention time window position establishment	Once after each ICAL for each analyte and surrogate.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA	Analyst/ Supervisor	HS-MSSV003 R6.0/MSSV006 R1.0/HS-EXT001 R11.1/HS-EXT002 R10.3
GC/MS (8270D LL and SIM)	ISs for all samples.	Immediately after or during data acquisition of calibration check standard.	Retention time ±30 seconds from RT of the daily CCV. EICP area within –50% to +100% of daily CCV.	Check mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system malfunctioned.	Analyst/ Supervisor	HS-MSSV003 R6.0/MSSV006 R1.0/HS-EXT001 R11.1/HS-EXT002 R10.3
GC/MS (TO-15)	BFB Tuning Verification	Once every 24-hours or analytical batch	Ion abundance criteria as described in Table 3 of Method TO-15	1) Repeat BFB analysis 2) Retune instrument	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R4
GC/MS (TO-15)	ICAL – minimum of five levels	Initially or if continuing calibration no longer meets criteria	1) <30% RSD 2) Area response at each calibration level within 40% of IS mean area response over the ICAL range 3) Retention time for each IS within 20 seconds of the mean retention time over the ICAL range	1) May repeat 1 point (if 5 levels) or 2 points (if 6 levels) 2) Inspect the system for problems and perform required maintenance 3) Repeat ICAL Problem must be corrected. Samples may not be analyzed until there is a valid ICAL.	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R24

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (TO-15)	CCV	Once every 24 hours prior to sample analysis, if an ICAL has not been performed (within the last 24 hours). A CCV standard must be analyzed at the end of the analytical batch	Percent difference of +/- 30% Note: If CCV is biased high and analyte is not detected, results are acceptable. It will be noted in case narrative.	1) Reanalyze CCV [DoD: Analyze two additional CCVs] 2) Identify and correct problem; re-analyze or if necessary qualify the data. 3) Repeat initial calibration if CCV CA is unsuccessful.	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R24
GC/MS (TO-15)	ISs	All samples, duplicates, blanks, and standards	1) RT must be <20 seconds from most recent valid calibration (ICAL midpoint or CCV) 2) Area response +/-40% of IS area response of most recent valid calibration (ICAL midpoint or CCV)	1) Identify and correct the problem 2) Reanalyze the sample unless obvious matrix interference exists. 3) If problem persists, qualify data.	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R24
GC/MS (TO-15)	Surrogate Standards	All samples, duplicates, blanks, and standards	70-130% recovery	1) Identify and correct the problem 2) Reanalyze the sample unless obvious matrix interference exists 3) If problem persists, qualify data	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R24
GC/MS (TO-15)	Method blank	Once every analytical batch of 20 or fewer samples	No analyte detected equal to or above the method reporting limit (MRL) [DoD: No analytes > ½ MRL; common lab contaminants none detected > MRL]	1) Reanalyze blank 2) Identify and correct problem 3) Reanalyze blank and affected samples 4) Qualify data	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R24

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (TO-15)	LCS	Once every analytical batch of 20 or fewer samples	Percent recovery (%R) within laboratory generated limits. [DoD: QSM limits depending on client specifications.]	1) Reanalyze 2) Identify and correct problem 3) Qualify data	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R24
GC/MS (TO-15)	LCSD	Once every analytical batch of 20 or fewer samples	RPD within +/-25% for positive hits	1) Analyze third aliquot 2) Flag data if third aliquot unacceptable	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R24
GC/MS (TO-15)	Holding Time	NA	SUMMA Canisters - 30 Days	Contact client and qualify data	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R24
GC/MS (TO-15)	LOQ	Quarterly verification required	1) At or above the low standard of the current initial calibration. 2) % R for each analyte within laboratory generated control limits.	1) Reanalyze 2) Identify and correct problem; re-analyze. 3) Repeat verification at higher level to set higher LOQ if corrective action is unsuccessful.	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15, R24
Spectrophotometer Ferrous Iron	ICAL	As needed	The correlation coefficient must be ≥ 0.997	Correct problem then repeat ICAL	Lab Section Supervisor	GEN-3500
Spectrophotometer Ferrous Iron	ICV	Immediately after each ICAL	± 10% of the expected value	Correct problem and rerun ICV. If that fails, correct problem and repeat ICAL.	Lab Section Supervisor	GEN-3500

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Spectrophotometer Ferrous Iron	CCV	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	± 10% of the expected value	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Lab Section Supervisor	GEN-3500
GC/FID & GC/TCD	ICAL – minimum of five levels	Initially, annually, or if continuing calibration no longer meets criteria	1) <20% RSD 2) RT for each analyte within 0.10 minutes of the mean RT over the ICAL range. Note: Higher injection volumes and/or higher concentrations may not meet this criteria.	1) May repeat 1 point (if 5 levels) or 2 points (if 6 levels) 2) Inspect the system for problems and perform required maintenance 3) Repeat ICAL Problem must be corrected. Samples may not be analyzed until there is a valid ICAL.	Department Supervisor, however other trained analysts in the team may be responsible	VOA-DISGAS R16.0
GC/FID & GC/TCD	ICV	Following every ICAL	Percent difference of +/-15%	1) Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration. 2) Problem must be corrected. Samples may not be analyzed until there is a valid ICV.	Department Supervisor, however other trained analysts in the team may be responsible	VOA-DISGAS R16.0
GC/FID & GC/TCD	CCV	CCV analyzed at the beginning and end of every sequence and after every 10 samples or every 12 hours, whichever is more frequent.	1) %D of +/-15%. 2) RT must fall within 0.33 minutes of mean RT from ICAL. Note: If CCV is biased high and analyte is not detected, results are acceptable. It will be noted in case narrative.	1) Analyze two additional CCVs 2) Identify and correct problem; re-analyze or if necessary qualify the data. 3) Repeat ICAL if CCV CA is unsuccessful.	Department Supervisor, however other trained analysts in the team may be responsible	VOA-DISGAS R16.0

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HPLC/UV (VFAs)	ICAL	Five point calibration. Prior to analysis.	RSD<20% or r^2 >0.990	Correct problem and repeat ICAL.	Analyst/ Laboratory Manager	HPLC-METACIDS R5.0
HPLC/UV (VFAs)	ICV	Once after each ICAL, prior to analytical sequence	All target analytes within ± 15% of the true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Analyst/ Laboratory Manager	HPLC-METACIDS R5.0
HPLC/UV (VFAs)	CCV	Perform after every 12 hours or 10 samples, whichever is more frequent and at the end of the analysis sequence.	All target analytes within ± 15% of the true value.	Correct problem. Then rerun calibration verification. If that fails, repeat ICAL and reanalyze all samples run since last acceptable CCV.	Analyst/ Laboratory Manager	HPLC-METACIDS R5.0
ABI 7300-DHC	Initial	Primary	Standard curve r^2 > 0.95	Rerun assay/check reagents	Laboratory manager	MI SOP ABI 7300
ABI 7300-DHC	CCV	Secondary-every plate (assay)	Calculated concentration within ±20% of same concentration on standard curve	Rerun assay/check reagents	Laboratory manager	MI SOP ABI 7300
GC/MS 8290A	Initial Calibration Standards	Prior to sample analysis (minimum 5- point)	Achieve calibration criteria for %RSD	Correct problem then repeat ICAL	Analyst/ Supervisor	HE-HRMS001
GC/MS 8290A	ICV	After each ICAL	All analytes within ± 20% of the expected value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst/ Supervisor	HE-HRMS001

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS 8290A	Calibration Verification Standard	Prior to sample analysis	All analytes within ± 20% of the expected value	Reanalyze standard. If still unacceptable, recalibrate and reanalyze samples from last acceptable calibration verification standard.	Analyst/ Supervisor	HE-HRMS001
GCECD (8081B)	Breakdown check (Endrin and DDT)	Prior to new ICAL and analysis (CVV) or each 12 hour work shift	Degradation for each, <15%.	Take corrective action (maintenance) prior to ICAL or CCV. Repeat breakdown check.	Analyst/ Supervisor	HS-GCECD001
GCECD (8081B)	Minimum five-point ICAL for all analytes.	ICAL prior to sample analysis.	Cal Factor – RSD for all <20%; or Linear – r ≥0.995; or Non-linear – r^2 > 0.990 (6 points must be used).	Correct problem then repeat ICAL.	Analyst/ Supervisor	HS-GCECD001
GCECD (8081B)	Second-source (ICV) calibration verification, all analytes. Once per each ICAL.	Once per each ICAL.	All analytes within ±20% of expected value for 8081 and	Correct problem then repeat initial calibration.	Analyst/ Supervisor	HS-GCECD001
GCECD (8081B)	RT window position established for each analyte and surrogate	Set once with each ICAL and at the beginning of each (12-hour) shift.	Position shall be set using ICAL midpoint standard, or set with the value of the CCV that is run at beginning of each 12-hour shift.	N/A	Analyst/ Supervisor	HS-GCECD001
GCECD (8081B)	CCV RT window verification for each analyte and surrogate	CCV RT window verification for each analyte and surrogate	All analytes and surrogates in CCV must fall within the RT windows	Correct problem then reanalyze CCV and all samples analyzed since the last acceptable RT verification. If CCV fails RT verification again, redo ICAL and reset RT window & position.	Analyst/ Supervisor	HS-GCECD001

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GCECD (8081B)	Calibration verification (CCV)	At beginning of each 12 hour shift, after every 10 samples and at the end of the analysis sequence.	All analytes within ±20% of expected value for %drift / %D 8081.	Correct problem, repeat the CCV, it repeat CCV fails, repeat ICAL and reanalyze all samples since last successful CCV.	Analyst/ Supervisor	HS-GCECD001
GCECD (8081B)	Second-column confirmation (excluding toxaphene and chlordane).	100% for all positive results.	Same as for initial or primary column analysis, RPD must be <40.	Same as for initial or primary column analysis. If RPD >40%, evaluate chromatography, for co-elutions. Apply P flag to data where RPD > 40%. In general, report lower value when RPD >40 %.	Analyst/ Supervisor	HS-GCECD001
GCECD (8082B)	Minimum of five points for ICAL for Aroclor 1016/1260 mix. Single point calibration for other Aroclors, for pattern recognition and calibration factor or prep multipoint current for all required Aroclor.	Initial calibration prior to sample analysis.	Calibration Factor – RSD for all analytes (peaks) <20%; or Linear – regression, r > 0.995; or Non-linear regression – r^2 >0.99 (6 points must be used for 2nd order). Grand mean not allowed.	Correct problem, then repeat initial calibration.	Analyst/ Supervisor	HS-GCECD002
GCECD (8082B)	Second-source Calibration Verification (ICV) for Aroclor 1016/1260 mix.	Once per ICAL.	Agree within ± 20 % of expected value	Correct problem then repeat ICAL.	Analyst/ Supervisor	HS-GCECD002

Instrument and/or Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GCECD (8082B)	Calibration verification (CCV) for Aroclor 1016/1260 mix.	Daily, before sample analysis, minimally every 10 samples and at the end of the analysis sequence.	Agree within ± 20 % of expected value.	Correct problem, then repeat CCV. If second CCV fails, repeat ICAL. Reanalyze all samples since last successful calibration verification.	Analyst/ Supervisor	HS-GCECD002
GCECD (8082B)	Absolute RT position established for each analyte and surrogate	Set once with each ICAL and with CCV at the beginning of each (12-hour) shift.	Position shall be set using the ICAL midpoint standard, or set with the value of CCV that is run at beginning of each 12-hour shift for 8082.	N/A	Analyst/ Supervisor	HS-GCECD002
GCECD (8082B)	RT window verification for each analyte and surrogate. RT window set ±0.07 minutes from the absolute RT for Aroclor 1016/1260 mix.	Each calibration verification (ICV and CCVs).	All analytes and surrogates in ICV & CCV must fall within the RT windows	Correct problem then reanalyze CCV and all samples analyzed since the last acceptable RT verification. If CCV fails RT verification again, redo ICAL and reset RT window & position.	Analyst/ Supervisor	HS-GCECD002
GCECD (8082B)	Dual Column Confirmation	Every sample and QC sample	The primary column is reported and case narrative completed for sample not meeting the 40% acceptance limits.	Inspect chromatography for co-elutions and narrate as necessary when due to sample matrix.	Analyst/ Supervisor	HS-GCECD002

Notes: BFB - 4-bromofluorobenzene ; DDT - dichlorodiphenyltrichloroethane; r – correlation coefficient; r^2 - coefficient of determination; ICV – Initial calibration verification; RSD – Relative Standard Deviation; EICP - Extracted Ion Current Profile; CCV - continuing calibration verification; ICAL – Initial calibration; %D – percent difference; % - Percent; mg – milligram; RF – Response Factor; UV – Ultraviolet

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WORKSHEET 25 – ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

To confirm that the analytical instrument and equipment are available and in working order when needed, all laboratory analytical equipment will be maintained and tested in accordance with procedures described in the laboratory SOPs as listed on Worksheet 23. The analytical instrument and equipment maintenance, testing, and inspection activities and acceptance criteria are provided in the following table.

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Table 13. Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Maintenance Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS	Clean the source and replace the filaments. Replace the seal, liner and septum. Change the column. Preventative maintenance such as semi-annual pump oil change.	Semi-volatiles (including 1,4-dioxane)	Check the gas supply. Check the seal, liner, and septum.	Source cleaning is performed when the instrument response deteriorates. Other instrument maintenance is done as needed to keep the instrument performing at peak performance.	The minimum RF for all analytes must meet limits stated in method. All analytes must be < 20 %D.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	HS-MSSV006 R1.0, HS-MSSV003 R6.0
GC/MS – Purge and Trap Concentrator	Clean the source and replace the filaments. Replace the seal, liner and septum. Change the column, transfer line and trap. Preventative maintenance such as annual pump oil change.	Volatiles	Check the gas supply. Check the seal, liner, and septum.	Source cleaning is performed when the instrument response deteriorates. Other instrument maintenance is done as needed to keep the instrument performing at peak performance.	The minimum RF for all analytes must meet limits stated in method. All analytes must be < 20 %D.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	HS-MSV001 R11.2

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Maintenance Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICPMS	Clean the torch assembly and the spray chamber when they become discolored or when degradation in data quality is observed. Clean the nebulizer, and check the argon supply. Replace the peristaltic pump tubing as needed.	Metals (except mercury)	Inspect the torch, nebulizer chamber, pump, and tubing.	Maintenance is performed prior to initial calibration or as necessary.	%D < 10%	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	HS-MET003 R8.6
Cold Vapor AA	Change the tubing, filter, clean windows, mercury lamp, and check gas flow. Check the reagents and standards.	Mercury	Inspect the tubing, filter, and the optical cell.	Maintenance is performed prior to initial calibration or as necessary.	%D ≤ 20%	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	HS-MET004 R12.0, HS-MET005 R9.3
Spectrophotometer	Change lamp, check wavelength, and clean light path.	Hexavalent Chromium, Ortho-phosphate, Total Phosphorus, COD, Ammonia	Check wavelength	At the beginning of every run.	ICV/CCV 90-110% of true value	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards.	Analyst/ Supervisor	HS-WC025 R3.4, HS-WC015 R7.0, HS-WC008 R7.2, HS-WC026 R5.0.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Maintenance Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
						Reanalyze affected data. Coefficient of determination Spec with built in curve, check with manufacturer.		
Ion Chromatograph	Replace column, seals, change suppressor, and change eluent.	Anions	Check gas supply, check for leaks, check pistons	Daily or as needed	ICV/CCV 90-110% of true value	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data	Analyst/ Supervisor	HS-IC001 R9.1
TOC Analyzer	Clean syringe, replace scrubber as needed, change filters as needed.	TOC	Check gas supply, check lamp, tubing, reagent volumes	Prior to sample analysis, or when instrument does not meet method criteria	CCV <10 %D for water CCV <30% D for soil	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	HS-WC022 R5.0

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Maintenance Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LC/MS	Check pressure and gas supply daily – change when <200 pounds per square inch, change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination. Clean the source and replace the filaments.	Perchlorate	Check pump pressure, check for leaks, check for adequate mobile phase.	Source cleaning is performed when the instrument response deteriorates. Other instrument maintenance is done as needed to keep the instrument performing at peak performance.	CCV < 15 %D	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	LC-MS-CLO4 R10.0
HPLC/UV Detector	Check pressure and gas supply daily – change when <200 pounds per square inch, change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet	Dinitrotoluenes and Nitroglycerin	Check pump pressure, check for leaks, check for adequate mobile phase.	Prior to initial calibration or as necessary.	CCV < 20 %D	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	HS-HPLC003

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Maintenance Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
	filters as needed for contamination.							
ManTec Auto Titrimetric	Change buffer solutions or pH probe	Alkalinity	Change buffer solutions or pH probe	Before analysis begins, check every 3 hours	4 and 7 + 0.05 pH units, pH 10 + 0.10 pH units, + 0.20 pH units for check	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	HS-WC001 R8.2
Analytical Balance	Annual service and daily checks	Oil and Grease	Clean pan and make sure scales are balanced	Daily or as needed	Daily verification bracketing target weight ±0.1% or ±0.0005 grams, whichever is greater.	Repeat maintenance activity or remove from service	Analyst/ Supervisor	HS-WC-036 R4.2
HPLC/UV	1. Change guard column 2. Change inlet filters 3. Inspect/ change gas tank	VFAs	Inspect daily	1. As needed 2. As needed 3. As needed, when pressure is <500 pounds per square inch	Same as initial and continuing calibration criteria	Repeat maintenance activity or remove from service.	Analyst/ Supervisor	HPLC-METACIDS

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Maintenance Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Spectrophotometer	Inspect lamp alignment. Adjust zero. Replace lamp as needed.	Ferrous Iron	Check wavelengths against NIST traceable standards.	Every 6 months	Within 3% of certified transmittance density values or 2 nanometers for holmium oxide	Repeat maintenance or remove from service	Analyst/ Supervisor	GEN-3500 R5.0
GC/FID & GC/TCD	Check column performance, injection port, in-line purifiers and injection septa	Dissolved Gases including CO_2	Change injection port liner and column ferrule as needed. Change liners when recent sample analyses predict a problem with chromatographic performance.	As recommended by supplier.	Passing ICAL or CCV	Perform maintenance and reanalyze CCV or perform new ICAL.	Department Supervisor, however other trained analysts in the team may be responsible	VOA-DISGAS R16.0
GC/MS	Check concentrating trap, column performance and vacuum system/pump oil	Volatiles, Air	ICAL and CCV	As needed indicated by calibration and QC difficulties. Vacuum system: Every 6 months, including changing the pump oil and checking the molecular sieve in the backstreaming trap.	Clean blank, sufficient sensitivity, and ICAL meets linearity criteria. Acceptable resolution and peak shape. Level of oil and quality is sufficient.	Routine maintenance includes periodic solvent cleaning of Silco steel lines in the valve oven if contamination is suspected. Also, periodic replacement of multi-sorbent or partial replacement of the trap if analyte specific deterioration is detected. Cut	Department Supervisor, however other trained analysts in the team may be responsible	VOA-TO15 R24

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Maintenance Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
						or replace column. Change oil.		
ABI 7300	Dye calibration and background	DHC/DHB	Run dye plate and run water plate	Dye calibration: Annual; Background: monthly	Dye calibration: Spectra follows normal pattern; background: No spectra detected	Contact manufacturer and/or clean instrument and rerun	Analyst	MI SOP qPCR
Titrimetric	Clean burette	Sulfide	Check burette tip for breakage	Before each use	Clean and unbroken	Replace broken burettes. Reanalyze	Analyst/ Supervisor	HS-WC018 R7.0
GCECD	Clean the source and replace the filaments. Replace the seal, liner and septum. Change the column gas scrubbers as needed. Semi-annual detector wipe test. Refoil detectors as needed.	Pesticides, PCBs	Check the gas supply. Check the seal, liner, and septum.	Instrument maintenance is done as needed to keep the instrument performing at peak performance.	The minimum RF for all analytes must meet limits stated in method. All analytes must be < 20 percent difference	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	HS-GCECD001, HS-GCECD002

Notes: NIST – National Institute of Standards and Technology

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WORKSHEETS 26 AND 27 – SAMPLE HANDLING, CUSTODY, AND DISPOSAL

To verify sample authenticity and data defensibility, a proper sample handling system will be followed from the time of sample collection to final sample disposal.

The Site Supervisor will be responsible for the sample collection, sample packing, and coordination of sample shipment. The samples will be sent to ALS via FedEx Priority overnight.

A laboratory representative will acknowledge receipt of the sample coolers upon arrival. The laboratory technicians will prepare and analyze the field samples in accordance with the analytical methods and laboratory SOPs. The field samples will be stored at the laboratory for 60 days after a final report has been submitted to Bhate. The Laboratory Hazardous Waste Manager will be responsible for the final sample disposal upon notice from the Project Chemist.

Table 14. Sample Handling System

Sample Collection, Packaging, and Shipment	
Sample Collection (Personnel/Organization):	Scott Beesinger (Bhate)
Sample Packaging (Personnel/Organization):	Scott Beesinger (Bhate)
Coordination of Shipment (Personnel/Organization):	Scott Beesinger (Bhate) or Marcia Olive (Bhate)
Type of Shipment/Carrier:	FedEx Priority Overnight service
Sample Receipt and Analysis	
Sample Receipt (Personnel/Organization):	Ragen Giga, ALS-Houston, TX
Sample Custody and Storage (Personnel/Organization):	James Guin, ALS-Houston, TX
Sample Preparation (Personnel/Organization):	Various, depending on analysis
Sample Determinative Analysis (Personnel/ Organization):	Various, depending on analysis
Sample Archiving	
Field Sample Storage (number of days from sample collection):	Samples are stored at the proper temperature until disposed – see Sample Disposal section below
Sample Extract/Digestate Storage (number of days from extraction/digestion):	Extracts are disposed after the holding time of 40 days and digestates are disposed 2 weeks after analysis (most is consumed)
Sample Disposal	
Personnel/Organization:	Jacob Turner, ALS-Houston, TX
ALS Hazardous Waste Treatment/Storage Disposal Contractor:	Clean Harbors Deer Park, LLC
Number of Days from Analysis:	30 days

Proper sample handling, shipment, and maintenance of chain-of-custody forms are key components of building the documentation and support for data that can be used to make project decisions. The sections below summarize the field and laboratory sample custody procedures to be followed during the project.

Field Sample Custody Procedures

Field work for sampling activities will be conducted in accordance with the SOPs provided in Worksheet 21 (Project Sampling Standard Operating Procedure References). These SOPs outline the methodologies for sampling, sample management, equipment decontamination, chain-of-custody procedures and sample collection activities. Sample packaging, shipment, and delivery to laboratory activities will be conducted in accordance with Worksheets 17-21.

Laboratory Sample Custody Procedures

The laboratory is not responsible for loss of or damage to samples until the laboratory accepts delivery of samples by notation on a chain of custody document or otherwise in writing. The laboratory, at its sole discretion, reserves the right to refuse or revoke Acknowledgment of Receipt for any sample due to insufficient sample volume, improper sample container, or risk of handling for any health, safety, environmental, or other reason. The laboratory does not accept samples that contain asbestos, biohazards, or radiological materials. Regardless of prior acceptance, the laboratory may return samples at its sole discretion if it is determined that the samples may pose a risk in handling, transport or processing, for any health, safety, environmental or other reason. Internal chain-of-custody procedures include the use of sample bar codes.

All samples must be scanned each time custody of the container is changed. This information is stored in the Laboratory Information Management System (LIMS), and includes a complete record of the sample custody from receipt to disposal. Information includes the location of the sample, the date and time of each custody transfer, unique initials of each person assuming custody, and a reason for the transfer.

The laboratory will retain all records related to sample analysis including raw test data, calculations, derived data, calibrations, and copies of test reports. These records are archived in accordance with regulatory requirements for a minimum of 10 years or as required by specific client contracts. If the laboratory is going out of business, Bhate will be notified at least 60 days (if time permits) prior to closure of the laboratory and will receive a final report for all submitted samples. The notification will request instructions on the retention or distribution of laboratory records and will provide contact information for after the closure. Software/hardware permitting the access of electronic data must be maintained.

The copy of Bhate reports is stored in a location with access restrictions. All reports must be signed out using the archived reports logbook. Bhate reports and chain of custodies are also scanned for electronic storage. All archived logbooks, corrective actions, training records, and other QA/QC reports are stored in a locked storage closet. Only members of the QA/QC Department have access to these records. Written and printed data records (bench sheets, logbooks, electronic printouts, etc.) are scanned before being boxed and placed in storage. Electronic data are stored on a dedicated server. This server is backed-up daily. Approximately 1 year of electronic data are accessible at workstations. Data removed from the servers and stored on tapes can be reloaded by submitting a request. The safety officer keeps safety and disposal information. The Comptroller keeps personnel information in locked files.

Archived data are stored on-site until capacity is met. The oldest archived data are then moved to a secure storage facility. The storage and on-site facility are monitored and protected from fire and theft. Electronic data storage is free from magnetic sources. It is the goal of ALS to have redundant copies (hard and electronic) to prevent loss of records due to being misplaced or environmental deterioration or catastrophe.

Sample Disposal

Samples are stored in the appropriate cooler for 60 days after receipt. After 60 days, samples are moved to a waste area. The samples are scanned out for disposal on the LIMS. The samples are then stored in the waste staging area until disposal into appropriate drums. Hazardous samples are returned to the client whenever possible to be disposed of with larger quantities of the sample material. Laboratory waste is segregated by laboratory personnel into waste streams, which have been established by the laboratory Regulatory Compliance Officer. The waste streams are determined by analysis of the waste and through process knowledge. All laboratory wastes are disposed of in the proper container. No waste is placed in regular trash containers or poured down the drain. Waste is stored in drums in satellite accumulation areas and then in the central accumulation facility. Waste disposal service is provided by approved vendors who will incinerate, landfill, treat, or reclaim the waste based on the characteristics.

Samples not consumed in testing will normally be retained for a maximum of 60 days before disposal. Samples will be returned to the Bhate when requested in writing or when they would pose a disposal problem as a hazardous waste as determined by ALS, at its sole discretion. ALS, in its sole discretion, may also agree in writing to retain samples at a monthly storage charge, agreed upon and payable in advance.

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WORKSHEET 28 – LABORATORY QUALITY CONTROL SAMPLE SUMMARY

This worksheet presents analytical QC requirements relevant to analysis of environmental samples that will be followed by laboratories producing definitive data. The purpose of the laboratory QC activities is to produce data of known quality that satisfy the project-specific DQOs. Laboratory QC samples will follow method specific requirements of the DoD Quality System Manual, Version 5.1 (Appendix F of the Quality Systems Manual) (DoD, January 2017).

Laboratory QC samples must be included in an analytical batch with the field samples. An analytical batch is a group of samples (not exceeding 20 environmental samples plus associated laboratory QC samples) similar in composition (matrix) that are extracted or digested at the same time and with the same lot of reagents and analyzed together as a group. The analytical batch also extends to cover samples that do not need separate extraction or digestion. The identity of each analytical batch will be clearly reported with the analyses so that a reviewer can identify the laboratory QC samples and the associated environmental samples. The type of laboratory QC samples and the frequency of use of these samples are discussed below and in method-specific laboratory SOPs.

Method Detection Limits

The method detection limit (MDL), as defined by Title 40 CFR Part 136, Appendix B, is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The MDL will be considered the detection limit (DL) for the purposes of this project in accordance with the DoD Quality System Manual, Version 5.1 (DoD, January 2017). The laboratory has established MDLs for each analyte, and provided them to Bhate. The MDL is used along with other measurements of sensitivity, such as the LOD and LOQ.

The laboratory participating in this work effort, ALS, will demonstrate the capability to achieve the MDLs for each instrument by presenting data for the most recent and comprehensive MDL studies for each instrument to be used to analyze project samples. If multiple instruments are used, the MDL used for reporting purposes will represent the least sensitive instrument response for each analyte spiked.

Limit of Detection

The MDL will be used to determine the LOD for each analyte and for all preparatory and cleanup methods routinely used on samples. The in-house LOD for each analyte is listed in Attachment 1. The laboratory will be required to repeat the determination of the LOD if there are significant changes to the method or instrumentation prior to analysis of the first environmental samples for this project. The laboratory will maintain documentation for all MDL and LOD determinations and verifications.

Limit of Quantitation

The in-house LOQ for each target analyte is presented in Attachment 1. During analysis of the project environmental samples, the laboratory will verify LOQs by including a standard equal to or below the LOQ as the lowest point on the ICAL curve.

If a result is greater than the MDL but less than the LOQ, the result will be reported as a detected concentration and flagged as estimated, “J”. If no detected concentration is determined down to the MDL, the result will be reported as not detected (flagged “U”) at the LOD. The LOD will be adjusted for each sample based on dilution, final sample volume, and sample weight. A detected result greater than or equal to the LOQ will be reported, by the laboratory, without a qualifying flag unless a specific QA/QC failure is associated with the data. For this project and for purposes of evaluation and reporting the LOQ will be considered equivalent to the reporting limit (RL).

At a minimum, the LOQ must be verified quarterly. The LOQ and associated precision and bias must meet project-specific requirements and will be provided by the laboratory upon request. If the method is modified or major changes made to the instrumentation, the LOQ must be verified and reported.

Sample dilution because of target and or non-target analyte concentrations or matrix interference could prevent LOQs from being achieved. Each sample must be initially analyzed while undiluted when reasonable. If dilution is necessary, both the original and diluted sample results must be reported and the dilution noted in the case narrative. Any samples that are not analyzed undiluted must have the express written approval of the Project Chemist within extraction and analysis holding time and supported by matrix interference documentation such as sample texture, color, odor or results from other analyses of the same sample, to show that undiluted analysis is not possible. Appropriate cleanup procedures must be followed to minimize matrix effects on LOQs.

Calibration

All analytes reported must be present in the initial and continuing calibration. The calibrations must meet the acceptance criteria specified in Worksheet 24 (Analytical Instrument Calibration). All results reported must be within the calibration range. Samples will be diluted, if necessary, to bring analyte responses within the calibration range. Records of standard preparation and instrument calibration will be maintained and available upon request. Records must clearly trace the standards and their use in calibration and quantitation of sample results.

Instrument calibration will be performed by beginning with the simplest approach first, the linear model through the origin and then progressing through other options until the acceptance criteria are met. In cases where an analyte has more than one acceptable calibration model, results from the simplest calibration model will be reported. If more than the minimum number of standards is analyzed for the ICV, all of the standards analyzed will be included in the ICV. The only exception to this rule is that a standard at either end of the calibration curve can be dropped from the calibration curve, providing that the requirement for the minimum number of standards is met and the low point of the calibration curve is at or below the quantitation limit for each analyte.

The CCV cannot be used as the LCS. A CCV will be performed daily before sample analysis, unless an ICAL and second-source standard verification is performed immediately before sample analysis, and as required by the method.

Laboratory Control Samples

An LCS is a sample of known composition that is spiked with all target analytes. The LCS is used with each analytical batch to determine whether the method is in control. Each analyte in the LCS will be spiked at a level less than or equal to the midpoint of the calibration curve, which is defined as the median point of the curve instead of the middle of the range. The LCS will be carried through the complete sample preparation and analysis procedure.

At least one LCS will be included in each analytical batch. If more than one LCS is analyzed in an analytical batch, results from all LCSs will be reported. Failure of an analyte in any LCS will necessitate appropriate corrective action, including qualification of the failed analyte in all of the samples as required.

The in-house LCS control limits will be used for the project until and unless new in-house limits are developed and approved for the project. When an analyte in the LCS is outside the acceptance limit, corrective action will be required. If an analyte in the LCS exceeds the upper or lower control limit and no corrective action is performed, or the corrective action taken is deemed to be ineffective, an appropriate data qualifier may be applied during data validation to all associated sample results.

Marginal Exceedance

The laboratory may not use marginal exceedances as part of their data review process but are encouraged to contact the Project Chemist to discuss the problem and CA to be taken.

Matrix Spike and Matrix Spike Duplicate Samples

An MS or MSD is an aliquot of sample collected in the field and spiked with known masses and concentrations of all target analytes in the laboratory. The spiking will occur before sample preparation and analysis. Each analyte in the MS and MSD must be spiked at a level less than or equal to the midpoint of the calibration curve for that analyte. The MS/MSD is used to document potential matrix effects associated with a site and will not be used to control the analytical process. The Site Supervisor will select the samples for MS/MSDs.

The performance of the MS/MSD will be evaluated against the accuracy and precision limits. If either the MS or the MSD is outside the acceptance limits, the data will be evaluated to determine whether there is a matrix effect or analytical error. The determination will be made during data validation. If the matrix effect is determined, the analytes in the parent sample will be qualified accordingly.

If the sample concentration exceeds the spike concentration by a factor of four or more, the associated parent sample data will not be qualified. The laboratory should communicate potential matrix difficulties to the Project Chemist so that an evaluation can be made with respect to the project-specific DQOs.

Surrogates

Surrogates are compounds similar to the target analytes in chemical composition and behavior in the analytical process, but not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance and extraction efficiency. Surrogates will be added to all environmental samples, controls, and blanks in accordance with method requirements.

The acceptance limits for the VOCs surrogates are presented in Attachment 1. If a surrogate recovery is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been re-established, the sample will be re-prepared and re-analyzed. If the surrogate outlier persists after re-analysis, the sample results from both the original and the re-analysis runs will be reported and discussed in the case narrative. The reported results will be evaluated during data validation and a decision on qualification of the affected data will be made.

Internal Standards

Internal standards are known amounts of standards that are added to a portion of a sample or sample extract and carried through the entire determination procedure. They are used as a reference for calibration and for controlling the precision and bias of the analytical method. Internal standards will be added to environmental samples, controls, and blanks, in accordance with the method requirements.

If the results of the internal standards are outside of the acceptance limits, corrective actions will be performed. After the system problems have been resolved and system control has been reestablished, all samples analyzed while the system was malfunctioning will be re-analyzed. If corrective actions are not performed or are ineffective, an appropriate flag will be applied to the sample results.

Retention Time Windows

RT windows are used in gas chromatography analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in each method. The center of the RT window is established for each analyte and surrogate using the RT of the midpoint standard of the initial calibration.

If the RT is outside of the acceptance limits, corrective action will be performed. This applies to all CCV subsequent to the ICV and to LCSs. If corrective actions are not performed or are ineffective, an appropriate flag will be applied to the sample results.

Method Blank

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is carried through the complete sample preparation and analytical procedure, and is used to assess potential contamination resulting from the analytical process.

A method blank will be included in every analytical batch. The presence of analytes in a method blank at concentrations greater than the LOD indicates the need for further assessment of the data. The source of contamination will be investigated and measures will be taken to correct, minimize, or eliminate the problem if the concentration exceeds the acceptance limits listed in Table 15. The laboratory shall reprocess affected samples in the associated batch.

If an analyte is detected in the method blank and in the associated samples and corrective actions are not performed due to insufficient sample volume or are ineffective, the results shall be reported with appropriate data qualifiers. The data will be evaluated during data validation and a decision on further qualification of data will be made at that time.

Quality Control Checks

Holding Time Compliance

All sample preparation and analyses will be performed within the method-required holding times. For methods not requiring sample preparation, holding time is calculated from the time of sample collection to the time of completion of all analytical runs. For methods requiring sample preparation before analysis, holding time is calculated from the time of preparation completion to the time of completion of all analytical runs.

Control Charts

Control charts are used to track laboratory performance over time. It is recommended that all analytes spiked into the LCS be tracked via control charts. These charts are useful for identifying trends and problems in an analytical method and the laboratory will use these charts to establish in-house LCS control limits. The control charts will be updated as needed (for example, when there is a significant change to the analytical system). At a minimum, the charts will be updated annually and reviewed each time a data point is generated so that corrective action can be taken in a timely manner. These charts can also be used to benchmark a laboratory's performance against QAPP requirements to determine possible areas for improvement.

Standard Materials

Standard materials (including second source materials) used in calibration and sample preparation must be traceable to NIST, USEPA, American Association of Laboratory Accreditation (A2LA), or other equivalent approved source, if available. If an NIST, USEPA, or A2LA standard material is not available, the standard material proposed for use must be included in an addendum to this QAPP and approved before use.

The standard materials must be current, and the following expiration policy must be followed:

- Expiration dates for ampulated solutions should not exceed the manufacturer's expiration date or one year from the date of receipt, whichever comes first.
- Expiration dates for laboratory-prepared stock and diluted standards must be no later than the expiration date of the stock solution.
- Expiration dates for pure chemicals will be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions.

- Expired standard materials will be discarded. The laboratory will label standard and QC materials with expiration dates.

A second source standard will be used to independently confirm the ICAL. A second source standard is a standard purchased from a vendor different from that supplying the material used in the ICAL. The second source material can be used for the continuing calibration standards and/or for the LCS. Two different lot numbers from the same vendor do not normally constitute a second source. However, when a project requires analyses for which there is not a separate vendor source available, the use of different lot numbers from the same vendor will be acceptable to verify calibration.

Table 15. Laboratory QC Samples

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Matrix: Aqueous/Solid Analytical Group: VOCs Analytical Method/SOP Reference: SW-846 8260C/HS-MSV001						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. Evaluate the samples and associated QC: if blank results are above LOQ, report sample results which are < LOQ or > 10 times the blank concentration. Reanalyze blank and samples >LOQ and < 10 times the blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
Surrogates	Every Sample	See associated Worksheet 15	Correct problem, then reprep and reanalyze all failed samples for all surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be needed.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per sample delivery group (SDG) of every 20 samples.	See associated Worksheet 15	Examine the project- specific requirements. Contact the client as to additional measures to be taken. CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
			unless RPD indicate obvious extraction/analysis difficulties.			
IS	One per sample	Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer or gas chromatograph for malfunctions. Mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Aqueous/Solid **Analytical Group: Metals** **Analytical Method/SOP Reference: SW-846 6020A, 7470A, 7471B/HS-MET-001, HS-MET002, HS-MET003, HS-MET004, HS-MET005**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ, request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per SDG of every 20 samples.	See associated Worksheet 15	Examine the project-specific requirements. Contact the client as to additional measures to be taken. CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/Bias	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Lab duplicate	One per prep batch of 20 or fewer samples of similar matrix (unless MSD performed)	RPD < 20%	Qualify associated data if original result >LOQ	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Confirmation Column	All compounds detected on the primary column exceeding the LOD.	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ±40%.	NA	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Serial Dilution (ICP only)	One per prep batch of 20 or fewer samples of similar matrix	1:5 dilution must agree within ±10 % of the original sample result if result is > 50 times the LOQ	Perform Post-digestion spike (PDS)	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
PDS addition (ICP only)	When dilution test fails or analyte concentration in all samples < 50 times the LOD.	Recovery within 75-125%	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Water **Analytical Group: Anions** **Analytical Method/SOP Reference: SW846 9056A/SOP IC001 R9.1**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ, request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS/MSD	One per SDG of every 20 samples.	See associated Worksheet 15	Examine the project- specific requirements. Contact the client as to additional measures to be taken. CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Lab duplicate	One per prep batch of 20 or fewer samples of similar matrix (unless MSD performed)	A laboratory must use the DoD QSM Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Qualify associated data if original result >LOQ	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Aqueous/Solid **Analytical Group: Ferrous Iron** **Analytical Method/SOP Reference: SM3500 FeB/GEN-3500 R5.0**						
Method Blank	One per batch of 20 or fewer samples	Method blank result < LOQ or, if method blank result > LOQ, method blank <1/10 amount in any measured sample. Samples <LOQ acceptable with contaminated method blank.	Correct the problem; if acceptance limits still not met, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst, Supervisor, QA Manager	Contamination/ Bias	Same as method
LCS	One per batch of 20 or fewer samples	Refer to Worksheet 15 for recovery limits.	Re-prepare and analyze all associated samples.	Analyst, Supervisor, QA Manager	Accuracy/Bias	Same as method
Lab Duplicate	One per batch of 20 or fewer samples	RPD ≤30 %	Note outlier in case narrative	Analyst, Supervisor, QA Manager	Precision	Same as method
MS/MSD	One per batch of 20 or fewer samples	Same as LCS and refer to Worksheet 15 for MS/MSD RPD.	Examine results of LCS. If both the LCS and MS are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst, Supervisor, QA Manager	Accuracy/Bias	Same as method

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Matrix: Aqueous **Analytical Group: MEE and CO_2** **Analytical Method/SOP Reference: RSK-175/SOP VOA-DISGAS R 16.0**						
Laboratory Method Control Sample	Once every analytical batch of 20 or fewer samples	No analytes >1/2 LOQ; common lab contaminants none detected >LOQ	1) Reanalyze 2) Identify and correct problem 3) Reanalyze blank and affected samples 4) Qualify data	Department Supervisor, however other trained analysts in the team may be responsible	System free of contamination	Per VOA-DISGAS R16.0
LCS/LCSD	Once every analytical batch of 20 or fewer samples	%R within QSM limits. RPD within laboratory generated limits.	1) Reanalyze 2) Identify and correct the problem 3) Qualify data	Department Supervisor, however other trained analysts in the team may be responsible	Accuracy	Per VOA-DISGAS R16.0
MS/MSD	Analyzed at the request of the client. Laboratory recommends six separate vials be submitted (three for back-up).	%R QSM limits RPD within +/-30%	1) Reanalyze 2) Identify and correct the problem 3) Qualify data	Department Supervisor, however other trained analysts in the team may be responsible	Matrix Affects	Per VOA-DISGAS R16.0
Matrix: Air **Analytical Group: Volatiles** **Analytical Method/SOP Reference: TO-15/SOP VOA TO-15**						
Method blank	Once every analytical batch of 20 or fewer samples	No analyte detected equal to or above the MRL [DoD: No analytes > ½ MRL; common lab contaminants none detected > MRL]	1) Reanalyze blank 2) Identify and correct problem 3) Reanalyze blank and affected samples 4) Qualify data.	Department Supervisor, however other trained analysts in the team may be responsible	Bias	Per VOA-TO15
LCS	Once every analytical batch of 20 or fewer samples [DoD QSM 5.1 - LCS Replicate required per each analytical batch]	%R within laboratory generated limits. [DoD: QSM limits depending on client specifications.]	1) Reanalyze 2) Identify and correct problem 3) Qualify data *DoD projects require corrective action for all exceedances	Department Supervisor, however other trained analysts in the team may be responsible	Accuracy	Per VOA-TO15

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Matrix: Aqueous Analytical Group: Volatile Fatty Acids Analytical Method/SOP Reference: HPLC/SOP HPLC-METACIDS R5.0						
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be < ½ LOQ or <1/10 the concentration found in the sample.	Re-prepare and analyze all associated samples. Discuss with client/qualify if re-extraction/re-analysis not feasible.	Analyst/ Laboratory Manager	Contamination/ Bias	Target analytes must be < ½ LOQ or <1/10 the concentration found in the sample
LCS/LCSD	One is performed for each batch of up to 20 samples.	Contains all target analytes. See Worksheet 15.	Re-prepare and analyze all associated samples. Discuss with client/qualify if re-extraction/re-analysis not feasible.	Analyst/ Laboratory Manager	Precision / Accuracy / Bias	Contains all target analytes. See Worksheet 15 LCS
MS/MSD	One is performed for each batch of up to 20 samples.	Percent recoveries must meet the control limits and RPD listed in Worksheet 15	Examine results of LCS. Report and narrate.	Analyst/ Laboratory Manager	Precision / Accuracy / Bias	Percent recoveries must meet the control limits and RPD listed in Worksheet 15 MS
Matrix: Aqueous/Solid Analytical Group: Semi-Volatiles (1,4-Dioxane) Analytical Method/SOP Reference: SW-846 8270D or 8270 SIM/HS-MSSV003 or HS-MSSV006						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. Evaluate the samples and associated QC: if blank results are above LOQ, report sample results which are < LOQ or > 10 times the blank concentration. Reanalyze blank and samples >LOQ and < 10 times the blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Surrogates	Every Sample	See associated Worksheet 15	Correct problem, then reprep and reanalyze all failed samples for all surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be needed.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per SDG of every 20 samples.	See associated Worksheet 15 and MSD	Examine the project- specific requirements. Contact the client as to additional measures to be taken. CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
IS	One per sample	Retention time within ± 10 seconds from midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer or gas chromatograph for malfunctions. Mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Matrix: Aqueous/Solid						
Analytical Group: Explosives						
Analytical Method/SOP Reference: SW-846 8330A/HS-HPLC003 R5.1						
Soil grinding blank (milled samples)	Between each sample.	A grinding blank using clean solid matrix (such as Ottawa sand) must be prepared (e.g., ground and subsampled) and analyzed in the same manner as a field sample. Grinding blanks can be analyzed individually or composited. No analytes detected > ½ LOQ or >1/10 sample concentration or >1/10 regulatory limit.	All blank results must be reported and the affected samples must be flagged accordingly if blank criteria is not met. If the composite grinding blank exceeds the acceptance criteria, apply B-flag to all samples associated with the grinding composite. If any individual grinding blank is found to exceed the acceptance criteria, apply B-flag to the sample following that blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
Surrogates	Every Sample	QC acceptance criteria specified by the project, if available; otherwise use DoD QSM limits or in-house LCS limits if analyte(s) are not listed.	Correct problem, then reprep and reanalyze all failed samples for all surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be needed.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS/MSD	One per SDG of every 20 samples.	See associated Worksheet 15.	Examine the project-specific requirements. Contact the client as to additional measures to be taken. Corrective action will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Aqueous/Solid **Analytical Group: Perchlorate** **Analytical Method/SOP Reference: SW-846 6850/LC-MS-CLO4 R10.**						
$^{35}CL/^{37}CL$ isotope ratio	Every sample, batch QC sample and standard.	Ratio must fall within 2.3 – 3.8	Rerun samples with unacceptable ratio – cleanup, post-spike or dilute, as necessary to reduce interference.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
Internal Standards	1 per sample	RRTs for internal standard must be 0.98-1.02 and the responses within +50% of the average response of the ICAL.	Reanalyze samples at increasing dilutions until the + 50% criteria can be met	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix	No analytes detected > ½ LOQ or >1/10 sample concentration or >1/10 regulatory limit.	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS/MSD	One per SDG of every 20 samples.	See associated Worksheet 15.	Examine the project-specific requirements. Contact the client as to additional measures to be taken. CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Interference Check Sample (ICS)	One ICS is prepared with every batch of 20 samples and must undergo the same preparation and pretreatment steps as the samples in the batch. It verifies the method performance at the matrix conductivity threshold (MCT). At least one ICS must be analyzed daily.	Within ±30% of the true value	Correct problem and then reanalyze all samples in that batch. If poor recovery from the cleanup filters is suspected, a different lot of filters must be used to re-extract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Aqueous **Analytical Group: Total Phosphorus/Ortho-phosphate** **Analytical Method/SOP Reference: SM4500P/SOP HS-WC015 R7.0**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per SDG of every 20 samples.	See associated Worksheet 15.	Examine the project-specific requirements. Contact the client as to additional measures to be taken. CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Lab duplicate	One per prep batch of 20 or fewer samples of similar matrix (unless MSD performed)	RPD < 20%	Qualify associated data if original result >LOQ	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Aqueous/Solid **Analytical Group: Hexavalent Chromium** **Analytical Method/SOP Reference: SW846 7196A / SOP HS-WC008 R7.2/HS-WC009 R6.1**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per SDG of every 20 samples.	See associated Worksheet 15.	Examine the project-specific requirements. Contact the client as to additional measures to be taken. Corrective action will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Lab duplicate	One per prep batch of 20 or fewer samples of similar matrix (unless MSD performed)	A laboratory must use the DoD QSM Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Qualify associated data if original result >LOQ	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Aqueous **Analytical Group: Ammonia/COD** **Analytical Method/SOP Reference: SM4500NH3 B F/SOP HS-WC026 R5.0 and USEPA 410.4/SOP HS-WC025 R3.4**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per SDG of every 20 samples.	See associated Worksheet 15.	Examine the project-specific requirements. Contact the client as to additional measures to be taken. Corrective action will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Lab duplicate	One per prep batch of 20 or fewer samples of similar matrix (unless MSD performed)	A laboratory must use the DoD QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Qualify associated data if original result >LOQ	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Aqueous/Solid **Analytical Group: TOC** **Analytical Method/SOP Reference: SW9060A/EPA 415.1/SOPs HS-WC021 R6.2, HS-WC022 R5.0**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	See associated Worksheet 15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per SDG of every 20 samples.	See associated Worksheet 15.	Examine the project- specific requirements. Contact the client as to additional measures to be taken. Corrective action will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Lab duplicate	One per prep batch of 20 or fewer samples of similar matrix (unless MSD performed)	A laboratory must use the DoD QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Qualify associated data if original result >LOQ	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Aqueous **Analytical Group: Oil & Grease** **Analytical Method/SOP Reference: EPA 1664A/SOP WC-036 R4.2**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	Must be 78-114% (LCSD ≤20% RPD).	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits
MS (MSD optional)	One per SDG of every 20 samples.	Must be 78-114% (MSD ≤20% RPD)	Examine the project-specific requirements. Contact the client as to additional measures to be taken. Corrective action will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits.
Matrix: Aqueous **Analytical Group: Alkalinity** **Analytical Method/SOP Reference: SM2320B/SOP HS-WC001 R8.2**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	80-120%	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Sample duplicate	One per batch	RPD <u><</u>20%	Qualify associated data if original result >LOQ	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Matrix: Aqueous **Analytical Group: Sulfide** **Analytical Method/SOP Reference: SM4500S2F/ SOP HS-WC018 R7.0**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	80-120% (LCSD RPD<20%)	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per SDG of every 20 samples.	±80-120% (MSD RPD<20%)	Examine the project-specific requirements. Contact the client as to additional measures to be taken. Corrective action will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Lab duplicate	One per prep batch of 20 or fewer samples of similar matrix (unless MSD performed)	A laboratory must use the DoD QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Qualify associated data if original result >LOQ	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Results between MDL and LOQ	NA	Apply "J" qualifier to results between MDL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Matrix: Solid **Analytical Group: Pesticides/PCBs** **Analytical Method/SOP Reference: SW-846 8081B / HS-GCECD001/ SW-846 8082A / HS-GCECD002**						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
Surrogates	Every Sample	QC acceptance criteria specified by the project, if available; otherwise use DOD QSM Appendix C limits or in-house LCS limits if analyte(s) are not listed.	Correct problem, then reprep and reanalyze all failed samples for all surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be needed.	Analyst, Laboratory/ Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	A laboratory must use the DOD QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per SDG of every 20 samples.	A laboratory must use the DOD QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. RPD analytes = 20% (between MS and MSD	Examine the project- specific requirements. Contact the client as to additional measures to be taken. Corrective action will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Confirmation Column	All detected on the primary column concentrations exceeding the LOD.	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ±40%.	NA	Analyst, Laboratory/ Supervisor	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits

QC Sample	Frequency Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Laboratory/ Supervisor	Accuracy	Same as QC Acceptance Limits
Matrix: Solid Analytical Group: Dioxins Analytical Method/SOP Reference: 8290A/SOP HE-HRMS001 R0.1						
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	Tetra through Hepta < MRL or Octa < 3 times MRL.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory/ Supervisor	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	A laboratory must use the DOD QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If the LCS recoveries are high but the sample results are <LOQ request client approval to qualify and narrate.	Analyst, Laboratory/ Supervisor	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits
MS/MSD	One per SDG of every 20 samples.	A laboratory must use the DOD QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. RPD analytes = 20% (between MS and MSD)	Examine the project- specific requirements. Contact the client as to additional measures to be taken. Corrective action will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPD indicate obvious extraction/analysis difficulties.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits
Labeled Standard Recovery(ies)	For all samples and QC samples	13C12-2,3,7,8-Tetrachlorodibenzodioxin 25-164% Outside acceptance criteria for all labeled standards or if any labeled standard recovery is <10%	Complete a corrective action form and re-extract the sample using a smaller sample size.	Analyst, Laboratory/ Supervisor	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits

WORKSHEET 29 – PROJECT DOCUMENTS AND RECORDS

The required data package deliverables during every aspect of the project are identified in this worksheet. These include, but are not limited to: 1) sample collection and field measurement records, 2) analytical records, and 3) QC records.

Sample Collection and Field Measurement Records

Sample collection and field measurement records generally include field log books, photo documentation, equipment decontamination records, sampling instrument calibration records, soil and groundwater sampling logs, chain-of-custody forms, and air bills.

Analytical Records

The data collection activities will include Level IV laboratory data packages from the analysis of samples, Geographic Information System (GIS) data, field measurements, and other site-derived information. This data will be entered into a single data management system for consistency in tracking samples, storing and retrieving data, evaluating analytical results, visualizing data in three dimensional and other views, and generating data tables and reports.

All project requirements, including analytical methods, DQOs, analyte lists, compounds of concern, regulatory limits, etc., will be incorporated into the project database for use in data screening, manual data review, and reporting. This electronic project setup information will be reviewed against the project QAPP and approved by the Project Chemist prior to receipt of laboratory data.

Chain-of-custody records along with the laboratory Work Order Acknowledgement will be emailed from the lab within one day of sampling, in order to be reviewed for correct sample identifications and analysis request. Analytical data will be downloaded from the laboratory into Excel spreadsheet file format.

Manual data verification will be conducted on all data collected for this project. In addition, Stage III data validation will be performed following a systematic review process to verify that precision and accuracy of the analytical data are adequate for the intended use.

Quality Control Records

Table 16. Sample Collection and Field Records

Record	Generation	Verification	Storage location
Field logs	Site Supervisor	Project Manager	Project file
Chain-of-custody Forms	Field Crew	Site Supervisor	Project file/Laboratory

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WORKSHEETS 31, 32, AND 33 – ASSESSMENTS AND CORRECTIVE ACTIONS

Periodic assessments will be performed during the course of the project so that the planned project activities are implemented in accordance with this document. The type, frequency, and responsible parties of planned assessment activities to be performed for the project are summarized in the table below.

Table 17. Periodic Assessment Schedule

Assessment Type	Frequency	Person(s)/Organization Responsible for Performing Assessment	Person(s) Responsible for Identifying and Implementing Corrective Actions
Data Validation	After receiving data from lab	Marcia Olive/Bhate	Marcia Olive/Bhate
Field Procedure Assessment	Weekly	Scott Beesinger/Bhate	Scott Beesinger/Bhate
Field Document Review	Daily	Scott Beesinger/Bhate	Scott Beesinger/Bhate
Safety and Health Audit	As needed	Sally Smith/Bhate	Sally Smith/Bhate
Internal Project Report Review	Once per report	Frank Gardner/Bhate	Frank Gardner/Bhate
External Project Report Review	Once per report	U.S. Army	U.S. Army COR

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WORKSHEET 34 – DATA VERIFICATION AND VALIDATION INPUTS

To confirm that scientifically-sound data of known and documented quality are used in making project decisions, the following three-step data review will be performed:

- Step I (verification) will confirm that all sampling and analytical requirements have been completed and documented.
- Step II (validation) will assess whether the sampling and analytical processes conform to stated requirements including those in the contract, method and QAPP.
- Step III (usability assessment) will determine whether the resulting data are suitable as a basis for the decision being made.

Worksheet 35 (Data Verification Procedures), and 36 (Data Validation Procedures) describe the processes to be followed for the above steps, respectively. This worksheet establishes the procedures that will be followed to verify project data including, but are not limited to, sampling documents and analytical data package.

Table 18. Data Verification Worksheet

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	X	
2	Contract	X	
3	Field SOPs	X	
4	Laboratory SOPs	X	
Field Records			
5	Field logbooks	X	X
6	Equipment calibration records	X	X
7	Chain-of-custody Forms	X	X
8	Sampling diagrams/surveys	X	X
9	Drilling logs	X	X
10	Geophysics reports	X	X
11	Relevant correspondence	X	X
12	Change orders/deviations	X	X
13	Field audit reports	X	X
14	Field corrective action reports	X	X
Level IV Analytical Data Package			
15	Cover sheet (laboratory identifying information)	X	X
16	Case narrative	X	X
17	Internal laboratory chain-of-custody	X	X
18	Sample receipt records	X	X
19	Sample chronology (dates and times of receipt, preparation, and analysis)	X	X
20	Communication records	X	X
21	MDL/LOD/LOQ establishment and verification	X	X
22	Instrument calibration records	X	X
23	Definition of laboratory qualifiers	X	X
24	Results reporting forms	X	X
25	QC sample results	X	X
26	Corrective action reports	X	X
27	Electronic data deliverable	X	X

WORKSHEET 35 – DATA VERIFICATION PROCEDURES

Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. It applies to both field and laboratory records.

Table 19. Data Verification Responsibilities

Records Reviewed	Description	Person(s) Responsible for Verification
Field SOPs	Verify that the sampling SOPs were followed	Scott Beesinger/Site Supervisor
Analytical SOPs	Verify that the analytical SOPs were followed	Laboratory QA Officer Marcia Olive/Project Chemist
Method QC Results	Verify that the required QC samples were run and met required limits	Laboratory QA Officer Marcia Olive/Project Chemist
Stage III Data Validation	Validate 100 percent of the data to confirm quality as defined in Worksheet 28 (Laboratory Quality Control Sample Summary)	Marcia Olive/Project Chemist
Data Usability Evaluation	Evaluate data based on precision, accuracy, representativeness, comparability, and completeness for project objectives	Marcia Olive/Project Chemist
Field Documentation	Verify accuracy and completeness of field notes	Scott Beesinger/Site Supervisor

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WORKSHEET 36 – DATA VALIDATION PROCEDURES

The objective of the data validation is to assess the performance associated with the analysis in order to determine the quality of the data. This will be accomplished by evaluating whether the collected data comply with the pre-defined project requirements (including method, procedural, or contractual requirements) and by comparing the collected data with criteria established based on the project DQOs.

All types of data, including screening data and definitive data, are relevant to the usability assessment. The following sections focus on the data review requirements for definite data only.

Table 20. Validation Summary Table

Validation Stage	Matrix	Analytical Group	Validation Criteria	Data Validator
III	Aqueous/Solid	Volatiles	Defined below	Marcia Olive/Project Chemist
III	Aqueous/Solid	Metals	Defined below	Marcia Olive/Project Chemist
III	Aqueous/Solid	Perchlorate	Defined below	Marcia Olive/Project Chemist
III	Aqueous/Solid	Anions	Defined below	Marcia Olive/Project Chemist
III	Aqueous/Solid	Explosives	Defined below	Marcia Olive/Project Chemist
III	Aqueous/Solid	Hexavalent Chromium	Defined below	Marcia Olive/Project Chemist
III	Aqueous/Solid	Semi-volatiles (including 1,4-Dioxane)	Defined below	Marcia Olive/Project Chemist
III	Aqueous/Solid	TOC	Defined below	Marcia Olive/Project Chemist
III	Aqueous	Ammonia, Phosphorus/Ortho-phosphate, Alkalinity, Oil & Grease, COD, Sulfide, Ferrous Iron, Methane, Ethane, Ethene, Carbon dioxide, VFAs	Defined below	Marcia Olive/Project Chemist
III	Air	Volatiles	Defined below	Marcia Olive/Project Chemist
III	Solid	Pesticides/PCBs	Defined below	Marcia Olive/Project Chemist
III	Solid	Dioxins	Defined below	Marcia Olive/Project Chemist
III	Biological	DHC/DHB	Defined below	Marcia Olive/Project Chemist

Data Review Requirements for Definitive Data

Scientifically sound data of known and documented quality that meet the PQOs are essential to the decision-making process. Data will be examined and evaluated to varying levels of detail and specificity by multiple personnel who have different responsibilities within the data management process. Data review includes verification, validation, and usability assessment. The data review process will be documented to facilitate efficient and accurate assessment of data quality and usability. The overall usability of the data is indicated with appropriate qualifiers.

Data verification is used to confirm that the specified requirements have been performed.

Data validation extends data verification and is used to confirm that the requirements for a specific intended use are fulfilled. Data validation is the systematic approach of evaluating the compliance of the data with the pre-defined requirements of the project (including method, procedural, or contractual requirements) and compliance of the data against criteria based on the quality objectives documented in this document. The purpose of data validation is to assess the performance associated with the analysis in order to determine the quality of the data. Data validation includes a determination, to the extent possible, of the reasons for any failure to meet performance requirements, and an evaluation of the impact of such failures on the usability of the data.

Data usability assessment is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment is used to determine whether the project execution and resulting data meet the PQOs. Both sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

Laboratory Requirements

Each analytical data package must contain adequate information and be presented in a clear and concise manner. The contents of each package must be equivalent to a CLP-like Level III data package. Minimum requirements include the following:

- Cover sheet, which identifies the laboratory generating the data and the project for which the data were generated and signed by the appropriate laboratory personnel
- Table of contents
- Case narrative, which summarizes samples, analyses, and discusses any issues that may affect data usability
- Analytical results
- Laboratory LODs and LOQs
- Sample management records
- CLP-like QC summary forms for the QC elements (including tuning, calibration, surrogates, LCS, MS/MSD, etc.)

Level IV data packages additionally will include:

- All supporting raw data for project, field, and lab QC samples (including chromatograms, quantitation reports, formulas, and example calculations and mass spectral data)

Each laboratory data package should represent a group of samples received, prepared, and analyzed together in an analytical batch, with associated laboratory quality control samples (i.e. a SDG). The complete data package for each SDG will be submitted electronically as a computer readable file (such as Adobe's portable document format [PDF]). In addition to the PDF, an EDD in Excel format will be submitted with each SDG. The EDD deliverables will be used for table generation for data validation purposes.

A schedule should be established so that laboratory data deliverables (including the PDF and EDD for each SDG) are provided in a timely manner to Bhate for data review, validation, assessment, and use. The data deliverables for each SDG will not be considered complete until the Project Chemist has evaluated them for completeness and compliance. Any deliverable found to be non-compliant will be returned to the laboratory for correction and re-submittal.

Laboratory Data Reporting Requirements

The case narrative of each analytical data package will include but is not be limited to the following:

- Table summarizing samples received, correlating field sample numbers, laboratory sample numbers, and laboratory tests completed
- Discussion of any and all issues that may affect data usability (such as temperature, preservation, sample containers, air bubbles, and multi-phases)
- Samples received but not analyzed and the reasons why
- Discussion of holding time exceedances for sample preparation and analyses
- Summary of any and all instances of outliers and corrective actions taken
- Identification of samples and analytes for which manual integration was necessary
- Discussion of all qualified data and definition of qualifying flags

The following requirements should also be met for the reporting:

- MDLs, LODs, LOQs and sample results should be reported with the appropriate number of significant figures for the measurement.

Samples will be analyzed undiluted if possible. Non-detects will be reported to the LODs. MDLs, LODs, and LOQs for minority chemicals in highly-contaminated samples may have to be adjusted because of dilutions.

Manual Integrations

Manual integrations are an integral part of the chromatographic analysis process and will be done only as a corrective action measure. Examples of instances where manual integration would be warranted include, but are not limited to, co-eluting compounds resulting in poor peak resolution, a misidentified peak, an incorrect retention time, or a problematic baseline.

When manual integrations are used, they must follow the procedures outlined in the laboratory's SOP for the method. Any and all instances of manual integration must be identified in the case narrative.

Laboratory Data Review Requirements

All definitive data will be reviewed first by the laboratory analyst and then by the laboratory supervisor of the respective analytical section using the same criteria before they are submitted to Bhate. This internal data review process, which is multi-tiered, should include all aspects of data generation, reduction, and QC assessment. Elements for review or verification at each level must include, but are not limited to, the following:

- Sample receipt procedures and conditions
- Sample preparation
- Appropriate laboratory SOPs and methodologies
- Accuracy and completeness of analytical results
- Correct interpretation of all raw data, including all manual integrations
- Appropriate application of QC samples and compliance with established control limits
- Verification of data transfers
- Documentation completeness
- Accuracy and completeness of data deliverables (hard copy and electronic)

Laboratory Data Evaluation

All definitive data will be reviewed, reduced, and validated by the laboratory following the procedures specified in the laboratory's SOPs for data reduction and validation.

Data qualifiers should be applied by the laboratory as part of their internal validation activities. The allowable data qualifiers for definitive data are Q, M, J, B, UJ, U, and 4. The definitions of the data qualifiers are provided on the table below. Flagging criteria apply when acceptance criteria are not met and corrective actions were not successful or not performed. The data qualifiers must be reviewed by the supervisor of the respective analytical sections.

The laboratory QA section should perform a 100 percent review of 10 percent of the completed data packages. The Project Chemist or designee will subsequently evaluate the flags applied by the laboratory as part of their data validation and usability assessment activities. The flags may be accepted, modified, or rejected. For all data qualifiers that are changed, clear justification will be provided. All Q-flagged data will be evaluated and either accepted without qualification, accepted with qualification, or rejected.

Table 21. Laboratory Data Qualifiers

Qualifier	Description
Q	This indicates that one or more QC criteria fail. Data must be carefully assessed by Bhate (or project team) with respect to the project-specific requirements and evaluated for usability. Subsequent assessment by DoD may result in rejection of data.

Qualifier	Description
M	Manually integrated compound
J	The analyte was positively identified; the quantitation is an estimation because of discrepancies in meeting certain analyte-specific QC criteria.
B	The analyte was found in an associated blank above one half the LOQ, as well as in the sample.
U	The analyte was analyzed for but not detected.
UJ	The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific QC criteria.
4	MS, MSD: The analyte present in the original sample is 4 times greater than the matrix spike concentration; therefore, control limits are not applicable.

Method Blank Evaluation Guidance

For method blanks, the source of contamination should be investigated and documented by the laboratory. The results of the investigation should be included in the case narrative. If all samples associated with method blank contamination are not reanalyzed, the results will be reported, by the Laboratory, with a B-flag, along with any other appropriate data qualifier. If an analyte is found only in the method blank, but not in any batch samples, no flagging is necessary. Sample results affected by the method blank contamination will be evaluated during data validation and the final result qualified accordingly.

Data Verification Guidelines

The Project Chemist will review the data verification performed by the laboratory for completeness and accuracy. Data verification may be done both electronically and manually (Project Chemist). Data verification may include but is not limited to the following:

- Sampling documentation (such as the chain-of-custody form);
- Preservation summary and holding times;
- Presence of all analyses and analytes requested;
- Use of required sample preparation and analysis procedures;
- LODs and LOQs;
- Correctness of concentration units; and
- Case narrative.

Data Validation Guidelines

Raw Data Review

The data validation process builds on data verification. Performing manual validation of the data, the Project Chemist will review and evaluate the samples results. The Project Chemist will also determine what, if any, flags need to be applied from assessing such QC as tuning verification, initial and continuing calibration, quantitation, multiple run samples, instrument performance, and sample preservation. The data validation qualifiers based on the manual data review will be incorporated into the final deliverables, discussed in the final data validation summary report, and incorporated into the final usability assessment.

Data validation guidelines have been developed in accordance with the method requirements, the USEPA's *National Functional Guidelines for Organic Data Review, National Functional Guidelines for Inorganic Superfund Data Review*, professional judgment and DoD Quality Systems Manual (Version 5.1) requirements. The following information will be reviewed as part of a Stage-III Data Validation:

- Chain-of-custody documentation
- Holding time
- QC sample frequencies
- Method blanks
- LCS
- Surrogate spikes
- MS/MSD
- Sample Results
- Field and laboratory duplicate precision
- Initial and continuing calibration information
- Internal standards
- Case narrative review and other method specific criteria
- Raw data, including chromatograms, necessary to recalculate sample results

Blank Evaluation Guidelines

The Project Chemist will evaluate laboratory B-qualified data such as method blanks, as well as other field blanks based on the concentration of the analyte in the samples in relation to the concentration in the blank. The B-flag may not be used if the analyte concentrations in the samples are much higher (≥ 5 times) than in the blank (≥ 10 times in case of common laboratory contaminants). Any blank contamination that may impact data usability must be discussed in conjunction with project-specific goals. When a data set contains low-level detects in field samples and has associated field or laboratory blanks that have detects at similar concentrations, this suggests that the low-level detects in these field samples may be artifacts because of either field or laboratory practices. A sample detect that is ≤ 5 times the blank concentration (≤ 10 times for common lab contaminants) may be considered a non-detect and flagged "UB".

Duplicate Evaluation Guidance

QC measures for precision include field duplicates, laboratory duplicates, MSDs, analytical replicates, and surrogates. These measures will be evaluated by the laboratory and qualified according to applicable procedures. These sample results can be used to assess field sampling precision, laboratory precision, and, potentially, the representativeness of the matrix sampled.

Flagging of results associated with field duplicates should be assigned such that the level of uncertainty required, as provided by the project-specific objectives, is taken into account.

Poor overall precision may be the result of one or more of the following: field instrument variation, analytical measurement variation, poor sampling technique, sample transport problems, or heterogeneous sample matrices. To identify the cause of imprecision, the project team should evaluate the field sampling design rationale and sampling techniques, and review both field and analytical duplicate sample results. If poor precision is indicated in both the field and analytical duplicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate results, then the sampling technique, field instrument variation, sample transport, and/or nature of the matrix may be the source of error.

Matrix Interference Evaluation Guidance

In the case of matrix interference, data validation qualifiers may be applied to additional samples from the same site and same matrix, based on the professional judgment of the data validator. In this case, it is the responsibility of the validator to document the reasons for the additional qualifiers.

Flagging Conventions

The allowable final data qualifiers for definitive data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are R, J, UJ, and UB. Their definitions are summarized in below.

Table 22. Usability Assessment Data Qualifiers

Qualifier	Description
R	The data are rejected because of deficiencies in meeting QC criteria and may not be used for decision making.
J	The analyte was positively identified; the quantitation is an estimation because of discrepancies in meeting certain analyte-specific quality control criteria.
UJ	The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific quality control criteria.
UB	The analyte was also detected in an associated laboratory or field blank at a concentration comparable to the concentration in the sample. The reported result has been re-qualified as not detected.

The following two tables present the specific guidelines for applying these data usability qualifiers.

Table 23. General Data Qualifying Conventions

QC Requirement	Criteria	Flag	Flag Applied To
Holding Time	Time exceeded for extraction or analysis	J for the positive results; R or UJ for non-detects*	All analytes in the sample
Sample Preservation	Water; not preserved >7 days Water; preserved >14 days Non aqueous; preserved or not	J positive results; R or UJ for non-detects* Use professional judgment	Sample
Temperature out of control	> 6°C	Professional judgment or if grossly outside; J for positive results; R or UJ for non-detects*	Sample
Sample Integrity (SW8260)	Bubbles in VOA vial > 1/4 inch used for analysis	J for the positive results; UJ for non-detects	Sample
Instrument Tuning	Ion abundance method-specific criteria not met	R for all results	All associated samples in analytical batch
Initial Calibration	All analytes must be within method-specified criteria	J for positive results; non-detects (use professional judgment)	All associated samples in analytical batch
Second Source Check or Continuing Calibration	All analytes must be within method-specified criteria	High Bias: J for positive results, no flag for non-detects Low Bias: J for positive results, UJ for non-detects	All associated samples in analytical batch
Low Level Calibration Check or ICS	All analytes must be within 20% of expected value	High Bias: J for positive results, no flag for non-detects Low Bias: J for positive results, UJ for non-detects	All associated samples in analytical batch
LCS	%R > Upper confidence limit (UCL) %R < Lower confidence limit (LCL)	J for the positive results; no qualification for the non-detects; J for the positive results; UJ for the non-detects	The specific analyte(s) in all samples in the associated analytical batch
Internal Standards	Area > UCL Area < LCL Sample is re-extracted and reanalyzed and recovery outside of criteria is confirmed as a matrix effect	J for positive results J for positive results; UJ for the non-detects	Sample

QC Requirement	Criteria	Flag	Flag Applied To
Surrogate Spikes	%R > UCL %R < LCL and >10% %R <10%	J for positive results J for positive results; UJ for non-detects J for positive results; R for non-detects	Sample
Blanks (Method, Equipment, Ambient, or Trip)	Analyte(s) detected > 1/2 LOQ (use the blank of the highest concentration)	UB for positive sample results < 5 times the highest blank concentration (<10 times for common lab contaminants)	All samples in preparation, field or analytical batch, whichever applies
Field duplicates or field replicates	RPD >30% water RPD >50% soil	J for the positive results	The specific analyte(s) in both parent and duplicate
MS/MSD	MS or MSD % R>UCL MS or MSD % R<LCL or MS/MSD RPD> Control limit (CL) Sample concentration > 4 times spike concentration	Cross reference with LCS. Possible J for positive results. Cross reference with LCS. Possible J for positive results. No flag required	The specific analyte(s) in the parent sample
Post-Digestion Spike (metals)	All analytes must be within 20% of expected value	High Bias: J for positive results Low Bias: J for positive results; UJ for non-detects	The specific analyte(s) in the parent sample
Serial Dilutions (metals)	All analytes must be within 10% of expected value	If Post Spike not analyzed High Bias: J for positive results Low Bias: J for positive results; UJ for non-detects	The specific analyte(s) in the parent sample
Retention Time Window	Analyte within established window	R for all results	Sample

* = Based on analyte-specific review

Table 24. Data Qualifying Conventions - Quantitation

Criteria	Flag
< MDL	U, UJ at the LOD
$\geq$ MDL < LOQ	J
$\geq$ LOQ	As needed
$\geq$ High standard/linear range	J

Examples:
MDL = 2, LOD = 4, LOQ = 15, sample is undiluted
Example #1: Analytical result: not detected; reported result: <4U
Example #2: Analytical result: 10; reported result: 10J
Sample #3: Analytical result: 15; reported result: 15

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WORKSHEET 37 – DATA USABILITY ASSESSMENT

The data usability assessment is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment is used to determine whether the project execution and resulting data meet the project DQOs. Both the sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

The following sections summarize the processes to determine whether the collected data are of the right type, quality, and quantity to support the environmental decision-making for the project, and describe how data quality issues will be addressed and how limitations of the use of the data will be handled.

Personnel Responsible for Participating in the Data Usability Assessment

- Marcia Olive, Project Chemist
- Scott Beesinger, Site Supervisor
- Kim Nemmers, PM

Summary of Usability Assessment Processes

Data gaps may result if:

- A sample is not collected
- A sample is not analyzed for the requested parameters
- The data are determined to be unusable.

If data gaps exist, the need for further investigation will be determined by the project leaders.

The Project Chemist and the laboratory QA Officer will confirm that the collected data meet the LODs, LOQs, and laboratory QC limits specified in this document. During the data validation assessment, non-conformances will be documented, and data will be qualified accordingly. The Project Chemist will determine whether the data are usable based on the requirements specified in this document.

All data as qualified during data validation are considered useable, with the exception of rejected data ("R" qualified data). Estimated results are considered usable.

Usability Summary Documentation

To ensure that quality data are continuously produced during analysis, and to enable the subsequent compliance review, systematic QC checks are incorporated into the sampling and analyses to show that procedures and test results remain reproducible and that the analytical method is without unacceptable bias. Systematic QC checks include the comparability of field and laboratory duplicates as well as the laboratory performance for each batch of samples. Discussion will cover PARCCS.

Precision

Total precision is the measurement of the variability associated with the entire sampling and analytical process. The required levels of precision for each method, matrix and analyte are provided in Worksheet 15 (Reference Limits and Evaluation). Laboratory precision is measured by the variability associated with duplicate (two) analyses. The field precision will be evaluated through the use of field duplicates, while the laboratory precision will be evaluated through the use of spike duplicates. For duplicate sample results, the precision is evaluated using the RPD.

If calculated from duplicate measurements:

$$\left(\frac{x_1 - x_2}{(x_1 + x_2)/2}\right) \times 100$$

Where:
X_1= larger of the two observed values
X_2 = smaller of the two observed values

Accuracy

Accuracy reflects the total error associated with a measurement. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits. The accuracy will be evaluated through the use of LCS, MS, and surrogates. In each case the accuracy will be determined by calculating the %R for each target analyte.

The formula for calculation of accuracy is included below as %R. Accuracy requirements are listed for each method, matrix, and analyte in Worksheet 15 (Reference Limits and Evaluation).

For measurements where matrix spikes are used:

(value of spiked sample – value of unspiked sampled)/value of added spike X 100

Representativeness

Representativeness is a qualitative term that is related to the sample collection procedures. Representativeness is determined by proper program design, with consideration of elements such as sampling locations. Samples that are improperly collected or preserved, or are analyzed beyond the method required holding time, would not provide data that represent the sampling site. In addition, if the laboratory subsampling criteria were not met (i.e., proper premixing and homogenizing), the resulting data would not be representative of the initial sample collected.

Comparability

Comparability is a qualitative indicator of the confidence with which one data set can be compared to another data set. The objective is to produce data with the greatest possible degree of comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, using standardized data collection forms and using standard and comprehensive reporting formats. In order to ensure that the data sets are comparable, the same method will be used for each sampling event.

Completeness

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples (for example, by site). Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an R-flag after data validation. The goal for completeness is 95 percent for aqueous samples.

Completeness is calculated as follows for all measurements:

$$\%C=100\ \% \times [A/T]$$

Where:

%C = percent completeness
A = number of individual analyte results deemed valid
T = total number of results

Sensitivity

Sensitivity is the ability of an analytical method or instrument to discriminate between measurement responses representing different concentrations. Sensitivity requirements include the establishment of various limits such as calibration requirements, instrument LODs and LOQs. The project QA/QC control on method requirements has been established to be compliant with the DoD Quality Systems Manual (Version 5.1). Project specific LOD and LOQs are established in Worksheet 15.

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ATTACHMENT 1
ANALYTICAL REFERENCE LIMITS – WORKSHEET 15

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Reference Limits and Evaluation – Volatiles

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Matrix: Aqueous **Analytical Group/Method: Volatiles/8260C** **Units: micrograms per liter (µg/L)**								
1,1,1,2-Tetrachloroethane	630-20-6	110	1	0.5	0.3	78	124	20
1,1,1-Trichloroethane	71-55-6	200**	1	0.5	0.2	74	131	20
1,1,2,2-Tetrachloroethane	79-34-5	14	1	0.5	0.5	71	121	20
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)	76-13-1	3,100,000	1	0.5	0.5	70	136	20
1,1,2-Trichloroethane	79-00-5	5**	1	0.5	0.3	80	119	20
1,1-Dichloroethane	75-34-3	10,000	1	0.5	0.2	77	125	20
1,1-Dichloroethene	75-35-4	7**	1	0.5	0.2	71	131	20
1,1-Dichloropropene	563-58-6	2.9	1	0.5	0.3	79	125	20
1,2,3-Trichlorobenzene	87-61-6	310	1	0.5	0.4	69	129	20
1,2,3-Trichloropropane	96-18-4	0.041	1	0.5	0.5	73	122	20
1,2,4-Trichlorobenzene	120-82-1	70**	1	0.5	0.5	69	130	20
1,2,4-Trimethylbenzene	95-63-6	5,100	1	0.5	0.3	76	124	20
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.2**	1	0.5	0.2	62	128	20
1,2-Dibromoethane (EDB)	106-93-4	0.05**	1	0.5	0.2	77	121	20
1,2-Dichlorobenzene	95-50-1	600**	1	0.5	0.5	80	119	20

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
1,2-Dichloroethane (EDC)	107-06-2	5**	1	0.5	0.2	73	128	20
1.2-Dichloropropane	78-87-5	5**	1	0.5	0.5	78	122	20
1,3,5-Trimethylbenzene	108-67-8	5,100	1	0.5	0.3	75	124	20
1,3-Dichlorobenzene	541-73-1	3,100	1	0.5	0.4	80	119	20
1,3-Dichloropropane	142-28-9	29	1	0.5	0.3	80	119	20
1,4-Dichlorobenzene	106-46-7	75**	1	0.5	0.4	79	118	20
2,2-Dichloropropane	594-20-7	42	1	0.5	0.2	60	139	20
2-Butanone (Methyl ethyl ketone)	78-93-3	61,000	2	1	0.5	56	143	20
2-Chlorotoluene (o-)	95-49-8	2,000	1	0.5	0.3	79	122	20
2-Hexanone (Methyl butyl ketone)	591-78-6	6,100	2	1	1	57	139	20
4-Chlorotoluene (p-)	106-34-4	2,000	1	0.5	0.4	78	122	20
4-Methyl-2-pentanone (Methyl isobutyl ketone)	108-10-1	8,200	2	1	0.7	67	130	20
Acetone (2-propanone)	67-64-1	92,000	2	1	0.4	39	160	20
Benzene	71-43-2	5**	1	0.5	0.2	79	120	20
Bromobenzene	108-86-1	2,000	1	0.5	0.4	80	120	20
Bromochloromethane	74-97-5	4,100	1	0.5	0.2	78	123	20
Bromodichloromethane (Dibromochloromethane)	75-27-4	4.6	1	0.5	0.2	79	125	20
Bromoform	75-25-2	36	1	0.5	0.4	66	130	20

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Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Bromomethane (methyl bromide)	74-83-9	140	1	0.5	0.4	53	141	20
Carbon Disulfide	75-15-0	10,000	2	1	0.6	64	133	20
Carbon Tetrachloride	56-23-5	5**	1	0.5	0.5	72	136	20
Chlorobenzene	108-90-7	100**	1	0.5	0.3	80	120	20
Chloroethane (ethyl chloride)	75-00-3	41,000	1	0.5	0.3	82	118	20
Chloroform	67-66-3	1,000	1	0.5	0.2	79	124	20
Chloromethane (methyl chloride)	74-87-3	220	1	0.5	0.2	50	139	20
cis-1,2-Dichloroethene	156-59-2	70**	1	0.5	0.2	78	123	20
cis-1,3-Dichloropropene	10061-01-5	5.3	1	0.5	0.1	75	124	20
Dibromochloromethane (Chlorodibromomethane)	124-48-1	34	1	0.5	0.3	74	126	20
Dibromomethane (methylene bromide)	74-95-3	380	1	0.5	0.2	79	123	20
Dichlorodifluoromethane (CFC-12)	75-71-8	20,000	1	0.5	0.3	32	152	20
Ethylbenzene	100-41-4	700**	1	0.5	0.3	79	121	20
Hexachlorobutadiene (HCBD)	87-68-3	20	1	0.5	1	66	134	20
Isopropylbenzene (Cumene)	98-82-8	10,000	1	0.5	0.3	72	131	20
m,p-Xylene	108-38-3 & 106-42-3	10,000**	2	1	0.5	80	121	20

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Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Methylene Chloride, or Dichloromethane	75-09-2	5**	2	0.5	0.4	74	124	20
Naphthalene	91-20-3	2,000	1	0.5	0.3	61	128	20
n-Butylbenzene	104-51-8	4,100	1	0.5	0.4	75	128	20
n-Propylbenzene	103-65-1	4,100	1	0.5	0.3	76	126	20
o-Xylene	95-47-6	10,000**	1	0.5	0.3	78	122	20
p-Isopropyltoluene	99-87-6	10,000	1	0.5	0.3	77	127	20
sec-Butylbenzene	135-98-8	4,100	1	0.5	0.3	77	126	20
Styrene	100-42-5	100**	1	0.5	0.3	78	128	20
tert-Butylbenzene	98-06-6	4,100	1	0.5	0.3	78	124	20
Tetrachloroethene (PCE: PERC)	127-18-4	5**	1	0.5	0.3	74	129	20
Toluene	108-88-3	1,000**	1	0.5	0.2	80	121	20
trans-1,2-Dichloroethene	156-60-5	100**	1	0.5	0.2	75	124	20
trans-1,3-Dichloropropene	10061-02-6	29	1	0.5	0.2	73	127	20
Trichloroethene (TCE)	79-01-6	5**	1	0.5	0.2	79	123	20
Trichlorofluoromethane (CFC-11)	75-69-4	31,000	1	0.5	0.3	65	141	20
Vinyl Chloride (VC)	75-01-4	2**	1	0.5	0.2	58	137	20
1,2-Dichloroethane-d4 (Surrogate)	17060-07-0	NA	NA	NA	NA	81	118	20
4-Bromofluorobenzene (Surrogate)	460-00-4	NA	NA	NA	NA	85	114	20

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Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Dibromofluoromethane (Surrogate)	1868-53-7	NA	NA	NA	NA	80	119	20
Toluene-d8 (Surrogate)	2037-26-5	NA	NA	NA	NA	89	112	20
Matrix: Solid **Analytical Group/Method: Volatiles/8260C** **Units: micrograms per kilogram (µg/kg)**								
1,1,1,2-Tetrachloroethane	630-20-6	11,000	5	1.25	0.6	78	125	20
1,1,1-Trichloroethane	71-55-6	20,000	5	1.25	0.5	73	130	20
1,1,2,2-Tetrachloroethane	79-34-5	1,400	5	1.25	0.8	70	124	20
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)	76-13-1	310,000,000	5	1.25	0.7	66	136	20
1,1,2-Trichloroethane	79-00-5	500	5	1.25	0.5	78	121	20
1,1-Dichloroethane	75-34-3	1,000,000	5	1.25	0.5	76	125	20
1,1-Dichloroethene	75-35-4	700	5	1.25	0.5	70	131	20
1,1-Dichloropropene	563-58-6	290	5	1.25	0.5	76	125	20
1,2,3-Trichlorobenzene	87-61-6	31,000	5	1.25	1	66	130	20
1,2,3-Trichloropropane	96-18-4	4.1	5	1.25	0.8	73	125	20
1,2,4-Trichlorobenzene	120-82-1	7,000	5	1.25	1	67	129	20
1,2,4-Trimethylbenzene	95-63-6	510,000	5	1.25	1	75	123	20
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	20	5	1.25	1	61	132	20
1,2-Dibromoethane (EDB)	106-93-4	5	5	1.25	0.5	78	122	20

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Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
1,2-Dichlorobenzene	95-50-1	60,000	5	1.25	1	78	121	20
1,2-Dichloroethane (EDC)	107-06-2	500	5	1.25	0.6	73	128	20
1.2-Dichloropropane	78-87-5	500	5	1.25	0.8	76	123	20
1,3,5-Trimethylbenzene	108-67-8	510,000	5	1.25	1	73	124	20
1,3-Dichlorobenzene	541-73-1	310,000	5	1.25	1	77	121	20
1,3-Dichloropropane	142-28-9	2,900	5	1.25	0.5	77	121	20
1,4-Dichlorobenzene	106-46-7	7,500	5	1.25	1	75	120	20
2,2-Dichloropropane	594-20-7	4,200	5	1.25	0.8	67	133	20
2-Butanone (Methyl ethyl ketone)	78-93-3	6,100,000	10	2.5	1.3	51	148	20
2-Chlorotoluene (o-)	95-49-8	200,000	5	1.3	0.9	75	122	20
2-Hexanone (Methyl butyl ketone)	591-78-6	610,000	10	2.5	1.4	53	145	20
4-Chlorotoluene (p-)	106-34-4	200,000	5	1.3	1	72	124	20
4-Methyl-2-pentanone (Methyl isobutyl ketone)	108-10-1	820,000	10	2.5	2	65	135	20
Acetone (2-propanone)	67-64-1	9,200,000	10	2.5	2	36	164	20
Benzene	71-43-2	500	5	1.25	0.5	77	121	20
Bromobenzene	108-86-1	200,000	5	1.25	0.9	78	121	20
Bromochloromethane	74-97-5	410,000	5	1.25	0.9	78	125	20
Bromodichloromethane (Dibromochloromethane)	75-27-4	460	5	1.25	0.5	75	127	20

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Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Bromoform	75-25-2	3,600	5	1.25	0.6	67	132	20
Bromomethane (methyl bromide)	74-83-9	14,000	10	2.5	1	53	143	20
Carbon Disulfide	75-15-0	1,000,000	10	2.5	1	63	132	20
Carbon Tetrachloride	56-23-5	500	5	1.25	0.6	70	135	20
Chlorobenzene	108-90-7	10,000	5	1.25	0.6	79	120	20
Chloroethane (ethyl chloride)	75-00-3	4,100,000	10	1.25	0.8	59	139	20
Chloroform	67-66-3	100,000	5	1.25	0.5	78	123	20
Chloromethane (methyl chloride)	74-87-3	22,000	10	2.5	0.5	50	136	20
cis-1,2-Dichloroethene	156-59-2	7,000	5	1.25	0.8	77	123	20
cis-1,3-Dichloropropene	10061-01-5	530	5	1.25	0.5	74	126	20
Dibromochloromethane (Chlorodibromomethane)	124-48-1	3,400	5	1.25	0.5	74	126	20
Dibromomethane (methylene bromide)	74-95-3	38,000	5	1.25	0.9	78	125	20
Dichlorodifluoromethane (CFC-12)	75-71-8	2,000,000	5	1.25	0.7	29	149	20
Ethylbenzene	100-41-4	70,000	5	1.25	0.7	72	126	20
Hexachlorobutadiene (HCBD)	87-68-3	2,000	5	1.25	1	61	135	20
Isopropylbenzene (Cumene)	98-82-8	1,000,000	5	1.25	0.9	68	134	20
m,p-Xylene	108-38-31 & 106-42-3	1,000,000	10	2.5	1.6	77	124	20

Notes:
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Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Methylene Chloride, or Dichloromethane	75-09-2	500	10	2.5	1	70	126	20
Naphthalene	91-20-3	200,000	5	1.25	0.8	62	129	20
n-Butylbenzene	104-51-8	410,000	5	1.25	0.6	70	128	20
n-Propylbenzene	103-65-1	410,000	5	1.25	0.9	73	125	20
o-Xylene	95-47-6	1,000,000	5	1.25	1	77	123	20
p-Isopropyltoluene	99-87-6	1,000,000	5	1.25	1	73	127	20
sec-Butylbenzene	135-98-8	410,000	5	1.25	1	73	126	20
Styrene	100-42-5	10,000	5	1.25	0.7	76	124	20
tert-Butylbenzene	98-06-6	410,000	5	1.25	1	73	125	20
Tetrachloroethene (PCE: PERC)	127-18-4	500	5	1.25	0.7	73	128	20
Toluene	108-88-3	100,000	5	1.25	0.6	77	121	20
trans-1,2-Dichloroethene	156-60-5	10,000	5	1.25	0.5	74	125	20
trans-1,3-Dichloropropene	10061-02-6	2,900	5	1.25	0.6	71	130	20
Trichloroethene (TCE)	79-01-6	500	5	1.25	0.6	77	123	20
Trichlorofluoromethane (CFC-11)	75-69-4	3,100,000	5	1.25	0.5	62	140	20
Vinyl Chloride (VC)	75-01-4	200	2	1.25	0.8	56	135	20
1,2-Dichloroethane-d4 (Surrogate)	17060-07-0	NA	NA	NA	NA	71	136	20
4-Bromofluorobenzene (Surrogate)	460-00-4	NA	NA	NA	NA	79	119	20

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Dibromofluoromethane (Surrogate)	1868-53-7	NA	NA	NA	NA	78	119	20
Toluene-d8 (Surrogate)	2037-26-5	NA	NA	NA	NA	85	116	20

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Reference Limits and Evaluation – Metals

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Matrix: Aqueous Analytical Group/Method: Total and Dissolved Metals/6020A/7470A Units: milligrams per liter (mg/L)								
Aluminum	7429-90-5	100	0.01	0.005	0.0018	84	117	20
Antimony	7440-36-0	0.006**	0.002	0.001	0.0004	85	117	20
Arsenic	7440-38-2	0.01**	0.002	0.001	0.0004	84	116	20
Barium	7440-39-3	2.0**	0.004	0.0025	0.0019	86	114	20
Beryllium	7440-41-7	0.004**	0.002	0.001	0.0002	83	121	20
Cadmium	7440-43-9	0.005**	0.002	0.001	0.0002	87	115	20
Calcium	7440-70-2	NA	0.5	0.1	0.034	87	118	20
Chromium, total	7440-47-3	0.1**	0.004	0.001	0.0004	85	116	20
Cobalt	7440-48-4	6.1	0.005	0.001	0.0001	86	115	20
Copper	7440-50-8	1.3**	0.002	0.002	0.001	85	118	20
Iron	7439-89-6	NA	0.2	0.1	0.012	87	118	20
Lead	7439-92-1	0.015**	0.002	0.001	0.0006	88	115	20
Magnesium	7439-95-4	NA	0.2	0.1	0.01	83	118	20
Manganese	7439-96-5	1.1***	0.005	0.001	0.0007	87	115	20
Nickel	7440-02-0	0.49***	0.002	0.001	0.0006	85	117	20
Potassium	7440-09-7	NA	0.2	0.1	0.018	87	115	20

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Selenium	7782-49-2	0.05**	0.002	0.001	0.0011	80	120	20
Silver	7440-22-4	0.51	0.002	0.001	0.0002	85	116	20
Sodium	7440-23-5	NA	0.2	0.1	0.014	85	117	20
Thallium	7440-28-0	0.002**	0.002	0.001	0.0002	82	116	20
Vanadium	7440-62-2	0.72	0.005	0.001	0.0006	86	115	20
Zinc	7440-66-6	31	0.004	0.0025	0.002	83	119	20
Mercury	7439-97-6	0.002**	0.0002	0.000115	0.00003	82	119	20
Matrix: Solid Analytical Group/Method: Metals/6020A/7471B Units: milligrams per kilogram (mg/kg)								
Aluminum	7429-90-5	10,000	1	0.4	0.2	78	124	20
Antimony	7440-36-0	0.6	0.5	0.25	0.2	72	124	20
Arsenic	7440-38-2	1	0.5	0.2	0.1	82	118	20
Barium	7440-39-3	200	0.5	0.1	0.08	86	116	20
Beryllium	7440-41-7	0.4	0.5	0.1	0.05	80	120	20
Cadmium	7440-43-9	0.5	0.5	0.1	0.05	84	116	20
Calcium	7440-70-2	NA	50	20	10	86	118	20
Chromium, total	7440-47-3	10	0.5	0.2	0.09	83	119	20
Cobalt	7440-48-4	610	0.5	0.1	0.07	84	115	20
Copper	7440-50-8	130	0.2	0.2	0.1	84	119	20

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Iron	7439-89-6	NA	50	20	10	81	124	20
Lead	7439-92-1	1.5	0.5	0.2	0.05	84	118	20
Magnesium	7439-95-4	NA	50	20	10	80	123	20
Manganese	7439-96-5	1,400	0.5	0.2	0.1	85	116	20
Nickel	7440-02-0	200	0.5	0.1	0.09	84	119	20
Potassium	7440-09-7	NA	50	20	13	85	119	20
Selenium	7782-49-2	5	0.5	0.2	0.18	80	119	20
Silver	7440-22-4	51	0.5	0.1	0.08	83	118	20
Sodium	7440-23-5	NA	50	20	11	79	125	20
Thallium	7440-28-0	0.2	0.5	0.1	0.07	83	118	20
Vanadium	7440-62-2	72	0.5	0.2	0.23	82	116	20
Zinc	7440-66-6	3,100	0.5	0.25	0.25	82	119	20
Mercury	7439-97-6	0.2	0.00333	0.0013	0.00047	80	124	20

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Reference Limits and Evaluation – Perchlorate, Explosives, Anions, Hexavalent Chromium, 1,4-Dioxane and Total Organic Carbon

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Matrix: Aqueous Analytical Group/Method: Perchlorate/6850 Units: µg/L								
Perchlorate	14797-73-0	17***	2	1	1	78.8	124	20
Matrix: Solid Analytical Group/Method: Perchlorate/6850 Units: µg/kg								
Perchlorate	14797-73-0	7,200	20	10	5	80	120	15
Matrix: Aqueous Analytical Group/Method: Explosives/8330A Units: µg/L								
2,4,6-Trinitrotoluene	118-96-7	51	0.078	0.039	0.023	71	123	30
2,4-Dinitrotoluene	121-14-2	0.42	0.078	0.039	0.011	78	120	30
2,6-Dinitrotoluene	606-20-2	0.42	0.078	0.039	0.02	77	127	30
2-Amino-4,6-dinitrotoluene	35572-78-2	17	0.078	0.039	0.01	79	120	30
4-Amino-2,6-dinitrotoluene	19406-51-0	17	0.078	0.039	0.015	76	125	30

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Matrix: Solid Analytical Group/Method: Explosives/8330A Units: µg/kg								
2,4,6-Trinitrotoluene	118-96-7	5.1	0.06	0.025	0.00496	75	125	30
2,4-Dinitrotoluene	121-14-2	42	0.06	0.025	0.00444	82	123	30
2,6-Dinitrotoluene	606-20-2	42	0.06	0.025	0.0108	86	119	30
2-Amino-4,6-dinitrotoluene	35572-78-2	1.7	0.06	0.025	0.0093	87	121	30
4-Amino-2,6-dinitrotoluene	19406-51-0	1.7	0.06	0.025	0.00976	84	124	30
Matrix: Aqueous Analytical Group/Method: Anions/9056A Units: mg/L								
Chloride	16887-00-6	NA	0.5	0.25	0.2	80	120	20
Nitrate as N	14797-55-8	10**	0.1	0.05	0.03	80	120	20
Nitrite as N	14797-65-0	1**	0.1	0.05	0.03	80	120	20
Sulfate as SO_4	14808-79-8	NA	0.5	0.25	0.2	80	120	20
Matrix: Solid Analytical Group/Method: Anions/9056A Units: mg/kg								
Chloride	16887-00-6	NA	5	2.5	2	80	120	20

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Nitrate as N	14797-55-8	1,000	1	0.5	0.3	80	120	20
Nitrite as N	14797-65-0	100	1	0.5	0.3	80	120	20
Sulfate as SO_4	14808-79-8	NA	5	2.5	2	80	120	20
Matrix: Aqueous **Analytical Group/Method: Hexavalent Chromium/SW7196A** **Units: mg/L**								
Hexavalent Chromium	18540-29-9	0.1	0.01	0.01	0.006	80	120	20
Matrix: Solid **Analytical Group/Method: Hexavalent Chromium/SW7196A** **Units: mg/kg**								
Hexavalent Chromium	18540-29-9	10	2	1	0.3	80	120	20
Matrix: Aqueous **Analytical Group/Method: 1,4-Dioxane/8270D SIM** **Units: µg/L**								
1,4-Dioxane	123-91-1	26	0.01	0.01	0.01	40	140	20
2-Fluorobiphenyl (surrogate)	321-60-8	NA	NA	NA	NA	40	140	20
4-Terphenyl-d14 (surrogate)	1718-51-0	NA	NA	NA	NA	40	140	20
Nitrobenzene-d5 (surrogate)	4165-60-0	NA	NA	NA	NA	40	140	20

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Analyte	CAS Number	TCEQ GW-Ind (aq)/GWP - Ind (s) MSC (except as noted)	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Matrix: Solid **Analytical Group/Method: 1,4-Dioxane/8270D SIM** **Units: µg/kg**								
1,4-Dioxane	123-91-1	2,600	0.33	0.33	0.33	40	140	20
2-Fluorobiphenyl (surrogate)	321-60-8	NA	NA	NA	NA	44	115	20
4-Terphenyl-d14 (surrogate)	1718-51-0	NA	NA	NA	NA	54	127	20
Nitrobenzene-d5 (surrogate)	4165-60-0	NA	NA	NA	NA	37	122	20
Matrix: Aqueous **Analytical Group/Method: Total Organic Carbon/SW9060A** **Units: mg/L**								
Total Organic Carbon	NA	NA	1	0.5	0.5	80	120	20
Matrix: Solid **Analytical Group/Method: TOC/SW9060A** **Units: mg/kg**								
Total Organic Carbon	NA	NA	600	600	600	80	120	30

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Reference Limits and Evaluation – MNA

Analyte	CAS Number	TCEQ GW-Ind (aq) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD (%)
Matrix: Aqueous Analytical Group/Method: Various Units: mg/L								
Ammonia as N (SM4500-NH3)	7664-41-7	NA	0.05	0.025	0.025	80	120	20
Phosphorus, as P (SM4500-P)	7723-14-0	NA	0.05	0.025	0.02	80	120	20
Ortho-phosphate (SM4500-P)	14265-44-2	NA	0.05	0.025	0.02	80	120	20
Alkalinity, Total (SM2320B)	471-34-1	NA	5	5	5	80	120	20
Oil and Grease (1664A)	NA	NA	2	1	0.61	78	114	18
Chemical Oxygen Demand (410.4)	NA	NA	15	7.5	5	85	115	20
Sulfide (SM4500-S2F)	112597-04-5	NA	1	1	1	80	120	20
Ferrous Iron (SM3500Fe-B)	NA	NA	0.05	0.25	0.02	80	120	20
Matrix: Aqueous Analytical Group/Method: Dissolved Gases/RSK-175 Units: µg/L								
Methane	74-82-8	NA	1.3	0.63	0.30	75	125	30
Ethene	74-85-1	NA	1.0	0.22	0.071	75	125	30

Notes:
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**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Analyte	CAS Number	TCEQ GW-Ind (aq) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD (%)
Ethane	74-84-0	NA	0.60	0.24	0.076	75	125	30
Carbon dioxide	124-38-9	NA	1,000	760	370	75	125	30
Matrix: Aqueous Analytical Group/Method: Volatile Fatty Acids/HPLC-METACIDS Units: µg/L								
Acetic Acid	64-19-7	NA	4	2	1	70	130	30
Butyric Acid	107-92-6	NA	2	1	0.32	70	130	30
Lactic Acid	79-33-4	NA	2	1	0.14	70	130	30
Propionic Acid	79-09-4	51,000	2	1	0.19	70	130	30
Pyruvic Acid	127-17-3	NA	0.2	0.1	0.016	70	130	30

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Reference Limits and Evaluation – Air Samples

Analyte	CAS Number	TCEQ Short-Term Health Effects Screening Level (Nov 2016)	LOQ	LOD	MDL
Matrix: Air **Analytical Group: Volatiles** **Method: TO-15** **Units: micrograms per cubic meter (µg/m³)**					
1,1-Dichloroethane	75-34-3	4,000	0.50	0.42	0.16
1,1-Dichloroethene	75-35-4	210	0.50	0.42	0.17
1,2-Dichloroethane	107-06-2	650	0.50	0.42	0.16
1,3-Dichlorobenzene	541-73-1	900	0.50	0.42	0.15
Acetone	67-64-1	7,800	5.0	2.1	0.77
alpha-Pinene	80-56-8	3,500	0.50	0.42	0.14
Benzene	71-43-2	170	0.50	0.44	0.16
Carbon Disulfide	75-15-0	7,500	5.0	0.39	0.15
Chloroform	67-66-3	100	0.50	0.42	0.17
cis-1,2-Dichloroethene	156-59-2	7,900	0.50	0.43	0.16
Dichloroditluoromethane (CFC 12)	75-71-8	50,000	0.50	0.40	0.17
d-Limonene	5989-27-5	1,100	0.50	0.42	0.14
Ethanol	64-17-5	18,800	5.0	2.0	0.80
Ethylbenzene	100-41-4	26,000	0.50	0.43	0.16
m,p-Xylenes	179601-23-1	2,200	1.0	0.84	0.30

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Analyte	CAS Number	TCEQ Short-Term Health Effects Screening Level (Nov 2016)	LOQ	LOD	MDL
Methylene Chloride	75-09-2	3,600	0.50	0.40	0.17
n-Hexane	110-54-3	6,200	0.50	0.41	0.15
o-Xvlene	95-47-6	2,200	0.50	0.41	0.15
Propene	115-07-1	NA	0.50	0.39	0.14
Styrene	100-42-5	110	0.50	0.44	0.15
Tetrachloroethene	127-18-4	2,000	0.50	0.39	0.14
Toluene	108-88-3	4,500	0.50	0.42	0.17
trans-1,2-Dichloroethene	156-60-5	7,900	0.50	0.42	0.19
Trichloroethene	79-01-6	540	0.50	0.42	0.14
Trichlorofluoromethane	75-69-4	56,000	0.50	0.40	0.17
Trichlorotrifluoroethane	76-13-1	38,000	0.50	0.43	0.17
Vinyl Chloride	75-01-4	20,000	0.50	0.41	0.17

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Reference Limits and Evaluation – Biological Samples

Analyte	CAS Number	TCEQ GW-Ind (aq) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD (%)
Matrix: Aqueous Analytical Group/Method: Dehalococcoides Ethogenes/qPCR Units: Cells/sample								
Dehalococcoides ethogenes	NA	NA	100 cells/sample	100 cells/sample	500 cells/sample	NA	NA	NA
Dehalobactor	NA	NA	100 cells/sample	100 cells/sample	5000 cells/sample	NA	NA	NA

Notes:
*Screening Standard Ecological Preliminary Remediation Goals - From Baseline Ecological Risk Assessment Table 16-1 (Shaw, November 2007)
**Maximum Contaminant Level (MCL)
***TRRP Tier 1 Groundwater Residential Protective Concentration Level (PCL)
CAS - Chemical Abstract Service; MDL – Method Detection limit; LOQ – Limit of Quantitation; LOD – Limit of Detection; TCEQ – Texas Commission on Environmental Quality; GWP-Ind (s) – Groundwater Protection Industrial (solid); GW-Ind (aq) – Groundwater Industrial (aqueous); MSC – Medium-Specific Concentration; % - percent; RPD – relative percent difference; NA – not applicable

Reference Limits and Evaluation – Semi-Volatile Organic Compounds, Pesticides, PCBs, and Dioxins

Analyte	CAS Number	TCEQ GWP - Ind (s) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Matrix: Solid Analytical Group/Method: Semi-volatiles/8270D LL Units: µg/kg								
1,1-Biphenyl	92-52-4	510,000	6.6	3.3	1.7	40	117	20
1,2,4,5-Tetrachlorobenzene	95-94-3	3,100	6.6	3.3	1	55	120	20
1,2,4-Trichlorobenzene	120-82-1	7,000	6.6	3.3	1.2	34	118	20
1,2-Dichlorobenzene	95-50-1	60,000	6.6	3.3	0.6	33	117	20
1,2-Diphenylhydrazine	122-66-7	36	6.6	3.3	1.1	41	125	20
1,3-Dichlorobenzene	541-73-1	310,000	6.6	3.3	0.6	30	115	20
1,3-Dinitrobenzene	99-65-0	1,000	6.6	3.3	2.6	55	120	20
1,4-Dioxane	123-91-1	2,600	6.6	3.3	2.2	40	140	20
1,4-Naphthoquinone	130-15-4	72,000	6.6	3.3	1.5	55	120	20
2,4,5-Trichlorophenol	95-95-4	1,000,000	6.6	3.3	2.4	41	124	20
2,4,6-Trichlorophenol	88-06-2	2,600	6.6	3.3	1.7	39	126	20
2,4-Dichlorophenol	120-83-2	31,000	6.6	3.3	1.3	40	122	20
2,4-Dimethylphenol	105-67-9	200,000	6.6	3.3	3.3	30	127	20
2,4-Dinitrophenol	51-28-5	20,000	13.2	6.6	4.5	40	125	20
2,4-Dinitrotoluene	121-14-2	42	6.6	3.3	0.9	48	126	20
2,6-Dichlorophenol	87-65-0	10,000	6.6	3.3	1.8	41	117	20
2,6-Dinitrotoluene	606-20-2	42	6.6	3.3	3.3	46	124	20

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Analyte	CAS Number	TCEQ GWP - Ind (s) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
2-Chloronaphthalene	91-58-7	820,000	6.6	3.3	1.3	41	114	20
2-Chlorophenol	95-57-8	51,000	6.6	3.3	1.2	34	121	20
2-Methylnaphthalene	91-57-6	41,000	3.3	3.3	0.5	38	122	20
Cresol, o- (2-methylphenol)	95-48-7	510,000	6.6	3.3	0.9	32	122	20
2-Nitroaniline	88-74-4	3,100	6.6	3.3	1.9	44	127	20
2-Nitrophenol	88-75-5	20,000	6.6	3.3	2.5	36	123	20
Cresol, m- (3-methylphenol)	108-39-4	510,000	6.6	3.3	1	34	119	20
Cresol, p- (4-methylphenol)	106-44-5	510,000	6.6	3.3	1	34	119	20
3,3´-Dichlorobenzidine	91-94-1	64	6.6	3.3	2.5	22	121	20
3-Nitroaniline	99-09-2	3,100	6.6	3.3	1.9	33	119	20
4,6-Dinitro-2-methylphenol	534-52-1	20,000	6.6	3.3	2.1	29	132	20
4-Bromophenyl phenyl ether	101-55-3	19	6.6	3.3	1.6	46	124	20
4-Chloro-3-methylphenol	59-50-7	51,000	6.6	3.3	0.7	45	122	20
4-Chloroaniline	106-47-8	41,000	6.6	3.3	1.1	17	106	20
4-Chlorophenyl phenyl ether	7005-72-3	19	6.6	3.3	1.5	45	121	20
4-Nitroaniline	100-01-6	7,500	6.6	3.3	2.5	55	120	20
4-Nitrophenol	100-02-7	20,000	13.2	3.3	1.9	30	132	20
Acenaphthene	83-32-9	NA	3.3	1.67	0.5	40	123	20
Acenaphthylene	208-96-8	610,000	3.3	1.67	1	32	132	20
Acetophenone	98-86-2	1,000,000	6.6	3.3	0.8	33	115	20

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Analyte	CAS Number	TCEQ GWP - Ind (s) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Anthracene	120-12-7	3,100,000	3.3	1.67	0.5	47	123	20
Atrazine	1912-24-9	300	6.6	3.3	2	47	127	20
Benzo(a)anthracene	56-55-3	39	3.3	1.67	1.6	49	126	20
Benzaldehyde	100-52-7	1,000,000	6.6	3.3	1.2	20	132	20
Benzidine	92-87-5	0.12	6.6	3.3	1.4	10	120	20
Benzo(a)pyrene	50-32-8	20	3.3	1.67	1	45	129	20
Benzo(b)fluoranthene	205-99-2	39	3.3	1.67	1.2	45	132	20
Benzo(g,h,i)perylene	191-24-2	310,000	3.3	1.67	0.7	43	134	20
Benzo(k)fluoranthene	207-08-9	390	3.3	1.67	0.9	47	132	20
Benzoic acid	65-85-0	41,000,000	6.6	3.3	0.7	10	120	20
Benzyl alcohol	100-51-6	3,100,000	6.6	3.3	0.7	29	122	20
Bis(2-chloroethoxy)methane	111-91-1	26	6.6	3.3	0.9	36	121	20
Bis(2-chloroethyl)ether	111-44-4	26	6.6	3.3	1.1	31	120	20
Bis(2-chloroisopropyl)ether	108-60-1	4,100	6.6	3.3	1.4	33	131	20
Bis(2-ethylhexyl)phthalate	117-81-7	600	6.6	3.3	1.7	51	133	20
Butyl benzyl phthalate	85-68-7	2,000,000	6.6	3.3	1.1	48	132	20
Caprolactam	105-60-2	5,100,000	6.6	3.3	1.2	46	117	20
Carbazole	86-74-8	1,400	6.6	3.3	1.2	50	123	20
Chrysene	218-01-9	3,900	3.3	1.67	0.8	50	124	20
Di-n-butyl phthalate	84-74-2	1,000,000	6.6	3.3	1.2	51	128	20

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Analyte	CAS Number	TCEQ GWP - Ind (s) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Di-n-octyl phthalate	117-84-0	200,000	6.6	3.3	0.8	45	140	20
Dibenz(a,h)anthracene	53-70-3	20	3.3	1.67	1.6	45	134	20
Dibenzofuran	132-64-9	41,000	3.3	1.67	0.2	44	120	20
Diethyl phthalate	84-66-2	8,200,000	6.6	3.3	1	50	124	20
Dimethyl phthalate	131-11-3	8,200,000	6.6	3.3	0.8	48	124	20
Fluoranthene	206-44-0	410,000	3.3	1.67	1.1	50	127	20
Fluorene	86-73-7	410,000	3.3	1.67	1.1	43	125	20
Hexachlorobenzene	118-74-1	100	6.6	3.3	0.9	45	122	20
Hexachlorobutadiene	87-68-3	2,000	6.6	3.3	1.2	32	123	20
Hexachlorocyclopentadiene (HCCPD)	77-47-4	5,000	6.6	3.3	0.7	50	120	20
Hexachloroethane	67-72-1	10,000	6.6	3.3	1.5	28	117	20
Indeno(1,2,3-cd)pyrene	193-39-5	39	3.3	1.67	0.8	45	133	20
Isophorone	78-59-1	300,000	6.6	3.3	0.3	30	122	20
N-Nitrosodi-n-propylamine	621-64-7	4.1	6.6	3.3	1.1	36	120	20
N-Nitrosodiethylamine	55-18-5	0.19	6.6	3.3	1.1	50	130	20
N-Nitrosodiphenylamine	86-30-6	5,800	6.6	3.3	0.7	38	127	20
Naphthalene	91-20-3	200,000	3.3	1.67	0.6	35	123	20
Nitrobenzene	98-95-3	5,100	6.6	3.3	0.9	34	122	20
Pentachlorophenol	87-86-5	100	6.6	3.3	3.3	25	133	20
Phenanthrene	85-01-8	310,000	3.3	1.67	1.5	50	121	20

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Analyte	CAS Number	TCEQ GWP - Ind (s) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Phenol	108-95-2	3,100,000	6.6	3.3	1.1	34	121	20
Pyrene	129-00-0	310,000	3.3	1.67	0.6	47	127	20
Pyridine	110-86-1	10,000	6.6	3.3	0.9	30	120	20
2,4,6-Tribromophenol (Surr)	118-79-6	NA	NA	NA	NA	39	132	20
2-Fluorobiphenyl (Surr)	321-60-8	NA	NA	NA	NA	44	115	20
2-Fluorophenol (Surr)	367-12-4	NA	NA	NA	NA	38	122	20
4-Terphenyl-d14 (Surr)	1718-51-0	NA	NA	NA	NA	54	127	20
Nitrobenzene-d5 (Surr)	4165-60-0	NA	NA	NA	NA	37	122	20
Phenol-d6 (Surr)	4165-62-2	NA	NA	NA	NA	33	122	20
Matrix: Solid Analytical Group/Method: Pesticides/8081B Units: μg/kg								
4,4´-DDD	72-54-8	120	3.3	0.833	0.5	56	139	30
4,4´-DDE	72-55-9	84	3.3	0.833	0.5	56	134	30
4,4´-DDT	50-29-3	84	3.3	0.833	0.5	50	141	30
Aldrin	309-00-2	1.7	1.67	0.417	0.3	45	136	30
Hexachlorocyclohexane, alpha (alpha-BHC)	319-84-6	4.5	1.67	0.417	0.3	45	137	30
Chlordane, cis- (alpha chlordane)	5103-71-9	82	1.67	0.417	0.2	54	133	30
Hexachlorocyclohexane, beta (beta-BHC)	319-85-7	160	1.67	0.417	0.3	50	136	30
Chlordane (technical)	12789-03-6	200	16.7	8.33	2	43	149	30

Notes:
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Analyte	CAS Number	TCEQ GWP - Ind (s) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Hexachlorocyclohexane, delta (delta-BHC)	319-86-8	16	1.67	0.417	0.2	47	139	30
Dieldrin	60-57-1	1.8	3.3	0.833	0.5	56	136	30
Endosulfan I	959-98-8	20,000	1.67	0.417	0.3	53	132	30
Endosulfan II	33213-65-9	61,000	3.3	0.833	0.6	53	134	30
Endosulfan sulfate	1031-07-8	61,000	3.3	0.833	0.6	55	136	30
Endrin	72-20-8	200	3.3	0.833	0.6	57	140	30
Endrin aldehyde	7421-93-4	3,100	3.3	0.833	0.6	35	137	30
Endrin ketone	53494-70-5	3,100	3.3	0.833	0.6	55	136	30
Hexachlorocyclohexane, gamma (lindane; gamma-BHC)	58-89-9	20	1.67	0.417	0.2	49	135	30
gamma-Chlordane	57-74-9	82	1.67	0.417	0.2	53	135	30
Heptachlor	76-44-8	40	1.67	0.417	0.3	47	136	30
Heptachlor epoxide	1024-57-3	20	1.67	0.417	0.3	52	136	30
Methoxychlor	72-43-5	4,000	16.7	8.33	3.4	52	143	30
Toxaphene	8001-35-2	300	16.7	8.33	4.8	33	141	30
Decachlorobiphenyl (Surr)	2051-24-3	NA	NA	NA	NA	59	144	30
Tetrachloro-m-xylene (Surr)	877-09-8	NA	NA	NA	NA	42	129	30
Matrix: Solid **Analytical Group/Method: Polychlorinated Biphenyls/8082A** **Units: µg/kg**								
Aroclor 1016	12674-11-2	NA	16.7	8.33	4.2	47	134	30

Notes:
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Analyte	CAS Number	TCEQ GWP - Ind (s) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
Aroclor 1221	11104-28-2	NA	16.7	8.33	5.6	0	0	0
Aroclor 1232	11141-16-5	NA	16.7	8.33	4.5	0	0	0
Aroclor 1242	53469-21-9	NA	16.7	8.33	5.9	0	0	0
Aroclor 1248	12672-29-6	NA	16.7	8.33	5.9	0	0	0
Aroclor 1254	11097-69-1	NA	16.7	8.33	4.7	0	0	0
Aroclor 1260	11096-82-5	NA	16.7	8.33	4	53	140	30
PCBs (Total)	1336-36-3	50	16.7	8.33	4	0	0	0
Decachlorobiphenyl (Surr)	2051-24-3	NA	NA	NA	NA	54	143	30
Tetrachloro-m-xylene (Surr)	877-09-8	NA	NA	NA	NA	44	130	30
Matrix: Solid Analytical Group/Method: Dioxins/8290A Units: mg/kg								
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	NA	0.5	0.3	0.3	67	158	50
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	NA	2.5	1.5	1.5	70	142	50
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	39227-28-6	NA	2.5	1.5	1.5	70	164	50
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	57653-85-7	NA	2.5	1.5	1.5	76	134	50
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	19408-74-3	NA	2.5	1.5	1.5	64	162	50

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Analyte	CAS Number	TCEQ GWP - Ind (s) MSC	LOQ	LOD	MDL	Lower Control Limit (%)	Upper Control Limit (%)	Precision Control Limit RPD
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-46-9	NA	2.5	1.5	1.5	70	140	50
Octachlorodibenzo-p-dioxin (OCDD)	3268-87-9	NA	5	3	3	78	144	50
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9	NA	0.5	0.3	0.3	75	158	50
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6	NA	2.5	1.5	1.5	80-	34	50
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4	NA	2.5	1.5	1.5	68	160	50
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9	NA	2.5	1.5	1.5	72	134	50
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9	NA	2.5	1.5	1.5	84	130	50
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	72918-21-9	NA	2.5	1.5	1.5	78	130	50
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5	NA	2.5	1.5	1.5	70	156	50
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4	NA	2.5	1.5	1.5	82	122	50
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7	NA	2.5	1.5	1.5	78	138	50
Octachlorodibenzofuran (OCDF)	39001-02-0	NA	5	1.5	1.5	63	170	50
2,3,7,8-TCDD Toxic Equivalent Concentration*		4×10^{-6}						

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