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OREGON

Environmental Laboratory Accreditation Program

NELAP Recognized

Columbia Analytical Services, Inc. Kelso

WA100010

1317 South 13th Ave.

Kelso,WA 98626

IS GRANTED APPROVAL BY ORELAP UNDER THE 2009 TNI STANDARDS, TO PERFORM ANALYSES ON ENVIRONMENTAL SAMPLES IN MATRICES AS LISTED BELOW :

Air	*Drinking Water*	*Non Potable Water*	*Solids and Chem. Waste*	*Tissue*
	Chemistry	Chemistry	Chemistry	Chemistry
	Microbiology	Microbiology		

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES, METHODS, ANALYTICAL TECHNIQUES, AND FIELDS OF TESTING ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

ACCREDITED STATUS DEPENDS ON SUCCESSFUL ONGOING PARTICIPATION IN THE PROGRAM AND CONTINUED COMPLIANCE WITH THE STANDARDS.

CUSTOMERS ARE URGED TO VERIFY THE LABORATORY'S CURRENT ACCREDITATION STATUS IN OREGON.

Gary K. Ward

Gary K. Ward, MS

Oregon State Public Health Laboratory

ORELAP Administrator

3150 NW. 229th Ave, Suite 100

Hillsboro, OR 97124

ISSUE DATE: 02/11/2013

EXPIRATION DATE: 02/10/2014

Certificate No: WA100010 - 005

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Oregon

Environmental Laboratory Accreditation Program

Department of Agriculture, Laboratory Division
Department of Environmental Quality, Laboratory Division
Oregon Health Authority, Public Health Division

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ORELAP Fields of Accreditation

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MATRIX : Biological Tissue

Reference	Code	Description
CAS SOC-Butyl	**60035009**	**Butyltin by GC/Flame Photometric Detector**

Analyte Code	*Analyte*
1201	Butyltin trichloride
1202	Dibutyltin dichloride
1209	Tetrabutyltin
1203	Tributyltin chloride

EPA 1631E	**10237204**	**Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence**

Analyte Code	*Analyte*
1095	Mercury

EPA 1632A	**10123407**	**Arsenic in Water by Gaseous Hydride Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic
1012	Arsenite (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

EPA 3540C	**10140203**	**Soxhlet Extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3541	**10140406**	**Automated Soxhlet Extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3630C	**10146802**	**Silica gel cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3640A	**10147203**	**Gel Preparation Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

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EPA 365.3 **10070607** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	*Analyte*
1908	Total Phosphate

EPA 3660B **10148400** **Sulfur cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3665A **10148808** **Sulfuric Acid / permanganate Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 5035A **10284807** **Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 6010C **10155803** **ICP - AES**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1175	Tin
1185	Vanadium
1190	Zinc

EPA 6020A **10156408** **Inductively Coupled Plasma-Mass Spectrometry**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium

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Analyte Code	Analyte
1150	Silver
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 7010 **10157809** **Metals by Graphite Furnace Atomic Absorption**

Analyte Code	Analyte
1010	Arsenic
1040	Chromium
1075	Lead
1140	Selenium
1165	Thallium

EPA 7196A **10162400** **Chromium Hexavalent colorimetric**

Analyte Code	Analyte
1045	Chromium VI

EPA 7471B **10166402** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

EPA 7742 **10169207** **Selenium by Borohydride Reduction and Atomic Absorption**

Analyte Code	Analyte
1140	Selenium

EPA 8081B **10178800** **Organochlorine Pesticides by GC/ECD**

Analyte Code	Analyte
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7005	Alachlor
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
4835	Hexachlorobutadiene
7725	Isodrin

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Analyte Code	*Analyte*
7810	Methoxychlor
7870	Mirex
8250	Toxaphene (Chlorinated camphene)

EPA 8082A **10179201** **Polychlorinated Biphenyls (PCBs) by GC/ECD**

Analyte Code	*Analyte*
9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)
9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)
9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)
9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)
9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)
9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)
9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)
9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)
9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)
9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)
9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)
9075	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)
9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)
9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)
9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)
9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)
9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)
9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)
8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)
9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)
9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)
9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)
8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)
8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)
8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)
8930	2,2',5-Trichlorobiphenyl (BZ-18)
9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)
8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)
8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)
9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)
9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)
9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)
9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)
9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
8920	2,3-Dichlorobiphenyl (BZ-5)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
8915	2-Chlorobiphenyl (BZ-1)
8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)
9266	3,4,4'-Trichlorobiphenyl (BZ-37)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)

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Analyte Code	Analyte
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
9105	Decachlorobiphenyl (BZ-209)

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	Analyte
6380	1-Methylnaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5670	Butyl benzyl phthalate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6605	Pentachlorophenol
6615	Phenanthrene
6665	Pyrene

EPA 8330B **10308006** **Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography (HPLC)**

Analyte Code	Analyte
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
6160	1,3-Dinitrobenzene (1,3-DNB)
9651	2,4,6-Trinitrotoluene (2,4,6-TNT)
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
9303	2-Amino-4,6-dinitrotoluene (2-am-dnt)
9507	2-Nitrotoluene
6150	3,5-Dinitroaniline
9510	3-Nitrotoluene
9306	4-Amino-2,6-dinitrotoluene (4-am-dnt)
9513	4-Nitrotoluene
6415	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
5015	Nitrobenzene
6485	Nitroglycerin
9522	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
9558	Pentaerythritoltetranitrate
9432	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)

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MATRIX : Drinking Water

Reference	Code	Description
EPA 180.1	**10011402**	**Turbidity - Nephelometric**

Analyte Code	*Analyte*
2055	Turbidity

EPA 200.7 4.4	**10013806**	**ICP - metals**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1055	Copper
1760	Hardness (calc.)
1070	Iron
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1990	Silica as SiO2
1150	Silver
1155	Sodium
1185	Vanadium
1190	Zinc

EPA 200.8 5.4	**10014605**	**Metals by ICP-MS**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1055	Copper
1075	Lead
1090	Manganese
1105	Nickel
1140	Selenium
1150	Silver
1165	Thallium

EPA 200.9 2.2	**10015404**	**Metals by Graphite Atomic Absorption**

Analyte Code	*Analyte*
1005	Antimony
1010	Arsenic
1055	Copper
1075	Lead
1140	Selenium
1165	Thallium

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EPA 245.1 3 **10036609** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	*Analyte*
1095	Mercury

EPA 300.0 2.1 **10053200** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*
1575	Chloride
1730	Fluoride
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N
2000	Sulfate

EPA 300.1 **10053608** **Ion chromatography - anions.**

Analyte Code	*Analyte*
1535	Bromate
1540	Bromide
1570	Chlorate
1595	Chlorite

EPA 314.0 **10055400** **Perchlorate in Drinking Water by Ion Chromatography**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 335.4 **10061208** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*
1645	Total cyanide

EPA 353.2 2 **10067604** **Nitrate/Nitrite Nitrogen - Automated, Cadmium**

Analyte Code	*Analyte*
1810	Nitrate as N
1840	Nitrite as N
1825	Total nitrate-nitrite

EPA 504.1 **10082807** **EDB/DBCP/TCP micro-extraction, GC/ECD**

Analyte Code	*Analyte*
5180	1,2,3-Trichloropropane
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)

EPA 508.1 2 **10086405** **Chlorinated Pesticides, Herbicides, and Organohalides, liquid/solid extraction by GC/ECD**

Analyte Code	*Analyte*
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7250	Chlordane (tech.)
7470	Dieldrin
7540	Endrin
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7685	Heptachlor
7690	Heptachlor epoxide
7810	Methoxychlor

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Analyte Code	*Analyte*
8870	PCBs
8250	Toxaphene (Chlorinated camphene)

EPA 515.4 1 **10088503** **Chlorinated acids Liquid/Solid and GC/ECD**

Analyte Code	*Analyte*
8655	2,4,5-T
8545	2,4-D
8505	Acifluorfen
8555	Dalapon
8570	DCPA di-acid degradate
8595	Dicamba
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)
6605	Pentachlorophenol
8645	Picloram
8650	Silvex (2,4,5-TP)

EPA 524.2 4.1 **10088809** **Volatile Organic Compounds GC/MS Capillary Column**

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4670	1,1-Dichloropropene
5150	1,2,3-Trichlorobenzene
5180	1,2,3-Trichloropropane
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane
4620	1,4-Dichlorobenzene
4665	2,2-Dichloropropane
4535	2-Chlorotoluene
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4397	Bromoethane (Ethyl Bromide)
4400	Bromoform
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4765	Ethylbenzene
4835	Hexachlorobutadiene
4900	Isopropylbenzene
4950	Methyl bromide (Bromomethane)

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Analyte Code	Analyte
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
4440	sec-Butylbenzene
5100	Styrene
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
5205	Total trihalomethanes
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride
5260	Xylene (total)

EPA 525.2 2 **10090003** **Semi-Volatile by SPE extraction and GC/MS**

Analyte Code	Analyte
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
4310	Acetochlor
7005	Alachlor
7065	Atrazine
5580	Benzo(a)pyrene
6062	bis(2-Ethylhexyl)adipate
7160	Butachlor
5670	Butyl benzyl phthalate
8550	Dacthal (DCPA)
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
7555	EPTC (Eptam, s-ethyl-dipropyl thio carbamate)
6275	Hexachlorobenzene
6285	Hexachlorocyclopentadiene
6320	Isophorone
7835	Metolachlor
7845	Metribuzin
7875	Molinate
8045	Propachlor (Ramrod)
8125	Simazine
8180	Terbacil

EPA 548.1 1 **10092805** **Endothall by Ion Exchange, Methylation and GC/MS**

Analyte Code	Analyte
7525	Endothall

EPA 549.2 **10093206** **Diquat/Paraquat, Liquid/Solid Extraction and HPLC/UV**

Analyte Code	Analyte
9390	Diquat
9528	Paraquat

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EPA 552.2 1 **10095804** **Haloacetic Acid/Dalapon, Liquid/Liquid Extraction, Derivitization and GC/ECD**

Analyte Code	*Analyte*
9312	Bromoacetic acid
9315	Bromochloroacetic acid
9336	Chloroacetic acid
9357	Dibromoacetic acid
9360	Dichloroacetic acid
9414	Total haloacetic acids
9642	Trichloroacetic acid

SM 2120 B 20th ED **20224004** **Color by Visual Comparison**

Analyte Code	*Analyte*
1605	Color

SM 2320 B 20th ED **20045209** **Alkalinity by Titration**

Analyte Code	*Analyte*
1505	Alkalinity as CaCO3

SM 2340 B 20th ED **20046202** **Hardness by calculation**

Analyte Code	*Analyte*
1750	Hardness

SM 2510 B 20th ED **20048208** **Conductivity by Probe**

Analyte Code	*Analyte*
1610	Conductivity

SM 2540 C 20th ED **20050004** **Total Dissolved Solids**

Analyte Code	*Analyte*
1955	Residue-filterable (TDS)

SM 4500-Cl F 20th ED **20080506** **Residual Chlorine by DPD Ferrous Titration**

Analyte Code	*Analyte*
1945	Residual free chlorine

SM 4500-F⁻C 20th ED **20102005** **Fluoride by Ion Selective Electrode**

Analyte Code	*Analyte*
1730	Fluoride

SM 4500-H+ B 20th ED **20104807** **pH by Probe**

Analyte Code	*Analyte*
1900	pH

SM 4500-P E 20th ED **20123802** **Phosphorus by Ascorbic Acid Reduction**

Analyte Code	*Analyte*
1870	Orthophosphate as P

SM 5310 C 20th ED **20138403** **Total Organic Carbon by Persulfate-Ultraviolet Oxidation Method**

Analyte Code	*Analyte*
2040	Total organic carbon

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SM 9215 B (PCA) 20th ED **20181208** **Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria**

Analyte Code	*Analyte*
2555	Heterotrophic plate count

SM 9223 B (Colilert-18® Multiple-tube) 20th ED **20229407** **Chromogenic/Fluorogenic Quantitative: Total Coliform and E. coli**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9223 B (Colilert®) 20th ED **20212208** **Chromogenic/Fluorogenic Qualitative (Colilert®): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

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MATRIX : Non-Potable Water

Reference	Code	Description
ASTM D1426-98B	**30023406**	**Ammonia by Titration**

Analyte Code	*Analyte*
1515	Ammonia as N

ASTM D3590-89B	**30016809**	**Total Kjeldahl Nitrogen in Water**

Analyte Code	*Analyte*
1795	Kjeldahl nitrogen - total

ASTM D4129 05	**30018907**	**Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection**

Analyte Code	*Analyte*
2040	Total organic carbon

CAS PestMS2 (1699 modified) 2	**60035101**	**Chlorinated Pesticides by GC/MS/MS**

Analyte Code	*Analyte*
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
7725	Isodrin
7810	Methoxychlor
7870	Mirex
7910	trans-Nanochlor

CAS SOC-Butyl	**60035009**	**Butyltin by GC/Flame Photometric Detector**

Analyte Code	*Analyte*
1201	Butyltin trichloride
1202	Dibutyltin dichloride
1209	Tetrabutyltin
1203	Tributyltin chloride

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Enterolert® **60030208** **Chromogenic/Fluorogenic Quantitative (Enterolert®): Enterococci**

Analyte Code	*Analyte*
2520	Enterococci

EPA 1020A **10117007** **Ignitability Setaflash Closed-cup Method**

Analyte Code	*Analyte*
1780	Ignitability

EPA 160.4 **10256801** **Total Volatile Solids, ignition @ 550 C.**

Analyte Code	*Analyte*
4075	Vol. residue, density, water & solids content of coatings

EPA 1630 **10122608** **Methyl Mercury by Purge & Trap Cold Vapor Atomic Fluorescence Spectrometry**

Analyte Code	*Analyte*
1205	Methyl Mercury

EPA 1631E **10237204** **Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence**

Analyte Code	*Analyte*
1095	Mercury

EPA 1632A **10123407** **Arsenic in Water by Gaseous Hydride Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic
1012	Arsenite (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

EPA 1650 **10124808** **Adsorbable Organic Halides by Adsorption and Coulometric Titration**

Analyte Code	*Analyte*
4345	Adsorbable organic halogens (AOX)

EPA 1653A **10125403** **Chlorinated Phenolics by "In Situ" Acetylation and GC/MS**

Analyte Code	*Analyte*
6735	2,3,4,6-Tetrachlorophenol
6835	2,4,5-Trichlorophenol
6840	2,4,6-Trichlorophenol
6805	3,4,5-Trichlorocatechol
6815	3,4,5-Trichloroguaiacol
6810	3,4,6-Trichlorocatechol
6820	3,4,6-Trichloroguaiacol
6825	4,5,6-Trichloroguaiacol
6605	Pentachlorophenol
6720	Tetrachlorocatechol
6725	Tetrachloroguaiacol
6875	Trichlorosyringol

EPA 1664A (HEM) **10127807** **N-Hexane Extractable Material (Oil and Grease) by Extraction and Gravimetry**

Analyte Code	*Analyte*
1803	n-Hexane Extractable Material (O&G)
1860	Oil & Grease

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EPA 1694 1.0 **10132908** **Pharmaceuticals and Personal Care Products by HPLC/MS/MS**

Analyte Code	*Analyte*
6769	17a-estradiol
6771	17a-ethynylestradiol
6773	17ß-estradiol
220	5,5-Diphenylhydantoin (Dilantin)
4307	Acetominophen
7052	Androstenedione
7065	Atrazine
9301	Bisphenol A
5675	Caffeine
7194	Carbamazepine
7375	DEET
7086	Diazepam
7087	Diclofenac
6075	Diethylstilbestrol
7253	Estriol
7254	Estrone
7257	Fluoxetine
7258	Gemfibrozil
7219	Hydrocodone
7259	Ibuprofen
7719	Iopromide
7313	Meprobamate
7316	Methadone
7269	Naproxen
7317	Oxybenzone
7318	Pentoxifylline
7284	Progesterone
9585	Salicylic acid
7297	Sulfamethoxazole
7301	Testosterone
7304	Triclosan
7307	Trimethoprim

EPA 180.1 **10011402** **Turbidity - Nephelometric**

Analyte Code	*Analyte*
2055	Turbidity

EPA 200.7 4.4 **10013808** **ICP - metals**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1055	Copper
1760	Hardness (calc.)
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel

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Analyte Code	Analyte
1125	Potassium
1140	Selenium
1990	Silica as SiO2
1150	Silver
1155	Sodium
1160	Strontium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 200.8 5.4 **10014605** **Metals by ICP-MS**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1165	Thallium
3035	Uranium
1185	Vanadium
1190	Zinc

EPA 200.9 2.2 **10015404** **Metals by Graphite Atomic Absorption**

Analyte Code	Analyte
1005	Antimony
1010	Arsenic
1055	Copper
1075	Lead
1140	Selenium
1165	Thallium

EPA 245.1 3 **10036609** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

EPA 300.0 2.1 **10053200** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	Analyte
1540	Bromide
1575	Chloride
1730	Fluoride
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N
2000	Sulfate

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EPA 3005A **10133207** **Acid Digestion of waters for Total Recoverable or Dissolved Metals**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3010A **10133605** **Acid Digestion of Aqueous samples and Extracts for Total Metals**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3020A **10134404** **Acid Digestion of Aqueous samples and Extracts for Total Metals for Analysis by GFAA**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 314.0 **10055400** **Perchlorate in Drinking Water by Ion Chromatography**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 330.4 **10059004** **Residual Chlorine - DPD-FAS Titration**

Analyte Code	*Analyte*
1940	Total residual chlorine

EPA 335.4 **10061208** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*
1645	Total cyanide

EPA 3510C **10138202** **Separatory Funnel Liquid-liquid extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3520C **10139001** **Continuous Liquid-liquid extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 353.2 2 **10067604** **Nitrate/Nitrite Nitrogen - Automated, Cadmium**

Analyte Code	*Analyte*
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N
1825	Total nitrate+nitrite

EPA 3535A **10139409** **Solid-Phase Extraction (SPE)**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3610B **10144602** **Alumina Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

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EPA 3620C **10146006** **Florisil Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3630C **10146802** **Silica gel cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3640A **10147203** **Gel Preparation Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 365.3 **10070607** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	*Analyte*
1870	Orthophosphate as P
1908	Total Phosphate

EPA 3660B **10148400** **Sulfur cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3665A **10148808** **Sulfuric Acid / permanganate Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 420.1 **10079206** **Phenolics - Spectrophotometric, manual.**

Analyte Code	*Analyte*
1905	Total phenolics

EPA 5030B **10153409** **Purge and trap for aqueous samples**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 6010C **10155863** **ICP - AES**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel

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Analyte Code	Analyte
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 6020A **10156408** **Inductively Coupled Plasma-Mass Spectrometry**

Analyte Code	Analyte
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 608 **10103603** **Organochlorine Pesticides & PCBs by GC/ECD**

Analyte Code	Analyte
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7685	Heptachlor
7690	Heptachlor epoxide

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Analyte Code	*Analyte*
7810	Methoxychlor
8250	Toxaphene (Chlorinated camphene)

EPA 624 **10107207** **Volatile Organic Compounds by purge and trap GC/MS**

Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4500	2-Chloroethyl vinyl ether
4325	Acrolein (Propenal)
4340	Acrylonitrile
4375	Benzene
4395	Bromodichloromethane
4400	Bromoform
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4680	cis-1,3-Dichloropropene
4765	Ethylbenzene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
4975	Methylene chloride (Dichloromethane)
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride
5260	Xylene (total)

EPA 625 **10300002** **Base/Neutrals and Acids by GC/MS**

Analyte Code	*Analyte*
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
6490	2-Nitrophenol
5945	3,3'-Dichlorobenzidine
5660	4-Bromophenyl phenyl ether
5700	4-Chloro-3-methylphenol

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Analyte Code	*Analyte*
5825	4-Chlorophenyl phenylether
6500	4-Nitrophenol
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5595	Benzidine
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6315	Indeno(1,2,3-cd) pyrene
6320	Isophorone
5005	Naphthalene
5015	Nitrobenzene
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
6605	Pentachlorophenol
6615	Phenanthrene
6625	Phenol
6665	Pyrene

EPA 7010 **10157809** **Metals by Graphite Furnace Atomic Absorption**

Analyte Code	*Analyte*
1005	Antimony
1010	Arsenic
1040	Chromium
1075	Lead
1140	Selenium
1165	Thallium

EPA 7062 **10159407** **Antimony and Arsenic by Borohydride Reduction and Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic

EPA 7195 **10162002** **Chromium, Hexavalent (Coprecipitation) by Graphite Furnace Atomic Absorption**

Analyte Code	*Analyte*
1045	Chromium VI

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EPA 7196A **10162400** **Chromium Hexavalent colorimetric**

Analyte Code	*Analyte*
1045	Chromium VI

EPA 7470A **10165807** **Mercury in Liquid Waste by Cold Vapor Atomic Absorption**

Analyte Code	*Analyte*
1095	Mercury

EPA 7742 **10169207** **Selenium by Borohydride Reduction and Atomic Absorption**

Analyte Code	*Analyte*
1140	Selenium

EPA 8015C **10173805** **Non-halogenated organics using GC/FID**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)
4785	Ethylene glycol
9408	Gasoline range organics (GRO)

EPA 8021B **10174808** **Aromatic and Halogenated Volatiles by GC with PID and/or ECD Purge & Trap**

Analyte Code	*Analyte*
4375	Benzene
4765	Ethylbenzene
5140	Toluene
5260	Xylene (total)

EPA 8081B **10178800** **Organochlorine Pesticides by GC/ECD**

Analyte Code	*Analyte*
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7005	Alachlor
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
4835	Hexachlorobutadiene
7725	Isodrin

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Analyte Code	*Analyte*
7810	Methoxychlor
7870	Mirex
8250	Toxaphene (Chlorinated camphene)
7910	trans-Nanochlor

EPA 8082A **10179201** **Polychlorinated Biphenyls (PCBs) by GC/ECD**

Analyte Code	*Analyte*
9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)
9090	2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-194)
9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)
9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)
9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)
9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)
9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)
9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)
9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)
9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)
9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)
9075	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)
9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)
9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)
9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)
9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)
9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)
9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)
8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)
9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)
9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)
9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)
8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)
8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)
8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)
8930	2,2',5-Trichlorobiphenyl (BZ-18)
9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)
8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)
8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)
9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)
9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)
9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)
9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)
9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
8920	2,3-Dichlorobiphenyl (BZ-5)
9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)
9252	2,4,4'-Trichlorobiphenyl (BZ-28)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
9256	2,4'-Dichlorobiphenyl (BZ-8)
8915	2-Chlorobiphenyl (BZ-1)
9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)

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Analyte Code	Analyte
9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)
8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)
8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)
9266	3,4,4'-Trichlorobiphenyl (BZ-37)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
8912	Aroclor-1262 (PCB-1262)
8913	Aroclor-1268 (PCB-1268)
9105	Decachlorobiphenyl (BZ-209)

EPA 8141B **10182204** **Organophosphorous Pesticides by GC/NPD**

Analyte Code	Analyte
7075	Azinphos-methyl (Guthion)
7125	Bolstar (Sulprofos)
7300	Chlorpyrifos
7315	Coumaphos
7395	Demeton-o
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
8625	Disulfoton
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8275	Trichloronate

EPA 8151A **10183207** **Chlorinated Herbicides by GC/ECD**

Analyte Code	Analyte
8655	2,4,5-T
8545	2,4-D
8560	2,4-DB
8555	Dalapon
8595	Dicamba
8605	Dichloroprop (Dichlorprop)
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)
7775	MCPA
7780	MCPP
8650	Silvex (2,4,5-TP)

EPA 8260C **10307003** **Volatile Organics: GC/MS (capillary column)**

Analyte Code	Analyte
5105	1,1,1,2-Tetrachloroethane
5185	1,1,1-Trichloro-2,2,2-trifluoroethane

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Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
5167	1,1,2-Trichlorofluoroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4670	1,1-Dichloropropene
5150	1,2,3-Trichlorobenzene
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
6800	1,3,5-Trichlorobenzene
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
4510	1-Chlorohexane
4665	2,2-Dichloropropane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4500	2-Chloroethyl vinyl ether
4535	2-Chlorotoluene
4860	2-Hexanone
5020	2-Nitropropane
4536	4-Bromofluorobenzene
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4305	Acetamide
4315	Acetone
4320	Acetonitrile
4325	Acrolein (Propenal)
4330	Acrylamide
4340	Acrylonitrile
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4505	Chloroform
4525	Chloroprene (2-Chloro-1,3-butadiene)
4705	cis & trans-1,2-Dichloroethene
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4725	Diethyl ether
4755	Ethyl acetate
4810	Ethyl methacrylate
4765	Ethylbenzene
4835	Hexachlorobutadiene
4870	Iodomethane (Methyl iodide)

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Analyte Code	*Analyte*
4875	Isobutyl alcohol (2-Methyl-1-propanol)
4900	Isopropylbenzene
5240	m+p-xylene
4925	Methacrylonitrile
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5245	m-Xylene
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
4440	sec-Butylbenzene
5100	Styrene
4370	T-amylmethylether (TAME)
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
4605	trans-1,4-Dichloro-2-butene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride
5260	Xylene (total)

EPA 8270D **10186002** **Semivolatile Organic compounds by GC/MS**

Analyte Code	*Analyte*
6715	1,2,4,5-Tetrachlorobenzene
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
6221	1,2-Diphenylhydrazine
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6420	1,4-Naphthoquinone
6630	1,4-Phenylenediamine
5790	1-Chloronaphthalene
6380	1-Methylnaphthalene
6425	1-Naphthylamine
6735	2,3,4,6-Tetrachlorophenol
6835	2,4,5-Trichlorophenol
6795	2,4,6-Trichloroaniline
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
5992	2,5-Dichlorophenol
6005	2,6-Dichlorophenol
6190	2,6-Dinitrotoluene (2,6-DNT)
5735	2-Chloroaniline
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
5145	2-Methylaniline (o-Toluidine)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6430	2-Naphthylamine
6460	2-Nitroaniline

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Analyte Code	*Analyte*
6490	2-Nitrophenol
5050	2-Picoline (2-Methylpyridine)
6412	3 & 4 Methylphenol
5945	3,3'-Dichlorobenzidine
6120	3,3'-Dimethylbenzidine
6355	3-Methylcholanthrene
6405	3-Methylphenol (m-Cresol)
6465	3-Nitroaniline
5540	4-Aminobiphenyl
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
6125	a-a-Dimethylphenethylamine
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
5545	Aniline
5555	Anthracene
5560	Aramite
7065	Atrazine
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5610	Benzoic acid
5630	Benzyl alcohol
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
7180	Caprolactam
5680	Carbazole
7260	Chlorobenzilate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7405	Diallate
7410	Diazinon
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
7580	Famphur
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6290	Hexachlorophene
6315	Indeno(1,2,3-cd) pyrene
7725	Isodrin
6320	Isophorone
7740	Kepone

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Analyte Code	Analyte
6345	Methapyrilene
7825	Methyl parathion (Parathion, methyl)
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6530	n-Nitrosodimethylamine
6535	n-Nitrosodiphenylamine
6555	n-Nitrosomorpholine
6560	n-Nitrosopiperidine
6565	n-Nitrosopyrrolidine
7955	Parathion, ethyl
6590	Pentachlorobenzene
6600	Pentachloronitrobenzene
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6625	Phenol
6650	Pronamide (Kerb)
6665	Pyrene
5095	Pyridine
6685	Safrole
8235	Thionazin (Zinophos)

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	Analyte
6380	1-Methylnaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo(b)fluoranthene
5670	Butylbenzylphthalate
5855	Chrysene
6065	Di(2-ethylhexyl)phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6605	Pentachlorophenol
6615	Phenanthrene
6665	Pyrene

EPA 8315A **10188008** **Determination of Carbonyl Compounds by HPLC/UV-VIS**

Analyte Code	Analyte
4815	Formaldehyde

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EPA 8330B **10308006** **Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography (HPLC)**

Analyte Code	*Analyte*
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
6160	1,3-Dinitrobenzene (1,3-DNB)
9651	2,4,6-Trinitrotoluene (2,4,6-TNT)
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
9303	2-Amino-4,6-dinitrotoluene (2-am-dnt)
9507	2-Nitrotoluene
6150	3,5-Dinitroaniline
9510	3-Nitrotoluene
9306	4-Amino-2,6-dinitrotoluene (4-am-dnt)
9513	4-Nitrotoluene
6415	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
5015	Nitrobenzene
6485	Nitroglycerin
9522	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
9558	Pentaerythritoltetranitrate
9432	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)

EPA 9012B **10243206** **Total and Amenable Cyanide (automated colorimetric with off-line distillation)**

Analyte Code	*Analyte*
1510	Amenable cyanide
1645	Total cyanide

EPA 9020B **10194408** **Total Organic Halides**

Analyte Code	*Analyte*
2045	Total organic halides (TOX)

EPA 9040C **10244403** **pH Electrometric Measurement**

Analyte Code	*Analyte*
1900	pH

EPA 9060A **10244801** **Total Organic Carbon**

Analyte Code	*Analyte*
2040	Total organic carbon

NCASI 94.03 0 **60031507** **Methanol in Process Liquids and Wastewaters**

Analyte Code	*Analyte*
4930	Methanol

NCASI 99.01 **60002804** **Selected HAPS in Condensates by GC/FID**

Analyte Code	*Analyte*
4930	Methanol

NWTPH-Dx **90018409** **Oregon DEQ TPH Diesel Range**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)

NWTPH-Gx **90018603** **Oregon DEQ TPH Gasoline Range Organics by GC/FID-PID Purge & Trap**

Analyte Code	*Analyte*
9408	Gasoline range organics (GRO)

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NWTPH-HCID **90013200** **Oregon DEQ Total Petroleum Hydrocarbon ID**

Analyte Code	*Analyte*
2050	Total Petroleum Hydrocarbons (TPH)

SM 2120 B 20th ED **20224004** **Color by Visual Comparison**

Analyte Code	*Analyte*
1605	Color

SM 2310 B 20th ED **20044206** **Acidity by Titration**

Analyte Code	*Analyte*
1500	Acidity, as CaCO3

SM 2320 B 20th ED **20045209** **Alkalinity by Titration**

Analyte Code	*Analyte*
1505	Alkalinity as CaCO3

SM 2340 B 20th ED **20046202** **Hardness by calculation**

Analyte Code	*Analyte*
1750	Hardness

SM 2540 B 20th ED **20049007** **Total Solids**

Analyte Code	*Analyte*
1950	Residue-total

SM 2540 C 20th ED **20050004** **Total Dissolved Solids**

Analyte Code	*Analyte*
1955	Residue-filterable (TDS)

SM 2540 D 20th ED **20050800** **Total Suspended Solids**

Analyte Code	*Analyte*
1960	Residue-nonfilterable (TSS)

SM 2540 F 20th ED **20051500** **Settleable Solids**

Analyte Code	*Analyte*
1965	Residue-settleable

SM 4500-Cl C 20th ED **20078802** **Chlorine by Iodometric Method II**

Analyte Code	*Analyte*
1575	Chloride

SM 4500-Cl F 20th ED **20080506** **Residual Chlorine by DPD Ferrous Titration**

Analyte Code	*Analyte*
1945	Residual free chlorine

SM 4500-CN E 20th ED **20092404** **Cyanide by Colorimetric Determination**

Analyte Code	*Analyte*
1635	Cyanide
1645	Total cyanide

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SM 4500-CN G 20th ED **20093203** **Cyanide Amenable to Chlorination after Distillation**

Analyte Code	Analyte
1510	Amenable cyanide

SM 4500-CN⁻E-97 online **20096406** **Cyanide by Colorimetric Method**

Analyte Code	Analyte
1635	Cyanide

SM 4500-F⁻C 20th ED **20102005** **Fluoride by Ion Selective Electrode**

Analyte Code	Analyte
1730	Fluoride

SM 4500-H+ B 20th ED **20104807** **pH by Probe**

Analyte Code	Analyte
1900	pH

SM 4500-NH3 E 20th ED **20109802** **Ammonia by Selective Ion Probe**

Analyte Code	Analyte
1515	Ammonia as N

SM 4500-NH3 G 20th ED **20111006** **Ammonia by Automated Phenate**

Analyte Code	Analyte
1515	Ammonia as N

SM 4500-O G 20th ED **20121204** **Dissolved Oxygen by Membrane Electrode Method**

Analyte Code	Analyte
1880	Oxygen, dissolved

SM 4500-S2⁻D 20th ED **20125400** **Sulfide by Methylene Blue Method**

Analyte Code	Analyte
2005	Sulfide

SM 4500-S2⁻D-97 online **20125808** **Sulfide by Methylene Blue Method**

Analyte Code	Analyte
2005	Sulfide

SM 4500-S2⁻F 20th ED **20126209** **Sulfide by Iodometric Titration**

Analyte Code	Analyte
2005	Sulfide

SM 4500-SO3⁻B 20th ED **20130205** **Sulfite by Iodometric Method**

Analyte Code	Analyte
2015	Sulfite-SO3

SM 5210 B 20th ED **20134809** **Biochemical Oxygen Demand, 5-Day (BOD5)**

Analyte Code	Analyte
1530	Biochemical oxygen demand

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SM 5220 C 20th ED **20135608** **Chemical Oxygen Demand by Closed Reflux and Titration**

Analyte Code	*Analyte*
1565	Chemical oxygen demand

SM 5310 C 20th ED **20138403** **Total Organic Carbon by Persulfate-Ultraviolet Oxidation Method**

Analyte Code	*Analyte*
2040	Total organic carbon

SM 5540 C 20th ED **20144609** **Surfactants as MBAS**

Analyte Code	*Analyte*
2025	Surfactants - MBAS

SM 5550 B 20th ED **20145306** **Tannin and Lignin**

Analyte Code	*Analyte*
9597	Tannin & Lignin

SM 9215 B (PCA) 20th ED **20181208** **Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria**

Analyte Code	*Analyte*
2555	Heterotrophic plate count

SM 9221 B (LTB) + C MPN 20th ED **20186805** **Multiple Tube Fermentation Quantitative (LTB): Total Coliform**

Analyte Code	*Analyte*
2500	Total coliforms

SM 9221 E (EC) 20th ED **20226806** **Multiple Tube Fermentation Quantitative (EC): Fecal Coliform**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9222 D (m-FC) 20th ED **20209603** **Membrane Filtration Quantitative (m-FC): Fecal Coliform**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9223 B (Colilert-18® Multiple-tube) 20th ED **20229407** **Chromogenic/Fluorogenic Quantitative: Total Coliform and E. coli**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9230 B (PSE) 20th ED **20217203** **Multiple Tube Fermentation Quantitative: Fecal Streptococci**

Analyte Code	*Analyte*
2540	Fecal streptococci

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MATRIX : Solids

Reference	Code	Description
ASTM D4129 05	**30018907**	**Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection**

Analyte Code	*Analyte*
2040	Total organic carbon

ASTM D422-63	**30030854**	**Partical Size Distribution (Grain sizing)**

Analyte Code	*Analyte*
6118	Distribution of particle sizes

CAS PestMS2 (1699 modified) 2	**60035101**	**Chlorinated Pesticides by GC/MS/MS**

Analyte Code	*Analyte*
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexan E)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
7725	Isodrin
7810	Methoxychlor
7870	Mirex
7910	trans-Nanochlor

CAS SOC-Butyl	**60035009**	**Butyltin by GC/Flame Photometric Detector**

Analyte Code	*Analyte*
1201	Butyltin trichloride
1202	Dibutyltin dichloride
1209	Tetrabutyltin
1203	Tributyltin chloride

EPA 1020A	**10117007**	**Ignitability Setaflash Closed-cup Method**

Analyte Code	*Analyte*
1780	Ignitability

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EPA 1110A **10235208** **Corrosivity Toward Steel**

Analyte Code	*Analyte*
1615	Corrosivity

EPA 1311 **10118806** **Toxicity Characteristic Leaching Procedure**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 1312 **10119003** **Synthetic Precipitation Leaching Procedure**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 160.3 **10009800** **Total Solids, dried @ 103-105 C.**

Analyte Code	*Analyte*
1950	Residue-total

EPA 1630 **10122608** **Methyl Mercury by Purge & Trap Cold Vapor Atomic Fluorescence Spectrometry**

Analyte Code	*Analyte*
1205	Methyl Mercury

EPA 1631E **10237204** **Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence**

Analyte Code	*Analyte*
1095	Mercury

EPA 1664A (HEM) **10127807** **N-Hexane Extractable Material (Oil and Grease) by Extraction and Gravimetry**

Analyte Code	*Analyte*
1803	n-Hexane Extractable Material (O&G)
1860	Oil & Grease

EPA 300.0 2.1 **10053200** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*
1575	Chloride
1730	Fluoride
2000	Sulfate

EPA 3050B **10135601** **Acid Digestion of Sediments, Sludges, and soils**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 314.0 **10055400** **Perchlorate in Drinking Water by Ion Chromatography**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 350.1 2 **10063602** **Ammonia Nitrogen - Colorimetric, Auto Phenate**

Analyte Code	*Analyte*
1515	Ammonia as N

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EPA 353.2 2 **10067604** **Nitrate/Nitrite Nitrogen - Automated, Cadmium**

Analyte Code	Analyte
1810	Nitrate as N
1840	Nitrite as N
1825	Total nitrate+nitrite

EPA 3540C **10140202** **Soxhlet Extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3541 **10140406** **Automated Soxhlet Extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3550C **10142004** **Ultrasonic Extraction**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3580A **10143007** **Waste Dilution**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3620C **10146006** **Florisil Cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3630C **10146802** **Silica gel cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3640A **10147203** **Gel Preparation Cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 365.3 **10070607** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	Analyte
1870	Orthophosphate as P
1908	Total Phosphate

EPA 3660B **10148400** **Sulfur cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 3665A **10148808** **Sulfuric Acid / permanganate Cleanup**

Analyte Code	Analyte
8031	Extraction/Preparation

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EPA 5030B **10153409** **Purge and trap for aqueous samples**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 5035A **10284807** **Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 6010C **10155803** **ICP - AES**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 6020A **10156408** **Inductively Coupled Plasma-Mass Spectrometry**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium
1165	Thallium

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Analyte Code	Analyte
1185	Vanadium
1190	Zinc

EPA 7010 **10157809** **Metals by Graphite Furnace Atomic Absorption**

Analyte Code	Analyte
1010	Arsenic
1040	Chromium
1075	Lead
1140	Selenium
1165	Thallium

EPA 7062 **10159407** **Antimony and Arsenic by Borohydride Reduction and Atomic Absorption**

Analyte Code	Analyte
1010	Arsenic

EPA 7196A **10162400** **Chromium Hexavalent colorimetric**

Analyte Code	Analyte
1045	Chromium VI

EPA 7471B **10166402** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

EPA 7742 **10169207** **Selenium by Borohydride Reduction and Atomic Absorption**

Analyte Code	Analyte
1140	Selenium

EPA 8015C **10173805** **Non-halogenated organics using GC/FID**

Analyte Code	Analyte
9369	Diesel range organics (DRO)
4785	Ethylene glycol
9408	Gasoline range organics (GRO)

EPA 8021B **10174803** **Aromatic and Halogenated Volatiles by GC with PID and/or ECD Purge & Trap**

Analyte Code	Analyte
4375	Benzene
4765	Ethylbenzene
5140	Toluene
5260	Xylene (total)

EPA 8081B **10178800** **Organochlorine Pesticides by GC/ECD**

Analyte Code	Analyte
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7005	Alachlor
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane

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Analyte Code	*Analyte*
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
4835	Hexachlorobutadiene
7725	Isodrin
7810	Methoxychlor
7870	Mirex
8250	Toxaphene (Chlorinated camphene)
7910	trans-Nanochlor

EPA 8082A **10179201** **Polychlorinated Biphenyls (PCBs) by GC/ECD**

Analyte Code	*Analyte*
9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)
9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)
9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)
9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)
9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)
9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)
9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)
9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)
9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)
9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)
9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)
9075	2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-183)
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)
9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)
9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)
9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)
9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)
9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)
9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)
8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)
9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)
9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)
9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)
8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)
8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)
8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)
8930	2,2',5-Trichlorobiphenyl (BZ-18)
9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)
8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)
8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)

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Analyte Code	Analyte
9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)
9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)
9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)
9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)
9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
8920	2,3-Dichlorobiphenyl (BZ-5)
9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)
9252	2,4,4'-Trichlorobiphenyl (BZ-28)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
9256	2,4'-Dichlorobiphenyl (BZ-8)
8915	2-Chlorobiphenyl (BZ-1)
9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)
9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)
8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)
8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)
9266	3,4,4'-Trichlorobiphenyl (BZ-37)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
8912	Aroclor-1262 (PCB-1262)
8913	Aroclor-1268 (PCB-1268)
9105	Decachlorobiphenyl (BZ-209)

EPA 8141B **10182204** **Organophosphorous Pesticides by GC/NPD**

Analyte Code	Analyte
7075	Azinphos-methyl (Guthion)
7125	Bolstar (Sulprofos)
7300	Chlorpyrifos
7315	Coumaphos
7395	Demeton-o
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
8625	Disulfoton
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8275	Trichloronate

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EPA 8151A **10183207** **Chlorinated Herbicides by GC/ECD**

Analyte Code	*Analyte*
8655	2,4,5-T
8545	2,4-D
8560	2,4-DB
8555	Dalapon
8595	Dicamba
8605	Dichloroprop (Dichlorprop)
8620	Dinoseb (2-Sec-butyl-4,6-dinitrophenol, DNBP)
7775	MCPA
7780	MCPP
8650	Silvex (2,4,5-TP)

EPA 8260C **10307003** **Volatile Organics: GC/MS (capillary column)**

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
5185	1,1,1-Trichloro-2,2,2-trifluoroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
5167	1,1,2-Trichlorofluoroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4670	1,1-Dichloropropene
5150	1,2,3-Trichlorobenzene
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
6800	1,3,5-Trichlorobenzene
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethylenoxide)
4510	1-Chlorohexane
4665	2,2-Dichloropropane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4500	2-Chloroethyl vinyl ether
4535	2-Chlorotoluene
4860	2-Hexanone
5020	2-Nitropropane
4536	4-Bromofluorobenzene
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4305	Acetamide
4315	Acetone
4320	Acetonitrile
4325	Acrolein (Propenal)
4330	Acrylamide
4340	Acrylonitrile
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane

NELAP RECOGNIZED ACCREDITATION BODY TNI

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

Columbia Analytical Services, Inc. Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2013 ***Expiration Date:*** 02/10/2014

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Analyte Code	*Analyte*
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4505	Chloroform
4525	Chloroprene (2-Chloro-1,3-butadiene)
4705	cis & trans-1,2-Dichloroethene
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4725	Diethyl ether
4755	Ethyl acetate
4810	Ethyl methacrylate
4765	Ethylbenzene
4835	Hexachlorobutadiene
4870	Iodomethane (Methyl iodide)
4875	Isobutyl alcohol (2-Methyl-1-propanol)
4900	Isopropylbenzene
5240	m+p-xylene
4925	Methacrylonitrile
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5245	m-Xylene
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
4440	sec-Butylbenzene
5100	Styrene
4370	T-amylmethylether (TAME)
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
4605	trans-1,4-Dichloro-2-butene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon-11)
5225	Vinyl acetate
5235	Vinyl chloride
5260	Xylene (total)

EPA 8270D **10186002** **Semivolatile Organic compounds by GC/MS**

Analyte Code	*Analyte*
6715	1,2,4,5-Tetrachlorobenzene
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
6221	1,2-Diphenylhydrazine
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6420	1,4-Naphthoquinone
6630	1,4-Phenylenediamine
5790	1-Chloronaphthalene
6380	1-Methylnaphthalene
6425	1-Naphthylamine
6735	2,3,4,6-Tetrachlorophenol

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Analyte Code	*Analyte*
6835	2,4,5-Trichlorophenol
6795	2,4,6-Trichloroaniline
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
5992	2,5-Dichlorophenol
6005	2,6-Dichlorophenol
6190	2,6-Dinitrotoluene (2,6-DNT)
5735	2-Chloroaniline
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
5145	2-Methylaniline (o-Toluidine)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6430	2-Naphthylamine
6460	2-Nitroaniline
6490	2-Nitrophenol
5050	2-Picoline (2-Methylpyridine)
6412	3 & 4 Methylphenol
5945	3,3'-Dichlorobenzidine
6120	3,3'-Dimethylbenzidine
6355	3-Methylcholanthrene
6405	3-Methylphenol (m-Cresol)
6465	3-Nitroaniline
5540	4-Aminobiphenyl
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
6125	a,a-Dimethylphenethylamine
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
5545	Aniline
5555	Anthracene
5560	Aramite
7065	Atrazine
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5610	Benzoic acid
5630	Benzyl alcohol
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
7180	Caprolactam
5680	Carbazole
7260	Chlorobenzilate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7405	Diallate
7410	Diazinon

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Analyte Code	*Analyte*
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
7580	Famphur
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6290	Hexachlorophene
6315	Indeno(1,2,3-cd) pyrene
7725	Isodrin
6320	Isophorone
7740	Kepone
6345	Methapyrilene
7825	Methyl parathion (Parathion, methyl)
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6530	n-Nitrosodimethylamine
6535	n-Nitrosodiphenylamine
6555	n-Nitrosomorpholine
6560	n-Nitrosopiperidine
6565	n-Nitrosopyrrolidine
7955	Parathion, ethyl
6590	Pentachlorobenzene
6600	Pentachloronitrobenzene
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6625	Phenol
6650	Pronamide (Kerb)
6665	Pyrene
5095	Pyridine
6685	Safrole
8235	Thionazin (Zinophos)

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	*Analyte*
6380	1-Methylnaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5670	Butyl benzyl phthalate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA00035
Certificate: WA100010 - 005

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Analyte Code	Analyte
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd)-pyrene
5005	Naphthalene
6605	Pentachlorophenol
6615	Phenanthrene
6665	Pyrene

EPA 8330B **10308006** **Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography (HPLC)**

Analyte Code	Analyte
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
6160	1,3-Dinitrobenzene (1,3-DNB)
9651	2,4,6-Trinitrotoluene (2,4,6-TNT)
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
9303	2-Amino-4,6-dinitrotoluene (2-am-dnt)
9507	2-Nitrotoluene
6150	3,5-Dinitroaniline
9510	3-Nitrotoluene
9306	4-Amino-2,6-dinitrotoluene (4-am-dnt)
9513	4-Nitrotoluene
6415	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
5015	Nitrobenzene
6485	Nitroglycerin
9522	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
9558	Pentaerythritoltetranitrate
9432	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)

EPA 9012B **10243206** **Total and Amenable Cyanide (automated colorimetric with off-line distillation)**

Analyte Code	Analyte
1510	Amenable cyanide
1645	Total cyanide

EPA 9013A **10308802** **Cyanide Extraction Procedure for Solids and Oils**

Analyte Code	Analyte
8031	Extraction/Preparation

EPA 9020B **10194408** **Total Organic Halides**

Analyte Code	Analyte
2045	Total organic halides (TOX)

EPA 9030B **10195605** **Acid-Soluble and Acid-Insoluble sulfides: Distillation**

Analyte Code	Analyte
2005	Sulfide

EPA 9034 **10196006** **Titrimetric Procedure for Acid-Soluble and Acid-Insoluble Sulfides**

Analyte Code	Analyte
2005	Sulfide

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EPA 9056A **10199607** **Determination of Inorganic Anions by Ion Chromatography**

Analyte Code	Analyte
1575	Chloride
1730	Fluoride
1805	Nitrate
1835	Nitrite
2000	Sulfate

EPA 9071A **10201408** **Oil and Grease Extraction Method for sludge and sediment samples**

Analyte Code	Analyte
1860	Oil & Grease

NWTPH-Dx **90018409** **Oregon DEQ TPH Diesel Range**

Analyte Code	Analyte
9369	Diesel range organics (DRO)

NWTPH-Gx **90018603** **Oregon DEQ TPH Gasoline Range Organics by GC/FID-PID Purge & Trap**

Analyte Code	Analyte
9408	Gasoline range organics (GRO)

NWTPH-HCID **90013200** **Oregon DEQ Total Petroleum Hydrocarbon ID**

Analyte Code	Analyte
2050	Total Petroleum Hydrocarbons (TPH)

PLUMB 1981 **60006259** **Extraction/Preparation**

Analyte Code	Analyte
6118	Distribution of particle sizes
8031	Extraction/Preparation

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QUALITY ASSURANCE MANUAL

ALS Environmental
Kelso Facility
1317 South 13th Avenue
Kelso, WA 98626
360-577-7222 (T)
360-636-1068 (F)
www.alsglobal.com

QUALITY ASSURANCE MANUAL

ALS-KELSO

SOPID:	KL-QAM	Rev. Number:	22	Effective Date:	06/15/2013

Approved By: _____ Date: 6/6/13
Laboratory Director - Jeff Grindstaff

Approved By: _____ Date: 6/6/13
QA Manager - Suzanne LeMay

Approved By: _____ Date: 06/12/13
Technical Director, Micro - Chris Kerksieck

Approved By: _____ Date: 6/6/13
Technical Director, Metals - Jeff Coronado

Approved By: _____ Date: 6/7/13
Technical Director, Gen Chem - Harvey Jacky

Approved By: _____ Date: 6/12/13
Technical Director, Org. GC - Loren Portwood

Approved By: _____ Date: 6/11/13
Tech. Director, Org. GC/MS, HPLC - Jon James

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Appendices

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2.0 INTRODUCTION AND COMPANY QUALITY ASSURANCE POLICY

ALS Environmental, Kelso is a professional analytical services laboratory which performs chemical and microbiological analyses on a wide variety of sample matrices, including drinking water, groundwater, surface water, wastewater, soil, sludge, sediment, tissue, industrial and hazardous waste, air, and other material.

We recognize that quality assurance requires a commitment to quality by everyone in the organization – individually, within each operating unit, and throughout the entire laboratory. Laboratory management is committed to ensuring the effectiveness of its quality systems and to ensure that all tests are carried out in accordance to customer requirements. Key elements of this commitment are set forth in CE-GEN001, Laboratory Ethics and Data Integrity (corporate) and in this Quality Assurance Manual (QAM). ALS Environmental, Kelso is committed to operate in accordance with these requirements and those of regulatory agencies, accrediting authorities, and certifying organizations. The laboratory also strives for improvement through varying continuous improvement initiatives and projects.

Quality Management Systems are established, implemented and maintained by management. Policies and procedures are established in order to meet requirements of accreditation bodies and applicable programs, such as the Department of Defense (DOD) Environmental Laboratory Accreditation Program, as well as client's quality objectives. Systems are designed so that there will be sufficient Quality Assurance (QA) activities conducted in the laboratory to ensure that all analytical data generated and processed will be scientifically sound, legally defensible, of known and documented quality, and will accurately reflect the material being tested. Quality Systems are applicable to all fields of testing in which the laboratory in involved.

Quality Control (QC) procedures are used to continually assess performance of the laboratory and quality systems. ALS Environmental, Kelso maintains control of analytical results by adhering to written standard operating procedures (SOPs), using analytical control parameters with all analyses, and by observing sample custody requirements. All analytical results are calculated and reported in units consistent with project specifications to allow comparability of data.

This QAM is applicable to the facility listed on the title page. The information in this QAM has been organized according to requirements found in the National Environmental Laboratory Accreditation Program (NELAP) Quality Systems Standards (2003 and 2009), the EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, USEPA, 2001; and *General Requirements for the Competence of Testing and Calibration Laboratories*, ISO/IEC 17025:2005.

3.0 PROGRAM DESCRIPTION

The purpose of the QA program at ALS Environmental, Kelso is to ensure that our clients are provided with analytical data that is scientifically sound, legally defensible, and of known and documented quality. The concept of Quality Assurance can be extended, and is expressed in the mission statement of Columbia Analytical:

> "The mission of ALS Environmental, Kelso is to provide high quality, cost-effective, and timely professional testing services to our customers. We recognize that our success as a company is based on our ability to maintain customer satisfaction. To do this requires constant attention to customer needs, maintenance of state-of-the-art testing capabilities and successful management of our most important asset - our people - in a way that encourages professional growth, personal development and company commitment."

3.1 Quality Management Systems

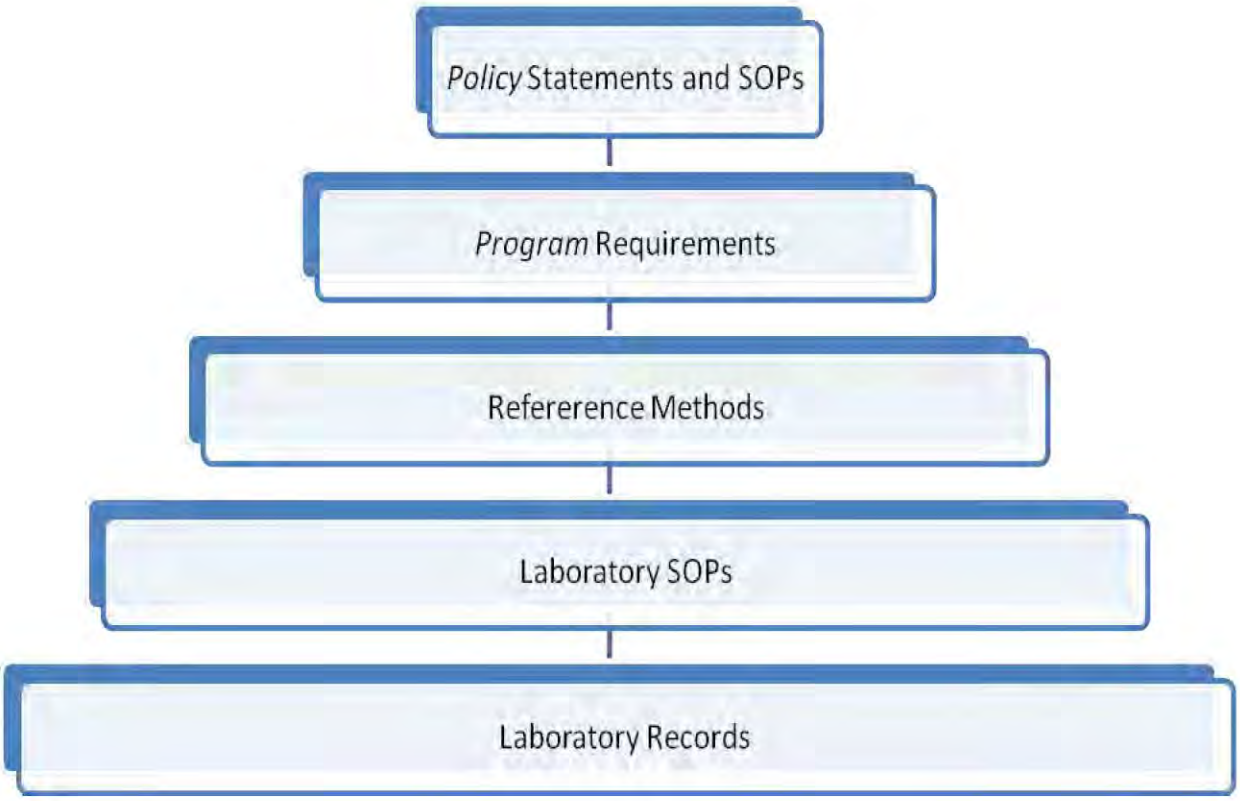
In support of this mission, the laboratory has developed a Quality Management System to ensure all products and services meet our client's needs. The system is implemented and maintained by the Quality Assurance Manager with corporate oversight by the Manager of Quality Assurance, USA. These systems are based upon ISO 17025:2005 standards, upon which fundamental programs (NELAC 2003, 2009 and DoD QSM) are based. Implementation and documentation against these standards are communicated in corporate policy statements, this QAM, and SOPs. Actual procedures, actions and documentation are defined in both administrative and technical SOPs. Figure 3-1 shows the relationships of the quality systems and associated documentation. Quality systems include:

- Standard Operating Procedures
- Sample Management and Chain of Custody procedures
- Statistical Control Charting
- Standards Traceability
- Ethics Training
- Document Control
- Corrective Action Program
- Management Reviews
- Demonstration of Capability

The effectiveness of the quality system is assessed in several ways, including:

- Internal and External Audits covering all aspects of the organization
- Annual Management Reviews
- Analysis of Customer Feedback
- Internal and External Proficiency Testing

Figure 3-1
Relationships of Quality Management Systems and Documentation



3.2 Facilities, Equipment, and Security

ALS Environmental, Kelso features over 45,000 square feet of laboratory and administrative workspace. The laboratory has been designed and constructed to provide safeguards against cross-contamination of samples and is arranged according to work function, which enhances the efficiency of analytical operations. The ventilation system has been specially designed to meet the needs of the analyses performed in each work space. Also, ALS Environmental, Kelso minimizes laboratory contamination sources by employing janitorial and maintenance staff to ensure that good housekeeping and facilities maintenance are performed. In addition, the segregated laboratory areas are designed for safe and efficient handling of a variety of sample types. These specialized areas (and access restrictions) include:

- Shipping and Receiving/Purchasing
- Sample Management Office, including controlled-access sample storage areas
- Inorganic/Metals Sample Preparation Laboratories (2)
- Inorganic/Metals "clean room" sample preparation laboratory
- ICP-AES Laboratory
- ICP-MS Laboratory
- AA Laboratory
- Water Chemistry & General Chemistry Laboratories (3)
- Semi-volatile Organics Sample Preparation Laboratory
- Gas Chromatography/High Performance Liquid Chromatography Laboratory
- Gas Chromatography/Mass Spectrometry Laboratory (2)
- Semi-volatile Organics Drinking Water Laboratories (2)
- Volatile Organics Laboratory
    - Separate sample preparation laboratory
    - Access by semi-volatile sample preparation staff only after removing lab coat and solvent-contaminated gloves, etc.
- Microbiology Laboratory
- Laboratory Deionized Water Systems (2)
- Laboratory Management, Client Service, Report Generation and Administration
- Data Archival, Data Review and support functions areas
- Information Technology (IT) and LIMS

In addition, the designated areas for sample receiving, refrigerated sample storage, dedicated sample container preparation and shipping provide for the efficient and safe handling of a variety of sample types. Figure 3-2 shows the facility floor plan. The laboratory is equipped with state-of-the-art analytical and administrative support equipment. The equipment and instrumentation are appropriate for the procedures in use. Appendix C lists the major equipment, illustrating the laboratory's overall capabilities and depth.

3.3 Technical Elements of the Quality Assurance Program

The laboratory's technical procedures are based upon procedures published by various agencies or organizations (See Section 17). The Quality Assurance Program provides to the laboratory organization, procedures, and policies by which the laboratory operates. The necessary certifications and approvals administered by external agencies are maintained by the QA department. This includes method approvals and audit administration. In addition, internal

audits are performed to assess compliance with policies and procedures. SOPs are maintained for technical and administrative functions. A document control system is used for SOPs, as well as laboratory notebooks, and this QA Manual. A list of QA Program documents is provided in Appendix A and SOPs in Appendix F.

Acceptable calibration procedures are defined in the SOP for each test procedure. Calibration procedures for other laboratory equipment (balances, thermometers, etc.) are also defined. Quality Control (QC) procedures are used to monitor the testing performed. Each analytical procedure has associated QC requirements to be achieved in order to demonstrate data quality. The use of method detection limit studies, control charting, technical training and preventive maintenance procedures further ensure the quality of data produced. Proficiency Testing (PT) samples are used as an external means of monitoring the quality and proficiency of the laboratory. PT samples are obtained from qualified vendors and are performed on a regular basis. In addition to method proficiency, documentation of analyst training is performed to ensure proficiency and competency of laboratory analysts and technicians. Sample handling and custody procedures are defined in SOPs. Procedures are also in place to monitor the sample storage areas. The technical elements of the QA program are discussed in further detail in later sections of this QA manual.

3.4 Operational Assessments and Service to the Client

The laboratory uses a number of systems to assess its daily operations. In addition to the routine quality control (QC) measurements, the senior laboratory management examines a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients including; on-time performance, customer complaints, training reports and non-conformity reports. A frequent, routine assessment must also be made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

ALS Environmental, Kelso utilizes a number of different methods to ensure that adequate resources are available for service demands. Senior staff meetings, tracking of outstanding proposals and an accurate, current synopsis of incoming work all assist the senior staff in properly allocating sufficient resources. All Requests for Proposal (RFP) documents are reviewed by the Project Manager and appropriate managerial staff to identify any project specific requirements that differ from the standard practices of the laboratory. Any requirements that cannot be met are noted and communicated to the client, as well as requesting the client to provide any project specific Quality Assurance Project Plans (QAPPs) if available. Status/production meetings are also conducted regularly with the laboratory and Project Managers to inform the staff of the status of incoming work, future projects, or project requirements.

When a customer requests a modification to an SOP, policy, or standard specification the Project Manager will discuss the proposed deviation with the Client Services Manager, Laboratory Director, and department manager to obtain approval for the deviation. The QA PM may also be involved. All project-specific requirements must be on-file and with the service request upon logging in the samples. The modification or deviation must be documented. A Project-Specific Communication Form, Form V, or similar, may be used to document such deviations.

The laboratory shall afford clients cooperation to clarify the client's request and to monitor the laboratory's performance in relation to the work performed, provided that the laboratory ensures

confidentiality to other clients. The laboratory maintains and documents timely communication with the client for the purposes of seeking feedback and clarifying customer requests. Feedback is used and analyzed to improve the quality of services. CE-GEN010, *Handling Customer Feedback* is in place for these events.

3.5 Document Control and Records

Procedures for control and maintenance of documents are described in CE-GEN005, *Document Control.* The requirements of the SOP apply to all laboratory logbooks (standards, maintenance, run logbooks, etc), certificates of analysis, SOPs, QAMs, quality assurance project plans (QAPPs), Environmental Health & Safety (EHS) manuals, and other controlled ALS Environmental, Kelso documents.

Each controlled copy of a controlled document will be released only after a document control number is assigned and the recipient is recorded on a document distribution list. Filing and distribution is performed by the QA PM, or designee, and ensure that only the most current version of the document is distributed and in use. A document control number is assigned to logbooks. Completed logbooks that are no longer in use are archived in a master logbook file. Logbook entries are standardized following CE-QA007, *Making Entries into Logbooks and onto Benchsheets.* The entries made into laboratory logbooks are reviewed and approved at a regular interval (quarterly).

A records system is used which ensures all laboratory records (including raw data, reports, and supporting records) are retained and available. The archiving system is described in ADM-ARCH, *Data Archiving.*

External documents relative to the management system are managed by the QA PM. To prevent the use of invalid and/or outdated external documents, the laboratory maintains a master list of current documents and their availability. The list is reviewed before making the documents available. External documents are not issued to personnel.

3.6 Subcontracting

Analytical services are subcontracted when the laboratory needs to balance workload or when the requested analyses are not performed by the laboratory. Subcontracting is only done with the knowledge and approval of the client and to qualified laboratories. Subcontracting to another ALS Environmental Group laboratory is preferred over external-laboratory subcontracting. Further, subcontracting is done using capable and qualified laboratories. Established procedures are used to qualify external subcontract laboratories. These procedures are described in CE-QA004, *Qualification of Subcontract Laboratories.* The Quality Assurance staff is responsible for maintaining a list of qualified subcontract laboratories.

3.7 Procurement

The quality level of reagents and materials (grade, traceability, etc.) required is specified in analytical SOPs. Department supervisors ensure that the proper materials are purchased. Inspection and verification of material ordered is performed at the time of receipt by receiving personnel. The receiving staff labels the material with the date received. Expiration dates are

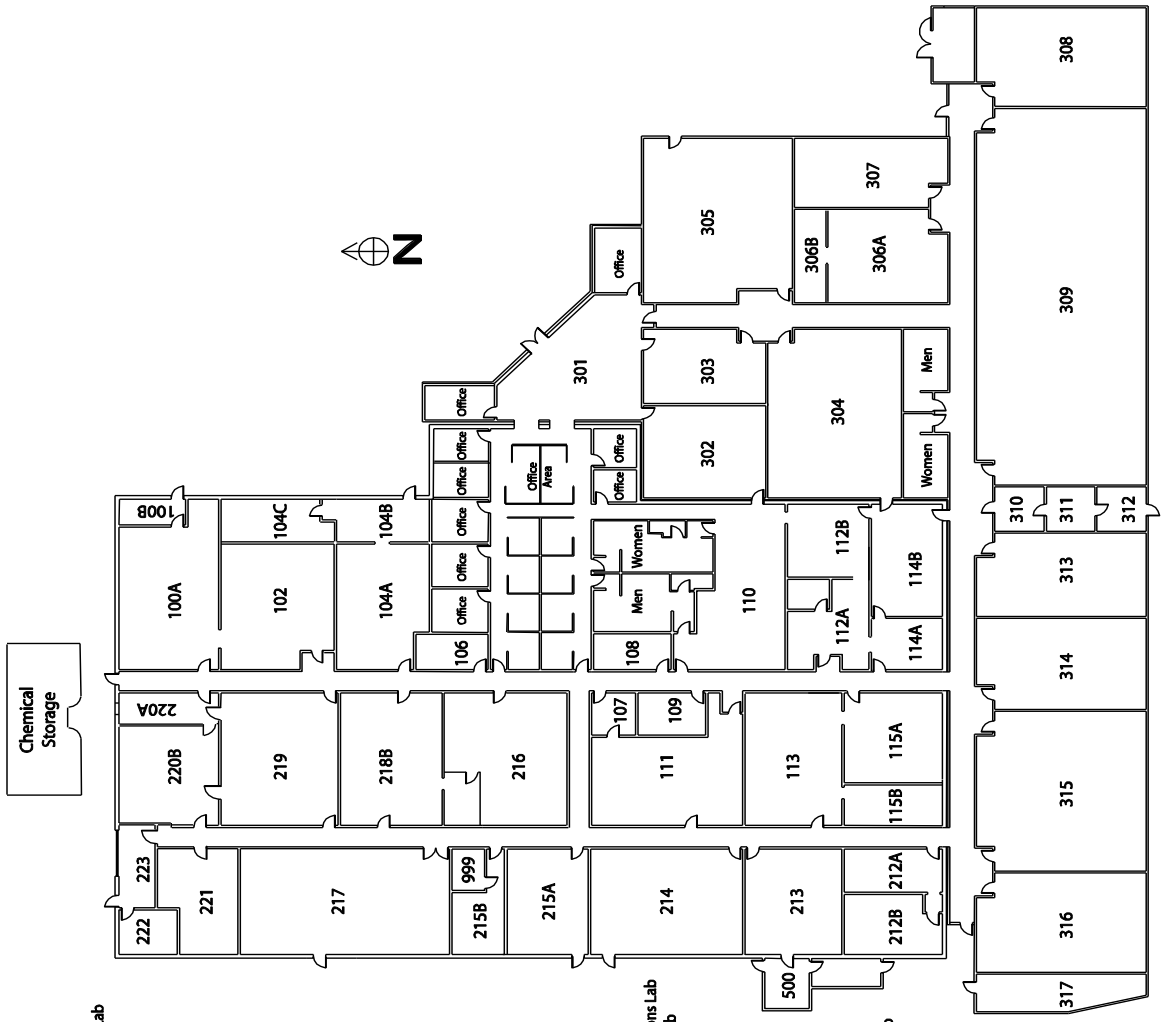
assigned as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. CE-QA012, *Quality of Reagents and Standards* and ADM-RLT, *Reagent and Standards Login and Tracking* provides default expiration requirements. Supplies and services that are critical in maintaining the quality of laboratory testing are procured from pre-approved vendors. The policy and procedure for purchasing and procurement are described in CE-GEN007, *Procurement and Control of Laboratory Services and Supplies*. Also, refer to section 9.4 for a discussion of reference materials.

Receipt procedures include technical review of the purchase order/request to verify that what was received is identical to the item ordered. The laboratory checks new lots of reagents for unacceptable levels of contamination prior to use in sample preservation, sample preparation, and sample analysis by following ADM-RLT, *Reagent and Standards Login and Tracking*.

3.8 Review of Requests, Tenders and Contracts (Procedures for Accepting New Work)

Requests for new work are reviewed prior to signing any contracts or otherwise agreeing to perform the work. The specific methods to be used are agreed upon between the laboratory and the client. A capability review is performed to determine if the laboratory has or needs to obtain certification to perform the work, to determine if the laboratory has the resources (personnel, equipment, materials, capacity, skills, expertise) to perform the work, and if the laboratory is able to meet the client's required reporting and QC limits. The results of this review are communicated to the client and any potential conflict, deficiency, lack of appropriate accreditation status, or concerns of the ability to complete the client's work are resolved. Any differences between the request or tender and the contract shall be resolved before any work commences. The client should be notified at this time if work is expected to be subcontracted. Each contract shall be acceptable both to the laboratory and the client. Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work. If a contract needs to be amended after work has commenced, the contract review process is repeated and any amendments are communicated to all affected personnel. Changes in accreditation status affecting ongoing projects must be reported to the client.

Figure 3-2
ALS Environmental, Kelso Laboratory Floor Plan



Room #	
100A	Semivolatile Organics GC Instrument Lab
100B	Electrical Room
102	Semivolatile Organics GC Office
104 A - C	Organics LC Labs and Offices
106	Deionized Water System Room
107	Oven Room
108	Zero Headspace Extraction Lab
109	Storeroom
110	Lunch Room
111	General Chemistry Lab
112A	Microbiology Lab
112B	Copy Center
113	ICP MS Lab
114A	Grain Size
114B	Total Solids/Oven Room
115A	ICP Lab
115B	Metals Reporting
212A	Mercury and Flame AA Lab
212B	Low Level Mercury Lab
213	General Chemistry Lab
214	General Chemistry Lab
215A	Drinking Water Lab
215B	Information Technology
216	Data Review & Storage
217	Sample Storage
218	Volatiles Organics Lab
219	Semivolatile Organics GC/MS Lab
220A	Semivolatile Organics GC/MS Office
220B	Semivolatile Organics GC/MS Extractions Lab
221	Drinking Water Sample Preparation Lab
222	Purchasing Office
223	General Receiving
301	Reception Lobby
302	Lunch Room
303	Conference Room
304	Sample Storage
305	Sample Receiving
306A	Pharmaceutical Metals
306B	Pharmaceutical Microbiology
307	Pharmaceutical Instrument Lab
308	Pharmaceutical General Chemistry Lab
309	Organics Sample Preparation Lab
310	Communication Room
311	Electrical Room
312	Fire Room/Water System
313	Glass Wash Room
314	Clean Room
315	Metals Digestion Room
316	Tissue Preparation
317	Mechanical
500	Janitorial Room
999	Computer Room

4.0 PROFESSIONAL CONDUCT, DATA INTEGRITY, AND ETHICS

One of the most important aspects of the success of ALS, Kelso is the emphasis placed on the integrity of the data provided and the services rendered. This success is reliant on both the professional conduct of all employees within ALS, Kelso as well as established laboratory practices. All personnel involved with environmental testing and calibration activities must familiarize themselves with the quality documentation and implement the policies and procedures in their work.

4.1 Professional Conduct

To promote quality, ALS, Kelso requires certain standards of conduct and ethical performance among employees. The following examples of documented CAS policy are representative of these standards, and are not intended to be limiting or all-inclusive:

- Under no circumstances is the willful act of fraudulent manipulation of analytical data condoned. Such acts are to be reported immediately to senior management for appropriate corrective action.
- Unless specifically required in writing by a client, alteration, deviation or omission of written contractual requirements is not permitted. Such changes must be in writing and approved by senior management.
- Falsification of data in any form will not be tolerated. While much analytical data is subject to professional judgment and interpretation, outright falsification, whenever observed or discovered, will be documented, and appropriate remedies and punitive measures will be taken toward those individuals responsible.
- It is the responsibility of all ALS Environmental, Kelso employees to safeguard sensitive company information, client data, records, and information; and matters of national security concern should they arise. The nature of our business and the well being of our company and of our clients is dependent upon protecting and maintaining proprietary company/client information. All information, data, and reports (except that in the public domain) collected or assembled on behalf of a client is treated as confidential. Information may not be given to third parties without the consent of the client. Unauthorized release of confidential information about the company or its clients is taken seriously and is subject to formal disciplinary action. All employees sign a confidentiality agreement upon hire to protect the company and client's confidentiality and proprietary rights.

4.2 Prevention and Detection of Improper, Unethical or Illegal Actions

It is the intention of ALS, Kelso to proactively prevent and/or detect any improper, unethical or illegal action conducted within the laboratory. This is performed by the implementation of a program designed for not only the detection but also prevention. Prevention consists of educating all laboratory personnel in their roles and duties as employees, company policies, inappropriate practices, and their corresponding implications as described here.
In addition to education, appropriate and inappropriate practices are included in SOPs such as manual integration, data review and specific method procedures. Electronic and hardcopy data audits are performed regularly, including periodic audits of chromatographic electronic data. Requirements are described in the Policy for Internal Quality Assurance Audits and details are listed in laboratory administrative SOPs. All aspects of this program are documented and retained on file according to the company policy on record retention.

The ALS Employee Handbook also contains information on the ALS ethics and data integrity program, including mechanisms for reporting and seeking advice on ethical decisions.

4.3 Laboratory Data Integrity and Ethics Training

Each employee receives in-depth core Data Integrity/Ethics Training. New employees are given a QA and Ethics orientation within the first month of hire, followed by the core training within 1 year of hire. On an ongoing basis, all employees receive semi-annual ethics refresher training. Topics covered are documented in writing and all training is documented. It is the responsibility of the QA PM to ensure that the training is conducted as described.

Key topics covered are the organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting, how and when to report data integrity issues and record keeping. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedure documentation.

Trainees are required to understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, or civil/criminal prosecution.

The training session includes many concepts and topics, numerous examples of improper actions (defined by DoD as deviations from contract-specified or method-specified analytical practices and may be intentional or unintentional), legal and liability implications (company and personal), causes, prevention, awareness, and reporting mechanisms.

4.4 Management and Employee Commitment

ALS Environmental, Kelso makes every attempt to ensure that employees are free from any commercial, financial, or other undue pressures that might affect their quality of work. Related policies are described in the ALS Employee Handbook. This includes:

- ALS Open Door Policy (ALS Employee Handbook) - Employees are encouraged to bring any work related problems or concerns to the attention of local management or their Human Resources representative. However, depending on the extent or sensitivity of the concern, employees are encouraged to directly contact any member of upper management.
- Faircall - An anonymous and confidential reporting system available to all employees that is used to communicate misconduct and other concerns. The program shall help minimize negative morale, promote a positive work place, and encourage reporting suspected misconduct without retribution. Associated upper management is notified and the investigations are documented.
- Use of flexible work hours. Within reason and as approved by supervisors, employees are allowed flexible work hours in order to help ease schedule pressures which could impact decision-making and work quality.
- Operational and project scheduling assessments are continually made to ensure that project planning is performed and that adequate resources are available during anticipated periods of increased workloads. Procedures for subcontracting work are

established, and within the ALS Environmental laboratory network additional capacity is typically available for subcontracting, if necessary.

- Gifts and Favors (ALS Employee Handbook) – To avoid possible conflict of interest implications, employees do not receive unusual gifts or favors to, nor accept such gifts or favors from, persons outside the Company who are, or may be, in any way concerned with the projects on which the Company is professionally engaged.

All employees are required to sign and adhere to the requirements set forth in the ALS Environmental *Confidentiality Agreement* and *Code of Conduct Policy.*

5.0 ORGANIZATION AND RESPONSIBILITIES

The ALS Environmental, Kelso staff, consisting of approximately 150 employees, includes chemists, technicians and support personnel. They represent diverse educational backgrounds and experience, and provide the comprehensive skills that the laboratory requires. During seasonal workload increases, additional temporary employees may be hired to perform specific tasks.

CAS is committed to providing an environment that encourages excellence. All employees share the responsibility for maintaining and improving the quality of our analytical services. The responsibilities of key personnel within the laboratory are described below. Table 5-1 lists the ALS Environmental, Kelso personnel assigned to these key positions. Managerial staff members are provided the authority and resources needed to perform their duties. An organizational chart of the laboratory, as well as the resumes of these key personnel, can be found in Appendix B.

- The role of the **Laboratory Director** is to provide technical, operational, and administrative leadership through planning, allocation and management of personnel and equipment resources. The Laboratory Director provides leadership and support for the QA program and is responsible for overall laboratory efficiency and the financial performance of the (Location) facility. The Laboratory Director has the authority to stop work in response to quality problems. The Laboratory Director also provides resources for implementation of the QA program, reviews and approves this QA Manual, reviews and approves standard operating procedures (SOPs), and provides support for business development by identifying and developing new markets through continuing support of the management of existing client activities.

- The **Quality Assurance Manager (QAM)** has the authority and responsibility for implementing, maintaining, and improving the quality system. This includes coordination of QA activities within the laboratory, ensuring that all personnel understand their contributions to the quality system, ensuring communication takes place at all levels within the laboratory regarding the effectiveness of the quality system, evaluating the effectiveness of training; and monitor trends and continually improve the quality system. Audit and surveillance results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews can all are used to support quality system implementation. The QAM is responsible for ensuring compliance with NELAC standards (and ISO, DoD QSM, etc. as applicable). The QAM works with laboratory staff to establish effective quality control and assessment plans and has the authority to stop work in response to quality problems. The QAM is responsible for maintaining the QA Manual and performing an annual review of it; reviewing and approving SOPs and ensuring the annual review of technical SOPs; maintaining QA records such as metrological records, archived logbooks, PT results, etc.; document control; conducting PT sample studies; approving nonconformity and corrective action reports; maintaining the laboratory's certifications and approvals; and performing internal QA audits.

  The QAM reports directly to the Laboratory Director and also reports indirectly to the Manager of Quality Assurance, USA. It is important to note that when evaluating data, the QAM does so in an objective manner and free of outside, or managerial, influence.

  The Manager of Quality Assurance, USA is responsible for the overall QA program at all the ALS Environmental Group laboratories. The Manager of Quality Assurance, USA is responsible for oversight of QAMs regulatory compliance efforts (NELAC, ISO, DOD, etc). The Manager of Quality

Assurance, USA performs annual internal audits at each laboratory; maintains a database of laboratory certification/accreditation programs; approves company-wide SOPs; maintains a database of approved subcontract laboratories; provides assistance to the laboratory QA staff and laboratory managers; prepares a quarterly QA activity report; etc.

- In the case of absence of the Laboratory Director or QAM, deputies are assigned to act in that role. Default deputies for these positions are the Client Services Manager or Metals Department Manager (for the Laboratory Director) and the Laboratory Director (for the QAM).
- In the event that work is stopped in response to quality problems, only the Laboratory Director or Quality Assurance Manager has the authority to resume work.

- The **Environmental Health and Safety Officer** (EH&S) is responsible for the administration of the laboratory health and safety policies. This includes the formulation and implementation of safety policies, the supervision of new-employee safety training, the review of accidents, incidents and prevention plans, the monitoring of hazardous waste disposal and the conducting of departmental safety inspections. The EH&S officer is also designated as the Chemical Hygiene Officer. The EH&S Officer has a dotted-line reporting responsibility to ALS Kelso's EH&S Director.
- The **Client Services Manager** is responsible for the Client Services Department defined for the laboratory (i.e. Project Managers, electronic deliverables, etc.) and the sample management office/bottle preparation sections. The Client Services Department provides a complete interface with clients from initial project specification to final deliverables. Sample management handles all activities associated with receiving, storage, and disposal of samples. The Client Services Manager has the authority to stop subcontractor work in response to quality problems.
- The **Project Manager** is a scientist assigned to each client to act as a technical liaison between the client and the laboratory. The Project Manager is responsible for ensuring that the analyses performed by the laboratory meet all project, contract, and regulatory-specific requirements. This entails coordinating with the ALS Environmental, Kelso laboratory and administrative staff to ensure that client-specific needs are understood and that the services ALS Environmental, Kelso provides are properly executed and satisfy the requirements of the client.
- The Analytical Laboratory is divided into operational units based upon specific disciplines. Each department is responsible for establishing, maintaining and documenting a QC program meeting department needs. Each **Department Manager and Supervisor** has the responsibility to ensure that QC functions are carried out as planned, and to guarantee the production of high quality data. Managers and bench-level supervisors monitor the day-to-day operations to ensure that productivity and data quality objectives are met. A department manager has the authority to stop work in response to quality problems in their area. Analysts have the responsibility to carry out testing according to prescribed methods, SOPs, and quality control guidelines particular to the laboratory in which he/she is working.
- The **Sample Management Office** plays a key role in the laboratory QA program by maintaining documentation for all samples received by the laboratory, and by assisting in the archival of all laboratory results. The sample management office staff is also responsible for the proper disposal of samples after analysis.
- **Information Technology** (IT) staff is responsible for the administration of the Laboratory Information Management System (LIMS) and other necessary support services. Other functions of the

IT staff include laboratory network maintenance, IT systems development and implementation, education of analytical staff in the use of scientific software, Electronic Data Deliverable (EDD) generation, and data back-up, archival and integrity operations.

Table 5-1
Summary of Technical Experience and Qualifications

Personnel	Years of Experience	Project Role
Jeff Grindstaff, B.S.	23	Laboratory Director
Suzanne LeMay, B.S.	25	Quality Assurance Program Manager
Lynda Huckestein, B.S.	23	Client Services Manager Sample Management Office Manager
Jeff Coronado, B.S.	22	Metals Department Manager
Harvey Jacky, B.S.	23	General Chemistry Department Manager
Loren Portwood	23	Semi-Volatile Organics Department Manager
Jon James, B.A.	21	HPLC, GC/MS Organics Department Manager
Christina Kerksieck, B.S.	4	Microbiology Technical Manager
Eileen Arnold, B.A.	30	Environmental Health and Safety Officer
Mike Sullivan, B.S.	12	Information Technology

6.0 INFORMATION MANAGEMENT

The generation, compilation, reporting, and archiving of electronic data is a critical component of laboratory operations. In order to generate data of known and acceptable quality, the quality assurance systems and quality control practices for electronic data systems must be complete and comprehensive and in keeping with the overall quality assurance objectives of the organization. CAS management provides the tools and resources to implement electronic data systems and establishes information technology standards and policies. Appendix C lists major computing equipment.

6.1 Software Quality Assurance Plan

ALS Environmental, Kelso has defined practices for assuring the quality of the computer software used throughout all laboratory operations to generate, compile, report, and store electronic data. These practices are described in the *ALS Information Management Policy*. The purpose of the SQAP is to describe the policies and practices for the procurement, configuration management, development, validation and verification, data security, maintenance, and use of computer software. The policies and practices described in the plan apply to purchased computer software as well as to internally developed computer software. Key components of this plan are policies for software validation and control.

6.2 IT Support

The local ALS Environmental, Kelso Information Technology (IT) department is established to provide technical support for all computing systems. The IT department staff continually monitors the performance and output of operating systems. The IT department oversees routine system maintenance and data backups to ensure the integrity of all electronic data. A software inventory is maintained. Additional IT responsibilities are described in the *ALS Information Management Policy*.

In addition to the local IT department, ALS Environmental, Corporate IT provides support for network-wide systems. ALS Environmental also has personnel assigned to information management duties such as development and implementation of reporting systems; data acquisition, and Electronic Data Deliverable (EDD) generation.

6.3 Information Management Systems

ALS Environmental, Kelso has various systems in place to address specific data management needs. The ALS Environmental, Kelso Laboratory Information Management System (LIMS) is used to manage sample information and invoicing. Access is controlled by password. This system defines sample identification, analysis specifications, and provides a means of sample tracking. This system is used during sample login to generate the internal service request. Included on the service request is a summary of client information, sample identification, required analyses, work instructions, deliverable requirements. The LIMS is used to track the status of a sample and is important in maintaining internal chain of custody.

Where possible, instrument data acquired locally is immediately moved to a server (Microsoft Windows2003® domain). This provides a reliable, easily maintained, high-volume acquisition and storage system for electronic data files. With password entry, users may access the system from

many available computer stations, improving efficiency and flexibility. The server is also used for data reporting, EDD generation, and administrative functions. Access to these systems is controlled by password. A standardized EDI (electronic data interchange) format is used as a reporting platform, providing functionality and flexibility for end users. With a common standardized communication platform, the EDI provides data reporting in a variety of hardcopy and electronic deliverable formats, including Staged Electronic Data Deliverable (SEDD) format.

6.4 Backup and Security

ALS Environmental, Kelso laboratory data is either acquired directly to the centralized acquisition server or acquired locally and then transferred to the server. All data is eventually moved to the centralized data acquisition server for reporting and archiving. Differential backups are performed on all file server information once per day, Sunday through Thursday. Full backups are performed each Friday night. Tapes are physically stored in a locked media cabinet within a locked, temperature controlled computer room, with every other full backup also securely stored offsite.

Access to sample information and data is on a need-to-know basis. Access is restricted to the person's areas of responsibility. Passwords are required on all systems. No direct external, non-ALS Environmental, Kelso access is allowed to any of our network systems.

The external e-mail system and Internet access is established via a single gateway to discourage unauthorized entry. ALS Environmental, Kelso uses a closed system for company e-mail. Files, such as electronic deliverables, are sent through the external e-mail system only via a trusted agent. The external messaging system operates through a single secure gateway. Email attachments sent in and out of the gateway are subject to a virus scan. Because the Internet is not regulated, we use a limited access approach to provide a firewall for added security. Virus screening is performed continuously on all network systems.

7.0 SAMPLE MANAGEMENT

7.1 Sampling and Sample Preservation

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve and store samples. ALS Environmental, Kelso recommends that clients follow sampling guidelines described in 40 CFR 136, 40 CFR 141, USEPA SW-846, and state-specific sampling guidelines, if applicable. Sampling factors that must be taken into account to insure accurate, defensible analytical results include:

- Amount of sample taken
- Type of container used
- Type of sample preservation
- Sample storage time
- Proper custodial documentation

ALS Environmental, Kelso uses the sample preservation, container, and holding-time recommendations published in a number of documents. The primary documents of reference are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IV for hazardous waste samples; USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, and Supplements; EPA 40CFR parts 136 and 141; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples (see Section 18 for complete citations). The container, preservation and holding time information for these references is summarized in Table 7-1 for soil, water, and drinking water. The current EPA CLP Statement of Work should be referred to for CLP procedures. Where allowed by project sampling and analysis protocols (such as Puget Sound Protocols) the holding time for sediment, soil, and tissue samples may be extended for a defined period when stored frozen at -20°C.

ALS Environmental, Kelso routinely provides sample containers with appropriate preservatives for our clients. Containers are purchased as precleaned to a level 1 status, and conform to the requirements for samples established by the USEPA. Certificates of analysis for the sample containers are available to clients if requested. Reagent water used for sampling blanks (trip blanks, etc.) and chemical preservation reagents are tested by the laboratory to ensure that they are free of interferences and documented. Our sample kits typically consist of foam-lined, precleaned shipping coolers, (cleaned inside and out with appropriate cleaner, rinsed thoroughly and air-dried), specially prepared and labeled sample containers individually wrapped in protective material, (VOC vials are placed in a specially made, foam holder), chain-of-custody (COC) forms, and custody seals. Container labels and custody seals are provided for each container.

Figure 7-1 shows the chain-of-custody form routinely used at ALS Environmental, Kelso and included with sample kits. For large sample container shipments, the containers may be shipped in their original boxes. Such shipments will consist of several boxes of labeled sample containers and sufficient materials (bubble wrap, COC forms, custody seals, shipping coolers, etc.) to allow the sampling personnel to process the sample containers and return them to Columbia Analytical. The proper preservative is added to the sample containers prior to shipment, unless otherwise instructed by the client.

If any returning shipping cooler exhibits an odor or other abnormality after receipt and subsequent decontamination by laboratory personnel, a second, more vigorous decontamination process is employed. Containers exhibiting an odor or abnormality after the second decontamination process are promptly and properly discarded. ALS Environmental, Kelso keeps client-specific shipping requirements on file and utilizes major transportation carriers to guarantee that sample shipping requirements (same-day, overnight, etc.) are met. ALS Environmental, Kelso also provides courier service that makes regularly scheduled trips to the Greater Portland, Oregon Metropolitan area.

When ALS Environmental, Kelso ships environmental samples to other laboratories for analysis each sample bottle is wrapped in protective material and placed in a plastic bag (preferably Ziploc®) to avoid any possible cross-contamination of samples during shipping. The sample management office (SMO) follows formalized procedures (SMO-GEN) for maintaining the samples' chain of custody, packaging and shipment. Dry ice or gel ice is the only temperature preservative used by ALS Kelso, unless otherwise specified by the client or receiving laboratory.

7.2 Sample Receipt and Handling

Standard Operating Procedures (SMO-GEN) are established for the receiving of samples into the laboratory. These procedures ensure that samples are received and properly logged into the laboratory, and that all associated documentation, including chain of custody forms, is complete and consistent with the samples received.

Once samples are delivered to the ALS Environmental, Kelso sample management office (SMO), a Cooler Receipt and Preservation Check Form (CRF - See Figure 7-2 for an example) is used to assess the shipping cooler and its contents as received by the laboratory personnel. Verification of sample integrity includes the following activities:

- Assessment of custody seal presence/absence, location and signature;
- Temperature of sample containers upon receipt;
- Chain of custody documents properly used (entries in ink, signature present, etc.);
- Sample containers checked for integrity (broken, leaking, etc.);
- Sample is clearly marked and dated (bottle labels complete with required information);
- Appropriate containers (size, type) are received for the requested analyses;
- The minimum amount of sample material is provided for the analysis.
- Sample container labels and/or tags agree with chain of custody entries (identification, required analyses, etc.);
- Assessment of proper sample preservation (if inadequate, corrective action is employed); and
- VOC containers are inspected for the presence/absence of bubbles. (Assessment of proper preservation of VOC containers is performed by lab personnel).

Samples are logged into a Laboratory Information Management System (LIMS). Any anomalies or discrepancies observed during the initial assessment are recorded on the CRF and COC documents. Potential problems with a sample shipment are addressed by contacting the client and discussing the pertinent issues. When the Project Manager and client have reached a satisfactory resolution, the login process may continue and analysis may begin. During the login process, each sample container is given a unique laboratory code and a service request form is generated. The LIMS generates a Service Request that contains client information, sample descriptions, sample matrix information, required analyses, sample collection dates, analysis due

dates and other pertinent information. The service request is reviewed by the appropriate Project Manager for accuracy, completeness, and consistency of requested analyses and for client project objectives.

Samples are stored as per method requirements until they undergo analysis, unless otherwise specified, using various refrigerators or freezers, or designated secure areas. ALS Environmental, Kelso has five walk-in cold storage units which house the majority of sample containers received at the laboratory. In addition, there are four additional refrigerators, including dedicated refrigerated storage of VOC samples. The dedicated storage areas for VOC samples are monitored using storage blanks, as described in VOC-BLAN, *VOA Storage Blanks*. ALS Environmental, Kelso also has nine sub-zero freezers capable of storing samples at -10 to -30° C primarily used for tissue and sediment samples requiring specialized storage conditions. The temperature of each sample storage unit is monitored real time with an electronic temperature monitoring system.

ALS Environmental, Kelso adheres to the method-prescribed or project-specified holding times for all analyses. The sampling date and time are entered into the LIMS system at the time of sample receipt and login. Analysts then monitor holding times by obtaining analysis-specific reports from the LIMS. These reports provide holding time information on all samples for the analysis, calculated from the sampling date and the holding time requirement. To document holding time compliance, the date and time analyzed is printed or written on the analytical raw data. For analyses with a holding time prescribed in hours it is essential that the sample collection time is provided, so holding time compliance can be demonstrated. If not, the sample collection time is assumed as the earliest in the day (i.e. the most conservative). Unless other arrangements have been made in advance, upon completion of all analyses and submittal of the final report, aqueous samples and sample extracts are retained at ambient temperature for 30 days, soil samples are retained at ambient temperature for 60 days, and tissue samples are retained frozen for 3 months. Upon expiration of these time limits, the samples are either returned to the client or disposed of according to approved disposal practices. All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. All hazardous waste samples are disposed of according to formal procedures outlined in the *ALS Environmental Health and Safety Manual.* All waste produced at the laboratory, including the laboratory's own various hazardous waste streams, is treated in accordance with applicable local and Federal laws. Documentation is maintained for each sample from initial receipt through final disposal to ensure that an accurate history of the sample from "cradle to grave" is available.

7.3 Sample Custody

Sample custody transfer at the time of sample receipt is documented using chain-of-custody (COC) forms accompanying the samples. During sample receipt, it is also noted if custody seals were present. This is described in *SMO-GEN, Sample Receiving*. Figure 7-1 is a copy of the chain-of-custody form routinely used at Columbia Analytical.

Facility security and access is important in maintaining the integrity of samples received at Columbia Analytical-Kelso. Access to the laboratory facility is limited by use of locked exterior doors with a coded entry, except for the reception area and sample receiving doors, which are manned during business hours and locked at all other times. In addition, the sample storage area within the laboratory is a controlled access area with locked doors with a coded entry. The

ALS Environmental, Kelso facility is equipped with an alarm system and ALS Environmental, Kelso employs a private security firm to provide nighttime and weekend security.

A barcoding system is used to document internal sample custody. Each person removing or returning samples from/to sample storage while performing analysis is required to document this custody transfer. The system uniquely identifies the sample container and provides an electronic record of the custody of each sample. For sample extracts and digestates the analyst documents custody of the sample extract or digestate by signing on the benchsheet, or custody record, that they have accepted custody. The procedures are described in the *SOP for Sample Tracking and Internal Chain of Custody (SMO-SCOC).*

7.4 Project Setup

The analytical method(s) used for sample analysis are chosen based on the client's requirements. Unless specified otherwise, the most recent versions of reference methods are used. For SW-846 methods, some projects may require the most recent *promulgated* version, and some projects may require the most recent *published* version. The Project Manager will ensure that the correct method version is used. LIMS codes are chosen to identify the analysis method used for analysis. The Project Manager ensures that the correct methods are selected for analysis, deliverable requirements are identified, and due dates are specified on the service request. To communicate and specify project-specific requirements, a Tier V form (Figure 7-3) is used and accompanies the service request form.

Table 7-1
Sample Preservation and Holding Times

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Bacterial Tests				
Coliform, Colilert (SM 9223)	W, DW	P, Bottle or Bag	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Coliform, Fecal and Total (SM 9221, 9222D)	W, S, DW	P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Fecal Streptococci (SM 9230B)	W	P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Inorganic Tests				
Acidity (SM 2310B)	W	P,G	Cool, 4°C	14 days[EPA]
Alkalinity (SM 2320B)	W, DW	P,G	Cool, 4°C	14 days[EPA]
Ammonia (SM 4500NH3)	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Biochemical Oxygen Demand(SM 5210B)	W	P,G	Cool, 4°C	48 hours
Bromate (EPA 300.1)	W, DW	P,G	50mg/L EDA, cool to 4°C	28 days
Bromide (EPA 300.1)	W, DW	P,G	None Required	28 days
Chemical Oxygen Demand (SM 5220C)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Chloride (EPA 300.0)	W, DW	P,G	None Required	28 days
Chloride (EPA 9056)	W, S	P,G	Cool, 4°C	28 days
Chlorine, Total Residual (SM 4500 Cl F)	W,S	P,G	None Required	24 hours
Chlorite (EPA 300.1)	W, DW	P,G	50mg/L EDA, cool to 4°C	14 days
Chlorophyll-A (SM 11200H)	W	G Amber	Cool, 4°C	Analyze immediately
Chromium VI (EPA 7196A)	W	P,G	Cool, 4°C	24 hours
Color (SM 2120B)	W, DW	P,G	Cool, 4°C	48 hours

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Cyanide, Total and Amenable to Chlorination (EPA 335.4, 9010, 9012) (SM 4500CN E,G)	W, S,DW	P,G	Cool, 4°C, NaOH to pH>12, plus 0.6 g Ascorbic Acid	14 days
Cyanide, Weak Acid Dissociable (SM 4500CN I)	W,S	P,G	Cool, 4°C, NaOH to pH >12	14 days
Ferrous Iron (CAS SOP)	W, D	G Amber	Cool, 4°C	24 hours
Fluoride (EPA 300.0, SM 4500 F-C)	W,S	P,G	Cool, 4°C	28 days
Fluoride (EPA 9056)	W,S	P,G	Cool, 4°C	Analyze immediately
Formaldehyde (ASTM D6303)	W	G Amber	Cool, 4°C	48 hours
Hardness (SM 2340C)	W, DW	P,G	HNO_3 to pH<2	6 months
Hydrogen Ion (pH) (SM 4500H B)	W, DW	P,G	None Required	Analyze immediately
Kjeldahl and Organic Nitrogen (ASTM D3590-89)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrocellulose	S	G	Cool, 4°C	28 days
Nitrate (EPA 300.0)	W, DW	P,G	Cool, 4°C	48 hours
Nitrate (EPA 353.2)	W, S	P,G	Cool, 4°C, H_2SO_4 to pH<2	48 hours
Nitrate (EPA 9056)	W,S	P,G	Cool, 4°C	Analyze immediately
Nitrate-Nitrite (EPA 353.2)	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrite (EPA 300.0)	W, DW	P,G	Cool, 4°C	48 hours
Nitrite (EPA 353.2)	W, S	P,G	Cool, 4°C, H_2SO_4 to pH<2	48 hours
Nitrite (EPA 9056)	W,S	P,G	Cool, 4°C	Analyze immediately
Orthophosphate (SM 4500 P-E)	W, DW	P,G	Cool, 4°C	Analyze immediately
Oxygen, Dissolved (Probe) (SM 4500O G)	W, DW	G, Bottle and Top	None Required	Analyze immediately

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Oxygen, Dissolved (Winkler)	W, DW	G, Bottle and Top	Fix on Site and Store in Dark	8 hours
Phenolics, Total (EPA 420.1,9056)	W, S	G Amber	Cool, 4°C, H_2SO_4 to pH<4	28 days
Perchlorate (EPA 314.0)	W, DW,S	P,G	Protect from temp. extremes	28 days
Phosphorus, Total (EPA 365.3)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Residue, Total (SM 2540B)	W	P,G	Cool, 4°C	7 days
Residue, Filterable (TDS) (SM2540C)	W	P,G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS) (SM 2540D)	W	P,G	Cool, 4°C	7 days
Residue, Settleable (SM 2540F)	W	P,G	Cool, 4°C	48 hours
Residue, Volatile (EPA 160.4)	W	P,G	Cool, 4°C	7 days
Silica (SM 4500SiO2 C)	W	P Only	Cool, 4°C	28 days
Specific Conductance(SM 2510 B)	W, DW	P,G	Cool, 4°C	28 days
Sulfate (EPA 300.0)	W, DW	P,G	Cool, 4°C	28 days
Sulfate (EPA 9056)	W, S	P,G	Cool, 4°C	28 days
Sulfide (SM 4500S2 D)	W	P,G	Cool, 4°C, Add Zinc Acetate,plus Sodium Hydroxide to pH>9	7 days
Sulfide (SM 4500S2 F)	W	P,G	Cool, 4°C, Add Zinc Acetate,plus Sodium Hydroxide to pH>9	7 days
Sulfide (9030/934)	W, S	P,G	Cool, 4°C, Add Zinc Acetate,plus Sodium Hydroxide to pH>9	7 days
Sullfides, Acid Voaltile	S	G	Cool, 4°C	14 days
Sulfite (SM 4500SO3 B)	W	P,G	None Required	24 hours

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Surfactants (MBAS) (SM 5540 C)	W	P,G	Cool, 4°C	48 hours
Tannin and Lignin (SM 5550B)	W	P,G	Cool, 4°C	28 days
Turbidity (EPA 180.1)	W, DW	P,G	Cool, 4°C	48 hours
Oil and Grease, Hexane Extractable Material (EPA 1664)	W	G, Teflon-Lined Cap	Cool, 4°C, H_2SO_4 or HCL to pH<2	28 days
Organic Carbon, Total (9060 & SM 5310 C)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Organic Carbon, Total (ASTM-D4129)	S	P,G	Cool, 4°C	28 days
Organic Halogens, Total (EPA 9020)	W	G, Teflon-Lined Cap	Cool, 4°C, H_2SO_4 to pH<2, No headspace	28 days
Organic Halogens, Adsorbable (EPA 1650B)	W	G, Teflon-Lined Cap	Cool, 4°C, HNO_3 to pH<2	6 months
Metals				
Chromium VI (EPA 7195/7191)	W	P,G	Cool, 4°C	24 hours
Metals (200.7, 200.8, 200.9, 6010, 6020)	W,DW	P,G	HNO_3 to pH<2	6 months
Metals (200.7, 200.8, 200.9, 6010, 6020)	S	G, Teflon-Lined cap	Cool, 4°C	6 months
Mercury (EPA 245.1, 7470, 7471)	W, DW	P,G	HNO_3 to pH<2	28 days
Mercury (7471)	S	P,G	Cool, 4°C	28 days
1631E	W	F	Cool, 4°C, HCl or H_2SO_4 to pH<2	90 days
1631E	S	F	Freeze < -15°C	1 Yr
Methyl Mercury 1630	W,S,T	F	HCL to pH<2	6 months
Arsenic Species 1632	W	G	HCL to pH<2, Cool < 4°C	28 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Volatile Organics				
Gasoline Range Organics (8015, NWTPH-Gx)	W	G, Teflon-Lined, Septum Cap	Cool, 4°C, HCl to pH<2, No headspace	14 days
Gasoline Range Organics (8015, NWTPH-Gx)	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days
Purgeable Halocarbons (624, 8021, 8260)	W	G, Teflon-Lined, Septum Cap	**No Residual Chlorine Present**: HCl to pH<2, Cool, 4°C, No Headspace	14 days
Purgeable Halocarbons (624, 8021, 8260)	W	G, Teflon-Lined, Septum Cap	**Residual Chlorine Present**: 10% $Na_2S_2O_3$, HCl to pH<2, Cool, 4°C	14 days
Purgeable Halocarbons (8021, 8260)	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days
Purgeable Halocarbons (8021, 8260)	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4C	48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Halocarbons (8021, 8260)	S	Method 5035	Sodium Bisulfate Cool, 4°C	48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	W	G, Teflon-Lined,Septum Cap, No Headspace	**No Residual Chlorine Present**: HCl to pH<2, Cool, 4°C, No Headspace	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	W	G, Teflon-Lined,Septum Cap, No Headspace	**Residual Chlorine Present**: 10% $Na_2S_2O_3$, HCl to pH<2, Cool 4°C	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4C	48 hrs to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8021, 8260)	S	Method 5035	Sodium Bisulfate Cool, 4°C	48 hrs to prepare from Encore, 14 days after preparation.
Acrolein, Acrylonitrile, Acetonitrile (624, 8260)	W	G, Teflon-Lined, Septum Cap	Adjust pH to 4-5, Cool, 4°C, No headspace	7 days
EDB and DBCP (EPA 8260)	W,S	G, Teflon-Lined Cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	28 days
Vinyl chloride,styrene, 2-chloroethyl vinyl ether (8260)	W	G, Teflon-Lined, Septum Cap	Cool, 4°C, Minimize Headspace	7 days
Vinyl chloride,styrene, 2-chloroethyl vinyl ether (8260)	W	G, Teflon-Lined, Septum Cap	Cool, 4°C, Minimize Headspace	7 days

Semivolatile Organics				
Nonyl Phenols	W	G, Teflon-Lined Cap	H2SO4 to pH<2, Cool, 4°C	28 days
Organotins (CAS SOP)	W,S	G, Teflon-Lined Cap	Cool, 4°C	7[f] days until extraction;40 days after extraction
Otto Fuel	W	G, Teflon-Lined Cap	Cool, 4°C	7[f] days until extraction;40 days after extraction
Resin and Fatty Acids (NCASI 85.02)	W	G, Teflon-Lined Cap	NaOH to pH >10, Cool, 4°Cg	30 days until extraction; 30 days after extraction
Methanol in Process Liquid NCASI 94.03	L	G, Teflon-Lined Cap	Cool, 4°C	30 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
HAPS - Condensates NCASI 99.01		G, Teflon-Lined Cap	Cool, 4°C	14/30 days
HAPS - Impinger/Canisters NCASI 99.02			Cool, 4°C	21 days
Perfluorinated Compounds HPLC/MS/MS	W	P	Cool, 4°C	14 days until extraction; 40 days after extraction
PBDE/PBB - ROHS GC/MS	W,S,T	G	Cool, 4°C	40 days after extraction
Pharma Personal Care Products 1694	W	Amber G, Teflon-Lined Cap	Cool, < 6°C	7[f] days until extraction;30 days after extraction
Nitroaromatics and Nitramines 8330B	W,S	G, Teflon-Lined Cap	Cool, 4°C	S 14, W 7 days until extraction; 40 days after extraction
Nitroaromatics/Nitoramines HPLC/MS/MS	W,S,T	G	Cool, 4°C Tissues < -10 C	S 14, W 7 days until extraction; 40 days after extraction
Organic acids HPLC/MS/MS	W	G, Teflon-Lined, Septum Cap	H2SO4 to pH<2, Cool, 4°C	14 days
Petroleum Hydrocarbons, Extractable (Diesel-Range Organics) (EPA 8015)	W,S	G, Teflon-Lined Cap	Cool, 4°C	7[f] days until extraction;40 days after extraction
Alcohols and Glycols (EPA 8015)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction
Acid Extractable Semivolatile Organics (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction
Chlorinated Herbicides (EPA 8151)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7[f] days until extraction;40 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Chlorinated Phenolics (EPA 1653)	W	G, Teflon-Lined Cap	H2SO4 to pH<2, Cool, 4°Cg	30 days until extraction; 30 days after extraction
Polynuclear Aromatic Hydrocarbons (EPA 625, 8270)	W,S	G, Teflon-Lined Cap	Cool, 4°C, Store in Darkg	7[f] days until extraction;40 days after extraction
Organochlorine Pesticides and PCBs (EPA 608, 8081, 8082, GC/MS/MS)	W,S	G, Teflon-Lined Cap	Cool, 4°C	7[f] days until extraction;40 days after extraction
Organophosphorus Pesticides (EPA 8141, GC/MS/MS)	W,S	G, Teflon-Lined Cap	Cool, 4°C, Store in Darkg	7[f] days until extraction;40 days after extraction
Nitrogen- and Phosphorus-Containing Pesticides (EPA 8141)	W,S	G, Teflon-Lined Cap	Cool, 4°Cg	7f days until extraction;40 days after extraction

Drinking Water Organics

Purgeable Organics (EPA 524.2)	DW	G, Teflon-Lined, Septum cap	Ascorbic Acid, HCl to pH≤2, Cool, 4°C, No Headspace	14 days
EDB, DBCP, and TCP (EPA 504.1)	DW	G, Teflon-Lined, Septum cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	14 days
Carbamates, Carbamoyloximes (EPA 531.1)	DW	G, Amber, Teflon-Lined Cap	1.8 mL monochloroacetic acid to pH<3; 80 mg/L $Na_2S_2O_3$ if Res.Cl.; Cool, 4°C	28 days
Chlorinated Herbicides (EPA 515.4)	DW	G, Amber, Teflon-Lined Cap	If Res.Cl, 2mg/4omL NaS; Cool , <6°C	14 days until extraction; 21 days after extraction
Chlorinated Pesticides (EPA 508.1, 525.2)	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH≤ 2;Cool 4°C	14 days until extraction; 30 days after extraction
Diquat and Paraquat (EPA 549.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$ if Res.Cl.Cool 4°C	7days until extraction; 21 days after extraction
Endothall (EPA 548.1)	DW	G, Amber, Teflon-Lined Cap	Cool, 4°C	7 days until extraction; 14 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Glyphosate (EPA 547)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$,Cool, 4°C	14 days
Haloacetic Acids (EPA 552.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L NH_4Cl,Cool, 4°C	14 days until extraction; 7 days after extraction
Semivolatile Organics (EPA 525.2)	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH≤ 2;Cool, 4°C	14 days until extraction; 30 days after extraction
Nitrosoamines (EPA 521)	DW	G, Amber, Teflon-Lined Cap	Dechlorinate at collection[g]	14 days until extraction; 28 days after extraction
Selected Pesticides and Flame Retardants (EPA 527)	DW	G, Amber, Teflon-Lined Cap	See Method, Cool, 4°C	14 days until extraction; 28 days after extraction
Toxicity Characteristic Leaching Procedure (TCLP)				
Semivolatile Organics (EPA 1311/8270)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C, Store in Dark[g]	14 days until TCLP ext'n;
			TCLP extract: Cool, 4°C, Store in Dark[g]	7 days until extraction; 40 days after extraction
Organochlorine Pesticides (EPA 1311/8081)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C	14 days until TCLP ext'n;
			TCLP extract: Cool, 4°C	7 days until extraction; 40 days after extraction
Chlorinated Herbicides (EPA 1311/8151)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C	14 days until TCLP ext'n;
			TCLP extract: Cool, 4°C	7 days until extraction; 40 days after extraction
Mercury(EPA 1311/7470)	HW	P,G	Sample: Cool, 4°C	28 days until extraction
			TCLP extract: HNO_3 to pH<2	28 days after extraction
Metals, except Mercury (EPA 1311/6010)	HW	P,G	Sample: Cool, 4°C	180 days until extraction;
			TCLP extract: HNO_3 to pH<2	14 days until TCLP ext'n;
Volatile Organics (EPA 1311/8260)	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C , Minimize Headspace	14 days until TCLP ext'n;

			Extract: Cool 4°C, HCL to pH,2, No Headspace	14 days after extraction

a For EPA SW-846 methods the method number is listed generically, without specific revision suffixes.

b DW = Drinking Water, W = Water; S = Soil or Sediment; HW = Hazardous Waste

c P = Polyethylene; G = Glass, F- Fluoropolymer

d For chlorinated water samples

e The maximum holding time is dependent upon the geographical proximity of sample source to the laboratory.

f Fourteen days until extraction for soil, sediment, and sludge samples.

g If the water sample contains residual chlorine, 10% sodium thiosulfate is used to dechlorinate.

Figure 7-1
Chain of Custody Form

ALS Environmental

CHAIN OF CUSTODY

SR# _____

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

PAGE _____ OF _____ COC# _____

PROJECT NAME:
PROJECT NUMBER:
PROJECT MANAGER:
COMPANY NAME:
ADDRESS:
CITY/STATE/ZIP:
E-MAIL ADDRESS:
PHONE # FAX #
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics Tri☐ Tetra☐ PCP☐	Metals, Total or Dissolved (See List below)	Cyanide☐ Hex-Chrom☐	(Circle) pH, Cond., Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS, Turb.	(Circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity ☐ CO_3 ☐ HCO_3 ☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases RSK 175☐ Methane☐ Ethane☐ Ethene☐ CO_2☐				REMARKS

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
___ IV. Data Validation Report
___ V. EDD

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

____ 24 hr. ____ 48 hr.
____ 5 day
____ Standard (15 working days)
____ Provide FAX Results

_____
Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature / Date/Time	Signature / Date/Time	Signature / Date/Time	Signature / Date/Time
Printed Name / Firm	Printed Name / Firm	Printed Name / Firm	Printed Name / Firm

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ALS Environmental

LANDFILL CHAIN OF CUSTODY

1317 South 13th Ave. • Kelso, WA 98626 • (360) 577-7222 • (800) 695-7222 • FAX (360) 636-1068

SR#_____

PAGE_____ OF_____ COC#_____

PROJECT NAME:
PROJECT NUMBER:
PROJECT MANAGER:
COMPANY NAME:
ADDRESS:
CITY/STATE/ZIP:
E-MAIL ADDRESS:
PHONE # FAX #
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Volatile Organics 524.2 ☐ 8260 ☐ TICs ☐	Base / Neutral Acid Organics 625 ☐ 8270 ☐ TICs ☐	Metals, Total or Dissolved (list below)	pH, Cond., TDS, TSS, BOD, Turb, Color Orthophosphate, Tannin/Lignin (circle)	COD, TOC, Total Phos. TKN, NH_3, (circle)	ALK, HCO_3, CO_3, Hardness (circle)	Anion (circle) Cl, SO_4, NO_3, NO_2, F	Anion:Cation Ratio	☐ Enterococcus ☐ E. coli ☐ T-Coliform ☐ F-Coliform	Cyanide ☐	TOX	Dissolved Silica								REMARKS

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
___ IV. Data Validation Report
___ V. EDD

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
___ 5 day
___ Standard (15 working days)

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: As Sb Ba Be Cd Ca Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Se Si Tl V Zn Hg
Dissolved Metals: As Sb Ba Be Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Se Si Tl V Zn Hg

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:
Signature / Date/Time	Signature / Date/Time	Signature / Date/Time	Signature / Date/Time
Printed Name / Firm	Printed Name / Firm	Printed Name / Firm	Printed Name / Firm

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Figure 7-2

PC_____

Cooler Receipt and Preservation Form

Client / Project:_____ Service Request ***K13***_____

Received:_____ Opened:_____ By:_____ Unloaded:_____ By:_____

1. Samples were received via? ***Mail*** ***Fed Ex*** ***UPS*** ***DHL*** ***PDX*** ***Courier*** ***Hand Delivered***
2. Samples were received in: (circle) ***Cooler*** ***Box*** ***Envelope*** ***Other***_____ ***NA***
3. Were custody seals on coolers? NA Y N If yes, how many and where?_____

   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed

4. Packing material: ***Inserts*** ***Baggies*** ***Bubble Wrap*** ***Gel Packs*** ***Wet Ice*** ***Dry Ice*** ***Sleeves*** _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions:_____

_____

_____

_____

Page_____***of***_____

Figure 7-2 cont.

Cooler Receipt and Preservation Form

lient / Project:_____ Service Request *K13*_____

Thermometer ID	Corr. Factor	@20 min, Raw Blank	@20 min, Corr. Blank	@40 min. Raw Blank	@40 min. Corr. Blank	@60 min. Raw Blank	@60 min Corr. Blank

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies & Resolutions:

_____

_____

_____

_____

_____

_____

_____

_____

_____

*Page*_____ *of*_____

Figure 7-2 cont.

Cooler Receipt and Preservation Form

Client / Project:____ Service Request ***K13***______________________

Notes, Discrepancies & Resolutions:

Page_____of_____

Figure 7-3

Tier V Form

Client:
Project Name:
Project Number:
Project Description:

Project Chemist:
Service Request:
LIMS Template ID:

QAPP/SOW Information:

Reporting

TierLevel:
In results field use:
Flagging Requirements:
Other Requirements:

PFD:

Report to:

Sample Considerations:

Sample Limitations:
Sample Prep/Analysis:
Non-Standard Holdtimes:
Historical Data:
Comments:

8.0 ANALYTICAL PROCEDURES

ALS Environmental, Kelso employs methods and analytical procedures from a variety of external sources. The primary method references are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IVA, IVB, and online updates for hazardous waste samples, and USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, EPA 40CFR parts 136 and 141, and Supplements; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples. Complete citations for these references can be found in Section 17.0. Other published procedures, such as state-specific methods, program-specific methods (such as Puget Sound Protocols), or in-house methods may be used. Several factors are involved with the selection of analytical methods to be used in the laboratory. These include the method detection limit, the concentration of the analyte being measured, method selectivity, accuracy and precision of the method, the type of sample being analyzed, and the regulatory compliance objectives. The implementation of methods by ALS Environmental, Kelso is described in SOPs specific to each method. A list of NELAP-accredited methods is given in Appendix G. Further details are described below.

8.1 Standard Operating Procedures (SOPs) and Laboratory Notebooks.

ALS Environmental, Kelso maintains SOPs for use in both technical and administrative functions. SOPs are written following standardized format and content requirements as described in CE-GEN009, *Preparation of Standard Operating Procedures*. Each SOP is reviewed and approved by a minimum of two managers (the Laboratory Director and/or Department Manager and the Quality Assurance Manager). All SOPs undergo a documented annual review to make sure current practices are described. The QAM maintains a comprehensive list of current SOPs. The document control process ensures that only the most currently prepared version of an SOP is being used. The QA Manual, QAPPs, SOPs, standards preparation logbooks, maintenance logbooks, et al., are controlled documents. The procedures for document control are described in CE-GEN005, *Document Control*. In addition to SOPs, each laboratory department maintains a current file, accessible to all laboratory staff, of the current methodology used to perform analyses. Laboratory notebook entries are standardized following the guidelines in CE-QA007, *Making Entries onto Analytical Records*. Entries made into laboratory notebooks are reviewed and approved by the appropriate supervisor at a regular interval.

8.2 Deviation from Standard Operating Procedures

When a customer requests a modification to an SOP (such as a change in reporting limit, addition or deletion of target analyte(s), etc.), the Project Manager handling that project must discuss the proposed deviation with the department manager in charge of the analysis and obtain their approval to accept the project. The Project Manager is responsible for documenting the approved or allowed deviation from the SOP by placing a detailed description of the deviation attached to the quotation or in the project file and also providing an appropriate comment on the service request when the samples are received.

For circumstances when a deviation or departure from company policies or procedures involving any non-technical function is found necessary, approval must be obtained from the appropriate supervisor, manager, the laboratory director, or other level of authority. Frequent departure from

policy is not encouraged. However, if frequent departure from any policy is noted, the laboratory director will address the possible need for a change in policy.

8.3 Modified Procedures

ALS Environmental, Kelso strives to perform published methods as described in the referenced documents. If there is a material deviation from the published method, the method is cited as a "Modified" method in the analytical report. Modifications to the published methods are listed in the standard operating procedure. Standard operating procedures are available to analysts and are also available to our clients for review, especially those for "Modified" methods. Client approval is obtained for the use of "Modified" methods prior to the performance of the analysis.

8.4 Analytical Batch

The basic unit for analytical quality control is the analytical batch. The definition that ALS Environmental, Kelso has adopted for the analytical batch is listed below. The overriding principle for describing an analytical batch is that all the samples in a batch, both field samples and quality control samples are to be handled exactly the same way, and all of the data from each analysis is to be manipulated in exactly the same manner. The minimum requirements of an analytical batch are:

1) The number of (field) samples in a batch is not to exceed 20.
2) All (field) samples in a batch are of the same matrix.
3) The QC samples to be processed with the (field) samples include:
   a) Method Blank (a.k.a. Laboratory Reagent Blank)

      Function: Determination of laboratory contamination.

   b) Laboratory Control Sample

      Function: Assessment of method performance

   c) Matrix Spiked (field) Sample (a.k.a. Laboratory Fortified Sample Matrix)*

      Function: Assessment of matrix bias

   d) Duplicate Matrix Spiked (field) Sample or Duplicate (field) Sample (a.k.a. Laboratory Duplicate)*

      Function: Assessment of batch precision

   * A sample identified as a field blank, an equipment blank, or a trip blank is not to be matrix spiked or duplicated.
4) A single lot of reagents is used to process the batch of samples.
5) Each operation within the analysis is performed by a single analyst, technician, chemist, or by a team of analysts/technicians/chemists.
6) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours between the start of processing of the first and last sample of the batch.

7) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours.
8) (Field) samples are assigned to batches commencing at the time that sample processing begins. For example: for analysis of metals, sample processing begins when the samples are digested. For analysis of organic constituents, it begins when the samples are extracted.
9) The QC samples are to be analyzed in conjunction with the associated field samples prepared with them. However, for tests which have a separate sample preparation step that defines a batch (digestion, extraction, etc.), the QC samples in the batch do not require analysis each time a field sample within the preparation batch is analyzed (multiple instrument sequences to analyze all field samples in the batch need not include re-analyses of the QC samples).
10) The batch is to be assigned a unique identification number that can be used to correlate the QC samples with the field samples.
11) Batch QC refers to the QC samples that are analyzed in a batch of (field) samples.
12) Project-specific requirements may be exceptions. If project, program, or method requirements are more stringent than these laboratory minimum requirements, then the project, program, or method requirements will take precedence. However, if the project, program, or method requirements are less stringent than these laboratory minimum requirements, these laboratory minimum requirements will take precedence.

8.5 Specialized Procedures

ALS Environmental, Kelso not only strives to provide results that are scientifically sound, legally defensible, and of known and documented quality; but also strives to provide the best solution to analytical challenges. Procedures using specialized instrumentation and methodology have been developed to improve sensitivity (provide lower detection limits), selectivity (minimize interferences while maintaining sensitivity), and overall data quality for low concentration applications. Examples are trace-level Mercury and Methyl mercury analyses, reductive precipitation metals analysis, specialized GC/MS analyses, LC/MS analyses, and ultra-low level organics analyses (including PAHs, pesticides and PCBs).

8.6 Sample Cleanup

ALS Environmental, Kelso commonly employs several cleanup procedures to minimize known common interferences prior to analysis. EPA methods (3620, 3630, 3640, 3660, and 3665) for cleanup of sample extracts for organics analysis are routinely used to minimize or eliminate interferences that may adversely affect sample results and data usability.

9.0 CALIBRATION PROCEDURES

All equipment and instruments used at ALS Environmental, Kelso are operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. Brief descriptions of the calibration procedures for our major laboratory equipment and instruments are described below. Calibration verification is performed according to the applicable analytical methodology. Calibration verification procedures and criteria are listed in laboratory Standard Operating Procedures. Documentation of calibration verification is maintained in appropriate reference files. Records are maintained to provide traceability of reference materials.

Laboratory support equipment (thermometers, balances, and weights) are routinely verified on an annual basis by a vendor accredited to A2LA or ISO/IEC 17025:2005 International Standards. All analytical measurements generated at ALS Environmental, Kelso are performed using materials where possible and/or processes that are traceable to a reference material. Metrology equipment (analytical balances, thermometers, etc.) is calibrated using reference materials traceable to the National Institute of Standards and Technology (NIST). These primary reference materials are themselves recertified on an annual basis. Vendors used for metrology support are required to verify compliance to International Standards by supplying the laboratory with a copy of their scope of accreditation.

Equipment subjected to overloading or mishandling, or has been shown by verification to be defective; is taken out of service until it is repaired. When an instrument is taken out of service, an *Out of Service* sign is placed by the laboratory on the instrument. The equipment is placed back in service only after verifying, by calibration, that the equipment performs satisfactorily.

9.1 Temperature Control Devices

Temperatures are monitored and recorded each day for all of the temperature-regulating support equipment such as sample refrigerators, freezers, and standards refrigerators/freezers. Temperatures are recorded in either laboratory logbook or through Check Point® Wireless Monitoring System. During weekends and holidays a min/max thermometer may be used.

Laboratory records contain the recorded temperature, identification and location of equipment, acceptance criteria and the initials of the technician who performed the checks. The procedure for performing these measurements is provided in the *SOP for Support Equipment Monitoring and Calibration (ADM-SEMC).* The SOP also includes the use of acceptance criteria and correction factors.

Where the operating temperature is specified as a test condition (such as ovens, incubators, evaporators) the temperature is recorded on the raw data. All thermometers are identified according to serial number, and the calibration is checked annually against a National Institute of Standards and Technology (NIST) certified thermometer. The NIST thermometer is recertified by a vendor accredited to A2LA or ISO/IEC 17025:2005 International Standard on an annual basis.

9.2 Analytical Balances

The calibration of each analytical balance is checked by the user each day of use with three Class S or S-1 weights, which assess the accuracy of the balance at low, mid-level and high levels bracketing the working range. Records are kept which contain the recorded measurements, identification of the balance, acceptance criteria, and the initials of user who performed the check. The procedure for performing these measurements and use of acceptance criteria is described in the SOP ADM-SEMC. The weights are recertified using NIST traceable standards by an accredited metrology organization on an annual basis.

As needed, the balances are recalibrated using the manufacturers recommended operating procedures. Analytical balances are serviced on a semi-annual basis by an accredited metrology organization.

9.3 Water Purification Systems

ALS Environmental, Kelso uses two independent water purification systems is designed to produce deionized water meeting method specifications. One system consists of a series of pumps, filters, and resin beds designed to yield deionized water meeting the specifications of ASTM Type II water, and *Standard Methods for the Examination of Water and Wastewater* (SM1080, 20th Ed.) *High Quality* water. Activated carbon filters are also in series with the demineralizers to produce "organic-free" water. A second system consists of pumps, filters, and treatment components designed to yield deionized water meeting the specifications of ASTM Type I water, and *Standard Methods for the Examination of Water and Wastewater* (SM1080, 20th Ed.) *High Quality* water. Following a written SOP, the status of each system is monitored continuously for conductivity and resistivity with an on-line meter and indicator light, and readings recorded daily in a bound record book. The meter accuracy is verified annually. Deionizers are rotated and replaced on a regular schedule. Microbiology water is checked on a daily basis at a point downstream of the purification system at a tap in the laboratory.

9.4 Source and Preparation of Standards and Reference Materials

Consumable reference materials routinely purchased by the laboratories (e.g., analytical standards) are purchased from nationally recognized, reputable vendors. All vendors where possible have fulfilled the requirements for 9001 certification and/or are ISO 17025 accredited. ALS Environmental, Kelso relies on a primary vendor for the majority of its analytical supplies. Consumable primary stock standards are obtained from certified commercial sources or from sources referenced in a specific method. Supelco, Ultra Scientific, AccuStandard, Chem Services, Inc., Aldrich Chemical Co., Baker, Spex, etc. are examples of the vendors used. Reference material information is recorded in the appropriate logbook(s) and materials are stored under conditions that provide maximum protection against deterioration and contamination. The logbook entry includes such information as an assigned logbook identification code, the source of the material (i.e. vendor identification), solvent (if applicable) and concentration of analyte(s), reference to the certificate of analysis and an assigned expiration date. The date that the standard is received in the laboratory is marked on the container. When the reference material is used for the first time, the date of usage and the initials of the analyst are also recorded on the container.

Stock solutions and calibration standard solutions are prepared fresh as often as necessary according to their stability. All standard solutions are properly labeled as to analyte concentration, solvent, date, preparer, and expiration date; these entries are also recorded in the appropriate notebook(s) following the *SOP for Reagent Login and Tracking* (SOP ADM-RTL). Prior to sample analysis, all calibration reference materials are verified with a second, independent source of the material (see section 11.3.5).

9.5 Inductively Coupled Plasma-Atomic Emission Spectrograph (ICP-AES)

Each emission line on the ICP is calibrated daily against a blank and against standards whose concentrations fall within the instruments linear range. Analyses of calibration standards, initial and continuing calibration verification standards, and inter-element interference check samples are carried out as specified in the applicable method SOP and analytical method (i.e. EPA 200.7, 6010B, 6010C, CLP SOW, etc.).

9.6 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)

Each element of interest is calibrated for using a blank and a single standard. Prior to calibration, a short-term stability check is performed on the system. Following calibration, an independent check standard is analyzed, and a continuing calibration verification standard (CCV) is analyzed with every ten samples.

9.7 Atomic Absorption Spectrophotometers (AAS)

These instruments are calibrated daily using a minimum of four standards and a blank. Calibration is validated using reference standards, and is verified at a minimum frequency of once every ten samples. Initial calibration points cannot be “dropped” from the resulting calibration curve.

9.8 GC/MS Systems

All GC/MS instruments are calibrated at multiple concentration levels for the analytes of interest (unless specified otherwise) using procedures outlined in Standard Operating Procedures and/or appropriate USEPA method citations. All reference materials used for this function are vendor-certified standards. Calibration verification is performed at method-specified intervals following the procedures in the SOP and reference method. For isotope dilution procedures, the internal standard response(s) and labeled compound recovery must meet method criteria. Method-specific instrument tuning is regularly checked using bromofluorobenzene (BFB) for volatile organic chemical (VOC) analysis, or decafluorotriphenylphosphine (DFTPP) for semi-volatile analysis. Mass spectral peaks for the tuning compounds must conform both in mass numbers and in relative intensity criteria before analyses can proceed. Calibration policies for organics chromatographic analyses are described in the *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOC-CAL).*

9.9 Gas Chromatographs and High Performance Liquid Chromatographs

Calibration and standardization follow SOP guidelines and/or appropriate USEPA method citations. All GC and HPLC instruments are calibrated at a minimum of five different concentration levels for the analytes of interest (unless specified otherwise). The lowest standard is equivalent to the method reporting limit; additional standards define the working range of the GC or LC detector. Results are used to establish response factors (or calibration curves) and retention-time windows for each analyte. Calibration is verified at a minimum frequency of once every ten samples, unless otherwise specified by the reference method. *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOC-CAL).*

9.10 LC/MS Systems

Calibration and tuning procedures are included in analytical SOPs written specifically for these tests. In general, multiple concentration levels for the analytes of interest are used to generate calibration curves. All reference materials used for this function are vendor-certified standards. Calibration and tuning verification is performed at SOP-defined intervals. Any other system performance checks are described in the applicable SOP. Calibration policies for organics chromatographic analyses are described in the SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOP SOC-CAL).

9.11 UV-Visible Spectrophotometer (manual colorimetric analyses)

Routine calibrations for colorimetric and turbidimetric analyses involve generating a 5-point calibration curve including a blank. Initial calibration points cannot be "dropped" from the resulting calibration curve. Correlation coefficients must meet method or SOP specifications before analysis can proceed. Independent calibration verification standards (ICVs) are analyzed with each batch of samples. Continuing calibration is verified at a minimum frequency of once every ten samples. Typical UV-Visible spectrophotometric methods at ALS Environmental, Kelso include total phenolics, phosphates, surfactants and tannin-lignin.

9.12 Flow Injection Analyzer (automated colorimetric analysis)

A minimum of six standards and a blank are used to calibrate the instrument for cyanide analysis. A blank and (minimum of) five standards are used to calibrate the instrument for all other automated chemistries. Initial calibration points cannot be "dropped" from the resulting calibration curve. Standard ALS Environmental, Kelso acceptance limits are used to evaluate the calibration curve prior to sample analysis.

9.13 Discrete Auto-Analyzer (automated absorbance analysis)

A minimum of five standards and a blank are used to calibrate the instrument. Initial calibration points cannot be "dropped" from the resulting calibration curve. Method specific acceptance limits are used to evaluate the calibration curve prior to sample analysis.

9.14 Ion Chromatographs

Calibration of the ion chromatograph (IC) involves generating a calibration curve with the method-specified number of points (or more). Initial calibration points cannot be "dropped" from the resulting calibration curve. A correlation coefficient of $\geq$ 0.995 for the curve is required before analysis can proceed. Quality Control (QC) samples that are routinely analyzed include blanks and laboratory control samples. The target analytes typically determined by the IC include nitrate, nitrite, chloride, fluoride, sulfate and drinking water inorganic disinfection byproducts. Calibration verification is performed at method-specified intervals following the procedures in the SOP and reference method.

9.15 Turbidimeter

Calibration of the turbidimeter requires analysis of three Nephelometric Turbidity Unit (NTU) formazin standards. Quality Control samples that are routinely analyzed include blanks, Environmental Resource Associates QC samples (or equivalent) and duplicates.

9.16 Ion-selective electrode

The method-prescribed numbers of standards are used to calibrate the electrodes before analysis. The slope of the curve must be within acceptance limits before analysis can proceed. Quality Control samples that are routinely analyzed include blanks, LCSs and duplicates.

9.17 Pipets

The calibration of pipets and autopipettors used to make critical-volume measurements is verified following ADM-VOLWARE, *Checking Volumetric Labware*. Both accuracy and precision verifications are performed, at intervals applicable to the pipet and use. The results of all calibration verifications are recorded in bound logbooks.

9.18 Other Instruments

Calibration for the total organic carbon (TOC), total organic halogen (TOX), and other instruments is performed following manufacturer's recommendations and applicable SOPs.

10.0 QUALITY CONTROL

A primary focus of ALS Kelso's QA Program is to ensure the accuracy, precision and comparability of all analytical results. Prior to using a procedure for the analysis on field samples, acceptable method performance is established by performing demonstration of capability analyses. Performance characteristics are established by performing method detection limit studies and assessing accuracy and precision according to the reference method. ALS Environmental, Kelso has established Quality Control (QC) objectives for precision and accuracy that are used to determine the acceptability of the data that is generated. These QC limits are either specified in the test methodology or are statistically derived based on the laboratory's historical data. Quality Control objectives are defined below.

10.1 Quality Control Objectives

10.1.1 Demonstration of Capability - A demonstration of capability (DOC) is made prior to using any new test method or when a technician is new to the method. This demonstration is made following regulatory, accreditation, or method specified procedures. In general, this demonstration does not test the performance of the method in real world samples, but in the applicable clean matrix free of target analytes and interferences.

A quality control sample material may be obtained from an outside source or may be prepared in the laboratory. The analyte(s) is (are) diluted in a volume of clean matrix (for analytes which do not lend themselves to spiking, e.g., TSS, the demonstration of capability may be performed using quality control samples). Where specified, the method-required concentration levels are used. Four aliquots are prepared and analyzed according to the test procedure. The mean recovery and standard deviations are calculated and compared to the corresponding acceptance criteria for precision and accuracy in the test method or laboratory-generated acceptance criteria (if there are not established mandatory criteria). All parameters must meet the acceptance criteria. Where spike levels are not specified, actual Laboratory Control Sample results may be used to meet this requirement, provided acceptance criteria is met.

10.1.2 Accuracy - Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. In addition, laboratory-fortified (i.e. matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix. Accuracy is expressed as percent recovery (% REC.) of the measured value, relative to the true or expected value. If a measurement process produces results whose mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination).

ALS Environmental, Kelso utilizes several quality control measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples and independent calibration verification standards. Because bias can be positive or negative, and because several

types of bias can occur simultaneously, only the net, or total, bias can be evaluated in a measurement.

10.1.3 Precision – Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling and in laboratory analysis. The American Society of Testing and Materials (ASTM) recognizes two levels of precision: repeatability – the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions, and reproducibility – the random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material.

"Within-batch" precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

10.1.4 Control Limits – The control limits for accuracy and precision originate from two different sources. For analyses having enough QC data, control limits are calculated at the 99% confidence limits. For analyses not having enough QC data, or where the method is prescriptive, control limits are taken from the method on which the procedure is based. If the method does not have stated control limits, then control limits are assigned method-default or reasonable values. Control limits are reviewed each year and may be updated if new statistical limits are generated for the appropriate surrogate, laboratory control sample, and matrix spike compounds (typically once a year) or when method prescribed limits change. The updated limits are reviewed by the QA PM. The new control limits replace the previous limits and data is assessed using the new values. Current acceptance limits for accuracy and precision are available from the laboratory. For inorganics, the precision limit values listed are for laboratory duplicates. For organics, the precision limit values listed are for duplicate laboratory control samples or duplicate matrix spike analyses. Procedures for establishing control limits are found in CE-QA009, *Control Limits*.

10.1.5 Representativeness – Representativeness is the degree to which the field sample, being properly preserved, free of contamination, and analyzed within holding time, represents the overall sample site or material. This can be extended to the sample itself, in that representativeness is the degree to which the subsample that is analyzed represents the entire field sample submitted for analysis. ALS Environmental, Kelso has sample handling procedures to ensure that the sample used for analysis is representative of the entire sample. These include the SOP for *Subsampling and Compositing of Samples* (GEN-SUBS) and the SOP for *Tissue Sample Preparation* (MET-TISP). Further, analytical SOPs specify appropriate sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample.

10.1.6 Comparability – Comparability expresses the confidence with which one data set can be compared to another and is directly affected by data quality (accuracy and precision) and sample handling (sampling, preservation, etc). Only data of known quality can be compared. The objective is to generate data of known quality with the highest level of comparability, completeness, and usability. This is achieved by employing the quality controls listed below and standard operating

procedures for the handling and analysis of all samples. Data is reported in units specified by the client and using ALS Environmental, Kelso or project-specified data qualifiers.

10.2 Method Detection Limits, Method Reporting Limits, and Limits of Detection/Quantitation

Method Detection Limits (MDL) for methods performed at Columbia Analytical/(Location) is determined during initial method set up and if any significant changes are made. If an MDL study is not performed annually, the established MDL is verified by performing a limit of detection (LOD) verification on every instrument used in the analysis. The MDLs are determined by following the SOP for Performing Method Detection Limits Studies and Establishing Limits of Detection and Quantitation (ADM-MDL), which is based on the procedure in 40 CFR Part 136, Appendix B. As required by NELAP and DoD protocols, the validity of MDLs is verified using LOD verification samples.

The Method Reporting Limit (MRL) is the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (i.e. limit of quantitation- LOQ). LOQ are analyzed on an annual basis and cannot be lower than the lowest calibration standard. Current MDLs and MRLs are available from the laboratory.

10.3 Quality Control Procedures

The specific types, frequencies, and processes for quality control sample analysis are described in detail in method-specific standard operating procedures and listed below. These sample types and frequencies have been adopted for each method and a definition of each type of QC sample is provided below.

10.3.1 Method Blank (a.k.a. Laboratory Reagent Blank)

The method blank is an analyte-free matrix (water, soil, etc.) subjected to the entire analytical process. When analyte-free soil is not available, anhydrous sodium sulfate, organic-free sand, or an acceptable substitute is used. The method blank is analyzed to demonstrate that the analytical system itself does not introduce contamination. The method blank results should be below the Method Reporting Limit (MRL) or, if required for DoD projects, < ½ MRL for the analyte(s) being tested. Otherwise, corrective action must be taken. A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

10.3.2 Calibration Blanks

For some methods, calibration blanks are prepared along with calibration standards in order to create a calibration curve. Calibration blanks are free of the analyte of interest and, where applicable, provide the zero point of the calibration curve. Additional project-specific requirements may also apply to calibration blanks.

10.3.3 Continuing Calibration Blanks

Continuing calibration blanks (CCBs) are solutions of analyte-free water, reagent, or solvent that are analyzed in order to verify the system is contamination-free when CCV standards are analyzed. The frequency of CCB analysis is either once every ten samples or as indicated in the method, whichever is greater. Additional project-specific requirements may also apply to continuing calibration blanks.

10.3.4 Calibration Standards

Calibration standards are solutions of known concentration prepared from primary standard or stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

10.3.5 Initial (or Independent) Calibration Verification Standards

Initial (or independent) calibration verification standards (ICVs) are standards that are analyzed after calibration but prior to sample analysis, in order to verify the validity and accuracy of the standards used in for calibration. Once it is determined that there is no defect or error in the calibration standard(s), standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). The ICV standards are prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). ICVs are also analyzed in accordance with method-specific requirements.

10.3.6 Continuing Calibration Verification Standards

Continuing calibration verification standards (CCVs) are midrange standards that are analyzed in order to verify that the calibration of the analytical system is still acceptable. The frequency of CCV analysis is either once every ten samples, or as indicated in the method.

10.3.7 Internal Standards

Internal standards are known amounts of specific compounds that are added to each sample prior to instrument analysis. Internal standards are generally used for GC/MS and ICP-MS procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by matrix effects. The requirements for evaluation of internal standards are specified in each method and SOP.

10.3.8 Surrogates

Surrogates are organic compounds which are similar in chemical composition and chromatographic behavior to the analytes of interest, but which are not normally found in environmental samples. Depending on the analytical method, one or more of these compounds is added to method blanks, calibration and check standards, and samples (including duplicates, matrix spike samples, duplicate matrix spike samples and laboratory control samples) prior to

extraction and analysis in order to monitor the method performance on each sample. The percent recovery is calculated for each surrogate, and the recovery is a measurement of the overall method performance.

Recovery (%) = (M/T) x 100

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

10.3.9 Laboratory Control Samples

The laboratory control sample (LCS) is an aliquot of analyte-free water or analyte-free solid (or anhydrous sodium sulfate or equivalent) to which known amounts of the method analyte(s) is (are) added. A reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. An LCS is prepared and analyzed at a minimum frequency of one LCS per 20 samples, with every analytical batch or as stated in the method, whichever is more frequent. The LCS sample is prepared and analyzed in exactly the same manner as the field samples.

The percent recovery of the target analytes in the LCS is compared to established control limits and assists in determining whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required reporting limit. Comparison of batch-to-batch LCS analyses enables the laboratory to evaluate batch-to-batch precision and accuracy.

Recovery (%) = (M/T) x 100

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

10.3.10 Laboratory Fortified Blanks - LFB

A laboratory blank fortified at the MRL used to verify the minimum reporting limit. The LFB is carried through the entire extraction and analytical procedure. A LFB is required with every batch of drinking water samples.

10.3.11 Matrix Spikes (a.k.a. Laboratory Fortified Sample Matrix)

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte (or analytes) is (are) added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as are routine samples. For the

appropriate methods, matrix spiked samples are prepared and analyzed and at a minimum frequency of one spiked sample (and one duplicate spiked sample, if appropriate) per twenty samples. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. Spike recoveries are calculated as follows:

Recovery (%) = (S - A) x 100 ÷ T

Where: S = The observed concentration of analyte in the spiked sample,
A = The analyte concentration in the original sample, and
T = The theoretical concentration of analyte added to the spiked sample.

10.3.12 Laboratory Duplicates and Duplicate Matrix Spikes

Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. Depending on the method of analysis, either a duplicate analysis (and/or a matrix spiked sample) or a matrix spiked sample and duplicate matrix spiked sample (MS/DMS) are analyzed. The relative percent difference between duplicate analyses or between an MS and DMS is a measure of the precision for a given method and analytical batch. The relative percent difference (RPD) for these analyses is calculated as follows:

Relative Percent Difference (RPD) = (S1 - S2) x 100 ÷ S_{ave}

Where S1 and S2 = The observed concentrations of analyte in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike, and

S_{ave} = The average of observed analyte concentrations in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike.

Depending on the method of analysis, either duplicates (and/or matrix spikes) or MS/DMS analyses are performed at a minimum frequency of one set per 20 samples. If an insufficient quantity of sample is available to perform a laboratory duplicate or duplicate matrix spikes, duplicate LCSs will be prepared and analyzed.

10.3.13 Interference Check Samples

An interference check sample (ICS) is a solution containing both interfering and analyte elements of known concentration that can be analyzed to verify background and interelement correction factors in metals analyses. The ICS is prepared to contain known concentrations (method or program specific) of elements that will provide an adequate

test of the correction factors. The ICS is analyzed at the beginning and end of an analytical run or at a method-specified frequency. Results must meet method criteria and any project-specific criteria.

10.3.14 Post Digestion Spikes

Post digestion spikes are samples prepared for metals analyses that have an analyte spike added to determine if matrix effects may be a factor in the results. The spike addition should produce a method-specified minimum concentration above the method reporting limit. A post digestion spike is analyzed with each batch of samples and recovery criteria are specified for each method.

10.3.15 Control Charting

The generation of control charts is routinely performed at Columbia Analytical. Surrogate, Matrix Spike and LCS recoveries are all monitored and charted. In addition, the laboratory also monitors the Relative Percent Difference (RPD) measurement of precision. Control charts are available to each individual laboratory unit to monitor the data generated in its facility using control charts that have been programmed to identify various trends in the analytical results. If trends in the data are perceived, various means of corrective action may then be employed in order to prevent future problems with the analytical system(s). Finally, data quality reports using control charts are generated for specific clients and projects pursuant to contract requirements. The control charting procedure is described in CE-QA009, *Control Limits.*

10.3.16 Glassware Washing

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at ALS Environmental, Kelso undergoes a rigorous cleansing procedure prior to every usage. A number of SOPs have been generated that outline the various procedures used at Columbia Analytical; each is specific to the end-use of the equipment as well as to the overall analytical requirements of the project. In addition, other equipment that may be routinely used at the laboratory is also cleaned following instructions in the appropriate SOP.

11.0 DATA PROCESSING, VALIDATION, AND REPORTING

ALS Environmental, Kelso reports the analytical data produced in its laboratories to the client via the certified analytical report. This report includes a transmittal letter, a case narrative, client project information, specific test results, quality control data, chain of custody information, and any other project-specific support documentation. The following procedures describe our data reduction, validation and reporting procedures.

11.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the data. All data is initially reviewed and processed by analysts using appropriate methods (e.g., chromatographic software, instrument printouts, hand calculation, etc.). Equations used for calculation of results are found in the applicable analytical SOPs. The resulting data set is either manually entered (e.g., titrimetric or microbiological data) into an electronic report form or is electronically transferred into the report from the software used to process the original data set (e.g., chromatographic software). Once the complete data set has been transferred into the proper electronic report form(s), it is then printed. The resulting hardcopy version of the electronic report is then reviewed by the analyst for accuracy. Once the primary analyst has checked the data for accuracy and acceptability, the hardcopy is forwarded to the supervisor or second qualified analyst, who reviews the data for errors. Where calculations are not performed using a validated software system, the reviewer rechecks a minimum of 10% of the calculations. When the entire data set has been found to be acceptable, a final copy of the report is printed and signed by the laboratory supervisor, departmental manager or designated laboratory staff. The entire data package is then placed into the appropriate service request file, and an electronic copy of the final data package is forwarded to the appropriate personnel for archival. Data review procedures are described in the *SOP for Laboratory Data Review Process (ADM-DREV).*

Policies and procedures for manual editing of data are established. The analyst making the change must initial and date the edited data entry, without obliteration of the original entry. The policies and procedures are described in the *CE-QA007, Making Entries onto Analytical Records*.

Policies and procedures for electronic manual integration of chromatographic data are established. The analyst performing the integration must document the integration change by printing both the "before" and "after" integrations and including them in the raw data records. The policies and procedures are described in CE-QA002, *Manual Integration Policy and* ADM-MI*, Manual Integration of Chromatographic Peaks.*

11.2 Confirmation Analysis

11.2.1 Gas Chromatographic and Liquid Chromatographic Analyses

For gas chromatographic (GC) and liquid chromatographic (LC) analyses, all positive results are confirmed by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis, unless exempted by one of the following situations:

- The analyte of interest produces a chromatogram containing multiple peaks exhibiting a characteristic pattern, which matches appropriate standards. This is

limited to petroleum hydrocarbon analyses (e.g., gasoline and diesel) and does not include polychlorinated biphenyls.

- The sample meets all of the following requirements:
    1. All samples (liquid or solid) come from the same source (e.g., groundwater samples from the same well) for continuous monitoring. Samples of the same matrix from the same site, but from different sources (e.g., different sampling locations) are not exempt.
    2. All analytes have been previously analyzed in sample(s) from the same source, identified and confirmed by a second column or by GC/MS. The chromatogram is largely unchanged from the one for which confirmation was carried out. The documents indicating previous confirmation must be available for review.

11.2.2 Confirmation Data

Confirmation data will be provided as specified in the method. Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods
    1. The analyte must fall within plus or minus three times the standard deviation (established for the analyte/column) of the retention time of the daily midpoint standard in order to be qualitatively identified. The retention-time windows will be established and documented, as specified in the appropriate Standard Operating Procedure (SOP).
    2. When sample results are confirmed by two dissimilar columns or detectors, the agreement between quantitative results must be evaluated. The relative percent difference between the two results is calculated and evaluated against SOP and/or method criteria.
- GC/MS Methods – Two criteria are used to verify identification:
    1. Elution of the analyte in the sample will occur at the same relative retention time (RRT) as that of the analyte in the standard.
    2. The mass spectrum of the analyte in the sample must, in the opinion of a qualified analyst or the department manager, correspond to the spectrum of the analyte in the standard or the current GC/MS reference library.

11.3 Data Review and Validation of Results

The integrity of the data generated is assessed through the evaluation of the sample results, calibrations, and QC samples (method blanks, laboratory control samples, sample duplicates, matrix spikes, trip blanks, etc.). A brief description of the evaluation of these analyses is described below, with details listed in applicable SOPs. The criteria for evaluation of QC samples are listed within each method-specific SOP. Other data evaluation measures may include (as necessary) a check of the accuracy check of the QC standards and a check of the system sensitivity. Data transcriptions and calculations are also reviewed.

Note: Within the scope of this document, all possible data assessment requirements for various project protocols cannot be included in the listing below. This listing gives a general description of data evaluation practices used in the laboratory in compliance with NELAP Quality Systems requirements. Additional requirements exist for certain programs, such as projects under the DoD QSM protocols, and project-specific QAPPs.

- Method Calibration - Following the analysis of calibration blanks and standards according to the applicable SOP the calibration correlation coefficient, average response factor, etc. is calculated and compared to specified criteria. If the calibration meets criteria analysis may continue. If the calibration fails, any problems are isolated and corrected and the calibration standards reanalyzed. Following calibration and analysis of the independent calibration verification standard(s) the percent difference for the ICV is calculated. If the percent difference is within the specified limits the calibration is complete. If not, the problem associated with the calibration and/or ICV are isolated and corrected and verification and/or calibration is repeated.
- Continuing Calibration Verification (CCV) - Following the analysis of the CCV standard the percent difference is calculated and compared to specified criteria. If the CCV meets the criteria analysis may continue. If the CCV fails, routine corrective action is performed and documented and a 2nd CCV is analyzed. If this CCV meets criteria, analysis may continue, including any reanalysis of samples that were associated with a failing CCV. If the routine corrective action failed to produce an immediate CCV within criteria, then either acceptable performance is demonstrated (after additional corrective action) with two consecutive calibration verifications or a new initial calibration is performed.
- Method Blank - Results for the method blank are calculated as performed for samples. If results are less than the MRL (<½ MRL for DoD projects), the blank may be reported. If not, associated sample results are evaluated to determine the impact of the blank result. If possible, the source of the contamination is determined. If the contamination has affected sample results the blank and samples are reanalyzed. If positive blank results are reported, the blank (and sample) results are flagged with an appropriate flag, qualifier, or footnote.
- Sample Results (Inorganic) - Following sample analysis and calculations (including any dilutions made due to the sample matrix) the result is verified to fall within the calibration range. If not, the sample is diluted and analyzed to bring the result into calibration range. When sample and sample duplicates are analyzed for precision, the calculated RPD is compared to the specified limits. The sample and duplicate are reanalyzed if the criteria are exceeded. The samples may require re-preparation and reanalysis. For metals, additional measures as described in the applicable SOP may be taken to further evaluate results (dilution tests and/or post-digestion spikes). Results are reported when within the calibration range, or as estimates when outside the calibration range. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including alternative analysis.
- Sample Results (Organic) - For GC/MS analyses, it is verified that the analysis was within the prescribed tune window. If not, the sample is reanalyzed. Following sample analysis and calculations (including any dilutions made due to the sample matrix) peak integrations, retention times, and spectra are evaluated to confirm qualitative identification. Internal standard responses and surrogate recoveries are evaluated against specified criteria. If internal standard response does not meet criteria, the sample is

diluted and reanalyzed. Results outside of the calibration range are diluted to within the calibration range. For GC and HPLC tests, results from confirmation analysis are evaluated to confirm positive results and to determine the reported value. The procedure to determine which result to report is described in the SOP for *Confirmation Procedure for GC and HPLC Analysis (SOC-CONF).* If obvious matrix interferences are present, additional cleanup of the sample using appropriate procedures may be necessary and the sample is reanalyzed. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including additional cleanup.

- Surrogate Results (Organic) – The percent recovery of each surrogate is compared to specified control limits. If recoveries are acceptable, the results are reported. If recoveries do not fall within control limits, the sample matrix is evaluated. When matrix interferences are present or documented, the results are reported with a qualifier that matrix interferences are present. If no matrix interferences are present and there is no cause for the outlier, the sample is reprepared and reanalyzed. However, if the recovery is above the upper control limit with non-detected target analytes, the sample may be reported. All surrogate recovery outliers are appropriately qualified on the report.
- Duplicate Sample and/or Duplicate Matrix Spike Results – The RPD is calculated and compared to the specified control limits. If the RPD is within the control limits the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used. Despite the use of homogenizing procedures prior to sample preparation or analysis, the sample may not be homogenous or duplicate sample containers may not have been sample consistently. If non-homogenous, the result is reported with a qualifier about the homogeneity of the sample. Also, the results are compared to the MRL. If the results are less than five times the MRL, the results are reported with a qualifier that the high RPD is due to the results being near the MRL. If the sample is homogenous and results above five times the MRL, the samples and duplicates are reanalyzed. If re-analysis also produces out-of-control results, the results are reported with an appropriate qualifier.
- Laboratory Control Sample Results – The LCS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits, the analysis is in control and results may be reported. If not, this indicates that the analysis is not in control. Samples associated with the 'out of control' LCS, shall be considered suspect and the samples re-extracted or re-analyzed or the data reported with the appropriate qualifiers. For analysis where a large number of analytes are in the LCS, it becomes more likely that some analytes (marginal exceedences) will be outside the control limits. The procedure described in the 2003 NELAC standards, Appendix D.1.1.2.1 are used to determine if the LCS is effective in validating the analytical system and the associated samples.
- Matrix Spike Results – The MS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits the results are reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as performing any additional cleanups, dilution and reanalysis, or re-preparation and

reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

11.4 Data Reporting

When an analyst determines that a data package has met the data quality objectives (and/or any client-specific data quality objectives) of the method and has qualified any anomalies in a clear, acceptable fashion, the data package is reviewed by a trained analyst or chemist. Prior to release of the report to the client, the Project Manager reviews and approves the entire report for completeness and to ensure that any and all client-specified objectives were successfully achieved. The original raw data, along with a copy of the final report, is scanned and archived by service request number. ALS Environmental, Kelso maintains control of analytical results by adhering to standard operating procedures and by observing sample custody requirements. All data are calculated and reported in units consistent with project specifications, to enable easy comparison of data from report to report.

To the extent possible, samples shall be reported only if all QC measures are acceptable. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). The *SOP for Data Reporting and Report Generation (ADM-RG)* addresses the flagging and qualification of data. The Columbia Analytical-defined data qualifiers, state-specific data qualifiers, or project-defined data qualifiers are used depending on project requirements. A case narrative may be written by the Project Manager to explain problems with a specific analysis or sample, etc.

For subcontracted analyses, the Project Manager verifies that the report received from the subcontractor is complete. This includes checking that the correct analyses were performed, the analyses were performed for each sample as requested, a report is provided for each analysis, and the report is signed. The Project Manager accepts the report if all verification items are complete. Acceptance is demonstrated by forwarding the report to the client.

11.5 Documentation

ALS Environmental, Kelso maintains a records system which ensures that all laboratory records of analysis data retained and available. Analysis data is retained for 5 years from the report date unless contractual terms or regulations specify a longer retention time. The archiving system is described in the *SOP for Data Archiving (ADM-ARCH)*.

11.5.1 Documentation and Archiving of Sample Analysis Data

The archiving system includes the following items for each set of analyses performed:

- Benchsheets describing sample preparation (if appropriate) and analysis;
- Instrument parameters (or reference to the data acquisition method);
- Sample analysis sequence;
- Instrument printouts, including chromatograms and peak integration reports for all samples, standards, blanks, spikes and reruns;
- Logbook ID number for the appropriate standards;

- Copies of report sheets submitted to the work request file; and
- Copies of Nonconformity and Corrective Action Reports, if necessary.

Individual sets of analyses are identified by analysis date and service request number. Since many analyses are performed with computer-based data systems, the final sample concentrations can be automatically calculated. If additional calculations are needed, they are written on the integration report or securely stapled to the chromatogram, if done on a separate sheet.

For organics analysis, data applicable to all analyses within the batch, such as GCMS tunes, CCVs, batch QC, and analysis sequences; are kept using a separate documentation system. This system is used to archive data on a batch-specific basis and is segregated according to the date of analysis. This system also includes results for the most recent calibration curves, as well as method validation results.

11.6 Deliverables

In order to meet individual project needs, ALS Environmental, Kelso provides several levels of analytical reports. Standard specifications for each level of deliverable are described in Table 11-1. Variations may be provided based on client or project specifications. This includes (but is not limited to) the following specialized deliverables:

- DoD QSM – Army Corp of Engineers, Air Force Center for Environmental Excellence, Navy
- Drinking water – State specific formats

When requested by the client or relevant to the validity of reported results, the estimation of measurement uncertainty will be provided to a client or regulatory agency. How the uncertainty will be reported may be dictated by the client's reporting specifications. Procedures for determining and reporting uncertainty are given in CE-QA010, *Estimation of Uncertainty of Analytical Measurements*.

When requested, ALS Environmental, Kelso provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. ALS Environmental, Kelso is capable of generating EDDs with many different formats and specifications. The EDD is prepared by report production staff using the electronic version of the laboratory report to minimize transcription errors. User guides and EDD specification outlines are used in preparing the EDD. The EDD is reviewed and compared to the hard-copy report for accuracy.

Table 11-1
Descriptions of ALS Environmental, Kelso Standard Data Deliverables

Tier I. Routine Certified Analytical Report (CAR) includes the following:

1. Transmittal letter
2. Chain of custody documents and sample/cooler receipt documentation
3. Sample analytical results
4. Method blank results
5. Surrogate recovery results and acceptance criteria for applicable organic methods
6. Dates of sample preparation and analysis for all tests
7. Case narrative – **optional**

Tier II. In addition to the Tier I Deliverables, this CAR includes the following:

1. Matrix spike result(s) with calculated recovery and including associated acceptance criteria
2. Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
3. Laboratory Control Sample result(s) with calculated recovery and including associated acceptance criteria
4. Case narrative – **optional**

Tier III. Data Validation Package. In addition to the Tier II Deliverables, this CAR includes the following:

1. Case narrative – **required**
2. Summary forms for all associated QC and Calibration parameters, with associated control criteria/acceptance limits

Note: Other summary forms specified in QAPPs or project/program protocols, or those related to specialized analyses such as HRGC/MS will be included.

Tier IV. Full Data Validation Package.

1. All raw data associated with the sample analysis, including but not limited to:
   a. Preparation and analysis bench sheets and instrument printouts,
   b. For organics analyses, all applicable chromatograms, spectral, confirmation, and manual integration raw data. For GC/MS this includes tuning results, mass spectra of all positive hits, and the results and spectra of TIC compounds when requested.
   c. QC data,
   d. Calibration data (initial, verification, continuing, etc),
   e. Calibration blanks or instrument blanks (as appropriate to method).
2. If a project QAPP or program protocol applies, the report will be presented as required by the QAPP.

12.0 PERFORMANCE AND SYSTEM AUDITS

Quality audits are an essential part of ALS Kelso's quality assurance program. There are two types of audits used at the facility: System Audits are conducted to qualitatively evaluate the operational details of the QA program, while Performance Audits are conducted by analyzing proficiency testing samples in order to quantitatively evaluate the outputs of the various measurement systems.

12.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of Columbia Analytical/Kelso are conducted regularly by various regulatory agencies and clients. Appendix G lists the certification and accreditation programs in which Columbia Analytical/Kelso participates. Programs and certifications are added as required. Additionally, internal system audits of Columbia Analytical/Kelso are conducted regularly under the direction of the Quality Assurance Program Manager. The internal audit procedures are described in CE-QA001, *Internal Audits*. The internal audits are performed as follows:

- Comprehensive lab-wide system audit – performed annually. This audit is conducted such that systems, technical operations, hardcopy data, and electronic data are assessed.
- Technical/method audits – minimum of 3 per quarter
- Hardcopy report audits – minimum of 2 per quarter.
- Chromatographic electronic data audits – each applicable instrument per quarter.

All audit findings, and corrective actions are documented. The results of each audit are reported to the Laboratory Director and Department Managers for review. Any deficiencies identified are summarized in the audit report. Managers must respond with corrective actions correcting the deficiency within a defined timeframe. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification within the corrective action period (if not already provided).

Electronic data audits may be performed in conjunction with hardcopy data audits. The electronic audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices, GCMS tuning data, peak response data, use of appropriate files, and other components of the analysis. The audit also verifies that the electronic data supports the hardcopy reported data.

Additional internal audits or data evaluations may be performed as needed to address any potential data integrity issues that may arise.

12.2 Performance Audits

ALS Kelso also participates in the analysis of interlaboratory proficiency testing (PT) samples. Participation in PT studies is performed on a regular basis and is designed to evaluate all analytical areas of the laboratory. General procedures for these analyses are described in CE-QA006, *Proficiency Sample Testing Analysis*. ALS Environmental, Kelso routinely participates in the following studies:

- Water Pollution (WP) and additional water parameters, 2 per year.
- Water Supply (WS) PT studies, 2 per year.
- Hazardous Waste/Soil PT studies, 2 per year.

- Underground Storage Tank PT studies, 2 per year.
- Microbiology (WS and WP) PT studies, 2 per year.
- Other studies as required for specific certifications, accreditations, or validations.

PT samples are processed by entering them into the LIMS system as samples (assigned Service Request, due date, testing requirements, etc.) and are processed the same as field samples. The laboratory sections handle samples the same as field samples, performing the analyses following method requirements and performing data review. The laboratory sections submit results to the QA Manager for subsequent reporting to the appropriate agencies or study provider. Results of the performance evaluation samples and audits are reviewed by the QAM, Laboratory Director, the laboratory staff, and the Manager of Quality Assurance, USA. For any results outside acceptance criteria, the analysis data is reviewed to identify a root cause for the deficiency, and corrective action is taken and documented through nonconformance (NCAR) procedures.

13.0 PREVENTIVE MAINTENANCE

Preventive maintenance is a crucial element of the Quality Assurance program. Instruments at ALS Environmental, Kelso (e.g., ICP/MS and ICP systems, GC/MS systems, atomic absorption spectrometers, analytical balances, gas and liquid chromatographs, etc.) are maintained under commercial service contracts or by qualified, in-house personnel. All instruments are operated and maintained according to the instrument operating manuals. All routine and special maintenance activities pertaining to the instruments are recorded in instrument maintenance logbooks. The maintenance logbooks used at ALS Environmental, Kelso contain extensive information about the instruments used at the laboratory.

An initial demonstration of analytical control is required on every instrument used at ALS Environmental, Kelso before it may be used for sample analysis. If an instrument is modified or repaired, a return to analytical control is required before subsequent sample analyses can occur. When an instrument is acquired at the laboratory, the following information is noted in a bound maintenance notebook specifically associated with the new equipment:

- The equipment's serial number;
- Date the equipment was received;
- Date the equipment was placed into service;
- Condition of equipment when received (new, used, reconditioned, etc.); and
- Prior history of damage, malfunction, modification or repair (if known).

Preventive maintenance procedures, frequencies, etc. are available for each instrument used at Columbia Analytical. They may be found in the various SOPs for routine methods performed on an instrument and may also be found in the operating or maintenance manuals provided with the equipment at the time of purchase.

Responsibility for ensuring that routine maintenance is performed lies with the section supervisor. The supervisor may perform the maintenance or assign the maintenance task to a qualified bench level analyst who routinely operates the equipment. In the case of non-routine repair of capital equipment, the section supervisor is responsible for providing the repair, either by performing the repair themselves with manufacturer guidance or by acquiring on-site manufacturer repair. Each laboratory section maintains a critical parts inventory. The parts inventories include the items needed to perform the preventive maintenance procedures listed in Appendix D.

This inventory or "parts list" also includes the items needed to perform any other routine maintenance and certain in-house non-routine repairs such as gas chromatography/mass spectrometry jet separators and electron multipliers and ICP/MS nebulizer. When performing maintenance on an instrument (whether preventive or corrective), additional information about the problem, attempted repairs, etc. is also recorded in the notebook. Typical logbook entries include the following information:

- Details and symptoms of the problem;
- Repairs and/or maintenance performed;
- Description and/or part number of replaced parts;
- Source(s) of the replaced parts;
- Analyst's signature and date; and
- Demonstration of return to analytical control.

See the table in Appendix E for a list of preventive maintenance activities and frequency for each instrument.

14.0 CORRECTIVE AND PREVENTIVE ACTION

The laboratory takes all appropriate steps necessary to ensure all sample results are reported with acceptable quality control results. When sample results do not conform to established quality control procedures, responsible management will evaluate the significance of the nonconforming work and take corrective action to address the nonconformance.

Nonconforming events such as errors, deficiencies, deviations from SOP, proficiency (PT) failure or results that fall outside of established QC limits are documented using the NCAR database. The procedure and responsibilities for addressing nonconforming work is defined in CE-QA008, *Nonconformance and Corrective Action.* Nonconformances are reported to the client using various means (voice, email, narrative, etc). When a nonconformance occurs that casts doubt on the validity of the test results or additional client instructions are needed, the Project Manager notifies the client the same business day that the nonconformance is confirmed and reported. The QAM reviews each problem, ensuring that appropriate corrective action has been taken by the appropriate personnel. The QAM periodically reviews all NCARs looking for chronic, systematic problems that need more in-depth investigation and alternative corrective action consideration. In addition, the appropriate Project Manager is promptly notified of any problems in order to inform the client and proceed with any action the client may want to initiate.

If a quality control measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). Failure to meet established analytical controls, such as the quality control objectives, prompts corrective action. Corrective action may take several forms and may involve a review of the calculations, a check of the instrument maintenance and operation, a review of analytical technique and methodology, and reanalysis of quality control and field samples. If a potential problem develops that cannot be solved directly by the responsible analyst, the supervisor, team leader, the department manager, and/or the QA PM may examine and pursue alternative solutions. In addition, the appropriate Project Manager is notified in order to ascertain if the client needs to be notified.

Part of the corrective action process involves determining the root cause. Identifying the root cause of a nonconformance can be difficult, but important for implementing effective corrective action. Root cause principles are used to determine assignable causes, which leads to corrective action taken to prevent recurrence. Various preventive action processes are used for eliminating a potential problem or averting a problem before it occurs. This is explained in CE-QA008, *Nonconformance and Corrective Action*.

In addition to internal communication of data issues, the laboratory also maintains a system for dealing with customer complaints. The person who initially receives the feedback (typically the Project Manager) is responsible for documenting the complaint. If the Project Manager is unable to satisfy the customer, the complaint is brought to the attention of the Client Services Manager, Laboratory Director, or QA PM for final resolution. The complaint and resolution are documented. The procedure is described in CE-GEN-010, *Handling Customer Feedback*.

15.0 QUALITY ASSURANCE REPORTS AND MANAGEMENT REVIEW

Quality assurance requires an active, ongoing commitment by ALS Environmental, Kelso personnel at all levels of the organization. Communication and feedback mechanisms are designed so that analysts, supervisors and managers are aware of QA issues in the laboratory. Analysts performing routine testing are responsible for generating a data quality narrative or data review document with every analytical batch processed. This report also allows the analyst to provide appropriate notes and/or a narrative if problems were encountered with the analyses. A Nonconformance and Corrective Action Report (NCAR) may also be attached to the data prior to review. Supervisors or qualified analysts review all of the completed analytical batches to ensure that all QC criteria have been examined and any deficiencies noted and addressed.

It is the responsibility of each laboratory unit to provide the Project Manager with a final report of the data, accompanied by signature approval. Footnotes and/or narrative notes must accompany any data package if problems were encountered that require further explanation to the client. Each data package is submitted to the appropriate Project Manager, who in turn reviews the entire collection of analytical data for completeness and to ensure that any and all client-specified objectives were successfully achieved. A case narrative is written by the Project Manager to explain any unusual problems with a specific analysis or sample, etc.

The QA PM provides overview support to the Project Managers as required (e.g., contractually specified, etc.). The QAM is also responsible for the oversight of all internal and external audits, for all proficiency testing sample and analysis programs, and for all laboratory certification/accreditation responsibilities. The QAM regularly communicates with the Laboratory Director to review the various QA/QC activities, priorities, and status of program implementation; including such topics as the following:

- Status, schedule, and results of internal and external audits;
- Status, schedule, and results of internal and external proficiency testing studies;
- Status of certifications, accreditations, and approvals;
- Status of QA Manual and SOP review and revision;
- Status of MDLs studies;
- Discussion of QC problems in the laboratory;
- Discussion of corrective action program issues;
- Status of staff training and qualification; and
- Other topics as appropriate.

An annual management review of the quality and testing systems is performed as described in CE-QA005, *Laboratory Management Review*. This is done to identify any necessary changes or improvements to the quality system or quality assurance policies. This review is documented in a Managerial Review of the Laboratory's Quality Systems and Testing Activities and sent to senior management.

16.0 PERSONNEL TRAINING

Technical position descriptions are available for all employees, regardless of position or level of seniority. These documents are maintained by the Human Resources personnel and are available for review. In order to assess the technical capabilities and qualifications of a potential employee, all candidates for employment at ALS Environmental, Kelso are evaluated, in part, against the appropriate technical description.

Training begins the first day of employment at ALS Environmental, Kelso when the company policies are presented and discussed. Safety and QA/QC requirements are integral parts of all technical SOPs and, consequently, are integral parts of all training processes at Columbia Analytical. Safety training begins with the reading of the ALS *Environmental Health and Safety Manual.* Employees are also required to attend periodic safety meetings where additional safety training may be performed by the Environmental, Health and Safety Officer.

Employees are responsible for complying with the requirements of the QA Manual and QA/QC requirements associated with their function(s). Quality Systems training begins with Quality Assurance orientation for new employees and reading the Quality Assurance Manual. During the employees first year, the employee attends Core Ethics training and learns about ALS Environmental, Kelso quality systems. Each employee participates in annual Ethics Refresher training.

ALS Environmental, Kelso also encourages its personnel to continue to learn and develop new skills that will enhance their performance and value to the Company. Ongoing training occurs for all employees through a variety of mechanisms. The corporate, company-wide training and development program, external and internal technical seminars and training courses, and laboratory-specific training exercises are all used to provide employees with professional growth opportunities.

All technical training is documented and records are maintained in the QA department. Training requirements and its documentation are described in ADM-TRAIN, *ALS-Kelso Training Procedure*. A training plan is developed whenever an employee starts a new procedure to new position. The training plan includes a description of the step-by-step process for training an employee and for initial demonstration of capability. Where the analyst performs the entire procedure, a generic training plan may be used.

16.1 Initial Demonstration of Capability (IDOC)

Training in analytical procedures typically begins with the reading of the Standard Operating Procedure (SOP) for the method. Hands-on training begins with the observation of an experienced analyst performing the method, followed by the trainee performing the method under close supervision, and culminating with independent performance of the method on quality control samples. Successful completion of the applicable Demonstration of Capability analysis qualifies the analyst to perform the method independently. Demonstration of Capability is performed by one of the following:

- Successful completion of an Initial Precision and Recovery (IPR) study (required where mandated by the method).
- Analysis of 4 consecutive Laboratory Control Samples, with acceptable accuracy and precision.

- Where spiking is not possible but QC standards are used ("non-spiked" Laboratory Control Samples), analysis of 4 consecutive Laboratory Control Samples with acceptable accuracy and precision.
- Where one of the three above is not possible, special requirements are as follows:
  - Total Settleable Solids: Successful single-blind PT sample analysis and duplicate results with RPD<10%.
  - Color: Four consecutive prepared LCSs with acceptable accuracy and precision of <10% RSD.
  - Physical Tests (Grain size, Corrosivity to Steel, etc.): Supervisor acknowledgement of training and approval.

A flowchart identifying the Demonstration of Proficiency requirements is given in Figure 16-1. The flowchart identifies allowed approaches to assessing Demonstration of Capability when a 4-replicate study is not mandated by the method, when spiking is not an option, or when QC samples are not readily available.

16.2 Continuing Demonstration of Proficiency

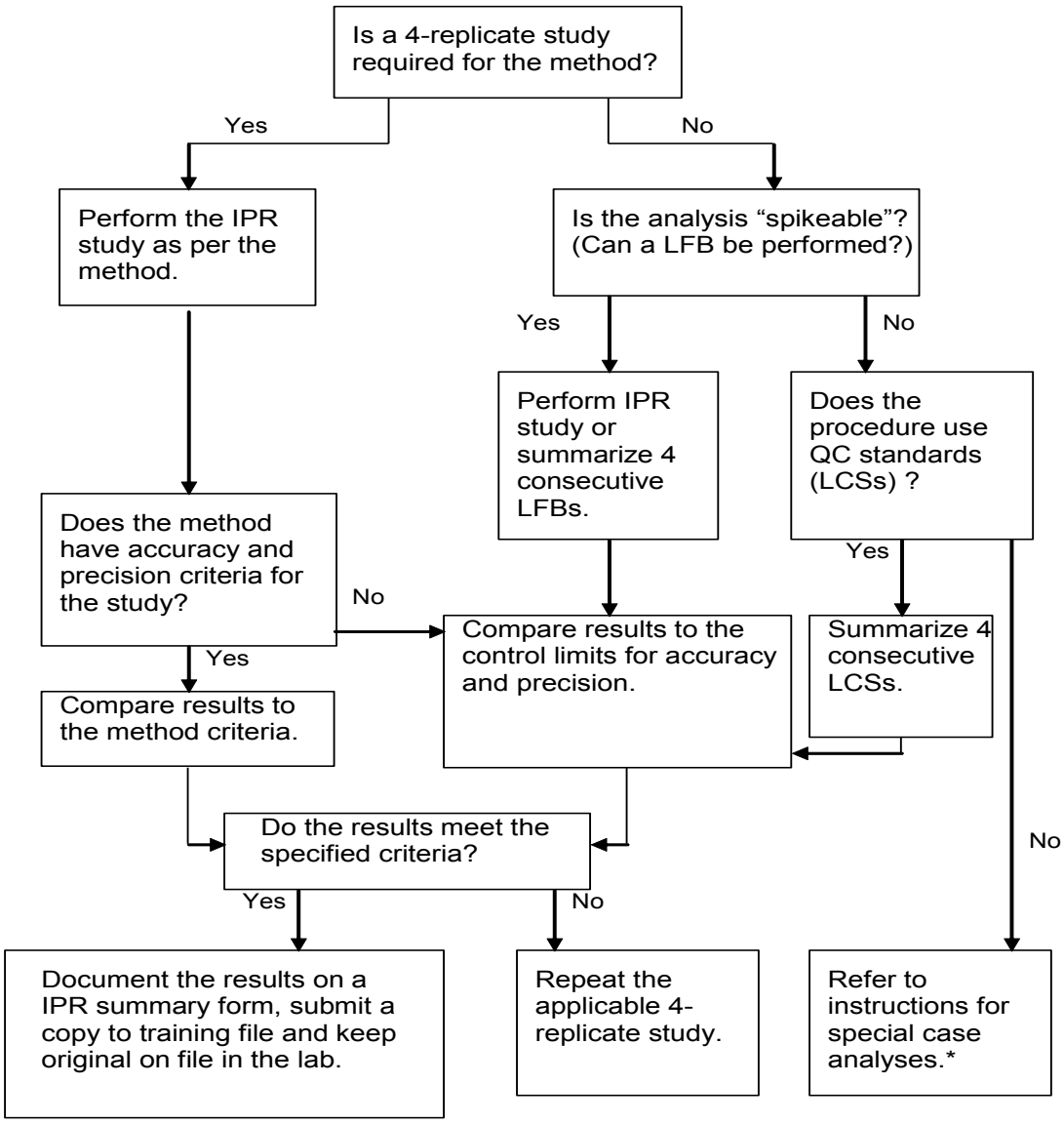
A periodic demonstration of proficiency is required to maintain continuing qualification. Continuing Demonstration of Proficiency is required each year, and may be performed one of the following ways:

- Successful performance on external (independent) single-blind sample analyses using the test method, or a similar test method using the same technology. I.e. PT sample or QC sample blind to the analyst.
- Performing Initial Demonstration of Capability as described above, with acceptable levels of precision and accuracy.
- Analysis of at least 4 consecutive LCSs with acceptable levels of accuracy and precision from in-control analytical batches.
- If the above cannot be performed, analysis of authentic samples with results statistically indistinguishable from those obtained by another trained analyst.
- For methods for which PT samples are not available and a spiked analysis (LFB, MDL, etc.) is not possible, analysis of field samples that have been analyzed by another analyst with statistically indistinguishable results.

16.3 Documentation of Training

Records are maintained to indicate the employee has the necessary training, education, and experience to perform their functions. Information of previously acquired skills and abilities for a new employee is maintained in Human Resources personnel files and ALS Environmental, Kelso resumes. QA maintains a database to record the various technical skills and training acquired while employed by Columbia Analytical. Information includes the employee's name, a description of the skill including the appropriate method and SOP reference, the mechanism used to document proficiency, and the date the training was completed. General procedures for documenting technical training are described in ADM-TRAIN, *ALS-Kelso Training Procedure*.

Figure 16-1
Initial Demonstration of Capability Requirements



* Refer to the ADM-TRAIN for details.

17.0 REFERENCES FOR QUALITY SYSTEMS, EXTERNAL DOCUMENTS, MANUALS, STANDARDS, AND ANALYTICAL PROCEDURES

The analytical methods used at ALS Environmental, Kelso generally depend upon the end-use of the data. Since most of our work involves the analysis of environmental samples for regulatory purposes, specified federal and/or state testing methodologies are used and followed closely. Typical methods used at ALS Environmental, Kelso are taken from the following references:

- National Environmental Laboratory Accreditation Program (NELAP), 2003 Quality Standards.
- TNI Standard – Environmental Laboratory Sector, Volume 1, *Management and Technical Requirements for Laboratories Performing Environmental Analysis,* EL-V1-2009.
- Quality Standards. American National Standard *General requirements for the competence of testing and calibration laboratories,* ANSI/ISO/IEC 17025:2005(E)
- *DoD Quality Systems Manual for Environmental Laboratories,* Version 4.2, 10/25/2010
- *Good Automated Laboratory Practices, Principles and Guidance to Regulations For Ensuring Data Integrity In Automated Laboratory Operations*, EPA 2185 (August 1995).
- *Manual for the Certification of Laboratories Analyzing Drinking Water*, 5th Edition, EPA 815-B-97-001 (January 2005).
- *Procedure Manual for the Environmental Laboratory Accreditation Program,* Washington Department of Ecology, 10-03-048, September 2010.
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, (September 1986) and Updates I (July 1992), II (September 1994), IIA (August 1993), IIB (January 1995), III (December 1996), Final Update IV (February 2007), and updates posted online at http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm. See Chapters 1, 2, 3, and 4.
- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, (Revised March 1983).
- *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA/600/R-93/100 (August 1993).
- *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91/010 (June 1991) and Supplements.
- *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, EPA 600/4-82-057 (July 1982) and 40 CFR Part 136, Appendix A.
- *Methods for the Determination of Organic Compounds in Drinking Water*, EPA/600/4-88/039 (December 1988) and Supplements.
- *Standard Methods for the Examination of Water and Wastewater*, 20th Edition (1998) and SM On-Line. See Introduction in Part 1000.
- 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act.
- 40 CFR Part 141, National Primary Drinking Water Regulations.
- *Analytical Methods for Petroleum Hydrocarbons*, ECY 97-602, Washington State Department of Ecology, June 1997.

- State-specific total petroleum hydrocarbon methods for the analysis of samples for gasoline, diesel, and other petroleum hydrocarbon products (Alaska, Arizona, California, Oregon, Washington, Wisconsin, etc.).
- Annual Book of ASTM Standards, Part 31, Water.
- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA-540/R-94/012 (February 1993).
- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA-540/R-94/013 (February 1994).
- *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*, for USEPA and USACE (March 1986), with revisions through April 1997.
- WDOE 83-13, *Chemical Testing Methods for Complying with the State of Washington Dangerous Waste Regulations* (March 1982) and as Revised (July 1983 and April 1991).
- *Identification and Listing of Hazardous Waste,* California Code of Regulations, Title 22, Division 4.5, Chapter 11.
- *Analytical Methods for the Determination of Pollutants in Pulp and Paper Industry Wastewater*, EPA 821-R-93-017 (October 1993).
- *Analytical Methods for the Determination of Pollutants in Pharmaceutical Manufacturing Industry Wastewaters*, EPA 821-B-98-016 (July 1998).
- National Council of the Pulp and Paper Industry for Air and Stream Improvement (NCASI).

18.0 ATTACHMENTS

- Appendix A: Approved Signatories, QA Program Documents, Corporate SOP List
- Appendix B: Organizational Chart and Resumes of Key Personnel
- Appendix C: Major Analytical Equipment
- Appendix D: Data Qualifiers and Acronyms
- Appendix E: Preventive Maintenance Procedures
- Appendix F: Standard Operating Procedures
- Appendix G: Laboratory Certifications and Accreditations

APPENDIX A

Approved Signatories

QA Program Documents

Corporate Policies

Administrative Corporate SOP List

APPROVED SIGNATORIES FOR ANALYTICAL REPORTS

ALS Environmental, Kelso, WA

ARNOLD, EILEEN
BAILEY, JOSH
CHAN, JIM
CORONADO, JEFFREY
DEGNER, CARL
DOMENIGHINI, LISA
GRINDSTAFF, JEFF
HADERLY, DOUGLAS
HARRIS, LISA
HOLMES, HOWARD
HUCKESTEIN, LYNDA
JACKY, HARVEY
JAMES, JON
KENNEDY, LES
LEAF, CHRIS
MALLOCH, JANET
MIHAI-LAZAR, CARMEN
MOORE, RACHEL
MURRY, SHANE
PORTWOOD, LOREN
REASONER, KAREN
SALATA, GREGORY
SAMY, SHAR
SHELDON, BRIAN

Update: April 19, 2013 Approved by: Lynda Huckestein/Client Services Manager

QA Program Files

Program	Location
Quality Assurance Manual	Q:\QA Manual\QAM.rXX.DOC
Software Quality Assurance Plan	Corp IT
CAS-Kelso Certifications/Accreditations	Cert_kel.xls
Columbia Analytical Services MDL Tracking Spreadsheet	Q:\MDL Tracking\MDL_LIST.r1.XLS
Technical Training Summary Database	TrainDat.mdb
Approved Signatories List	QAM App A
Personnel resumes/qualifications	HR dept
Personnel Job Descriptions	HR Department
CAS/KELSO DATA QUALITY OBJECTIVES	CAS Kelso DQO 20XX.rX.xls
Master Logbook of Laboratory Logbooks	QA Masterlog-001
Standard Operating Procedure Database	Q:\ENVIRONMENTAL\1 SOP & Policy Statements\1_ Kelso SOP.xls

Corporate SOPs

SOP TITLE	SOP Code	Rev	SOP Date
LABORATORY ETHICS AND DATA QUALITY	CE-GEN001	1.00	09/15/12
BP LABORATORY MANAGEMENT PROGRAM SOP	CE-GEN002	1.00	11/1/12
RECORDS MANAGEMENT POLICY	CE-GEN003	00.0	7/15/12
PREVENTIVE ACTION	CE-GEN004	00.0	7/1/12
DOCUMENT CONTROL	CE-GEN005	00.0	9/1/12
DATA RECALL	CE-GEN006	00.0	9/1/12
PROCUREMENT CONTROL OF LABORATORY SERVICES AND SUPPLIES	CE-GEN007	00.0	9/1/12
METHOD DEVELOPMENT	CE-GEN008	0.00	12/01/12
ESTABLISHING STANDARD OPERATING PROCEDURES	CE-GEN009	0.00	01/01/13
HANDLING CUSTOMER FEEDBACK	CE-GEN010	0.00	02/15/13
ASSIGNING A TSR TO A PROJECT	CE-GEN011	0.00	04/01/13
INTERNAL AUDITS	CE-QA001	00.0	1/1/12
MANUAL INTEGRATION POLICY	CE-QA002	00.0	3/15/12
TRAINING POLICY	CE-QA003	00.0	8/1/12
QUALIFICATION OF SUBCONTRACT LABORATORIES	CE-QA004	00.0	8/1/12
LABORATORY MANAGEMENT REVIEW	CE-QA005	00.0	9/1/12
PROFICIENCY TESTING SAMPLE ANALYSIS	CE-QA006	00.0	9/15/12

SOP TITLE	SOP Code	Rev	SOP Date
MAKING ENTRIES ONTO ANALYTICAL RECORDS	CE-QA007	00.0	9/1/12
NONCONFORMITY AND CORRECTIVE ACTION	CE-QA008	00.0	10/1/12
CONTROL LIMITS	CE-QA009	0.00	12/01/12
ESTIMATION OF UNCERTAINTY OF ANALYTICAL MEASUREMENTS	CE-QA010	0.00	01/15/13
PERFORMING METHOD DETECTION LIMIT STUDIES AND ESTABLISHING LIMITS OF DETECTION AND QUANTITATION	CE-QA011	0.00	02/15/13
QUALITY OF REAAGENTS AND STANDARDS	CE-QA012	0.00	02/15/13

Forms

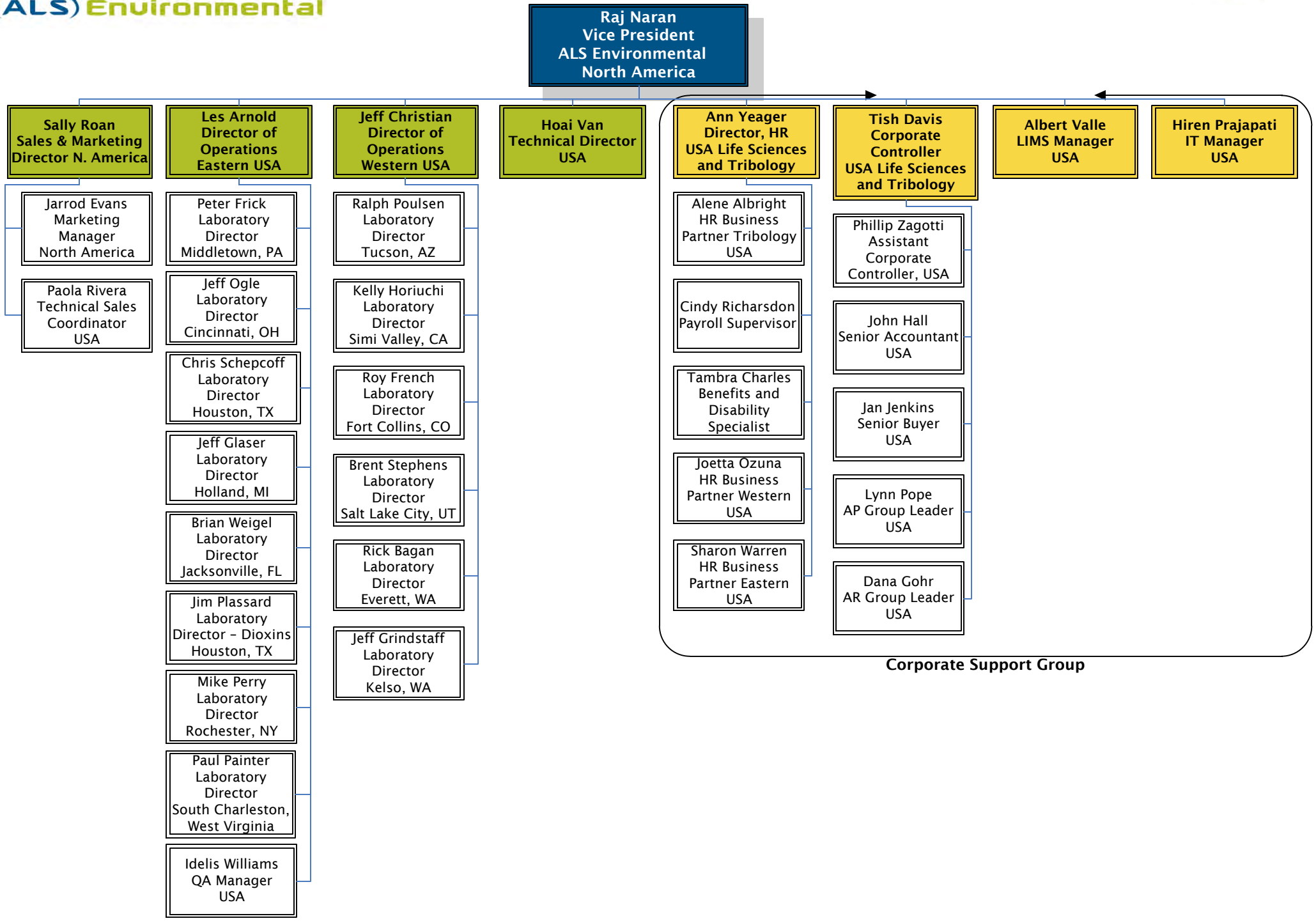
FORM	FILE NAME	DATE
Complaint Report	G:\QA\QA_Forms/Complaint Report_r121509	09/10/12
Critical Job Function Authorization Statement	G:\QA\QA_Forms\IDC-CDC Certification Statements/Critical Job Function Authorization	12/15/09
Data Re-submittal Request Form	G:\QA\QA_Forms/Data Resubmittal Request Form_r112107	11/21/07
Demonstration of Capability Certification Statement (no table version)	G:\QA\QA_Forms\IDC-CDC Certification Statements/DOC Certification Statement_r071206-	06/10/11
Extraction Solvent Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables/ Critical Consumables Evaluation xxxxxx	2012
Laboratory Training Certification	LAB-TRNG_r092109	9/21/09
Metals Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables /Critical Consumables Metals Evaluation xxxx	2012
Method Detection Limit Study Calculation Spreadsheet	R:\LAB MDL LOD LOQ/MDL_FORMR4_r030510	3/5/10
New Vendor Evaluation	G:\QA\QA_Forms\Purchasing/ New Vendor Evaluation 092612	10/15/09
Pipettes Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables /Critical Consumables Pipettes	11/08/11
Procedure Change Form	Q:\ENVIRONMENTAL\1 SOP & Policy Statements/SOP DISTRIBUTION FORMS	12/16/10
Reagent/Consumable Critical Consumables Evaluation	G:\QA\QA_Forms\Critical Consumables/ Critical Consumables Evaluation xxxxxx	5/3/11
Standard Operating Procedure Change Form	G:\QA\QA_Forms//SOP Change Form	9/21/09
LOD Verification	G \QA\QA_Forms\LOD Verification071610.xls	07/16/10

LOQ Verification	G \QA\QA_Forms\LOQ Verification022410.xls	02/24/10
Various Training Plans	G:\QA\QA_Forms\Training Plans\	NA

APPENDIX B

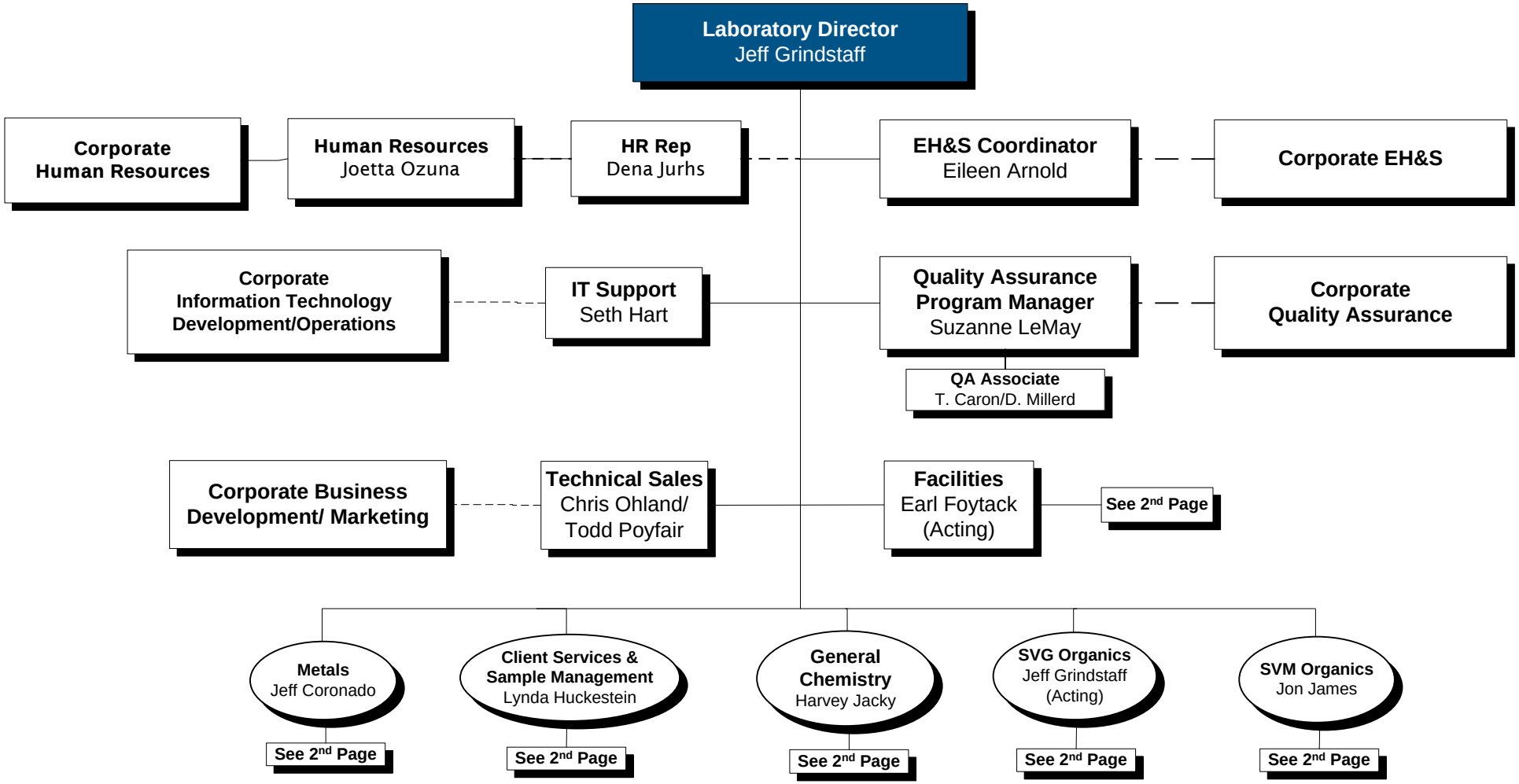
ORGANIZATIONAL CHARTS and RESUMES OF KEY PERSONNEL

USA
March 2013



Kelso, Washington Laboratory

February 4, 2013



Kelso, Washington Laboratory

February 4, 2013
Operations

Laboratory Director
Jeff Grindstaff

Kelso Facilities
E. Foytack (acting)

B. Wick
J. Kanaly
D. Iverson

Metals
Jeff Coronado

Metals
J. Bailey (S)
L. Jording (S)
E. Arnold (S)
B. Sheldon (S)
N. Becker
E. Cabrera
J. Chan
A. Cheatley
B. Hall
G. Jasper
J. Jones (T)
E. Mcallister
A. Mckorney
R. Moore
S. Patterson
M. Ritola
R. Stillick
T. Thomas
S. Tscheu
J. Wolf

Client Services & Sample Management
Lynda Huckestein

Project Management
L. Domenighini
H. Holmes
A. Juell
C. Leaf
J. Malloch
G. Salata
S. Samy

Sample Custodian
S. Heflin
D. Moore

Bottle Preparation
J. Wick (S)
L. Garr
S. Maximiliano (T)
K. Morrow

Report Production
A. Sheldon (S)
C. Blair
L. Bohannon
R. Hall
M. Jacobson
L. Ninneman
E. Peterson
J. Wygant

Sample Receiving
L. Kennedy (S)
F. Adair
S. Davis
G. Hokkanen
B. Tobin
S. Wolf
B. Wygant

General Chemistry
Harvey Jacky

General Chemistry
C. Mihai-Lazar (S)
B. Kirby (S)
T. Hanganu (S)
A. Bradbury (TL)
B. Hetland (TL)
M. Kanaly (TL)
E. Minium (TL)
N. Bakotich
G. Beatley
M. Bevans
B. Chappelle
A. Cheatley
P. Faiman
I. Franks
E. Lazar
S. Olsen
C. Schroeder
C. Sethe
N. Slater
M. Specht

SVG Organics
Jeff Grindstaff (Acting)

GC
L. Portwood (S)

SVG Extractions
E. Bruno (S)
S. Caggiano
C. Christian (T)
Z. Dumke
L. Harris
R. Hayes
C. Huggins
C. Jones (PT)
Y. Kopitko
K. Miller
P. Mohseni
S. Murray
J. Schwab
J. Smith
S. Smith
M. Stueve
S. Sullivan
D. Vaillencourt
C. Vecchitto
B. Willard

SVM Organics
Jon James

LC
D. Haderly
M. Hall
S. Jones
M. May
C. Schroeder

Volatiles
H. Butcher
J. McCoy
K. Reasoner-Weiderman
G. Roettger
N. Salata (PT)

SVM
C. Degner (S)

SVM Extractions
H. Bailey (S)
K. Bailey
R. Bencz (T)
W. Blake
M. Butcher
K. Collins
S. Dunnavant
S. Eldridge
C. Hart
R. Holden
D. Hongel
J. Laycock (T)
D. Marin (T)
A. Meyers
J. Peterson
K. Schmid
N. Selstad
L. Weiskopf
J. Westerdahl

Jeffrey A. Grindstaff

1317 S. 13th Avenue ● Kelso, WA 98626 ● +1 360 577 7222

ALS Environmental

Education

Allan Hancock College,
Santa Maria, CA
AA, Liberal Arts, 1986

California Polytechnic
State University
San Luis Obispo, CA
BS, Chemistry, 1989

Hewlett-Packard Analytical
Education Center
Interpretation of Mass Spectra I, 1992

Hewlett-Packard Analytical
Education Center
Mass Selective Detector Maintenance, 1993

Richard Rogers Group
Leadership Training, 1996

PTI International
Sampling and Testing of Raw Materials, 2004

Affiliations

American Chemical Society, 1989

Publications

Mr. Grindstaff has a number of publications and presentations. For a complete list, contact ALS – Columbia.

Laboratory Director

2010 - Present

Responsible for all phases of laboratory operations at the Kelso (WA) facility, including project planning, budgeting, and quality assurance. Primary duties include the direct management of the Kelso laboratory.

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA

Technical Manager III, Pharmaceutical, GC/MS VOA and Semi-VOA Laboratories, '97-'10

Primary responsibilities include leadership of the Pharmaceutical, GC/MS VOA and Semi-VOA staff, management of method development, training, data review, tracking department workload, scheduling analyses. Responsible for ensuring data quality and timeliness. Also responsible for project management and coordination for pharmaceutical clients.

Columbia Analytical Services, Inc.
Kelso, WA

Manager, GC/MS VOA Laboratory, '94-'97

Responsible for supervision of GC/MS VOA staff, method development, training, data review, tracking department workload, scheduling analyses, and general maintenance and troubleshooting of GC/MS systems.

Columbia Analytical Services, Inc.
Kelso, WA

Scientist III, GC/MS VOA Laboratory, '91-'94

Responsibilities included scheduling workload, data review, instrument maintenance and troubleshooting, and personnel training and evaluation. Also responsible for supervision of extraction personnel and instrument analysts. Additional supervisory duties included report generation and data review for GC analyses. Responsibilities also included project management and customer service.

Enseco-CRL
Ventura, CA

Chemist, '90-'91

Established GC/MS department including inventory maintenance, preparation of state certification data packages, method development, SOPs, and extended data programs. Performed daily maintenance and troubleshooting of GC and GC/MS instrumentation. Scheduled and performed routine and non-routine VOA analyses.

Coast to Coast Analytical Service
San Luis Obispo, CA

GC/MS Chemist, VOA Laboratory, '90-'91

Responsible for standard preparation for VOA analyses, instrument calibration, tuning, and maintenance. Also implemented and further developed EPA methods for quantitative analysis of pesticides and priority pollutants.

Suzanne LeMay

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

Education

University of Oregon – Eugene, OR
BS Geology, 1981

Ethics and Integrity Training; ORELAP/OELA Workshop, **2007**
How to Be a QA Manager; Advanced Systems, Inc., **2007**
Assessments for ISO/IEC 17025 and NELAC (ASI Course 300); Advanced Systems, Inc., **2005**
Introduction to Assessments; Advanced Systems, Inc., **2005**
Environmental Training, Quality Assurance/Quality Control (ASI Course 103); Advanced Systems, Inc., **2004**
Manager/Supervisor Training; Portland General Electric, **1998**
Statistics for Methodology Development; AOAC Short Course, **1994**
Quality Assurance for Analytical Laboratories, AOAC, **1991**

Quality Assurance Manager

2012 – Present

Responsible for the overall implementation of the laboratory QA program. Oversees implementation of Quality management systems including: Quality Assurance Manual, Certifications, SOP Control, Proficiency Testing (PT), Non-Conformity, Preventative Actions, Internal Auditing, Control Charting, Documentation of Training, and Metrology. Conducts employee QA training including orientations, sop, and ethics. Maintains state, agency and program certifications/accreditations. Acts as primary point of contact during laboratory audits coordinates audit responses and corrective actions.

Previous Experience

Test America — **Quality Assurance Manager, '00 – '10**
Portland, OR.

Developed and implemented a Quality System compliant with state and national regulatory standards, including: Safe Drinking Water Act, Clean Water Act, and Resource Conservation and Recovery Act. Acquired and maintained multiple laboratory accreditations including Oregon Environmental Laboratory Accreditation Program (ORELAP), Alaska Department of Environmental Conservation, Washington Department of Ecology, and California Environmental Laboratory Accreditation Program. Developed and implemented an internal compliance auditing program. Lead Quality Management projects designed to improve laboratory productivity, quality, and customer service. Organized and directed activities designed to anticipate and address quality issues in the laboratory. Oversight of laboratory support systems and equipment including the DI water system, cold storage, foreign soil storage and disposal, and calibration of balances, thermometers, pipettes, etc. Provided Quality Systems and Ethics training to laboratory staff.

Oregon Analytical Laboratory — **QA/QC Chemist, '92 – '00**
Beaverton, OR.

Developed and implemented a lab quality system encompassing certifications, proficiency testing, corrective actions, internal auditing, training, and maintenance of lab support systems and equipment. Wrote the lab QA Manual and developed and implemented document control procedures. Obtained and maintained multiple laboratory accreditations and transitioned the quality system toward compliance with the emerging NELAP. Directed a lab QA committee and participated in Total Quality Management and process improvement teams.

Oregon Analytical Laboratory — **Asbestos Team Leader, '90 – '92**
Beaverton, OR.

Obtained program accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP). Analyzed samples for bulk and airborne asbestos and supervised department analysts. Provided method, quality and ethics training. Obtained program accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP).

Oregon Analytical Laboratory — **Analyst/Technician, '85 – '90**
Beaverton, OR.

Performed sample preparation and analysis in the areas of bulk and airborne asbestos, transformer oil analysis, lube/fuel oil analysis, water chemistry, and particle analysis.

Eileen M. Arnold

1317 S. 13th Avenue ● Kelso, WA 98626 ● +1 360 577 7222

ALS Environmental

Education

Immaculata College,
Immaculata, PA
BA, Chemistry, 1977

Affiliations

American Chemical Society, Member since 1987.

Scientist, Metals Laboratory/Kelso Health and Safety Officer

2011 - Present

Supervisor of the Metals reporting group responsible for ensuring timely, accurate reporting of all metals reports. Responsible for updating instrument specific data, such as MDL and control limits. Analyst for the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques.

Environmental, Health and Safety Officer responsibilities include development and implementation of the Kelso Health and Safety program, including accident investigation and incident review, maintenance of all safety related equipment, review of monthly safety audits, and completion of all Federal and State mandated EH&S reports.

Previous Experience

Columbia Analytical Services, Inc. **Scientist IV Metals Laboratory/Kelso Health and Safety Officer,** *'94-'11*
Kelso, WA
Duties as described above.

Columbia Analytical Services, Inc. **Project Chemist**, '92-'94
Kelso, WA
Duties included technical project management and customer service. Responsible for meeting the clients' needs of timely and appropriate analyses, and to act as liaison for all client-related activities within Columbia Analytical Services, Inc.

Columbia Analytical Services, Inc. **Scientist IV Metals Laboratory**, '87-'92
Kelso, WA
Duties include the operation and maintenance of the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques.

Dow Corning Corporation. **Chemist,** '86-'87
Springfield, OR
Responsibilities included ICP and atomic absorption work in silicon manufacturing. Methods development for ICP analysis of minor impurities found in silicon.

Ametek, Inc. **Chemist, '**86-'87
Harleysville, PA
Responsibilities included product research and development chemist involved in production of thin-film semiconductors for use as solar cells. Work involved AA and SEM techniques

Janbridge, Inc.. **Chemist,** '78-'82
Philadelphia, PA
Responsibilities included maintaining electroplating process lines through wet chemical analysis techniques, and performed Quality Assurance testing on printed circuit boards.

Lynda A. Huckestein

1317 S. 13th Avenue ● Kelso, WA 98626 ● +1 360 577 7222

ALS Environmental

Education

Oregon State University, Corvallis, OR
BS in Microbiology, 1983

Client Services Manager IV

1998 - Present

Management of the Client Services Departments: Project Management, Electronic Data Deliverables and Report Generation, and Sample Management. Oversee the client services for approximately $15 million in revenue annually. Personally responsible for approximately $2 million of direct technical project management annually providing technical and regulatory interpretation assistance, as well as project organization of work received by the laboratory.

Previous Experience

Columbia Analytical Services, Inc. — **Project Chemist**, '92-'98
Kelso, WA

Primary responsibilities included technical project management and client service in areas of pulp & paper, marine sediment and tissue services, mining, and DOD. Also responsible for providing technical and regulatory interpretation assistance as-well-as project organization to work received by the laboratory.

Columbia Analytical Services, Inc. — **Project Chemist and Dept. Manager**, General Chemistry Laboratory, '89-'92
Kelso, WA

Responsible for management of the General Chemistry laboratory for routine wastewater, bioassay, and microbiological analyses. Also responsible for supervision of staff, data review, and reporting.

Columbia Analytical Services, Inc. — **Analyst III**, 1989
Kelso, WA

Primary responsibilities included coliform testing, total recoverable petroleum hydrocarbon extractions and analysis, BODs, ammonias, and TKN, in addition to miscellaneous wet chemistry analyses.

Coffey Laboratories — **Microbiologist/Chemist**, 1983
Portland, OR

Was responsible for Coliform analysis; water chemistry.

Oregon State University — **Laboratory Assistant**, 1983
Corvallis, OR

Performed wheat spike dissection and tissue culture.

Jeffrey A. Coronado

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

ALS Environmental

Technical Manager IV, Metals Department Manager

1992 – Present

Management of the Kelso Metals Department with a staff of 22 chemists and technicians, and annual revenues approaching $4 million. Responsible for data quality and timeliness, annual budgeting, revenues, expenses, workload coordination, method development efforts, and resource allocation. 2001 to Present—Project Manager: Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and providing technical support to clients regarding laboratory application to projects.2008 to Present— Participation in the corporate Information Technology governance team ensuring software development activities are in line with the companies operational objectives.2010 to Present—Participation in multiple LIMS development teams responsible for defining the CAS product. Team leader for defining specifications of the Sample Preparation Module to capture preparation information across all laboratory departments.

Previous Experience

Columbia Analytical Services, Inc. **Metals Department Manager,**
Kelso, WA **'92 – present**

Responsibilities included management of all aspects of the metal laboratory operation, including personnel training and evaluation, review of all metals data, and report generation. Also responsible for client service on a number of ongoing CAS accounts. Technical duties include primary analytical responsibility for trace level metals analysis by ICP/MS. Analyses range from routine water and soil analysis, to marine tissues, as well as industrial applications such as ultra-trace QA/QC work for various semiconductor clients. Also responsible for a number of specialized sample preparation techniques including trace metals in seawater by reductive precipitation, and arsenic and selenium speciation by ion-exchange chromatography. Developed methodology for performing mercury analysis at low part per trillion levels by cold vapor atomic fluorescence.

Columbia Analytical Services, Inc. **Supervisor, GFAA Laboratory,**
Kelso, WA **'89 – '92**

Responsibilities included supervision of metals analysis by graphite furnace atomic absorption following SW 846 and EPA CLP methodologies. Duties include workload scheduling, data review, instrument maintenance, personnel training and evaluation.

Education

Western Washington University – Bellingham, WA
BS, Chemistry, 1988

Western Washington University – Bellingham, WA
BA, Business Administration, 1985

Winter Conference on Plasma Spectrochemistry – Tucson, AZ, 2012

LC/ICP-MS Training Course – PerkinElmer, 2008

Field Immunaossay Training Course – EnSys Inc., 1995

Winter Conference on Plasma Spectrochemistry – San Diego, CA, 1994

ICP-MS Training Course – VG-Elemental, 1992

Harvey Jacky

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

General Chemistry Department Manager

2008 – Present

Oversee the operation of the General Chemistry and Microbiology groups. Responsible for the quality and timeliness of the inorganic laboratories analytical reports, departmental budgets, workload coordination, method development efforts, cost-effectiveness, and resource allocation.

Previous Experience

Columbia Analytical Services, Inc. **Project Manager III, '99 – '08**
Kelso, WA

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and providing technical support to clients regarding laboratory application to projects. Additionally, acts as a consultant to clients regarding industrial/environmental compliance issues; serving as liaison between clients and regulatory agencies.

Coffey Laboratories **Director of Project Management, '97 – '99**
Portland, OR

Responsible for technical project management. Communicated with clients to determine needs and expectations. Monitored laboratory production and ensured the timely completion of analytical projects. Technical consultant for clients regarding environmental compliance. Supervised and managed other members of the project management team. Served as a member of the senior management team for oversight of general operations, strategic planning, finances, and policy.

Coffey Laboratories **Project Manager/Chemist, '97 – '99**
Portland, OR

Responsibilities: Served as primary liaison between Coffey Laboratories and major clients. Ensured that work was completed in a timely manner and done to client specifications. Served as technical consultant regarding environmental chemistry, soil remediation, and waste water industrial compliance. Clients included the Oregon Department of Transportation, Hazmat Unit, Portland, Oregon; Raythion Demilitarization Co., Umatilla, Oregon; Hydroblast - Wastewater Evaporator Systems, Vancouver, Washington; and Union Pacific Railroad, Northwest Region, Klamath Falls, Oregon.

Coffey Laboratories **Technical Sales Representative, '95 – '97**
Portland, OR

Responsible for marketing and sales, including actively prospecting for new potential clients. Additional responsibilities included procurement and preparation of all major project bids; ensuring that client expectations were met; and maintaining customer satisfaction. Served as consultant regarding industrial compliance issues, environmental remediation projects, and hazardous waste management.

Coffey Laboratories **Senior Chemist/Laboratory Chemical Hygiene Officer, '88 – '95**
Portland, OR

Responsibilities: Performed analytical tests including Anions by Ion Chromatography (EPA 300.0), PAHs by HPLC (EPA 8310), Cyanides (EPA 335), and other inorganic, wet chemistry, and organic analytical tests on a wide variety of sample matrices. Responsible for the initial quality assurance review of work performed, supervised and managed personnel. Developed and implemented Laboratory Chemical Hygiene Plan. Directed personnel in regards to safety issues and hazardous waste management. Served as consultant and teacher regarding analytical methodology, environmental compliance, and industrial hygiene.

Education

Oregon State University – Corvallis, OR
BS, Zoology, 1988

Oregon State University – Corvallis, OR
BS, General Science, 1988

Linfield College – McMinnville, OR
General Studies, 1981 - 1982

40-Hour Hazmat Certification, PBS Environmental, 1996

Industrial Emergency Response, SFSP Seminar, 1991

Presentations

American Chemical Society, Member since 1988

Biochemical and Physical Factors Involved in the Application and Measurement of a Soil Bioremediation System. Biogeochemistry, Portland State University, 1996

Jonathan (Jon) James

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

VOA/MS, Semivolatile GC/MS and HPLC Department Manager

2009 – Present

Oversee the operation of the Volatiles GC/MS, Semivolatile GC/MS and HPLC laboratories. Responsibilities include organizing and prioritizing workload, training and development of staff, working with PCs on client specific project requirements, departmental budgets, workload coordination, method development efforts and resource allocation. Responsible for the quality and timeliness of analytical reports. Other responsibilities include ensuring compliance with CAS QA protocols and assisting staff with troubleshooting equipment and procedural problems.

Previous Experience

Columbia Analytical Services, Inc. **Manager VOA and PHC/HPLC**
Kelso, WA **Laboratories, '04- '09**

Oversee daily operation of the Volatiles GC/MS and PHC/HPLC laboratories. Responsibilities include organizing and prioritizing workload, initiating process improvements, training and development of staff and working wit PCs on client specific project requirements. Responsible for analytical duties as listed below for Scientist IV. Other responsibilities include ensuring compliance with CAS QA protocols and assisting staff with troubleshooting equipment and procedural problems.

Columbia Analytical Services, Inc. **Scientist IV, VOA Laboratory,**
Kelso, WA **'99 – '04**

Perform sample analysis and data review for EPA methods 524.2, 624 and 8260. Duties also include Project Management.

Columbia Analytical Services, Inc. **Project Chemist, Supervisor**
Kelso, WA **Pesticides GC Laboratory, '98 – '99**

Primary responsibilities included workload scheduling, data review, instrument maintenance and troubleshooting, and personnel training and evaluation. Also responsible for supervision of extraction personnel and instrument analysts.

Columbia Analytical Services, Inc. **Analyst, SVOC GC Lab**
Kelso, WA **'92 – '98**

Primary responsibilities included analysis of samples using GC and HPLC techniques, report generation, data review, preparation of analytical standards, maintenance of instrumentation, Client Services and some Project Management. Routine duties included analysis of soil and water samples for pesticides, PCBs, CLP Pesticides, Explosives and PAHs using EPA methods.

Columbia Analytical Services, Inc. **Analyst, Organic Extractions**
Kelso, WA **Lab, '91 – '92**

. Responsibilities included extraction of soil and water samples for various SVOCs, and TCLP extraction of SVOC and VOC compounds using TCLP equipment. Other duties included performing cleanup procedures, validation studies, MDL studies, and the training of employees in advanced extraction procedures and techniques..

Education

Evergreen State College
Olympia, WA
BA, Chemistry/Biology
1991

Introduction to LC Methods Development & Troubleshooting, *Hewlett-Packard, Tacoma, WA,* **1995**.
HPLC Maintenance Seminar, *Waters, Portland, OR,* **1994**.
GC/HPLC Maintenance Seminar, *Hewlett-Packard, Olympia, WA,* **1993**.
Gas Chromatography Seminar, *Curtis Matheson Scientific, Kelso, WA,* **1992**.
HPLC Seminar, *Hewlett-Packard, Kelso, WA,* **1991**.

Lester "Les" Kennedy

1317 S. 13th Avenue ● Kelso, WA 98626 ● +1 360 577 7222

ALS Environmental

Education

Lower Columbia College, Longview, WA
Coursework, general Studies, 1988 - 1990

Portland Bible College Portland, OR
Batchelor ofTheology, 2009

Sample Custodian/Sample Management Manager

2010 - Present

Responsible for the operation of the Sample Management, Sample Control, Bottle preparation departments, including sample receiving, courier service, sample control, storage and disposal, bottle preparation and shipping, and general freight receiving. Responsible for employee supervision, personnel evaluations, workload coordination, and adherence to all standard operating procedures within said departments. Additional duties include oversight of quarantined soil importation for laboratory testing. Is the designated Sample Custodian for the laboratory.

Previous Experience

Columbia Analytical Services, Inc. Kelso, WA — **Project Manager** '99 -'11; **SMO Supervisor**, '06 -'11

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and serving as liaison to clients and regulatory agencies. Oversight of the daily activities in sample management department including receipt, login, storage, and proper disposal of all samples received in the laboratory.

Columbia Analytical Services, Inc. Kelso, WA — **Supervisor Organic Extractions Laboratory**, '97-'99

Responsible for managing work load; directing efficiency; and ensuring that all critical holding times and QC are met each day. This involves GC/MS prep work, including extracting and GPC clean up; and subsequent sample screening of the GC/MS prep work. Additional responsibilities include data processing of GC/MS analytical runs including all steps of the data review and reporting process.

Columbia Analytical Services, Inc. Kelso, WA — **Senior Analyst, GC/MS Laboratory**, '96-'97

Primary duties were performing analyses by EPA Method 8270, SIM TCL. SIM PAH, including all steps in the data review and reporting process.

Columbia Analytical Services, Inc. Kelso, WA — **Senior Analyst, Organic Extractions Laboratory,** '93-'96

Primary responsibilities include managing workload; directing efficiency; and ensuring that all critical holding times and QC are met each day. This involves GC/MS prep work, including extracting and GPC clean up; and subsequent sample screening of the GC/MS prep work.

Columbia Analytical Services, Inc. Kelso, WA — **Analyst, Organic Extractions Laboratory,** '91-'93

Duties primarily as listed above

APPENDIX C

MAJOR ANALYTICAL EQUIPMENT

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balances (16):			
Precisa,Mettler,OHOUS, Adams models	1990-2011	LM	13
Autoclave - Market Forge Sterilmatic	1988	LM	5
Autotitrator – Thermo Orion 500	2007	LM	3
Calorimeters (2):			
Parr 1241 EA Adiabatic	1987	LM	4
Parr 6300 Isoparabolic	2005	LM	4
Centrifuge - Damon/IEC Model K	1992	LM	13
Colony Counter - Quebec Darkfield	1988	LM	2
Conductivity Meters (2):			
YSI Model 3200	2004	LM	4
VWR	2001	LM	4
Digestion Systems (5):			
COD (4)	1987, 1989	LM	4
Kjeldahl, Lachat 46-place (1)	1999	LM	3
Dissolved Oxygen Meter - YSI Model 58 (3)	1987, 1988, 1991	LM	4
Distillation apparatus (Midi) - Easy Still (2)	1996, 2000	LM	5
Drying Ovens (12):	1990-2010		
Shel-Lab and VWR models		LM	13
Air Drying Cabinets	2011	LM	NA
Flash Point Testers (2):			
ERDCO Setaflash Tester	1991	LM	3
Petroleum Systems Services	2005	LM	3
Flow-Injection Analyzers (2):			
Bran-Leubbe	2002	LM	2
Lachat 8500	2007	LM	2
Ion Chromatographs (4)			
Dionex DX-120 with Peaknet Data System	1998	LM	3
Dionex ICS-2500 with Chromchem Data System	2002	LM	3
Dionex ICS-2000 with Chromchem Data System	2006	LM	3
Dionex ICS-1600 with Chromchem Data System	2009	LM	
Meters (ISE and pH) (4)			
Fisher Scientific Accument Model 50	1997	LM	4
Fisher Scientific Accument Model 25	1993	LM	4
Fisher Scientific Accument Model 20	2000	LM	4
Fisher Scientific Accument Model AR25	1990	LM	4
	1992	LM	4
Microscope - Olympus	1988	LM	1

Muffle Furnace- Sybron Thermolyne Model F-A1730	1991	LM	13

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY (continued)			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Shatter Box (2): GP 1000 SPEX 8530	 1989 2011	LM	5
Sieve Shakers (2): CE Tyler - Portable RX 24 WS Tyler - RX 86	 1990 1991	 LM LM	 5 5
Thomas-Wiley Laboratory Mill, Model 4	1989	LM	5
Total Organic Carbon (TOC) Analyzers (2) Coulemetrics Model 5012 Teledyne Tekmar Fusion 1	 1997 2009	 LM LM	 3 3
Total Organic Halogen (TOX) Analyzers (2): Mitsubishi TOX-100	 2001	 LM	 2
Turbidimeter - Hach Model 2100N	1996	LM	5
UV-Visible Spectrophotometers (3): Beckman-Coulter DU520 Perkin Elmer Lambda 25 Abrazix	 1986 2005 2008 2011	 LM LM LM LM	 4 4 4 2
Discrete Autoanlayzer –Westco SmartChem AD20-1	2011	LM	2
Vacuum Pumps (3): Welch Duo-Seal Model 1376 Busch R-5 Series Single Stage Chem Star 1402N-01	 1990 1991 2011	LM	13
Water Baths/Incubators (5): Various Fisher Scientific and VWR Models	1986 - 2009	LM	13
Drill Press – Craftsman	2012		

METALS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance (8) Mettler AE 200 analytical balance Various Mettler, Sartorius, and Ohaus models	1988-2010	MM	12
Atomic Absorption Spectrophotometers (5): Varian SpectrAA Zeeman/220 AA (2) CETAC Mercury Analyzer M-6000A Perkin Elmer AAnalyst 200 Flame AA CETAC Mercury Analyzer M-6100	 2000 2000 2005 2010	 LM LM MM MM	 2 2 2 2
Buck AA Spectrophotometer Model 205	2008	LM	2
Atomic Fluorescence Spectrophotometer Brooks-Rand Model III (1) Leeman Mercury Analyzer (1)	 1996, 2005 2006	 LM LM	 3 2
Centrifuge - IEC Model Clinical Centrifuge	1990	LM	12
Drying Oven - VWR Model 1370F	1990	LM	12
Freeze Dryers (1) - Labconco	2006	LM	5
Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES) (2) Thermo Scientific Model iCAP 6500 Thermo Scientific Model iCAP 6500	 2007 2012	MM	3
Inductively Coupled Plasma Mass Spectrometers (ICP-MS): VG Excell Thermo X-Series Nexion Model 300D	 2001 2006 2011	 MM MM MM	 3 2 2
Muffle Furnace (2) - Thermolyne Furnatrol - 53600	1991, 2005	LM	5
Shaker - Burrell Wrist Action Model 75	1990	LM	12
TCLP Extractors (3)	1989, 2002	LM	5
Turbidimeter – Hach			

SEMIVOLATILE ORGANICS SAMPLE PREPARATION LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance (4) Mettler PM480, BB300 ,AG204 OHaus EP613	1999 - 2011	MM	12
Centrifuge – Beckman J-6B	1988	LM	12
Drying Ovens (2) Fisher Model 655G VWR Model 1305U	 1991 1999	 LM LM	 12 12
Evaporators/concentrators Organomation N-Evap (8) Organomation S-Evap (8) Zymark Turbovap (2)	 1990-2010 1990-2010 1998-2000	 LM LM LM	 12 12 12
Extractor Heaters: Lab-Line Multi-Unit Models for Continuous Liquid-Liquid and Soxhlet Extractions (102)	1987-2007	LM	8
Solids Extractors: Sonic Bath VWR (2) Sonic Horn (5) Soxhtherm Gerhardt (2) OI Analytical (6)	 1991 -1994 1994 2000 2008	 LM LM LM	 6 6 6
Extractors, TCLP (10): Millipore TCLP Zero Headspace Extractors (5) TCLP Extractor - Tumbler (12 position)	 1987-1992 1989	 LM LM	 2 2
Gel Permeation Chromatography (GPC) (6) ABC single column (3) J2 Scientific AccuPrep (2)	 1998, 1999, 2007 2005, 2010	 LM LM	 4 4
Muffle Furnace - 4	1994-2006	LM	4
Solid Phase Extractors (18) – Horizon SPE-Dex 4790	2003, 2006,2008	LM	4

GC SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Gas Chromatographs (17):			
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual ECD Detectors	1990 – 1995	LM	6
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual FPD Detectors	1991	LM	3
Agilent 6890 GC with Agilent 7683 Autosampler and Dual ECD Detectors (6)	2001, 2005, 2007,2011	LM	6
Agilent 6890 GC with Agilent 7683 Autosampler and Dual FPD Detectors	2003	LM	3
Agilent 7890A Dual ECD Detectors Agilent 7683B autosampler (4)	2010, 2012	LM	6
Hewlett-Packard 5890 GC with HP 7673 Autosampler and FID Detector	1995	LM	3
Agilent 6890 with Dual FID Detectors and Agilent 7873 Autosampler (4)	2001, 2005	LM	6
Agilent 7890A Dual NPD Detectors and Agilent 7683B autosampler	2012		
Varian Ion trap GC/MS:	2003	LM	2
Varian 3800 GC w/CP8400 autosampler	2006	LM	2
Varian Saturn 2100T mass spectrometer	2003	LM	2
Thremo Ion Trap ITQ-90C GC/MS w/TriPlus autosampler	2008	LM	2

GC/MS SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler AB 104-S	2000	MM	6
Gas Chromatograph: Hewlett-Packard 5890 with HP 7673 autosampler and FID Detector	1994	LM	6
Semivolatile GC/MS Systems (12):			
Agilent 6890/5973 with ATAS Optic2 LVI and HP 7673 Autosampler (2)	1997, 2001	LM	6
Agilent 5890/5970 and HP 7673 Autosampler	1990	LM	6
Agilent 5890/5970 with ATAS Optic2 LVI and HP 7673 Autosampler	1994	LM	6
Agilent 5890/5972 with ATAS Optic2 LVI and HP 7673 Autosampler (3)	1993, 1994, 1998	LM	6
Agilent 6890/5973 with Agilent PTV Injector and 7683 Autosampler	2007	LM	6
Agilent7890A/5975C with Agilent 7693 Autosampler (4)	2010	LM	6
Semivolatile GC/MS/MS – Waters Quattro Micro GC Micromass with Agilent 6890, Agilent PTV Injector, 7683B Autosampler	2008	MM	2

HPLC LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler BB240	1994	MM	4
Drying Oven - Fisher Model 630F	1991	LM	4
Evaporator – Turbo Vap	2009	LM	4
Centrifuge Marathon 21K	1996	LM	4
High-Performance Liquid Chromatographs (3):			
HP 1090M Series II with Diode Array UV Detector	1999	LM	2
HP 1050/1100 Series with Fluorescence & Diode Array UV Detectors	2004	LM	2
Agilent 1260 Infinity with Diode Array UV Detector	2011	LM	2
High-Performance LC/MS (3)			
Spectrometer - Thermo Electron TSQ Quantum LC/MS/MS and Autosampler	2005	MM	2
API 5000 LC/MS/MS and SIL-20AC Autosampler	2008	MM	2
AB Sciex 5500 and Schimadzo DGU 20A5	2011	MM	2
Agilent 1100 HPLC -UV/Fluoescence detectors- Pickering PCX-5200 Post-column derivitization unit	2003	LM	2

VOLATILE ORGANICS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler PE 160	1989	MM	5
Fisher Vortex Mixer	1989	LM	5
Drying Ovens (2):			
Boekel 107801	1989	LM	5
VWR 1305 U	1991	LM	5
Sonic Water Bath - Branson Model 2200	1989	LM	5
Volatile GC/MS Systems (8):			
Agilent 5890/5970	1989	LM	5
Tekmar 3000 Purge and Trap Concentrator	1995	LM	5
Dynatech ARCHON 5100 Autosampler	1996	LM	5
Agilent 5890/5971	1991	LM	5
Tekmar 3000 Purge and Trap Concentrator	2001	LM	5
Dynatech ARCHON 5100 Autosampler	1995	LM	5
Agilent 6890/5973	2001	LM	5
Tekmar 3100 Purge and Trap Concentrator	2001	LM	5
Varian Archon Autosampler	2001	LM	5
Agilent 6890/5973	2005	LM	5
Tekmar Velocity Purge and Trap Concentrator	2005	LM	5
Tekmar Aquatech Autosampler	2005	LM	5
Agilent 6890/5973 (2)	2007	LM	5
Tekmar 3000 Purge and Trap Concentrator	2007	LM	5
Varian Archon 5100 Autosampler	2007	LM	5
Agilent 7980A/5975C (2)	2010, 2011	LM	5
Teledyne Tekmar-Automx	2010,2011	LM	5
Hewlett-Packard 5890 Series II with PID/PID/FID	1991	LM	2
EST-ENCON Purge and Trap Concentrator	1991		
Dynatech Archon 5100 Autosampler	1992		

AUTOMATED DATA PROCESSING EQUIPMENT			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
1-WAN: LIMS Sample Manager using Oracle 10g & 11g DBMS running on Redhat Advanced Server 4.0 (Linux) platform connected/linked via both fiber and MPLS circuits.	1994-2007	LM	NA
1 - Network Server Pentium 4 class, 1 for Reporting and Data Acquisition running Windows 2003 SP2 Advanced Server, 1 for Applications running Windows 2003 Advanced Server SP2. Data acquisition capacity at 195 GB with redundant tape and disk arrays.	2004-2008	LM	NA
Approximately 80+ HP, Dell, Kyocera Laserjet printers (various types including models III, 4, 5, 8150, 4000, 4041, 4050, 4200 4250, 8150, 1720dn, W5300, 1300D, M4000)	1991 - 2010	LM	NA
Approximately 280 + Gateway/Dell/HP PC/Workstations running Windows 2000/XP on LAN connected via 10BT/100BT and TCP/IP for LIMs Terminal Emulation	1993 - 2010	LM	NA
Microsoft Office 2003 Professional as the base application for all PC/Workstations. Some systems using Office 2000/97, Office 2007.	1996 - 2010	LM	NA
E-Mail with link to SMTP for internal/external messaging. Web mail via Outlook Web Access interface. Microsoft Outlook 2003.	1994 - 2006	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Facsimile Machines - Brother 4750e; Brother 2920; Brother 1860	1991 - 2010	LM	NA
Copiers/Scanners: Konica BizHub 420 (1), BizHub 600 (1), BizHub 920 (2), BizHub Pro 1050 (3), BizHub Pro 1051 (1). All are accessible via LAN for network scanning.	2000 - 2010	LM	NA
Dot Matrix Panasonic KX-P1150	1991 - 2004	LM	NA
Thruput, MARRS, Stealth, Harold, Blackbird, EDDGE, CASLIMS reporting software systems.	1998 - 2004	LM	NA
Data processing terminals (74) Enviroquant (63) Target (10)			

Saturn (1)			

NA: Not applicable. This equipment administered by IT staff but may be used by all staff.

APPENDIX D

DATA QUALIFIERS AND ACRONYMS

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria are not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value that was detected outside the quantitation range.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM definition*: Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Metals Data Qualifiers

#	The control limit criteria are not applicable. See case narrative.
J	The result is an estimated value that was detected outside the quantitation range.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.1 definition*: Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria were outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criterion is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value that was detected outside the quantitation range.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria were exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.1 definition*: Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LUFT	Leaking Underground Fuel Tank
LOD	Limit of Detection
LOQ	Limit of Quantitation
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons

APPENDIX E

PREVENTIVE MAINTENANCE PROCEDURES

Instrument	Activity	Maint[a]	Frequency
Refrigerators and Coolers	Record temperatures	LM	Daily
	Clean coils	LM	Annually
	Check coolant	LM	Annually or if temperature outside limits
Vacuum Pumps	Clean and change pump oil	LM	Every month or as needed
Fume Hoods	Face velocity measured	LM	Quarterly
	Sash operation	LM	As needed
	Change filters	LM	Annually
	Inspect fan belts	LM	Annually
Ovens	Clean	LM	As needed or if temperature outside lim.
	Record temperatures	LM	Daily, when in use
Incubators	Record temperatures	LM	Daily, morning and evening
Water Baths	Record temperatures	LM	Daily, morning and evening
	Wash with disinfectant solution	LM	When water is murky, dirty, or when growth appears
Autoclave	Check sterility	LM	Every month
	Check temperature	LM	Every month
	Clean	LM	When mold or growth appears
	Calibrate thermometer	VM	Once a year
Analytical Balances	Check alignment	LM	Before every use
	Verify calibration	LM	Daily
	Clean pans and compartment	LM	After every use
	Certified calibration	VM	Once a year
Dissolved Oxygen Meter	Change membrane	LM	When fluctuations occur
pH probes	Condition probe	LM	When fluctuations occur
Fluoride ISE	Store in storage solution	LM	Between uses
Ammonia ISE	Store in storage solution	LM	Between uses
UV-visible Spectrophotometer	Wavelength check	VM	Twice a year

Instrument	Activity	Maint[a]	Frequency
Total Organic Carbon Analyzers	Check IR zero	LM	Weekly
	Check digestion/condensation vessels	LM	Each use
	Clean digestion chamber	LM	Every 2000 hours, or as needed
	Clean permeation tube	LM	Every 2000 hours, or as needed
	Clean six-port valves	LM	Every 200 - 2000 hours, or as needed
	Clean sample pump	LM	Every 200 - 2000 hours, or as needed
	Clean carbon scrubber	LM	Every 200 - 2000 hours, or as needed
	Clean IR cell	LM	Every 2000 - 4000 hours, or as needed
Total Organic Carbon Analyzers	Change cell electrolyte	LM	Daily
	Change electrode fluids	LM	Daily
	Change pyrolysis tube	LM	As needed
	Change inlet and outlet tubes	LM	As needed
	Change electrodes	LM	As needed
Flow Injection Analyzer	Check valve flares	LM	Each use
	Check valve ports	LM	Each use
	Check pump tubing	LM	Each use
	Check light counts	LM	Each use
	Check flow cell flares	LM	Quarterly
	Change bulb	LM	As needed
	Check manifold tubing	LM	Each use
	Check T's and connectors	LM	Each use
Discrete Auto Analyzer	Clean probe, wash reservoirs	LM	Every 2 weeks
	Replace peristaltic pump tubing	LM	Every 3 months
	Replace hydraulic circuit tubing	LM	Once/year

Instrument	Activity	Maint[a]	Frequency
Ion Chromatographs	Change column	LM	Every six months or as needed
	Change valve port face & hex nut	LM	Every six months or as needed
	Clean valve slider	LM	Every six months or as needed
	Change tubing	LM	Annually or as needed
	Eluent pump	LM	Annually
Atomic Absorption Spectro-photometers - FAA and CVAA	Check gases	LM	Daily
	Clean burner head	LM	Daily
	Check aspiration tubing	LM	Daily
Atomic Absorption Spectro-photometers - GFAA	Clean optics	LM	Every three months
	Empty waste container	LM	Weekly
	Check gases	LM	Daily
	Check argon dewar	LM	Daily
	Change graphite tube	LM	Daily, as needed
	Clean furnace windows	LM	Monthly
ICP - AES	Check argon dewar	LM	Daily
	Replace peristaltic pump tubing	LM	Daily
	Empty waste container	LM	Weekly
	Clean nebulizer, spray chamber, and torch	LM	Every two weeks
	Replace water filter	LM	Quarterly
	Replace vacuum air filters	LM	Monthly
ICP - MS	Check argon dewar	LM	Daily
	Check water level in chiller	LM	Daily
	Complete instrument log	LM	Daily
	Replace peristaltic pump tubing	LM	Daily
	Clean sample and skimmer cones	LM	As needed
	Clean RF contact strip	LM	As needed
	Inspect nebulizer, spray chamber, and torch	LM	Clean as needed
	Clean lens stack/extraction lens	LM	As needed

	Check rotary pump oil	LM	Monthly
	Change rotary pump oil	LM	Every six months

Instrument	Activity	Maint[a]	Frequency
Gel-Permeation Chromatographs	Clean and repack column	LM	As needed
	Backflush valves	LM	As needed
HPCL Chromatographs	Backflush guard column	LM	As needed
	Backflush column	LM	As needed
	Change guard column	LM	As needed when back pressure too high
	Change column	LM	Annually or as needed
	Change in-line filters	LM	As needed
	Leak check	LM	After column maintenance
	Change pump seals	LM	As needed
	Change pump diaphragm	LM	Annually
	Clean flow cell	LM	As needed
	Fluorescence detector check	LM	Daily
	Diode array absorbance check	LM	Daily
HPLC MS/MS	Clean ion transfer tube	LM	Daily or noticeable decrease in signal
	Clean inlet assembly	LM	Monthly or as needed
	Forepump	LM	Blast weekly; change oil every 3 months
Gas Chromatographs, Semivolatiles	Check gas supplies	LM	Daily, replace if pressure reaches 50psi
	Change in-line filters	LM	Quarterly or after 30 tanks of gas
	Change septum	LM	Daily
	Change injection port liner	LM	Weekly or as needed
	Clip first 6-12" of capillary column	LM	As needed
	Change guard column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails
	Check system for gas leaks	LM	After changing columns and after any power failure
	Clean FID	LM	Weekly or as needed
	Clean ECD	LM	Quarterly or as needed
	Leak test ECD	LM	Annually

Instrument	Activity	Maint[a]	Frequency
Gas Chromatograph/Mass Spectrometers, Semivolatiles	Check gas supplies	LM	Daily, replace if pressure reaches 50psi
	Change in-line filters	LM	Annually or as needed
	Change septum	LM	Daily, when in use
	Change injection port liner	LM	Weekly or as needed
	Clip first 6-12" of capillary column	LM	As needed
	Change guard column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails
	Clean source	LM	As needed when tuning problems
	Change pump oil	LM	As specified by service specifications
Purge and Trap Concentrators	Change trap	LM	Every four months or as needed
	Change transfer lines	LM	Every six months or as needed
	Clean purge vessel	LM	Daily
Gas Chromatographs, Volatiles	Check gas supplies	LM	Daily, replace when pressure reaches 50 psi
	Change in-line filters	LM	Quarterly or after 30 tanks of gas
	Change septum	LM	Daily
	Clip first 6-12" of capillary column	LM	As needed
	Change guard column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails
	Check system for gas leaks	LM	After changing columns and after any power failure
	Clean PID lamp	LM	As needed
	Clean FID	LM	As needed
	Change ion exchange resin	LM	Every 60 days
	Replace nickel tubing	LM	Quarterly or as needed
Gas Chromatograph/Mass Spectrometers, Volatiles	Check gas supplies	LM	Daily, replace when pressure reaches 50 psi
	Change in-line filters	LM	Annually or as needed
	Change septum	LM	Daily
	Clip first foot of capillary column	LM	As needed
	Replace analytical column	LM	As needed when peak resolution fails

Instrument	Activity	Maint[a]	Frequency
	Clean source	LM	As needed when tuning problems
	Change pump oil		As specified by service specifications

APPENDIX F

LABORATORY
STANDARD OPERATING PROCEDURES

SOP TITLE	FILE NAME
KELSO ADMINISTRATIVE SOPS	
ALS KELSO TRAINING PROCEDURE	ADM-TRAIN
CHECKING VOLUMETRIC LABWARE	ADM-VOLWARE
CONTINGENCY PLAN FOR LABORATORY EQUIPMENT FAILURE	ADM-ECP
CONTROL CHARTING QUALITY CONTROL DATA	ADM-CHRT
DATA ARCHIVING	ADM-ARCH
DATA REPORTING AND REPORT GENERATION	ADM-RG
DEPARTMENT OF DEFENSE PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT	ADM-DOD
LABORATORY BALANCE MONITORING AND CALIBRATION	ADM-BAL
LABORATORY DATA REVIEW PROCESS	ADM-DREV
METHOD VALIDATION DOCUMENTATION	ADM-MDLC
PROJECT MANAGEMENT	ADM-PCM
REAGENT LOGIN AND TRACKING	ADM-RLT
SUPPORT EQUIPMENT MONITORING AND CALIBRATION	ADM-SEMC
SAMPLE BATCHES	ADM-BATCH
SAMPLE MANAGEMENT SOPS	
BOTTLE ORDER PREPARATION AND SHIPPING	SMO-BORD
FOREIGN SOILS HANDLING TREATMENT	SMO-FSHT
SAMPLE DISPOSAL	SMO-SDIS
SAMPLE RECEIVING	SMO-GEN
SAMPLE TRACKING AND LABORATORY CHAIN OF CUSTODY	SMO-SCOC
KELSO FACILITY SOPS	
FACILITY AND LABORATORY CLEANING	FAC-CLEAN
OPERATION AND MAINTENANCE OF LABORATORY REAGENT WATER SYSTEMS	FAC-WATER

BIOLOGY SOPS

COLIFORM, FECAL	BIO-9221FC
COLIFORM, TOTAL	BIO-9221TC
COLIFORM, FECAL (MEMBRANE FILTER PROCEDURE)	BIO-9222D
COLILERT® , COLILERT-18®, & COLISURE®	BIO-9223
ENTEROLERT	BIO-ENT
HEPTEROTROPHIC PLATE COUNT	BIO-HPC
MICROBIOLOGY QUALITY ASSURANCE AND QUALITY CONTROL	BIO-QAQC
SHEEN SCREEN/OIL DEGRADING MICROORGANISMS	BIO-SHEEN

EXTRACTION SOPS

SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION	EXT-3510
CONTINUOUS LIQUID - LIQUID EXTRACTION	EXT-3520
SOLID PHASE EXTRACTION	EXT-3535
SOXHLET EXTRACTION	EXT-3540
AUTOMATED SOXHLET EXTRACTION	EXT-3541
ULTRASONIC EXTRACTION	EXT-3550
WASTE DILUTION EXTRACTION	EXT-3580
SILICA GEL CLEANUP	EXT-3630
GEL PERMEATION CHROMATOGRAPHY	EXT-3640A
REMOVAL OF SULFUR USING COPPER	EXT-3660
REMOVAL OF SULFUR USING MERCURY	EXT-3660M

SULFURIC ACID CLEANUP	EXT-3665
CARBON CLEANUP	EXT-CARCU
DIAZOMETHANE PREPARATION	EXT-DIAZ
DMD SYNTHESIS	EXT-DMD
FLORISIL CLEAN-UP	EXT-FLOR
ORGANICS EXTRACTIONS GLASSWARE CLEANING	EXT-GC
PERCENT LIPIDS IN TISSUE	EXT-LIPID
EXTRACTION METHOD FOR ORGANOTINS IN SEDIMENTS, WATER AND TISSUE	EXT-OSWT
PREPARATION OF REAGENTS AND BLANK MATRICES USED IN SEMIVOLATILE ORGANICS COMPOUNDS	EXT-REAG
ADDITION OF SPIKES AND SURROGATES	EXT-SAS
MEASURING SAMPLE WEIGHTS AND VOLUMES FOR ORGANIC ANALYSIS	EXT-WVOL

GENERAL CHEMISTRY SOPS

FLASHPOINT DETERMINATION - SETAFLASH	GEN-1020
COLOR	GEN-110.2
TOTAL SOLIDS	GEN-160.3
SOLIDS, TOTAL VOLATILE AND PERCENT ASH IN SOIL AND SOLID SAMPLES	GEN-160.4
SETTEABLE SOLIDS	GEN-160.5
HALIDES, ADSORBABLE ORGANIC (AOX)	GEN-1650
GRAVIMETRIC DETERMINATION OF HEAXANE EXTRACTABLE MATERIAL (1664)	GEN-1664
ALKALINITY TOTAL	GEN-2320
HARDNESS, TOTAL	GEN-2340
DETERMINATION OF INORGANIC ANIONS IN DRINKING WATER BY ION CHROMATOGRAPHY	GEN-300.1

ACIDITY	GEN-305.2
PERCHLORATE BY ION CHROMATOGRAPHY	GEN-314.0
CHLORIDE (TITRIMETRIC, MERCURIC NITRATE)	GEN-325.3
CHLORINE, TOTAL/FREE RESIDUAL	GEN-330.4
TOTAL RESIDUAL CHLORINE - METHOD 330.5	GEN-330.5
AMMONIA BY FLOW INJECTION ANALYSIS	GEN-350.1
AMMONIA AS NITROGEN BY ION SPECIFIC ELECTRODE	GEN-4500 NH3E
NITRATE/NITRITE, NITRITE BY FLOW INJECTION ANALYSIS	GEN-353.2
PHOSPHORUS DETERMINATION USING COLORMETRIC PROCEDURE	GEN-365.3
PHENOLICS, TOTAL	GEN-420.1
ORTHOPHOSPHATE DETERMINATION USING COLORIMETRIC PROCEDURE	GEN-4500-PE
DISSOLVED SILICA	GEN-4500 -SIO_2C
SILICA DETERMINATION USING SMARTCHEM METHOD	GEN-4500-SIO2E
GRAVIMETRIC SULFATE	GEN-4500 SO4 C
NITRITE BY COLORIMETRIC PROCEDURE	GEN-4500NO2 B
SULFIDE, METHYLENE BLUE	GEN-4500S2D
SULFIDE, TITRIMETRIC (IODINE)	GEN-4500S2F
TRIAZINES AS ATRAZINE by QUANTITATIVE IMMUNOASSAY	GEN-4670
HALOGENS TOTAL AS CHLORIDE BY BOMB COMBUSTION	GEN-5050
BIOCHEMICAL OXYGEN DEMAND	GEN-5210B
HALIDES, ADSORBABLE ORGANIC (AOX) - SM 5320B	GEN-5320B
AQUATIC HUMIC SUBSTANCES	GEN-5510B

DETERMINATION OF METHYLENE BLUE ACTIVE SUBSTANCES (MBAS)	GEN-5540C
TANNIN AND LIGNIN	GEN-5550
HALIDES, TOTAL ORGANIC (TOX)	GEN-9020
HALIDES, EXTRACTABLE ORGANIC (EOX)	GEN-9020M
TOTAL SULFIDES BY METHYLENE BLUE DETERMINATION	GEN-9030
TOTAL HALIDES BY OXIDATIVE COMBUSTION AND MICROCOULOMETRY	GEN-9076
CARBON, TOTAL ORGANIC IN SOIL	GEN-ASTM
AUTOFLUFF	GEN-AUTOFLU
SULFIDES, ACIDS VOLATILE	GEN-AVS
HEAT OF COMBUSTION	GEN-BTU
CHLOROPHYLL-a BY COLORIMETRY	GEN-CHLOR
TOTAL CYANIDES AND CYANIDES AMENABLE TO CHLORINATION	GEN-CN
CYANIDE, WEAK ACID DISSOCIABLE	GEN-CNWAD
CHEMICAL OXYGEN DEMAND	GEN-COD
CONDUCTIVITY IN WATER AND WASTES	GEN-COND
CORROSIVITY TOWARDS STEEL	GEN-CORR
HEXAVALENT CHROMIUM - COLORIMETRIC	GEN-CR6
STANDARD TEST METHODS FOR DETERMINING SEDIMENT CONCENTRATION IN WATER SAMPLES	GEN-D3977
CARBONATE (CO3) BY EVOLUTION AND COLUMETRIC TITRATION	GEN-D513-82M
SULFIDE, SOLUBLE DETERMINATION OF SOLUBLE SULFIDE IN SEDIMENT	GEN-DIS.S2
BULK DENSITY OF SOLID WASTE FRACTIONS	GEN-E1109
FDA EXTRACTABLES	GEN-FDAEX

FERROUS IRON IN WATER	GEN-FeII
FLUORIDE BY ION SELECTIVE ELECTRODE	GEN-FISE
FORMALDEHYDE COLORIMETRIC DETERMINATION	GEN-FORM
HYDROGEN HALIDES BY ION CHROMATOGTRAPHY (METHOD 26)	GEN-HA26
HYDROGEN PEROXIDE BY PERMANGANATE TITRATION	GEN-H2O2
HYDAZINE IN WATER USING COLORIMETRIC PROCEDURE	GEN-HYD
TOTAL SULFUR FOR ION CHROMATOGRAPHY	GEN-ICS
ION CHROMATOGRAPHY	GEN-IONC
COLOR, NCASI	GEN-NCAS
NITROCELLULOSE IN SOIL	GEN-NCEL
OXYGEN CONSUMPTION RATE	GEN-O2RATE
CARBON, TOTAL ORGANIC DETERMINATION (WALKELY BLACK METHOD)	GEN-OSU
Ph IN SOIL AND SOLIDS	GEN-Phs
Ph IN WATER	GEN-Phw
PARTICLE SIZE DETERMINATION - ASTM PROCEDURE	GEN-PSASTM
PARTICLE SIZE DETERMINATION	GEN-PSP
SULFIDES, REACTIVE	GEN-RS
TOTAL SULFIDE BY PSEP	GEN-S2PS
SULFITE	GEN-SO3
SPECIFIC GRAVITY	GEN-SPGRAV
SUBSAMPLING AND COMPOSITING OF SAMPLES	GEN-SUBS
SOLIDS, TOTAL DISSOLVED (TDS)	GEN-TDS

THIOCYANATE	GEN-THIOCN
NITROGEN, TOTAL AND SOLUBLE KJELDAHL	GEN-TKN
TOTAL NITROGEN AND TOTAL PHOSPHORUS BY ALKALINE PERSULFATE DIGESTION NCASI METHOD TNTP-W10900	GEN-TNTP
TOTAL ORGANIC CARBON IN WATER	GEN-TOC
SOLIDS, TOTAL SUSPENDED (TSS)	GEN-TSS
TURBIDITY MEASUREMENT	GEN-TURB
ULTIMATE BOD	GEN-UBOD
GLASSWASHING FOR INORGANIC ANALYSES	GEN-WASH

ORGANIC LIQUID CHROMATOGRAPHY SOPS

PHARMACEUTICALS, PERSONAL CARE PRODUCTS AND ENDOCRINE DISRUPTING COMPOUNDS HPLC/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-1694
DETERMINATION OF TRIAZINE PESTICIDES AND THEIR DEGRADATES IN WATER BY LIQUID CHROMATOGRAPHY ELECTROSPRAY IONOIZATION TANDEM MASS SPECTROMETRY.	LCP-536
DETERMINATION OF SELECTED PERFLORINATED ALKL ACIDS IN DRINING WATER BY SOLID PHASE EXTRASCTION AND TANDEM LC/MS/MS.	LCP-537
ALDEHYDES BY HPLC	LCP-8315
DETERMINATION OF HORMONES IN DRINKING WATER BY SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY ELECTROSPRAY IONIZATION TANDEM (LC/ESI-MS/MS)	LCP-539
POLYNUCLEAR AROMATIC HYDROCARBONS BY HPLC	LCP-610
QUANTITATIVE DETERMINATION OF CARBAMATE PESTICIDES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDAM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-8321
DETERMINATION OF CARBAMATES IN WATER BY EPA 8321 USING LC TANDEM MASS SPECTROMETRY	LCP-8321W

NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY(HPLC)	LCP-8330B
ACRYLAMIDE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)..	LCP-ACRYL
QUANTITATIVE DETERMINATION OF AFLATOXINS BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-AFLA
QUANTITATIVE DETERMINATION OF 2,2-DIBROMO-3-NITRILOPROPIONAMIDE BY HPLC	LCP-DBNPA
DIOCTYL SULFOSUCCINATE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)..	LCP-DOS
QUANTITATION OF NITROAROMATICS AND NITRAMINES IN WATER, SOIL, AND TISSUE BY LIQUID CHROMATOGRAPHY AND TANDEM MASS SPECTROMETRY (LC-MS/MS)	LCP-LCMS4
NITROGUANIDINE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	LCP-NITG
QUANTITATION OF NITROPHENOLS IN SOILS BY LIQUID CHROMATOGRAPHYAND TANDEM MASS SPECTORMETRY (LC-MS/MS)	LCP-NITRO
ORGANIC ACIDS IN AQUEOUS MATRICES BY HPLC	LCP-OALC
QUANTITATIVE DETERMINATION OF OPTICAL BRIGHTENER 220 BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)	LCP-OPBR
PERFLUORINATED COMPOUNDS BY HPLC/MS/MS	LCP-PFC
DETERMINATION FO PHTHALATES IN FOOD BY LIQUID CHROMATOGRAPHY TANDEM MASS SPECTROMETRY (LC/MSMS)	LCP-PHT
DETERMINATION OF MANNOSE AND GALACTOSE IN WATER BY HPLC/MS/MS	LCP-SUGAR
TOTAL OLEANOLIC ACID SAPONINS IN WATER BY ACID HYDROLYSIS AND HPLC/MS/MS	SOC-LCMS3
PICRIC ACID AND PICRAMIC ACID BY HPLC	SOC-PICRIC
DIQUAT AND PARAQUAT BY HPLC	SVD-549

METALS SOPS

METHYL MERCURY IN SOIL AND SEDIMENT BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630S
METHYL MERCURY IN TISSUE BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630T
METHYL MERCURY IN WATER BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630W
MERCURY IN WATER BY OXIDATION, PURGE&TRAP, AND COLD VAPOR ATOMIC FLUORES. SPECTROMETRY	MET-1631
DETERMINATION OF ARSENIC SPECIES BY HYDRIDE GENERATION CRYOGENIC TRAPPING GAS CHROMATOGRAPY ATOMIC ABSORPTION SPECTROPOTOMETRY	MET-1632
DETERMINATION OF TRACE ELEMENTS IN AMBIENT WATERS BY ICP-MS	MET-1638
DETERMINATION OF TRACE METALS IN WATERS BY ON-LINE CHELATION PRECONCENTRATION AND INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY	MET-1640
MERCURY IN WATER	MET-245.1
METALS DIGESTION	MET-3010A
METALS DIGESTION	MET-3020A
METALS DIGESTION	MET-3050
CLOSED VESSEL OIL DIGESTION	MET-3051M
CLOSED VESSEL DIGESTION OF SILICEOUS AND ORGANICALLY BASED MATRICIES	MET-3052M
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 6020)	MET-6020
ARSENIC BY BOROHYDRIDE REDUCTION ATOMIC ABSORPTION	MET-7062
METALS DIGESTION FOR HEXAVALENT CHROMIUM	MET-7195
MERCURY IN LIQUID WASTE	MET-7470A

MERCURY IN SOLID OR SEMISOLID WASTE	MET-7471
SELENIUM BY BOROHYDRIDE REDUCTION ATOMIC ABSORPTION	MET-7742
BIOACCESSIBILITY OF METALS IN SOIL AND SOLID WASTE	MET-BIOACC
METALS DIGESTION	MET-DIG
SAMPLE FILTRATION FOR METALS ANALYSIS	MET-FILT
METALS LABORATORY GLASSWARE CLEANING	MET-GC
DETERMINATION OF TRACE METALS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY (GFAA)	MET-GFAA
DETERMINATION OF METALS AND TRACE ELEMENTS BY ICP/AES	MET-ICP
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 200.8)	MET-ICP.MS
TRACE METALS IN WATER BY PRECONCENTRATION USING REDUCTIVE PRECIPITATION FOLLOWED BY ICP-MS	MET-RPMS
METALS AND SEMIVOLATILES SPLP EXTRACTION (EPA METHOD 1312)	MET-SPLP
WASTE EXTRACTION TEST (WET) PROCEDURE (STLC) for NONVOLATILE and SEMIVOLATILE PARAMETERS	MET-STLC
METALS AND SEMIVOLATILES TCLP EXTRACTION (EPA METHOD 1311)	MET-TCLP
SAMPLE PREPARATION OF BIOLOGICAL TISSUES FOR METALS ANALYSIS BY GFAA, ICP-OES, AND ICP-MS	MET-TDIG
TISSUE SAMPLE PREPARATION	MET-TISP

PETROLEUM HYDROCARBON SOPS

ANALYSIS OF WATER AND SOLID SAMPLES FOR ALIPHATIC HYDROCARBONS	PET-ALIPHAT
ANALYSIS OF WATER, SOLIDS AND SOLUBLE WASTE SAMPLES FOR SEMI-VOLATILE FUEL HYDROCARBONS	PET-SVF
ANALYSIS OF WATER AND SOLIDS SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS	PET-TPH

ANALYSIS OF SOLID AND AQUEOUS SAMPLES FOR STATE OF WISCONSIN DIESEL RANGE ORGANICS	PHC-WIDRO

SEMI-VOLATILE ORGANIC SOPS

ORGANOCHLORINE PESTICIDES AND PCBs (METHOD 608)	SOC-608
GLYCOLS	SOC-8015M
ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY: CAPILLARY COLUMN TECHNIQUE	SOC-8081
PCBS AS AROCLORS	SOC-8082Ar
CONGENER-SPECIFIC DETERMINATION OF PCBS BY GC/ECD	SOC-8082Co
DETERMINATION OF NITROGEN OR PHOSPHORUS CONTAINING PESTICIDES	SOC-8141
CHLORINATED HERBICIDES	SOC-8151
CHLORINATED PHENOLS METHOD 8151 MODIFIED	SOC-8151M
METHANOL IN PROCESS LIQUIDS AND STATIONARY SOURCE EMISSIONS	SOC-9403
HAZARDOUS AIR POLLUTANTS (HAPS) IN PULP AND PAPER INDUSTRY CONDENSATES	SOC-9901
HAPS AND OTHER COMPOUNDS IN IMPINGER/CANISTER SAMPLES FROM WOOD PRODUCTS FACILITIES	SOC-9902
ALCOHOLS	SOC-ALC
BUTYLTINS	SOC-BUTYL
DIMP	SOC-DIMP
MONOCHLOROACETIC ACID BY GC-ECD	SOC-MCA
DETERMINATION OF OTTO FUEL II IN WATER	SOC-OTTO
CALIBRATION OF INSTRUMENTS FOR ORGANICS CHROMATOGRAPHIC ANALYSES	SOC-CAL
CONFIRMATION PROCEDURE FOR GC AND HPLC ANALYSES	SOC-CONF

SEMI-VOLATILE ORGANICS SCREENING	SOC-SCR

ORGANIC DRINKING WATER SOPS

1,2-DIBROMOETHANE, 1,2-DIBROMO-3-CHLOROPROPANE, AND 1,2,3-TCP BY GC	SVD-504
ORGANOCHLORINE PESTICIDES AND PCBS IN DRINKING WATER	SVD-508.1
CHLORINATED HEBICIDES IN DRINKING WATER	SVD-515.4
N-NITROSAMINES BY GC/MS/MS	SVD-521
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS (METHOD 525.2)	SVD-525
ENDOTHALL IN DRINKING WATER BY GC/MS	SVD-548
HALOACETIC ACIDS IN DRINKING WATER	SVD-552

SEMI-VOLATILE GC/MS SOPS

CHLORINATED PHENOLICS BY IN-SITU ACETYLATION AND GC/MS	SVM-1653A
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SVM-625
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - METHOD 8270D	SVM-8270D
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - LOW LEVEL PROCEDURE	SVM-8270L
POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SIM	SVM-8270P
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTED ION MONITORING	SVM-8270S
ENDOCRINE DISRUPTING COMPOUNDS BY DERIVATIZATION AND GC/MS	SVM-EDC
NONYLPHENOLS ISOMERS AND NONYLPHENOL ETHOXYLATES	SVM-NONYL
ORGANOPHOSPHOROUS PESTICIDES BY GC/MS/MS	SVM-OPPMS2
CHLORINATED PESTICIDES BY GC/MS/MS, EPA METHOD 1699 MODIFIED	SVM-PESTMS2

POLYBROMINATED DIPHENYL ETHERS (PBDEs) AND POLYBROMINATED BIPHENYLS (PBBs) BY GC/MS	SOC-ROHS

VOLATILE ORGANIC SOPS

GASOLINE RANGE ORGANICS BY GAS CHROMATOGRAPHY	PET-GRO
METHOD FOR DETERMINING GASOLINE RANGE ORGANICS, WISCONSIN DNR	PET-WIGRO
PURGE AND TRAP FOR AQUEOUS SAMPLES	VOC-5030
PURGE AND TRAP/EXTRACTION FOR VOC IN SOIL AND WASTE SAMPLES , CLOSED SYSTEM	VOC-5035
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-524.2
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-624
AROMATIC VOLATILE ORGANICS (BTEX) BY GC - METHOD 8021	VOC-8021BTEX
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-8260
VOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTIVE ION MONITORING	VOC-8260S
VOA STORAGE BLANKS	VOC-BLAN
SAMPLE SCREENING FOR VOLATILE ORGANIC COMPOUNDS IN SOIL, WATER AND MISC. MATRICES	VOC-BVOC
ZERO HEADSPACE EXTRACTION (EPA METHOD 1311)	VOC-ZHE

APPENDIX G

List of Laboratory Certifications and Accreditations

Federal and National Programs

- The TNI (The NELAC Institute) National Environmental Laboratory Accreditation Program (NELAP) Accredited Drinking Water, Non-Potable Water, Solid & Hazardous Waste, and Biological Tissue Laboratory
- ANSI-ASQ National Accreditation Board/ACLASS ISO 17025:2005
- DoD- ELAP Environmental Laboratory Accreditation Program
- U.S. EPA Region 8
  Approved Drinking Water Laboratory

State and Local Programs

- State of Alaska, Department of Environmental Conservation
  UST Laboratory, Lab I.D. UST040
- State of Arizona, Department of Health Services
  License No. AZ0339
- State of Arkansas, Department of Environmental Quality
  Certified Environmental Laboratory, Lab I.D. 88-0637
- State of California, Department of Health Services, Environmental Laboratory Accreditation Program, Certification No. 2286
- State of Florida, Department of Health
  Accredited Environmental Laboratory No. E87412
- State of Georgia, Department of Natural Resources
  Certified Drinking Water Laboratory
- State of Hawaii, Department of Health
  Certified Drinking Water Laboratory
- State of Idaho, Department of Health and Welfare
  Certified Drinking Water Laboratory
- State of Indiana, Department of Health
  Certified Drinking Water Laboratory, Lab I.D. C-WA-01
- State of Louisiana, Department of Environmental Quality
  Accredited Environmental Laboratory, Lab I.D. 3016
- State of Maine, Department of Human Services
  Certified Environmental Laboratory, Lab I.D. WA0035
- State of Michigan, Department of Environmental Quality
  Certified Drinking Water Laboratory, Lab I.D. 9949

State and Local Programs (continued)

- State of Minnesota, Department of Health
  Certified Environmental Laboratory, Lab I.D. 053-999-368
- State of Montana, Department of Health and Environmental Sciences
  Certified Drinking Water Laboratory, Lab I.D. 0047
- State of Nebraska, Division of Public Health
  Certified Drinking Water Laboratory, Lab I.D. NE-OS-23-13
- State of Nevada, Division of Environmental Protection
  Certified Drinking Water Laboratory, Lab I.D. WA35
- State of New Jersey, Department of Environmental Protection
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STANDARD OPERATING PROCEDURE

CHLORINATED PESTICIDES BY GC/MS/MS

SVM-PESTMS2
Revision 3

Effective Date: July 30, 2011

Approved By: _____ Supervisor — 7/13/11 Date

_____ QA Manager — 7/14/11 Date

_____ Laboratory Director — 7/14/11 Date

COLUMBIA ANALYTICAL SERVICES, INC.
1317 South 13th Avenue
Kelso, Washington 98626

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CHLORINATED PESTICIDES BY GC/MS/MS

1. SCOPE AND APPLICATION

1.1. This Standard Operating Procedure (SOP) describes the method used for trace analysis of various chlorinated pesticides by high performance gas chromatography/tandem mass spectrometry (HPGC/MS/MS). This SOP describes both the extraction and chromatographic procedures used to determine the target analytes. Table 1 indicates compounds that may be determined by this method and lists their method reporting limits (MRLs) in water and soil. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL). Therefore, MRL=EQL. The reported MRL may be adjusted to meet specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. Method Detection Limits (MDLs) which have been achieved are also given. The Method Detection Limits (MDLs) will vary depending on the instrument used and preparation method.

1.2. This procedure is used to determine the concentrations of chlorinated pesticides in water, soil, and tissue using HPGC/MS/MS. The procedure may be applied to other miscellaneous sample matrices providing that the analyst demonstrates the ability of the procedure to give data of acceptable quality in that matrix.

2. METHOD SUMMARY

2.1. This SOP describes HPGC/MS/MS conditions for the detection chlorinated pesticides. Prior to the use of this method, an appropriate sample preparation method must be used to recover the analytes of interest. Stable, isotopically labeled analogs of the analytes of interest are spiked into the samples before they are extracted. They are used to both assess the efficiency of the extraction and to quantitate the analytes of interest.

2.2. A 5.0 µL aliquot of the extract is injected into the gas chromatograph (GC). The compounds are separated on a fused silica capillary column. Compounds of interest are detected by a mass selective detector. Identification of the analytes of interest is performed by comparing the retention times of the analytes with the respective retention times of an authentic standard, and by comparing the ratio of the two parent/daughter transitions acquired for each compound with the same ratio in the CCV Standard. Quantitative analysis is performed by using the authentic standard to produce a response factor and calibration curve, and using the calibration data to determine the concentration of an analyte in the extract. The concentration in the sample is calculated using the sample weight or volume and the extract volume.

2.3. The following compounds may require special treatment when being determined by this method. DDT and Endrin are subject to thermal decomposition in the inlet of the gas chromatograph. EndosulfanI , EndosulfanII, Dieldrin, Endrin, Endrin aldehyde, and Endrin ketone produce relatively low response areas due to their fragmentation patterns.

3. DEFINITIONS

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3.1. **Analysis Sequence** - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with injection of a DFTPP Standard, followed by a DDT/Endrin standard and then the initial calibration standards. Once calibrated, a CCV is evaluated and extracts can be run. The sequence ends after 12 hours based on the DFTPP injection time.

3.2. **Matrix Spike/Duplicate Matrix Spike Analysis** - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample extraction and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the methods used for the analyses. Samples are split into duplicates, then spiked and analyzed. Percent recoveries are calculated for each of the analytes detected. The relative percent difference between the samples is calculated and used to assess analytical precision.

3.3. **Standard Curve** - A standard curve is a calibration curve which plots concentrations of a known analyte standard versus the instrument response to the analyte.

3.4. **Surrogate** - Surrogates for this analysis are isotpically labeled pesticides which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These are the same as the labeled internal standards. The purpose of the surrogates is to evaluate the preparation and analysis of samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate.

3.5. **Method Blank** - The method blank is an artificial sample designed to monitor introduction of artifacts into the process. The method blank is carried through the entire analytical procedure.

3.6. **Laboratory Control Sample (LCS)** – A Laboratory Control Sample is a method blank spiked with known quantities of analytes. The LCS is analyzed exactly like a sample. Its purpose is to assure that the results produced by the laboratory remain within the limits specified in this SOP for precision and recovery.

3.7. **Continuing Calibration Verification Standard (CCV)** - A mid-level standard injected into the instrument at specified intervals and is used to verify the validity of the initial calibration.

3.8. **Independent Calibration Verification Standard (ICV)** - A mid-level standard injected into the instrument after the calibration curve from a different source than the standards in the curve and is used to verify the validity of the initial calibration.

3.9. **Multiple Reaction Monitoring (MRM**) – A HRGC/MS/MS technique where most background noise/interfering compound are filtered out by the tandem mass spectrometer. MRM mode allows only one parent ion through the first quadrapole at a time. In the collision cell (Q2) the parent ion is fragmented. In the third quadrapole (Q3) all ions except the quantitation fragment (product ion) are filtered out. The only ions that are allowed through the instrument are ions that have the same parent mass producing the same product mass during a particular segment of analysis time. These are referred to as a Parent/Daughter ion pair, or as a transition, which is

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abbreviated as P>D by the Waters MassLynx software. This analysis segment is specified for a particular retention time range that corresponds to the retention time of a certified standard.

4. INTERFERENCES

4.1. The GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Determine if the source of interference is in the preparation of the samples. Corrective action should be taken to eliminate the interferences.

4.2. Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed out between samples with solvent. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross contamination.

4.3. The reporting limits for these analytes are in the low ppb to ppt level. Therefore, low level background contamination is a concern when conducting this method. Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the CAS safety policies, approved methods and in MSDSs where available. Refer to the CAS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.3. This method uses Methylene Chloride, a known human carcinogen. Viton brand gloves should be used while rinsing, pouring or transferring the solvent

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Containers used to collect samples should be purchased pre-cleaned containers. Alternatively, containers used to collect samples for the determination of pesticides may be soap and water washed followed by methanol (or isopropanol) rinsing. The sample containers should be of glass or Teflon and have screw-top covers with Teflon liners. In situations where Teflon is not available, solvent-rinsed aluminum foil may be used as a liner. Highly acidic or basic samples may react with the aluminum foil, causing eventual contamination of the sample. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic.

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6.2. Sample containers should be filled with care so as to prevent any portion of the collected sample coming in contact with the sampler's gloves, thus causing contamination. Samples should not be collected or stored in the presence of exhaust fumes. If the sample comes in contact with the sampler (e.g., if an automatic sampler is used), run reagent water through the sampler and use the rinseate as a field blank.

6.3. Water and soil samples must be iced or refrigerated at 4 ± 2°C from time of collection until extraction.

6.4. Tissue samples should be kept frozen until they are extracted to minimize decomposition.

6.5. Water samples must be extracted within 7 days and the extracts analyzed within 40 days following extraction. Soil samples must be extracted within 14 days and the extract analyzed within 40 days following extraction. Extracts are stored at < -10°C.

7. APPARATUS AND MATERIALS

7.1. Gas Chromatograph/Mass Spectrometer System

7.1.1. Gas Chromatograph - An analytical system complete with a temperature-programmable gas chromatograph suitable for large volume cool splitless injection and all required accessories, including syringes, analytical columns, and gases. The capillary column should be directly coupled to the source. Agilent 6890N equipped with the Agilent PTV injector recommended.

7.1.2. Column: ZB-Multiresidue-1 30 m x 0.25 mm ID x 0.25 µm film thickness silicone-coated fused-silica capillary column or equivalent. Recommended: Phenomenex #7HG-G016-11.

7.1.3. MS/MS System – Waters Micromass Quattro Micro GC, tandem mass spectrometer or equivalent.

7.1.4. Data System - A computer system must be interfaced to the mass spectrometer. The system must allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. (Waters MassLynx or equivalent) This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between specified time or scan-number limits. The most recent version of the EPA/NIST Mass Spectral Library should also be available.

7.2. Appropriate analytical balance (0.0001 g), volumetric flasks, syringes, vials, and bottles for standards preparation.

8. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

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8.1. Solvents: Acetone, methylene chloride, methanol, hexane, and other appropriate solvents. Solvents must be of sufficient purity to permit usage without lessening the accuracy of the determination or introducing interferences.

8.2. Stock Standard Solutions

8.2.1. Commercially prepared stock standards are typically used, and are available from several vendors. They must be A2LA or ISO9000 certified by the manufacturer. Standard concentrations can be verified by comparison versus an independently prepared standard. Alternatively, prepare stock standard solutions at a concentration of 1000 µg/ml by dissolving 0.0100 g of reference material in hexane, methylene chloride or other suitable solvent and diluting to volume in a 10mL volumetric flask. Larger volumes can be used at the convenience of the analyst. When compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard.

8.2.2. Transfer the stock standard solutions into Teflon-sealed screw-cap bottles. Store at -10°C and protect from light, or store as recommended by the manufacturer. Stock standards should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.

8.2.3. Stock standard solutions must be replaced after one year, or sooner, if comparison with check standards or samples indicates a problem.

8.3. Instrument Internal Standard – 10 ul of a 10ug/ml Pyrene-d10 solution is added to each 1 ml sample extract undergoing analysis. The resulting concentration of the standard is 100ng/mL. Store at 4 ± 2°C when not being used. When using premixed certified solutions, store according to the manufacturer's recommendations. Other internal standards can be used as long as they do not interfere with the target analytes, and have similar retention times.

8.4. DDT/Endrin calibration standard. A hexane solution containing 20ng/mL of 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, Endrin, Endrin Ketone, Endrin aldehyde, and 100ng/mL of the instrument internal standard.

8.5. DDT/ Endrin Standard - A hexane solution containing 20ng/ml of 4,4'-DDT, and Endrin, and 100ng/ml of the instrument internal standard. This is used to verify injection port inertness and GC column performance. Store at 4 ± 2°C when not being used, or store according to the manufacturer's recommendations.

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8.6. Calibration Standards

8.6.1. A minimum of eight initial calibration standards should be prepared from stock solutions. One of the calibration standards should be at a concentration at or below the method reporting limit; the others should correspond to the range of concentrations found in real samples, but should not exceed the working range of the GC/MS system. At least one calibration standard must be at a concentration corresponding to a sample concentration meeting project-specific data quality objectives. Each standard should contain each analyte for detection by this method. Each 1 ml aliquot of calibration standards should be spiked with 10 µL of the internal standard solution prior to analysis. All calibration standards should be stored at 4 ± 2°C or less and should be freshly prepared once a year, or sooner if check standards indicate a problem.

8.6.2. The daily calibration standard (CCV) is prepared at a nominal 20 ng/ml concentration from stock solutions. The CCV is prepared weekly and can be stored at 4 ± 2°C, or as recommended by the manufacturer.

8.7. QC Standards

8.7.1. Labeled internal standards: These are isotopically labeled of the pesticides being analyzed. Prepare a working solution in acetone containing: Hexachlorobenzene13c6, Chlorpyrifos-d10, gamma.BHC-d6, Aldrin13c12, Heptachlor13c10, Endrin13c12, cis-Heptachlorepoxide13c10, Oxychlordane13c10, Octachlorostyrene13c8, Isodrin13c12, Methoxychlor-d14, Endrin ketone13c12, 4,4'-DDD-d4, 4,4'DDT-d4, and Mirex13c10 at the concentrations listed in Table 4. Aliquots of the solution are spiked into all extracted samples, blanks, and QC samples according to the extraction SOP used. All labeled internal standards should be stored at 4 ±2°C or less. General expiration guidelines do not apply to labeled isotopes, but standard should be freshly prepared once a year, or sooner if problems are identified. To certify that the labeled internal standards are not degraded or concentrated from storage, and still suitable for use: prepare and analyze a standard containing the labeled standards and the unlabeled target analytes at 100 ng/ml. The ratio of: Labeled Compound Area/ Unlabeled Compound Area should be between 0.5-1.5.

8.7.2. Matrix Spike Standards: Prepare a working solution in methanol containing all analytes of interest ("full list spike") from the standard analyte list (Table1) at 200ng/mL. Aliquots of the solution are spiked into the selected QC aliquots according to the extraction SOP used.

Note: The spiking level of Labeled internal standards and spike may need to be adjusted according to project requirements, if dilutions are expected due to high levels of extracted components, or if a lower calibration range is used.

9. PREVENTIVE MAINTENANCE

9.1. All maintenance activities are recorded in a maintenance logbook kept for each instrument.

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9.2. Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.

9.3. Gas Chromatograph

9.3.1. Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, o-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used.

9.3.2. Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column cutting tool.

9.3.3. Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

9.4. Mass Spectrometer

9.4.1. For units under service contract, certain maintenance is performed by instrument service staff, including pump oil changed, vacuuming boards, etc., as recommended by the manufacturer.

9.4.2. MS source cleaning should be performed as needed, depending on the performance of the unit. This may be done by the analyst or by instrument service staff.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency, as described in 8270C, is also the responsibility of the department supervisor/manager.

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11. PROCEDURE

11.1. Sample Preparation

11.1.1. Water samples

11.1.1.1. Water samples are prepared using solid phase extraction (SPE) and EPA method 3535. Refer to the CAS SOP EXT-3535. Alternative extraction procedures such as EPA 3520 and EPA 3510 may be used for aqueous samples not suitable for SPE.

11.1.1.2. Perform the extraction on a 1000mL aliquot of sample. For heavily contaminated samples use a smaller volume or dilute the sample before extraction.

11.1.2. Soil, sediment, and solid samples are prepared using automated soxhlet extraction (SOP EXT-3541). The nominal sample size is 10g. Sample amounts may be decreased in the case of high-concentration waste samples.

11.1.2.1. Tissue samples are prepared using automated soxhlet extraction (SOP EXT-3541). The nominal sample size is 2.0g.

11.1.3. Product samples may not be analyzed by this method.

11.1.4. Extracts should be screened by GC/FID (SOP SOC-SCR). Cleanup by GPC, and carbon columns is mandatory for soil and tissue samples, and may be needed for contaminated water samples. All colored extracts must be cleaned with carbon columns. GPC is used to remove lipids from tissue extracts.

11.1.5. Extracts are solvent exchanged to hexane before they are taken to final volume. The final volume for all extracts is 1.0ml.

11.1.6. Following sample preparation, sample extracts are then transferred to the extract cold storage unit. Extracts must be analyzed within 40 days of extraction.

11.2. Analysis

11.2.1. The recommended GC/MS operating conditions are listed below. The GC conditions may be modified to accommodate specific instrument models and configurations.

<u>GC Conditions</u>
Injector Agilent PTV
Mode Solvent Vent, Ramped pressure
Injector liner: Baffled, Restek Siltek Deactivated #21704-214.10
Injection volume: 5uL
Injection speed: Slow
Post injection dwell: 1.0min

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Carrier gas: Helium @ 0.7 ml/min
Injector temperature: 20 – 320°C, temperature programmed
GC Temperature program:

- Initial temperature 65°C for 2 min
- Initial ramp 65 – 240°C @ 20°C per min
- Second ramp 240 – 280°C @ 6.1°C per min
- Third ramp 280 – 310°C @ 15°C per min
- Final Hold 0.7 min or until Mirex or the last analyte elutes

<u>Mass Spectrometer Conditions</u>
Source temperature 225°C
Detector interface temp: 290°C
Trap Current 200
Collision Gas Argon @ 2-3 × 10^{-3} torr
Tune file dtrscan
Photomultiplier 650

11.2.2. Tune the MS as needed to maximize sensitivity for MS/MS analysis. For the Micromass Quattro micro GC in EI mode the parameters will be similar to these:

Electron Energy	70
Trap	200
Repeller	0.5
Extraction Lens	5.0
Focus lens 1	40
Focus Lens 3	45
LM1 Resolution	10
HM1 Resolution	10
Ion Energy 1	0.9
Entrance	-1
Collision	2
Exit	+1
LM 2 Resolution	12
HM 2 Resolution	12
Ion Energy 2	1.0
Multiplier	650

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11.2.3. Daily DFTPP Tune Verification

11.2.3.1.1. 5ul of a 1.0ug/ml DFTPP standard is injected and analyzed in MRM mode to verify the MS/MS functioning of the instrument. The 442>198, 443>198, 198>110, 255>186, and the 127>77 transitions are monitored. Acceptance criteria are listed in table 8.

11.2.3.1.2. The analysis time for DFTPP is used to define the start of the 12-hour window in which all analyses must be performed. Once the instrument is tuned, all subsequent analyses of standards, samples, and QA/QC samples within the same 12-hour window must be analyzed using the identical mass spectrometer operating conditions.

11.2.4. Initial Calibration

NOTE: The calibration procedure(s) and options chosen must follow the CAS protocols. Any exceptions to the calibration procedures detailed in the CAS SOP for *Calibration of Instruments for Organics Chromatographic Analyses* are described as follows:

11.2.4.1. To assess column performance and injection port inertness; first analyze 5uL of the DDT/Endrin calibration standard by MRM and update the calibration file. Then analyze the DDT/Endrin standard and quantitate it against the DDT/Endrin calibration.

11.2.4.2. Calculate the DDT/Endrin breakdown as follows:

%DDT = (4,4'-DDE + 4,4'-DDD)*100/(4,4'-DDE + 4,4'-DDD + 4,4'-DDT)

%Endrin = (endrin aldehye + endrin ketone)*100/(endrin aldehyde + endrin ketone + endrin)

11.2.4.3. DDT and Endrin degradation should not exceed 20%. If degradation of >20% is noted, the injection port may require cleaning. It may also be necessary to remove the first 15-30 cm of the GC column

11.2.4.4. The internal standards should permit most of the components of interest in the chromatogram to have retention times of 0.80-1.20 relative to one of the internal standards. Refer to Table 6 for internal standards and corresponding analytes assigned for quantitation.

11.2.4.5. Analyze 5.0 µL of each calibration standard (containing internal standards) and tabulate the area of the primary characteristic ion against concentration for each compound (as indicated in Table 1). Calculate response factors (RFs) for each compound relative to one of the internal standards as follows:

$$RF = (A_x C_{is})/(A_{is} C_x)$$

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where:
A_x = Area of the characteristic ion for compound being measured.
A_{is} = Area of the characteristic ion for specific internal standard.
C_{is} = Concentration of the specific internal standard (ng/µL).
C_x = Concentration of the compound being measured (ng/µL).

11.2.4.6. The minimum RF for analytes and surrogates is 0.01

11.2.4.7. Calculate the %RSD for each analyte and internal standard.

$$\%RSD = \frac{SD}{\overline{RF}} \times 100$$

where:
RSD=relative standard deviation.
$\overline{RF}$ =mean of initial RFs for a compound.
SD=standard deviation of average RFs for a compound.

$$SD = \sqrt{\sum_{i=1}^{N} \frac{(RF_i - \overline{RF})^2}{N - 1}}$$

where:
RF_i=RF for each of the calibration levels
N=Number of RF values (i.e., 8)

11.2.4.8. The % RSD should be less than 20% for each compound.

11.2.4.9. If the % RSD for any compound is ≤ 20%, linearity can be assumed over the calibration range, and the relative response factor for each analyte and surrogate is used.

11.2.4.10. If the %RSD for a compound is >20%, then alternative calibration models should be used. See the SOP (SOC-CAL) *Calibration of Instruments for Organics Chromatographic Analysis* for further guidance.

11.2.5. Independent Calibration Verification

11.2.5.1. Following initial calibration, analyze an ICV standard. The ICV solution must contain all analytes in the calibration standards. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. The ICV should quantitate within 75–125 % of the target concentration.

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11.3. Continuing Calibration

11.3.1. First analyze the DDT/Endrin breakdown standard as detailed in 11.3.1 to 11.3.3

11.3.2. A mid-level calibration verification standard, containing all pesticides, labeled, and recovery internal standards must be analyzed every 12 hours during analysis. Calculate the percent drift using:

$$\% \, Drift = \frac{C_t - C_m}{C_t} x \, 100$$

where:
C_t = Analyte standard concentration.
C_m = Measured concentration using selected quantitation method.

11.3.3. If the percent drift for each analyte is less than or equal to 25%, the initial calibration is assumed to be valid. If no source of the problem can be determined after corrective action has been taken, a new multipoint calibration must be generated. This criterion must be met before sample analysis begins. If the % RSD for any analyte exceeds 25%, the analyst must determine if the response is sufficient to attain MRL for that analyte and any hits for that analyte must be rerun for quantitation.

11.3.4. The internal standard responses and retention times in the calibration verification standard must be evaluated immediately after or during data acquisition. If the retention time for the instrument internal standard changes by more than 30 seconds from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as required. If the EICP area for the PCB-52 13C12 internal standard changes by a factor of two (50% to 200%) from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as appropriate. When corrective action is taken, reanalysis of samples analyzed while the system was malfunctioning is required. Update retention times and transition ratios in the quantitation database for the instrument method or ID file. The initial calibration average RF or calibration curve is then used in the quantitation of subsequent analyses.

11.3.5. A blank (method blank, GPC blank, or solvent blank) should be analyzed after the CCV to prove the system is free of contaminants. If contaminants are found in a method blank or GPC blank, then a solvent blank should be ran to help isolate the source of contamination.

11.4. GC/MS Analysis

11.4.1. Evaluate FID screen and make proper dilution (See FID screening SOP).

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11.4.2. Spike the 1 mL extract obtained from sample preparation with 10 µL of the instrument internal standard solution just prior to analysis. Use the same operating conditions as were used for initial calibration.

11.4.3. If the response for any quantitation ion exceeds the initial calibration curve range of the GC/MS system, extract dilution must take place. Additional internal standard must be added to the diluted extract to maintain the required 100ng/ml of the instrument internal standard in the extract volume. The diluted extract must be reanalyzed.

11.4.4. If a dilution of more than 10X is required; re-extract the sample using a smaller aliquot.

11.4.5. Store the extracts at -10°C or less, protected from light in vials equipped with un-pierced Teflon lined septa. Archive the extract in freezer for 3 months after analysis in the instrument/date specific storage boxes.

12. QA/QC REQUIREMENTS

12.1.Initial Precision and Recovery Validation

12.1.1. The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made. To do this, four laboratory generated samples are spiked with the LCS spike solution, then prepared and analyzed. The acceptance criterion is the same as LCS criteria.

12.2.Method Detection Limits, Limits of Detection and Limits of Quantification

12.2.1. Method detection limit (MDL), Limits of Detection (LOD) and Limits of Quantification (LOQ) must be determined before analysis of samples can begin. Refer to the SOP for the *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation (ADM-MDL).*

12.2.2. Calculate the average concentration found (x) in ng/L, and the standard deviation of the concentrations (s) in ng/L for each analyte. Calculate the MDL for each analyte.

12.3.Ongoing QC Samples required are described in the CAS-Kelso Quality Assurance Manual and in the *SOP for Sample Batches*. In general, these include:

12.3.1. Method blank - A method blank is extracted and analyzed with every batch of 20 or fewer samples to demonstrate that there are no method interferences. The method blank must demonstrate that interferences from the analytical and preparation steps minimized. No target analytes should be detected above the MRL in the method blank. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported.

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12.3.2. An LCS or Laboratory Control Sample must be extracted and analyzed with every batch of 20 or fewer samples. The LCS is prepared by spiking a blank with the matrix spike solution, and going through the entire extraction and analysis.

12.3.2.1. Calculate percent recovery (%R) as follows:

%R = X/TV x 100

Where X = Concentration of the analyte recovered
TV= True value of amount spiked

12.3.2.2. Acceptance criteria for lab control samples are listed in Table 5. If the LCS recovery for any control analyte fails acceptance limits, corrective action is required. If instrument corrective action is not applicable or ineffective, re-extraction of the associated samples is required. If any other analyte fails the advisory acceptance limits, the analyst must evaluate the impact on data quality and take any necessary corrective action, which may include re-extraction of the associated samples. Project-specific requirements may require all compounds to be treated as control analytes, or dictate use of project acceptance criteria.

12.3.3. A matrix spike/duplicate matrix spike (MS/DMS) must be extracted and analyzed with every batch of 20 or fewer samples. The MS is prepared by spiking a sample aliquot with the matrix spike solution, and going through the entire extraction and analysis.

12.3.3.1. Calculate percent recovery (%R) as follows:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where X = Concentration of the analyte recovered
X1= Concentration of unspiked analyte
TV= True value of amount spiked

12.3.3.2. Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where R1 = recovered concentration in the MS
R2 = recovered concentration in the DMS

12.3.3.3. The acceptance limits for the MS/DMS recovery are given in Table5. If the MS/DMS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken. The RPD acceptance limits are 30% for water and 40% for soils,

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sediments, and solids. Project-specific requirements may dictate the use of project acceptance criteria.

12.3.4. The acceptance limits for the Labeled Internal Standards are given in Table 5. If any internal standard recovery is outside acceptance criteria, the sample data must be closely evaluated for possible matrix interferences. If none are present, then corrective action must be taken. The sample should be re-analyzed if instrument factors (calibration, injection port) are suspected. If not, re-extraction and re-analysis is required, except in cases of high recovery and no positive hits in the sample for the analyte class represented by the particular surrogate.

12.3.5. Additional QA/QC measures include control charting of QC sample results.

13. DATA REDUCTION, REVIEW, AND REPORTING

13.1. Qualitative Analysis - The qualitative identification of compounds determined by this procedure is based on retention time, and the ratio of the quantitation transition and the qualifier transition. Compounds should be identified as present when the criteria below are met.

13.1.1. The intensities of the characteristic transitions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing transitions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

13.1.2. The RRT of the sample component is within ± 0.06 RRT units of the RRT of the standard component.

13.1.3. The ratio of the quantitation transition/qualifier transition agrees within 30% of the ratio of these transitions in the reference spectrum.

13.1.4. Structural isomers that produce very similar transitions should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is <25% of the sum of the 2 peak heights. Otherwise, structural isomers are identified as isomeric pairs.

13.1.5. Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing transitions contributed by more than one analyte. When gas chromatographic peaks appear to represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important. Examination of extracted transition current profiles of appropriate transitions can aid in the selection of spectra, and in qualitative identification. When analytes coelute, the identification criteria can be met, but each analyte spectrum will contain extraneous transitions contributed by the coeluting compound.

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13.2. Quantitation and Calculations

13.2.1. The GC/MS/MS data stations, in current use, use the Waters MassLynx Integrator to generate the raw data used to calculate the standards $\overline{RF_x}$ values, the sample amounts, and the spike values. The software does three passes through each data file. The first two identify and integrate each internal standard and surrogate. The third pass uses the time-drift information from the first two passes to search for all method analytes in the proper retention times and with the proper characteristic quantitation transitions.

When $\overline{RF_x}$ is used, calculate the extract concentration as follows:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF_x})}$$

Where: C_{ex} = the concentration in the sample extract (ppm);
$Resp_x$ = the peak area of the analytes of interest;
$Resp_{ISTD}$ = the peak area of the associated internal standard;
Amt_{ISTD} = the amount, in ppm, of internal standard added
$\overline{RF_x}$ = the average response from the initial calibration.

13.2.2. The concentration of analytes in the original sample is computed using the following equations:

Aqueous Samples: $$Concentration\ (\mu g / L) = \frac{(Cex)\ (Vf)\ (D)}{(Vs)}$$

Where Cex = Concentration in extract in µg/mL
Vf = Final volume of extract in mL
D = Dilution factor
Vs = Volume of sample extracted, liters

Nonaqueous Samples: $$Concentration\ (mg / Kg) = \frac{(Cex)\ (Vf)\ (D)}{(W)}$$

Where Cex =Concentration in extract in µg/mL
Vf =Final volume of extract in mL
D =Dilution factor
W =Weight of sample extracted in grams.

13.2.2.1. If the area of the quantitation transition for any of the pesticides exceeds the calibration range, dilute and reanalyze the extract. Add additional recovery internal standard to maintain its concentration at 100ng/ml.

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13.2.2.2. If a dilution greater than 10X is required; re-extract the sample using a smaller aliquot.

13.2.2.3. If the recovery of any of the labeled internal standards is outside of the limits in Table 5, extract and analyze a smaller aliquot of the sample. Adjust the MRL/MDL to account for this dilution.

13.3. Data Review

13.3.1. Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process* for details.

13.4. Reporting

13.4.1. Reports are generated using the STEALTH Data Reporting System which compiles the SMO login information and Enviroquant data. This compilation is then transferred to a file, which STEALTH uses to generate a report. The forms generated may be CAS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.4.2. As an alternative, reports are generated using Excel© templates located in R:\SVM\forms. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The detected analytes, surrogate and matrix spikes are then transferred, by hand or electronically, to the templates.

14. CONTINGENCIES FOR HANDLING OUT-OF- CONTROL OR UNACCEPTABLE DATA

Corrective action measures applicable to specific analysis steps are discussed in the applicable section of this (and other applicable) SOP(s). Also, refer to the *SOP for Corrective Action* for correct procedures for identifying and documenting such data. Procedures for applying data qualifiers are described in the SOP for Report Generation or in project-specific requirements.

15. METHOD PERFORMANCE

15.1. This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

15.2. The method detection limit (MDL) is established using the procedure described in Section 12. Method Reporting Limits are established for this method based on MDL studies and as specified in the CAS Quality Assurance Manual.

16. POLLUTION PREVENTION

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It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible, and within method requirements. Standards are prepared in volumes consistent with laboratory use in order to minimize the volume of expired standards to be disposed of. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

17. WASTE MANAGEMENT

17.1. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the CAS EH&S Manual.

17.2. This method uses Methylene Chloride and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and recycled off site.

17.3. This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

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18. REFERENCES

18.1. *Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry*, Method 8270C, EPA Test Methods for Evaluating Solid Waste, SW-846, Final Update III, December 1996.

18.2. Pesticides in Water, Soil, Biosolids, and Tissue by HRGC/HRMS, Method 1699, USEPA Office of Water, Office of Science and Technology, Engineering and Analysis Division. December 2007

19. CHANGES SINCE THE LAST REVISION

19.1. Changed SOP file name to SVM from SOC
19.2. Remove method EPA 1699M reference
19.3. Replaced the word *ions* with *transitions* throughout document
19.4. Sec 1.1 removed PQL as equivalent to MRL
19.5. Sec 3.1 replace CCV with DFTPP
19.6. Sec 3.6 replaced OPR with LCS
19.7. .Sec 8.3 last sentence is new
19.8. Sec 11.1.2.1 is new
19.9. Sec 11.1.4 replaced lipid removal cartridges with GPC
19.10. Sec 11.1.5 is new
19.11. Sec 11.3 is new
19.12. Sec 11.2.4 Note under this section is new
19.13. Sec 11.2.4.8 – 11.2.4.10 is new
19.14. Sec 12.1 changed to follow lab developed method QC criteria
19.15. Sec 13.4.1 updated to Stealth reporting
19.16. All Tables updated

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TABLE 1

ORGANOCHLORINE PESTICIDES- STANDARD ANALYTE LIST

	Water		Soil		Tissue	
Compound	**MDL (ng/L)**	**MRL (ng/L)**	**MDL(µg/Kg)**	**MRL (µg/Kg)**	**MDL(µg/Kg)**	**MRL (µg/Kg)**
alpha-BHC	0.27	0.50	0.0069	0.050	0.26	1.0
gamma-BHC	0.15	0.50	0.011	0.050	17	0.50
beta-BHC	0.31	0.50	0.012	0.050	0.40	1.0
delta-BHC	0.19	0.50	0.011	0.050	0.28	1.0
Hexachlorobenzene	0.13	0.50	0.015	0.050	0.70	2.5
Heptachlor	0.17	1.0	0.0091	0.10	0.090	0.50
Chlorpyrifos	0.17	0.50	0.0072	0.050	0.13	0.5
Aldrin	0.47	1.0	0.012	0.10	0.22	1.0
Octachlorostyrene	0.28	1.0	0.017	0.10	0.16	0.50
Isodrin	1.1	2.0	0.029	0.20	0.23	1.0
Oxychlordane	0.72	2.0	0.092	0.20	0.77	2.50
Heptachlor epoxide	0.47	1.0	0.030	0.10	0.061	0.50
2,4’-DDE	0.19	0.50	0.0069	0.050	0.42	1.0
gamma-Chlordane	0.20	0.5	0.0081	0.050	0.13	0.50
alpha-Chlordane	0.15	0.50	0.0066	0.050	0.12	0.50
trans-Nonachlor	0.24	0.50	0.014	0.050	0.094	0.50
Endosulfan I	1.2	2.0	0.050	0.20	0.42	1.0
4,4’-DDE	0.13	0.50	0.0055	0.050	0.70	2.5
2,4’-DDD	0.11	0.50	0.0094	0.050	0.31	1.0
Dieldrin	2.3	5.0	0.098	0.50	0.22	1.0
Endrin	0.84	2.0	0.045	0.20	0.45	1.0
2,4’-DDT	0.13	0.50	0.0060	0.050	0.46	1.0
cis-Nonachlor	0.31	0.5	0.015	0.20	0.13	0.50
4,4’-DDD	0.20	0.50	0.015	0.050	013	1.0
Endosulfan II	0.51	1.0	0.043	0.10	0.35	1.0
Endrin aldehyde	0.67	1.0	0.051	0.10	56	1.0
4,4’-DDT	0.23	0.50	0.014	0.050	0.35	1.0
Endosulfan sulfate	0.12	0.50	0.017	0.050	0.22	1.0

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TABLE 1 (continued)

	Water		Soil		Tissue	
Compound	**MDL (ng/L)**	**MRL (ng/L)**	**MDL(µg/Kg)**	**MRL (µg/Kg)**	**MDL(µg/Kg)**	**MRL (µg/Kg)**
Methoxychlor	0.16	0.50	0.018	0.050	0.15	0.50
Endrin Ketone	0.70	1.0	0.036	0.10	0.16	0.50
Mirex	0.12	1.0	0.029	0.10	0.11	0.50

Table 2: Labeled Compound Spiking Solution

Compound Name		**Spiking solution conc. (ng/ml)**	**Spike amount (ng) 100ul spike volume**
g-BHC-d6		200	20
Hexachlorobenzene13C6		200	20
Heptachlor-13C10		200	20
Chlorpyrifos-d10		200	20
Aldrin-13C12		200	20
Octachlorostyrene-13C8		200	20
Isodrin-13C12		200	20
Oxychlordane-13C10		200	20
Heptachlorepox13C10		200	20
Endrin-13C12		200	20
4,4'-DDD-d4		50	5
4,4'-DDT-d4		50	5
Methoxychlor-d14		200	20
Endrin ketone-13C12		200	20
Mirex-13C10		50	5

Table 3: Recovery Internal Standard Spiking Solution

Compound Name		**Spiking solution conc. (ug/ml)**	**Spike amount (ng) 100ul spike volume**
Pyrene-d10		10	100

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Table 4 Concentration of calibration solutions (ng/ml)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6 CCV	CS-7	CS-8	CS-9
Pyrene-d10	100	100	100	100	100	100	100	100	100
g-BHC-d6	20	20	20	20	20	20	20	20	20
Hexachlorobenzene13C6	20	20	20	20	20	20	20	20	20
Heptachlor-13C10	20	20	20	20	20	20	20	20	20
Chlorpyrifos-d10	20	20	20	20	20	20	20	20	20
Aldrin-13C12	20	20	20	20	20	20	20	20	20
Octachlorostyrene-13C8	20	20	20	20	20	20	20	20	20
Isodrin-13C12	20	20	20	20	20	20	20	20	20
Oxychlordane-13C10	20	20	20	20	20	20	20	20	20
Heptachlorepox13C10	20	20	20	20	20	20	20	20	20
Endrin-13C12	20	20	20	20	20	20	20	20	20
4,4’-DDD-d4	5	5	5	5	5	5	5	5	5
4,4’-DDT-d4	5	5	5	5	5	5	5	5	5
Methoxychlor-d14	20	20	20	20	20	20	20	20	20
Endrin ketone-13C12	20	20	20	20	20	20	20	20	20
Mirex-13C10	5	5	5	5	5	5	5	5	5
alpha-BHC	0.5	1	2	5	10	20	50	70	100
Gamma-BHC	0.5	1	2	5	10	20	50	70	100
Beta-BHC	0.5	1	2	5	10	20	50	70	100
Delta-BHC	0.5	1	2	5	10	20	50	70	100
Hexachlorobenzene	0.5	1	2	5	10	20	50	70	100
Heptachlor	0.5	1	2	5	10	20	50	70	100
Chlorpyrifos	0.5	1	2	5	10	20	50	70	100
Aldrin	0.5	1	2	5	10	20	50	70	100
Octachlorostyrene	0.5	1	2	5	10	20	50	70	100
Isodrin	0.5	1	2	5	10	20	50	70	100
Oxychlordane	0.5	1	2	5	10	20	50	70	100
Heptachlor epoxide	0.5	1	2	5	10	20	50	70	100
2,4’-DDE	0.5	1	2	5	10	20	50	70	100
Gamma-Chlordane	0.5	1	2	5	10	20	50	70	100
Alpha-Chlordane	0.5	1	2	5	10	20	50	70	100
Trans-Nonachlor	0.5	1	2	5	10	20	50	70	100
EndosulfanI	0.5	1	2	5	10	20	50	70	100

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Table 4 Concentration of calibration solutions (ng/ml) continued

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6 CCV	CS-7	CS-8	CS-9
4,4'-DDE	0.5	1	2	5	10	20	50	70	100
2,4'-DDD	0.5	1	2	5	10	20	50	70	100
Dieldrin	0.5	1	2	5	10	20	50	70	100
Endrin	0.5	1	2	5	10	20	50	70	100
2,4'-DDT	0.5	1	2	5	10	20	50	70	100
Cis-Nonachlor	0.5	1	2	5	10	20	50	70	100
4,4'-DDD	0.5	1	2	5	10	20	50	70	100
EndosulfanII	0.5	1	2	5	10	20	50	70	100
Endrin aldehyde	0.5	1	2	5	10	20	50	70	100
4,4'-DDT	0.5	1	2	5	10	20	50	70	100
Endosulfan sulfate	0.5	1	2	5	10	20	50	70	100
Methoxychlor	0.5	1	2	5	10	20	50	70	100
Endrin ketone	0.5	1	2	5	10	20	50	70	100
Mirex	0.5	1	2	5	10	20	50	70	100

LABELED PESTICIDE STANDARDS

Isotopically labeled pesticide and PCB standards are obtained from Cambridge Isotope Laboratories, C/D/N Isotopes, and Dr Erhenstorfer Laboratories.

CALIBRATION

The multipoint calibration is prepared from: AccuStandard catalog # M-8081-SC, M-8080-OP, P-297S, P-184S, P-331S-H, P-066S, P-094S, P-471S, APP-9-112 (or equivalent from other vendors*)

ICV

The ICV standard is prepared from the following: Ultra Scientific catalog # PPM-808C-1, PPM-828-1, PST-480C100A01, PST-590C100A01, PST-120C100A01, PST-3185C100A01, PP-430-1, PST-2705M100A01, PST-1200C100A01, PST-720C100A01

CCV

Use the same solutions that were used for the calibration curve
Prepare 1 ml of 20 ng/ml CCV standard, place in autosampler vial and cap. Expiration date is 1 week after CCV was prepared.

RECAP AND STORE IMMEDIATELY AFTER INJECTING

Store remaining stock solutions in 1 ml amber vial. Expiration date is one year after ampule is opened or the manufacturers expiration date which ever is first Order when down to one unopened ampule.

* Vendor must be A2LA and/or ISO9000 certified.

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Table 5 QC Acceptance Criteria[a]

		IPR			
Compound	**CCV (%)**	**X(%)**	**RSD (%)**	**LCS/MS (%)**	**Recovery in samples (%)**
Pyrene-d10	70-130	50-200	50	50-200	50-200
g-BHC-d6	70-130	6-112	62	5-124	11-120
Hexachlorobenzene13C6	70-130	6-108	70	5-120	5-120
Heptachlor-13C10	70-130	6-115	67	5-128	5-120
Chlorpyrifos-d10	70-130	5-200	50	5-200	5-200
Aldrin-13C12	70-130	6-113	75	5-126	5-120
Octachlorostyrene-13C8	70-130	5-200	50	5-200	5-200
Isodrin-13C12	70-130	5-200	50	5-200	5-200
Oxychlordane-13C10	70-130	6-129	54	5-144	23-135
Heptachlorepox13C10	70-130	9-131	52	8-146	27-137
Endrin-13C12	70-130	22-141	45	20-157	35-155
4,4’-DDD-d4	70-130	5-200	50	5-200	5-200
4,4’-DDT-d4	70-130	15-180	52	13-200	5-120
Methoxychlor-d14	70-130	8-180	54	8-200	5-120
Endrin ketone-13C12	70-130	5-200	50	5-200	5 -200
Mirex-13C10	70-130	6-125	56	5-138	5-120
alpha-BHC	75-125	55-108	30	50-120	
gamma-BHC	75-125	55-108	30	50-120	
beta-BHC	75-125	55-108	30	50-120	
delta-BHC	75-125	55-108	30	50-120	
Hexachlorobenzene	75-125	55-108	30	50-120	
Heptachlor	75-125	55-108	30	50-120	
Chlorpyrifos	75-125	21-147	46	19-163	
Aldrin	75-125	55-108	30	50-120	

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Table 5 QC Acceptance Criteria$_a$ (continued)

		IPR			
Compound	**CCV (%)**	**X(%)**	**RSD (%)**	**LCS/MS (%)**	**Recovery in samples (%)**
Octachlorostyrene	75-125	55-158	30	50-175	
Isodrin	75-125	5-200	40	5-200	
Oxychlordane	75-125	55-108	30	50-120	
Heptachlor epoxide	75-125	55-108	30	50-120	
2,4'-DDE	75-125	26-111	30	50-120	
gamma-Chlordane	75-125	55-108	30	50-120	
alpha-Chlordane	75-125	55-108	30	50-120	
trans-Nonachlor	75-125	55-108	30	50-120	
EndosulfanI	75-125	55-108	30	50-120	
4,4'-DDE	75-125	55-108	30	50-120	
2,4'-DDD	75-125	55-108	30	50-120	
Dieldrin	75-125	55-108	30	50-120	
Endrin	75-125	55-108	30	50-120	
2,4'-DDT	75-125	55-108	30	50-120	
cis-Nonachlor	75-125	55-108	30	50-120	
4,4'-DDD	75-125	55-108	30	50-120	
EndosulfanII	75-125	5-200	50	5-200	
Endrin aldehyde	75-125	5-200	50	5-200	
4,4'-DDT	75-125	55-108	30	50-120	
Endosulfan sulfate	75-125	55-180	30	5-200	
Methoxychlor	75-125	55-108	30	50-120	
Endrin ketone	75-125	55-120	30	50-134	
Mirex	75-125	55-108	30	50-120	

a- QC Acceptance criteria based on *Pesticides in Water, Soil, Biosolids, and Tissue by HRGC/HRMS*, Method 1699, until laboratory control limits can be calculated.

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Table 6 Quantitation References

Compound		Quantitiation Reference
Pyrene-d10		None
g-BHC-d6		Pyrene-d10
Hexachlorobenzene13C6		Pyrene-d10
Heptachlor-13C10		Pyrene-d10
Chlorpyrifos-d10		Pyrene-d10
Aldrin-13C12		Pyrene-d10
Octachlorostyrene-13C8		Pyrene-d10
Isodrin-13C12		Pyrene-d10
Oxychlordane-13C10		Pyrene-d10
Heptachlorepox13C10		Pyrene-d10
Endrin-13C12		Pyrene-d10
4,4'-DDD-d4		Pyrene-d10
4,4'-DDT-d4		Pyrene-d10
Methoxychlor-d14		Pyrene-d10
Endrin ketone-13C12		Pyrene-d10
Mirex-13C10		Pyrene-d10
alpha-BHC		g-BHC-d6
Gamma-BHC		g-BHC-d6
Beta-BHC		g-BHC-d6
Delta-BHC		g-BHC-d6
Hexachlorobenzene		Hexachlorobenzene13C6
Heptachlor		Heptachlor-13C10
Chlorpyrifos		Chlorpyrifos-d10
Aldrin		Aldrin-13C12
Octachlorostyrene		Octachlorostyrene-13C8
Isodrin		Isodrin-13C12
Oxychlordane		Oxychlordane-13C10
Heptachlor epoxide		Heptachlorepox13C10
2,4'-DDE		4,4'-DDD-d4
Gamma-Chlordane		Oxychlordane-13C10
Alpha-Chlordane		Oxychlordane-13C10
Trans-Nonachlor		Oxychlordane-13C10
EndosulfanI		Endrin-13C12
4,4'-DDE		4,4'-DDD-d4
2,4'-DDD		4,4'-DDD-d4
Dieldrin		Endrin-13C12
Endrin		Endrin-13C12
2,4'-DDT		4,4'-DDT-d4
Cis-Nonachlor		Oxychlordane-13C10

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Table 6 Quantitation References (continued)

Compound		Quantitiation Reference
4,4'-DDD		4,4'-DDD-d4
EndosulfanII		Endrin-13C12
Endrin aldehyde		Endrin-13C12
4,4'-DDT		4,4'-DDT-d4
Endosulfan sulfate		Endrin-13C12
Methoxychlor		Methoxychlor-d14
Endrin ketone		Endrin ketone-13C12
Mirex		Mirex-13C10

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Table 7 Target Compound Transitions and Collision Energy

Compound		Ionization Mode	Quan Transition Trace	Qual Transition Trace	Collision energy (v)
					Quan|Qual
Pyrene-d10		EI+	212>208	212>184	20|20
g-BHC-d6		EI+	223.9>187	184.9>150	10|20
Hexachlorobenzene13C6		EI+	289.8>254.8	254.8>219.8	20|20
Heptachlor-13C10		EI+	276.8>241.8	279>244	15|15
Chlorpyrifos-d10		EI+	324>259.8	199.9>171.9	15|20
Aldrin-13C12		EI+	269.8>200	304.8>269.9	30|20
Octachlorostyrene-13C8		EI+	385.7>315.8	315.8>245.8	25|30
Isodrin-13C12		EI+	199.9>130.1	269.8>200.2	30|30
Oxychlordane-13C10		EI+	154>125	190>154	5|5
Heptachlorepox13C10		EI+	362.8>270	362.8>291.8	15|15
Endrin-13C12		EI+	269.8>200	289.9>254	35|10
4,4’-DDD-d4		EI+	243>173.1	243>208	25|10
4,4’-DDT-d4		EI+	243>173.1	243>208	25|10
Methoxychlor-d14		EI+	241.2>149.2	241.2>177	30|20
Endrin ketone-13C12		EI+	327.9>291.8	327.9>255	10|20
Mirex-13C10		EI+	276.8>241.8	279>244	15|20
alpha-BHC		EI+	218.9>182.9	183>147	10|20
Gamma-BHC		EI+	218.9>182.9	183>147	10|20
Beta-BHC		EI+	218.9>182.9	183>147	10|20
Delta-BHC		EI+	218.9>182.9	183>147	10|20
Hexachlorobenzene		EI+	283.8>248.8	248.8>213.9	20|20
Heptachlor		EI+	271.8>236.8	269.8>234.8	15|15
Chlorpyrifos		EI+	314>257.8	196.9>168.9	15|20
Aldrin		EI+	262.9>192.9	293>222	30|20
Octachlorostyrene		EI+	379.7>309.4	307.8>237.8	25|30
Isodrin		EI+	192.9>123	262.9>192.8	30|30
Oxychlordane		EI+	149>121	185>149	5|5
Heptachlor epoxide		EI+	352.8>262.8	352.8>281.8	15|15
2,4’-DDE		EI+	246>176	317.9>248	30|18
Gamma-Chlordane		EI+	373>265.8	373>300.8	20|10
Alpha-Chlordane		EI+	373>265.8	373>300.8	20|10
Trans-Nonachlor		EI+	408.8>299.8	410.9>301.9	20|20
EndosulfanI		EI+	195>159	241>170	6|20
4,4’-DDE		EI+	246>176	317.9>248	30|18
2,4’-DDD		EI+	235>165	235>199	25|10
Dieldrin		EI+	262.8>192.9	279>243	35|10
Endrin		EI+	262.8>192.9	279>243	35|10

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Table 7 Target Compound Transitions and Collision Energy (continued)

Compounds		Ionization Mode	Quan Transition Trace	Qual Transition Trace	Collision energy (v)
2,4'-DDT		EI+	235>165	235>199	25|10
Cis-Nonachlor		EI+	408.8>299.8	410.9>301.9	20|20
4,4'-DDD		EI+	235>165	235>199	25|10
EndosulfanII		EI+	195>159	241>206	6|10
Endrin aldehyde		EI+	344.8>280.7	344.8>244.9	10|20
4,4'-DDT		EI+	235>165	235>199	25|10
Endosulfan sulfate		EI+	271.8>236.7	386.8>288.8	15|8
Methoxychlor		EI+	227>141	227>169.1	30|20
Endrin ketone		EI+	316.9>280.8	316.9>244.9	10|20
Mirex		EI+	271.8>236.8	269.8>234.8	15|15

Table 8: DFTPP Transitions, Collision Energy, Acceptance Criteria

Transitions	Range	Ionization Mode	Transition		Collision energy (v)
DFTPP1	1.000 (base)	EI+	442>198		14
DFTPP2	4.557-11.374	EI+	443>198		14
DFTPP3	1.380-3.834	EI+	198>110		14
DFTPP4	1.545-5.505	EI+	255>186		14
DFTPP5	10.211-34.819	EI+	127>77		20

Note: Relative abundance defined as: abundance (DFTPP1)/abundance (DFTPPX). Criteria developed by CAS

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STANDARD OPERATING PROCEDURE

SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS –LOW LEVEL PROCEDURE

SVM-8270L
Revision 8

Effective date: June 11, 2012

Approved By:	Supervisor	5/15/12 Date
	QA Manager	5/16/12 Date
	Laboratory Manager	5/16/12 Date

COLUMBIA ANALYTICAL SERVICES, INC.
1317 South 13th Avenue
Kelso, Washington 98626

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SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS
LOW LEVEL PROCEDURE

1. SCOPE AND APPLICATION

1.1. This procedure is used to determine low level concentrations of Semi-Volatile Organic Compounds in water and soil using EPA Method 8270D. This procedure may also be applicable to various miscellaneous waste samples. Table 6 indicates compounds that may be determined by this method and lists their method reporting limits (MRLs) in water and soil. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL). The reported MRL may be adjusted if required for specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. Table 6 lists Method Detection Limits (MDLs) that have been achieved, however, MDLs may change as MDL studies are performed, and will vary depending on the instrument used and preparation method.

1.2. This procedure can be used to quantitate most neutral, acidic, and basic organic compounds that are soluble in methylene chloride and capable of being eluted without derivatization as sharp peaks from a gas chromatographic fused-silica capillary column coated with a slightly polar silicone phase. Such compounds include polynuclear aromatic hydrocarbons, chlorinated hydrocarbons and pesticides, phthalate esters, organophosphate esters, nitrosamines, haloethers, aldehydes, ethers, ketones, anilines, pyridines, quinolines, aromatic nitro compounds, and phenols, including nitrophenols. Other compounds than those listed in Tables 4 and 6 may be analyzed. Refer to Section 1 of method 8270D.

2. METHOD SUMMARY

2.1. This method provides Gas Chromatography/Mass Spectrometry (GC/MS) conditions for the detection of Semi-volatile Organic Compounds. Prior to the use of this method, an appropriate sample preparation method must be used to recover the analytes of interest. A 20 µL aliquot of the extract is injected into the gas chromatograph (GC) using a large volume injector. The compounds are separated on a fused silica capillary column. Compounds of interest are detected by a mass selective detector. Identification of the analytes of interest is performed by comparing the retention times of the analytes with the respective retention times of an authentic standard, and by comparing mass spectra of analytes with mass spectra of reference materials. Quantitative analysis is performed by using the authentic standard to produce a response factor and calibration curve, and using the calibration data to determine the concentration of an analyte in the extract. The concentration in the sample is calculated using the sample weight or volume and the extract volume.

2.2. The following compounds may require special treatment when being determined by this method. Hexachlorocyclopentadiene is subject to decomposition in the injection port of the gas chromatograph, to a chemical reaction in acetone, and can undergo photochemical

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decomposition. N-nitroso-dimethylamine is difficult to separate from the solvent under the chromatographic conditions described. N-nitroso-diphenylamine decomposes in the gas chromatographic inlet and cannot be separated from diphenylamine. Benzoic acid, pentachlorophenol, 2,4-dinitrophenol, 2-nitroaniline, 3-nitroaniline, 4-chloroaniline, and benzyl alcohol are subject to erratic chromatographic behavior, especially if the GC system is contaminated with high boiling material.

3. DEFINITIONS

3.1. **Analysis Sequence** - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with injection of Decafluorotriphenylphosphine (DFTPP) followed by initial calibration standard(s). Once calibrated, a CCV is evaluated and extracts can be run. The sequence ends after 12 hours based on the DFTPP injection time.

3.2. **Matrix Spike/Duplicate Matrix Spike Analysis** - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample extraction and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the methods used for the analyses. Samples are split into duplicates, then spiked and analyzed. Percent recoveries are calculated for each of the analytes detected. The relative percent difference between the samples is calculated and used to assess analytical precision.

3.3. **Standard Curve** - A standard curve is a calibration curve which plots concentrations of a known analyte standard versus the instrument response to the analyte.

3.4. **Surrogate** - Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to evaluate the preparation and analysis of samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate.

3.5. **Method Blank** - The method blank is an artificial sample designed to monitor introduction of artifacts into the process. The method blank is carried through the entire analytical procedure.

3.6. **Continuing Calibration Verification Standard (CCV)** - A mid-level standard injected into the instrument at specified intervals and is used to verify the validity of the initial calibration.

3.7. **Independent Calibration Verification Standard (ICV)** - A mid-level standard injected into the instrument after the calibration curve from a different source than the standards in the curve and is used to verify the validity of the initial calibration.

3.8. **Instrument Blank (CCB)** - The instrument blank (also called continuing calibration blank) is a volume of clean solvent analyzed on each column and instrument used for sample analysis.

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The purpose of the instrument blank is to determine the levels of contamination associated with the instrumental analysis itself, particularly with regard to the carry-over of analytes from standards or highly contaminated samples into subsequent sample analyses.

3.9. **Laboratory Control Samples (LCS)** – The LCS is an aliquot of analyte free water or analyte free solid to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control.

4. INTERFERENCES

4.1. Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Determine if the source of interference is in the preparation of the samples. Corrective action should be taken to eliminate the interferences.

4.2. Accurate determination of phthalate esters can pose difficulties when using this methodology. Common flexible plastics contain varying amounts of phthalates. These phthalates are easily extracted or leached from such materials during laboratory operations. Cross contamination of clean glassware may occur when plastics are handled during extraction steps, especially when solvent-wetted surfaces are handled. Interferences from phthalates can best be minimized by avoiding contact with any plastic materials. Exhaustive cleanup of reagents and glassware may be required to eliminate background phthalate contamination.

4.3. Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed out between samples with solvent. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of a solvent blank to check for cross contamination.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the CAS safety policies, approved methods and in MSDSs where available. Refer to the CAS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.3. This method uses Methylene Chloride, a known human carcinogen. Viton brand gloves should be used while rinsing, pouring or transferring the solvent

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

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6.1. Containers used to collect samples for the determination of semivolatile organic compounds should be soap and water washed followed by methanol (or isopropanol) rinsing. The sample containers should be of glass or teflon and have screw-top covers with teflon liners. In situations where teflon is not available, solvent-rinsed aluminum foil may be used as a liner. Highly acidic or basic samples may react with the aluminum foil, causing eventual contamination of the sample. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic.

Sample containers should be filled with care so as to prevent any portion of the collected sample coming in contact with the sampler's gloves, thus causing contamination. Samples should not be collected or stored in the presence of exhaust fumes. If the sample comes in contact with the sampler (e.g., if an automatic sampler is used), run reagent water through the sampler and use the rinsate as a field blank.

6.2. Water and soil samples must be iced or refrigerated at 4 ± 2 C from time of collection until extraction.

6.3. Water samples must be extracted within 7 days and the extracts analyzed within 40 days following extraction. Soil samples must be extracted within 14 days and the extract analyzed within 40 days following extraction. Extracts are stored at <-10°C.

7. APPARATUS AND MATERIALS

7.1. Gas Chromatograph/Mass Spectrometer System

7.1.1. Gas Chromatograph – HP 5890 or Agilent 6890 -An analytical system complete with a temperature-programmable gas chromatograph suitable for large volume injection with cryogenic cooling.

7.1.1.1. Atas Optic 2 or 3 large volume injector units – This allows for injection of up to 100uL of solvent for each analysis. After injection into the cold injector, the solvent is vented while the analytes are retained within a specially packed liner. The injector is then flash heated and the analytes are transferred into the GC. The unit also controls gas flow rates.

7.1.1.2. Autosampler – HP 7673 or Agilent 7683, or equivalent with programmable operation.

7.1.1.3. All other required accessories, syringes, analytical columns, and gases. The capillary column should be directly coupled to the source.

7.1.2. Column: ZB-5MS, 30m x 0.25mm ID x 0.25µm film thickness silicone-coated fused-silica capillary column with 5m guard column (or equivalent). Recommended part number 7HG-6010-11-GGA.

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7.1.3. Mass Spectrometer – HP 5972 or Agilent 5973 - Capable of scanning from 35 to 500 amu every 1 second or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass spectrometer must be capable of producing a mass spectrum for decafluorotriphenylphosphine (DFTPP) which meets all of the criteria in Table 1 when 20 µL of the GC/MS tuning standard is injected through the GC (50 ng of DFTPP).

7.1.4. GC/MS Interface - Any GC-to-MS interface that gives acceptable calibration points at 50 ng per injection for each compound of interest and achieves acceptable tuning performance criteria may be used.

7.1.5. Data System - A computer system must be interfaced to the mass spectrometer. The system must allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between specified time or scan-number limits. NIST98 Mass Spectral Library is used for spectral comparisons.

7.2. Appropriate analytical balance (0.0001 g), volumetric flasks, syringes, vials, and bottles for standards preparation.

8. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1. Solvents: Acetone, methylene chloride, methanol, and other appropriate solvents. Solvents must be of sufficient purity to permit usage without lessening the accuracy of the determination or introducing interferences.

8.2. Stock Standard Solutions (See Table 2)

8.2.1. Commercially prepared stock standards are typically used when available at a concentration of 1000 ug/ml or more. They must be obtained from a A2LA or ISO9000 certified vendor. Standard concentrations can be verified by comparison versus an independently prepared standard. Alternatively, prepare stock standard solutions at a concentration of 1000 µg/ml by dissolving 0.0100 g of reference material in methylene chloride or other suitable solvent and diluting to volume in a 10mL volumetric flask. Larger volumes can be used at the convenience of the analyst. When compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. Store according to vendors recommendations.

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8.2.2. Transfer the stock standard solutions into Teflon-sealed screw-cap bottles. Store at <-10°C and protect from light. Stock standards should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.

8.2.3. Stock standard solutions must be replaced after one year, or sooner, if comparison with check standards or samples indicates a problem.

8.3. Internal Standard Solutions (See Table 4) - The internal standards are 1,4-dichlorobenzene-d_4, naphthalene-d_8, acenaphthene-d_{10}, phenanthrene-d_{10}, chrysene-d_{12}, and perylene-d_{12} (See Table 4 for corresponding compounds). The nominal concentration of the standard is 100 ng/µL. Each 1 ml of sample extract undergoing analysis should be spiked with 10 µL of the internal standard solution, resulting in a concentration of 1.0 ng/µL of each internal standard. Store at -10°C or less when not being used. When using premixed certified solutions, store according to the vendors recommendations.

8.4. GC/MS Tuning Standard - A methylene chloride solution containing 2.5 ng/µL of decafluorotriphenylphosphine (DFTPP). The standard should also contain 2.5ng/µL of benzidine, DDT, and pentachlorophenol, to verify injection port inertness and GC column performance. Store at -10°C or less when not being used, or store according to the manufacturer's recommendations.

8.5. Calibration Standards (See Table 2)

8.5.1. A minimum of five initial calibration standards should be prepared from stock solutions. One of the calibration standards should be at a concentration at or below the method reporting limit; the others should correspond to the range of concentrations found in real samples, but should not exceed the working range of the GC/MS system. At least one calibration standard must be at a concentration corresponding to a sample concentration meeting project-specific data quality objectives. Each standard should contain each analyte for detection by this method. Each 1 ml aliquot of calibration standards should be spiked with 10 µL of the internal standard solution prior to analysis. All calibration standards should be stored at -10°C or less and should be freshly prepared once a year, or sooner if check standards indicate a problem.

8.5.2. The daily calibration standard (CCV) is prepared from stock solutions at a concentration at the midpoint of the calibration curve (typically 2-4 ng/µL). The CCV is prepared weekly and can be stored at 4 ± 2°C, or as recommended by the manufacturer. The DFTPP standard may be combined with this standard (maintaining 2.5 ng/µL concentration) providing tuning verification and calibration verification can be done without interferences.

8.6. QC Standards (See Table 3)

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8.6.1. Surrogates: Prepare a working solution in methanol containing 2-fluorophenol, phenol-d6, and 2,4,6-tribromophenol at 150 ng/µL and nitrobenzene-d5, 2-fluorobiphenyl, and terphenyl-d14 at 100 ng/µL. Aliquots of the solution are spiked into all extracted samples, blanks, and QC samples according to the extraction SOP used.

8.6.2. Matrix Spike Standards: Prepare a working solution in methanol containing all analytes of interest ("full list spike") at 100 ng/µL. Aliquots of the solution are spiked into the selected QC aliquots according to the extraction SOP used.

Note: The spiking level of surrogate and spike may need to be adjusted according to project requirements, if dilutions are expected due to high levels of extracted components, or if a lower calibration range is used.

9. PREVENTIVE MAINTENANCE

9.1. All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described in section 9. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.

9.2. Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.

9.3. Gas Chromatograph

9.3.1. Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance may include swabbing out the port, changing the injection port liner, seal, washer, o-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used.

9.3.2. Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column cutting tool. The column headpressure must be adjusted to maintain proper flow rates.

9.3.3. Over time, the column will exhibit poorer overall performance, as indicated by poor peak shape and reduced responses. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in performance is evident, more thorough maintenance is necessary. Some steps are to solvent rinse the split

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vent and septum lines with a mix of 20% methanol in DCM. When these and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

9.4. Mass Spectrometer

9.4.1. Tune the MS as needed to result in consistent and acceptable performance while meeting the required ion abundance criteria given in section 11.

9.4.2. For units under service contract, certain maintenance is performed by instrument service staff, including pump oil changed, vacuuming boards, etc., as recommended by the manufacturer.

9.4.3. MS source cleaning should be performed as needed, depending on the performance of the unit. This may be done by the analyst or by instrument service staff.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency, as described in 8270D is also the responsibility of the department supervisor/manager.

11. PROCEDURE

11.1. Sample Preparation

11.1.1. Water samples

11.1.1.1. Water samples are prepared using continuous liquid-liquid extraction and EPA method 3520C. Refer to the CAS SOP EXT-3520. In some circumstances, such as rush samples, samples may be prepared using separatory funnel procedures (EPA 3510C). Refer to the CAS SOP EXT-3510.

11.1.1.2. Perform the extraction on a 1000mL aliquot of sample.

11.1.2. Soil, sediment, and solid samples are prepared using automated soxhlet extraction CAS SOP EXT-3541). The nominal sample size is 20g. Sample amounts may be

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decreased in the case of high-concentration waste samples. GPC cleanup is required (SOP SOC-3640A).

11.1.3. Extracts should be screened by GC/FID (SOP SOC-SCR).

11.1.4. Following sample preparation, sample extracts are then transferred to the extract cold storage unit. Extracts must be analyzed within 40 days of extraction.

11.2. The recommended GC/MS operating conditions are listed below. The GC conditions may be modified to accommodate specific instrument models and configurations.

Mass range:	35-500 amu
Scan Time:	1 sec/scan
Initial temperature:	45°C, hold for 3.5 minutes
Temperature program:	45-100°C at 15°C/min, 100-270°C at 10°C/min, 270-320°C at 6°C/min, hold until 3 minutes after benzo[g,h,i]perylene has eluted.
Detector interface temp:	300°C
Injector:	Atas Optic 2, or Optic 3 or equivalent

Final time: 32.7 min.
Initialization time: 0.00 min.
Temperature profile:

Initial temperature 5°C

Ramp	Rate	Final Temp	Isothermal time
1	-	5°C	2.20 min.
2	6°C/sec	305°C	30.5 min.

Pressure ramps:

Ramp	Start Press.	Step time	Target press.
1	5.00 psi	0.7 min.	5.00 psi
2	10.00 psi	3.30 min.	10.00 psi
3*	* psi	19 min.	* psi
4*	* psi	8.0	* psi

* Will vary to give 1.0 ml/min. @ 45°C and the target pressure is set to give 1.5 ml/min @ 320°C.

Split state:

Time	Split state
Initial	Vent
0.75 min.	Closed/splitless*
1.90 min.	Open/split

* Splitless time may be adjusted to optimize GC performance.
Vent flow: 85ml/min. @ 5 psi, 5°C

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Split flow:	2-5ml/min. @ 45°C and 10 psi
Sample volume:	20 µL
Carrier gas:	helium at 30-45 cm/sec

11.3. Initial Calibration

NOTE: The calibration procedure(s) and options chosen must follow the CAS protocols. Any exceptions to the calibration procedures detailed in the CAS SOP for *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL) are described as follows:

11.3.1. Prior to calibration, analyze the GC/MS tuning standard using instrument conditions used for calibration. Obtain the spectrum for evaluation using one of the following options:

- Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the DFTPP peak or part of any other closely eluting peak.

- Use one scan at the apex of the peak. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the DFTPP peak or part of any other closely eluting peak.

- Use one scan either directly preceding or following the apex of the peak. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the DFTPP peak or part of any other closely eluting peak.

- Use the average across the entire peak up to a total of 5 scans. If the peak is wider than 5 scans, the tune will consist of the peak apex scan and the two scans immediately preceding and following the apex. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed

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or instrument background ions. Do not subtract part of the DFTPP peak or part of any other closely eluting peak.

11.3.2. Evaluate the spectrum obtained for DFTPP against the tuning criteria. Criteria are given in Tables 1and 1A. The GC/MS must meet the DFTPP ion abundance criteria prior to further analyses. To assess column performance and injection port inertness, pentachlorophenol should be present at an acceptable level and peak tailing should not be excessive. DDT degradation should not exceed 20%. If excessive tailing, poor chromatography, or degradation of >20% is noted, the injection port may require cleaning. It may also be necessary to remove the first 15-30 cm of the GC column. If hardware tuning criteria can not be met, the source may need cleaning, filaments replaced or other maintenance.

11.3.3. The internal standards should permit most of the components of interest in the chromatogram to have retention times of 0.80-1.20 relative to one of the internal standards. Refer to Table 4 for internal standards and corresponding analytes assigned for quantitation. Use the base peak ion from the specific internal standard as the primary ion for quantitation (see Table 1 in EPA method 8270D). If interferences are noted, use the next most intense ion as the quantitation ion (i.e. for 1,4-dichlorobenzene-d_4, use 152 m/z for quantitation).

11.3.4. Analyze 20 µL of each calibration standard (containing internal standards) and tabulate the area of the primary characteristic ion against concentration for each compound (see Table 1 in EPA method 8270D). Calculate response factors (RFs) for each compound relative to one of the internal standards as follows:

$$RF = (A_x C_{is})/(A_{is} C_x)$$

where:
A_x = Area of the characteristic ion for compound being measured.
A_{is} = Area of the characteristic ion for specific internal standard.
C_{is} = Concentration of the specific internal standard (ng/µL).
C_x = Concentration of the compound being measured (ng/µL).

11.3.5. The percent relative standard deviation (%RSD) should be less than or equal to 20% for each compound. It is also recommended that a minimum response factor for the most common target analytes, as noted in Table 5, be demonstrated as a means to ensure that these compounds are performing as expected.

$$\%RSD = \frac{SD}{RF} \times 100$$

where:
RSD = relative standard deviation.

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$\overline{RF}$ = mean of initial RFs for a compound.
SD = standard deviation of average RFs for a compound.

$$SD = \sqrt{\sum_{i=1}^{N} \frac{(RF_i - \overline{RF})^2}{N - 1}}$$

where:
RF_i = RF for each of the calibration levels
N = Number of RF values (e.g., 6)

11.3.6. The relative retention times (RRT) of each compound in each calibration run should agree within 0.06 relative retention time units.

$$RRT = \frac{\text{Retention time of the analyte}}{\text{Retention time of the internal standard}}$$

11.3.7. Linearity - If the % RSD of any compound is 20% or less, then the relative response factor is assumed to be constant over the calibration range, and the average relative response factor may be used for quantitation.

11.3.8. If the %RSD for a compound is >20%, then alternative calibration models should be used. Refer to the SOP for *Calibration of Instruments for Organics Chromatographic Analysis* (SOC-CAL) for alternative fit guidance.

11.3.9. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too reactive for analysis to begin. Clean or replace the injector liner and/or capillary column, then repeat the calibration procedure.

11.3.10. When calculating the calibration curves using the alternative curve fits, a minimum quantitation check on the viability of the lowest calibration point should be performed by re-fitting the response from the low concentration calibration standard back into the curve (see Method 8000C for additional details). It is not necessary to re-analyze a low concentration standard; rather the data system can recalculate the concentrations as if it were an unknown sample. The recalculated concentration of the low calibration point should be within ± 30% of the standard's true concentration.

11.4. Independent Calibration Verification

11.4.1. Following initial calibration, analyze an ICV standard. The ICV solution must contain all analytes in the calibration standards at a concentration in the middle of

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the range of the initial calibration. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. The maximum allowed % Difference or % Drift is ±30%.

11.4.2. If a second source standard is not available or is cost prohibitive (such as certain non-routine analytes), then an independently prepared solution (prepared by analyst other than analyst preparing initial calibration standards) may be used as the ICV and must meet the criteria above.

11.4.3. After the multi-point calibration has passed all of the above criteria, and the Independent Calibration Verification has been performed, samples can be analyzed. The calibration curve mid-point standard may serve as the CCV for the opening set of samples within the same 12-hour window as the initial calibration.

11.5. Continuing Calibration

11.5.1. A calibration standard, or standards, at mid-concentration (See Table 2) containing all semivolatile analytes, DFTPP, and all required surrogates, must be analyzed every 12 hours during analysis. The DFTPP must result in a mass spectrum which meets the criteria given in Tables1 or 1A. These criteria must be demonstrated during each 12 hour shift. Obtain the DFTPP spectrum as described in section 11.3.1.

11.5.2. The internal standard responses and retention times in the calibration check standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as required. If the EICP area for any of the internal standards changes by a factor of two (50% to 200%) from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as appropriate. When corrective action is taken, reanalysis of samples analyzed while the system was malfunctioning is required. Update the reference spectra and retention times in the quantitation database for the instrument method or ID file. The initial calibration average RF or calibration curve is then used in the quantitation of subsequent analyses.

11.5.3. If the percent difference or percent drift for each compound is less than or equal to 20%, the initial calibration is assumed to be valid and the analysis of samples may begin.

Calculate the percent drift using:

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$$\% \, Drift = \frac{C_1 - C_c}{C_1} \times 100$$

where:

C_1 = Compound standard concentration.
C_c = Measured concentration using selected quantitation method.

11.5.4. If the percent difference or percent drift for a compound is less than or equal to 20%, then the initial calibration for that compound is assumed to be valid. Due to the large number of compounds that may be analyzed by this method, some compounds may fail to meet the ≤ 20% criteria. If no more than 20% of the compounds, included in the initial calibration, differ from their true concentration by 40%, the initial calibration is valid and no corrective action is necessary.

11.5.5. In cases where compounds fail, they may still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compound at the applicable quantitation limit.

11.5.6. Non-detected analytes can be reported from analyses when a CCV exhibit a positive bias (i.e., outside the upper control limit), no further documentation is required.

11.5.7. For situations when the CCV fails to meet the criterion in section 11.5.4, and a confirmed detection exceeds the MRL, the sample must be reanalyzed to ensure accurate quantification. If it is not possible to reanalyze the sample, the result must be reported as an estimated value.

11.5.8. A blank (method blank, GPC blank, or solvent blank) should be analyzed after the CCV, or at any other time during the analytical shift, to prove the system is free of contaminants. If contaminants are found in a method blank or GPC blank, then a solvent blank should be analyzed to help isolate the source of contamination.

11.5.9. Each of the most common target analytes in the calibration verification standard should meet the minimum response factors noted in Table 5.

11.5.10. If the minimum response factors are not met, the system should be evaluated, and corrective action should be taken before sample analysis begins. Possible problems include standard mixture degradation, injection port inlet contamination, contamination of the front end of the analytical column, and active sites in the column or chromatographic system.

11.6. GC/MS Analysis

11.6.1. Evaluate FID screen and make proper dilution (See FID screening SOP).

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11.6.2. Spike the 1 ml extract obtained from sample preparation with 10 µL of the internal standard solution just prior to analysis. Use the same operating conditions as were used for initial calibration.

11.6.3. If the response for any quantitation ion exceeds the initial calibration curve range of the GC/MS system, extract dilution must take place. Additional internal standard must be added to the diluted extract to maintain the required 1.0ng/µL of each internal standard in the extracted volume. The diluted extract must be reanalyzed.

11.6.4. Store the extracts at -10°C or less, protected from light in vials equipped with unpierced Teflon lined septa. Archive the extract in freezer for 3 months after analysis in the instrument/date specific storage boxes.

12. QA/QC REQUIREMENTS

12.1. In addition to instrument criteria for calibration, the ability of each analyst/instrument to generate acceptable accuracy and precision must be documented prior to sample analysis (IPR study). This must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four tap water samples are spiked with each target analyte, extracted, and analyzed.

12.2. Method Detection Limits

12.2.1. A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank replicates with a MDL spiking solution (at a level below the MRL) for each target analyte, extract, and analyze. The MDL studies should be done for each matrix, prep method, and instrument. Refer to the CAS SOP *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (ADM-MDL)*

12.2.2. Calculate the average concentration found (x) in the *sample concentration*, and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates. The MDL study must be verified annually.

12.3. Limits of Quantification (LOQ)

12.3.1. The laboratory establishes a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the

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method. The LOQ recoveries should be within the laboratories LCS acceptance limits to verify the data reporting limit. Refer to the CAS SOP *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (ADM-MDL)*

12.4. The Method Reporting Limits (MRLs) used at CAS are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which CAS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.

12.5. Ongoing QC Samples required are described in the CAS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). General QA requirements for DoD QSM are defined in the laboratory SOP, Department *of Defense Projects – Laboratory Practices and Project Management (ADM-DOD).* General QC Samples are:

12.5.1. Method blank - A method blank is extracted and analyzed with every batch of 20 or fewer samples to demonstrate that there are no method interferences. The method blank must demonstrate that interferences from the analytical and preparation steps are minimized. No target analytes should be detected above the MRL in the method blank. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants (phthalate esters, etc.).

12.5.2. A lab control sample (LCS) must be extracted and analyzed with every batch of 20 or fewer samples. The LCS is prepared by spiking a blank with the matrix spike solution, and going through the entire extraction and analysis. Calculate percent recovery (%R) as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered
TV = True value of amount spiked

Acceptance criteria for lab control samples are listed in Table 6. The accuracy of the analysis is controlled on a subset of target analytes. If the project analyte list is fewer than 20 analytes, all are considered control analytes. Analytes which are used for control analytes are listed in Table 7. For DoD projects all project target analytes are considered control analytes. If the LCS recovery for any control analyte fails acceptance limits, corrective action is required. If instrument corrective action is not applicable or ineffective, re-extraction of the associated samples is required. If any other analyte fails the advisory acceptance limits, the analyst must evaluate the impact on data quality and take any necessary corrective action, which may include re-extraction of the associated samples. Project-specific

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requirements may require all compounds to be treated as control analytes, or dictate use of project acceptance criteria.

12.5.3. A matrix spike/duplicate matrix spike (MS/DMS) must be extracted and analyzed with every batch of 20 or fewer samples. The MS is prepared by spiking a sample aliquot with the matrix spike solution, and going through the entire extraction and analysis. Calculate percent recovery (%R) as follows:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where X = Concentration of the analyte recovered
X1 = Concentration of unspiked analyte
TV = True value of amount spiked

Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{R1 - R2}{(R1 + R2)/2} \times 100$$

Where R1 = recovered concentration in the MS
R2 = recovered concentration in the DMS

The acceptance limits for the MS/DMS recovery are given in Table 6. If the MS/DMS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken. (See Quality Assurance Manual section 11) The RPD acceptance limits are 30% for water and 40% for soils, sediments, and solids. Project-specific requirements may dictate the use of project acceptance criteria.

12.5.4. The acceptance limits for the surrogates are given in Table 6. If any surrogate recovery is outside acceptance criteria, the sample data must be closely evaluated for possible matrix interferences. If none are present, then corrective action must be taken. The sample should be re-analyzed if instrument factors (calibration, injection port) are suspected. If not, re-extraction and re-analysis is required, except in cases of high recovery and no positive hits in the sample for the analyte class represented by the particular surrogate.

12.5.5. The acceptance criteria listed in Table 6 are current criteria, but are subject to change as control limits are updated.

12.5.6. Additional QA/QC measures include control charting of QC sample results.

13. DATA REDUCTION, REVIEW, AND REPORTING

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13.1. Qualitative Analysis - The qualitative identification of compounds determined by this procedure is based on retention time, and comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the instrument and conditions used for the sample analysis. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity, if less than three such ions occur in the reference spectrum. Compounds should be identified as present when the criteria below are met.

13.1.1. The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

13.1.2. The RRT of the sample component is within ± 0.06 RRT units of the RRT of the standard component.

13.1.3. The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum.

13.1.4. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is <25% of the sum of the 2 peak heights. Otherwise, structural isomers are identified as isomeric pairs.

13.1.5. Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks appear to represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important. Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification. When analytes coelute, the identification criteria can be met, but each analyte spectrum will contain extraneous ions contributed by the coeluting compound.

13.2. For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. Refer to method 8270D for guidance on tentatively identified compound (TIC) identification and quantification.

13.3. Quantitation and Calculations

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13.3.1. The GC/MS data stations, in current use, all use the H-P RTE Integrator to generate the raw data used to calculate the standards $\overline{RF_x}$ values, the sample amounts, and the spike values. The software does three passes through each data file. The first two identify and integrate each internal standard and surrogate. The third pass uses the time-drift information from the first two passes to search for all method analytes in the proper retention times and with the proper characteristic quantitation ions.

When $\overline{RF_x}$ is used, calculate the extract concentration as follows:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF_x})}$$

Where: C_{ex} = the concentration in the sample extract (ppb);
$Resp_x$ = the peak area of the analytes of interest;
$Resp_{ISTD}$ = the peak area of the associated internal standard;
Amt_{ISTD} = the amount, in ppb, of internal standard added
$\overline{RF_x}$ = the average response from the initial calibration.

13.3.2. The concentration of analytes in the original sample is computed using the following equations:

Aqueous Samples: $$Concentration\ (\mu g / L) = \frac{(Cex)\ (Vf)\ (D)}{(Vs)}$$

Where	Cex	=	Concentration in extract in ng/mL
	Vf	=	Final volume of extract in mL
	D	=	Dilution factor
	Vs	=	Volume of sample extracted, liters

Nonaqueous Samples: $$Concentration\ (ug/Kg) = \frac{(Cex)(Vf)(D)}{(W)}$$

Where	Cex	=	Concentration in extract in ng/mL
	Vf	=	Final volume of extract in mL
	D	=	Dilution factor
	W	=	Weight of sample extracted in grams.

13.4. Data Review and Assessment

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13.4.1. Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative

13.5. Reporting

13.5.1. Refer to the SOP for *Data Reporting and Report Generation* for reporting guidelines.

13.5.2. Reports are generated in the CAS LIMS by compiling the SMO login, sample prep database, instrument, date, and client-specified report requirements (when specified). This compilation is then transferred to a file which the Stealth reporting system uses to generate a report. The forms generated may be CAS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

14. CONTINGENCIES FOR HANDLING OUT-OF- CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Corrective Action (ADM-CA)* for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc)
- Sample preservation or handling discrepancies due to laboratory or operations error

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15. METHOD PERFORMANCE

15.1. This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

15.2. The method detection limit (MDL) is established using the procedure described in the SOP for *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (ADM-MDL).* Method Reporting Limits are established for this method based on MDL studies and as specified in the CAS Quality Assurance Manual.

16. POLLUTION PREVENTION

It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible, and within method requirements. Standards are prepared in volumes consistent with laboratory use in order to minimize the volume of expired standards to be disposed of. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

17. WASTE MANAGEMENT

17.1. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the CAS EH&S Manual.

17.2. This method uses Methylene Chloride and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and recycled off site.

18. TRAINING OUTLINE

18.1. Training outline – Training Plan

18.1.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

18.1.2. The next training step is to assist in the procedure under the guidance of an experienced analyst for a period of 2-3 months. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

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18.1.3. Perform an Initial Demonstration of Capability (IDOC) as described in section 12.1. Summaries of the IDOC are reviewed and signed by the departments Technical Services Manager. Copies of the IDOC and Training Plan are forwarded to QA for record keeping. For applicable tests, IPR studies are performed in order to be equivalent to NELAC's Initial Demonstration of Capability.

18.2. Training is documented following the SOP *for Documentation of Training*.

18.2.1. When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

19. METHOD MODIFICATIONS

19.1. 11.5.4 No limit defined in reference method, so lab assigned a limit of 40% based on CLP protocols.

19.2. Lower reporting levels are achieved in this procedure through injection of larger volumes and a lower calibration range. Lower limits of quantitation for soils are > 10 ug/Kg for soils and > 0.2 ug/L for waters.

19.3. Minimum Response factors listed in Table 5 were determined from representative initial calibrations performed after system maintenance. Recommended minimum response factors listed in Table 4 of EPA 8270D are not applicable due the differences in quantitation levels from the reference method.

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20. REFERENCES

Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method 8270D, EPA Test Methods for Evaluating Solid Waste, SW-846, Final Update IV, February 2007

Determinative Chromatographic Separations, Method 8000C, EPA Test Methods for Evaluating Solid Waste, SW-846, On-Line March 2003.

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21. CHANGES SINCE THE LAST REVISION

21.1. Replaced 8270C with 8270D in sections 10.2 & 13.2
21.2. Sec 11.5.4 from previous revision removed because redundant
21.3. Sec 12.5.2 – updated to describe use of LCS batch control and added Table 7
21.4. Sec 14.2.2 – revised to reflect lab requirements

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TABLE 1
DFTPP KEY IONS AND ION ABUNDANCE CRITERIA

Method 8270D Ion Abundance Criteria		**CLP OLM04.2 Ion Abundance Criteria**	
Mass	Ion Abundance Criteria	Mass	Ion Abundance Criteria
51	30-60% of mass 198	51	30-80% of mass 198
68	< 2% of mass 69	68	<2% of mass 69
70	< 2% of mass 69	69	Present
127	40-60% of mass 198	70	<2% of mass 69
197	< 1% of mass 198	127	25-75% of mass 198
198	Base peak,100% relative abundance	197	<1% of mass 198
199	5-9% of mass 198	198	Base peak,100% relative abundance
275	10-30% of mass 198	199	5-9% of mass 198
365	> 1% of mass 198	275	10-30% of mass 198
441	Present but less than mass 443	365	>0.75% of mass 198
442	> 40% of mass 198	441	Present, but less than mass 443
443	17-23% of mass 442	442	40-110% of mass 198
		443	15-24% of mass 442

TABLE 1A
DFTPP KEY IONS AND ION ABUNDANCE CRITERIA
FOR **5973** GC/MS SYSTEMS

Mass	Ion Abundance Criteria
51	10-80% of mass 198
68	0-2% of mass 69
70	0-2% of mass 69
127	10-80% of 198
197	0-2% of 198
198	30-100% of 442 (alternate base)
199	5-9% of 198
275	10-60% of 198
365	1-50% of 442
441	0.01-100% of 443
442	30-100% of 198 (alternate base)
443	15-24% of 442

Alternate tuning criteria (from Method 525.2 or CLP OLM04.2) may be used provided that method performance is not adversely affected and that method performance criterion is met. The criteria used must be the same for **all** ion abundance criteria checks associated with a given analysis. For example, initial calibration, continuing calibration(s), QC, and sample analyses for a given sample must all use the same criteria.

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TABLE 2
8270-LL STANDARDS

CALIBRATION

The calibration curve is prepared from the following Supelco stock standards (or equivalent from other vendors*):8270 CLP Mix, Equity 8270 Mix 4, Equity Benzidines Mix, Equity N-Nitrosodiphenylamine, 1-Methylnaphthalene, Acetophenone and 8270 Surrogates Mix.

The mix of standards to prepare the ICAL intermediate may be changed to meet project requirements.

Calibration curve is prepared from a 100 ppm intermediate solution and ranges from 50 – 10000ppb depending upon project requirements. Add internal standard when curve is prepared.

Place in amber autosampler vial, cap.

Store at -10°C. Expiration is 1 year from date prepared.

ICV

Recommended: AccuStandard catalog #(or equivalent from other vendors*):

CLP-HC-BN-R	2000 ppm BN mix
CLP-HC-A-PAK	2000 ppm Acid composite mix
Z-014E-R3	2000 ppm Composite 3 mix
M-8270-SS-PAK	4000 ppm Surrogates mix
Z-014J	4000 ppm Internal standards mix
M-625C	25000 ppm DFTPP
Z-014F	2000 ppm Benzidines mix

Add 10 µl internal standard for each 1 ml of ICV prepared.
Place in autosampler vial, analyze, recap, and refrigerate.
Expiration is one year after ICV was prepared or the expiration date from the manufacturer, which ever is earlier.

CCV & TUNE

Prepare 1 ml 8270_LL CCV standard that falls near the mid point of the calibration curve. DFTPP is added to the CCV to give a final concentration of 2.5ug/ml. The CCV is stored in an amber autosampler vial and is good for one week.

RECAP AND STORE IMMEDIATELY AFTER INJECTING

* Vendor must be A2LA and/or ISO9000 certified.

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TABLE 3
QC Standards

Surrogate Spiking Solution					
Parent	Initial Concentration	Aliquot	Final Volume	Final Concentration	Solvent
8-61377*	5000 ug/mL	20 mL	1000 mL **	100 ug/mL	Methanol
8-61376*	10000 ug/mL	15 mL	↓	150 ug/mL	↓
S-8522*	5000 ug/mL	20 mL	↓	100 ug/mL	↓
Expiration – Unopened = 6 months from prep date. Opened = 3 months from open or prep date, whichever is sooner. When opening, write the new expiration date on the bottle and in the standards logbook, initial, and date.					
* 8-61377 – Supelco BN Surrogate Standard (custom mix) – reorder 4 at a time					
* 8-61376 – Supelco Acids Surrogate Standard (custom mix) – reorder 3 at a time					
* S-8522 – Accustandard custom – reorder 4 at a time.					
** Split into 4 – 250 mL bottles.					
LCS/MS Spiking Solution*					
Parent	Initial Concentration (ppm)	Aliquot	Final Volume	Final Concentration	Solvent
50608	1000	10 ml	100 ml	100 ppm	MeOH
4-8467	2000	5			
46702-u	5000	2			
86-1148	2000	5			
79131	1000	10			
48462	2000	5			
App9186-20x	2000	5			
Expiration – Unopened = 6 months from prep date. Opened = 3 months from open or prep date, whichever is sooner. When opening, write the new expiration date on the bottle and in the standards logbook, initial, and date.					
*Split into 2 – 50 mL bottles.					

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TABLE 4
SEMIVOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES ASSIGNED FOR QUANTITATION

1,4-Dichlorobenzene-d4 Internal Standard		
N-Nitrosodimethylamine	2-Chlorophenol	N-Nitrosodi-n-propylamine
Aniline	Benzyl Alcohol	Hexachloroethane
2-Fluorophenol (surrogate)	Pyridine	2-Methylphenol
Bis(2-chloroethyl) Ether	1,2-Dichlorobenzene	3- and 4-Methylphenol(coeluting cpds)
Phenol-d5 (surrogate)	1,3-Dichlorobenzene	Bis(2-chloroisopropyl) Ether
Phenol	1,4-Dichlorobenzene	
Naphthalene-d8 Internal Standard		
Nitrobenzene-d5(surrogate)	Naphthalene	2,4-Dimethylphenol
Nitrobenzene	4-Chloroaniline	Benzoic Acid
Isophorone	Hexachlorobutadiene	2,4-Dichlorophenol
Bis(2-chloroethoxy)methane	2-Methylnaphthalene	4-Chloro-3-methylphenol
1,2,4-Trichlorobenzene	2-Nitrophenol	
Acenaphthene-d10 Internal Standard		
2-Fluorobiphenyl (surrogate)	Acenaphthylene	Fluorene
Hexachlorocyclopentadiene	Acenaphthene	4-Nitrophenol
2-Chloronaphthalene	Dibenzofuran	2,4,6-Trichlorophenol
2-Nitroaniline	2,4-Dinitrotoluene	2,4,5-Trichlorophenol
3-Nitroaniline	2,6-Dinitrotoluene	2,4-Dinitrophenol
4-Nitroaniline	Diethyl Phthalate	Azobenzene
Dimethyl Phthalate	4-Chlorophenyl Phenyl Ether	2,4,6-Tribromophenol (surrogate)

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Pnenanthrene-d10 Internal Standard		
N-Nitrosodiphenylamine	Anthracene	Pentachlorophenol
4-Bromophenyl Phenyl Ether	Di-n-butyl Phthalate	Carbazole
Hexachlorobenzene	Fluoranthene	
Phenanthrene	2-Methyl-4,6-dinitrophenol	

TABLE 4 continued

Chrysene-d12 Internal Standard		
Pyrene	Benz(a)anthracene	Terphenyl-d14 (surrogate)
Butylbenzyl Phthalate	Bis(2-ethylhexyl) Phthalate	
3,3'-Dichlorobenzidine	Chrysene	
Perylene-d12 Internal Standard		
Di-n-octyl Phthalate	Benzo(a)pyrene	Benzo(g,h,i)perylene
Benzo(b)fluoranthene	Indeno(1,2,3-c,d)pyrene	
Benzo(k)fluoranthene	Dibenz(a,h)anthracene	

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TABLE 5 – Recommended Minimum Response Factors

Compound	Minimum Response Factor (RF)
Benzaldehyde	0.010
Phenol	0.800
Bis(2-chloroethyl) Ether	0.700
2-Chlorophenol	0.800
2-Methylphenol	0.500
2,2'-Oxybis-(1-chloropropane)	0.010
Acetophenone	0.010
4-Methylphenol	0.600
N-Nitrosodi-n-propylamine	0.500
Hexachloroethane	0.300
Isophorone	0.300
Nitrobenzene	0.200
2-Nitrophenol	0.100
2,4-Dimethylphenol	0.100
Bis(2-chloroethoxy)methane	0.200
2,4-Dichlorophenol	0.100
Naphthalene	0.700
4-Chloroaniline	0.010
Hexachlorobutadiene	0.010
Caprolactam	0.010
2-Methylnaphthalene	0.300
Hexachlorocyclopentadiene	0.050
2,4,6-Trichlorophenol	0.200
2,4,5-Trichlorophenol	0.200
1,1'-Biphenyl	0.010
2-Chloronaphthalene	0.700
2,-Nitroaniline	0.010
Dimethyl Phthalate	0.010

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TABLE 5 (continued)

Compound	Minimum Response Factor (RF)
2,6-Dinitrotoluene	0.100
Acenaphthylene	0.900
3-Nitroaniline	0.010
Acenaphthene	0.700
2,4-Dinitrophenol	0.010
4-Nitrophenol	0.010
Dibenzofuran	0.800
2,4-Dinitrotoluene	0.200
Diethyl phthalate	0.010
1,2,4,5-Tetrachlorobenzene	0.010
4-Chlorophenyl-phenyl ether	0.400
Fluorene	0.800
4-Nitroaniline	0.010
4,6-Dinitro-2-methylphenol	0.010
4-Bromophenyl-phenyl ether	0.100
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Atrazine	0.010
Pentachlorophenol	0.050
Phenanthrene	0.600
Anthracene	0.600
Carbazole	0.010
Di-n-butyl phthalate	0.010
Fluoranthene	0.600
Pyrene	0.600
Butyl benzyl phthalate	0.010
3,3’-Dichlorobenzidine	0.010
Benzo(a)anthracene	0.600

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TABLE 5 (continued)

Compound	Minimum Response Factor (RF)
Chrysene	0.600
Bis-(2-ethylhexyl)phthalate	0.010
Di-n-octyl phthalate	0.010
Benzo(b)fluoranthene	0.600
Benzo(k)fluoranthene	0.600
Benzo(a)pyrene	0.600
Indeno(1,2,3-cd)pyrene	0.500
Dibenz(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500
2,3,4,6-Tetrachlorophenol	0.010

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CAS/KELSO DATA QUALITY OBJECTIVES – TABLE 6

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
8270 LL	1,2,4,5-Tetrachlorobenzene	95-94-3	Soil	2.1	10	5	10	ug/kg	70-130	70-130	40
8270 LL	1,2,4-Trichlorobenzene	120-82-1	Soil	2.6	10	5	10	ug/kg	27-94	23-99	40
8270 LL	1,2-Dichlorobenzene	95-50-1	Soil	2.4	10	5	10	ug/kg	27-91	11-91	40
8270 LL	1,3-Dichlorobenzene	541-73-1	Soil	2.3	10	5	10	ug/kg	27-88	10-90	40
8270 LL	1,4-Dichlorobenzene	106-46-7	Soil	2.5	10	5	10	ug/kg	28-89	19-93	40
8270 LL	2,4,5-Trichlorophenol	95-95-4	Soil	3	10	5	10	ug/kg	33-97	24-104	40
8270 LL	2,4,6-Trichlorophenol	88-06-2	Soil	3	10	5	10	ug/kg	31-97	18-105	40
8270 LL	2,4-Dichlorophenol	120-83-2	Soil	2.6	10	5	10	ug/kg	31-96	19-98	40
8270 LL	2,4-Dimethylphenol	105-67-9	Soil	6.3	50	15	50	ug/kg	10-93	10-99	40
8270 LL	2,4-Dinitrophenol	51-28-5	Soil	29	200	200	200	ug/kg	10-91	10-131	40
8270 LL	2,4-Dinitrotoluene	121-14-2	Soil	2.5	10	5	50	ug/kg	41-104	25-114	40
8270 LL	2,6-Dinitrotoluene	606-20-2	Soil	2.9	10	5	10	ug/kg	38-102	29-109	40
8270 LL	2-Chloronaphthalene	91-58-7	Soil	3.2	10	5	10	ug/kg	31-95	24-97	40
8270 LL	2-Chlorophenol	95-57-8	Soil	3	10	5	10	ug/kg	28-95	19-92	40
8270 LL	2-Methyl-4,6-dinitrophenol	534-52-1	Soil	27	100	50	200	ug/kg	23-99	10-126	40
8270 LL	2-Methylnaphthalene	91-57-6	Soil	2.8	10	5	10	ug/kg	27-96	19-99	40
8270 LL	1-Methylnaphthalene	90-12-0	Soil	3.9	10	5	10	ug/kg	34-84	13-111	40
8270 LL	2-Methylphenol	95-48-7	Soil	4.1	10	7.5	10	ug/kg	18-95	10-94	40
8270 LL	2-Nitroaniline	88-74-4	Soil	3.3	20	10	20	ug/kg	34-104	26-107	40
8270 LL	2-Nitrophenol	88-75-5	Soil	4	10	7.5	30	ug/kg	29-96	25-96	40
8270 LL	3,3'-Dichlorobenzidine	91-94-1	Soil	4.1	100	10	100	ug/kg	37-99	10-86	40
8270 LL	3-Nitroaniline	99-09-2	Soil	4.4	20	7.5	20	ug/kg	38-97	10-97	40
8270 LL	4-Bromophenyl Phenyl Ether	101-55-3	Soil	3.1	10	5	10	ug/kg	35-101	30-108	40
8270 LL	4-Chloro-3-methylphenol	59-50-7	Soil	2.9	10	5	10	ug/kg	28-101	12-106	40
8270 LL	4-Chloroaniline	106-47-8	Soil	2.6	10	10	30	ug/kg	30-86	10-75	40
8270 LL	4-Chlorophenyl Phenyl Ether	7005-72-3	Soil	3.2	10	5	10	ug/kg	33-95	31-97	40
8270 LL	4-Methylphenol	106-44-5	Soil	4.5	10	7.5	10	ug/kg	17-99	10-104	40
8270 LL	4-Nitroaniline	100-01-6	Soil	3.8	20	10	20	ug/kg	37-104	10-106	40
8270 LL	4-Nitrophenol	100-02-7	Soil	7.7	100	20	100	ug/kg	34-103	11-131	40

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CAS/KELSO DATA QUALITY OBJECTIVES – TABLE 6

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
8270 LL	Acetophenone	98-86-2	Soil	12	50	25	100	ug/kg	70-130	10-129	40
8270 LL	Aniline	62-53-3	Soil	2	20	20	20	ug/kg	21-77	10-70	40
8270 LL	Anthracene	120-12-7	Soil	3.2	10	5	10	ug/kg	40-98	14-113	40
8270 LL	Atrazine	1912-24-9	Soil	3.2	10	5	20	ug/kg	70-130	52-116	40
8270 LL	Azobenzene	103-33-3	Soil	3.5	10	5	10	ug/kg	31-101	23-104	40
8270 LL	Benz(a)anthracene	56-55-3	Soil	3.6	10	5	10	ug/kg	44-108	10-137	40
8270 LL	Benzaldehyde	100-52-7	Soil	3.8	20	10	20	ug/kg	70-130	10-106	40
8270 LL	Benzo(a)pyrene	50-32-8	Soil	3.6	10	5	10	ug/kg	42-110	13-126	40
8270 LL	Benzo(b)fluoranthene	205-99-2	Soil	3.4	10	5	10	ug/kg	46-106	23-122	40
8270 LL	Benzo(g,h,i)perylene	191-24-2	Soil	3.7	10	5	10	ug/kg	44-108	20-121	40
8270 LL	Benzo(k)fluoranthene	207-08-9	Soil	4	10	5	10	ug/kg	47-107	28-119	40
8270 LL	Benzoic Acid	65-85-0	Soil	96	200	200	600	ug/kg	Oct-96	10-126	40
8270 LL	Benzyl Alcohol	100-51-6	Soil	4.9	20	7.5	20	ug/kg	25-103	19-102	40
8270 LL	Biphenyl	92-52-4	Soil	2.2	20	5	20	ug/kg	70-130	39-90	40
8270 LL	Bis(2-chloroethoxy)methane	111-91-1	Soil	2.8	10	7.5	10	ug/kg	30-95	23-100	40
8270 LL	Bis(2-chloroethyl) Ether	111-44-4	Soil	3.1	10	7.5	10	ug/kg	29-93	21-100	40
8270 LL	Bis(2-chloroisopropyl) Ether	39638-32-9	Soil	2.8	10	7.5	10	ug/kg	22-95	14-95	40
8270 LL	Bis(2-ethylhexyl) Phthalate	117-81-7	Soil	8.9	100	10	100	ug/kg	47-110	20-138	40
8270 LL	Butyl Benzyl Phthalate	85-68-7	Soil	3.7	10	5	10	ug/kg	45-111	10-145	40
8270 LL	Caprolactam	105-60-2	Soil	37	50	50	50	ug/kg	70-130	10-117	40
8270 LL	Carbazole	86-74-8	Soil	3.8	10	5	10	ug/kg	44-102	10-144	40
8270 LL	Chrysene	218-01-9	Soil	4.1	10	5	10	ug/kg	46-108	10-146	40
8270 LL	Dibenz(a,h)anthracene	53-70-3	Soil	3	10	5	10	ug/kg	47-106	27-123	40
8270 LL	Dibenzofuran	132-64-9	Soil	3.4	10	5	10	ug/kg	34-92	21-106	40
8270 LL	Diethyl Phthalate	84-66-2	Soil	3.7	10	5	10	ug/kg	41-100	29-110	40
8270 LL	Dimethyl Phthalate	131-11-3	Soil	4	10	5	10	ug/kg	39-100	10-135	40
8270 LL	Di-n-butyl Phthalate	84-74-2	Soil	4.8	20	10	20	ug/kg	42-109	27-125	40
8270 LL	Di-n-octyl Phthalate	117-84-0	Soil	3.2	10	5	10	ug/kg	45-109	32-132	40

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CAS/KELSO DATA QUALITY OBJECTIVES – TABLE 6

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
8270 LL	Hexachlorobenzene	118-74-1	Soil	3.3	10	5	10	ug/kg	40-99	30-106	40
8270 LL	Hexachlorobutadiene	87-68-3	Soil	3	10	5	10	ug/kg	25-96	14-92	40
8270 LL	Hexachlorocyclopentadiene	77-47-4	Soil	4	50	50	50	ug/kg	18-71	10-71	40
8270 LL	Hexachloroethane	67-72-1	Soil	2.5	10	5	10	ug/kg	26-90	10-96	40
8270 LL	Indeno(1,2,3-cd)pyrene	193-39-5	Soil	3.2	10	5	10	ug/kg	47-109	22-129	40
8270 LL	Isophorone	78-59-1	Soil	2.8	10	5	10	ug/kg	31-95	25-92	40
8270 LL	Naphthalene	91-20-3	Soil	2.9	10	5	10	ug/kg	27-93	12-104	40
8270 LL	Nitrobenzene	98-95-3	Soil	3.4	10	5	10	ug/kg	26-100	17-108	40
8270 LL	N-Nitrosodimethylamine	62-75-9	Soil	20	50	50	100	ug/kg	24-98	10-109	40
8270 LL	N-Nitrosodi-n-propylamine	621-64-7	Soil	3.3	10	7.5	10	ug/kg	25-103	14-104	40
8270 LL	N-Nitrosodiphenylamine	86-30-6	Soil	3.2	10	5	10	ug/kg	36-96	13-113	40
8270 LL	Pentachlorophenol	87-86-5	Soil	5.3	100	50	100	ug/kg	22-93	10-123	40
8270 LL	Phenanthrene	85-01-8	Soil	3.6	10	5	10	ug/kg	39-98	15-121	40
8270 LL	Phenol	108-95-2	Soil	3.1	30	5	30	ug/kg	27-97	15-98	40
8270 LL	Pyrene	129-00-0	Soil	3.7	10	5	10	ug/kg	45-106	17-129	40
8270 LL	Pyridine	110-86-1	Soil	50	200	150	200	ug/kg	10-68	10-118	40
8270 LL	2,4,6-Tribromophenol (Surr.)	118-79-6	Soil	NA	NA	NA	NA	%	15-115	NA	NA
8270 LL	2-Fluorobiphenyl (Surr.)	321-60-8	Soil	NA	NA	NA	NA	%	25-98	NA	NA
8270 LL	2-Fluorophenol (Surr.)	367-12-4	Soil	NA	NA	NA	NA	%	12-92	NA	NA
8270 LL	Nitrobenzene-d5 (Surr.)	4165-60-0	Soil	NA	NA	NA	NA	%	18-100	NA	NA
8270 LL	Phenol-d6 (Surr.)	13127-88-3	Soil	NA	NA	NA	NA	%	16-101	NA	NA
8270 LL	Terphenyl-d14 (Surr.)	1718-51-0	Soil	NA	NA	NA	NA	%	37-132	NA	NA

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CAS/KELSO DATA QUALITY OBJECTIVES – TABLE 6

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
8270 LL	1,2,4,5-Tetrachlorobenzene	95-94-3	Water	0.057	0.2			ug/L	70-130	70-130	30
8270 LL	1,2,4-Trichlorobenzene	120-82-1	Water	0.016	0.2	0.05	0.2	ug/L	26-90	19-87	30
8270 LL	1,2-Dichlorobenzene	95-50-1	Water	0.022	0.2	0.05	0.2	ug/L	27-87	16-89	30
8270 LL	1,3-Dichlorobenzene	541-73-1	Water	0.021	0.2	0.05	0.2	ug/L	21-84	Dec-84	30
8270 LL	1,4-Dichlorobenzene	106-46-7	Water	0.029	0.2	0.05	0.2	ug/L	23-84	12-86	30
8270 LL	2,4,5-Trichlorophenol	95-95-4	Water	0.031	0.5	0.1	0.5	ug/L	56-108	37-120	30
8270 LL	2,4,6-Trichlorophenol	88-06-2	Water	0.058	0.5	0.1	0.5	ug/L	52-110	39-113	30
8270 LL	2,4-Dichlorophenol	120-83-2	Water	0.047	0.5	0.05	0.5	ug/L	52-112	39-110	30
8270 LL	2,4-Dimethylphenol	105-67-9	Water	2.2	4.0	3	4.0	ug/L	10-128	10-124	30
8270 LL	2,4-Dinitrophenol	51-28-5	Water	0.17	4.0	2	4.0	ug/L	10-107	10-107	30
8270 LL	2,4-Dinitrotoluene	121-14-2	Water	0.018	0.2	0.1	0.2	ug/L	59-111	55-109	30
8270 LL	2,6-Dinitrotoluene	606-20-2	Water	0.033	0.2	0.1	0.2	ug/L	60-109	55-109	30
8270 LL	2-Chloronaphthalene	91-58-7	Water	0.041	0.2	0.05	0.2	ug/L	47-101	39-102	30
8270 LL	2-Chlorophenol	95-57-8	Water	0.054	0.5	0.05	0.5	ug/L	53-110	35-110	30
8270 LL	2-Methyl-4,6-dinitrophenol	534-52-1	Water	0.025	2.0	0.4	2.0	ug/L	38-109	41-113	30
8270 LL	2-Methylnaphthalene	91-57-6	Water	0.026	0.2	0.05	0.2	ug/L	38-102	16-128	30
8270 LL	1-Methylnaphthalene	90-12-0	Water	0.2	0.2	0.05	0.2	ug/L	31-93	31-93	30
8270 LL	2-Methylphenol	95-48-7	Water	0.11	0.5	0.15	0.5	ug/L	20-118	10-115	30
8270 LL	2-Nitroaniline	88-74-4	Water	0.024	0.2	0.1	0.2	ug/L	53-113	29-123	30
8270 LL	2-Nitrophenol	88-75-5	Water	0.063	0.5	0.1	0.5	ug/L	53-111	38-108	30
8270 LL	3,3'-Dichlorobenzidine	91-94-1	Water	0.43	2.0	6	4	ug/L	10-113	10-109	30
8270 LL	3-Nitroaniline	99-09-2	Water	0.029	1.0	0.15	1.0	ug/L	32-116	10-112	30
8270 LL	4-Bromophenyl Phenyl Ether	101-55-3	Water	0.026	0.2	0.1	0.2	ug/L	55-105	54-103	30
8270 LL	4-Chloro-3-methylphenol	59-50-7	Water	0.037	0.5	0.05	0.5	ug/L	44-115	32-120	30
8270 LL	4-Chloroaniline	106-47-8	Water	0.025	0.2	0.05	0.2	ug/L	10-124	10-106	30
8270 LL	4-Chlorophenyl Phenyl Ether	7005-72-3	Water	0.027	0.2	0.05	0.2	ug/L	48-106	48-101	30
8270 LL	4-Methylphenol	106-44-5	Water	0.12	0.5	0.15	0.5	ug/L	19-121	10-118	30
8270 LL	4-Nitroaniline	100-01-6	Water	0.019	1.0	0.1	1.0	ug/L	43-113	10-113	30
8270 LL	4-Nitrophenol	100-02-7	Water	0.28	2.0	0.3	2.0	ug/L	49-113	43-130	30

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CAS/KELSO DATA QUALITY OBJECTIVES – TABLE 6

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
8270 LL	Acetophenone	98-86-2	Water	0.16	0.5			ug/L	35-146	10-164	30
8270 LL	Aniline	62-53-3	Water	0.043	1.0	0.1	1.0	ug/L	10-98	10-98	30
8270 LL	Anthracene	120-12-7	Water	0.024	0.2	0.05	0.2	ug/L	55-103	48-103	30
8270 LL	Atrazine	1912-24-9	Water	0.053	0.2			ug/L	70-130	70-130	30
8270 LL	Azobenzene	103-33-3	Water	0.021	0.2	0.05	0.2	ug/L	43-116	43-116	30
8270 LL	Benz(a)anthracene	56-55-3	Water	0.018	0.2	0.05	0.2	ug/L	61-104	58-106	30
8270 LL	Benzaldehyde	100-52-7	Water	0.046	0.2			ug/L	70-130	70-130	30
8270 LL	Benzo(a)pyrene	50-32-8	Water	0.031	0.2	0.05	0.2	ug/L	56-105	48-107	30
8270 LL	Benzo(b)fluoranthene	205-99-2	Water	0.017	0.2	0.05	0.2	ug/L	62-107	57-110	30
8270 LL	Benzo(g,h,i)perylene	191-24-2	Water	0.019	0.2	0.05	0.2	ug/L	62-108	56-111	30
8270 LL	Benzo(k)fluoranthene	207-08-9	Water	0.024	0.2	0.05	0.2	ug/L	63-108	56-109	30
8270 LL	Benzoic Acid	65-85-0	Water	1.1	5.0	3	5.0	ug/L	10-87	10-121	30
8270 LL	Benzyl Alcohol	100-51-6	Water	0.073	5.0	0.1	5.0	ug/L	46-118	37-116	30
8270 LL	Biphenyl	92-52-4	Water	0.037	0.2			ug/L	70-130	70-130	30
8270 LL	Bis(2-chloroethoxy)methane	111-91-1	Water	0.024	0.2	0.05	0.2	ug/L	52-111	45-106	30
8270 LL	Bis(2-chloroethyl) Ether	111-44-4	Water	0.035	0.2	0.05	0.2	ug/L	52-107	33-112	30
8270 LL	Bis(2-chloroisopropyl) Ether	39638-32-9	Water	0.026	0.2	0.15	0.2	ug/L	43-111	24-112	30
8270 LL	Bis(2-ethylhexyl) Phthalate	117-81-7	Water	0.13	1.0	0.15	1.0	ug/L	61-118	42-133	30
8270 LL	Butyl Benzyl Phthalate	85-68-7	Water	0.018	0.2	0.05	0.2	ug/L	62-112	57-118	30
8270 LL	Caprolactam	105-60-2	Water	0.22	0.50			ug/L	70-130	70-130	30
8270 LL	Carbazole	86-74-8	Water	0.018	0.2	0.05	0.2	ug/L	55-111	64-106	30
8270 LL	Chrysene	218-01-9	Water	0.028	0.2	0.05	0.2	ug/L	61-107	61-107	30
8270 LL	Dibenz(a,h)anthracene	53-70-3	Water	0.017	0.2	0.05	0.2	ug/L	62-108	56-108	30
8270 LL	Dibenzofuran	132-64-9	Water	0.018	0.2	0.05	0.2	ug/L	50-104	44-104	30
8270 LL	Diethyl Phthalate	84-66-2	Water	0.012	0.2	0.05	0.2	ug/L	56-112	53-113	30
8270 LL	Dimethyl Phthalate	131-11-3	Water	0.021	0.2	0.05	0.2	ug/L	58-110	54-109	30
8270 LL	Di-n-butyl Phthalate	84-74-2	Water	0.023	0.2	0.05	0.2	ug/L	58-113	54-116	30
8270 LL	Di-n-octyl Phthalate	117-84-0	Water	0.018	0.2	0.1	0.2	ug/L	60-110	56-112	30

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CAS/KELSO DATA QUALITY OBJECTIVES – TABLE 6

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
8270 LL	Hexachlorobenzene	118-74-1	Water	0.022	0.2	0.05	0.2	ug/L	55-105	47-101	30
8270 LL	Hexachlorobutadiene	87-68-3	Water	0.027	0.2	0.05	0.2	ug/L	10-85	10-74	30
8270 LL	Hexachlorocyclopentadiene	77-47-4	Water	0.19	1.0	0.6	1.0	ug/L	10-47	10-51	30
8270 LL	Hexachloroethane	67-72-1	Water	0.024	0.2	0.1	0.2	ug/L	11-82	10-75	30
8270 LL	Indeno(1,2,3-cd)pyrene	193-39-5	Water	0.021	0.2	0.05	0.2	ug/L	63-108	56-110	30
8270 LL	Isophorone	78-59-1	Water	0.016	0.2	0.05	0.2	ug/L	51-109	41-107	30
8270 LL	Naphthalene	91-20-3	Water	0.022	0.2	0.05	0.2	ug/L	43-98	44-97	30
8270 LL	Nitrobenzene	98-95-3	Water	0.028	0.2	0.15	0.2	ug/L	52-112	24-128	30
8270 LL	N-Nitrosodimethylamine	62-75-9	Water	0.42	2.0	0.6	2.0	ug/L	46-122	46-122	30
8270 LL	N-Nitrosodi-n-propylamine	621-64-7	Water	0.037	0.2	0.1	0.2	ug/L	50-113	32-114	30
8270 LL	N-Nitrosodiphenylamine	86-30-6	Water	0.048	0.2	0.05	0.2	ug/L	44-111	27-113	30
8270 LL	Pentachlorophenol	87-86-5	Water	0.34	1.0	0.4	1.0	ug/L	33-106	39-123	30
8270 LL	Phenanthrene	85-01-8	Water	0.022	0.2	0.05	0.2	ug/L	56-103	52-104	30
8270 LL	Phenol	108-95-2	Water	0.063	0.5	0.1	0.5	ug/L	50-112	24-123	30
8270 LL	Pyrene	129-00-0	Water	0.019	0.2	0.05	0.2	ug/L	59-109	51-109	30
8270 LL	Pyridine	110-86-1	Water	1.4	5.0	2	5.0	ug/L	10-114	10-114	30
8270 LL	2,4,6-Tribromophenol (Surr.)	118-79-6	Water	NA	NA	NA	NA	%	27-128	NA	NA
8270 LL	2-Fluorobiphenyl (Surr.)	321-60-8	Water	NA	NA	NA	NA	%	38-102	NA	NA
8270 LL	2-Fluorophenol (Surr.)	367-12-4	Water	NA	NA	NA	NA	%	23-121	NA	NA
8270 LL	Nitrobenzene-d5 (Surr.)	4165-60-0	Water	NA	NA	NA	NA	%	38-124	NA	NA
8270 LL	Phenol-d6 (Surr.)	13127-88-3	Water	NA	NA	NA	NA	%	31-122	NA	NA
8270 LL	Terphenyl-d14 (Surr.)	1718-51-0	Water	NA	NA	NA	NA	%	56-138	NA	NA

a Method Detection Limits are subject to change as new MDL studies are completed.
a MDL is the smallest analyte concentration that can be demonstrated to be different from zero with 99% confidence
b The LOD is the smallest amount of a substance that must be present in a sample in order to be detected with 99% confidence.
Verification is acceptable if the response is > 3x instrument noise & ion abundance
c The LOQ is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias.

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TABLE 7

Control Analytes for Non-DoD Projects

1,2,4-Trichlorobenzene
1,4-Dichlorobenzene
2,4-Dinitrotoluene
2-Chloronaphthalene
2-Chlorophenol
4-Bromophenyl Phenyl Ether
4-Chloro-3-methylphenol
4-Nitrophenol
Acenaphthene
Benzo(a)pyrene
Diethyl Phthalate
Hexachloroethane
N-Nitrosodi-n-propylamine
Pentachlorophenol
Phenol
Pyrene

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