Appendix A

Field Analytical Measurement Technologies Matrix

TECHNOLOGY: TPH Immunoassay Test

	MILLIPORE TPH		ENSYS TPH		OHMICRON TPH	
MEDIA	SOIL	WATER	SOIL	WATER	SOIL	WATER
DETECTION LIMIT (ppm)	2	0.1	10-40	0.2-0.5	10	0.2
FALSE NEGATIVE RATE @ 2X LOD (a)	0-2% (see each manufacturer's product literature for additional information)					
FALSE POSITIVE RATE @ 0.5XLOD (a)	0-45% (see each manufacturer's product literature for additional information)					
AVG. COST/TEST	$20	$20	$11-32	$38	$13	$5
CAPITAL EQUIPMENT INVESTMENT(b)	$500-1,500		$1,500-3,800	$1,850	$400-5,500	$400-5,500
VALIDATION (c)	USEPA/CALEPA	—	USEPA/CALEPA	CALEPA (in process)	USEPA CALEPA(in process)	CALEPA(in process)
UNSUITABLE PHYSICAL CONDITIONS	Extremes of temperature (less than 40º F and greater than 90º F), pH less than 3 and greater than 11, and water content greater than 30% are generally not recommended. See product literature for more specific information.					
GENERAL CHEMICAL INTERFERENCES	See individual product's literature for tables of cross-reactivities to structurally similar and dissimilar compounds.					
ESTIMATED SAMPLES/DAY	Varies from 35-200/person/day depending on matrix (soil requires extraction yielding lower throughout) and skill of personnel.					
ADDITIONAL TECHNICAL COMMENTS	Colorimetric, four assay calibrators plus blank, semi-quantitative, give results as ranges between the calibrators. Kit must be stored at 4-8º C before use. pH range of test is 2-12. False negative and positive rates determined at 200% and 20% of action level (10 ppm), respectively.		Colorimetric, spectrophotometer required, two standards, semi-quantitative result, some fuels heavier than fuel oil #6 can be done, call tech service.		Technology can be used in three different modes depending on sample and desired analytical performance quantitative (numerical index result), semi-quantitative (above or below a numerical result), qualitative (positive or negative relative to a given cut-off).	

(A) Limit of Detection. Each manufacturer calculates these values in a different way making comparisons difficult.

(B) Ranges represent a variety or rental or purchase arrangements for automation and data processing. Contact vendor for specific information. All accessory equipment necessary for testing is included.

(C) USEPA validation: listed in the Office of Solid Waste SW-846 Method 4030. CALEPA validation: Environmental Technology Certification Program.

	MILLIPORE TPH		ENSYS TPH		OHMICRON TPH	
	SOIL	WATER	SOIL	WATER	SOIL	WATER
FUEL	DETECTION LIMITS FOR INDIVIDUAL FUELS (ppm)					
Gasoline	1	Not Provided	10	0.2	10	0.2
Diesel	4	Not Provided	15	0.2	29	1.3
Jet a fuel	4	Not Provided	15	0.3	58	2.7
JP-4	Not Provided	Not Provided	15	0.2	20	0.5
Kerosene	2	Not Provided	15	0.2	34	0.8
Fuel oil #2	Not Provided	Not Provided	15	0.2	13	0.4
Fuel oil #6	5	Not Provided	25	Not Provided	13	0.2
Mineral spirits	Not Provided	Not Provided	40	0.5	29	1.12

TECHNOLOGY: BTEX Immunoassay Test

	D TECH BTEX		MILLIPORE BTEX		OHMICRON BTEX		ENSYS TPH		ENSYS BENZENE
MEDIA	SOIL	WATER	SOIL	WATER	SOIL	WATER	SOIL	WATER	WATER
DETECTION LIMIT (ppm)	2.5	0.6	2	0.1	0.9	0.02	10-40	0.2-0.5	0.006-0.060
FALSE NEGATIVE RATE @ 2X LOD (a)	0-2% (see each manufacturer's product literature for additional information)								
FALSE POSITIVE RATE @ 0.5XLOD (a)	0-45% (see each manufacturer's product literature for additional information)								
AVG. COST/TEST	$32	$26	$10-20	$10-20	$13	$6	$11-32	$38	$30
CAPITAL EQUIPMENT INVESTMENT (b)	$299	$299	$500-1,500		$400-4,400		$1,500-3,800	$1,650	$1,320
VALIDATION (c)	USEPA/CALEPA (in process)		USEPA/CALEPA		USEPA CALEPA (in process)	CALEPA	USEPA CALEPA	CALEPA (in process)	—
UNSUITABLE PHYSICAL CONDITIONS	Extremes of temperature (less than 40º F and greater than 90º F), pH less than 3 and greater than 11, and water content greater than 30% are generally not recommended. See product literature for more specific information.								
GENERAL CHEMICAL INTERFERENCES	See individual product's literature for tables of cross-reactivities to structurally similar and dissimilar compounds.								
ESTIMATED SAMPLES/DAY	Varies from 35-200/person/day depending on matrix (soil requires extraction yielding lower throughout) and skill of personnel.								
ADDITIONAL TECHNICAL COMMENTS	Visual comparison or reflectometry, single calibrator used, semi-quantitative. Kits should be stored between 40-100º F. Special sampling techniques due to volatility of the analytes should be followed. Samples should be stored at 35-45º F until analysis. Some soils require extremely vigorous shaking during extraction. Salt water samples require special preparation. 39% cross reactive with benzene.		Colorimetric, four assay calibrators plus blank, semi-quantitative, give results as ranges between the calibrators. Kit must be stored at 4-8º C before use. pH range of tests is 2-12. False negative and positive rates determined at 200% and 20% of action level (10 ppm), respectively.		Technology can be used in three different modes depending on sample and desired analytical performance: quantitative (numerical index result), semi-quantitative (above or below a numerical result), qualitative (positive or negative relative to a given cut-off)		Colorimetric, spectrophotometer required, two standards, semi-quantitative result; some fuels heavier than fuel oil #6 can be done, call tech service.		Colorimetric, spectro-photometer required, two standards, semiquanti-tative result

(a) Limit of detection. Each manufacturer calculates these values in a different way making comparisons difficult.

(b) Ranges represent a variety or rental or purchase arrangements for automation and data processing. Contact vendor for specific information. All accessory equipment necessary for testing is included.

(c) USEPA validation: listed in the Office of Solid Waste SW-846 Method 4030. CALEPA validation: Environmental Technology Certification Program.

TECHNOLOGY: PAH Immunoassay Test

	DTECH PAH		ENSYS PAH	OHMICRON PAH		OHMICRON cPAH(a)		MILLIPORE PAH	
MEDIA	SOIL	WATER	SOIL	SOIL	WATER	SOIL	WATER	SOIL	WATER
DETECTION LIMIT (ppm)	0.6-25	0.008-0.250	0.012-2.92	0.2	0.0009	10 (B[a]P)(a)	0.06 (B[a]P)(a)	0.2-356	0.00
FALSE NEGATIVE RATE @ 2X LOD (b)	0-4% (see each manufacturer's product literature for additional information)								
FALSE POSITIVE RATE @ 0.5XLOD (b)	0-50% (see each manufacturer's product literature for additional information)								
AVG. COST/TEST	$32	$25	$14-47	$19	$11	$20	$12	$20	$20
CAPITAL EQUIPMENT INVESTMENT (c)	$299		$1,500-3,800	$400-5,500				$500-1,500	
VALIDATION (d)	USEPA CALEPA (in process)		USEPA/ CALEPA	USEPA/ CALEPA	CALEPA	USEPA	—	CALEPA (in process)	—
UNSUITABLE PHYSICAL CONDITIONS	Extremes of temperature (less than 40º F and greater than 90º F), pH less than 3 and greater than 11, and water content greater than 30% are generally not recommended. See product literature for more specific information.								
GENERAL CHEMICAL INTERFERENCES	See individual product's literature for tables of cross-reactivities to structurally similar and dissimilar compounds.								
ESTIMATED SAMPLES/DAY	Varies from 35-200/person/day depending on matrix (soil requires extraction yielding lower throughout) and skill of personnel.								
ADDITIONAL TECHNICAL COMMENTS	Visual comparison or reflectometry, single calibrator used, semi-quantitative. Kits should be stored between 40-100º F. Special sampling techniques due to volatility of the analytes should be followed. Samples should be stored at 35-45º F until analysis. Some soils require extremely vigorous shaking during extraction. Saltwater samples require a special sample preparation		Colorimetric, spectro-photometer required, two standards, semi-quanti-tative result	Technology can be used in three different modes depending on sample and desired analytical performance: quantitative (numerical index result), semi-quantitative (above or below a numerical result), or qualitative (positive or negative relative to a given cut-off).				Colorimetric, spectro-photometer required, two standards, semi-quantitative result.	

(a) Ohmicron Carcinogenic PAH test. B[a]P: benzo[a]pyrene

(b) Limit of Detection. Each manufacturer calculates these values in a different way making comparisons difficult.

(c) Ranges represent a variety of rental or purchase arrangements for automation and data processing. Contact vendor for specific information. All accessory equipment necessary for testing is included.

(d) USEPA validation: listed in the Office of Solid Waste SW-846 Method 4030. CALEPA validation: Environmental Technology Certification Program.

	DTECH PAH		ENSYS	OHMICRON PAH		OHMICRON cPAH		MILLIPORE PAH	
	SOIL	WATER	SOIL	SOIL	WATER	SOIL	WATER	SOIL	WATER
PAH	DETECTION LIMITS FOR INDIVIDUAL PAH (ppm)								
Phenanthrene	52.500	0.421	0.015	0.200	0.001	403	2.7	0.9	0.040
Fluoranthene	0.625	0.005	0.020	0.025	0.0004	222	2.0	0.3	0.005
Benzo[a]pyrene	1.250	0.010	0.125	0.048	0.001	10	0.08	0.8	0.004
Pyrene	1.250	0.010	0.051	0.029	0.0003	92	2.0	0.2	0.002
Chrysene	1.000	0.008	0.017	0.081	0.001	5	0.04	4.3	0.041
Anthracene	1.250	0.010	0.012	0.180	0.001	579	0.44	7.6	0.185
Indeno[1,2,3,c,d]pyrene	1.000	0.008	0.161	0.170	0.001	8	0.02	6.5	0.007
Benz[a]anthracene	5.250	0.042	—	0.190	0.001	2	0.02	4.9	0.041
Fluorene	13.200	0.106	0.022	0.390	0.002	3520	37	3.4	0.337
Benzo[b]fluoranthene	6.800	0.053	0.067	0.100	0.001	5	0.04	6.2	0.015
Acenaphthylene	38.800	0.311	0.109	2.600	0.013	21700	148	2.4	0.745
Benzo[k]fluoranthene	8.750	0.070	0.137	0.240	0.001	3	0.02	6.2	0.051
Acenaphthene	38.800	0.311	0.118	4.900	0.002	100000	1078	3.7	1000
Benzo[g,h,i]perylene	5.250	0.042	—	10.000	0.020	125	0.3	5.3	0.036
Naphthalene	220.000	1.761	2.920	10	0.066	35900	376	40.0	1000

TECHNOLOGY: PCB Immunoassay Test

	D TECH PCB	MILLIPORE PCB	OHMICRON PCB			ENSYS PCB		
MEDIA	SOIL	SOIL	SOIL	WATER	WIPE	SOIL	WIPE	OIL
DETECTION LIMIT (ppm)	0.5-25	1-50	0.25-10	0.0002-0.001	5µG/100 cm^2	0.1-0.8	1-8µG	1-20
FALSE NEGATIVE RATE @ 2X LOD (a)	0-1% (see each manufacturer's product literature for additional information)							
FALSE POSITIVE RATE @ 0.5XLOD (a)	0-20% (see each manufacturer's product literature for additional information)							
AVG. COST/TEST	$31	$10-20	$19	$11	$11	$11-36	$11-36	$33
CAPITAL EQUIPMENT INVESTMENT (b)	$299	$500-1,500	$400-5,500			$1500-3800		$2700
VALIDATION (c)	USEPA/CALEPA	USEPA/CALEPA DOE	USEPA (in process)/ CALEPA	CALEPA	CALEPA	USEPA/CALEPA DOE	CALEPA (IN PROCESS)	USEPA
UNSUITABLE PHYSICAL CONDITIONS	Extremes of temperature (less than 40º F and greater than 90º F), pH less than 3 and greater than 11, and water content greater than 30% are generally not recommended. See product literature for more specific information.							
GENERAL CHEMICAL INTERFERENCES	Halowax 1099, Bifenox, some chlorinated solvents if present at 1000 ppm	Some interferences from chlorinated benzene and phenols	TCE100,000 ppm, Gasoline25,000 ppm, Diesel1000 ppm, Transformer fluid5000 ppm			Some interferences from chlorinated benzene and phenols, oil contamination in sample, and Diuron.		Water
ESTIMATED SAMPLES/DAY	Varies from 35-200/person/day depending on matrix (soil requires extraction yielding lower throughout) and skill of personnel.							
ADDITIONAL TECHNICAL COMMENTS	Visual comparison or reflectometry, single calibrator used. Semi-quantitative, specific for Aroclors 1254, 1242, 1248, 1260, 1262, 1268	Colorimetric, four assay calibrators plus blank, semi-quantitative, specific for Aroclors 1016, 1242, 1248, 1254, 1260	Technology can be used in three different modes depending on sample and desired analytical performance: quantitative (numerical index result), semi-quantitative (above or below a numerical result),or qualitative (positive or negative relative to a given cut-off).			Colorimetric, spectrophotometer required, two standards, semi-quantitative result, cloudy buffer or oil.		Extraction required

(a) Limit of detection. Each manufacturer calculates these values in a different way making comparisons difficult.

(b) Ranges represent a variety or rental or purchase arrangements for automation and data processing. Contact vendor for specific information. All accessory equipment necessary for testing is included.

(c) USEPA validation: listed in the Office of Solid Waste SW-846 Method 4020. CALEPA validation: Environmental Technology Certification Program. DOE validation: listed in the DOE METHODS for Evaluating Environmental and Waste Management Samples.

	D TECH	MILLIPORE	OHMICRON PCB			ENSYS PCB		
	SOIL	SOIL	SOIL	WATER	WIPE	SOIL	WIPE	OIL
AROCLOR	DETECTION LIMITS FOR AROCLOR MIXTURES (ppm)							
AROCLOR 1016	5.7	—	2.7	0.00094	36	0.8	8 µG	9-18
AROCLOR 1232	9.0	—	2.24	0.00064	26	0.8	8 µG	10-20
AROCLOR 1242	1.5	1	0.8	0.00034	12	0.4	4 µG	3.5-10
AROCLOR 1248	0.8	1	0.42	0.00022	8	0.2	2 µG	2.5-6
AROCLOR 1264	0.5	1	0.5	0.0002	5	0.1	1 µG	1-3
AROCLOR 1260	0.5	1	0.3	0.0002	3	0.1	1 µG	1-3
AROCLOR 1262	0/5	—	0.64	0.00036	6	02	2 µG	-
AROCLOR 1268	3.8	—	2.3	0.00082	31	0.8	8 µG	-

TECHNOLOGY: TNT/RDX Test (immunochemical and colorimetric)

	DTECH TNT		MILLIPORE TNT		OHMICRON TNT		ENSYS TNT	ENSYS RDX	D TECH RDX	
MEDIA	SOIL	WATER	SOIL	WATER	SOIL	WATER	SOIL	SOIL	SOIL	WATER
DETECTION LIMIT (ppm)	0.5	0.005	0.2	0.0005	0.25	0.00007	0.7	0.8	0.5	0.005
FALSE NEGATIVE RATE @ 2X LOD (a)	0-5% (see each manufacturer's product literature for additional information)									
FALSE POSITIVE RATE @ 0.5XLOD (a)	0-45% (see each manufacturer's product literature for additional information)									
AVG. COST/TEST	$31	$25	$10-20	$9	$13	$6	$21	$23	$31	$25
CAPITAL EQUIPMENT INVESTMENT (b)	$299		$500-1,500		$400-5,500		$1,350	$1,350	$299	
VALIDATION (c)	USEPA/CALEPA		CALEPA		USEPA/ CALEPA (in process)	CALEPA (in process)	USEPA	USEPA (in process)	USEPA/CALEPA	
UNSUITABLE PHYSICAL CONDITIONS	Extremes of temperature (less than 40º F and greater than 90º F), pH less than 3 and greater than 11, and water content greater than 30% are generally not recommended. See product literature for more specific information.									
GENERAL CHEMICAL INTERFERENCES	Several related nitroaromatic compound cross-react in these assays: these include aminodinitrotoluenes, dinitrotoluenes, tetryl, and 1,3,5-TNB. Extent of cross-reactivity varies with manufacturer. Gross particulate matter must be filtered out.						HMX, PETN, nitroglycerine, nitroguanidine, and nitrocellulose cross-react.		HMX	
ESTIMATED SAMPLES/DAY	Varies from 35-200/person/day depending on matrix (soil request extraction yielding lower throughout) and skill of personnel.									
ADDITIONAL TECHNICAL COMMENTS	Latex particle-based enzyme immunoassay using reflectometry or visual inspection for concentration estimation. Four samples analyzed per kit.		Antibody-bound tube enzyme immunoassay using spectrophotometry and calibrators to estimate range of concentrations for unknowns.		Can be used in 3 modes depending on sample and analysis: quantitative (numerical index result), semi-quantitative (above or below a numerical result), qualitative (positive or negative relative to a cut-off).		Colorimetric assay; not immunoassay method.		Latex particle- based enzyme immunoassay using reflectometry or visual inspection for concentration estimation. Four samples analyzed per kit.	

(A) Limit of detection. Each manufacturer calculates these values in a different way making comparisons difficult.

(B) Ranges represent a variety of rental or purchase arrangements for automation and data processing. Contact vendor for specific information. Accessory equipment necessary for testing is included.

(C) USEPA validation: listed in the Office of Solid Waste SW-846 Method 4050 (TNT) and 4051 (RDX); The Ensys TNT test is listed in SW-846 Method 8515. CALEPA validation: Environmental Technology Certification Program.

TECHNOLOGY: Mercury Test

	ENSYS / BIMELYZE MERCURY		UCD MERCURY (Experimental)
MEDIA	SOIL	WATER	SOIL
DETECTION LIMIT (ppm)	0.5	0.00025	1
FALSE NEGATIVE RATE @ 2X LOD (a)	0%	0%	5%
FALSE POSITIVE @ 0.5X LOD (a)	%	%	5%
AVG. COST/TEST	$25	$25	$20
CAPITAL EQUIPMENT INVESTMENT	$1,000	$1,000	—
VALIDATION (b)	CALEPA/DOE		—
UNSUITABLE CONDITIONS	Soils containing much oil; limestone or other high carbonate soils; temperatures less than 50º F and greater than 98º F.		—
GENERAL INTERFERENCES	None		Ag^{+}, Au^{+}, Cu^{2+}
ESTIMATED SAMPLES/DAY	60		20
ADDITIONAL TECHNICAL COMMENTS	None	None	Product in development (not commercially available). Silver and copper interferences may be eliminated before product release.

(A) Limit of detection. Each manufacturer calculates these values in a different way making comparisons difficult.

(B) CALEPA validation: Environmental Technology Certification Program. DOE validation: listed in the DOE METHODS for Evaluating Environmental and Waste Management Samples.

TECHNOLOGY: SCAPS (PAH/TPH) In Situ Field Analytical Method for Petroleum, Oil, and Lubricant (POLs) Contamination

MEDIA	Soil (all phases)
DETECTION LIMIT (ppm)	10 - 1,000 (soil and contaminant dependent)
FALSE NEGATIVE RATE @ 2x LOD	8% for TPH
FALSE POSITIVE RATE @ 0.5x LOD	9% for TPH
AVG. COST/TEST	$250.push, $12.50.foot, $2.50/measurement
CAPITAL EQUIPMENT INVESTMENT	Rental Services
VALIDATION	CALEPA
UNSUITABLE CONDITIONS	Hard rock geology and severe topography (cone penetrometer limitations)
GENERAL INTERFERENCES	Natural mineral fluorescence (can be resolved spectrally)
ESTIMATED SAMPLES/DAY	200 feet of push, 10 pushes, 1000 measurements
ADDITIONAL TECHNICAL COMMENTS	The Site Characterization and Analysis Penetrometer System-Laser Induced Fluorescence (SCAPS-LIF) system consists of a truck-mounted cone penetrometer instrumented with a fiber optic chemical sensor for real time in situ field screening of petroleum, oil, and lubricant contamination to depths of 150 feet. Measurements are performed continuously through the vadose and saturated zones with a 2 inch depth resolution. The 20 ton truck has 6 wheel drive for off road maneuvering. Valid operating range for temperature is 35 - 110º F.

TECHNOLOGY: X-RAY FLUORESCENCE (XRF) (a)

METHOD	TN Spectrace 9000	Metorex X-Met 920
MEDIA	Solid matrices	Solid matrices
SOURCE: APPLICABILITY	Fe55(50mCi) : Si-V, Nb-Ce Cd109(5mCi) : Cr-Mo, Tb-U Am241 (5mCi) : Zn-Nd, Hf-U	Fe55 (50 mCi) : Si-V, Nb-Ce Cd109 (20 mCi) : Cr-Mo, Tb-U Am241 (30 mCi) : Zn-Nd, Hf-U Cm244 (70mCi) : Ti-Se, La-Pb
DETECTOR : RESOLUTION	HgI_2 : 270 eV near ambient temperature	Si(Li) : 170 eV LN2 cooled or Gas-filled : 750eV ambient temperature.
CALIBRATION MODELS (b)	2048 channel MCA/ High Resolution/FP - 4 models/FP with SSCS	2048 channel MCA/High Resolution/FP or Low Resolution/SSCS only.
DETECTION LIMIT (ppm)	20 - 300 mg/kg (element dependent)	20 - 300 mg/kg or 100 - 500 mg/kg (gas-filled)
AVG. COST/TEST	50/sample depending on number of samples and rent or purchase of instrument	
CAPITAL EQUIPMENT INVESTMENT	$58,000	$47,470 (SiLi), $36,325 (gas-filled)
VALIDATION		
UNSUITABLE CONDITIONS	Moisture 20%; Sample inhomogeneity or large particle size distribution; Sample presentation to source; Large amounts of light elements present; Ambient temperatures outside 30 - 100 degree F range.	
GENERAL INTERFERENCES	Spectral overlap, such as As/Pb; Absorption, such as attenuation of Ni by Fe; Enhancement, such as secondary excitation of Cr by Fe	
ESTIMATED SAMPLES/DAY	30 - 50 (100 screening)	30 - 50 (200 with 50 sec. acquisition time, no sample prep) (gas-filled)
NO. of SIMULTANEOUS ANALYSES	25	24 (SSCS); 32 (FP)
ADDITIONAL TECHNICAL COMMENTS (c)	Lower resolution may cause difficulties in measuring Hg concentration in the presence of high amounts of Zn, for example.	Empirical modeling software does not allow correction of all possible interelement effects. Not more than 6 elements may be determined simultaneously; empirical calibration requires collecting and analyzing site-specific calibration samples prior to site investigation activities; requires liquid nitrogen.
TECHNOLOGY: X-RAY FLUORESCENCE (XRF) (a)		
METHOD	Scitec MAP Spectrum Analyzer	HNU Systems SEFA-P
MEDIA	Solid matrices	Solid matrices
SOURCE : APPLICABILITY	Co57 (40mCi) : Po-Ca Cd109 (20mCi) : Cr-Mo, Tb-U Am241 (30 mCi) : Zn-Nd, Hf-U (only uses one source)	Fe55 (50mCi) : Si-V, Nb-Ce Cd109 (10mCi) : Cr-Mo, Tb-U Am241 (25mCi) : Zn-Nd, Hf-U
DETECTOR : RESOLUTION	Si PIN: 170 keV ambient temperature	Si(Li) : 180 eV LN2 cooled
CALIBRATION MODELS (b)	256 channel MCA/Low Resolution/SSCS or STCS	4096 channel MCA/Hi Resolution/SSCS or STCS or Compton normalization
DETECTION LIMIT (ppm)	150-1000 mg/kg (element dependent)	20 - 300 mg/kg (element dependent)
AVG. COST/TEST	50/sample depending on number of samples and rent or purchase of instrument	
CAPITAL EQUIPMENT INVESTMENT	$32,000	$45,000; instrument no longer manufactured.
VALIDATION		
UNSUITABLE CONDITIONS	Moisture 20%; Sample inhomogeneity or large particle size distribution; Sample presentation to source; Large amounts of light elements present; Ambient temperatures outside 30 - 100 degree F range.	

GENERAL INTERFERENCES	Low resolution requires extensive software deconvolution of neighboring peaks	Spectral overlap, such as As/Pb; Absorption, such as attenuation of Ni by Fe; Enhancement, such as secondary excitation of Cr by Fe.
ESTIMATED SAMPLES/DAY	50 - 100	30 - 50 (100 screening)
NO. of SIMULTANEOUS ANALYSES	4	29
ADDITIONAL TECHNICAL COMMENTS (c)	Co57 source requires special licensing and yearly replacement; source is unusable for Fe analysis; no good method available to calibrate instrument of perform calibration verification checks. Cannot perform intensive analysis.	$FP^{(2)}$ calibration not available. Heaviest of the field-portable technologies. Very stable detector system. Service dept. reliability varies. Requires liquid nitrogen. Cannot perform in situ analysis.
TECHNOLOGY: X-RAY FLUORESCENCE (XRF) (a)		
METHOD	Niton XL Spectrum Analyzer	TN Spectrace Lead Analyzer
MEDIA	Solid matrices	Solid matrices
SOURCE: APPLICABILITY	Cd109 (10mCi) : Pb specific can also analyze for As, Cr, Fe, Ni, Cu, Mo, Sr, Rb, and Zr	Cd109 (30 mCi) : Pb specific, soils application may be used for Pb, As, Cr, Fe, Cu, Zn, and Mn
DETECTOR : RESOLUTION	Si diode PIN : 700 eV Peltier cooled near ambient temperature	Hgl_2 : 270 eV near ambient temperature
CALIBRATION MODELS (b)	1024 channel MCA/Mid Resolution/Compton normalization	2048 channel MCA/High Resolution/FP-5 models
DETECTION LIMIT (ppm)	20 - 1000 mg/kg (element dependent)	40 - 500 mg/kg (element dependent)
AVG. COST/TEST	50/sample depending on number of samples and rent or purchase of instrument	
CAPITAL EQUIPMENT INVESTMENT	$12,000 to purchase	$39,500 to purchase
VALIDATION		
UNSUITABLE CONDITIONS	Moisture 20%; Sample inhomogeneity or large particle size distribution; Sample presentation to source; Large amounts of light elements present; Ambient temperatures outside 30 - 100 degree F range.	
GENERAL INTERFERENCES	Surface conditions (latex paint, moisture, etc) may cause bias in results. Spectral overlaps and chemical matrix effects.	
ESTIMATED SAMPLES/DAY	100 - 200	100 - 200
NO. of SIMULTANEOUS ANALYSES	11	7
ADDITIONAL TECHNICAL COMMENTS (c)	Specific for lead in paint. Additional features allow analysis of selected metals in soil. Instrument not completely weatherproof, may be affected by moisture. Low reactivity for chromium.	Specific for lead in paint, soils application permits analysis of other select metals. Sensitivity for Cr expected to be low.
TECHNOLOGY: X-RAY FLUORESCENCE (XRF) (a)		
METHOD	HNU Systems SEFA-Px	ASOMA Series 200
MEDIA	Solid matrices	Solid matrices
SOURCE: APPLICABILITY	Co57 (10mCi) : Pb specific	Fe55 (20 mCi) : Si-V, Nb-Ce Cd109 (10mCi) : Cr-Mo, Tb-U tube-excited model available; Rh, Ag, Fe, W, and Ti targets available.
DETECTOR : RESOLUTION	Si(Li) : 180 eV LN2 cooled	gas-filled : 300 eV (est)
CALIBRATION MODELS (b)	4096 channel MCA/High Resolution/SSCS or STCS, also factory calibration	4096 channel MCA/High Resolution/factory- installed calibration models

DETECTION LIMIT (ppm)	20 mg/kg	1 -50 mg/kg (element dependent)
AVG. COST/TEST	information not provided	information not provided
CAPITAL EQUIPMENT INVESTMENT	information not provided	information not provided
VALIDATION	information not provided	information not provided
UNSUITABLE CONDITIONS	Moisture 20%; Sample inhomogeneity or large particle size distribution; Sample presentation to source; Large amounts of light elements present; Ambient temperatures outside 30 - 100 degree F range.	
GENERAL INTERFERENCES	Specific for lead in paint, surface conditions (latex paint, moisture, etc) may cause bias in results.	Spectral overlap, such as As/Pb; Absorption, such as attenuation of Ni by Fe; Enhancement, such as secondary excitation of Cr by Fe.
EST. SAMPLES/DAY	100	30 - 50
NO. of SIMULTANEOUS ANALYSES	1	7
ADDITIONAL TECHNICAL COMMENTS (c)	Analysis time is selected by technology based on signal level. Low activity source, short half-life. Operated under general NRC license.	Automatic gain stabilization. Tube-excited option would lower detection limits by 2-10 times.

(A) The description of this technology is limited to solid matrices. Although it may be possible to determine metals concentrations in liquids, there are many limitations which must be considered. For example, metals in oil is an appropriate application. On the other hand, direct measurement of metals in water is not due to the severe scattering of x-rays by the matrix. Metals may be concentrated by passing water through an ion exchange resin, but quantitation is nevertheless performed on the solid matrix. Likewise, air filters may be analyzed using XRF to determine air concentrations, but the measurement is made on the solid (filter) matrix. Preparation of calibration standards for these types of analyses may be difficult.

(B) FP - Fundamental Parameters: A principle components-based modeling scheme, requiring at least one sample and a detailed knowledge of all sample constituents. May use different algorithms depending upon the matrix of interest. FP with SSCS - FP calibration modeling using site-specific calibration standards. A more comprehensive modeling scheme better able to account for matrix interferences. SSCS - An empirical method in which corrected x-ray intensities are related to their assay (laboratory-determined) concentrations for soil collected from the actual site. STCS - Similar to SSCS, but the calibration samples are not actually from the site - they are selected based on similar matrix characteristics as are found on-site.

Compton Ratio - An empirical, one-point calibration modeling scheme is available, in which the intensity of the Compton peak (incoherent scattering) is used to normalize sample results for matrix effects.

(C) Some general technical comments are: best for use at sites where metals have been previously characterized; a minimum of 5% of samples should be submitted for confirmatory analysis; ideal sample preparation involves sieving through 10-mesh followed by particle size reduction to d-mesh; A good SSCS will always yield more accurate results than will FP calibration modeling; SSCS calibration models should not span more than 40000 mg/kg (and not more than 2000 mg/kg for most accurate results); discarding any points from calibration models is discouraged; and terms included in calibration models should be physically realistic.