Closure Documentation For
Solid Waste Management Unit 10
Biological Treatment Plant Equalization Basin
Radford Army Ammunition Plant, Radford, VA

EPQ ID# VA1210020730

Volume 2 Of 2

Quality Environmental Services

REI Consultants Inc.

Research, Environmental & Industrial Consultants, Inc.

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January 20, 1998

Mr. Arnie Olsen
Alliant Techsystems, Inc.
P O Box 1 State Route 114
Radford VA 24141

RE: REIC Job #: 1297-57482

Dear Mr. Olsen:

Please find enclosed your analysis report for the samples submitted to our laboratory on December 29, 1997. Please note that the samples are identified as follows:

Custody No.'s: 57957 & 57956

Please do not hesitate to call if you have any questions.

Thank you.

Sincerely,

Ray Erickson
Vice President
REI Consultants, Inc.

enclosure
RE/pjm

MEMBER: American Chemical Society • Association of Official Analytical Chemists • Petroleum Marketers Association
Rural Water Association • Mining and Reclamation Association

ALLIANT TECHSYSTEMS, INC.
P O BOX 1 STATE ROUTE 114
RADFORD VA 24141

REIC JOB #: 1297-57482
CUSTODY NO.'S: 57957 & 57956

Prepared By:
REI Consultants, Inc.
P O Box 286
Beaver WV 25813

Phone: 304-255-2500
800-999-0105
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ATI SAMPLE #: 07.03.01
REIC SAMPLE #: 57482-1

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 22%

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/kg	8021A	5	01-06-98/TC
Carbon Tetrachloride	ND	ug/kg	8021A	5	01-06-98/TC
Chlorobenzene	ND	ug/kg	8021A	5	01-06-98/TC
Chloroform	ND	ug/kg	8021A	5	01-06-98/TC
trans-1,2-Dichloroethene	ND	ug/kg	8021A	5	01-06-98/TC
Hexachlorobutadiene	ND	ug/kg	8021A	5	01-06-98/TC
Methyl Bromide	ND	ug/kg	8021A	5	01-06-98/TC
Methyl Chloride	ND	ug/kg	8021A	5	01-06-98/TC
Methylene Chloride	ND	ug/kg	8021A	5	01-06-98/TC
Naphthalene	ND	ug/kg	8021A	5	01-06-98/TC
Tetrachloroethene	ND	ug/kg	8021A	5	01-06-98/TC
Toluene	ND	ug/kg	8021A	5	01-06-98/TC
1,2,4-Trichlorobenzene	ND	ug/kg	8021A	5	01-06-98/TC
1,1,1-Trichloroethane	ND	ug/kg	8021A	5	01-06-98/TC
1,1,2-Trichloroethane	ND	ug/kg	8021A	5	01-06-98/TC
Trichloroethene	ND	ug/kg	8021A	5	01-06-98/TC
Trichlorofluoromethane	ND	ug/kg	8021A	5	01-06-98/TC
Vinyl Chloride	ND	ug/kg	8021A	5	01-06-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	*45
1,1,1-trifluorotoluene	67

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #:	**07.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-1**	**MATRIX:**	**SOLID**
		MOISTURE:	**22%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/kg	8240B	100	01-06-98/TC
Carbon Disulfide	ND	ug/kg	8240B	20	01-06-98/TC
Methyl Ethyl Ketone	ND	ug/kg	8240B	100	01-06-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	*68
toluene-D8	*164
4-bromofluorobenzene	*54

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/kg	8070	67	01-10-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	85

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	62

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #: 07.03.01
REIC SAMPLE #: 57482-1

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 22%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/kg	8110	30	01-08-98/JA
Bis(2-chloroethyl) ether	ND	ug/kg	8110	30	01-08-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/kg	8110	30	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	101

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachloroethane	ND	ug/kg	8121	3.3	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	102

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/kg	8151	17	01-06-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	95

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**07.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-1**	**MATRIX:**	**SOLID**
		MOISTURE:	**22%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Butyl benzyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
4-Chloro-3-methyl phenol	ND	ug/kg	8270B	330	01-06-98/WP
2-Chlorophenol	ND	ug/kg	8270B	330	01-06-98/WP
Di-n-butyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Diethyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
2,4-Dimethylphenol	ND	ug/kg	8270B	330	01-06-98/WP
Dimethyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/kg	8270B	330	01-06-98/WP
Di-n-octyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Phenol	ND	ug/kg	8270B	330	01-06-98/WP
2,4,5-Trichlorophenol	ND	ug/kg	8270B	330	01-06-98/WP
2,4,6-Trichlorophenol	ND	ug/kg	8270B	330	01-06-98/WP

Surrogates	% Recovery
2-fluorophenol	*2
phenol-d6	*2
2,4,6-tribromophenol	*2

Surrogates	% Recovery
nitrobenzene-d5	*3
2-fluorobiphenyl	*4
p-terphenyl-d14	*2

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #:	**07.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-1**	**MATRIX:**	**SOLID**
		MOISTURE:	**22%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/kg	8310	140	01-13-98/WP
Fluorene	ND	ug/kg	8310	140	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/kg	8330	250	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**07.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-1**	**MATRIX:**	**SOLID**
		MOISTURE:	**22%**

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1221	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1232	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1242	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1248	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1254	4210	ug/kg	8082	2500	01-07-98/JA
PCB-1260	ND	ug/kg	8082	2500	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	94

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/kg	8081	3	01-07-98/JA
Chlordane	ND	ug/kg	8081	9.4	01-07-98/JA
Dieldrin	ND	ug/kg	8081	1.3	01-07-98/JA
Endosulfan I	ND	ug/kg	8081	9.4	01-07-98/JA
Endosulfan II	ND	ug/kg	8081	3	01-07-98/JA
Endrin	ND	ug/kg	8081	4	01-07-98/JA
Heptachlor	ND	ug/kg	8081	2	01-07-98/JA
Heptachlor Epoxide	ND	ug/kg	8081	21	01-07-98/JA
Methoxychlor	ND	ug/kg	8081	120	01-07-98/JA
Toxaphene	ND	ug/kg	8081	57	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	94

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**07.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-1**	**MATRIX:**	**SOLID**

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	28200	ug/kg	6020	100	12-30-97/KC
Beryllium	458	ug/kg	6020	100	12-30-97/KC
Cadmium	190	ug/kg	6020	100	12-30-97/KC
Chromium	72800	ug/kg	6020	100	12-30-97/KC
Lead	28800	ug/kg	6020	100	12-30-97/KC
Mercury	280	ug/kg	7470A	100	01-02-98/MR
Nickel	22200	ug/kg	6020	100	12-30-97/KC
Selenium	ND	ug/kg	6020	300	12-30-97/KC
Silver	452	ug/kg	6020	100	12-30-97/KC
Thallium	ND	ug/kg	6020	100	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	ND	ug/kg	9010A	500	01-05-98/LK

ND - None Detected at PQL
PQL - Practical Quantitation Limit

ATI SAMPLE #: 08.04.01
REIC SAMPLE #: 57482-2

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 76%

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/kg	8021A	5	01-02-98/TC
Carbon Tetrachloride	ND	ug/kg	8021A	5	01-02-98/TC
Chlorobenzene	ND	ug/kg	8021A	5	01-02-98/TC
Chloroform	ND	ug/kg	8021A	5	01-02-98/TC
trans-1,2-Dichloroethene	ND	ug/kg	8021A	5	01-02-98/TC
Hexachlorobutadiene	ND	ug/kg	8021A	5	01-02-98/TC
Methyl Bromide	ND	ug/kg	8021A	5	01-02-98/TC
Methyl Chloride	ND	ug/kg	8021A	5	01-02-98/TC
Methylene Chloride	ND	ug/kg	8021A	5	01-02-98/TC
Naphthalene	ND	ug/kg	8021A	5	01-02-98/TC
Tetrachloroethene	ND	ug/kg	8021A	5	01-02-98/TC
Toluene	ND	ug/kg	8021A	5	01-02-98/TC
1,2,4-Trichlorobenzene	ND	ug/kg	8021A	5	01-02-98/TC
1,1,1-Trichloroethane	ND	ug/kg	8021A	5	01-02-98/TC
1,1,2-Trichloroethane	ND	ug/kg	8021A	5	01-02-98/TC
Trichloroethene	ND	ug/kg	8021A	5	01-02-98/TC
Trichlorofluoromethane	ND	ug/kg	8021A	5	01-02-98/TC
Vinyl Chloride	ND	ug/kg	8021A	5	01-02-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	85
1,1,1-trifluorotoluene	90

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**08.04.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-2**	**MATRIX:**	**SOLID**
		MOISTURE:	**76%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/kg	8240B	100	01-01-98/TC
Carbon Disulfide	ND	ug/kg	8240B	20	01-01-98/TC
Methyl Ethyl Ketone	ND	ug/kg	8240B	100	01-01-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	84
toluene-D8	107
4-bromofluorobenzene	84

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/kg	8070	67	01-10-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	37

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	68

ND - None Detected at Reporting Limit

ATI SAMPLE #: 08.04.01
REIC SAMPLE #: 57482-2

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 76%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/kg	8110	30	01-08-98/JA
Bis(2-chloroethyl) ether	ND	ug/kg	8110	30	01-08-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/kg	8110	30	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	82

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachloroethane	ND	ug/kg	8121	3.3	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	68

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/kg	8151	17	01-06-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	96

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**08.04.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-2**	**MATRIX:**	**SOLID**
		MOISTURE:	**76%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Butyl benzyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
4-Chloro-3-methyl phenol	ND	ug/kg	8270B	330	01-06-98/WP
2-Chlorophenol	ND	ug/kg	8270B	330	01-06-98/WP
Di-n-butyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Diethyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
2,4-Dimethylphenol	ND	ug/kg	8270B	330	01-06-98/WP
Dimethyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/kg	8270B	330	01-06-98/WP
Di-n-octyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Phenol	ND	ug/kg	8270B	330	01-06-98/WP
2,4,5-Trichlorophenol	ND	ug/kg	8270B	330	01-06-98/WP
2,4,6-Trichlorophenol	ND	ug/kg	8270B	330	01-06-98/WP

Surrogates	% Recovery
2-fluorophenol	*6
phenol-d6	*4
2,4,6-tribromophenol	*7

Surrogates	% Recovery
nitrobenzene-d5	*6
2-fluorobiphenyl	*7
p-terphenyl-d14	*5

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #: 08.04.01
REIC SAMPLE #: 57482-2

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 76%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/kg	8310	140	01-13-98/WP
Fluorene	ND	ug/kg	8310	140	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/kg	8330	250	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #: 08.04.01
REIC SAMPLE #: 57482-2

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 76%

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1221	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1232	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1242	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1248	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1254	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1260	ND	ug/kg	8082	2500	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	64

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/kg	8081	3	01-07-98/JA
Chlordane	ND	ug/kg	8081	9.4	01-07-98/JA
Dieldrin	ND	ug/kg	8081	1.3	01-07-98/JA
Endosulfan I	ND	ug/kg	8081	9.4	01-07-98/JA
Endosulfan II	ND	ug/kg	8081	3	01-07-98/JA
Endrin	ND	ug/kg	8081	4	01-07-98/JA
Heptachlor	ND	ug/kg	8081	2	01-07-98/JA
Heptachlor Epoxide	ND	ug/kg	8081	21	01-07-98/JA
Methoxychlor	ND	ug/kg	8081	120	01-07-98/JA
Toxaphene	ND	ug/kg	8081	57	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	64

ND - None Detected at Reporting Limit

ATI SAMPLE #: 08.04.01
REIC SAMPLE #: 57482-2

DATE SAMPLED: 12-23-97
MATRIX: SOLID

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	40200	ug/kg	6020	100	12-30-97/KC
Beryllium	364	ug/kg	6020	100	12-30-97/KC
Cadmium	ND	ug/kg	6020	100	12-30-97/KC
Chromium	25800	ug/kg	6020	100	12-30-97/KC
Lead	10500	ug/kg	6020	100	12-30-97/KC
Mercury	ND	ug/kg	7470A	100	01-02-98/MR
Nickel	7500	ug/kg	6020	100	12-30-97/KC
Selenium	ND	ug/kg	6020	300	12-30-97/KC
Silver	ND	ug/kg	6020	100	12-30-97/KC
Thallium	134	ug/kg	6020	100	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	ND	ug/kg	9010A	500	01-05-98/LK

ND - None Detected at PQL
PQL - Practical Quantitation Limit

ATI SAMPLE #: 02.03.04
REIC SAMPLE #: 57482-3

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 69%

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/kg	8021A	5	01-02-98/TC
Carbon Tetrachloride	ND	ug/kg	8021A	5	01-02-98/TC
Chlorobenzene	ND	ug/kg	8021A	5	01-02-98/TC
Chloroform	ND	ug/kg	8021A	5	01-02-98/TC
trans-1,2-Dichloroethene	ND	ug/kg	8021A	5	01-02-98/TC
Hexachlorobutadiene	ND	ug/kg	8021A	5	01-02-98/TC
Methyl Bromide	ND	ug/kg	8021A	5	01-02-98/TC
Methyl Chloride	ND	ug/kg	8021A	5	01-02-98/TC
Methylene Chloride	ND	ug/kg	8021A	5	01-02-98/TC
Naphthalene	ND	ug/kg	8021A	5	01-02-98/TC
Tetrachloroethene	ND	ug/kg	8021A	5	01-02-98/TC
Toluene	ND	ug/kg	8021A	5	01-02-98/TC
1,2,4-Trichlorobenzene	ND	ug/kg	8021A	5	01-02-98/TC
1,1,1-Trichloroethane	ND	ug/kg	8021A	5	01-02-98/TC
1,1,2-Trichloroethane	ND	ug/kg	8021A	5	01-02-98/TC
Trichloroethene	ND	ug/kg	8021A	5	01-02-98/TC
Trichlorofluoromethane	ND	ug/kg	8021A	5	01-02-98/TC
Vinyl Chloride	ND	ug/kg	8021A	5	01-02-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	76
1,1,1-trifluorotoluene	80

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**02.03.04**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-3**	**MATRIX:**	**SOLID**
		MOISTURE:	**69%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/kg	8240B	100	01-05-98/TC
Carbon Disulfide	ND	ug/kg	8240B	20	01-05-98/TC
Methyl Ethyl Ketone	ND	ug/kg	8240B	100	01-05-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	79
toluene-D8	117
4-bromofluorobenzene	74

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/kg	8070	67	01-10-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	65

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	79

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**02.03.04**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-3**	**MATRIX:**	**SOLID**
		MOISTURE:	**69%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroethyl) ether	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/kg	8110	30	01-09-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	86

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachloroethane	ND	ug/kg	8121	3.3	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	52

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/kg	8151	17	01-06-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	96

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**02.03.04**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-3**	**MATRIX:**	**SOLID**
		MOISTURE:	**69%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Butyl benzyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
4-Chloro-3-methyl phenol	ND	ug/kg	8270B	330	01-06-98/WP
2-Chlorophenol	ND	ug/kg	8270B	330	01-06-98/WP
Di-n-butyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Diethyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
2,4-Dimethylphenol	ND	ug/kg	8270B	330	01-06-98/WP
Dimethyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/kg	8270B	330	01-06-98/WP
Di-n-octyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Phenol	ND	ug/kg	8270B	330	01-06-98/WP
2,4,5-Trichlorophenol	ND	ug/kg	8270B	330	01-06-98/WP
2,4,6-Trichlorophenol	ND	ug/kg	8270B	330	01-06-98/WP

Surrogates	% Recovery
2-fluorophenol	*5
phenol-d6	*5
2,4,6-tribromophenol	*6

Surrogates	% Recovery
nitrobenzene-d5	*6
2-fluorobiphenyl	*8
p-terphenyl-d14	*3

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #:	**02.03.04**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-3**	**MATRIX:**	**SOLID**
		MOISTURE:	**69%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/kg	8310	140	01-13-98/WP
Fluorene	ND	ug/kg	8310	140	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/kg	8330	250	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #: 02.03.04
REIC SAMPLE #: 57482-3

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 69%

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1221	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1232	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1242	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1248	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1254	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1260	ND	ug/kg	8082	2500	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	90

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/kg	8081	3	01-07-98/JA
Chlordane	ND	ug/kg	8081	9.4	01-07-98/JA
Dieldrin	ND	ug/kg	8081	1.3	01-07-98/JA
Endosulfan I	ND	ug/kg	8081	9.4	01-07-98/JA
Endosulfan II	ND	ug/kg	8081	3	01-07-98/JA
Endrin	ND	ug/kg	8081	4	01-07-98/JA
Heptachlor	ND	ug/kg	8081	2	01-07-98/JA
Heptachlor Epoxide	ND	ug/kg	8081	21	01-07-98/JA
Methoxychlor	ND	ug/kg	8081	120	01-07-98/JA
Toxaphene	ND	ug/kg	8081	57	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	90

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**02.03.04**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-3**	**MATRIX:**	**SOLID**

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	86700	ug/kg	6020	100	12-30-97/KC
Beryllium	571	ug/kg	6020	100	12-30-97/KC
Cadmium	145	ug/kg	6020	100	12-30-97/KC
Chromium	32400	ug/kg	6020	100	12-30-97/KC
Lead	43800	ug/kg	6020	100	12-30-97/KC
Mercury	130	ug/kg	7470A	100	01-02-98/MR
Nickel	14200	ug/kg	6020	100	12-30-97/KC
Selenium	ND	ug/kg	6020	300	12-30-97/KC
Silver	333	ug/kg	6020	100	12-30-97/KC
Thallium	261	ug/kg	6020	100	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	ND	ug/kg	9010A	500	01-05-98/LK

ND - None Detected at PQL
PQL - Practical Quantitation Limit

ATI SAMPLE #: 02.03.01
REIC SAMPLE #: 57482-4

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 63%

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/kg	8021A	5	01-05-98/TC
Carbon Tetrachloride	ND	ug/kg	8021A	5	01-05-98/TC
Chlorobenzene	ND	ug/kg	8021A	5	01-05-98/TC
Chloroform	ND	ug/kg	8021A	5	01-05-98/TC
trans-1,2-Dichloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Hexachlorobutadiene	ND	ug/kg	8021A	5	01-05-98/TC
Methyl Bromide	ND	ug/kg	8021A	5	01-05-98/TC
Methyl Chloride	ND	ug/kg	8021A	5	01-05-98/TC
Methylene Chloride	ND	ug/kg	8021A	5	01-05-98/TC
Naphthalene	ND	ug/kg	8021A	5	01-05-98/TC
Tetrachloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Toluene	ND	ug/kg	8021A	5	01-05-98/TC
1,2,4-Trichlorobenzene	ND	ug/kg	8021A	5	01-05-98/TC
1,1,1-Trichloroethane	ND	ug/kg	8021A	5	01-05-98/TC
1,1,2-Trichloroethane	ND	ug/kg	8021A	5	01-05-98/TC
Trichloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Trichlorofluoromethane	ND	ug/kg	8021A	5	01-05-98/TC
Vinyl Chloride	ND	ug/kg	8021A	5	01-05-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	77
1,1,1-trifluorotoluene	74

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**02.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-4**	**MATRIX:**	**SOLID**
		MOISTURE:	**63%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/kg	8240B	100	01-02-98/TC
Carbon Disulfide	ND	ug/kg	8240B	20	01-02-98/TC
Methyl Ethyl Ketone	ND	ug/kg	8240B	100	01-02-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	88
toluene-D8	105
4-bromofluorobenzene	81

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/kg	8070	67	01-10-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	50

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	*22

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #:	**02.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-4**	**MATRIX:**	**SOLID**
		MOISTURE:	**63%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroethyl) ether	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/kg	8110	30	01-09-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	31

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachloroethane	ND	ug/kg	8121	3.3	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	*22

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/kg	8151	17	01-06-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	98

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #:	**02.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-4**	**MATRIX:**	**SOLID**
		MOISTURE:	**63%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Butyl benzyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
4-Chloro-3-methyl phenol	ND	ug/kg	8270B	330	01-06-98/WP
2-Chlorophenol	ND	ug/kg	8270B	330	01-06-98/WP
Di-n-butyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Diethyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
2,4-Dimethylphenol	ND	ug/kg	8270B	330	01-06-98/WP
Dimethyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/kg	8270B	330	01-06-98/WP
Di-n-octyl phthalate	ND	ug/kg	8270B	330	01-06-98/WP
Phenol	ND	ug/kg	8270B	330	01-06-98/WP
2,4,5-Trichlorophenol	ND	ug/kg	8270B	330	01-06-98/WP
2,4,6-Trichlorophenol	ND	ug/kg	8270B	330	01-06-98/WP

Surrogates	% Recovery
2-fluorophenol	*5
phenol-d6	*5
2,4,6-tribromophenol	*4

Surrogates	% Recovery
nitrobenzene-d5	*6
2-fluorobiphenyl	*9
p-terphenyl-d14	*3

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #: 02.03.01
REIC SAMPLE #: 57482-4

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 63%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/kg	8310	140	01-13-98/WP
Fluorene	ND	ug/kg	8310	140	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/kg	8330	250	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**02.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-4**	**MATRIX:**	**SOLID**
		MOISTURE:	**63%**

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1221	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1232	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1242	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1248	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1254	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1260	ND	ug/kg	8082	2500	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	*21

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/kg	8081	3	01-07-98/JA
Chlordane	ND	ug/kg	8081	9.4	01-07-98/JA
Dieldrin	ND	ug/kg	8081	1.3	01-07-98/JA
Endosulfan I	ND	ug/kg	8081	9.4	01-07-98/JA
Endosulfan II	ND	ug/kg	8081	3	01-07-98/JA
Endrin	ND	ug/kg	8081	4	01-07-98/JA
Heptachlor	ND	ug/kg	8081	2	01-07-98/JA
Heptachlor Epoxide	ND	ug/kg	8081	21	01-07-98/JA
Methoxychlor	ND	ug/kg	8081	120	01-07-98/JA
Toxaphene	ND	ug/kg	8081	57	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	*21

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #: 02.03.01 **DATE SAMPLED:** 12-23-97
REIC SAMPLE #: 57482-4 **MATRIX:** SOLID

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	76000	ug/kg	6020	100	12-30-97/KC
Beryllium	511	ug/kg	6020	100	12-30-97/KC
Cadmium	ND	ug/kg	6020	100	12-30-97/KC
Chromium	32400	ug/kg	6020	100	12-30-97/KC
Lead	21300	ug/kg	6020	100	12-30-97/KC
Mercury	140	ug/kg	7470A	100	01-02-98/MR
Nickel	11800	ug/kg	6020	100	12-30-97/KC
Selenium	ND	ug/kg	6020	300	12-30-97/KC
Silver	244	ug/kg	6020	100	12-30-97/KC
Thallium	213	ug/kg	6020	100	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	ND	ug/kg	9010A	500	01-05-98/LK

ND - None Detected at PQL
PQL - Practical Quantitation Limit
NOTE - Internal Standards failed REIC control limits of Method 6020.

ATI SAMPLE #:	**09.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-5**	**MATRIX:**	**SOLID**
		MOISTURE:	**84%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/kg	8021A	5	01-05-98/TC
Carbon Tetrachloride	ND	ug/kg	8021A	5	01-05-98/TC
Chlorobenzene	ND	ug/kg	8021A	5	01-05-98/TC
Chloroform	ND	ug/kg	8021A	5	01-05-98/TC
trans-1,2-Dichloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Hexachlorobutadiene	ND	ug/kg	8021A	5	01-05-98/TC
Methyl Bromide	ND	ug/kg	8021A	5	01-05-98/TC
Methyl Chloride	ND	ug/kg	8021A	5	01-05-98/TC
Methylene Chloride	ND	ug/kg	8021A	5	01-05-98/TC
Naphthalene	ND	ug/kg	8021A	5	01-05-98/TC
Tetrachloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Toluene	ND	ug/kg	8021A	5	01-05-98/TC
1,2,4-Trichlorobenzene	ND	ug/kg	8021A	5	01-05-98/TC
1,1,1-Trichloroethane	ND	ug/kg	8021A	5	01-05-98/TC
1,1,2-Trichloroethane	ND	ug/kg	8021A	5	01-05-98/TC
Trichloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Trichlorofluoromethane	ND	ug/kg	8021A	5	01-05-98/TC
Vinyl Chloride	ND	ug/kg	8021A	5	01-05-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	94
1,1,1-trifluorotoluene	82

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**09.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-5**	**MATRIX:**	**SOLID**
		MOISTURE:	**84%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/kg	8240B	100	01-06-98/TC
Carbon Disulfide	ND	ug/kg	8240B	20	01-06-98/TC
Methyl Ethyl Ketone	ND	ug/kg	8240B	100	01-06-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	85
toluene-D8	100
4-bromofluorobenzene	94

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/kg	8070	67	01-10-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	*12

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	64

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #:	**09.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-5**	**MATRIX:**	**SOLID**
		MOISTURE:	**84%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroethyl) ether	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/kg	8110	30	01-09-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	63

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachloroethane	ND	ug/kg	8121	3.3	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	46

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/kg	8151	17	01-06-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	92

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**09.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-5**	**MATRIX:**	**SOLID**
		MOISTURE:	**84%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Butyl benzyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4-Chloro-3-methyl phenol	ND	ug/kg	8270B	330	01-07-98/WP
2-Chlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-butyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Diethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
2,4-Dimethylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Dimethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-octyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Phenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,5-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,6-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP

Surrogates	% Recovery
2-fluorophenol	*12
phenol-d6	*13
2,4,6-tribromophenol	60

Surrogates	% Recovery
nitrobenzene-d5	*14
2-fluorobiphenyl	*18
p-terphenyl-d14	24

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #:	**09.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-5**	**MATRIX:**	**SOLID**
		MOISTURE:	**84%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/kg	8310	140	01-13-98/WP
Fluorene	ND	ug/kg	8310	140	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/kg	8330	250	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**09.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-5**	**MATRIX:**	**SOLID**
		MOISTURE:	**84%**

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1221	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1232	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1242	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1248	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1254	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1260	ND	ug/kg	8082	2500	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	53

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/kg	8081	3	01-07-98/JA
Chlordane	ND	ug/kg	8081	9.4	01-07-98/JA
Dieldrin	ND	ug/kg	8081	1.3	01-07-98/JA
Endosulfan I	ND	ug/kg	8081	9.4	01-07-98/JA
Endosulfan II	ND	ug/kg	8081	3	01-07-98/JA
Endrin	ND	ug/kg	8081	4	01-07-98/JA
Heptachlor	ND	ug/kg	8081	2	01-07-98/JA
Heptachlor Epoxide	ND	ug/kg	8081	21	01-07-98/JA
Methoxychlor	ND	ug/kg	8081	120	01-07-98/JA
Toxaphene	ND	ug/kg	8081	57	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	53

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**09.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-5**	**MATRIX:**	**SOLID**

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	127000	ug/kg	6020	100	12-30-97/KC
Beryllium	876	ug/kg	6020	100	12-30-97/KC
Cadmium	175	ug/kg	6020	100	12-30-97/KC
Chromium	21000	ug/kg	6020	100	12-30-97/KC
Lead	16600	ug/kg	6020	100	12-30-97/KC
Mercury	ND	ug/kg	7470A	100	01-02-98/MR
Nickel	13500	ug/kg	6020	100	12-30-97/KC
Selenium	ND	ug/kg	6020	300	12-30-97/KC
Silver	ND	ug/kg	6020	100	12-30-97/KC
Thallium	138	ug/kg	6020	100	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	ND	ug/kg	9010A	500	01-05-98/LK

ND - None Detected at PQL
PQL - Practical Quantitation Limit

ATI SAMPLE #:	**12.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-6**	**MATRIX:**	**SOLID**
		MOISTURE:	**87%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/kg	8021A	5	01-05-98/TC
Carbon Tetrachloride	ND	ug/kg	8021A	5	01-05-98/TC
Chlorobenzene	ND	ug/kg	8021A	5	01-05-98/TC
Chloroform	ND	ug/kg	8021A	5	01-05-98/TC
trans-1,2-Dichloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Hexachlorobutadiene	ND	ug/kg	8021A	5	01-05-98/TC
Methyl Bromide	ND	ug/kg	8021A	5	01-05-98/TC
Methyl Chloride	ND	ug/kg	8021A	5	01-05-98/TC
Methylene Chloride	ND	ug/kg	8021A	5	01-05-98/TC
Naphthalene	ND	ug/kg	8021A	5	01-05-98/TC
Tetrachloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Toluene	ND	ug/kg	8021A	5	01-05-98/TC
1,2,4-Trichlorobenzene	ND	ug/kg	8021A	5	01-05-98/TC
1,1,1-Trichloroethane	ND	ug/kg	8021A	5	01-05-98/TC
1,1,2-Trichloroethane	ND	ug/kg	8021A	5	01-05-98/TC
Trichloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Trichlorofluoromethane	ND	ug/kg	8021A	5	01-05-98/TC
Vinyl Chloride	ND	ug/kg	8021A	5	01-05-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	86
1,1,1-trifluorotoluene	78

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**12.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-6**	**MATRIX:**	**SOLID**
		MOISTURE:	**87%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/kg	8240B	100	01-02-98/TC
Carbon Disulfide	ND	ug/kg	8240B	20	01-02-98/TC
Methyl Ethyl Ketone	ND	ug/kg	8240B	100	01-02-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	87
toluene-D8	104
4-bromofluorobenzene	85

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/kg	8070	67	01-10-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	56

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	66

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**12.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-6**	**MATRIX:**	**SOLID**
		MOISTURE:	**87%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroethyl) ether	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/kg	8110	30	01-09-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	86

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachloroethane	ND	ug/kg	8121	3.3	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	72

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/kg	8151	17	01-06-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	96

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**12.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-6**	**MATRIX:**	**SOLID**
		MOISTURE:	**87%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Butyl benzyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4-Chloro-3-methyl phenol	ND	ug/kg	8270B	330	01-07-98/WP
2-Chlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-butyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Diethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
2,4-Dimethylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Dimethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-octyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Phenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,5-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,6-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP

Surrogates	% Recovery
2-fluorophenol	39
phenol-d6	38
2,4,6-tribromophenol	53

Surrogates	% Recovery
nitrobenzene-d5	36
2-fluorobiphenyl	42
p-terphenyl-d14	21

ND - None Detected at Reporting Limit

ATI SAMPLE #: 12.03.01
REIC SAMPLE #: 57482-6

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 87%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/kg	8310	140	01-13-98/WP
Fluorene	ND	ug/kg	8310	140	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/kg	8330	250	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**12.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-6**	**MATRIX:**	**SOLID**
		MOISTURE:	**87%**

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1221	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1232	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1242	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1248	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1254	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1260	ND	ug/kg	8082	2500	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	64

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/kg	8081	3	01-07-98/JA
Chlordane	ND	ug/kg	8081	9.4	01-07-98/JA
Dieldrin	ND	ug/kg	8081	1.3	01-07-98/JA
Endosulfan I	ND	ug/kg	8081	9.4	01-07-98/JA
Endosulfan II	ND	ug/kg	8081	3	01-07-98/JA
Endrin	ND	ug/kg	8081	4	01-07-98/JA
Heptachlor	ND	ug/kg	8081	2	01-07-98/JA
Heptachlor Epoxide	ND	ug/kg	8081	21	01-07-98/JA
Methoxychlor	ND	ug/kg	8081	120	01-07-98/JA
Toxaphene	ND	ug/kg	8081	57	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	64

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**12.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-6**	**MATRIX:**	**SOLID**

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	73800	ug/kg	6020	100	12-30-97/KC
Beryllium	223	ug/kg	6020	100	12-30-97/KC
Cadmium	ND	ug/kg	6020	100	12-30-97/KC
Chromium	10100	ug/kg	6020	100	12-30-97/KC
Lead	11400	ug/kg	6020	100	12-30-97/KC
Mercury	180	ug/kg	7470A	100	01-02-98/MR
Nickel	9520	ug/kg	6020	100	12-30-97/KC
Selenium	ND	ug/kg	6020	300	12-30-97/KC
Silver	ND	ug/kg	6020	100	12-30-97/KC
Thallium	ND	ug/kg	6020	100	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	ND	ug/kg	9010A	500	01-05-98/LK

ND - None Detected at PQL
PQL - Practical Quantitation Limit

ATI SAMPLE #:	**04.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-7**	**MATRIX:**	**SOLID**
		MOISTURE:	**53%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/kg	8021A	5	01-06-98/TC
Carbon Tetrachloride	ND	ug/kg	8021A	5	01-06-98/TC
Chlorobenzene	ND	ug/kg	8021A	5	01-06-98/TC
Chloroform	ND	ug/kg	8021A	5	01-06-98/TC
trans-1,2-Dichloroethene	ND	ug/kg	8021A	5	01-06-98/TC
Hexachlorobutadiene	ND	ug/kg	8021A	5	01-06-98/TC
Methyl Bromide	ND	ug/kg	8021A	5	01-06-98/TC
Methyl Chloride	ND	ug/kg	8021A	5	01-06-98/TC
Methylene Chloride	ND	ug/kg	8021A	5	01-06-98/TC
Naphthalene	ND	ug/kg	8021A	5	01-06-98/TC
Tetrachloroethene	ND	ug/kg	8021A	5	01-06-98/TC
Toluene	ND	ug/kg	8021A	5	01-06-98/TC
1,2,4-Trichlorobenzene	ND	ug/kg	8021A	5	01-06-98/TC
1,1,1-Trichloroethane	ND	ug/kg	8021A	5	01-06-98/TC
1,1,2-Trichloroethane	ND	ug/kg	8021A	5	01-06-98/TC
Trichloroethene	ND	ug/kg	8021A	5	01-06-98/TC
Trichlorofluoromethane	ND	ug/kg	8021A	5	01-06-98/TC
Vinyl Chloride	ND	ug/kg	8021A	5	01-06-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	70
1,1,1-trifluorotoluene	73

ND - None Detected at Reporting Limit

ATI SAMPLE #: 04.03.01
REIC SAMPLE #: 57482-7

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 53%

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/kg	8240B	100	01-06-98/TC
Carbon Disulfide	ND	ug/kg	8240B	20	01-06-98/TC
Methyl Ethyl Ketone	ND	ug/kg	8240B	100	01-06-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	76
toluene-D8	109
4-bromofluorobenzene	74

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/kg	8070	67	01-11-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	29

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	63

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**04.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-7**	**MATRIX:**	**SOLID**
		MOISTURE:	**53%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroethyl) ether	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/kg	8110	30	01-09-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	68

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachloroethane	ND	ug/kg	8121	3.3	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	62

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/kg	8151	17	01-06-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	96

ND - None Detected at Reporting Limit

ATI SAMPLE #: 04.03.01
REIC SAMPLE #: 57482-7

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 53%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Butyl benzyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4-Chloro-3-methyl phenol	ND	ug/kg	8270B	330	01-07-98/WP
2-Chlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-butyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Diethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
2,4-Dimethylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Dimethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-octyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Phenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,5-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,6-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP

Surrogates	% Recovery
2-fluorophenol	*6
phenol-d6	*6
2,4,6-tribromophenol	*6

Surrogates	% Recovery
nitrobenzene-d5	*10
2-fluorobiphenyl	*10
p-terphenyl-d14	*4

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #: 04.03.01
REIC SAMPLE #: 57482-7

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 53%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/kg	8310	140	01-13-98/WP
Fluorene	ND	ug/kg	8310	140	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/kg	8330	250	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**04.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-7**	**MATRIX:**	**SOLID**
		MOISTURE:	**53%**

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1221	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1232	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1242	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1248	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1254	14800	ug/kg	8082	2500	01-07-98/JA
PCB-1260	ND	ug/kg	8082	2500	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	82

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/kg	8081	3	01-07-98/JA
Chlordane	ND	ug/kg	8081	9.4	01-07-98/JA
Dieldrin	ND	ug/kg	8081	1.3	01-07-98/JA
Endosulfan I	ND	ug/kg	8081	9.4	01-07-98/JA
Endosulfan II	ND	ug/kg	8081	3	01-07-98/JA
Endrin	ND	ug/kg	8081	4	01-07-98/JA
Heptachlor	ND	ug/kg	8081	2	01-07-98/JA
Heptachlor Epoxide	ND	ug/kg	8081	21	01-07-98/JA
Methoxychlor	ND	ug/kg	8081	120	01-07-98/JA
Toxaphene	ND	ug/kg	8081	57	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	82

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**04.03.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-7**	**MATRIX:**	**SOLID**

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	58800	ug/kg	6020	100	12-30-97/KC
Beryllium	398	ug/kg	6020	100	12-30-97/KC
Cadmium	116	ug/kg	6020	100	12-30-97/KC
Chromium	26900	ug/kg	6020	100	12-30-97/KC
Lead	41200	ug/kg	6020	100	12-30-97/KC
Mercury	100	ug/kg	7470A	100	01-02-98/MR
Nickel	12000	ug/kg	6020	100	12-30-97/KC
Selenium	ND	ug/kg	6020	300	12-30-97/KC
Silver	245	ug/kg	6020	100	12-30-97/KC
Thallium	ND	ug/kg	6020	100	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	ND	ug/kg	9010A	500	01-05-98/LK

ND - None Detected at PQL
PQL - Practical Quantitation Limit
NOTE - Internal Standards failed REIC control limits of Method 6020.

ATI SAMPLE #:	**08.08.05**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-8**	**MATRIX:**	**LIQUID**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/l	8021A	1	01-06-98/TC
Carbon Tetrachloride	ND	ug/l	8021A	1	01-06-98/TC
Chlorobenzene	ND	ug/l	8021A	1	01-06-98/TC
Chloroform	5	ug/l	8021A	1	01-06-98/TC
trans-1,2-Dichloroethene	ND	ug/l	8021A	1	01-06-98/TC
Hexachlorobutadiene	ND	ug/l	8021A	1	01-06-98/TC
Methyl Bromide	ND	ug/l	8021A	1	01-06-98/TC
Methyl Chloride	ND	ug/l	8021A	1	01-06-98/TC
Methylene Chloride	1	ug/l	8021A	1	01-06-98/TC
Naphthalene	ND	ug/l	8021A	1	01-06-98/TC
Tetrachloroethene	ND	ug/l	8021A	1	01-06-98/TC
Toluene	ND	ug/l	8021A	1	01-06-98/TC
1,2,4-Trichlorobenzene	ND	ug/l	8021A	1	01-06-98/TC
1,1,1-Trichloroethane	ND	ug/l	8021A	1	01-06-98/TC
1,1,2-Trichloroethane	ND	ug/l	8021A	1	01-06-98/TC
Trichloroethene	ND	ug/l	8021A	1	01-06-98/TC
Trichlorofluoromethane	ND	ug/l	8021A	1	01-06-98/TC
Vinyl Chloride	ND	ug/l	8021A	1	01-06-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	82
1,1,1-trifluorotoluene	81

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**08.08.05**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-8**	**MATRIX:**	**LIQUID**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/l	8240B	100	01-02-98/TC
Carbon Disulfide	ND	ug/l	8240B	20	01-02-98/TC
Methyl Ethyl Ketone	ND	ug/l	8240B	100	01-02-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	85
toluene-D8	102
4-bromofluorobenzene	95

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/l	8070	10	01-11-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	39

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/l	8090	1.5	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/l	8090	1.5	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	115

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**08.08.05**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-8**	**MATRIX:**	**LIQUID**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/l	8110	4.5	01-09-98/JA
Bis(2-chloroethyl) ether	ND	ug/l	8110	4.5	01-09-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/l	8110	4.5	01-09-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	92

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/l	8121	0.50	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/l	8121	0.50	01-08-98/JA
Hexachloroethane	ND	ug/l	8121	0.50	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	90

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/l	8151	0.85	01-06-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	95

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**08.08.05**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-8**	**MATRIX:**	**LIQUID**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/l	8270B	30	01-07-98/WP
Butyl benzyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
4-Chloro-3-methyl phenol	ND	ug/l	8270B	60	01-07-98/WP
2-Chlorophenol	ND	ug/l	8270B	60	01-07-98/WP
Di-n-butyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
Diethyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
2,4-Dimethylphenol	ND	ug/l	8270B	60	01-07-98/WP
Dimethyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/l	8270B	60	01-07-98/WP
Di-n-octyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
Phenol	ND	ug/l	8270B	60	01-07-98/WP
2,4,5-Trichlorophenol	ND	ug/l	8270B	60	01-07-98/WP
2,4,6-Trichlorophenol	ND	ug/l	8270B	60	01-07-98/WP

Surrogates	% Recovery
2-fluorophenol	26
phenol-d6	26
2,4,6-tribromophenol	40

Surrogates	% Recovery
nitrobenzene-d5	56
2-fluorobiphenyl	62
p-terphenyl-d14	35

ND - None Detected at Reporting Limit

ATI SAMPLE #: 08.08.05 **DATE SAMPLED:** 12-23-97
REIC SAMPLE #: 57482-8 **MATRIX:** LIQUID

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/l	8310	10	01-13-98/WP
Fluorene	ND	ug/l	8310	10	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/l	8330	20	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #: **08.08.05** **DATE SAMPLED:** **12-23-97**
REIC SAMPLE #: **57482-8** **MATRIX:** **LIQUID**

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/l	8082	375	01-07-98/JA
PCB-1221	ND	ug/l	8082	375	01-07-98/JA
PCB-1232	ND	ug/l	8082	375	01-07-98/JA
PCB-1242	ND	ug/l	8082	375	01-07-98/JA
PCB-1248	ND	ug/l	8082	375	01-07-98/JA
PCB-1254	ND	ug/l	8082	375	01-07-98/JA
PCB-1260	ND	ug/l	8082	375	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	106

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/l	8081	0.45	01-07-98/JA
Chlordane	ND	ug/l	8081	1.41	01-07-98/JA
Dieldrin	ND	ug/l	8081	0.20	01-07-98/JA
Endosulfan I	ND	ug/l	8081	1.41	01-07-98/JA
Endosulfan II	ND	ug/l	8081	0.45	01-07-98/JA
Endrin	ND	ug/l	8081	0.60	01-07-98/JA
Heptachlor	ND	ug/l	8081	0.30	01-07-98/JA
Heptachlor Epoxide	ND	ug/l	8081	3.15	01-07-98/JA
Methoxychlor	ND	ug/l	8081	18.0	01-07-98/JA
Toxaphene	ND	ug/l	8081	8.56	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	106

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**08.08.05**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-8**	**MATRIX:**	**LIQUID**

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	ND	ug/l	6020	20	12-30-97/KC
Beryllium	ND	ug/l	6020	3	12-30-97/KC
Cadmium	ND	ug/l	6020	1	12-30-97/KC
Chromium	ND	ug/l	6020	10	12-30-97/KC
Lead	ND	ug/l	6020	10	12-30-97/KC
Mercury	ND	ug/l	6020	1	12-30-97/KC
Nickel	ND	ug/l	6020	30	12-30-97/KC
Selenium	ND	ug/l	6020	20	12-30-97/KC
Silver	ND	ug/l	6020	4	12-30-97/KC
Thallium	ND	ug/l	6020	10	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	IS				

ND - None Detected at PQL
PQL - Practical Quantitation Limit
IS - Insufficient Sample

ATI SAMPLE #:	**14.08.03**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-9**	**MATRIX:**	**LIQUID**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/l	8021A	1	01-05-98/TC
Carbon Tetrachloride	ND	ug/l	8021A	1	01-05-98/TC
Chlorobenzene	ND	ug/l	8021A	1	01-05-98/TC
Chloroform	ND	ug/l	8021A	1	01-05-98/TC
trans-1,2-Dichloroethene	ND	ug/l	8021A	1	01-05-98/TC
Hexachlorobutadiene	ND	ug/l	8021A	1	01-05-98/TC
Methyl Bromide	ND	ug/l	8021A	1	01-05-98/TC
Methyl Chloride	ND	ug/l	8021A	1	01-05-98/TC
Methylene Chloride	ND	ug/l	8021A	1	01-05-98/TC
Naphthalene	ND	ug/l	8021A	1	01-05-98/TC
Tetrachloroethene	ND	ug/l	8021A	1	01-05-98/TC
Toluene	ND	ug/l	8021A	1	01-05-98/TC
1,2,4-Trichlorobenzene	ND	ug/l	8021A	1	01-05-98/TC
1,1,1-Trichloroethane	ND	ug/l	8021A	1	01-05-98/TC
1,1,2-Trichloroethane	ND	ug/l	8021A	1	01-05-98/TC
Trichloroethene	ND	ug/l	8021A	1	01-05-98/TC
Trichlorofluoromethane	ND	ug/l	8021A	1	01-05-98/TC
Vinyl Chloride	ND	ug/l	8021A	1	01-05-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	93
1,1,1-trifluorotoluene	90

ND - None Detected at Reporting Limit

ATI SAMPLE #: 14.08.03
REIC SAMPLE #: 57482-9
DATE SAMPLED: 12-23-97
MATRIX: LIQUID

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/l	8240B	100	01-02-98/TC
Carbon Disulfide	ND	ug/l	8240B	20	01-02-98/TC
Methyl Ethyl Ketone	ND	ug/l	8240B	100	01-02-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	97
toluene-D8	103
4-bromofluorobenzene	92

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/l	8070	10	01-11-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	51

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/l	8090	1.5	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/l	8090	1.5	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	110

ND - None Detected at Reporting Limit

ATI SAMPLE #: 14.08.03 **DATE SAMPLED:** 12-23-97
REIC SAMPLE #: 57482-9 **MATRIX:** LIQUID

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/l	8110	4.5	01-09-98/JA
Bis(2-chloroethyl) ether	ND	ug/l	8110	4.5	01-09-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/l	8110	4.5	01-09-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	102

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/l	8121	0.50	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/l	8121	0.50	01-08-98/JA
Hexachloroethane	ND	ug/l	8121	0.50	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	90

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/l	8151	0.85	01-06-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	94

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**14.08.03**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-9**	**MATRIX:**	**LIQUID**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/l	8270B	30	01-07-98/WP
Butyl benzyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
4-Chloro-3-methyl phenol	ND	ug/l	8270B	60	01-07-98/WP
2-Chlorophenol	ND	ug/l	8270B	60	01-07-98/WP
Di-n-butyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
Diethyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
2,4-Dimethylphenol	ND	ug/l	8270B	60	01-07-98/WP
Dimethyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/l	8270B	60	01-07-98/WP
Di-n-octyl phthalate	ND	ug/l	8270B	30	01-07-98/WP
Phenol	ND	ug/l	8270B	60	01-07-98/WP
2,4,5-Trichlorophenol	ND	ug/l	8270B	60	01-07-98/WP
2,4,6-Trichlorophenol	ND	ug/l	8270B	60	01-07-98/WP

Surrogates	% Recovery
2-fluorophenol	68
phenol-d6	66
2,4,6-tribromophenol	99

Surrogates	% Recovery
nitrobenzene-d5	76
2-fluorobiphenyl	84
p-terphenyl-d14	44

ND - None Detected at Reporting Limit

ATI SAMPLE #: 14.08.03 **DATE SAMPLED:** 12-23-97
REIC SAMPLE #: 57482-9 **MATRIX:** LIQUID

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/l	8310	10	01-13-98/WP
Fluorene	ND	ug/l	8310	10	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/l	8330	20	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #: 14.08.03
REIC SAMPLE #: 57482-9

DATE SAMPLED: 12-23-97
MATRIX: LIQUID

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/l	8082	375	01-07-98/JA
PCB-1221	ND	ug/l	8082	375	01-07-98/JA
PCB-1232	ND	ug/l	8082	375	01-07-98/JA
PCB-1242	ND	ug/l	8082	375	01-07-98/JA
PCB-1248	ND	ug/l	8082	375	01-07-98/JA
PCB-1254	ND	ug/l	8082	375	01-07-98/JA
PCB-1260	ND	ug/l	8082	375	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	112

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/l	8081	0.45	01-07-98/JA
Chlordane	ND	ug/l	8081	1.41	01-07-98/JA
Dieldrin	ND	ug/l	8081	0.20	01-07-98/JA
Endosulfan I	ND	ug/l	8081	1.41	01-07-98/JA
Endosulfan II	ND	ug/l	8081	0.45	01-07-98/JA
Endrin	ND	ug/l	8081	0.60	01-07-98/JA
Heptachlor	ND	ug/l	8081	0.30	01-07-98/JA
Heptachlor Epoxide	ND	ug/l	8081	3.15	01-07-98/JA
Methoxychlor	ND	ug/l	8081	18.0	01-07-98/JA
Toxaphene	ND	ug/l	8081	8.56	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	112

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**14.08.03**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-9**	**MATRIX:**	**LIQUID**

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	ND	ug/l	6020	20	12-30-97/KC
Beryllium	ND	ug/l	6020	3	12-30-97/KC
Cadmium	ND	ug/l	6020	1	12-30-97/KC
Chromium	ND	ug/l	6020	10	12-30-97/KC
Lead	ND	ug/l	6020	10	12-30-97/KC
Mercury	ND	ug/l	6020	1	12-30-97/KC
Nickel	ND	ug/l	6020	30	12-30-97/KC
Selenium	ND	ug/l	6020	20	12-30-97/KC
Silver	ND	ug/l	6020	4	12-30-97/KC
Thallium	ND	ug/l	6020	10	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	IS				

ND - None Detected at PQL
PQL - Practical Quantitation Limit
IS - Insufficient Sample

ATI SAMPLE #: 11.06.01
REIC SAMPLE #: 57482-10

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 79%

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/kg	8021A	5	01-05-98/TC
Carbon Tetrachloride	ND	ug/kg	8021A	5	01-05-98/TC
Chlorobenzene	ND	ug/kg	8021A	5	01-05-98/TC
Chloroform	ND	ug/kg	8021A	5	01-05-98/TC
trans-1,2-Dichloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Hexachlorobutadiene	ND	ug/kg	8021A	5	01-05-98/TC
Methyl Bromide	ND	ug/kg	8021A	5	01-05-98/TC
Methyl Chloride	ND	ug/kg	8021A	5	01-05-98/TC
Methylene Chloride	ND	ug/kg	8021A	5	01-05-98/TC
Naphthalene	ND	ug/kg	8021A	5	01-05-98/TC
Tetrachloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Toluene	ND	ug/kg	8021A	5	01-05-98/TC
1,2,4-Trichlorobenzene	ND	ug/kg	8021A	5	01-05-98/TC
1,1,1-Trichloroethane	ND	ug/kg	8021A	5	01-05-98/TC
1,1,2-Trichloroethane	ND	ug/kg	8021A	5	01-05-98/TC
Trichloroethene	ND	ug/kg	8021A	5	01-05-98/TC
Trichlorofluoromethane	ND	ug/kg	8021A	5	01-05-98/TC
Vinyl Chloride	ND	ug/kg	8021A	5	01-05-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	88
1,1,1-trifluorotoluene	105

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**11.06.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-10**	**MATRIX:**	**SOLID**
		MOISTURE:	**79%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/kg	8240B	100	01-03-98/TC
Carbon Disulfide	ND	ug/kg	8240B	20	01-03-98/TC
Methyl Ethyl Ketone	ND	ug/kg	8240B	100	01-03-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	87
toluene-D8	104
4-bromofluorobenzene	88

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/kg	8070	67	01-11-98/JA

Surrogates	% Recovery
4-chloro- 3-nitrobenzotrifluoride	46

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	38

ND - None Detected at Reporting Limit

ATI SAMPLE #: 11.06.01
REIC SAMPLE #: 57482-10

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 79%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroethyl) ether	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/kg	8110	30	01-09-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	49

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachloroethane	ND	ug/kg	8121	3.3	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	29

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/kg	8151	17	01-07-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	98

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**11.06.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-10**	**MATRIX:**	**SOLID**
		MOISTURE:	**79%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Butyl benzyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4-Chloro-3-methyl phenol	ND	ug/kg	8270B	330	01-07-98/WP
2-Chlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-butyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Diethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
2,4-Dimethylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Dimethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-octyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Phenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,5-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,6-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP

Surrogates	% Recovery
2-fluorophenol	*21
phenol-d6	21
2,4,6-tribromophenol	31

Surrogates	% Recovery
nitrobenzene-d5	24
2-fluorobiphenyl	*19
p-terphenyl-d14	*15

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #: 11.06.01
REIC SAMPLE #: 57482-10

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 79%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/kg	8310	140	01-13-98/WP
Fluorene	ND	ug/kg	8310	140	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/kg	8330	250	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #: **11.06.01**
REIC SAMPLE #: **57482-10**

DATE SAMPLED: **12-23-97**
MATRIX: **SOLID**
MOISTURE: **79%**

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1221	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1232	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1242	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1248	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1254	ND	ug/kg	8082	2500	01-07-98/JA
PCB-1260	ND	ug/kg	8082	2500	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	33

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/kg	8081	3	01-07-98/JA
Chlordane	ND	ug/kg	8081	9.4	01-07-98/JA
Dieldrin	ND	ug/kg	8081	1.3	01-07-98/JA
Endosulfan I	ND	ug/kg	8081	9.4	01-07-98/JA
Endosulfan II	ND	ug/kg	8081	3	01-07-98/JA
Endrin	ND	ug/kg	8081	4	01-07-98/JA
Heptachlor	ND	ug/kg	8081	2	01-07-98/JA
Heptachlor Epoxide	ND	ug/kg	8081	21	01-07-98/JA
Methoxychlor	ND	ug/kg	8081	120	01-07-98/JA
Toxaphene	ND	ug/kg	8081	57	01-07-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	33

ND - None Detected at Reporting Limit

ATI SAMPLE #: 11.06.01
REIC SAMPLE #: 57482-10
DATE SAMPLED: 12-23-97
MATRIX: SOLID

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	47700	ug/kg	6020	100	12-30-97/KC
Beryllium	370	ug/kg	6020	100	12-30-97/KC
Cadmium	ND	ug/kg	6020	100	12-30-97/KC
Chromium	22300	ug/kg	6020	100	12-30-97/KC
Lead	10000	ug/kg	6020	100	12-30-97/KC
Mercury	ND	ug/kg	7470A	100	01-02-98/MR
Nickel	7770	ug/kg	6020	100	12-30-97/KC
Selenium	ND	ug/kg	6020	300	12-30-97/KC
Silver	ND	ug/kg	6020	100	12-30-97/KC
Thallium	158	ug/kg	6020	100	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	ND	ug/kg	9010A	500	01-05-98/LK

ND - None Detected at PQL
PQL - Practical Quantitation Limit
NOTE - Internal Standards failed REIC control limits of Method 6020.

ATI SAMPLE #:	**14.48.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-11**	**MATRIX:**	**SOLID**
		MOISTURE:	**68%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/kg	8021A	5	01-06-98/TC
Carbon Tetrachloride	ND	ug/kg	8021A	5	01-06-98/TC
Chlorobenzene	ND	ug/kg	8021A	5	01-06-98/TC
Chloroform	ND	ug/kg	8021A	5	01-06-98/TC
trans-1,2-Dichloroethene	ND	ug/kg	8021A	5	01-06-98/TC
Hexachlorobutadiene	ND	ug/kg	8021A	5	01-06-98/TC
Methyl Bromide	ND	ug/kg	8021A	5	01-06-98/TC
Methyl Chloride	ND	ug/kg	8021A	5	01-06-98/TC
Methylene Chloride	ND	ug/kg	8021A	5	01-06-98/TC
Naphthalene	ND	ug/kg	8021A	5	01-06-98/TC
Tetrachloroethene	ND	ug/kg	8021A	5	01-06-98/TC
Toluene	ND	ug/kg	8021A	5	01-06-98/TC
1,2,4-Trichlorobenzene	ND	ug/kg	8021A	5	01-06-98/TC
1,1,1-Trichloroethane	ND	ug/kg	8021A	5	01-06-98/TC
1,1,2-Trichloroethane	ND	ug/kg	8021A	5	01-06-98/TC
Trichloroethene	ND	ug/kg	8021A	5	01-06-98/TC
Trichlorofluoromethane	ND	ug/kg	8021A	5	01-06-98/TC
Vinyl Chloride	ND	ug/kg	8021A	5	01-06-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	84
1,1,1-trifluorotoluene	95

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**14.48.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-11**	**MATRIX:**	**SOLID**
		MOISTURE:	**68%**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/kg	8240B	100	01-05-98/TC
Carbon Disulfide	ND	ug/kg	8240B	20	01-05-98/TC
Methyl Ethyl Ketone	ND	ug/kg	8240B	100	01-05-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	82
toluene-D8	117
4-bromofluorobenzene	72

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
N-Nitrosodimethylamine	ND	ug/kg	8070	67	01-11-98/JA

Surrogates	% Recovery
4-chloro-3-nitrobenzotrifluoride	44

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
2,4-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA
2,6-Dinitrotoluene	ND	ug/kg	8090	10	01-06-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	*22

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #:	**14.48.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-11**	**MATRIX:**	**SOLID**
		MOISTURE:	**68%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-chloroethoxy) methane	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroethyl) ether	ND	ug/kg	8110	30	01-09-98/JA
Bis(2-chloroisopropyl) ether	ND	ug/kg	8110	30	01-09-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	26

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Hexachlorobenzene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachlorocyclopentadiene	ND	ug/kg	8121	3.3	01-08-98/JA
Hexachloroethane	ND	ug/kg	8121	3.3	01-08-98/JA

Surrogates	% Recovery
tetrachloro-m-xylene	17

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Pentachlorophenol	ND	ug/kg	8151	17	01-07-98/JA

Surrogates	% Recovery
2,4-dichlorophenylacetic acid	95

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**14.48.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-11**	**MATRIX:**	**SOLID**
		MOISTURE:	**68%**

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Bis(2-ethylhexyl) phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Butyl benzyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4-Chloro-3-methyl phenol	ND	ug/kg	8270B	330	01-07-98/WP
2-Chlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-butyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Diethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
2,4-Dimethylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Dimethyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
4,6-Dinitro-2-methylphenol	ND	ug/kg	8270B	330	01-07-98/WP
Di-n-octyl phthalate	ND	ug/kg	8270B	330	01-07-98/WP
Phenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,5-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP
2,4,6-Trichlorophenol	ND	ug/kg	8270B	330	01-07-98/WP

Surrogates	% Recovery
2-fluorophenol	*11
phenol-d6	*11
2,4,6-tribromophenol	*16

Surrogates	% Recovery
nitrobenzene-d5	*12
2-fluorobiphenyl	*14
p-terphenyl-d14	*7

ND - None Detected at Reporting Limit
* - Surrogate Recovery exceeds REIC control limits due to sample matrix interference.

ATI SAMPLE #: 14.48.01
REIC SAMPLE #: 57482-11

DATE SAMPLED: 12-23-97
MATRIX: SOLID
MOISTURE: 68%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Fluoranthene	ND	ug/kg	8310	140	01-13-98/WP
Fluorene	ND	ug/kg	8310	140	01-13-98/WP

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Nitrobenzene	ND	ug/kg	8330	250	01-05-98/WP

ND - None Detected at Reporting Limit

ATI SAMPLE #:	**14.48.01**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-11**	**MATRIX:**	**SOLID**
		MOISTURE:	**68%**

PCB'S

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
PCB-1016	ND	ug/kg	8082	2500	01-08-98/JA
PCB-1221	ND	ug/kg	8082	2500	01-08-98/JA
PCB-1232	ND	ug/kg	8082	2500	01-08-98/JA
PCB-1242	ND	ug/kg	8082	2500	01-08-98/JA
PCB-1248	ND	ug/kg	8082	2500	01-08-98/JA
PCB-1254	ND	ug/kg	8082	2500	01-08-98/JA
PCB-1260	ND	ug/kg	8082	2500	01-08-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	19

PESTICIDES

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Aldrin	ND	ug/kg	8081	3	01-08-98/JA
Chlordane	ND	ug/kg	8081	9.4	01-08-98/JA
Dieldrin	ND	ug/kg	8081	1.3	01-08-98/JA
Endosulfan I	ND	ug/kg	8081	9.4	01-08-98/JA
Endosulfan II	ND	ug/kg	8081	3	01-08-98/JA
Endrin	ND	ug/kg	8081	4	01-08-98/JA
Heptachlor	ND	ug/kg	8081	2	01-08-98/JA
Heptachlor Epoxide	ND	ug/kg	8081	21	01-08-98/JA
Methoxychlor	ND	ug/kg	8081	120	01-08-98/JA
Toxaphene	ND	ug/kg	8081	57	01-08-98/JA

Surrogate	% Recovery
tetrachloro-m-xylene	19

ND - None Detected at Reporting Limit

ATI SAMPLE #: 14.48.01
REIC SAMPLE #: 57482-11

DATE SAMPLED: 12-23-97
MATRIX: SOLID

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Barium	72400	ug/kg	6020	100	12-30-97/KC
Beryllium	588	ug/kg	6020	100	12-30-97/KC
Cadmium	133	ug/kg	6020	100	12-30-97/KC
Chromium	19100	ug/kg	6020	100	12-30-97/KC
Lead	12300	ug/kg	6020	100	12-30-97/KC
Mercury	130	ug/kg	7470A	100	01-02-98/MR
Nickel	9420	ug/kg	6020	100	12-30-97/KC
Selenium	ND	ug/kg	6020	300	12-30-97/KC
Silver	ND	ug/kg	6020	100	12-30-97/KC
Thallium	ND	ug/kg	6020	100	12-30-97/KC

GENERAL CHEMISTRY

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
Cyanide	ND	ug/kg	9010A	500	01-05-98/LK

ND - None Detected at PQL
PQL - Practical Quantitation Limit
NOTE - Internal Standards failed REIC control limits of Method 6020.

ATI SAMPLE #:	**14.08.04**	**DATE SAMPLED:**	**12-23-97**
REIC SAMPLE #:	**57482-12**	**MATRIX:**	**LIQUID**

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Benzene	ND	ug/l	8021A	1	01-05-98/TC
Carbon Tetrachloride	ND	ug/l	8021A	1	01-05-98/TC
Chlorobenzene	ND	ug/l	8021A	1	01-05-98/TC
Chloroform	ND	ug/l	8021A	1	01-05-98/TC
trans-1,2-Dichloroethene	ND	ug/l	8021A	1	01-05-98/TC
Hexachlorobutadiene	ND	ug/l	8021A	1	01-05-98/TC
Methyl Bromide	ND	ug/l	8021A	1	01-05-98/TC
Methyl Chloride	ND	ug/l	8021A	1	01-05-98/TC
Methylene Chloride	ND	ug/l	8021A	1	01-05-98/TC
Naphthalene	ND	ug/l	8021A	1	01-05-98/TC
Tetrachloroethene	ND	ug/l	8021A	1	01-05-98/TC
Toluene	ND	ug/l	8021A	1	01-05-98/TC
1,2,4-Trichlorobenzene	ND	ug/l	8021A	1	01-05-98/TC
1,1,1-Trichloroethane	ND	ug/l	8021A	1	01-05-98/TC
1,1,2-Trichloroethane	ND	ug/l	8021A	1	01-05-98/TC
Trichloroethene	ND	ug/l	8021A	1	01-05-98/TC
Trichlorofluoromethane	ND	ug/l	8021A	1	01-05-98/TC
Vinyl Chloride	ND	ug/l	8021A	1	01-05-98/TC

Surrogates	% Recovery
1,4-dichlorobutane	87
1,1,1-trifluorotoluene	104

ND - **None Detected at Reporting Limit**

ATI SAMPLE #: 14.08.04
REIC SAMPLE #: 57482-12

DATE SAMPLED: 12-23-97
MATRIX: LIQUID

VOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED/BY
Acrolein	ND	ug/l	8240B	100	01-03-98/TC
Carbon Disulfide	ND	ug/l	8240B	20	01-03-98/TC
Methyl Ethyl Ketone	ND	ug/l	8240B	100	01-03-98/TC

Surrogates	% Recovery
1,2-dichloroethane-D4	87
toluene-D8	102
4-bromofluorobenzene	90

ND - None Detected at Reporting Limit

DATE 1-21-98

APPROVED Ivan W Leef
Ivan W. Leef

Janet M Satterfield
Janet M. Satterfield

Table 5-1

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

~~Hercules~~ Alliant · Arnie Olsen

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
VOLATILES			
METHOD 8021A			
Benzene	0.09	0.37	5
Carbon Tetrachloride	0.03	0.94	5
Chlorobenzene	0.01	0.38	5
Chloroform	0.02	1.1	5
[redacted]	0.02	0.93	5
Hexachlorobutadiene	0.20	1.8	5
Methyl Bromide	0.30	1.7	5
Methyl Chloride	0.10	0.94	5
Methylene Chloride	0.20	1.4	5
Naphthalene	0.60	3.4	5
Tetrachloroethene	0.01	0.21	5
Toluene	0.10	0.34	5
1,2,4-Trichlorobenzene	0.20	1.5	5
1,1,1-Trichloroethane	0.01	1.3	5
1,1,2-Trichloroethane	0.07	0.59	5
Trichloroethene	0.01	0.52	5
Trichlorofluoromethane	0.30	0.50	5
Vinyl Chloride	0.06	0.94	5
METHOD 8240B			
Acrolein	7	21	100
Carbon Disulfide	100	0.98	20
Methyl Ethyl Ketone	100	6.1	100
SEMIVOLATILES			
METHOD 8070			
N-Nitrosodimethylamine	1.5	12	67
METHOD 8090			
2,4-Dinitrotoluene (FID/ECD)	13	82/0.56	330/10
2,6-Dinitrotoluene (FID/ECD)	7	82/0.65	330/10

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
SEMIVOLATILES (Continued)			
METHOD 8110			
Bis(2-chloroethoxy) methane	5	16	30
Bis(2-chloroethyl) ether	3	9.9	30
Bis(2-chloroisopropyl) ether	8	24	30
METHOD 8121			
Hexachlorobenzene	3.8	0.12	3.3
Hexachlorocyclopentadiene	160	0.82	3.3
Hexachloroethane	1.1	0.11	3.3
METHOD 8151			
Pentachlorophenol	1.6	4.3	17
METHOD 8270B			
Bis(2-ethylhexyl) phthalate	180	27	330
Butyl benzyl phthalate	28	26	330
4-Chloro-3-methyl phenol	240	42	330
2-Chlorophenol	210	38	330
Di-n-butyl phthalate ✓	220	27	330
Diethyl phthalate	170	21	330
2,4-Dimethylphenol	210	35	330
Dimethyl phthalate	190	24	330
4,6-Dinitro-2-methylphenol O-CRES	3,300	27	330
Di-n-octyl phthalate	33	16	330
Phenol	94	38	330
2,4,5-Trichlorophenol	600	34	330
2,4,6-Trichlorophenol	390	33	330
METHOD 8310			
Fluoranthene	140	0.27	10
Fluorene	140	1.0	10
METHOD 8330			
Nitrobenzene	260	12	250
PESTICIDES/PCBs			
METHOD 8080A			

4 6 dinitrocresol

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
METALS (Continued)			
Silver	2	0.52 µg/L[a]	100
Thallium	10	0.08 µg/L[a]	100
METHOD 7471A			
Mercury	2	0.03 µg/L[a]	100
METHOD 9010A			
Cyanide	20	8 µg/L[a]	100

[a] These detection limits are based on a MDL study of an aqueous matrix.

REIC 57474

REIC Laboratory
225 Industrial Park Rd.
P.O. Box 286, Beaver, WV 25813
Phone: 304-255-2500 or 800-999-0105
FAX: 304-255-2572

CHAIN OF CUSTODY RECORD

NO. 57957

CLIENT: ALLIANT TECHSYSTEM
ADDRESS: RADFORD AAD
CITY/STATE/ZIP: RADFORD VA
BILL TO:
CITY/STATE/ZIP:

CONTACT PERSON: OLSEN
TELEPHONE/FAX: 540 639 8220 7714
SITE ID & STATE:
PROJECT ID:
SAMPLER: OLSEN

SAMPLE LOG AND ANALYSIS REQUEST

TURNAROUND TIME REQUIREMENTS
REGULAR: ___
*RUSH: ___ 5-Day
___ 3-Day
___ 2-Day
___ 1-Day

*Rush work needs prior Laboratory approval and will include surcharges

PRESERVATIVES
0 No Preservative
1 Hydrochloric Acid
2 Nitric Acid
3 Sulfuric Acid
4 Sodium Thiosulfate
5 Sodium Hydroxide
6 Zinc Acetate
7 EDTA

PRESERVATIVE CODES
NOTE PRESERVATIVES → 0

ANALYSIS REQUESTED & METHOD: AS ATTACHED

SAMPLE ID	NO. & TYPE OF CONTAINERS	SAMPLING DATE / TIME	MATRIX	SAMPLE COMP / GRAB	AS ATTACHED	12-29 COMMENTS
07·03·01	4/9oz	12·23·97	SOIL	GRAB	X	AS- 2 day Rush
08·04·01	4/9oz	12·23·97	SOIL	"	X	per Claude.
02·03·04	4/9oz	12·23·97	SOIL	"	X	
02·03·01	4/9oz	12·23·97	SOIL	"	X	
09·03·01	3/9oz	12·23·97	SOIL	"	X	
12·03·01	4/9oz	12·20·97	SOIL	"	X	Level II QC
04·03·01	4/9oz	12·23·97	SOIL	"	X	per Chemical Thompson
08·08·05	4/9oz	12·23·97	~~SOIL~~ LIQ	"	X	/Jeff Rath
14·08·03	4/9oz	12·23·97	~~SOIL~~ LIQ	"	X	-Alef
11·06·01	4/9oz	17:23·97	H_2O	"	X	1-07-98

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
	12·23·97					Rita	12-29-97 8:00

Special Requests: PLEASE RUN AS ON 2DAY RUSH OTHERS NORMAL

Sample Condition: Good? Y N

Temperature Upon Arrival 4.1 °C OK

Shipment: Hand-Del: Courier: UPS: FedEx: X

Shipment Date:

FAX Results: Y N

REIC

REIC Laboratory
225 Industrial Park Rd.
P.O. Box 286, Beaver, WV 25813
Phone: 304-255-2500 or 800-999-0105
FAX: 304-255-2572

CHAIN OF CUSTODY RECORD

NO. 57956

CLIENT: ALLIANT TECHSYSTEMS
ADDRESS: RADFORD AAP
CITY/STATE/ZIP: RADFORD VA 24141
BILL TO:
CITY/STATE/ZIP:

CONTACT PERSON: OLSEN
TELEPHONE/FAX: 540 639 8220 7214
SITE ID & STATE:
PROJECT ID:
SAMPLER: OLSEN

SAMPLE LOG AND ANALYSIS REQUEST

TURNAROUND TIME REQUIREMENTS

REGULAR: ___
*RUSH: ___ 5-Day
___ 3-Day
___ 2-Day
___ 1-Day

*Rush work needs prior Laboratory approval and will include surcharges

PRESERVATIVES

- 0 No Preservative
- 1 Hydrochloric Acid
- 2 Nitric Acid
- 3 Sulfuric Acid
- 4 Sodium Thiosulfate
- 5 Sodium Hydroxide
- 6 Zinc Acetate
- 7 EDTA

PRESERVATIVE CODES

NOTE PRESERVATIVES → 0

ANALYSIS REQUESTED & METHOD

SAMPLE ID	NO. & TYPE OF CONTAINERS	SAMPLING DATE / TIME	MATRIX	SAMPLE COMP / GRAB	AS ATTACHED	VOLATILES AS ATTACHED													COMMENTS
14·48·01	4/907	12·23·97	LIQUID	GRAB	+														
14·08·04	4/VOA	12·23·97	LIQUID	GRAB		+													

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
	12-23-97					Juanita Pitts	12-29-97 8:00

Special Requests: PLEASE RUN AS ON TWO DAY RUSH OTHERS NORMAL

Sample Condition: Good? Y N

Temperature Upon Arrival 4.1 °C OK

Shipment: Hand-Del: Courier: UPS: FedEx: X

Shipment Date:

FAX Results: Y N

RADIAN
CORPORATION

2455 Horsepen Road, Suite 250
Herndon, VA 22071
(703) 713-1500

21 January 1997

Marc Gutterman
Civil Engineer
GeoEnvironmental Branch
Norfolk District, Corps of Engineers
803 Front Street
Norfolk, Virginia 23510-1096

Subject: Replacement Pages - Draft Site Investigation/Evaluation
Delivery Order 10, Contract DACA65-95-D-0030

Dear Mr. Gutterman:

Enclosed are replacement pages for Section 3 and for Appendix C of the Draft Site Investigation/Evaluation for the Bioplant Equalization Basin Site Investigation/ Evaluation at Radford Army Ammunition Plant you received on 15 January 1997.

Section 3 was rewritten in response to a comment from Alliant Techsystems to include a critical value for fluoranthene. The elevations for basin nodes 14 and 15 were incorrectly presented in Appendix C. Please discard the pages from the report and replace them with the enclosed pages.

If you have any questions, please call me at (703) 713-6410 or Steve Falatko at (703) 713-6408.

Sincerely,

Stephen M. Falatko / for

William R. Hearn
Project Manager

Enclosure

WRH:nrj

c: Jerry Redder, Alliant Techsystems, Inc.

NRJ-096
0121-01.nrj

3.0 ANALYTICAL DATA

During site investigation, eight background soil samples and seven subsoil samples were collected and analyzed for 70 hazardous constituents of concern (HCOCs), as specified in the Chemical Data Acquisition Plan (Radian, 1996). The samples for the organic HCOCs were analyzed by Savannah Laboratories and Environmental Services, Inc. of Tallahassee, Florida. The samples for the inorganic HCOCs were analyzed by Quanterra, Inc. of West Sacramento, California. Additionally, four concrete wall samples and one basin liner sample (comprised of a composite from the basin liner collected from each of the sampling locations) were collected and analyzed for the TCLP list of hazardous constituents. The sample for TCLP analysis was performed by Radian Corporation of Austin, Texas.

3.1 Results

Table 3-1 presents the analytical results for the eight background soil samples. For the organic constituents, only 2,4-dinitrotoluene and Aroclor-1254 were detected in the samples. All other organic HCOCs were not detected. 2,4-Dinitrotoluene was found in only one sample (#2) at a concentration less than the reporting limit. Aroclor-1254 was detected in two samples (#2 and #7). The result in sample #2 was at a concentration less than the reporting limit. For the inorganic constituents, arsenic, barium, beryllium, chromium, lead, and nickel were measured in all eight samples. Thallium was measured in seven of eight samples.

Table 3-2 presents the analytical results for the seven subsoil samples. For the organic constituents, only fluoranthene (in Basin sample #9) was detected in the samples. All other organic HCOCs were not detected. For the inorganic constituents, arsenic, barium, beryllium, chromium, lead, nickel, and thallium were measured in all seven samples.

E 3-1

Analytical Results and Critical Values for the Background Samples

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
METHOD D2216 (%)									
Moisture Content	15	14	16	17	16	16	16	17	NC
VOLATILES									
METHOD 8021A (ug/kg)									
Benzene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Bromomethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Carbon tetrachloride	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Chlorobenzene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Chloroform	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Chloromethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
trans-1,2-Dichloroethene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Hexachlorobutadiene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Methylene chloride (Dichloromethane)	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Naphthalene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Tetrachloroethene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Toluene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
1,2,4-Trichlorobenzene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
1,1,1-Trichloroethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
1,1,2-Trichloroethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Trichloroethene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Trichlorofluoromethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Vinyl chloride	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
METHOD 8240B (ug/kg)									
Acrolein	<120	<120	<120	<120	<120	<120	<120	<120	NC
Carbon disulfide	<5.8	<5.8	<5.9	<6.1	<6.0	<6.0	<6.0	<6.1	NC
2-Butanone (MEK)	<29	<29	<29	<30	<30	<30	<30	<30	NC
SEMIVOLATILES									
METHOD 8070 (ug/kg)									
N-Nitrosodimethylamine	<100	<78	<80	<81	<80	<80	<80	<81	NC
METHOD 8090 (ug/kg)									
2,4-Dinitrotoluene	<12	2.4 J	<12	<12	<12	<12	<12	<12	NC
2,6-Dinitrotoluene	<12	<12	<12	<12	<12	<12	<12	<12	NC
METHOD 8110 (ug/kg)									
Bis(2-Chloroethoxy) methane	<35	<35	<36	<36	<36	<36	<36	<36	NC
Bis(2-Chloroethyl) ether	<35	<35	<36	<36	<36	<36	<36	<36	NC
Bis(2-Chloroisopropyl) ether	<35	<35	<36	<36	<36	<36	<36	<36	NC
METHOD 8121 (ug/kg)									
Hexachlorobenzene	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Hexachlorocyclopentadiene	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value; constituents present below the reporting limit.
NC - Critical value not calculated; see Section 3.2.

E 3-1

Analytical Results and Critical Values for the Background Samples

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
SEMIVOLATILES Continued									
Hexachloroethane	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
METHOD 8151 (ug/kg)									
Pentachlorophenol	<20	<20	<20	<20	<20	<20	<20	<20	NC
METHOD 8270B (ug/kg)									
Bis(2-Ethylhexyl)phthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
Butylbenzylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
4-Chloro-3-methylphenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
2-Chlorophenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
Di-n-butylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
Di-n-octylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
Diethylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
2,4-Dimethylphenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
Dimethylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
2-Methyl-4,6-dinitrophenol	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<2000	NC
Phenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
2,4,5-Trichlorophenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
2,4,6-Trichlorophenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
METHOD 8310 (ug/kg)									
Fluoranthene	<12	<12	<12	<12	<12	<12	<12	<12	6.0
Fluorene	<12	<12	<12	<12	<12	<12	<12	<12	NC
METHOD 8330 (ug/kg)									
Nitrobenzene	<290	<290	<300	<300	<300	<300	<300	<300	NC
PESTICIDES/PCBs									
METHOD 8080A (ug/kg)									
Aldrin	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Chlordane	<20	<20	<20	<20	<20	<20	<20	<20	NC
Dieldrin	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Endosulfan I	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Endosulfan II	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Endrin	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Heptachlor	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Heptachlor epoxide	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Methoxychlor	<20	<20	<20	<20	<20	<20	<20	<20	NC
Aroclor-1016	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1221	<79	<78	<80	<81	<80	<80	<80	<81	NC
Aroclor-1232	<39	<38	<39	<40	<39	<39	<39	<40	NC

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value; constituents present below the reporting limit.
NC - Critical value not calculated; see Section 3.2.

TABLE 3-1

Analytical Results and Critical Values for the Background Samples

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
PESTICIDES/PCBs Continued									
Aroclor-1242	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1248	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1254	<39	17 J	<39	<40	<39	<39	46	<40	NC
Aroclor-1260	<39	<38	<39	<40	<39	<39	<39	<40	NC
Toxaphene	<200	<200	<200	<200	<200	<200	<200	<200	NC
METALS									
METHOD 6020 (mg/kg)									
Arsenic	2	2.5	2.9	1.6	2.1	1.2	3.2	0.95	5.5
Barium	172	157	139	187	169	108	165	93	292
Beryllium	0.85	0.99	0.87	1.2	1.1	0.72	1.1	0.76	1.71
Cadmium	<0.24	<0.24	<0.24	< 0.27	<0.24	<0.22	<0.24	<0.24	NC
Chromium	27.3	28.1	25.9	26	28.6	18.4	34.4	19.1	48.6
Lead	11.6	26.6	16.8	16.7	20.2	8.6	22	7.9	45.1
Nickel	15.2	14.3	13.9	17.2	17	11.8	20.5	11.7	28.1
Selenium	<0.24	<0.24	<0.24	<0.27	<0.24	<0.22	<0.24	<0.24	NC
Silver	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
Thallium	0.29	0.23	0.22	<0.21	0.25	0.16	0.41	0.17	0.63
METHOD 7471A (mg/kg)									
Mercury	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
METHOD 9010A (mg/kg)									
Cyanide, Total	<0.59	<0.60	<0.60	<0.67	<0.59	<0.55	<0.60	<0.60	NC
Chromium	27.3	28.1	25.9	26	28.6	18.4	34.4	19.1	NC
Lead	11.6	26.6	16.8	16.7	20.2	8.6	22	7.9	NC
Nickel	15.2	14.3	13.9	17.2	17	11.8	20.5	11.7	NC
Selenium	<0.24	<0.24	<0.24	<0.27	<0.24	<0.22	<0.24	<0.24	NC
Silver	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
Thallium	0.29	0.23	0.22	<0.21	0.25	0.16	0.41	0.17	NC
METHOD 7471A (mg/kg)									
Mercury	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
METHOD 9010A (mg/kg)									
Cyanide, Total	<0.59	<0.60	<0.60	<0.67	<0.59	<0.55	<0.60	<0.60	NC

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value; constituents present below the reporting limit.
NC - Critical value not calculated; see Section 3.2.

Table 3-2
Analytical Results and Critical Values for the Basin Subsoil Samples

ANALYTE	BASIN #1	BASIN #5	BASIN #6	BASIN #9	BASIN #10	BASIN #14	BASIN #15	Critical Value
METHOD D2216 (%)								
Percent Water	16	20	16	32	20	15	20	- -
VOLATILES								
METHOD 8021A (ug/kg)								
Benzene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Carbon tetrachloride	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Chlorobenzene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Chloroform	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
trans-1,2-Dichloroethylene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Hexachlorobutadiene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Bromomethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Chloromethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Methylene chloride (Dichloromethane)	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Naphthalene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Tetrachloroethene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Toluene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
1,2,4-Trichlorobenzene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
1,1,1-Trichloroethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
1,1,2-Trichloroethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Trichloroethlene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Trichlorofluoromethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Vinyl chloride	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
METHOD 8240B (ug/kg)								
Acrolein	<120	<120	<120	<150	<120	<120	<120	NC
Carbon disulfide	<5.9	<6.2	<6.0	<7.3	<6.2	<5.9	<6.2	NC
2-Butanone (MEK)	<30	<31	<30	<36	<31	<30	<32	NC
SEMIVOLATILES								
METHOD 8070 (ug/kg)								
N-Nitrosodimethylamine	<80	<84	<80	<99	<84	<79	<84	NC
METHOD 8090 (ug/kg)								
2,4-Dinitrotoluene	<180 a	<11	<12	<15	<2500 b	<35 c	<12	NC
2,6-Dinitrotoluene	<180 a	<11	<12	<15	<2500 b	<35 c	<12	NC
METHOD 8121 (ug/kg)								
Hexachlorobenzene	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
Hexachlorocyclopentadiene	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
Hexachloroethane	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
METHOD 8151 (ug/kg)								
Pentachlorophenol	<20	<21	<20	<25	<21	<20	<21	NC

Reporting limits and concentrations are presented on a dry weight basis.

Table 3-2
Analytical Results and Critical Values for the Basin Subsoil Samples

ANALYTE	BASIN #1	BASIN #5	BASIN #6	BASIN #9	BASIN #10	BASIN #14	BASIN #15	Critical Value
METHOD 8110 (ug/kg)								
bis(2-Chloroethoxy) methane	<30	<30	<30	<44	<30	<30	<30	NC
bis(2-Chloroethyl) ether	<30	<30	<30	<44	<30	<30	<30	NC
bis(2-Chloroisopropyl) ether	<30	<30	<30	<44	<30	<30	<30	NC
METHOD 8270B (ug/kg)								
bis(2-Ethylhexyl)phthalate	<390	<410	<390	<490	<410	<390	<410	NC
Butylbenzylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
4-Chloro-3-methylphenol	<390	<410	<390	<490	<410	<390	<410	NC
2-Chlorophenol	<390	<410	<390	<490	<410	<390	<410	NC
Di-n-butylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
Diethylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
2,4-Dimethylphenol	<390	<410	<390	<490	<410	<390	<410	NC
Dimethylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
2-Methyl-4,6-dinitrophenol	<2000	<2100	<2000	<2500	<2100	<2000	<2100	NC
Di-n-octylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
Phenol	<390	<410	<390	<490	<410	<390	<410	NC
2,4,5-Trichlorophenol	<390	<410	<390	<490	<410	<390	<410	NC
2,4,6-Trichlorophenol	<390	<410	<390	<490	<410	<390	<410	NC
METHOD 8310 (ug/kg)								
Fluoranthene	<12	<12	<12	330	<12	<12	<12	6.0
Fluorene	<12	<12	<12	<12	<12	<12	<12	NC
METHOD 8330 (ug/kg)								
Nitrobenzene	<320	<310	<300	<370	<310	<290	<310	NC
PESTICIDES/PCBs								
METHOD 8080A (ug/kg)								
Aldrin	<30 a	<1.9	<2.0	<2.5	<420 b	<6.0 c	<2.1	NC
Chlordane	<300 a	<19	<20	<25	<4200 b	<6.0 c	<21	NC
Dieldrin	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
Endosulfan I	<30 a	<1.9	<2.0	<2.5	<420 b	<6.0 c	<2.1	NC
Endosulfan II	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
Endrin	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
Heptachlor	<30 a	<1.9	<2.0	<2.5	<420 b	<6.0 c	<2.1	NC
Heptachlor epoxide	<30 a	<1.9	<2.0	<2.5	<420 b	<6.0 c	<2.1	NC
Methoxychlor	<300 a	<19	<20	<25	<4200 b	<60 c	<21	NC
Aroclor-1016	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Aroclor-1221	<1200 a	<74	<80	<99	<17000 b	<240 c	<84	NC
Aroclor-1232	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Aroclor-1242	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC

Reporting limits and concentrations are presented on a dry weight basis.

Table 3-2
Analytical Results and Critical Values for the Basin Subsoil Samples

ANALYTE	BASIN #1	BASIN #5	BASIN #6	BASIN #9	BASIN #10	BASIN #14	BASIN #15	Critical Value
Aroclor-1248	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Aroclor-1254	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Aroclor-1260	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Toxaphene	<3000 a	<190	<200	<250	<42000 b	<600 c	<210	NC
METALS								
METHOD 6020 (mg/kg)								
Arsenic	2.2	2.1	2.4	4.6	3	2.3	4.3	5.5
Barium	91.2	86	45	72.7	51.4	67.2	94.6	29.2
Beryllium	0.42	0.58	0.23	0.5	0.34	0.27	0.4	1.71
Cadmium	<0.23	<0.25	<0.23	<0.30	<0.25	<0.24	<0.24	NC
Chromium	21.9	25	14.8	33.4	22.5	16.5	37.1	48.6
Lead	12.5	12.1	6.7	11.9	14.8	12.9	26.2	45.1
Nickel	6.5	11.6	5.9	14.1	8.4	5.4	14	28.1
Selenium	<0.23	<0.49	<0.23	<0.30	<0.25	<0.24	<1.2	NC
Silver	<0.11	<0.12	<0.12	<0.15	<0.13	<0.12	<0.12	NC
Thallium	0.18	0.21	0.14	0.26	0.21	0.15	0.5	0.63
METHOD 7471A (mg/kg)								
Mercury	<0.11	<0.12	<0.12	<0.15	<0.13	<0.12	<0.12	NC
METHOD 9010A (mg/kg)								
Cyanide, Total	<0.57	<0.62	<0.58	<0.75	<0.63	<0.60	<0.61	NC

Reporting limits and concentrations are presented on a dry weight basis.

a - Due to matrix interference, this sample was analyzed at a 15-fold dilution.
b - Due to matrix interference, this sample was analyzed at a 200-fold dilution.
c - Due to matrix interference, this sample was analyzed at a 3-fold dilution.

Table 3-3 presents the results of the four concrete wall samples and the basin liner composite sample. No TCLP list constituents were detected in these samples above the regulatory level.

3.2 Statistical Treatment

The purpose of the statistical treatment of the background data is to calculate a critical value (CV) for comparison against the basin subsoil data. Based on the Closure Plan and discussions with the VaDEQ, CVs were calculated only for the seven metals detected in the background samples. These CVs are included in Tables 3-1 and 3-2. Critical values were calculated for those HCOCs that were detected in both the background and basin samples (metals) or detected in the basin samples but not in the background (fluoranthene). The CVs were calculated as an upper tolerance limit (UTL) for the 99th percentile (i.e., a coverage of 99%) with 95% confidence, as specified in the Closure Plan.

Prior to calculating the UTLs, the data were evaluated to determine if the concentrations follow a normal distribution for each analyte according to the Shapiro-Wilk W test (Shapiro and Wilk, 1965). Each of the HCOCs were determined to have a normal distribution according to the W test, so only normal UTLs were calculated using the following equation:

$$\mathrm{UTL} = \underline{x} + (K)(s)$$

where $\underline{x}$ is the estimated sample mean; K is the tolerance factor; and s is the estimated standard deviation. The tolerance factor, K, is from Hahn and Meeker, 1991. Table 3-4 shows the appropriate statistics used in the UTL calculations.

TABLE 3-3
ANALYTICAL TCLP RESULTS

ANALYTE	REGULATORY LEVEL	BL-01-01	WC-01-01	WC-02-01	WC-03-01	WC-04-01
METALS, TOTAL (MG/L)						
Arsenic	5.0	0.00804	0.00299	0.00442	0.00497	0.00525
Barium	100.0	0.071	0.332	0.248	0.233	0.255
Cadmium	1.0	0.0002	0.0002	0.0002	0.0002	0.0002
Chromium	5.0	0.00263	0.017	0.0138	0.0201	0.0124
Lead	5.0	<0.00129	<0.00129	<0.00129	<0.00129	<0.00129
Mercury	0.2	<0.000039	<0.000039	<0.000039	<0.000039	<0.000039
Selenium	1.0	0.00715	0.00972	0.00992	0.00877	0.00933
Silver	5.0	<0.00187	<0.00187	<0.00187	<0.00187	<0.00187
VOLATILE ORGANICS (UG/L)						
Benzene	500	1.70 B	<0.940	<0.940	<0.940	<0.940
2-Butanone(MEK)	200,000	<5.78	<5.78	<5.78	<5.78	<5.78
Carbon tetrachloride	500	<2.26	<2.26	<2.26	<2.26	<2.26
Chlorobenzene	100,000	<1.38	<1.38	<1.38	<1.38	<1.38
Chloroform	6,000	<2.44	<2.44	<2.44	<2.44	<2.44
1,2-Dichloroethane	500	<2.50	<2.50	<2.50	<2.50	<2.50
1,1-Dichloroethene	700	<1.53	<1.53	<1.53	<1.53	<1.53
Tetrachloroethene	700	<3.34	<3.34	<3.34	<3.34	<3.34
Trichloroethene	500	<1.86	<1.86	<1.86	<1.86	<1.86
Vinyl chloride	200	<4.64	<4.64	<4.64	<4.64	<4.64
SEMIVOLATILE ORGANICS (UG/L)						
1,4-Dichlorobenzene	7,500	<5.71	<5.71	<5.71	<4.86	<5.71
2,4-Dinitrotoluene	130	<3.47	<3.47	<3.47	<2.32	<3.47
Hexachlorobenzene	130	<2.55	<2.55	<2.55	<2.06	<2.55
Hexachlorobutadiene	500	<15.0	<15.0	<15.0	<14.5	<15.0
Hexachloroethane	3,000	<13.6	<13.6	<13.6	<17.1	<13.6
2-Methylphenol (o-cresol)	200,000	<2.46	<2.46	<2.46	<2.78	<2.46
4-Methylphenol/3-Methylphenol	200,000	<2.00	<2.00	<2.00	<2.59	<2.00
Nitrobenzene	2,000	<3.57	<3.57	<3.57	<4.14	<3.57
Pentachlorophenol	100,000	<4.11	<4.11	<4.11	<4.79	<4.11
Pyridine	5,000	<5.29	<5.29	<5.29	<24.6	<5.29
2,4,5-Trichlorophenol	400,000	<2.74	<2.74	<2.74	<2.17	<2.74
2,4,6-Trichlorophenol	2,000	<7.25	<7.25	<7.25	<3.41	<7.25
ORGANOCHLORINE PESTICIDES (UG/L)						
gamma-BHC(Lindane)	400	<0.0346	<0.0346	<0.0346	<0.0346	<0.0346
Chlordane	30	<0.338	<0.338	<0.338	<0.338	<0.338
Endrin	20	<0.0762	<0.0762	<0.0762	<0.0762	<0.0762
Heptachlor	8	<0.0462	<0.0462	<0.0462	<0.0462	<0.0462
Heptachlor epoxide	8	<0.0138	<0.0138	<0.0138	<0.0138	<0.0138
Methoxychlor	10,000	<0.448	<0.448	<0.448	<0.448	<0.448
Toxaphene	500	<0.923	<0.923	<0.923	<0.923	<0.923
PHENOXYACID HERBICIDES (UG/L)						
2,4-D	10,000	<1.06	<1.06	<1.06	<1.06	<1.06
2,4,5-TP (Silvex)	1,000	<0.1000	<0.1000	<0.1000	<0.1000	<0.1000

B - Benzene detected in laboratory blank at 1.22 ug/L

Table 3-4

Statistics for Calculating the Critical Values

Constituent	Mean, $\underline{x}$	Standard Deviations, s	Tolerance Factor, K	Upper Tolerance Limit, UTL
Arsenic	2.0563	0.7917	4.3539	5.5031
Barium	148.7500	32.9708	4.3539	292.3000
Beryllium	0.9488	0.1750	4.3539	1.7109
Chromium	25.9750	5.1933	4.3539	48.5860
Lead	16.3000	6.6132	4.3539	45.0929
Nickel	15.2000	2.9674	4.3539	28.1198
Thallium	0.2294	0.0931	4.3539	0.6345
Fluoranthene	6.0	0	4.3539	6.0

Each basin sample result was compared to the critical values. All results for the inorganic HCOCs were below the critical values. Fluoranthene was detected in one basin sample (#9 at 330 μg/kg); however, fluoranthene was not detected in any of the background samples. A CV for fluoranthene was calculated using the equation above. Using one-half the sample result (per telephone conference with VaDEQ) yields a CV for fluoranthene of 6 μg/kg. Therefore, the concentration of fluoranthene for one sample exceeds the CV.

Elevations of Basin Subsoil Locations

Sampling Node	Elevation (ft MSL)
1	1,698.45
5	1,700.26
6	1,699.02
9	1,695.88
10	1,698.77
14	1,698.37
15	1,698.17

Final
Site Investigation/Evaluation

Bioplant Equalization Basin Closure
Site Investigation/Evaluation
Radford Army Ammunition Plant
Radford, Virginia

Submitted to:

Norfolk District
U.S. Army Corps of Engineers

FINAL

SITE INVESTIGATION/EVALUATION BIOPLANT EQUALIZATION BASIN CLOSURE SITE INVESTIGATION/EVALUATION RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Prepared for:

Norfolk District, U.S. Army Corps of Engineers
Engineering Division
HTRW Branch

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Contract No. DACA65-95-D-0030

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1.0 INTRODUCTION

Radian Corporation (Radian) has conducted a site investigation to support the closure of the Bioplant Equalization Basin at Radford Army Ammunition Plant (RAAP). The work is authorized by Delivery Order No. 10, Contract No. DACA65-95-D-0030 with the Norfolk District of the U.S. Army Corps of Engineers. The site investigation was conducted in accordance with the closure plan entitled "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 and SWMU-10," dated 12 December 1995. This plan was approved by Virginia Department of Environmental Quality (VaDEQ) on 2 January 1996.

The objective of this report is to present the results of the site investigation including the comparison of statistically-derived background concentrations (critical values) of the 70 hazardous constituents of concern (HCOCs) to the concentrations of HCOCs in the basin subsoil. In addition, the waste characterization of the basin liner and concrete wall are presented.

Radian has collected and chemically analyzed samples from eight background locations and seven subsoil samples at RAAP, as specified in the Chemical Data Acquisition Plan (CDAP) (Radian, 1996). The CDAP is included as Appendix A. The analytical data has been verified and statistically analyzed to calculate the above-mentioned background critical values. The individual basin subsoil samples are compared to determine if clean closure is a viable plan for the equalization basin. Section 2.0 discusses the selection of sampling locations and sampling procedures. Section 3.0 presents the analytical results and statistical analysis of the data. Section 4.0 presents an evaluation of the quality assurance/quality control performed for the laboratory analysis. Section 5.0 presents a list of references.

2.0 SITE ACTIVITIES

2.1 Background Sampling

RAAP personnel selected eight locations from which to collect background samples of subsurface soil. The locations were chosen from areas thought to be free from contamination from past or present industrial activities. These proposed sampling locations were submitted to VaDEQ for approval. VaDEQ requested the relocation of three of the sampling points. This approval was conveyed in the 5 August 1996 letter from Khoa Nguyen, VaDEQ, to RAAP. A map containing the approved locations is presented in Figure 2-1. The sampling locations are designated #1 through #8.

The closure plan requires the background soil samples to be geologically similar to the basin subsoil. For this reason, Radian collected samples of the basin subsoil to determine the lithology prior to collecting background samples. Radian initiated the sampling of basin subsoil on 19 September 1996. The basin subsoil samples were found to consist of reddish-brown, fine-grained, clayey sand.

The collection of background soil samples was conducted on 23 and 24 September 1996. Radian employed a drill rig operated by a subcontractor, Bedford Drilling Services, to drill soil borings at the selected locations. Soil borings were advanced with a 8.5-inch diameter hollow-stem auger, and the samples collected with a 3-inch diameter, stainless steel split spoon. The subsurface soil was sampled continuously with the split spoon for the entire depth of each boring. A Radian geologist classified the soil in each sample and measured the organic vapor concentration of the headspace above each sample with a photoionization detector. For borings #1-#7, the total depth of the boring was 8 feet. Boring #8 was drilled to 10 feet. All the selected samples were classified as clayey sand. The boring log for each of the background soil borings is presented in this report as Appendix B.

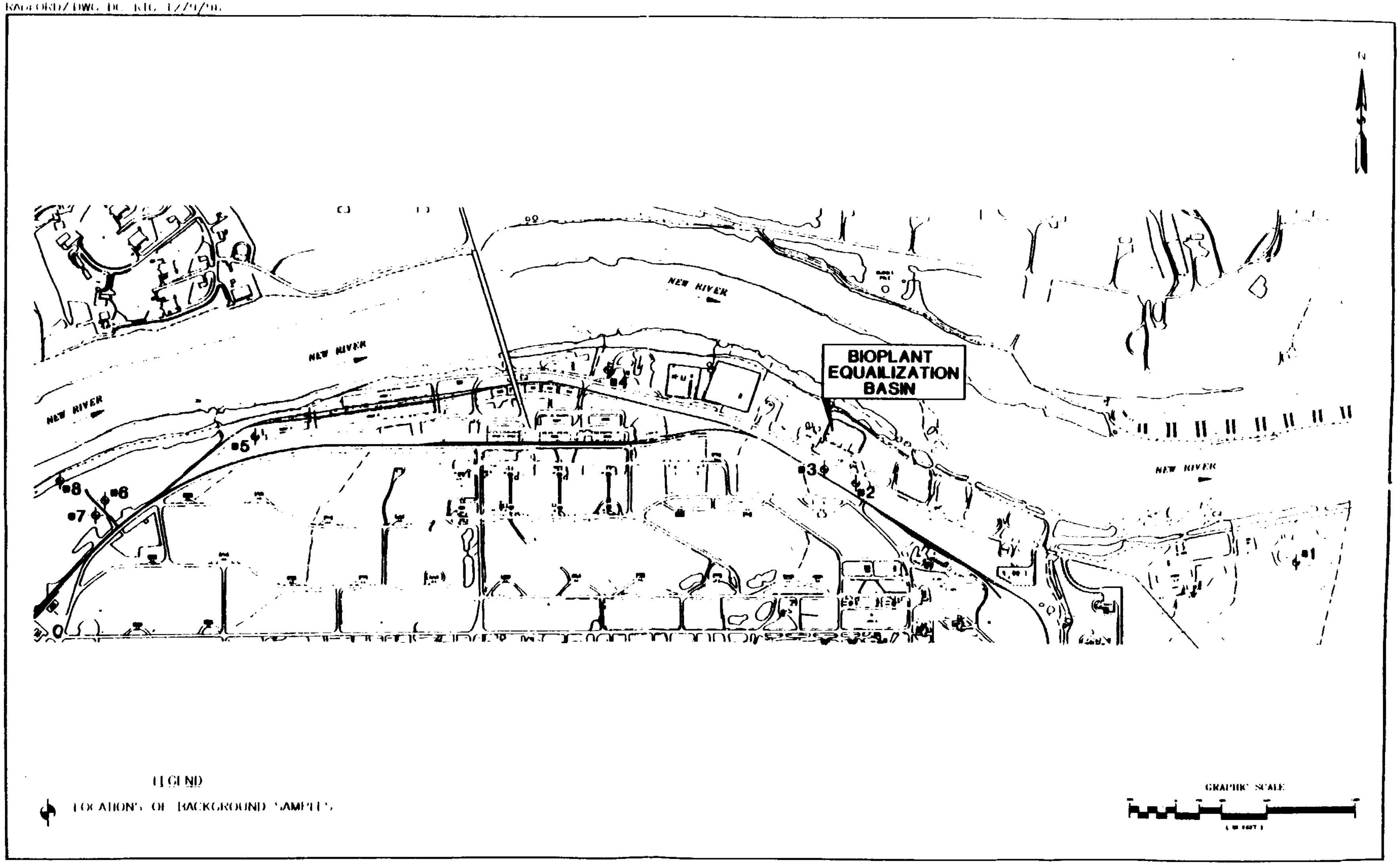

Figure 2-1. Location of Background Samples
Radford Army Ammunition Plant, Radford, Virginia

The samples were preserved with ice and shipped overnight in plastic coolers to the laboratories. Additional sample volume from selected background soil locations were collected for matrix spike analysis. An equipment rinsate blank and a trip blank were collected for QA/QC purposes.

2.2 Basin Subsoil Sampling

2.2.1 Sample Location Selection

Radian followed the methodology in the Closure Plan for selecting the locations from which the basin subsoil samples were collected. Fifteen grid nodes were identified in the closure plan. The grid nodes represented areas of the basin with dimensions of 50 feet by 50 feet. The grid nodes were numbered from 1 to 15. The closure plan requires a minimum of seven subsoil samples to be collected from the total population of the 15 grid nodes. Radian utilized a table of random numbers (Milton and Arnold, 1990) to select the seven locations. The selected grid nodes were 1, 5, 6, 9,10,14, and 15.

2.2.2 Sampling Activities

As previously mentioned, Radian initiated the basin sampling on 16 September 1996. The field crew set up the 15 grid nodes by selecting a starting point in the southeast corner of the basin and measuring 50 foot increments around the basin wall. Figure 2-2 presents the grid system. A sampling point was selected in each grid node and marked with a wooden stake. At the time the sampling points were selected, water covered the center of the basin including all of grid node No. 9. The sampling point for No. 9 was marked by placing a large piece of concrete in the water in the area of the proposed sampling location. The sampling locations and elevations were surveyed following completion of the sampling. The elevations of the basin subsoil samples are presented in Appendix C.

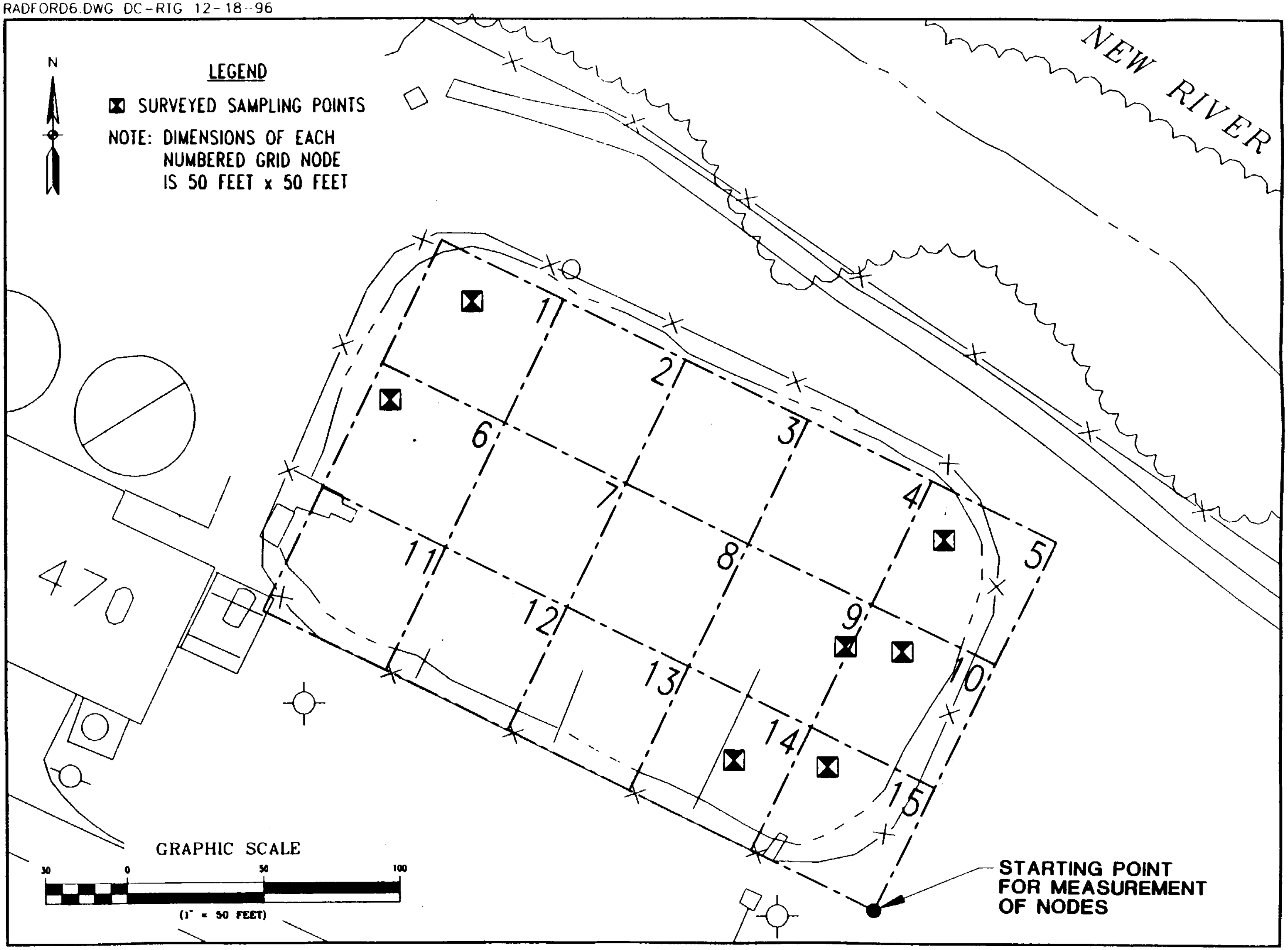

Figure 2-2. Location of Basin Subsoil Samples

Radian collected samples of basin subsoil from all seven sampling locations. A hole was made in the 12-inch thick basin liner with an air hammer. Radian field personnel used a stainless steel hand auger to collect soil from the top 6 inches of the soil directly underneath the liner (subsoil). The clayey sand material was split into the sampling containers following the protocol in the CDAP. Seven discrete samples were collected. The samples were identified with the following field ID's: RAAP-#10-01, -05, -06, -09, -10, -14, and -15. All pertinent sampling information was recorded in a notebook. Radian backfilled each of the boreholes in the liner with bentonite following the completion of the sampling.

The samples were packed with ice and shipped overnight with the proper chain-of-custody to the appropriate laboratory. Additional soil was collected for the QA/QC samples. Equipment rinsate blank, a field blank, and trip blanks also were collected.

2.3 Waste Characterization Sampling

Radian collected samples of the basin liner and of the concrete wall which surrounds the basin to identify if the material will need to be managed as hazardous waste when removed. For the basin liner, one composite sample was made up from all seven sampling grid nodes. Radian placed approximately one-half liter of liner material in a stainless steel bowl from each of the seven sampling locations. The material was pulverized and completely mixed with a stainless steel spoon and split into the appropriate sampling containers. The sample containers were packed with ice and shipped overnight with the proper chain-of-custody to the laboratory. The material appeared to be a mixture of brownish-colored soil and bentonite.

Radian collected four discrete samples of concrete from the basin wall. The field personnel used a hammer and chisel to remove concrete chip from the base of the 2-foot high wall. The chips were pulverized with the hammer on a piece of plastic sheeting and placed into the sampling containers. This procedure was repeated at each wall sampling location so that one concrete wall sample was collected from each quadrant of the perimeter wall.

3.0 ANALYTICAL DATA

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During site investigation, eight background soil samples and seven subsoil samples were collected and analyzed for 70 hazardous constituents of concern (HCOCs), as specified in the Chemical Data Acquisition Plan (Radian, 1996). The samples for the organic HCOCs were analyzed by Savannah Laboratories and Environmental Services, Inc. of Tallahassee, Florida. The samples for the inorganic HCOCs were analyzed by Quanterra, Inc. of West Sacramento, California. Additionally, four concrete wall samples and one basin liner sample (comprised of a composite from the basin liner collected from each of the sampling locations) were collected and analyzed for the TCLP list of hazardous constituents. The sample for TCLP analysis was performed by Radian Corporation of Austin, Texas.

3.1 Results

Table 3-1 presents the analytical results for the eight background soil samples. For the organic constituents, only 2,4-dinitrotoluene and Aroclor-1254 were detected in the samples. All other organic HCOCs were not detected. 2,4-Dinitrotoluene was found in only one sample (#2) at a concentration less than the reporting limit. Aroclor-1254 was detected in two samples (#2 and #7). The result in sample #2 was at a concentration less than the reporting limit. For the inorganic constituents, arsenic, barium, beryllium, chromium, lead, and nickel were measured in all eight samples. Thallium was measured in seven of eight samples.

Table 3-2 presents the analytical results for the seven subsoil samples. For the organic constituents, only fluoranthene (in Basin sample #9) was detected in the samples. All other organic HCOCs were not detected. For the inorganic constituents, arsenic, barium, beryllium, chromium, lead, nickel, and thallium were measured in all seven samples.

TABLE 3-1
Analytical Results and Critical Values for the Background Samples

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
METHOD D2216 (%)									
Moisture Content	15	14	16	17	16	16	16	17	NC
VOLATILES									
METHOD 8021A (ug/kg)									
Benzene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Bromomethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Carbon tetrachloride	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Chlorobenzene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Chloroform	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Chloromethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
trans-1,2-Dichloroethene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Hexachlorobutadiene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Methylene chloride (Dichloromethane)	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Naphthalene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Tetrachloroethene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Toluene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
1,2,4-Trichlorobenzene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
1,1,1-Trichloroethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
1,1,2-Trichloroethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Trichloroethene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Trichlorofluoromethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Vinyl chloride	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
METHOD 8240B (ug/kg)									
Acrolein	<120	<120	<120	<120	<120	<120	<120	<120	NC
Carbon disulfide	<5.8	<5.8	<5.9	<6.1	<6.0	<6.0	<6.0	<6.1	NC
2-Butanone (MEK)	<29	<29	<29	<30	<30	<30	<30	<30	NC
SEMIVOLATILES									
METHOD 8070 (ug/kg)									
N-Nitrosodimethylamine	<100	<78	<80	<81	<80	<80	<80	<81	NC
METHOD 8090 (ug/kg)									
2,4-Dinitrotoluene	<12	2.4 J	<12	<12	<12	<12	<12	<12	NC
2,6-Dinitrotoluene	<12	<12	<12	<12	<12	<12	<12	<12	NC
METHOD 8110 (ug/kg)									
Bis(2-Chloroethoxy) methane	<35	<35	<36	<36	<36	<36	<36	<36	NC

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value; constituents present below the reporting limit.
NC - Critical value not calculated; see Section 3.2.

TABLE 3-1
Analytical Results and Critical Values for the Background Samples

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
Bis(2-Chloroethyl) ether	<35	<35	<36	<36	<36	<36	<36	<36	NC
Bis(2-Chloroisopropyl) ether	<35	<35	<36	<36	<36	<36	<36	<36	NC
METHOD 8121 (ug/kg)									
Hexachlorobenzene	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Hexachlorocyclopentadiene 140	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
SEMIVOLATILES Continued									
Hexachloroethane	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
METHOD 8151 (ug/kg)									
Pentachlorophenol 85	<20	<20	<20	<20	<20	<20	<20	<20	NC
METHOD 8270B (ug/kg)									
Bis(2-Ethylhexyl)phthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
Butylbenzylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
4-Chloro-3-methylphenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
2-Chlorophenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
Di-n-butylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
Di-n-octylphthalate 115	<390	<380	<390	<400	<390	<390	<390	<400	NC
Diethylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
2,4-Dimethylphenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
Dimethylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
2-Methyl-4,6-dinitrophenol	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<2000	NC
Phenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
2,4,5-Trichlorophenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
2,4,6-Trichlorophenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
METHOD 8310 (ug/kg)									
Fluoranthene 145	<12	<12	<12	<12	<12	<12	<12	<12	6.0
Fluorene	<12	<12	<12	<12	<12	<12	<12	<12	NC
METHOD 8330 (ug/kg)									
Nitrobenzene	<290	<290	<300	<300	<300	<300	<300	<300	NC
PESTICIDES/PCBs									
METHOD 8080A (ug/kg)									
Aldrin	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Chlordane 130	<20	<20	<20	<20	<20	<20	<20	<20	NC
Dieldrin	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value; constituents present below the reporting limit.
NC - Critical value not calculated; see Section 3.2.

TABLE 3-1
Analytical Results and Critical Values for the Background Samples

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
Endosulfan I	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Endosulfan II	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Endrin	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Heptachlor	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Heptachlor epoxide	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Methoxychlor	<20	<20	<20	<20	<20	<20	<20	<20	NC
Aroclor-1016	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1221	<79	<78	<80	<81	<80	<80	<80	<81	NC
Aroclor-1232	<39	<38	<39	<40	<39	<39	<39	<40	NC
PESTICIDES/PCBs Continued									
Aroclor-1242	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1248	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1254	<39	17 J	<39	<40	<39	<39	46	<40	NC
Aroclor-1260	<39	<38	<39	<40	<39	<39	<39	<40	NC
Toxaphene	<200	<200	<200	<200	<200	<200	<200	<200	NC
METALS									
METHOD 6020 (mg/kg)									
Arsenic	2	2.5	2.9	1.6	2.1	1.2	3.2	0.95	5.5
Barium	172	157	139	187	169	108	165	93	292
Beryllium	0.85	0.99	0.87	1.2	1.1	0.72	1.1	0.76	1.71
Cadmium	<0.24	<0.24	<0.24	< 0.27	<0.24	<0.22	<0.24	<0.24	NC
Chromium	27.3	28.1	25.9	26	28.6	18.4	34.4	19.1	48.6
Lead	11.6	26.6	16.8	16.7	20.2	8.6	22	7.9	45.1
Nickel	15.2	14.3	13.9	17.2	17	11.8	20.5	11.7	28.1
Selenium	<0.24	<0.24	<0.24	<0.27	<0.24	<0.22	<0.24	<0.24	NC
Silver	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
Thallium	0.29	0.23	0.22	<0.21	0.25	0.16	0.41	0.17	0.63
METHOD 7471A (mg/kg)									
Mercury	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
METHOD 9010A (mg/kg)									
Cyanide, Total	<0.59	<0.60	<0.60	<0.67	<0.59	<0.55	<0.60	<0.60	NC
Chromium	27.3	28.1	25.9	26	28.6	18.4	34.4	19.1	NC
Lead	11.6	26.6	16.8	16.7	20.2	8.6	22	7.9	NC

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value, constituents present below the reporting limit
NC - Critical value not calculated, see Section 3 2

TABLE 3-1
Analytical Results and Critical Values for the Background Samples

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
Nickel	15.2	14.3	13.9	17.2	17	11.8	20.5	11.7	NC
Selenium	<0.24	<0.24	<0.24	<0.27	<0.24	<0.22	<0.24	<0.24	NC
Silver	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
Thallium	0.29	0.23	0.22	<0.21	0.25	0.16	0.41	0.17	NC
METHOD 7471A (mg/kg)									
Mercury	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
METHOD 9010A (mg/kg)									
Cyanide, Total	<0.59	<0.60	<0.60	<0.67	<0.59	<0.55	<0.60	<0.60	NC

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value; constituents present below the reporting limit.
NC - Critical value not calculated; see Section 3.2.

Table 3-2
Analytical Results and Critical Values for the Basin Subsoil Samples

ANALYTE	BASIN #1	BASIN #5	BASIN #6	BASIN #9	BASIN #10	BASIN #14	BASIN #15	Critical Value
METHOD D2216 (%)								
Percent Water	16	20	16	32	20	15	20	- -
VOLATILES								
METHOD 8021A (ug/kg)								
Benzene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Carbon tetrachloride	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Chlorobenzene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Chloroform	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
trans-1,2-Dichloroethylene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Hexachlorobutadiene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Bromomethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Chloromethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Methylene chloride (Dichloromethane)	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Naphthalene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Tetrachloroethene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Toluene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
1,2,4-Trichlorobenzene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
1,1,1-Trichloroethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
1,1,2-Trichloroethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Trichloroethlene	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Trichlorofluoromethane	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
Vinyl chloride	<6.0	<6.2	<5.9	<7.4	<6.3	<5.8	<6.2	NC
METHOD 8240B (ug/kg)								
Acrolein	<120	<120	<120	<150	<120	<120	<120	NC
Carbon disulfide	<5.9	<6.2	<6.0	<7.3	<6.2	<5.9	<6.2	NC
2-Butanone (MEK)	<30	<31	<30	<36	<31	<30	<32	NC
SEMIVOLATILES								
METHOD 8070 (ug/kg)								
N-Nitrosodimethylamine	<80	<84	<80	<99	<84	<79	<84	NC
METHOD 8090 (ug/kg)								
2,4-Dinitrotoluene	<180 a	<11	<12	<15	<2500 b	<35 c	<12	NC
2,6-Dinitrotoluene	<180 a	<11	<12	<15	<2500 b	<35 c	<12	NC
METHOD 8121 (ug/kg)								
Hexachlorobenzene	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
Hexachlorocyclopentadiene	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC

Reporting limits and concentrations are presented on a dry weight basis.

Table 3-2
Analytical Results and Critical Values for the Basin Subsoil Samples

ANALYTE	BASIN #1	BASIN #5	BASIN #6	BASIN #9	BASIN #10	BASIN #14	BASIN #15	Critical Value
Hexachloroethane	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
METHOD 8151 (ug/kg)								
Pentachlorophenol	<20	<21	<20	<25	<21	<20	<21	NC
METHOD 8110 (ug/kg)								
bis(2-Chloroethoxy) methane	<30	<30	<30	<44	<30	<30	<30	NC
bis(2-Chloroethyl) ether	<30	<30	<30	<44	<30	<30	<30	NC
bis(2-Chloroisopropyl) ether	<30	<30	<30	<44	<30	<30	<30	NC
METHOD 8270B (ug/kg)								
bis(2-Ethylhexyl)phthalate	<390	<410	<390	<490	<410	<390	<410	NC
Butylbenzylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
4-Chloro-3-methylphenol	<390	<410	<390	<490	<410	<390	<410	NC
2-Chlorophenol	<390	<410	<390	<490	<410	<390	<410	NC
Di-n-butylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
Diethylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
2,4-Dimethylphenol	<390	<410	<390	<490	<410	<390	<410	NC
Dimethylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
2-Methyl-4,6-dinitrophenol	<2000	<2100	<2000	<2500	<2100	<2000	<2100	NC
Di-n-octylphthalate	<390	<410	<390	<490	<410	<390	<410	NC
Phenol	<390	<410	<390	<490	<410	<390	<410	NC
2,4,5-Trichlorophenol	<390	<410	<390	<490	<410	<390	<410	NC
2,4,6-Trichlorophenol	<390	<410	<390	<490	<410	<390	<410	NC
METHOD 8310 (ug/kg)								
Fluoranthene	<12	<12	<12	330	<12	<12	<12	6.0
Fluorene	<12	<12	<12	<12	<12	<12	<12	NC
METHOD 8330 (ug/kg)								
Nitrobenzene	<320	<310	<300	<370	<310	<290	<310	NC
PESTICIDES/PCBs								
METHOD 8080A (ug/kg)								
Aldrin	<30 a	<1.9	<2.0	<2.5	<420 b	<6.0 c	<2.1	NC
Chlordane	<300 a	<19	<20	<25	<4200 b	<6.0 c	<21	NC
Dieldrin	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
Endosulfan I	<30 a	<1.9	<2.0	<2.5	<420 b	<6.0 c	<2.1	NC
Endosulfan II	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
Endrin	<59 a	<3.7	<3.9	<4.9	<820 b	<12 c	<4.1	NC
Heptachlor	<30 a	<1.9	<2.0	<2.5	<420 b	<6.0 c	<2.1	NC

a dry weight basis.

Table 3-2
Analytical Results and Critical Values for the Basin Subsoil Samples

ANALYTE	BASIN #1	BASIN #5	BASIN #6	BASIN #9	BASIN #10	BASIN #14	BASIN #15	Critical Value
Heptachlor epoxide	<30 a	<1.9	<2.0	<2.5	<420 b	<6.0 c	<2.1	NC
Methoxychlor	<300 a	<19	<20	<25	<4200 b	<60 c	<21	NC
Aroclor-1016	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Aroclor-1221	<1200 a	<74	<80	<99	<17000 b	<240 c	<84	NC
Aroclor-1232	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Aroclor-1242	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Aroclor-1248	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Aroclor-1254	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Aroclor-1260	<590 a	<37	<39	<49	<8200 b	<120 c	<41	NC
Toxaphene	<3000 a	<190	<200	<250	<42000 b	<600 c	<210	NC
METALS								
METHOD 6020 (mg/kg)								
Arsenic	2.2	2.1	2.4	4.6	3	2.3	4.3	5.5
Barium	91.2	86	45	72.7	51.4	67.2	94.6	29.2
Beryllium	0.42	0.58	0.23	0.5	0.34	0.27	0.4	1.71
Cadmium	<0.23	<0.25	<0.23	<0.30	<0.25	<0.24	<0.24	NC
Chromium	21.9	25	14.8	33.4	22.5	16.5	37.1	48.6
Lead	12.5	12.1	6.7	11.9	14.8	12.9	26.2	45.1
Nickel	6.5	11.6	5.9	14.1	8.4	5.4	14	28.1
Selenium	<0.23	<0.49	<0.23	<0.30	<0.25	<0.24	<1.2	NC
Silver	<0.11	<0.12	<0.12	<0.15	<0.13	<0.12	<0.12	NC
Thallium	0.18	0.21	0.14	0.26	0.21	0.15	0.5	0.63
METHOD 7471A (mg/kg)								
Mercury	<0.11	<0.12	<0.12	<0.15	<0.13	<0.12	<0.12	NC
METHOD 9010A (mg/kg)								
Cyanide, Total	<0.57	<0.62	<0.58	<0.75	<0.63	<0.60	<0.61	NC

Reporting limits and concentrations are presented on a dry weight basis.

a - Due to matrix interference, this sample was analyzed at a 15-fold dilution.

b - Due to matrix interference, this sample was analyzed at a 200-fold dilution.

c - Due to matrix interference, this sample was analyzed at a 3-fold dilution.

Table 3-3 presents the results of the four concrete wall samples and the basin liner composite sample. No TCLP list constituents were detected in these samples above the regulatory level.

3.2 Statistical Treatment

The purpose of the statistical treatment of the background data is to calculate a critical value (CV) for comparison against the basin subsoil data. Based on the Closure Plan and discussions with the VaDEQ, CVs were calculated only for the seven metals detected in the background samples. These CVs are included in Tables 3-1 and 3-2. Critical values were calculated for those HCOCs that were detected in both the background and basin samples (metals) or detected in the basin samples but not in the background (fluoranthene). The CVs were calculated as an upper tolerance limit (UTL) for the 99th percentile (i.e., a coverage of 99%) with 95% confidence, as specified in the Closure Plan.

Prior to calculating the UTLs, the data were evaluated to determine if the concentrations follow a normal distribution for each analyte according to the Shapiro-Wilk W test (Shapiro and Wilk, 1965). Each of the HCOCs were determined to have a normal distribution according to the W test, so only normal UTLs were calculated using the following equation:

$$\text{UTL} = \underline{x} + (K)(s)$$

where $\underline{x}$ is the estimated sample mean; K is the tolerance factor; and s is the estimated standard deviation. The tolerance factor, K, is from Hahn and Meeker, 1991. Table 3-4 shows the appropriate statistics used in the UTL calculations.

TABLE 3-3
ANALYTICAL TCLP RESULTS

ANALYTE	REGULATORY LEVEL	BL-01-01	WC-01-01	WC-02-01	WC-03-01	WC-04-01
METALS, TOTAL (MG/L)						
Arsenic	5.0	0.00804	0.00299	0.00442	0.00497	0.00525
Barium	100.0	0.071	0.332	0.248	0.233	0.255
Cadmium	1.0	0.0002	0.0002	0.0002	0.0002	0.0002
Chromium	5.0	0.00263	0.017	0.0138	0.0201	0.0124
Lead	5.0	<0.00129	<0.00129	<0.00129	<0.00129	<0.00129
Mercury	0.2	<0.000039	<0.000039	<0.000039	<0.000039	<0.000039
Selenium	1.0	0.00715	0.00972	0.00992	0.00877	0.00933
Silver	5.0	<0.00187	<0.00187	<0.00187	<0.00187	<0.00187
VOLATILE ORGANICS (UG/L)						
Benzene	500	1.70 B	<0.940	<0.940	<0.940	<0.940
2-Butanone(MEK)	200,000	<5.78	<5.78	<5.78	<5.78	<5.78
Carbon tetrachloride	500	<2.26	<2.26	<2.26	<2.26	<2.26
Chlorobenzene	100,000	<1.38	<1.38	<1.38	<1.38	<1.38
Chloroform	6,000	<2.44	<2.44	<2.44	<2.44	<2.44
1,2-Dichloroethane	500	<2.50	<2.50	<2.50	<2.50	<2.50
1,1-Dichloroethene	700	<1.53	<1.53	<1.53	<1.53	<1.53
Tetrachloroethene	700	<3.34	<3.34	<3.34	<3.34	<3.34
Trichloroethene	500	<1.86	<1.86	<1.86	<1.86	<1.86
Vinyl chloride	200	<4.64	<4.64	<4.64	<4.64	<4.64
SEMIVOLATILE ORGANICS (UG/L)						
1,4-Dichlorobenzene	7,500	<5.71	<5.71	<5.71	<4.86	<5.71
2,4-Dinitrotoluene	130	<3.47	<3.47	<3.47	<2.32	<3.47
Hexachlorobenzene	130	<2.55	<2.55	<2.55	<2.06	<2.55
Hexachlorobutadiene	500	<15.0	<15.0	<15.0	<14.5	<15.0
Hexachloroethane	3,000	<13.6	<13.6	<13.6	<17.1	<13.6
2-Methylphenol (o-cresol)	200,000	<2.46	<2.46	<2.46	<2.78	<2.46
4-Methylphenol/3-Methylphenol	200,000	<2.00	<2.00	<2.00	<2.59	<2.00
Nitrobenzene	2,000	<3.57	<3.67	<3.57	<4.14	<3.57
Pentachlorophenol	100,000	<4.11	<4.11	<4.11	<4.79	<4.11
Pyridine	5,000	<5.29	<5.29	<5.29	<24.6	<5.29
2,4,5-Trichlorophenol	400,000	<2.74	<2.74	<2.74	<2.17	<2.74
2,4,6-Trichlorophenol	2,000	<7.25	<7.25	<7.25	<3.41	<7.25
ORGANOCHLORINE PESTICIDES (UG/L)						
gamma-BHC(Lindane)	400	<0.0346	<0.0346	<0.0346	<0.0346	<0.0346
Chlordane	30	<0.338	<0.338	<0.338	<0.338	<0.338
Endrin	20	<0.0762	<0.0762	<0.0762	<0.0762	<0.0762
Heptachlor	8	<0.0462	<0.0462	<0.0462	<0.0462	<0.0462
Heptachlor epoxide	8	<0.0138	<0.0138	<0.0138	<0.0138	<0.0138
Methoxychlor	10,000	<0.448	<0.448	<0.448	<0.448	<0.448
Toxaphene	500	<0.923	<0.923	<0.923	<0.923	<0.923
PHENOXYACID HERBICIDES (UG/L)						
2,4-D	10,000	<1.06	<1.06	<1.06	<1.06	<1.06
2,4,5-TP (Silvex)	1,000	<0.1000	<0.1000	<0.1000	<0.1000	<0.1000

B - Benzene detected in laboratory blank at 1.22 ug/L.

Table 3-4

Statistics for Calculating the Critical Values

Constituent	Mean, $\bar{x}$	Standard Deviations, s	Tolerance Factor, K	Upper Tolerance Limit, UTL
Arsenic	2.0563	0.7917	4.3539	5.5031
Barium	148.7500	32.9708	4.3539	292.3000
Beryllium	0.9488	0.1750	4.3539	1.7109
Chromium	25.9750	5.1933	4.3539	48.5860
Lead	16.3000	6.6132	4.3539	45.0929
Nickel	15.2000	2.9674	4.3539	28.1198
Thallium	0.2294	0.0931	4.3539	0.6345
Fluoranthene	6.0	0	4.3539	6.0

Each basin sample result was compared to the critical values. All results for the inorganic HCOCs were below the critical values. Fluoranthene was detected in one basin sample (#9 at 330 μg/kg); however, fluoranthene was not detected in any of the background samples. A CV for fluoranthene was calculated using the equation above. Using one-half the sample result (per telephone conference with VaDEQ) yields a CV for fluoranthene of 6 μg/kg. Therefore, the concentration of fluoranthene for one sample exceeds the CV.

4.0 DATA EVALUATION AND USABILITY FOR THE BACKGROUND RESULTS

This section presents a summary of the quality control tasks associated with the background soil sampling. The data were evaluated according to the data quality objectives (DQOs) presented in the Chemical Data Acquisition Plan (CDAP) (Radian, 1996). These DQOs are statements of the acceptable level of measurement uncertainty in chemical data. The measurement objectives were established in terms of accuracy, precision, representativeness, sensitivity, comparability, and completeness.

For the background sampling, eight soil samples, one equipment blank sample, one trip blank sample and one field blank sample were collected. The soil samples and the equipment blank were analyzed for all HCOCs while the trip blank and field blank were analyzed only for the volatile HCOCs (Methods 8021 and 8240) in accordance with the CDAP.

4.1 Accuracy

Accuracy is a measure of the agreement between a measured value and a reference or true value. The accuracy of the analytical methods was assessed by calculating the recovery (as a percentage) of known compounds that were spiked into the background soil samples. Three spiked samples, laboratory control Samples (LCS), surrogates and matrix spikes, were utilized for this purpose and are discussed separately below:

Laboratory Control Samples: All LCS recoveries were met.

Surrogates: In general, the specification for surrogate recoveries were met. There were some instances of recoveries being outside the specifications due to matrix

interference. In these instances, the laboratory followed the corrective action which involved re-extraction and reanalysis. The following instances are noted:

- Recoveries for both surrogate compounds by Method 8021 in sample #2 in the original and reanalysis were greater than the project criteria. The data are still usable but are considered to be biased high;
- Recoveries for all six surrogate compounds by Method 8270 in sample #2 in the original and reanalysis were less than the project criteria. The data are still usable but are considered to be biased low; and
- Recoveries for all three surrogate compounds by Methods 8080 and 8090 in sample #2 in the original and reanalysis were less than the project criteria. The data are still usable but are considered to be biased low.

Matrix Spikes: In general, the specification for matrix spikes recoveries were met. The following instances are noted:

- The matrix spikes were not performed for Method 8240 on the samples from this study; instead, samples from another client were used for the matrix spike. The recoveries from these samples met the project criteria;
- The matrix spike recovery for benzene by Method 8021 was greater than the project criteria. The benzene results for the background samples are still usable but are considered to be biased high; and
- The matrix spike and matrix spike duplicate recoveries for barium by Method 6020 were not calculated as the spiked amount when compared to the amount of barium in the soil sample was too small to yield a useful calculation. These samples are discussed further in Section 4.2. Because the spiked amount was too low, the matrix spike and matrix spike duplicate samples can be treated as laboratory duplicates. The RPDs of the duplicate samples were <20%, which demonstrates good reproducibility. The data are still usable.

4.2 Precision

Precision is a measure of the reproducibility or agreement among repeated measurements, and is typically evaluated by calculating the relative percent difference between the results from one or more types of "duplicate" analyses. For the background soil sampling, two types of duplicate analyses were performed, laboratory control samples and matrix spikes. These samples are discussed separately below:

Laboratory control sample/laboratory control sample duplicate (LCS/LCSD): The specifications for all LCS/LCSD for this project were met.

Matrix spikes/matrix spike duplicates (MS/MSD): The specifications for MS/MSD for this project were met. The following instances are noted:

- The RPD of 58% for bis(2-chloroethyl) ether by Method 8110 did not meet the project criteria of 52%; although, the recoveries of both the matrix spike and matrix spike duplicate met the project criteria. Non-homogeneity of the soil was the probable major factor. The data are still usable.
- The matrix spike and matrix spike duplicate recoveries for barium by Method 6020 were not calculated as the spiked amount when compared to the amount of barium in the soil sample was too small to yield a useful calculation. Because the spiked amount was too low, the matrix spike and matrix spike duplicate samples can be treated as laboratory duplicates. The RPDs of the duplicate samples were <20%, which demonstrates good reproducibility. The barium data are still usable.

4.3 Representativeness

The purpose of sampling is to obtain data that represent the system being studied. Representativeness is achieved by carefully selecting sampling sites and locations (discussed in Section 2), and controlling procedures for sample collection, preservation and handling. Field and laboratory quality control samples are also used to measure contamination of the sampling or analytical conditions. These quality control samples include equipment blanks, trip blanks, field blanks, and method (laboratory) blanks. Additionally, calibration of the instruments is performed and verified prior to analysis of environmental samples.

For this soil sampling, no analytes were detected in the equipment blank, trip blank, or field blank samples. Chromium and nickel were detected in the method blank; however, at concentrations less than twenty times the sample results. Consequently, the soil sample results for chromium and nickel are not impacted.

4.4 Sensitivity

The reporting limits presented in Section 3.0 appear to be greater than the reporting limits shown in Table 5-1 of the CDAP. This is due to the CDAP reporting limits having been adjusted to reflect the concentration of moisture in each sample. By presenting the concentrations in Section 3.0 on a dry-weight basis, a valid comparison can be made between background and subsoil samples.

The reporting limits specified in the CDAP for the background soil samples were met with two exceptions. The laboratory achieved a reporting limit of 2,000 μg/kg (1,700 μg/kg on an as-received basis) for 2-methyl-4,6-dinitrophenol. This reporting limit is greater than 330 μg/kg, as stated in the CDAP. The reporting limit for 2-methyl-4,6-dinitrophenol should have been presented in the CDAP as 1,700 μg/kg, based on information provided by the laboratory. Because of its chemical properties, 2-methyl-4,6-dinitrophenol is less sensitive to analysis by the gas chromatography/mass spectrometry configuration, provided in Method 8270B, than the other HCOCs analyzed by Method 8270B. Consequently, a higher reporting limit is necessary. The correct reporting limit of 1,700 μg/kg is less than the required PQL of 3,300 μg/kg shown in the CDAP.

For cyanide, the laboratory achieved a reporting limit of 0.5 mg/kg. This reporting limit is greater than 0.1 mg/kg as stated in the CDAP. The reporting limit of 0.1 mg/kg was based on an MDL study performed by the laboratory on an aqueous matrix. Because soil is a more complex matrix compared to laboratory pure water, the reporting limit based on the MDL study is not achievable in a soil matrix; hence, the increase from 0.1 mg/kg to 0.5 mg/kg.

4.5 Comparability

Comparability is a qualitative measure of confidence with which the data sets can be compared. Data comparability for this samples was achieved by following approved, standard analytical procedures and by reporting results in standard units of measure, as required in the specific methods.

4.6 Completeness

Completeness is expressed as the percentage of the amount of valid data (i.e., data which meet the measurement objective) obtained compared to the amount of data planned. Since all samples were collected as planned and the measurement objectives were met for all of the samples, the completeness for this phase of the project was 100 percent.

4.7 Data Usability

Overall, the data generated for the background soil samples can be used for their intended purpose.

5.0 DATA EVALUATION AND USABILITY FOR THE BASIN SUBSOIL RESULTS

This section presents a summary of the quality control tasks associated with the basin subsoil sampling. The data were evaluated according to the data quality objectives (DQOs) presented in the Chemical Data Acquisition Plan (CDAP) (Radian, 1996). These DQOs are statements of the acceptable level of measurement uncertainty in chemical data. The measurement objectives were established in terms of accuracy, precision, representativeness, sensitivity, comparability, and completeness.

For the basin sampling, seven soil samples, one field duplicate, one equipment blank sample, one trip blank sample and one field blank sample were collected. The subsoil samples, field duplicate, and the equipment blank were analyzed for all HCOCs while the trip blank and field blank were analyzed only for the volatile HCOCs (Methods 8021 and 8240).

5.1 Accuracy

Accuracy is a measure of the agreement between a measured value and a reference or true value. The accuracy of the analytical methods was assessed by calculating the recovery (as a percentage) of known compounds that were spiked into the background soil samples. Three spiked samples, laboratory control samples (LCS), surrogates and matrix spikes, were utilized for this purpose and are discussed separately below:

Laboratory Control Samples: All LCS recoveries were met.

Surrogates: In general, the specification for surrogate recoveries were met. There were some instances of recoveries being outside the specifications due to matrix

interference. In these instances, the laboratory followed the corrective action which involved re-extraction and reanalysis. The following instances are noted:

- Recoveries for one of the three surrogate compounds (dibromofluoromethane) for Method 8240 were below the project criteria for five samples (basin #'s 5, 6, 14, 14 [duplicate], and 15). The recoveries of the other two surrogates met the project criteria. The data are still usable.
- Recoveries for one of the six surrogate compounds by Method 8270 in sample #'s 1, 5, 10, and 14 in the original and reanalysis were less than the project criteria due to matrix interference. The data are still usable.

Matrix Spikes: In general, the specification for matrix spikes recoveries were met. The following instances are noted:

- The matrix spikes were not performed for Method 8240 on the samples from this study; instead, samples from another client were used for the matrix spike. The recoveries from these samples met the project criteria.
- The matrix spike recovery for benzene by Method 8021 was greater than the project criteria. The benzene results for the subsoil samples are still usable but are considered to be biased high.
- The matrix spike and matrix spike duplicate recoveries for barium by Method 6020 were greater than the project criteria. The RPD value for these samples met the project criteria. The barium data are still usable but are considered to be biased high.
- The matrix spike recovery for chromium by Method 6020 was greater than the project criteria. The recovery of the matrix spike duplicate and the RPD value met the project criteria. The chromium results are usable.

5.2 Precision

Precision is a measure of the reproducibility or agreement among repeated measurements, and is typically evaluated by calculating the relative percent difference between the results from one or more types of "duplicate" analyses. For the basin subsoil sampling, three types of duplicate analyses were performed, laboratory control samples, matrix spikes, and field duplicates. These samples are discussed separately below:

Laboratory control sample/laboratory control sample duplicate (LCS/LCSD): The specifications for all LCS/LCSD for this project were met.

Matrix spikes/matrix spike duplicates (MS/MSD): The specifications for all MS/MSD for this project were met.

7-#4

Field Duplicate: One subsoil sample was collected in duplicate from basin location #14 during the basin investigation. The analytical result from the original sample and duplicate sample are presented in Table 5-1. The RPD values for these two samples are also provided in this table. The RPD values met the project criteria. Note that RPD values were not calculated when the results of the primary and duplicate samples were not detected.

5.3 Representativeness

The purpose of sampling is to obtain data that represent the system being studied. Representativeness is achieved by carefully selecting sampling sites and locations (discussed in Section 2), and controlling procedures for sample collection, preservation and handling. Field and laboratory quality control samples are also used to measure contamination of the sampling or analytical conditions. These quality control

TABLE 5-1
Results of Field Duplicate Sample - Basin Sampling

COMPOUND	BASIN #6	BASIN #6 (Duplicate)	RPD (%)
METHOD D2216 (%)			
Percent Water	15	15	- -
VOLATILES			
METHOD 8021A (ug/kg)			
Benzene	<5.8	<5.9	NC
Carbon tetrachloride	<5.8	<5.9	NC
Chlorobenzene	<5.8	<5.9	NC
Chloroform	<5.8	<5.9	NC
trans-1,2-Dichloroethylene	<5.8	<5.9	NC
Hexachlorobutadiene	<5.8	<5.9	NC
Bromomethane	<5.8	<5.9	NC
Chloromethane	<5.8	<5.9	NC
Methylene chloride (Dichloromethane)	<5.8	<5.9	NC
Naphthalene	<5.8	<5.9	NC
Tetrachloroethene	<5.8	<5.9	NC
Toluene	<5.8	<5.9	NC
1,2,4-Trichlorobenzene	<5.8	<5.9	NC
1,1,1-Trichloroethane	<5.8	<5.9	NC
1,1,2-Trichloroethane	<5.8	<5.9	NC
Trichloroethene	<5.8	<5.9	NC
Trichlorofluoromethane	<5.8	<5.9	NC
Vinyl chloride	<5.8	<5.9	NC
METHOD 8240B (ug/kg)			
Acrolein	<120	<120	NC
Carbon disulfide	<5.9	<5.9	NC
2-Butanone (MEK)	<30	<30	NC
SEMIVOLATILES			
METHOD 8070 (ug/kg)			
N-Nitrosodimethylamine	<79	<79	NC
METHOD 8090 (ug/kg)			
2,4-Dinitrotoluene	<35	<12	NC
2,6-Dinitrotoluene	<35	<12	NC
METHOD 8121 (ug/kg)			
Hexachlorobenzene	<12	<3.9	NC
Hexachlorocyclopentadiene	<12	<3.9	NC
Hexachloroethane	<12	<3.9	NC
METHOD 8151 (ug/kg)			
Pentachlorophenol	<20	<20	NC
METHOD 8110 (ug/kg)			
bis(2-Chloroethoxy) methane	<30	<30	NC
bis(2-Chloroethyl) ether	<30	<30	NC
bis(2-Chloroisopropyl) ether	<30	<30	NC
METHOD 8270B (ug/kg)			
bis(2-Ethylhexyl)phthalate	<390	<390	NC
Butylbenzylphthalate	<390	<390	NC
4-Chloro-3-methylphenol	<390	<390	NC
2-Chlorophenol	<390	<390	NC
Di-n-butylphthalate	<390	<390	NC
Diethylphthalate	<390	<390	NC
2,4-Dimethylphenol	<390	<390	NC
Dimethylphthalate	<390	<390	NC
2-Methyl-4,6-dinitrophenol	<2000	<2000	NC
Di-n-octylphthalate	<390	<390	NC
Phenol	<390	<390	NC
2,4,5-Trichlorophenol	<390	<390	NC
2,4,6-Trichlorophenol	<390	<390	NC
METHOD 8310 (ug/kg)			
Fluoranthene	<12	<12	NC
Fluorene	<12	<12	NC

TABLE 5-1
Results of Field Duplicate Sample - Basin Sampling

COMPOUND	BASIN #6	BASIN #6 (Duplicate)	RPD (%)
METHOD 8330 (ug/kg)			
Nitrobenzene	<290	<290	NC
PESTICIDES/PCBs			
METHOD 8080A (ug/kg)			
Aldrin	<6.0	<2.0	NC
Chlordane	<6.0	<20	NC
Dieldrin	<12	<3.9	NC
Endosulfan I	<6.0	<2.0	NC
Endosulfan II	<12	<3.9	NC
Endrin	<12	<3.9	NC
Heptachlor	<6.0	<2.0	NC
Heptachlor epoxide	<6.0	<2.0	NC
Methoxychlor	<60	<20	NC
Aroclor-1016	<120	<39	NC
Aroclor-1221	<240	<79	NC
Aroclor-1232	<120	<39	NC
Aroclor-1242	<120	<39	NC
Aroclor-1248	<120	<39	NC
Aroclor-1254	<120	<39	NC
Aroclor-1260	<120	<39	NC
Toxaphene	<600	<200	NC
METALS			
METHOD 6020 (mg/kg)			
Arsenic	2.3	2.2	4.4
Barium	67.2	71.6	6.3
Beryllium	0.27	0.3	0
Cadmium	<0.24	<0.23	NC
Chromium	16.5	18.9	13
Lead	12.9	13.6	5.3
Nickel	5.4	6.4	17
Selenium	<0.24	<0.23	NC
Silver	<0.12	<0.12	NC
Thallium	0.15	0.16	6.4
METHOD 7471A (mg/kg)			
Mercury	<0.12	<0.12	NC
METHOD 9010A (mg/kg)			
Cyanide, Total	<0.60	<0.58	NC

samples include equipment blanks, trip blanks, field blanks, and method (laboratory) blanks. Additionally, calibration of the instruments is performed and verified prior to analysis of environmental samples.

For the basin subsoil sampling, no HCOCs were detected in the trip blank or field blank; however, fluoranthene (at 0.57 μg/L) and nickel (at 0.0022 mg/L) were detected in the equipment blank; and chromium (at 0.12 mg/L) was detected in the method blank. These concentrations are less than five times the detected sample results. Consequently, the subsoil sample results for fluoranthene, nickel, and chromium are not impacted.

5.4 Sensitivity

The reporting limits presented in Section 3.0 appear to be greater than the reporting limits shown in the CDAP. This is due to the CDAP reporting limits having been adjusted to reflect the concentration of moisture in each sample. By presenting the concentrations in Section 3.0 on a dry-weight basis, a valid comparison can be made between background and subsoil samples.

The specified reporting limits for the background soil samples were met with two exceptions. The laboratory achieved a reporting limit of 2,000 μg/kg for 2-methyl-4,6-dinitrophenol. This value is greater than the 330 μg/kg value listed in the CDAP, but is less than the required PQL in the Closure Plan of 3,300 μg/kg. For cyanide, the laboratory achieved a reporting limit of 0.5 mg/kg. This value is greater than the reporting limit listed in the CDAP (0.1 mg/kg). The reporting limit in the CDAP was incorrectly stated as achievable on a solid matrix, when, in fact, the 0.1 mg/kg value is only achievable in an aqueous mixture.

Additionally, the reporting limits for the HCOCs by Method 8080 in basin sample #'s 1, 10, and 14 were exceeded due to matrix interference. The laboratory diluted the samples by 15-times, 200-times, and 3-times, respectively in order to analyze the samples. Consequently, the reporting limits for these three samples were elevated by the dilution factor. These three methods employed an electron capture detector, which is very sensitive to halogenated compounds. The HCOCs analyzed by 8090 and by 8121 are more commonly analyzed by Method 8270 which employs a mass spectrometry as the detector. The laboratory reviewed the analytical runs from the 8270 analyses and determined that the 8270 results did not show significant improvement versus the elevated detection limits from the 8080, 8090, or 8121 results.

5.5 Comparability

Comparability is a qualitative measure of confidence with which the data sets can be compared. Data comparability for this samples was achieved by following approved, standard analytical procedures and by reporting results in standard units of measure, as required in the specific methods.

5.6 Completeness

Completeness is expressed as the percentage of the amount of valid data (i.e., data which meet the measurement objective) obtained compared to the amount of data planned. Since all samples were collected as planned and the measurement objectives were met for all of the samples, the completeness for this phase of the project was 100 percent.

5.7 Data Usability

Overall, the data generated for the subsoil samples can be used for their intended purpose.

6.0 REFERENCES

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Appendix A

CHEMICAL DATA ACQUISITION PLAN

CHEMICAL DATA ACQUISITION PLAN (CDAP)
BIOPLANT EQUALIZATION BASIN CLOSURE
SITE INVESTIGATION/EVALUATION
RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Prepared for:

Norfolk District, U.S. Army Corps of Engineers
Engineering Division
HTRW Branch

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Contract No. DACA65-95-D-0030
U.S. Army Corps of Engineers
Norfolk District

September 1996

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PURPOSE OF DOCUMENT

This Chemical Data Acquisition Plan (CDAP) is for use by field and laboratory personnel during the Bioplant Equalization Basin Closure Site Investigation/Evaluation at Radford Army Ammunition Plant (RAAP). The CDAP details the procedures for sample collection, sample analysis, and quality control measures. Conformance with the plan by field and laboratory personnel will ensure a quality and thorough site investigation.

The success of the closure at RAAP depends upon the field and laboratory personnel closely following guidance provided in the CDAP. Every effort will be made to ensure adherence to the procedures provided in the CDAP.

Radford Army Ammunition Plant Chemical Data Acquisition Plan Approval

This Chemical Data Acquisition Plan was developed for the Bioplant Equalization Basin Site Closure at Radford Army Ammunition Plant, Radford, Virginia. The signatures of key project personnel below indicate concurrence with the procedures specified in the plan and a commitment to communicate the plan and the philosophy of quality to all project personnel.

Torsten Rothman, Contract Manager

Signature: ______________ Date: 16 Sept '96

William Hearn, Project Manager

Signature: ______________ Date: 9-16-96

Steve Falatko, Project QA Coordinator

Signature: ______________ Date: 9/16/96

This plan is approved for use in the Radford Army Ammunition Plant, Bioplant Equalization Basin Site Closure.

Steve Lantz, USACE Project Manager

Signature: Steve M. Lantz Date: 9/13/96

Marc Gutterman, USACE Project Chemist COPY FURNISHED TO MARC - NO COMMENTS

Signature: ______________ Date: ______________

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1.0 PROJECT DESCRIPTION

This section provides a brief project description, an overview of project objectives, the environmental setting and a site description.

1.1 Background

This Chemical Data Acquisition Plan (CDAP) outlines a site investigation/evaluation for the proposed closure of the Bioplant Equalization (EQ) Basin at Radford Army Ammunition Plant (RAAP), Radford, Virginia. A closure plan has been approved by the Virginia Department of Environmental Quality (VaDEQ). The plan is entitled "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 and SWMU-10" dated 12 December 1995. The basin was originally part of the wastewater treatment system at RAAP, but has been taken out of service.

The EQ Basin received wastewater from various manufacturing processes at the facility. The EQ Basin is constructed of an approximate 12-inch thick bentonite liner overlying compacted soil made up of sand, silt, and clay. This CDAP provides for a site investigation to determine if the subsoil under the liner contains concentrations of the chemicals of concern in excess of background concentrations of those chemicals. The closure plan identifies 70 Hazardous Constituents of Concern (HCOC).

Under contract to the U.S. Army Corps of Engineers, Norfolk District, Radian will perform a site investigation to characterize shallow subsurface soils for the presence of organics, metals, and cyanide. Radian also will characterize the materials comprising the basin liner and the basin's concrete wall for waste disposal purposes. The investigation will be completed according to Delivery Order #10, Contract DACA65-95-D-0030. This document is prepared according to the USACE requirements outlined in

Chemical Data Quality Management for Hazardous Waste Remedial Activities, ER 1110-1-263, 1 October 1990, and in *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, 1 September 1994.

1.2 Objective

The objective of this site investigation/evaluation is to determine if HCOCs have impacted the subsoil below the basin liner in concentrations greater than found in background soil samples in the area of the basin and to determine the proper disposal procedure for the liner and concrete wall. This information will provide input to the type of closure required for the EQ Basin.

1.3 Environmental Setting

This subsection describes the environmental setting of the Radford Army Ammunition Plant (RAAP), Radford, Virginia. Included in the subsection are discussions of the site topography, geology, hydrogeology, and surface water features based on data compiled from existing RAAP records.

1.3.1 Topography

The site is located in the Valley and Ridge Physiographic province of southwestern Virginia. Within the RAAP, the EQ Basin site is located along the upper flood plain of the New River, which makes a horseshoe meander through the plant property. The ground surface elevation of the site generally slopes northward with a relief of 1,707 feet mean sea level (ft MSL) to 1,684 ft MSL at the New River (Norfolk COE, 1977).

1.3.2 Geology

According to Norfolk COE (1977), the site lies on the Pulaski thrust sheet approximately 1 mile from the fault zone. The site is underlain by the Cambrian-age Elbrook formation, which consists of light to dark grey argillaceous limestone. Much of the Elbrook formation beneath the site has been brecciated by mass movement along the fault plain, but has been recommended with a fine-grained limy matrix. Bedrock was encountered in test borings, installed before the EQ basin was constructed, at depths between 16 and 20 feet, and was found to be sloping northward.

The unconsolidated material above the bedrock consists an average of 18 feet of alluvium comprised of two distinct layers. The shallower alluvial layer is composed of brown to orange micaceous silts and very fine to fine-grained sands with traces of quartz gravel and cobbles. The shallower alluvial layer ranges from 10 to 15 feet thick. The deeper alluvial layer is composed of fine to coarse-grained sand and quartz gravel and cobbles. The deeper alluvial layer ranges from 2 to 6 feet thick.

Discontinuous layers of residual soils, typically less than 2-feet thick, are encountered in places between the alluvium and top of bedrock. The residual soils are composed of gravel-size bedrock fragments within a silt matrix.

Fill material was encountered in two test borings previously installed through an earthen dike around an abandoned lagoon. The fill material was composed of fine sand and silt.

1.3.3 Hydrogeology

According to Norfolk COE (1977), the average depth to groundwater, encountered at the time the test borings were drilled, was 15 feet. The water table is

present within the deeper alluvial layer. It is anticipated that groundwater flows northward to the New River.

1.3.4 Surface Water

According to Norfolk COE (1977), surface water drainage at the EQ basin site is northward, towards the New River.

1.4 Site Description

The EQ Basin served as a surge/settling basin for the biological wastewater treatment at RAAP. The basin was operated from 1980 until 1994. The following types of wastewater flowed into the basin:

- Non-acidic wastewater from propellant manufacturing;
- Wastewater from nitroglycerine manufacturing and alcohol rectification; and
- Wastewater from ethyl ether recovery.

Solids (sludge) that settled out over the operating life of the basin were removed in November 1995. The sludge was managed as a hazardous waste, K044.

The equalization basin was constructed over an abandoned nitrocellulose settling basin. All sludge was removed and fill material was placed and compacted. A 12-inch thick bentonite bottom was added onto the compacted fill. For flood protection, a concrete wall was constructed on top of the dike in 1987. The basin is located on the south bank of the New River.

2.0 CHEMICAL DATA QUALITY OBJECTIVES

The primary objective of this CDAP is to ensure that data is of the quality necessary to characterize shallow subsurface soils for the presence or absence of organics, metals, and cyanide, and to determine whether any additional investigation/ remediation work is necessary. Data quality objectives (DQOs) include statements of the acceptable levels of measurement uncertainty in chemical data. Measurement objectives are established in terms of precision and accuracy, completeness, representativeness, and comparability.

The overall project quality objectives are to:

- Collect representative samples specified in Section 4 in an effort to determine the presence or absence of organics, metals, or cyanide at the site;
- Ensure data comparability through the use of standard methods and controlled systems to collect and analyze samples; and
- Provide analytical results of known and acceptable precision and accuracy.

The overall uncertainty in chemical data is a function of sampling design, field procedures, and analytical procedures; therefore, attention to quality is required in all of these aspects of the data gathering effort.

Procedures and methods performed in the laboratories will be documented in the form of standard operating procedures (SOPs) which meet or exceed the requirements specified in the analytical methods. This includes the routine analysis of quality control samples which are described in more detail in Section 6.0. Sampling procedures are described in detail in Section 4.0.

2.1 Precision and Accuracy

Precision is a measure of the reproducibility or agreement among repeated measurements. Precision is typically evaluated by calculating the relative percent difference (RPD) between the results from one or more types of "duplicate" analyses. The formula for calculating RPD is:

$$RPD = \frac{(S - D)}{1/2(S + D)} \times 100$$

where: S = first sample result
D = duplicate sample result

The overall precision of the entire sample collection, handling, preparation, and analysis process will be evaluated through the analyses of field duplicates. For field duplicates, an RPD of $\leq 50\%$ is the goal of this program. The precision of the laboratory operations will be evaluated through the analyses of duplicate laboratory control samples. Laboratory precision requirements are detailed in Section 6.0.

The evaluation of precision is often combined with an evaluation of accuracy through the use of spiked sample aliquots, or matrix spike/matrix spike duplicate (MS/MSD) pairs. A known amount of the compound of interest is added to each of two aliquots of the field sample prepared in the laboratory. The spiked samples are then treated to the same handling, extraction, cleanup, and analysis steps as the field samples. The RPD for the spiked samples is calculated and used to evaluate the effects of the matrix on precision and accuracy.

Accuracy is a measure of the agreement between a measured value and a reference or "true" value. Because the "true" concentration of an analyte in a field sample is never known, accuracy in field samples is evaluated through the use of spiked

sample pairs (MS/MSD). As noted above, a known amount of the compound of interest is added to each of two aliquots of the field sample prepared in the laboratory. The spiked samples are then treated to the same handling, extraction, cleanup, and analysis steps as the field samples. The accuracy is expressed as percent recovery (%R). The formula for calculating %R is:

$$\%R = \frac{(SSR - SR)}{SA} \times 100$$

where:
SSR = spiked sample result
SR = sample result
SA = spike added

The objective of this investigation is to achieve method-specified acceptance criteria for precision and accuracy which are presented and discussed in Section 6.0. These limits are based primarily on method validation studies as typically measured in matrices developed from laboratory reagent blanks. Recoveries in actual environmental samples may be less than the method-specified requirements because of matrix interferences. Matrix interferences cannot be controlled but will be evaluated and described in the final report.

2.2 Completeness

Completeness is expressed as the percentage of the amount of valid data (i.e., data which meets the measurement objectives) obtained compared to the amount of data planned. The objective of this project is 90% completeness. Conditions which prevent reaching this objective, such as significant sample matrix difficulties, or sample loss will be evaluated and addressed in the final report.

2.3 Representativeness

The purpose of sampling is to obtain data that represent the system being studied. Representativeness is achieved by carefully selecting sampling sites, sample locations, and sampling intervals; and controlling procedures for sample collection, preservation and handling. Detailed sampling procedures are described in Section 4.0.

2.4 Comparability

Comparability is a qualitative measure of the confidence with which data sets can be compared. Data comparability will be achieved by following approved, standard analytical procedures and by reporting results in standard units of measure, as required in the specific methods.

2.5 Quality Control Samples

The following sections describe quality control samples which will be prepared during both field and laboratory activities.

2.5.1 Field Quality Control Samples

The following samples will be used to assess the quality control of field operations. The frequency for field QC sample collection is discussed in Section 6.0.

- **Trip Blanks**--Trip blanks are samples of organic-free water (HPLC-grade water) which have been transported unopened from the sample bottle preparation area to the sampling site and finally to the laboratory, and will be analyzed for volatile organics. Trip blanks identify the potential for sample contamination from sample bottles and transportation.

- **Field Blanks**--Field blanks are samples of organic-free water (HPLC-grade water) which are poured directly into the sample containers in the vicinity of the sampling locations, and will be analyzed for volatile organics. Field blanks identify the potential for sample contamination from the ambient air.

- **Equipment Rinsate Blanks**--Equipment rinsate blanks are samples of organic-free water (HPLC water) which are poured over the sampling equipment after decontamination. They are designed to identify the potential for cross-contamination of samples from improperly decontaminated equipment.

- **Duplicate Field Samples**--Duplicate field samples are used as indicators of overall measurement data precision. The analysis of duplicate samples involves collecting two samples from the same sampling location and handling them as separate samples. Precision estimates based on duplicate sample results incorporate both sampling and analytical variability.

- **QA Duplicate Samples**--The QA samples are duplicate samples which will be sent to EA Laboratories, as specified by the Norfolk COE. The QA field duplicates will be assigned the same sample number as the initial sample so results may be easily correlated and used as an independent assessment of combined sampling and analytical variability.

2.5.2 Laboratory Quality Control Samples

The following QC samples will be used to control and assess data quality in the laboratory.

- **System Blank**--Deionized water will be analyzed after calibration to assess system contamination.

- **Method Blank**--Reagent water will be taken through the extraction process as though it were an actual sample.

- **Calibration Check Sample**--A standard will be used to verify instrument calibration.

- **Laboratory Control Sample (LCS)**--Known concentration of alternate-source reference materials will be spiked into an aliquot of deionized water. This sample is taken through the digestion/extraction process as though it were an actual sample. The purpose of an LCS analysis is to verify that the analytical system remains in control.

- **Matrix Spike/Matrix Spike Duplicates (MS/MSD)**--Splits from field samples will be spiked with known concentrations of reference materials and taken through the entire extraction and analysis process. The matrix spike allows the laboratory to assess the efficiency of extraction, accuracy of the analysis, and possible matrix effects. Analysis of a duplicate matrix spike, another aliquot of the sample spiked at the same concentration as the MS, allows the laboratory to assess precision at known concentrations.

- **Surrogate Spikes**--Identifiable compounds not present in the sample matrix are added to every field sample to evaluate method accuracy.

3.0 PROJECT ORGANIZATION AND FUNCTIONAL AREA RESPONSIBILITIES

The project team for the RAAP Equalization Basin Site Closure will be composed of a contract manager, a project manager, a quality assurance coordinator (QAC), laboratory coordinator, and a field task leader. Roles and responsibilities of key personnel are discussed below.

3.1 Roles and Responsibilities

Mr. Torsten Rothman will serve as the Contract Manager. In this role Mr. Rothman will have the overall responsibility, authority, and accountability for the project. He will function as the primary interface between the USACE and the project team. In executing these duties, he will:

- Ensure that all contractual requirements are met;
- Initiate work plans in accordance with client directions;
- Keep the USACE project manager informed on all aspects of the program;
- Be available to the Project Manager for action on any problem requiring additional management or technical support; and
- Review technical project outputs prior to issue.

Mr. William Hearn will serve as the Project Manager. In this capacity, he will be responsible for organizing and directing the technical activities of the project and for reporting the results of these activities. He will have day-to-day interaction with the technical staff. In the execution of these duties, Mr. Hearn will:

- Establish technical objectives and direct the preparation and review of work plans;
- Be responsible for responding to work plan revisions;
- Advise the contract manager of technical progress, expenditures, program needs, potential problems, and recommended solutions;
- Ensure technical quality of reports, memoranda, and other communications through review of results; and
- Maintain contact with the USACE project manager in areas that require decisions on technical matters.

Mr. Steve Falatko will serve as the QAC. In this role, he will be responsible for developing and executing quality assurance (QA) activities in all phases of the project. In fulfilling these responsibilities, he will:

- Coordinate any external QA audit activities requested by the USACE;
- Serve as an in-house consultant to the project manager and task leaders in defining data quality goals or requirements;
- Implement any necessary corrective action; and
- Document the results of all QA/QC activities in reports to project management and to clients.

Mr. Todd Church will serve as task leader for the field investigation. His responsibilities include field preparation, supervision of field activities, and preparation of the final report. The general responsibilities of the task leader are as follows:

- Supervise the subcontractor activities;
- Maintain close contact with the project manager so that schedule, budget, and/or technical problems are addressed in a timely manner;

- Coordinate day-to-day QC activities and completion of daily quality control reports (DQCRs), as required as part of the internal QC system;
- Serve as site safety officer during the field investigation and ensure compliance with the SSHP;
- Ensure compliance with all QC acceptance criteria as specified in the CDAD; and
- Keep the QAC and project director advised of any quality problems that arise.

Mr. Church will also supervise the project field staff, and will be responsible for all on-site activities, including any necessary coring activities, sample collection, field analysis, chain of custody, and reporting.

The laboratory client services representative will also be Mr. Steve Falatko. He will have ultimate responsibility for ensuring that all analyses performed at the laboratories adhere to the methods and criteria specified in Section 6.0 of this CDAP.

3.2 Laboratory Qualifications

The RAAP subsurface and background samples will be analyzed by Quanterra Incorporated in West Sacramento, California, and Savannah Laboratories in Tallahassee, Florida, depending on the specified method. Radian's laboratory in Austin, Texas, will perform the liner and concrete sample analyses. All of the laboratories have been certified by the USACE Missouri River Division.

3.3 Subcontractor Qualifications

A Virginia licensed drilling company will be subcontracted to provide all drilling and subsurface sampling for the project. At the time this CDAP was prepared,

the drilling subcontractor was not selected. This plan will be updated at the time the drilling subcontractor is selected.

4.0 FIELD ACTIVITIES

A field sampling program will be conducted at the EQ Basin site at the RAAP in support of the closure plan for the EQ Basin. This plan was part of the document entitled, "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 & SWMU-10, Radford, Virginia", dated December 12, 1995. The field activities include chip sampling of the concrete flood control wall installed around the EQ Basin, sampling of the soil cement liner which served as the floor of the EQ Basin, sampling of the subsoil beneath the soil cement liner, and sampling of background soil similar to the subsoil below the soil cement liner. Chemical analytical data will be used to determine the appropriate procedures for the EQ Basin closure and the disposal options of the wastes generated during closure activities. The required equipment, field procedures, field documentation, and site-specific investigation strategies are discussed in detail in this section.

4.1 List of Equipment, Containers, and Supplies

Table 4-1 summarizes the specific equipment, containers, and supplies required for the collection of the field samples.

4.2 Sampling Locations

The RAAP EQ Basin Closure Plan specifies the number and location of the sample of the concrete flood wall, the soil cement liner and associated subsoil, and the background soil.

Table 4-1

List of Supplies

Sampling Equipment and Supplies:

- Sampling Containers
- Stainless Steel Hand Augers
- Split Spoon Samplers
- Boring Log Forms
- Daily Quality Control Report Sheets
- Camera and Film
- One-gallon Plastic Storage Bags
- Marking Pens
- Hammers and Chisels
- Portable Concrete Corer
- Traffic Cones
- Coolers with Ice
- Stainless Steel Bowls
- Measuring Tape
- Chain of Custody Forms and Seals
- Shipping Airbills
- Field Notebook
- Sample Labels
- Drum Labels
- Trash Bags
- Plastic Sheeting
- Bentonite Pellets

Decontamination Equipment and Supplies:

- Phosphate Free Detergent
- Scrub Brushes
- Steam Cleaner
- Plastic Squirt Bottles
- Trash Bags
- Potable Water
- Distilled/Deionized Water
- Organic-Free Water
- Plastic Wash Tub
- Paper Towels
- Plastic Sheeting
- Five-gallon Buckets
- Aluminum Foil

Safety Equipment:

As specified in Radian's Site-Specific Safety and Health Plan (SSHP). The SSHP will be approved by the Norfolk District Industrial Hygienist prior to beginning any work on site.

4.2.1 Concrete Flood Wall Samples

Chip samples of the concrete flood wall around the EQ Basin will be collected from four representative locations and analyzed for hazardous waste characteristics. The exact locations of these chip samples will be finalized in the field by the supervising geologist in consultation with RAAP personnel. These chip samples will be collected by hand using hammers and chisels. These samples will be analyzed for the toxicity characteristic analytes following the TCLP extraction.

4.2.2 Soil Cement Liner

One composite sample of the 1-foot thick soil cement liner will be collected from the EQ Basin and analyzed for hazardous waste characteristics. Cores of the liner will be collected from seven randomly-selected nodes out of the 15 total nodes shown on Figure 4-1. The final locations of the liner samples may be adjusted in the field in order to collect samples at locations where cracks in the liner may have allowed leakage of wastewater to the subsoils. The liner will be cored using a diamond bit core barrel. Samples will be chipped off each of the seven cores with hammers and chisels, and then composited to make a single composite chip sample. This sample will be analyzed for the toxicity characteristic analytes following the TCLP extraction.

4.2.3 Subsoil

Seven samples of the subsoil below the soil cement liner will be collected from the same locations used to obtain liner samples. Subsoil samples will be collected at a depth of 0-6 inches below the bottom of the liner with a stainless steel hand auger and stainless steel trowels. These soil samples will be analyzed for the HCOCs.

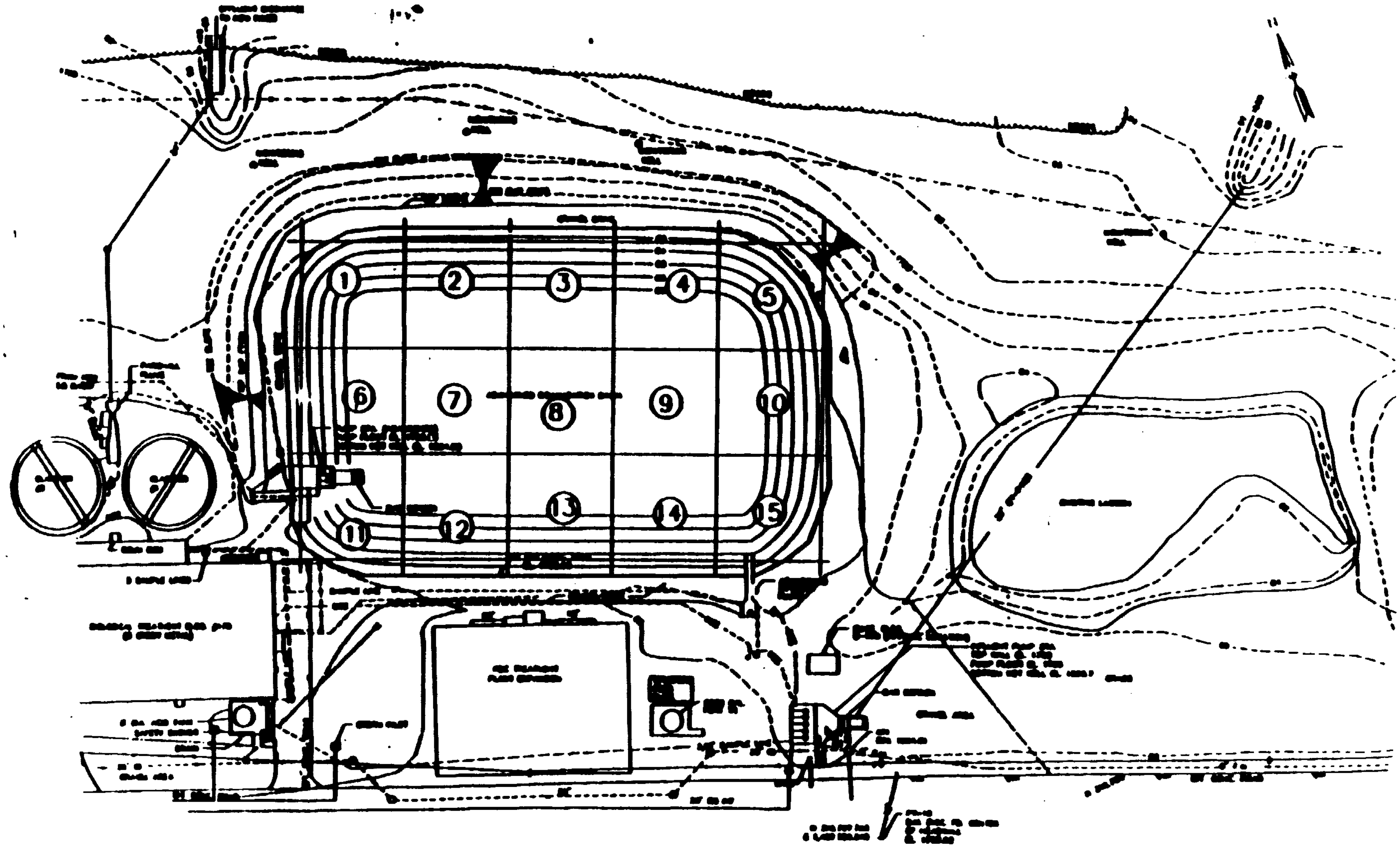


Figure 4-1. Proposed Sampling Locations

4.2.4 Background Soil

Eight soil borings will be drilled at locations upgradient of the EQ Basin in order to obtain soil samples for characterization of background chemical concentrations. These borings will be located in areas that are reasonably expected to be uncontaminated by industrial activities, and will be finalized in the field by the supervising geologist in consultation with RAAP personnel. One sample of background soil will be collected and analyzed per boring, for a total of eight background soil samples. The borings will be drilled with a hollow-stem auger drill rig using a minimum 2-inch diameter, standard split spoon to collect the soil samples. The background soil samples will be collected in soil that is lithologically similar to the subsoil below the liner. These samples will be analyzed for HCOCs.

4.3 General Information and Definitions

4.3.1 Laboratory Information

Laboratory analyses will be conducted by Quanterra Incorporated in Sacramento, California, Savannah Laboratories in Tallahassee, Florida, and by Radian's laboratory in Austin, Texas. EA Laboratories will serve as the COE-designated QA laboratory.

4.3.2 Decontamination Procedures for Drilling and Sampling Equipment

All hand-held sampling tools that will come in contact with samples will be decontaminated by the following:

1. Wash in a phosphate-free detergent and potable water solution;
2. Rinse with potable water;
3. Rinse with distilled water;

4. Final rinse with organic-free water; and
5. Air dry.

Large pieces of equipment, such as the drilling rig and hollow-stem augers, will be decontaminated by steam cleaning with potable water. Decontamination of this equipment will take place on a temporary decontamination pad.

Decontamination procedures will take place at the start of field work and between each sample collection. The subcontractor will supply several split spoon samplers so that a stock of decontaminated split spoons will be available during the background soil sampling effort. Wash and rinse water generated during decontamination activities will be handled in accordance with the procedures outlined in Section 4.3.3 of this plan.

4.3.3 Disposal of Drill Cuttings and Decontamination Water

Drill cuttings will be generated during the background soil sampling effort. Drill cuttings will be containerized in DOT-approved 55-gallon drums. Each drum will be labelled showing its content, origin, and date of generation. The drum contents will be sampled for waste characterization, and disposal options will be coordinated with RAAP personnel following receipt of the analytical results.

Following completion of the subsoil sampling effort, any volume of soil remaining will be placed back into the coreholes.

Following completion of the liner coring and sampling effort, the remaining volume of the liner cores will be temporarily stored in a plastic-lined 55-gallon drum. These cores will be held so that they can be included in the final closure procedures along with the rest of the liner. This drum will also be labelled showing its content and dates of generation.

All decontamination water will be containerized in DOT-approved 55-gallon drums. Each drum will be labelled showing its content, origin, and date of generation. The drum contents will be sampled for waste characterization, and disposal options will be coordinated with RAAP personnel following receipt of the analytical results.

4.3.4 Site Restoration

The EQ Basin will be restored to its original condition following completion of the sampling activities. Coreholes through the liner will be backfilled with hydrated bentonite to seal the holes and prevent any rainwater that may collect in the basin from draining to the subsoil. The background soil borings will be backfilled upon completion with a Portland cement and bentonite grout. The restoration efforts must meet the approval of RAAP personnel.

4.3.5 Utility Clearance

RAAP personnel will conduct site utility clearance investigations following agreement on the location of proposed background soil borings. Utility clearances will be obtained prior to initiating site activities.

4.4 Sampling and Analysis Procedures

A total of 15 soil samples (7 from the subsoil below the liner and 8 from background soil borings) and a total of 5 chip samples (4 from the concrete flood wall and 1 composite from the soil cement liner) will be collected during sampling activities at the site. This section describes the sampling methodologies including sampling and QA/QC procedures; analysis; and sample containers, preservation, and holding times.

4.4.1 Soil Sample Collection

Soil samples, including QA/QC samples, will be collected for laboratory analysis from 15 locations at the site. Seven of the samples are from the basin liner subsoil, and eight are from background soil borings located upgradient of the basin.

Samples of basin liner subsoil will be collected from a depth of 0 to 6 inches below the bottom of the liner with a stainless steel hand auger. Samples will be collected by advancing the hand auger to the 6-inch depth, removing it from the hole, and then initially filling the sample containers for volatile organic analysis directly from the auger bucket. After the volatile organics containers are filled, the remainder of the sample volume will be mixed in a stainless steel bowl before filling the remainder of the sample containers for the other analyses. Basin liner subsoil will be lithologically described by a Radian geologist.

Samples of background soil will be collected from soil borings by the drilling subcontractor using 2-inch or 3-inch diameter, standard split spoons. Background samples will be collected by retrieving the split spoon from the borehole and initially filling the sample containers for volatile organic analysis directly from the opened split-spoon. After the volatile organics containers are filled, the remainder of the sample volume will be mixed in a stainless steel bowl before filling the remainder of the sample containers for the other analyses.

Each background soil boring will be continuously sampled and lithologically described in order to determine the depth at which the background soil, lithologically similar to the basin liner subsoil, is first encountered. The background soil borings will be drilled using a maximum 4.25-inch inside diameter hollow-stem auger. All lithologic descriptions will be made by the Radian geologist while on site and recorded on a geologic log, an example of which is shown in Figure 4-2. All soil samples

Figure 4-2 Geologic Log

Radian International, LLC
Herndon, Virginia

LOG OF BORING _____

Page 1 of

DEPTH (ft)	USCS Code	Recovery (%)	Blows/6"	PID (ppm)	Sample Interval	Sample No.	DEPTH (ft)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION
5							5			
10							10			
15							15			
20							20			

PROJECT ____________________
LOCATION ____________________
JOB NUMBER ____________________
GEOLOGIST ____________________
DRILL RIG ____________________
DRILLING COMPANY ____________________
DATE DRILLED ____________________
SURFACE ELEVATION ____________________
TOTAL DEPTH OF HOLE ____________________
WATER LEVEL ____________________

will be visually classified according to the Unified Soil Classification System (ASTM-D-2488). Completed logs will be included in the final report.

Soil samples will also be screened in the field for the presence of total organic vapors by allowing a portion of each sample to volatilize in a sealed plastic bag for a minimum of 15 minutes in a warm location. The probe of an HNu photoionization detector (PID) will be inserted into the bag to measure the organic vapor concentration. These measurements will be recorded on the geologic logs.

Immediately after filling, all soil sample containers will be affixed with sample labels showing field sample number and other required information (see Section 4.7) and cooled to approximately 4°C by placing them in a durable cooler containing regular ice.

4.4.2 Basin Liner/Flood Wall Chip Sample Collection

A total of five chip samples for the purpose of hazardous waste characterization will be collected from 11 locations at the site. One sample will be a composite from seven cores of the soil cement basin liner. The remaining four chip samples are from the concrete flood wall located around the basin.

Samples of the soil cement basin liner will be collected by initially coring the liner in seven locations with a portable concrete coring machine using a minimum 6-inch diameter diamond tip core barrel. After the core barrel penetrates the 1-foot thickness of the liner, the resulting liner core will be removed and placed on plastic sheeting. After all the cores are collected, the sides of each liner core will be chipped with a hammer and chisel along the entire height of the core. The chips from each core will be mixed to create one composite sample.

Four chip samples of the concrete flood wall will be collected from four locations with a hammer and chisel. The concrete chips will be collected on plastic sheeting at the bottom of the wall at each sample location until sufficient sample volume is collected.

Immediately after filling, all chip sample containers will be affixed with sample labels showing field sample number and other required information (see Section 4.7) and cooled to approximately 4°C by placing them in a durable cooler containing regular ice.

Use of the portable coring machine will require an electrical source to power the machine, and a water source to supply water to cool the barrel during coring. The water will be collected at each coring location with a "wet-dry" vacuum and then placed into 55-gallon drums, which will be handled in the same manner outlined in Section 4.3.3.

4.4.3 Analyses

Table 4-2 presents a summary of the analyses to be performed on all soil samples and the chip samples from the basin liner and concrete flood wall. Sample preparation and chemical analysis will be performed according to procedures published in *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846* (EPA, Third Edition, November 1986 and its Updates, September 1994).

4.4.4 Sample Containers, Preservation, and Holding Times

The sample containers, preservation, and holding times are summarized in Table 4-3. All containers used for chemical analyses will be precleaned by the container supplier, in accordance with EPA protocol.

Table 4-2

Sampling and Analysis Summary

Method	Parameters	Primary Sample Location Subsurface/ Background	Field Duplicate Subsurface/ Background	MS/MSD Subsurface/ Background	Equipment Rinsate Blanks[a]	Trip Blank/Field Blank	Total A-E Samples	External QA Dups[b]
Methods 8021 and 8240B	Volatile Organics	7/8	1/0	1/1	1/1	2/2	26	2
Methods 8070, 8090, 8110, 8121, 8151, 8270B, 8310, and 8330	Semivolatile Organics	7/8	1/0	1/1	1/1	0/0	22	2
Method 8080A	Pesticides/PCBs	7/8	1/0	1/1	1/1	0/0	22	2
Methods 6020 and 7471	Metals	7/8	1/0	1/1	1/1	0/0	22	2
Method 9012	Cyanide	7/8	1/0	1/1	1/1	0/0	22	2
Method 1311	Full TCLP Suite	5	0	0	0	0	5	2

[a] Equipment rinsate blanks include one aqueous sample generated from the soil sampling equipment rinsate from the auger used for the subsurface sampling; and one sample generated from the split spoon used for the background sampling equipment rinsate.

[b] QA field duplicate samples submitted to EA Laboratories for analysis, including trip blanks for volatile organics.

Table 4-3

Sample Containers, Preservation, Holding Times, and Laboratory

Reference Method	Container No., Volume, and Type	Preservation and Storage Requirements	Maximum Holding Time (Preparation)/Analysis	Laboratory Performing Analysis
Soil Samples				
8021A	(2) 120-mL glass, Teflon-lined cap	4°C	N/A	Savannah
8240B	(2) 120-mL glass, Teflon-lined cap	4°C	N/A	Savannah
8070	(2) 500 mL glass, wide mouth jar	4°C	7 days/40 days	Savannah
8090				
8110				
8121				
8151				
8270B				
8310				
8330				
8080A				
6020	(1) 500 mL glass, wide mouth jar	4°C	180 days	Quanterra
7471			28 days	Quanterra
9012			N/A	Quanterra
Concrete Samples				
TCLP (1311)	(1) 125 mL glass jar and (1) 500 mL glass, wide mouth jar	4°C	7 days	Radian

4.5 Quality Assurance/Quality Control Samples

A field QA/QC program will be used to ensure that data quality objectives are met. Sample collection errors will be controlled through the use of standard sample collection methods and field log books. Environmental matrix effects will be estimated by evaluating standard QA/QC samples such as matrix spikes and field duplicates. The following field QA/QC samples will be collected:

- Trip Blanks. One trip blank will accompany each cooler containing volatile organic sample containers, and analyzed only for volatile organics;
- Duplicate Sample. One duplicate soil sample will be collected during this subsurface investigation;
- QA Split Sample. One QA split soil sample will be collected and shipped to the government's QA laboratory;
- Matrix Spike and Matrix Spike Duplicate (MS/MSD). One MS/MSD pair will be collected from both the subsurface investigation and from the background sampling;
- Equipment Rinse Blank. One equipment rinse blank will be collected from the soil sampling equipment; and
- Field Blank. One field blank consisting of organic-free water will be collected from both the subsurface investigation and from the background sampling and analyzed only for volatile organics.

4.6 Field Documentation

A field log book and daily quality control report (DQCR) will be maintained by the supervising Radian geologist. A copy of a DQCR sheet is presented in Figure 4-3. All observations made during field activities will be recorded in indelible ink as necessary to maintain a thorough record of all field activities. The field log book is a bound book with sequentially numbered pages and a unique document control

Figure 4-3. AE Daily QC Report

DAILY QUALITY CONTROL REPORT

REPORT No. ____________ CONTRACT No. ____________ DATE ________

LOCATION OF WORK ____________________________

DESCRIPTION OF WORK ____________________________

WEATHER ________ RAINFALL (INCHES) ______ TEMPERATURE ______ MIN ______ MAX

WIND DIRECTION ________

1. WORK PERFORMED ____________________________

2. SAMPLES COLLECTED ____________________________

3. PERSONNEL AND VISITORS AT SITE ____________________________

SITE MANAGER: ____________________

HF

number. All corrections will be crossed out with a single line. The Radian field geologist will sign and date the logbook and DQCR sheets at the end of each work day. Radian will submit the DQCRs to the USACE project manager at the conclusion of the field program.

4.7 Sample Chain of Custody, Packing, and Transportation

A sample label and custody seal, shown in Figure 4-4, will be affixed to all sampling containers submitted for laboratory analysis. The labels will document the sample type, matrix, initials of the sampler(s), sampling locations, depth, time, date, and unique number assigned to each sample. Indelible ink will be used to complete all sample labels.

A chain-of-custody record, shown in Figure 4-5, will be used to record the number of samples collected and the corresponding laboratory analyses; indelible ink will be used. Information on this form includes time and date of sample collection, sample number, type of sample, sampler's name, preservatives used, and any special instructions. Samples collected for matrix spike/matrix spike duplicate analysis will be identified on the chain-of-custody form. A copy of the chain-of-custody form will be retained by the field geologist along with other field documentation.

All samples will be kept on ice in a double plastic bag following collection and during shipment. The samples will also be sealed in plastic bags. The samples will be stored upright in a durable ice chest. Sufficient packing material (i.e., vermiculite) will be used to separate the bottles, filling any intervening voids.

The ice will be placed above and around the top of the sample containers. The remaining space will be filled with additional packing material. The chain-of-custody form will be sealed in a plastic Ziploc® bag and affixed to the top lid of the cooler. The cooler will be secured by completely wrapping it with strapping tape around

Figure 4-4. Sample Label and Custody Seal

Field Number ______________________
Sample Type: ______________________
Client: ______________________
Location: ______________________
Preservative: ______________________
Sampler: ______________________
Date: ______________________
Comment: ______________________

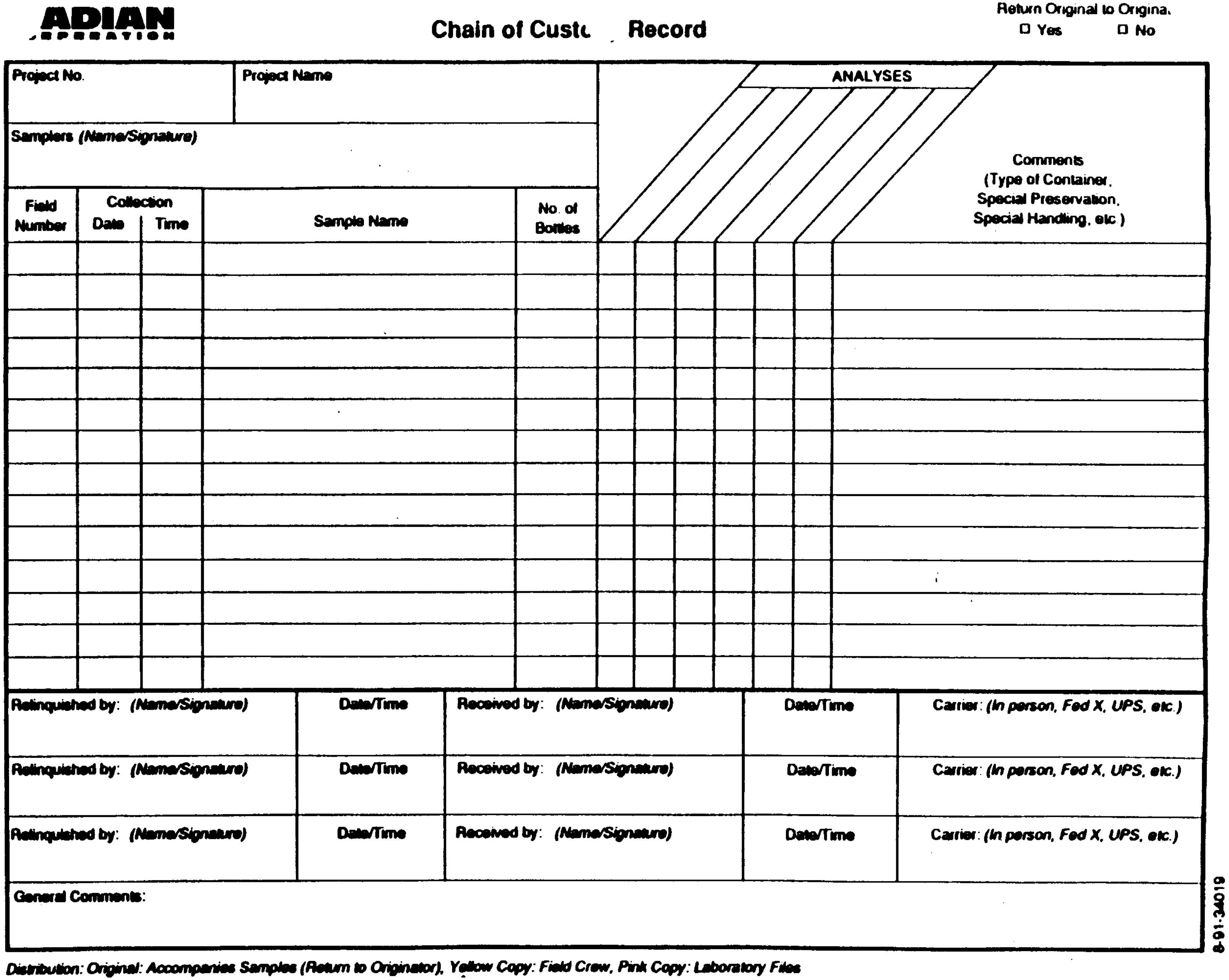
6-89-31426

6-89-31426

ATTENTION:
BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.

I.D. # ______________________

ATTENTION:
BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.



ADIAN

Chain of Custc Record

Return Original to Origina
☐ Yes ☐ No

Project No.	Project Name
Samplers *(Name/Signature)*	

Field Number	Collection		Sample Name	No. of Bottles	ANALYSES						Comments (Type of Container, Special Preservation, Special Handling, etc.)
	Date	Time									

Relinquished by: *(Name/Signature)*	Date/Time	Received by: *(Name/Signature)*	Date/Time	Carrier: *(In person, Fed X, UPS, etc.)*
Relinquished by: *(Name/Signature)*	Date/Time	Received by: *(Name/Signature)*	Date/Time	Carrier: *(In person, Fed X, UPS, etc.)*
Relinquished by: *(Name/Signature)*	Date/Time	Received by: *(Name/Signature)*	Date/Time	Carrier: *(In person, Fed X, UPS, etc.)*

General Comments:

8-91-34019

Distribution: Original: Accompanies Samples (Return to Originator), Yellow Copy: Field Crew, Pink Copy: Laboratory Files

Figure 4-5. Chain-of-Custody Record

both ends. If there is a drain on the cooler, it will be taped shut. Custody seals, shown in Figure 4-4, will also be affixed to coolers to indicate tampering.

Samples will be shipped daily to the laboratory by overnight courier. The laboratory will be notified at least one week before samples are shipped to coordinate delivery. The following address will be used for sample shipment:

Lou Schneider
Savannah Laboratories
2846 Industrial Plaza Drive
Tallahassee, Florida 32317-3056
(904) 878-3994

Nilo Ligi
Quanterra Incorporated
880 Riverside Parkway
West Sacramento, California 95605
(916) 374-4427

Kelly Young
Radian Corporation
14046 Summit Drive, #101
Austin, Texas 78728
(512) 244-0855

Quanterra will perform the soil analyses for the metals and cyanide. Savannah Laboratories will perform the volatiles organics, semivolatile organics, and pesticides/PCBs analyses. Radian will perform the TCLP analyses.

If Saturday delivery is required, samples are to be sent to the same addresses. For coordination of sample delivery on Saturday, mark "Saturday Delivery" on the Federal Express airbill.

External QA Samples will be sent to:

EA Laboratories
19 Loveton Circle
Sparks, Maryland 21152
ATTN: Sample Management Office

5.0 LABORATORY ANALYTICAL PROCEDURES

The methods and procedures that will be used to prepare and analyze samples are discussed in this section. Laboratory-specific SOPs and laboratory protocol specifications are on file at the laboratories and are available for review upon request. Individual parameters, analytical methods, and reporting limits to be used are listed in Table 5-1. Table 5-2 lists the analytical methods by analyte, the preparation technique and method, and the analysis technique and method. All of the tables for this section are presented at the end of the section.

The analytical methods to be used in this project require the measurement system to initially satisfy specific criteria for calibration linearity, reference material recovery, and freedom from contamination. Results of control samples will be used to monitor any changes in the quality of data being produced and indicate which corrective actions are necessary to correct an out-of-control condition. An out-of-control condition is defined as:

- Detection of any compounds of interest in a method blank at concentrations greater than or equal to the reporting limit, with the exception of common laboratory contaminants. The analyte considered a common laboratory contaminants is methylene chloride. Detection of methylene chloride at concentrations greater than or equal to three times the reporting limit will necessitate corrective actions.

- Failure to meet the acceptance criteria for recovery of any compound of interest in a laboratory control sample (LCS).

- Exceeding the acceptance criteria for matrix spike recovery and subsequent failure to meet the acceptance criteria for an LCS for the same parameter(s). Any parameter that fails the matrix spike test but passes the LCS test will be flagged as suspect for the parameter because of matrix effects.

When an out-of-control situation is detected, efforts are undertaken to determine the cause. Routine QC checks and corrective actions are outlined by method in Tables 5-3, 5-4, 5-5, 5-6, and 5-7. Acceptance criteria for the laboratory control samples, matrix spikes, and surrogates are presented in Tables 5-8, 5-9, and 5-10, respectively.

During the course of this project, it will be the responsibility of the laboratory staff and the project team members to ensure that all measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In the event a problem arises, it is imperative that prompt action be taken to correct the problem. Laboratory managers will initiate corrective action in the event that QC results exceed acceptance criteria. Corrective action may be initiated by the laboratory quality officer if, during data review, QC data or other anomalies are noted.

For this project, all soil sample results will be reported on a dry-weight basis. The dry-weight calculation will be based on a moisture analysis.

The data analysis required to calculate sample concentrations will proceed according to method-specified procedures. Data reduction involves converting instrument responses or other raw into calculated concentrations for each target analyte. Data validation involves examining the systems producing the data to be sure they are operating properly and quality objectives have been met. Data will be reviewed and validated by the analyst(s) and/or the laboratory manager. Data will be validated for conformance with method specifications and laboratory protocol specifications, including:

- Calibration;
- Duplicate analysis;
- Blank analysis;
- Spike analysis;

- Sample data calculations; and
- QC sample frequency.

5.1 Analytical Methods

The analytical methods to be used for this project are presented in Table 5-2. All of the methods, both preparatory and analytical, are contained in SW-846. Any deviations performed by the laboratory will be pre-approved by the QAC.

Table 5-1

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
VOLATILES			
METHOD 8021A			
Benzene	0.09	0.37	5
Carbon Tetrachloride	0.03	0.94	5
Chlorobenzene	0.01	0.38	5
Chloroform	0.02	1.1	5
trans-1,2-Dichloroethene	0.02	0.93	5
Hexachlorobutadiene	0.20	1.8	5
Methyl Bromide	0.30	1.7	5
Methyl Chloride	0.10	0.94	5
Methylene Chloride	0.20	1.4	5
Naphthalene	0.60	3.4	5
Tetrachloroethene	0.01	0.21	5
Toluene	0.10	0.34	5
1,2,4-Trichlorobenzene	0.20	1.5	5
1,1,1-Trichloroethane	0.01	1.3	5
1,1,2-Trichloroethane	0.07	0.59	5
Trichloroethene	0.01	0.52	5
Trichlorofluoromethane	0.30	0.50	5
Vinyl Chloride	0.06	0.94	5
METHOD 8240B			
Acrolein	7	21	100
Carbon Disulfide	100	0.98	20
Methyl Ethyl Ketone	100	6.1	100
SEMIVOLATILES			
METHOD 8070			
N-Nitrosodimethylamine	1.5	12	67
METHOD 8090			
2,4-Dinitrotoluene (FID/ECD)	13	82/0.56	330/10
2,6-Dinitrotoluene (FID/ECD)	7	82/0.65	330/10

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
SEMIVOLATILES (Continued)			
METHOD 8110			
Bis(2-chloroethoxy) methane	5	16	30
Bis(2-chloroethyl) ether	3	9.9	30
Bis(2-chloroisopropyl) ether	8	24	30
METHOD 8121			
Hexachlorobenzene	3.8	0.12	3.3
Hexachlorocyclopentadiene	160	0.82	3.3
Hexachloroethane	1.1	0.11	3.3
METHOD 8151			
Pentachlorophenol	1.6	4.3	17
METHOD 8270B			
Bis(2-ethylhexyl) phthalate	180	27	330
Butyl benzyl phthalate	28	26	330
4-Chloro-3-methyl phenol	240	42	330
2-Chlorophenol	210	38	330
Di-n-butyl phthalate	220	27	330
Diethyl phthalate	170	21	330
2,4-Dimethylphenol	210	35	330
Dimethyl phthalate	190	24	330
4,6-Dinitro-2-methylphenol	3,300	27	330
Di-n-octyl phthalate	33	16	330
Phenol	94	38	330
2,4,5-Trichlorophenol	600	34	330
2,4,6-Trichlorophenol	390	33	330
METHOD 8310			
Fluoranthene	140	0.27	10
Fluorene	140	1.0	10
METHOD 8330			
Nitrobenzene	260	12	250
PESTICIDES/PCBs			
METHOD 8080A			

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
Aldrin	3	0.58	1.7
Chlordane	9.4	3.5	17
Dieldrin	1.3	0.35	3.3
Endosulfan I	9.4	0.43	1.7
Endosulfan II	3	2.8	3.3
Endrin	4	0.30	3.3
Heptachlor	2	0.80	1.7
Heptachlor Epoxide	21	0.47	1.7
Methoxychlor	120	3.6	17
PCB 1016	2,500	4.6	33
PCB 1221	2,500	8.8	67
PCB 1232	2,500	13	33
PCB 1242	2,500	15	33
PCB 1248	2,500	5.0	33
PCB 1254	2,500	5.2	33
PCB 1260	2,500	13	33
Toxaphene	57	34	170
METALS			
METHOD 6020			
Arsenic	10	0.85 µg/L[a]	200
Barium	20	0.16 µg/L[a]	100
Beryllium	3	0.15 µg/L[a]	100
Cadmium	1	0.17 µg/L[a]	200
Chromium	10	0.34 µg/L[a]	100
Lead	10	0.36 µg/L[a]	100
Nickel	0.2	0.67 µg/L[a]	100
Selenium	20	0.51 µg/L[a]	200

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
METALS (Continued)			
Silver	2	0.52 µg/L[a]	100
Thallium	10	0.08 µg/L[a]	100
METHOD 7471A			
Mercury	2	0.03 µg/L[a]	100
METHOD 9010A			
Cyanide	20	8 µg/L[a]	100

[a] These detection limits are based on a MDL study of an aqueous matrix.

Table 5-2

Analytical Methods

Parameter	Preparation		Analysis	
	Technique	Method	Technique	Method
METALS				
Arsenic	Acid Digestion	3050	ICPMS	6020
Barium	Acid Digestion	3050	ICPMS	6020
Beryllium	Acid Digestion	3050	ICPMS	6020
Cadmium	Acid Digestion	3050	ICPMS	6020
Chromium	Acid Digestion	3050	ICPMS	6020
Cyanide	Distillation	9012	Colorimetric/UV	9012
Lead	Acid Digestion	3050	ICPMS	6020
Mercury	$KMnO_4$/Acid Digestion	7471A	CVAA	7471A
Nickel	Acid Digestion	3050	ICPMS	6020
Selenium	Acid Digestion	3050	ICPMS	6020
Silver	Acid Digestion	3050	ICPMS	6020
Thallium	Acid Digestion	3050	ICPMS	6020
Pesticides and PCBs				
Aldrin	Extraction	3550	GC	8080A
Chlordane	Extraction	3550	GC	8080A
Dieldrin	Extraction	3550	GC	8080A
Endosulfan I	Extraction	3550	GC	8080A
Endosulfan II	Extraction	3550	GC	8080A
Endrin	Extraction	3550	GC	8080A
Heptachlor	Extraction	3550	GC	8080A
Heptachlor epoxide	Extraction	3550	GC	8080A
Methoxychlor	Extraction	3550	GC	8080A
Toxaphene	Extraction	3550	GC	8080A
PCBs	Extraction	3550	GC	8080A
VOLATILE ORGANICS				
Acrolein	Purge and Trap	5030	GC/MS	8240B
Benzene	Purge and Trap	5030	GC/PID	8021A
Carbon disulfide	Purge and Trap	5030	GC/MS	8240B

Table 5-2 (Continued)

Analytical Methods

Parameter	Preparation		Analysis	
	Technique	Method	Technique	Method
Carbon tetrachloride	Purge and Trap	5030	GC/PID	8021A
Chlorobenzene	Purge and Trap	5030	GC/PID	8021A
Chloroform	Purge and Trap	5030	GC/PID	8021A
trans-1,2-Dichloroethene	Purge and Trap	5030	GC/PID	8021A
Hexachlorobutadiene	Purge and Trap	5030	GC/PID	8021A
Methyl Bromide	Purge and Trap	5030	GC/PID	8021A
Methyl Chloride	Purge and Trap	5030	GC/PID	8021A
Methylene chloride	Purge and Trap	5030	GC/PID	8021A
2-Butanone (MEK)	Purge and Trap	5030	GC/MS	8240B
Naphthalene	Purge and Trap	5030	GC/PID	8021A
Tetrachloroethene	Purge and Trap	5030	GC/PID	8021A
Toluene	Purge and Trap	5030	GC/PID	8021A
1,1,1-Trichloroethane	Purge and Trap	5030	GC/PID	8021A
1,1,2-Trichloroethane	Purge and Trap	5030	GC/PID	8021A
1,2,4-Trichlorobenzene	Purge and Trap	5030	GC/PID	8021A
Trichloroethene	Purge and Trap	5030	GC/PID	8021A
Trichlorofluoromethane	Purge and Trap	5030	GC/PID	8021A
Vinyl chloride	Purge and Trap	5030	GC/PID	8021A
SEMIVOLATILE ORGANICS				
Butyl benzyl phthalate	Extraction	3550	GC/MS	8270B
4-Chloro-3-methylphenol	Extraction	3550	GC/MS	8270B
Bis(2-Chloroethoxy)methane	Extraction	3550	GC	8110
Bis(2-Chloroethyl)ether	Extraction	3550	GC	8110
Bis(2-Chloroisopropyl)ether	Extraction	3550	GC	8110
2-Chlorophenol	Extraction	3550	GC/MS	8270B
Diethylphthalate	Extraction	3550	GC/MS	8270B
2,4-Dimethylphenol	Extraction	3550	GC/MS	8270B
Dimethylphthalate	Extraction	3550	GC/MS	8270B
Di-n-butylphthalate	Extraction	3550	GC/MS	8270B
Di-n-octylphthalate	Extraction	3550	GC/MS	8270B

Table 5-2 (Continued)

Analytical Methods

Parameter	Preparation		Analysis	
	Technique	Method	Technique	Method
2,4-Dinitrotoluene	Extraction	3550	GC	8090
2,6-Dinitrotoluene	Extraction	3550	GC	8090
Bis(2-Ethylhexyl)phthalate	Extraction	3550	GC/MS	8270B
Fluoranthene	Extraction	3550	HPLC	8310
Fluorene	Extraction	3550	HPLC	8310
Hexachlorobenzene	Purge and Trap	5030	GC	8121
Hexachlorocyclopentadiene	Purge and Trap	5030	GC	8121
Hexachloroethane	Purge and Trap	5030	GC	8121
N-Nitrosodimethylamine	Extraction	3550	GC	8070
Nitrobenzene	Extraction	8330	HPLC	8330
Pentachlorophenol	Extraction	3550	GC	8151
Phenol	Extraction	3550	GC/MS	8270B
2,4,5-Trichlorophenol	Extraction	3550	GC/MS	8270B
4,6-Dinitro-2-methylphenol	Extraction	3550	GC/MS	8270B
2,4,6-Trichlorophenol	Extraction	3550	GC/MS	8270B

ICPMS = Inductively Coupled Plasma Mass Spectrometry.
CVAA = Cold Vapor Atomic Absorption.
GC/MS = Gas Chromatography/Mass Spectrometry.
FID = Flame Ionization Detector.
PID = Photo Ionization Detector.
HPLC = High Performance Liquid Chromatography.
UV = Ultraviolet Detector.

Table 5-3

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
6020	ICP/MS Metals	Initial calibration standard (2 points)	Daily, prior to sample analysis	NA	NA
	Refer to: SW846-3005A[b] SW846-3050A[b]	Initial Calibration Verification (ICV) (concentration = upscale calibration standard)	Following initial calibration	90 - 110% recovery	1. Repeat ICV 2. Recalibrate if still out
		Continuing calibration verification (CCV)	Following Interference check standards and after every 10 samples and at end of analytical batch	90 - 110% recovery	1. Repeat CCV 2. If still out, identify and correct problem, then re-analyze all samples since last valid CCV.
		Calibration blank (CCB)	Every 10 samples and at end of analytical run	< Quantitation limits	1. Re-analyze CCB 2. If CCB is still contaminated, identify and correct source of contamination, then repeat calibration blank analysis 3. Re-analyze all samples since last valid CCB, if necessary.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
6020 (Continued)	ICP/MS Metals	LCS/LCSD	One LCS/LCSD for each digestion batch and each analytical batch	Recoveries within QC acceptance criteria in Table 5-8.	Accuracy: 1. Re-analyze LCS/LCSD. If recoveries for same analytes are still out, stop, identify and correct problem before proceeding. Redigestion may be necessary. Precision: 2. Reanalyze LCS/LCSD. If recoveries for same analytes are still out, stop, identify and correct problem before proceeding.
		Interference check sample	Daily at beginning and end of analytical run or twice per 8 hour shift	Assess possible interference problems	1. Adjust interference factors or element equations if necessary
		Method blank	One per digestion batch and analytical batch	< quantitation limits (QL)	1. If the sample element concentration is <QL or the sample element concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-digest/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
6020 (Continued)	ICP/MS Metals	MS/MSD	1 MS/MSD per digestion batch	Recovery within QC acceptance criteria in Table 5-9.	1. If either MS or MSD is outside of accuracy or precision tolerances and LCS/LCSD is acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Linearity Check	Semi-annually	Highest point at which the recovery of the standard is within 10% of the expected value	No data will be reported for any element that exceeds the upper limit of the linear range by more than 10%.
7470A/7471A[b]	Mercury Refer to: 7000A	Initial Calibration (5 point and a blank)	Daily before any analysis	Correlation coefficient ≥0.995	Identify and repeat outlying point(s); recalculate curve using repeated points
		Initial Calibration Verification (ICV)	Daily before batch one is analyzed	90 - 110% of theoretical value	Accuracy: 1. Repeat calibration verification 2. If still out, identify and correct problem, run calibration verification again; if still out, recalibrate

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
7470A/7471A[b] (Continued)	Mercury	Initial Calibration Blank (ICB)	After ICV	Within ±QL	Re-analyze calibration blank; if still out, recalibrate
		Continuing Calibration Blank (CCB)	Following each CCV and at end of batch	Within ±QL	Re-analyze calibration blank; if still out, correct problem and re-analyze all samples since last valid CCB.
		Method Blank	One per digestion batch and analytical batch	Measured concentrations for all elements must be <quantitation limit (QL)	1. If the sample element concentration is <QL or if the sample element concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-digest/ re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.
		LCS	One LCS per each digestion and analytical batch	QC acceptance criteria in Table 5-8.	1. Accuracy: Re-analyze LCS. If recovery for same analytes are still out, stop, identify, and correct problem before proceeding. Digestion batch may need to be re-prepared. 2. Precision: Re-analyze LCS. If recovery for same analytes are still out, stop, identify, and correct problem before proceeding.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
7470A/7471A[b] (Continued)	Mercury	MS/MSD	One MS/MSD pair per digestion batch	Recoveries within QC acceptance criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and the LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Continuing Calibration Verification (CCV)	After 10th sample and at the end of the batch	80-120% of true value	Accuracy: 1. Repeat calibration verification 2. If still out, identify and correct problem, then reanalyze all samples analyzed since last valid CCV.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
9012	Cyanide	Five-point calibration	Daily, prior to sample analysis	r ≥0.995	Repeat calibration
		ISV (Initial Standard Verification)	Once per multipoint calibration before samples are analyzed	Within ±15% of expected value	1. Reanalyze ISV 2. If still out, identify and correct problem and repeat ISV 3. If still out, repeat initial calibration
		ICV	Once per multipoint calibration before samples are analyzed	Within ±15% of expected value	1. Repeat ICV 2. If still out, identify and correct problem and repeat ICV 3. If still out, repeat initial calibration
		Method blank	One per each preparation batch and analytical batch	<QL	1. If the sample analyte concentration is <QL or the sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-prepare samples if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.
		LCS/LCSD	1 LCS/LCSD pair per batch	QC acceptance criteria in Table 5-8.	1. Reanalyze LCS 2. Identify and correct problem 3. If still out, redigest and reanalyze affected samples

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
9012 (Continued)	Cyanide	MS/MSD	1 MS/MSD per preparation batch	QC acceptance criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and the LCS/LCSD is acceptable, then flag results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
NA = Not Applicable.

Table 5-4

Summary of Calibration and Internal Quality Control Procedures for Volatile and Semivolatile Compounds by Gas Chromatography and by High Performance Liquid Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8021A, 8070, 8090, 8110, 8121, 8310, 8330	Volatile organics and semi-volatile organics Refer to: SW846-8000A[b] SW846-3500A[b]	Initial Calibration	Biannually or when daily calibration fails to meet acceptance criteria	%RSD <20% for average RFs or calibration curve Correlation coefficient (r) ≥0.995	Identify and repeat outlying point(s); recalculate curve using repeated point(s)
		Calibration Verification (ICV/CCV)	At the beginning, following every 10th sample, and at the end of each analytical sequence	Recovery for all analytes of interest must be within ±15% of true value for primary column and ±20% for confirmation column	1. Repeat calibration check 2. If still out, identify and correct problem and repeat calibration check; if still out,repeat multipoint calibration, if necessary.
		LCS/LCSD	One LCS/LCSD pair per extraction batch and analytical batch	Recovery for all analytes within QC Acceptance criteria in Table 5-8.	1. Accuracy: a. If the same analytes are out in both the LCS/LCSD and if the calibration check standard is acceptable, contact CSC for decision to proceed or re-extract. If samples must be analyzed without re-extraction, flag sample data for failed analytes. If analytes in calibration check standard are out, correct instrument problem. b. If one or more analytes is out in either LCS or LCSD, then analyze previously acceptable calibration check standard for the analytes that failed. If analytes in calibration check standard are in, proceed with analyses. If analytes are out, correct instrument problem.

Table 5-4 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile and Semivolatile Compounds by Gas Chromatography and by High Performance Liquid Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action^a
8021A, 8070, 8090, 8110, 8121, 8310, 8330 (Continued)	Volatile organics and semi-volatile organics Refer to: SW846-8000A^b SW846-3500A^b	LCS/LCSD	One LCS/LCSD pair per extraction batch and analytical batch	Recovery for all analytes within QC Acceptance criteria in Table 5-9.	2. Precision: Demonstrate acceptable RPDs on analytes that failed by reanalyzing previously acceptable 3rd LCS. If RPDs are in, proceed with analyses. If analytes are out, correct instrument problem before proceeding.
		MS/MSD	One MS/MSD pair per extraction batch	QC Acceptance criteria Table 2.5-13	1. If either MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences
		Surrogate Spike	All samples, standards, and blanks	Table 5-10 Surrogate limits	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze affected samples 3. If none of the above, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

Table 5-4 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile and Semivolatile Compounds by Gas Chromatography and by High Performance Liquid Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8021A, 8070, 8090, 8110, 8121, 8310, 8330 (Continued)	Volatile organics and semi-volatile organics Refer to: SW846-8000A[b] SW846-3500A[b]	Method Blank	Each extraction batch and each analytical batch	<Quantitation limit (QL)	1. If sample analyte concentration is <QL or if sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER; 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
NA = Not applicable.

Table 5-5

Summary of Calibration and Internal Quality Control Procedures for Pesticides, PCBs, and Herbicides by Gas Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8080, 8151	Pesticides, PCBs, and herbicides Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Five-point calibration (for all analytes)	Biannually or when daily calibration fails to meet acceptance criteria	%RSD < 20% for average RFs or calibration curve correlation coefficient (r) ≥0.995	Identify and repeat outlying point(s); recalculate curve using repeated points
		Initial daily Calibration Verification (ICV)	Daily, before sample analysis	Recovery for any analyte within ±15% of nominal concentration for primary column; ±20% for confirmation column	1. Repeat ICV 2. If still out, identify and correct problem before proceeding 3. Recalibrate if necessary
		LCS\LCSD	One LCS/LCSD pair per extraction batch and analytical batch	Recovery for all analytes within QC acceptance criteria in Table 5-8.	1. Accuracy: a. If the same analytes are out in both the LCS and LCSD, and the calibration check standard is acceptable, contact CSC for decision to proceed or re-extract. If samples must be analyzed without re-extraction, flag sample data for failed analytes. If analytes in calibration check standard are out, correct instrument problem. b. If one or more analytes is out in either LCS or LCSD, then analyze previously acceptable calibration check standard for the analytes that failed. If analytes in calibration check standard are in, proceed with analyses. If analytes are out, correct instrument problem. 2. Precision: Demonstrate acceptable RPDs on analytes that failed by reanalyzing previously acceptable 3rd LCS. If RPDs are in, proceed with analyses. If analytes are out, correct instrument problem.

Table 5-5 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Pesticides, PCBs, and Herbicides by Gas Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action^a
8080, 8151 (Continued)	Pesticides, PCBs, and herbicides Refer to: SW846-3500A^b SW846-3600B^b SW846-8000A^b	Continuing Calibration Verification (CCV)	Every ten samples and at end of batch.	a)Primary: Recovery of analytes within ±15% of nominal concentration; Confirmation: ±20% of nominal concentration b)Ongoing calibration analytes elute within daily RT windows	1. Repeat CCV. 2. If still out, identify and correct problem. 3. Re-analyze all samples since last valid CCV.
		Breakdown check (Endrin and DDT)	Daily prior to analysis of samples and as needed during analysis	Degradation ≤20% (each)	Perform system maintenance.
		MS/MSD	1 MS/MSD pair for each extraction batch	QC Acceptance Criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences
		Surrogate spike	Every sample, spike, standard, and method blank	Table 5-10 Only one surrogate must meet acceptance criteria.	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze affected samples 3. If none of the above, re-extract/re-analyze samples if still within HT and enough sample volume, otherwise contact CSC for decision.

Table 5-5 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Pesticides, PCBs, and Herbicides by Gas Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8080, 8151 (Continued)	Pesticides, PCBs, and herbicides Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Method blank	Each extraction batch and each analytical batch	< Quantitation limits (QL)	1. If the sample analyte concentration is <QL or the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER; 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
NA = Not applicable.

Table 5-6

Summary of Calibration and Internal Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8240B	Volatile Organic Compounds Refer to: SW846-5030[b] SW846-8000A[b]	BFB Tuning	Analyze at the beginning of each analytical sequence and at the beginning of every subsequent 12 hours (if applicable)	Established criteria in method	1. Repeat BFB analysis. 2. Adjust MS tune until criteria met.
		Five-point calibration (for all analytes) (ICAL)	Annually or when daily calibration check fails to meet acceptance criteria.	1. SPCCs[c,d] 2. %RSD <30% for CCC[e]	Repeat 5-point calibration
		Calibration Verification (CV)	Analyzed at the beginning of each analytical sequence and at the beginning of every subsequent 12 hours (if applicable)	1. SPCCs[c,d] 2. CCC[e] percent difference (%D) <20% recovery relative to ICAL	1. Repeat CV 2. If still out, identify and correct problem, run CV again; if still out recalibrate.
		Internal Standards (IS) Retention Times (RT)	All samples, standards, and method blanks	RT:Must be <30 second change from daily CV IS: EICP[f] area must be within a factor of 2 from daily CV	1. Inspect system for malfunctions. 2. Make appropriate system corrections, if necessary. 3. Reanalyze samples analyzed while system was malfunctioning unless matrix interferences demonstrated.
		LCS/LCSD	One LCS/LCSD pair per analytical batch	Recovery for all analytes within QC Acceptance Criteria in Table 5-8.	1. Accuracy: a. If recoveries for the same analytes are out in both the LCS and LCSD, stop and correct problem. If obtain CSC approval to proceed, write QCER b. If one or more analytes is out in either the LCS or LCSD, analyze a 3rd LCS. If the recoveries for the 3rd LCS are acceptable, proceed with analyses. If same analytes are out, stop and correct instrument problem. If obtain CSC approval to proceed, write QCER

Table 5-6 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8240B (Continued)	Volatile Organic Compounds Refer to: SW846-5030[b] SW846-8000A[b]	LCS/LCSD	One LCS/LCSD pair per analytical batch	Recovery for all analytes within QC Acceptance Criteria in Table 5-8.	2. Precision: Demonstrate acceptable RPDs for analytes that failed by analyzing a 3rd LCS. If RPDs between the 3rd and either LCS or LCSD are acceptable, proceed with analyses. If RPDs are still not acceptable, stop and correct instrument problem. If obtain CSC approval to proceed, write QCER.
		MS/MSD	1 MS/MSD pair for each extraction batch	QC Acceptance Criteria in Table 5-9.	1. If either the MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Surrogate spike	Every sample, spike, standard, and method blank	Table 5-10 acceptance criteria	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze the affected samples 3. If none of the above, re-extract/re-analyze if still within HT and enough sample volume, otherwise contact CSC for decision.

Table 5-6 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8240B (Continued)	Volatile Organic Compounds Refer to: SW846-5030[b] SW846-8000A[b]	Method blank	One per analytical batch	No analytes > quantitation limit (QL)	1. If sample analyte concentration is <QL (except for analytes listed as exceptions) or if the sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
[c] SPCC = System Performance Check Compounds.
[d] SPCC = for 8240B 15ml purge: 1,1-dichloroethane, chloromethane and bromoform avg. RF >/= 0.10, 1,1,2,2-tetrachloroethane avg RF >/= 0.20 and chlorobenzene avg RF >/= 0.30; for 8240B soils and 5ml purge: the same as SW8260A 15ml except 1,1,2,2-tetrachloroethane avg RF >/= 0.30.
[e] CCC = Calibration Check Compounds.
[f] EICP = Extracted Ion Current Profile.
NA = Not applicable.

Table 5-7

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action^a
8270B	Semivolatile Organic Compounds Refer to: SW846-3500A^b SW846-3600B^b SW846-8000A^b	Check of mass spectral ion intensities using DFTPP, (4,4'-DDT, pentachlorophenol and benzidine also to be included in tuning standard to verify injection port inertness and GC column performance)	At the beginning of each analytical sequence and at the beginning of each subsequent 12 hour period, if applicable.	Ion Abundance criteria in Table 3 of SW846-8270B^b – Degradation of DDT to DDE and DDD $\leq$20% – Benzidine and pentachlorophenol must each exceed 7000 area counts with a tailing factor of <3 at 10% peak height.	Ion Abundance: 1. Re-analyze DFTPP. 2. Adjust MS tune until analysis of DFTPP passes criteria Column/Injection Port: 1. Clean injection port, if necessary. 2. Remove first 6 to 12 inches of column, if necessary.
		Five-point calibration for all commercially available analytes^f	Biannually or when daily calibration check fails to meet acceptance criteria	1. %RSD <30% for each individual CCC^d 2. SPCCs^e average RF $\geq$0.050	Repeat concentrations not meeting criteria.
		Calibration Verification (CV)	At beginning of each analytical sequence and at the beginning of each subsequent 12 hour period, if applicable.(CV standard is prepared from a concentrated cocktail every two weeks).	1. SPCCs^e RF$\geq$0.050 2. CCC^d percent difference (%D) <30% from average RF	1. Reanalyze CV standard 2. If still out, identify and correct problem. 3. Reanalyze CV standard again. 4. If still out, perform a new multi-point calibration.
		Internal Standards (IS) and Retention Times (RT)	All samples, standards and blanks	RT: Must be <30 second change from daily CV IS:Extracted ion area counts must be within a factor of 2 from the daily CV.	1. Reanalyze sample if out of specification (unless matrix interference demonstrated). 2. If still out, identify and correct problem. 3. Reanalyze affected samples, if necessary.

Table 5-7 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8270B (Continued)	Semivolatile Organic Compounds	LCS/LCSD	One LCS/LCSD pair for each extraction batch and each analytical batch	Recovery for all analytes within QC Acceptance Criteria in Table 5-8.	1. Accuracy: a. If the same analytes are out in both the LCS and LCSD, then analyze a 3rd previously acceptable LCS for the analytes that failed. If 3rd LCS is acceptable, contact CSC for decision to proceed or re-extract. If samples must be analyzed without re-extraction, flag data for failed analytes. If analytes in 3rd LCS are out, correct instrument problem. b. If one or more analytes is out in either LCS or LCSD, then analyze previously acceptable 3rd LCS for the analytes that failed. If 3rd LCS analytes in, proceed, if out, correct instrument problem. 2. Precision: Demonstrate acceptable RPDs on analytes that failed by reanalyzing previously acceptable 3rd LCS. If RPDs in, proceed, if out, correct instrument problem.

Table 5-7 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action*
SW8270B (Continued)	Semivolatile Organic Compounds	MS/MSD	1 MS/MSD per extraction batch	QC Acceptance Criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Surrogate spike	Every sample, standard, and blank.	Table 5-10 criteria. Corrective action required only if more than 1 acid and/or 1 base surrogate exceeds criteria.	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze affected samples 3. If none of the above, re-extract/reanalyze samples if still within HT and enough sample volume, otherwise, contact CSC for decision.

Table 5-7 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
SW8270B (Continued)	Semivolatile Organic Compounds	Method blank	Each extraction batch and each analytical batch	All analytes < quantitation limits (QL)	1. If sample analyte concentration is <QL or if the sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER; 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
[c] SPCC = System Performance Check Compounds.
[d] CCC = Calibration Check Compounds.
[e] The following analytes use four point calibration curves to determine the average RF due to erratic behavior of these analytes: benzoic acid, and 2,4-dinitrophenol. The following use a RF obtained from a single analysis of an aliquot of the individual analyte because of erratic response, decomposition or other problems with the analytes: hexachlorophene.
NA = Not applicable.

Table 5-8

Summary of Acceptance Criteria for Laboratory Control Samples

Analyte	Recovery (%)	Precision (PRD)
METALS		
METHOD 6020		
Arsenic	80-120	20
Barium	80-120	20
Beryllium	80-120	20
Cadmium	80-120	20
Chromium	80-120	20
Lead	80-120	20
Nickel	80-120	20
Selenium	80-120	20
Silver	80-120	20
Thallium	80-120	20
METHOD 7470/7471A		
Mercury	80-120	20
METHOD 9012		
Cyanide	75-125	20
PESTICIDES and PCBs		
METHOD 8080		
Aldrin	40-137	38
Chlordane	45-119	40
Dieldrin	42-139	30
Endosulfan I	45-153	40
Endosulfan II	10-202	65
Endrin	44-151	32
Heptachlor	40-136	38
Heptachlor Epoxide	37-142	40
Methoxychlor	34-166	40
Toxaphene	41-126	50
PCB-1016	52-152	44
PCB-1221	15-178	20
PCB-1232	10-215	20
PCB-1242	39-150	20
PCB-1248	38-158	20
PCB-1254	66-122	23
PCB-1260	58-122	40

Table 5-8 (Continued)

Summary of Acceptance Criteria for Laboratory Control Samples

Analyte	Recovery (%)	Precision (PRD)
VOLATILE ORGANICS		
METHOD 8021		
Benzene	61-131	31
Carbon Tetrachloride	42-141	50
Chloroethane	43-158	52
Chlorobenzene	48-143	24
Chloroform	53-134	36
Hexachlorobutadiene	52-145	41
Methylene Chloride	44-150	56
Naphthalene	67-133	42
Toluene	64-144	22
1,2,4-Trichlorobenzene	44-139	53
1,1,1-Trichloroethane	59-136	47
1,1,2-Trichloroethane	64-160	53
Tetrachloroethene	53-150	57
Trichloroethene	51-140	48
Trichlorofluoromethane	58-152	37
Vinyl chloride	44-173	61
METHOD 8240B		
Acrolein	22-164	40
Carbon Disulfide	35-244	65
Methyl Ethyl Ketone	10-111	40
SEMIVOLATILE ORGANICS		
METHOD 8070		
N-Nitrosodimethylamine	40-135	36
METHOD 8090		
2,4-Dinitrotoluene	10-125	40
2,6-Dinitrotoluene	10-126	40
METHOD 8110		
Bis(2-Chloroethoxy)methane	47-152	59
Bis(2-Chloroethyl)ether	46-141	52
Bis(2-Chloroisopropyl)ether	26-121	49

Table 5-8 (Continued)

Summary of Acceptance Criteria for Laboratory Control Samples

Analyte	Recovery (%)	Precision (PRD)
METHOD 8121		
Hexachlorobenzene	23-118	39
Hexachlorocyclopentadiene	5-116	65
Hexachloroethane	9-135	53
METHOD 8151		
Pentachlorophenol	10-150	40
METHOD 8270B		
Bis(2-Ethylhexyl)phthalate	10-158	40
Butyl Benzyl Phthalate	10-152	40
4-Chloro-3-Methylphenol	45-113	25
2-Chlorophenol	45-101	25
Di-n-butylphthalate	10-118	50
Diethylphthalate	10-114	40
2,4-Dimethylphenol	15-151	22
Dimethyl phthalate	10-112	40
4,6-Dinitro-2-methylphenol	10-181	93
Di-n-octylphthalate	10-146	50
Phenol	41-105	24
2,4,5-Trichlorophenol	39-123	27
2,4,6-Trichlorophenol	37-144	40
METHOD 8310		
Fluoranthene	56-136	28
Fluorene	10-142	40
METHOD 8330		
Nitrobenzene	52-152	30

Table 5-9

Summary of Acceptance Criteria for Matrix Spike Analyses

Analyte	Recovery (%)	Precision (PRD)
METALS		
METHOD 6020		
Arsenic	75-125	20
Barium	75-125	20
Beryllium	75-125	20
Cadmium	75-125	20
Chromium	75-125	20
Lead	75-125	20
Nickel	75-125	20
Selenium	75-125	20
Silver	75-125	20
Thallium	75-125	20
METHOD 7470/7471		
Mercury	75-125	20
METHOD 9012		
Cyanide	75-125	20
PESTICIDES and PCBs		
METHOD 8080		
Aldrin	40-137	38
Chlordane	45-119	40
Dieldrin	42-139	30
Endosulfan I	45-153	40
Endosulfan II	10-202	65
Endrin	44-151	32
Heptachlor	40-136	38
Heptachlor Epoxide	37-142	40
Methoxychlor	34-166	40
Toxaphene	41-126	50
PCB-1016	52-152	44
PCB-1221	15-178	20
PCB-1232	10-215	20
PCB-1242	39-150	20
PCB-1248	38-158	20
PCB-1254	66-122	23
PCB-1260	58-122	40

Table 5-9 (Continued)

Summary of Acceptance Criteria for Matrix Spike Analyses

Analyte	Recovery (%)	Precision (PRD)
VOLATILE ORGANICS		
METHOD 8021		
Benzene	61-131	31
Carbon Tetrachloride	42-141	50
Chloroethane	43-158	52
Chlorobenzene	48-143	24
Chloroform	53-134	36
Hexachlorobutadiene	52-145	41
Methylene Chloride	44-150	56
Naphthalene	67-133	42
Toluene	64-144	22
1,2,4-Trichlorobenzene	44-139	53
1,1,1-Trichloroethane	59-136	47
1,1,2-Trichloroethane	64-160	53
Tetrachloroethene	53-150	57
Trichloroethene	51-140	48
Trichlorofluoromethane	58-152	37
Vinyl chloride	44-173	61
METHOD 8240B		
Acrolein	22-164	40
Carbon Disulfide	35-244	65
Methyl Ethyl Ketone	10-111	40
SEMIVOLATILE ORGANICS		
METHOD 8070		
N-Nitrosodimethylamine	40-135	36
METHOD 8090		
2,4-Dinitrotoluene	10-125	40
2,6-Dinitrotoluene	10-126	40
METHOD 8110		
Bis(2-Chloroethoxy)methane	47-152	59
Bis(2-Chloroethyl)ether	46-141	52
Bis(2-Chloroisopropyl)ether	26-121	49

Table 5-9 (Continued)

Summary of Acceptance Criteria for Matrix Spike Analyses

Analyte	Recovery (%)	Precision (PRD)
METHOD 8121		
Hexachlorobenzene	23-118	39
Hexachlorocyclopentadiene	5-116	65
Hexachloroethane	9-135	53
METHOD 8151		
Pentachlorophenol	10-150	40
METHOD 8270B		
Bis(2-Ethylhexyl)phthalate	10-158	40
Butyl Benzyl Phthalate	10-152	40
4-Chloro-3-Methylphenol	45-113	25
2-Chlorophenol	45-101	25
Di-n-butylphthalate	10-118	50
Diethylphthalate	10-114	40
2,4-Dimethylphenol	15-151	22
Dimethyl phthalate	10-112	40
4,6-Dinitro-2-methylphenol	10-181	93
Di-n-octylphthalate	10-146	50
Phenol	41-105	24
2,4,5-Trichlorophenol	39-123	27
2,4,6-Trichlorophenol	37-144	40
METHOD 8310		
Fluoranthene	56-136	28
Fluorene	10-142	40
METHOD 8330		
Nitrobenzene	52-152	30

Table 5-10

Summary of Surrogate Spike Acceptance Criteria

Surrogate Compound	Soil (% Recovery)
METHOD 8080 PESTICIDES AND PCBs	
2,4,5,6-Tetrachloro-m-xylene (TCMX)	19-132
Dibutylchlorendate (DBC)	47-126
Decachlorobiphenyl	45-131
METHOD 8151 HERBICIDES	
2,4-DB	20-160
2,4-DCAA	10-148
METHOD 8021A	
2-Bromo-1-chloropropane	70-130
Fluorobenzene	70-130
VOLATILE ORGANICS	
METHOD 8240B	
Toluene-d_8	68-123
4-Bromofluorobenzene	64-126
Dibromofluoromethane	80-120
1,2-Dichloroethane-d_4	46-143
METHOD 8090	
2,4,5,6-Tetrachloro-m-xylene (ECD)	19-132
SEMIVOLATILE ORGANICS	
METHOD 8270B	
2-Chlorophenol-d_4	20-130
1,2-Dichlorobenzene-d_4	20-130
2-Fluorobiphenyl	35-116
2-Fluorophenol	27-120
2,4,6-Tribromophenol	17-123
Nitrobenzene-d_5	22-124
p-Terphenyl-d_{14}	29-137
Phenol-d_5	32-123
METHOD 8310	
4-Terphenyl-d_{14}	28-106
METHOD 8330	
3,4-Dinitrotoluene	40-140

6.0 CHEMICAL DATA QUALITY MANAGEMENT (CDQM) DELIVERABLES

The following deliverables will be prepared for this project:

- Draft and Final Chemical Data Acquisition Plan (CDAP);
- Draft and Final Site Safety and Health Plan (SSHP);
- A-E Daily Quality Control Reports; and
- Draft, Draft Final, and Final Site Characterization Reports.

7.0 DATA MANAGEMENT AND REPORTING

This section presents the data reporting and management procedures that will be followed for the RAAP Basin Closure.

7.1 Data Management

The data management requirements of this CDAP will facilitate the organizing and reporting of investigation data and results. The Project Director will oversee all aspects of the work and will be responsible for ensuring that proper documentation procedures are followed and that tracking of the accumulated data during the investigation is performed.

There are four goals for the data management task:

- Provide timely access to an organized body of data to facilitate analysis and decision making throughout the investigation;
- Provide a useful index of project information;
- Present project information in tabular and graphic form; and
- Report progress on the project.

7.2 Sample Tracking Record

A bound, numbered field logbook will be used to permanently record all field procedures, sample locations, types, unique identification numbers, and general observations. The specific parameters for which each sample is to be analyzed will also be recorded. A unique sample field identification number will be assigned at the time of sample collection to track each sample. A corresponding laboratory ID number will be

assigned by the laboratory and will be used to track each sample through the analytical process.

All pages of the field logbook will be signed and dated by the supervising geologist who is entering the data. Also, the names and affiliations of all visitors on site will be entered in the notebook, as well as general notes on project progress, problems encountered, and any deviations from plans.

Field sample ID number, along with sample collection point, sample collection date/time, sampler, required analysis, and preservation will be entered on the sample label for each container. Chain-of-custody documentation will also be completed and will accompany all samples to document the chain of possession and track the samples throughout shipping, handling, and analysis.

Samples are received by the Sample Control Area, and all containers and security seals, when appropriate, are inspected for physical damage or evidence of tampering. The samples are unpacked, inspected, and checked against the chain of custody form by the sample custodian. The temperature and pH of the samples are verified. The samples are logged into the laboratory information management system and assigned a unique number. Analytical requirements for each sample are entered into the computer. All sample information, including the date for sample disposal or return, is stored in the laboratory information management system. Labels are printed with sample information and secured to each sample. Work sheets, containing the sample information, storage location, and analytical requirements, are submitted to the appropriate laboratory managers. Following sample log in, the samples are placed in a secure storage area.

7.3 Field Data

Radian will maintain field records in a manner which will allow a reviewer to recreate all sampling and measurement activities. The requirements apply to all measuring and sampling data. The information will be recorded with indelible ink in a permanently-bound logbook with sequentially-numbered pages.

7.4 Laboratory Data

Laboratory data reports will be issued for each work order generated by the laboratory. A work order is generated for a single client's samples, received by the laboratory on the same day, typically including less than 50 samples, and requiring similar analytical procedures. This may result in multiple work orders for a sample. The analyst is responsible for all of the primary calculations, editing of initial quantitative reports, calculation of percent recoveries and RPDs for comparison to applicable tolerance limits, comparison of QC results to acceptance limits, and compiling all data for peer review. The peer reviewer is responsible for checking that calibration and QC results meet applicable tolerance limits and checking a subset of results for analytes from a subset of samples included in each analytical batch. The work order results are reported in both hard copy and electronic format. Radian will maintain records of all laboratory data, including sample IDs, analytical results, detection limits, analytical methods, and other related data.

7.6 Data Analysis and Reporting

Tabular and graphic summarization will be used to present the results of all data collection efforts in the final report. Radian will compile and report the data generated during the project within 45 days following the completion of field sampling.

Tables summarizing field and/or laboratory data will be generated from the project database. Data in the tables will be verified against hard-copy laboratory reports. For laboratory data, both environmental sample and QC sample results will be reported.

Tables will be used in the report as a convenient means of presenting a summary of the analytical results. Approximate sampling locations will be noted on CADD-based figures included in the site characterization report. Contour plots may be generated to pictorially present analytical data. Analytical laboratory reports will be stored at the site for a minimum of five years and will be made available to agency reviewers upon request.

8.0 REFERENCES

1. "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 & SWMU-10," Radford Army Ammunition Plant, 12 December 1995.

2. Chemical Data Quality Management for Hazardous Waste Remedial Activities, ER 1110-1-263, 1 October 1990, U.S. Army Corps of Engineers.

3. Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3, 1 September 1994, U.S. Army Corps of Engineers.

4. "Foundation Analysis for Project No. 33.10B," Norfolk District, U.S. Army Corps of Engineers, 1977.

5. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington, DC, September 1994.

Appendix B

BORING LOGS OF BACKGROUND SAMPLING LOCATIONS

Radian Corporation
Herndon, VA

LOG OF BORING BG-0

Page 1 of

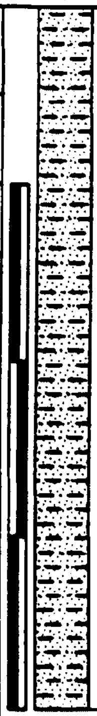
DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	DEPTH (ft)	MATERIALS DESCRIPTION
								Clayey Sand: fine grained, brown, trace mica, loose, damp.
	RAAP-BG 01-04 01	2.0-4.0	100%	3 4 5 6	2.0	SC		
		4.0-6.0	100%	3 4 8 8	0.0	SC		
5							5	Clayey Sand: as above, brown to red.
		6.0-8.0	100%	4 7 8 7	0.0	SC		Clayey Sand: as above, trace quartz gravel.
								Bottom of boring at 8.0 feet.
10							10	
15							15	

PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger
DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/24/96
SURFACE ELEVATION 1704.53 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-02

Page 1 of



DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	DEPTH (ft)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION
										Clayey Sand: fine grained, brown, trace mica, loose, damp.
	RAAP-BG 02-04 01	2.0-4.0	100%	4 5 4 6	2.0	SC				
		4.0-6.0	100%	5 6 8 8	0.0	SC				Clayey Sand: as above
5							5			
		6.0-8.0	100%	5 7 9 7	0.0	SC				Clayey Sand: as above.
										Bottom of boring at 8.0 feet.
10							10			
15							15			

PROJECT RAAP EQ Basin Closure

LOCATION Radford, Virginia

JOB NUMBER 631-210-01

GEOLOGIST RT Church

DRILL RIG Hollow Stem Auger

DRILLING COMPANY Bedford Drilling Services

DATE DRILLED 9/24/96

SURFACE ELEVATION 1711.11 ft MSL

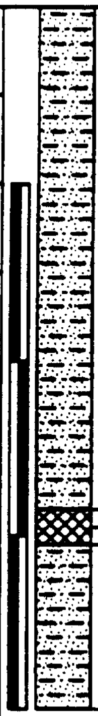
TOTAL DEPTH OF HOLE 8.0 Feet

WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-0

Page 1 o



DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	DEPTH (ft)	MATERIALS DESCRIPTION
								Clayey Sand: fine grained, brown to red, trace mica, trace gravel, medium dense to dense, dry.
	RAAP-BG 03-04 01	2.0-4.0	100%	4 5 16 21	1.0	SC		
		4.0-6.0	100%	6 7 21 47	2.0	SC		Clayey Sand: as above
5							5	
								cobble: 5.7 ft. to 6.1 ft.
		6.0-8.0	100%	5 7 10 6	1.0	SC		Clayey Sand: as above.
								Bottom of boring at 8.0 feet.
10							10	
15							15	

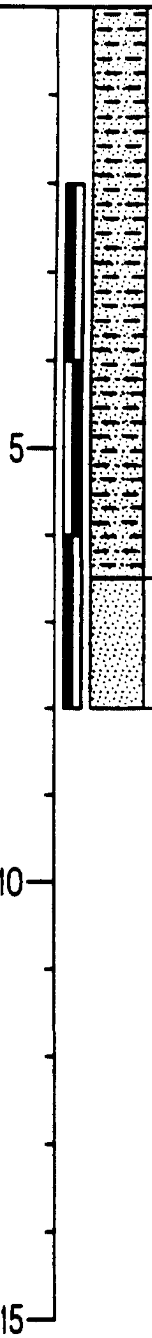
PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger
DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/24/98
SURFACE ELEVATION 1710.77 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-04

Page 1 of

DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	MATERIALS DESCRIPTION
	RAAP-BG 04-04 01	2.0-4.0	100%	2 3 2 4	0.0	SC	Clayey Sand: fine grained, brown, trace mica, loose, damp.
		4.0-6.0	100%	2 1 2 3	1.0	SC	Clayey Sand: as above
5							
		6.0-8.0	100%	2 2 2 2	1.0	SC SP	Sand: fine grained, brown, trace mica, loose, damp.
							Bottom of boring at 8.0 feet.
10							
15							



PROJECT RAAP EQ Basin Closure	**DRILLING COMPANY** Bedford Drilling Services
LOCATION Radford, Virginia	**DATE DRILLED** 9/24/96
JOB NUMBER 631-210-01	**SURFACE ELEVATION** 1697.57 ft MSL
GEOLOGIST RT Church	**TOTAL DEPTH OF HOLE** 8.0 Feet
DRILL RIG Hollow Stem Auger	**WATER LEVEL**

Radian Corporation
Herndon, VA

LOG OF BORING BG-0

Page 1 o

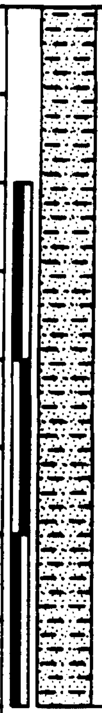
DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	MATERIALS DESCRIPTION
							Clayey Sand: fine grained, brown, trace mica, medium dense, dry.
	RAAP-BG 05-04 01	2.0-4.0	100%	4 4 5 5	0.0	SC	
		4.0-6.0	100%	3 4 3 4	0.0	SP	Sand: fine to medium grained, brown to red, trace clay, trace mica, moist to wet at 6.0 ft.
5							
		6.0-8.0	100%	3 3 15 16	0.0	SP	Sand: as above.
							Bottom of boring at 8.0 feet.
10							
15							

PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger
DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/23/96
SURFACE ELEVATION 1698.58 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL 6.0 Feet

Radian Corporation
Herndon, VA

LOG OF BORING BG-06

Page 1 of



DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	DEPTH (ft)	MATERIALS DESCRIPTION
	RAAP-BG 06-04 01	2.0-4.0	100%	8 11 10 10	0.0	SC		Clayey Sand: fine grained, brown, trace mica, medium dense, dry.
		4.0-6.0	100%	8 9 11 10	0.0	SC		Clayey Sand: as above, damp.
5							5	
		6.0-8.0	100%	13 12 13 18	0.0	SC		Clayey Sand: as above.
								Bottom of boring at 8.0 feet.
10							10	
15							15	

PROJECT RAAP EQ Basin Closure

LOCATION Radford, Virginia

JOB NUMBER 831-210-01

GEOLOGIST RT Church

DRILL RIG Hollow Stem Auger

DRILLING COMPANY Bedford Drilling Services

DATE DRILLED 9/23/98

SURFACE ELEVATION 1706.89 ft MSL

TOTAL DEPTH OF HOLE 8.0 Feet

WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-0

Page 1 o

DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	DEPTH (ft)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION
	RAAP-BG 07-04 01	2.0-4.0	100%	4 4 5 5	1.0	SC				Clayey Sand: fine grained, brown with red mottling, trace mica, medium dense, damp to dry.
		4.0-6.0	100%	4 7 9 7	0.0	SC				Clayey Sand: as above, trace coarse gravel, damp.
5							5			
		6.0-8.0	100%	5 9 7 9	0.0	SC				Clayey Sand: as above.
										Bottom of boring at 8.0 feet.
10							10			
15							15			

PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger
DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/23/98
SURFACE ELEVATION 1706.56 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-08

Page 1 of

DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	DEPTH (ft)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION
	RAAP-BG 08-04 01	2.0-4.0	100%	4 3 4 4	0.0	SC				Clayey Sand: fine grained, brown, trace mica, loose, damp.
5		4.0-6.0	100%	3 3 2 3	0.0	SP	5			Sand: fine grained, brown, trace clay, trace mica, loose, damp.
		6.0-8.0	100%	3 2 3 3	0.0	SP				Sand: as above, wet at 7.5 feet below grade.
		8.0-10.0	100%	2 1 2 3	0.0	SP				
10							10			Bottom of boring at 10.0 feet.
15							15			

PROJECT RAAP EQ Basin Closure

LOCATION Radford, Virginia

JOB NUMBER 631-210-01

GEOLOGIST RT Church

DRILL RIG Hollow Stem Auger

DRILLING COMPANY Bedford Drilling Services

DATE DRILLED 9/23/96

SURFACE ELEVATION 1702.91 ft MSL

TOTAL DEPTH OF HOLE 10.0 Feet

WATER LEVEL 7.5 Feet

Appendix C

ELEVATIONS OF BASIN SUBSOIL LOCATIONS

Elevations of Basin Subsoil Locations

Sampling Node	Elevation (ft MSL)
1	1,698.45
5	1,700.26
6	1,699.02
9	1,695.88
10	1,698.77
14	1,698.37
15	1,698.17

Analytical Results
Background Soil Samples

Bioplant Equalization Basin Closure
Site Investigation/Evaluation
Radford Army Ammunition Plant
Radford, Virginia

Submitted to:

Norfolk District
U.S. Army Corps of Engineers

RADIAN
CORPORATION

Analytical Results
Background Soil Samples

Bioplant Equalization Basin Closure
Site Investigation/Evaluation
Radford Army Ammunition Plant
Radford, Virginia

Submitted to:

Norfolk District
U.S. Army Corps of Engineers

ANALYTICAL RESULTS BACKGROUND SOIL SAMPLES BIOPLANT EQUALIZATION BASIN CLOSURE SITE INVESTIGATION/EVALUATION RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Prepared for:

Norfolk District, U.S. Army Corps of Engineers
Engineering Division
HTRW Branch

Prepared by:

Radian Corporation
2455 Horsepen Road, Suite 250
Herndon, Virginia 20171

Contract No. DACA65-95-D-0030

December 1996

NRJ-094
1213-01.nrj

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APPENDIX A: CHEMICAL DATA ACQUISITION PLAN

APPENDIX B: BORING LOGS

1.0 INTRODUCTION

Radian Corporation (Radian) is conducting a site investigation to support the closure of the Bioplant Equalization Basin at Radford Army Ammunition Plant (RAAP). The work is authorized by Delivery Order No. 10, Contract No. DACA65-95-D-0030 with the Norfolk District of the U.S. Army Corps of Engineers. The site investigation is conducted in accordance with the closure plan entitled "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 and SWMU-10," dated 12 December 1995. This plan was approved by Virginia Department of Environmental Quality (VaDEQ) on 2 January 1996.

This objective of this report is to notify VaDEQ of the analytical results and statistical treatment of soil samples collected from background areas of RAAP. By pursuing a "clean closure" of the basin, RAAP is conducting sampling and analysis of basin subsoils to show that constituent concentrations are not statistically greater than background soil concentrations for the 70 hazardous constituents of concern (HCOCs). The statistical analysis of the background data will yield a "critical value" to which each individual basin subsoil sample will be compared.

Radian has collected and chemically analyzed samples from eight background locations at RAAP. The analytical data has been verified and statistically analyzed to calculate the above-mentioned critical value to which individual basin subsoil samples will be compared to determine "clean closure." Section 2.0 discusses the selection of background locations and sampling procedures. Section 3.0 presents the analytical results and statistical analysis of the data. Section 4.0 presents an evaluation of the quality assurance/quality control performed for the laboratory analysis.

2.0 BACKGROUND SAMPLING

RAAP personnel selected eight locations from which to collect background samples of subsurface soil. The locations were chosen from areas thought to be free from contamination from past or present industrial activities. These proposed locations were submitted to VaDEQ for approval. VaDEQ requested the relocation of three of the sample points. This approval was conveyed in the 5 August 1996 letter from Khoa Nguyen, VaDEQ, to RAAP. A map containing the approved locations is presented in Figure 1. The sample locations are designated #1 through #8.

The closure plan requires the background soil samples to be geologically similar to the basin subsoil. For this reason, Radian collected samples of the basin subsoil to determine the lithology prior to collecting background samples. Radian initiated the sampling of basin subsoil on 19 September 1996. The basin subsoil samples were found to consist of reddish-brown, fine-grained, clayey sand.

The collection of background soil samples was conducted on 23 and 24 September 1996. All field activities were conducted in accordance with the procedures specified in the Chemical Data Acquisition Plan (CDAP) (Radian, 1996). The CDAP is presented in Appendix A. Radian employed a drill rig operated by a subcontractor, Bedford Drilling Services, to drill soil borings at the selected locations. Soil borings were advanced with a 2.25-inch inside diameter hollow-stem auger, and the samples collected with a two-inch diameter, stainless steel split spoon. The subsurface soil was sampled continuously with the split spoon for the entire depth of each boring. A Radian geologist classified the soil in each sample and measured the organic vapor concentration of the headspace above each sample with a photoionization detector. For borings #1 - #7, the total depth of the boring was eight feet. Boring #8 was drilled to 10 feet. All the selected samples were classified as clayey sand. The boring log for each of the background soil borings is presented in this report as Appendix B.

The samples were preserved with ice and shipped overnight in plastic coolers to the laboratories. Additional sample volume from selected background soil locations were collected for matrix spike analysis. An equipment rinsate blank and a trip blank were collected for QA/QC purposes.

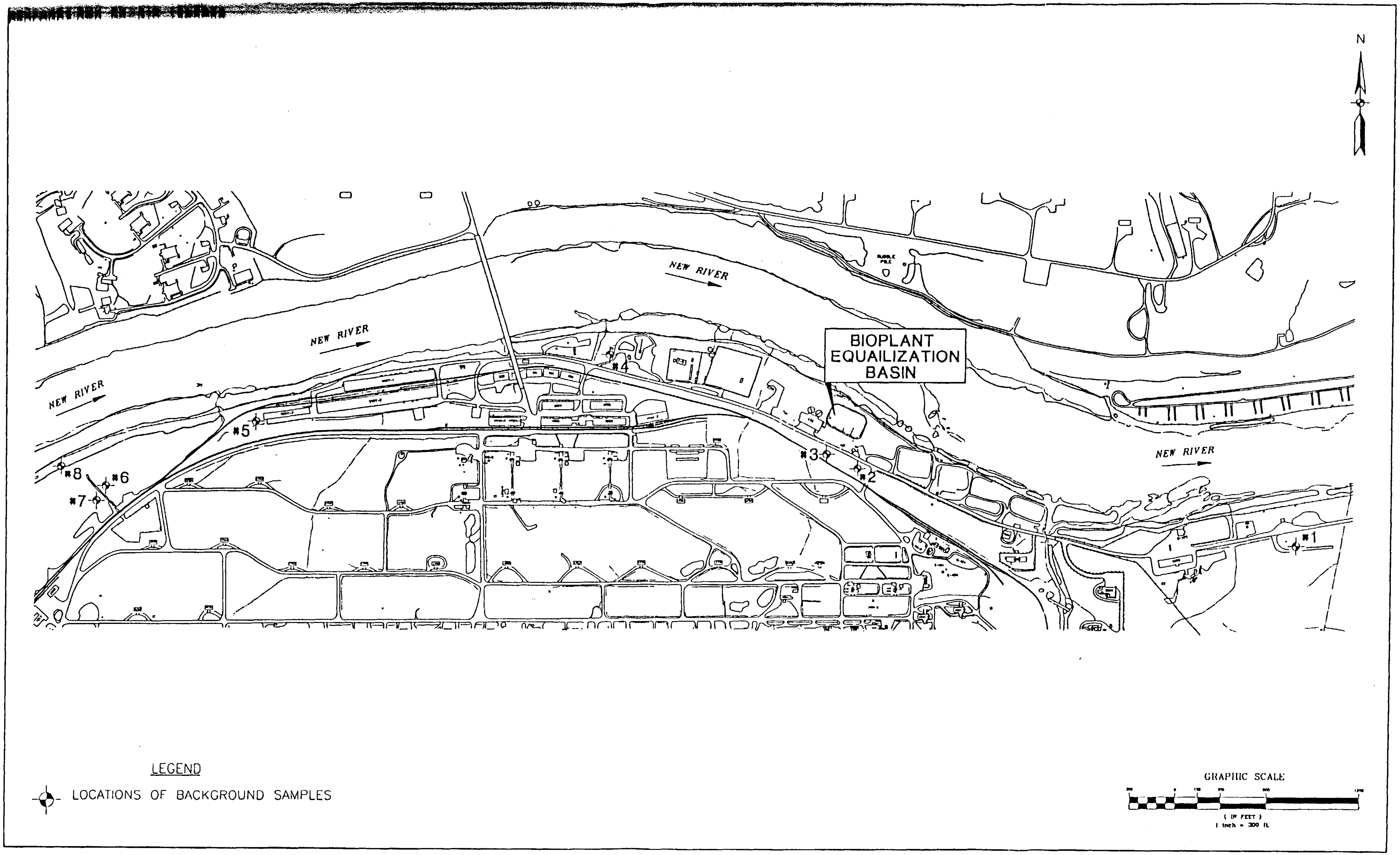

Figure 1. Location of Background Samples
Radford Army Ammunition Plant, Radford, Virginia

3.0 ANALYTICAL DATA

During the RAAP background soil investigation, eight samples were collected and analyzed for 70 hazardous constituents of concern (HCOCs), as specified in the Chemical Data Acquisition Plan (Radian, 1996). The samples for the organic HCOCs were analyzed by Savannah Laboratories and Environmental Services, Inc. of Tallahassee, Florida. The samples for the inorganic HCOCs were analyzed by Quanterra, Inc. of West Sacramento, California.

3.1 Results

Table 3-1 presents the analytical results for the eight background soil samples. For the organic constituents, only 2,4-dinitrotoluene and Aroclor-1254 were detected in the samples. All other organic HCOCs were not detected. 2,4-Dinitrotoluene was found in only one sample (#2) at a concentration less than the reporting limit. Aroclor-1254 was detected in two samples (#2 and #7). The result in sample #2 was at a concentration less than the reporting limit. For the inorganic constituents, arsenic, barium, beryllium, chromium, lead, and nickel were measured in all eight samples. Thallium was measured in seven of eight samples.

3.2 Statistical Treatment

The purpose of the statistical treatment of the background data is to calculate a critical value (CV) for comparison against the basin subsoil data. Based on the Closure Plan and discussions with the VaDEQ, CVs were calculated only for the seven metals detected in the background samples. These CVs are included in Table 3-1. Critical values were not calculated for any organic constituents, because the two organic constituents detected in the background samples were not detected in any of the basin subsoil samples, nor were CVs calculated for the inorganic constituents not detected in any background sample. Because the seven metals were detected in all eight samples

TABLE 3-1
Analytical Results and Critical Values for the Background Samples

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
METHOD D2216 (%)									
Moisture Content	15	14	16	17	16	16	16	17	NC
VOLATILES									
METHOD 8021A (ug/kg)									
Benzene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Bromomethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Carbon tetrachloride	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Chlorobenzene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Chloroform	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Chloromethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
trans-1,2-Dichloroethene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Hexachlorobutadiene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Methylene chloride (Dichloromethane)	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Naphthalene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Tetrachloroethene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Toluene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
1,2,4-Trichlorobenzene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
1,1,1-Trichloroethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
1,1,2-Trichloroethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Trichloroethene	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Trichlorofluoromethane	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
Vinyl chloride	<5.9	<5.8	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	NC
METHOD 8240B (ug/kg)									
Acrolein	<120	<120	<120	<120	<120	<120	<120	<120	NC
Carbon disulfide	<5.8	<5.8	<5.9	<6.1	<6.0	<6.0	<6.0	<6.1	NC
2-Butanone (MEK)	<29	<29	<29	<30	<30	<30	<30	<30	NC
SEMIVOLATILES									
METHOD 8070 (ug/kg)									
N-Nitrosodimethylamine	<100	<78	<80	<81	<80	<80	<80	<81	NC
METHOD 8090 (ug/kg)									
2,4-Dinitrotoluene	<12	2.4 J	<12	<12	<12	<12	<12	<12	NC
2,6-Dinitrotoluene	<12	<12	<12	<12	<12	<12	<12	<12	NC
METHOD 8110 (ug/kg)									
Bis(2-Chloroethoxy) methane	<35	<35	<36	<36	<36	<36	<36	<36	NC
Bis(2-Chloroethyl) ether	<35	<35	<36	<36	<36	<36	<36	<36	NC
Bis(2-Chloroisopropyl) ether	<35	<35	<36	<36	<36	<36	<36	<36	NC
METHOD 8121 (ug/kg)									
Hexachlorobenzene	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Hexachlorocyclopentadiene	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Hexachloroethane	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
METHOD 8151 (ug/kg)									
Pentachlorophenol	<20	<20	<20	<20	<20	<20	<20	<20	NC

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value; constituents present below the reporting limit.
NC - Critical value not calculated; see Section 3.2.

TABLE 3-1
Analytical Results and Critical Values for the Background Samples (Continued)

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
METHOD 8270B (ug/kg)									
Bis(2-Ethylhexyl)phthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
Butylbenzylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
4-Chloro-3-methylphenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
2-Chlorophenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
Di-n-butylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
Di-n-octylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
Diethylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
2,4-Dimethylphenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
Dimethylphthalate	<390	<380	<390	<400	<390	<390	<390	<400	NC
2-Methyl-4,6-dinitrophenol	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<2000	NC
Phenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
2,4,5-Trichlorophenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
2,4,6-Trichlorophenol	<390	<380	<390	<400	<390	<390	<390	<400	NC
METHOD 8310 (ug/kg)									
Fluoranthene	<12	<12	<12	<12	<12	<12	<12	<12	NC
Fluorene	<12	<12	<12	<12	<12	<12	<12	<12	NC
METHOD 8330 (ug/kg)									
Nitrobenzene	<290	<290	<300	<300	<300	<300	<300	<300	NC
PESTICIDES/PCBs									
METHOD 8080A (ug/kg)									
Aldrin	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Chlordane	<20	<20	<20	<20	<20	<20	<20	<20	NC
Dieldrin	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Endosulfan I	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Endosulfan II	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Endrin	<3.9	<3.8	<3.9	<4.0	<3.9	<3.9	<3.9	<4.0	NC
Heptachlor	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Heptachlor epoxide	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NC
Methoxychlor	<20	<20	<20	<20	<20	<20	<20	<20	NC
Aroclor-1016	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1221	<79	<78	<80	<81	<80	<80	<80	<81	NC
Aroclor-1232	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1242	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1248	<39	<38	<39	<40	<39	<39	<39	<40	NC
Aroclor-1254	<39	17 J	<39	<40	<39	<39	46	<40	NC
Aroclor-1260	<39	<38	<39	<40	<39	<39	<39	<40	NC
Toxaphene	<200	<200	<200	<200	<200	<200	<200	<200	NC
METALS									
METHOD 6020 (mg/kg)									
Arsenic	2	2.5	2.9	1.6	2.1	1.2	3.2	0.95	5.5
Barium	172	157	139	187	169	108	165	93	292
Beryllium	0.85	0.99	0.87	1.2	1.1	0.72	1.1	0.76	1.71

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value; constituent present below the reporting limit.
NC - Critical value not calculated; see Section 3.2.

TABLE 3-1
Analytical Results and Critical Values for the Background Samples (Continued)

CONSTITUENT	#1	#2	#3	#4	#5	#6	#7	#8	Critical Value
METALS Continued									
Cadmium	<0.24	<0.24	<0.24	< 0.27	<0.24	<0.22	<0.24	<0.24	NC
Chromium	27.3	28.1	25.9	26	28.6	18.4	34.4	19.1	48.6
Lead	11.6	26.6	16.8	16.7	20.2	8.6	22	7.9	45.1
Nickel	15.2	14.3	13.9	17.2	17	11.8	20.5	11.7	28.1
Selenium	<0.24	<0.24	<0.24	<0.27	<0.24	<0.22	<0.24	<0.24	NC
Silver	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
Thallium	0.29	0.23	0.22	<0.21	0.25	0.16	0.41	0.17	0.63
METHOD 7471A (mg/kg)									
Mercury	<0.12	<0.12	<0.12	<0.13	<0.12	<0.11	<0.12	<0.12	NC
METHOD 9010A (mg/kg)									
Cyanide, Total	<0.59	<0.60	<0.60	<0.67	<0.59	<0.55	<0.60	<0.60	NC

Reporting limits and concentrations are presented on a dry weight basis.
J - Estimated value; constituent present below the reporting limit.

(seven of eight samples for thallium), the CV will be calculated as an upper tolerance limit (UTL) for the 99th percentile (i.e., a coverage of 99%) with 95% confidence, as specified in the Closure Plan.

Prior to calculating the UTLs, the data were evaluated to determine if the concentrations follow a normal distribution for each analyte according to the Shapiro-Wilk W test (Shapiro and Wilk, 1965). Each of the seven analytes were determined to have a normal distribution according to the W test, so only normal UTLs were calculated using the following equation:

$$\text{UTL} = \underline{x} + (K)(s)$$

where $\underline{x}$ is the estimated sample mean; K is the tolerance factor; and s is the estimated standard deviation. The tolerance factor, K, is from Hahn and Meeker, 1991. Table 3-2 shows the appropriate statistics used in the UTL calculations.

Table 3-2

Statistics for Calculating the Critical Values

Constituent	Mean, x	Standard Deviations, s	Tolerance Factor, K	Upper Tolerance Limit, UTL
Arsenic	2.0563	0.7917	4.3539	5.5031
Barium	148.7500	32.9708	4.3539	292.3000
Beryllium	0.9488	0.1750	4.3539	1.7109
Chromium	25.9750	5.1933	4.3539	48.5860
Lead	16.3000	6.6132	4.3539	45.0929
Nickel	15.2000	2.9674	4.3539	28.1198
Thallium	0.2294	0.0931	4.3539	0.6345

4.0 DATA EVALUATION AND USABILITY

This section presents a summary of the quality control tasks associated with the background soil sampling. The data were evaluated according to the data quality objectives (DQOs) presented in the Chemical Data Acquisition Plan (CDAP) (Radian, 1996). These DQOs are statements of the acceptable level of measurement uncertainty in chemical data. The measurement objectives were established in terms of accuracy, precision, representativeness, sensitivity, comparability, and completeness.

For the background sampling, eight soil samples, one equipment blank sample, one trip blank sample and one field blank sample were collected. The soil samples and the equipment blank were analyzed for all HCOCs while the trip blank and field blank were analyzed only for the volatile HCOCs (Methods 8021 and 8240) in accordance with the CDAP.

4.1 Accuracy

Accuracy is a measure of the agreement between a measured value and a reference or true value. The accuracy of the analytical methods was assessed by calculating the recovery (as a percentage) of known compounds that were spiked into the background soil samples. Three spiked samples, laboratory control Samples (LCS), surrogates and matrix spikes, were utilized for this purpose and are discussed separately below:

Laboratory Control Samples: All LCS recoveries were met.

Surrogates: In general, the specification for surrogate recoveries were met. There were some instances of recoveries being outside the specifications due to matrix

interference. In these instances, the laboratory followed the corrective action which involved re-extraction and reanalysis. The following instances are noted:

- Recoveries for both surrogate compounds by Method 8021 in sample #2 in the original and reanalysis were greater than the project criteria. The data are still usable but are considered to be biased high;
- Recoveries for all six surrogate compounds by Method 8270 in sample #2 in the original and reanalysis were less than the project criteria. The data are still usable but are considered to be biased low; and
- Recoveries for all three surrogate compounds by Methods 8080 and 8090 in sample #2 in the original and reanalysis were less than the project criteria. The data are still usable but are considered to be biased low.

Matrix Spikes: In general, the specification for matrix spikes recoveries were met. The following instances are noted:

- The matrix spikes were not performed for Method 8240 on the samples from this study; instead, samples from another client were used for the matrix spike. The recoveries from these samples met the project criteria;
- The matrix spike recovery for benzene by Method 8021 was greater than the project criteria. The benzene results for the background samples are still usable but are considered to be biased high; and
- The matrix spike and matrix spike duplicate recoveries for barium by Method 6020 were not calculated as the spiked amount when compared to the amount of barium in the soil sample was too small to yield a useful calculation. These samples are discussed further in Section 4.2. Because the spiked amount was too low, the matrix spike and matrix spike duplicate samples can be treated as laboratory duplicates. The RPDs of the duplicate samples were <20%, which demonstrates good reproducibility. The data are still usable.

4.2 Precision

Precision is a measure of the reproducibility or agreement among repeated measurements, and is typically evaluated by calculating the relative percent difference between the results from one or more types of "duplicate" analyses. For the background soil sampling, two types of duplicate analyses were performed, laboratory control samples and matrix spikes. These samples are discussed separately below:

Laboratory control sample/laboratory control sample duplicate (LCS/LCSD): The specifications for all LCS/LCSD for this project were met.

Matrix spikes/matrix spike duplicates (MS/MSD): The specifications for MS/MSD for this project were met. The following instances are noted:

- The RPD of 58% for bis(2-chloroethyl) ether by Method 8110 did not meet the project criteria of 52%; although, the recoveries of both the matrix spike and matrix spike duplicate met the project criteria. Non-homogeneity of the soil was the probable major factor. The data are still usable.
- The matrix spike and matrix spike duplicate recoveries for barium by Method 6020 were not calculated as the spiked amount when compared to the amount of barium in the soil sample was too small to yield a useful calculation. Because the spiked amount was too low, the matrix spike and matrix spike duplicate samples can be treated as laboratory duplicates. The RPDs of the duplicate samples were <20%, which demonstrates good reproducibility. The barium data are still usable.

4.3 Representativeness

The purpose of sampling is to obtain data that represent the system being studied. Representativeness is achieved by carefully selecting sampling sites and locations (discussed in Section 2), and controlling procedures for sample collection, preservation and handling. Field and laboratory quality control samples are also used to measure contamination of the sampling or analytical conditions. These quality control samples include equipment blanks, trip blanks, field blanks, and method (laboratory) blanks. Additionally, calibration of the instruments is performed and verified prior to analysis of environmental samples.

For this soil sampling, no analytes were detected in the equipment blank, trip blank, or field blank samples. Chromium and nickel were detected in the method blank; however, at concentrations less than twenty times the sample results. Consequently, the soil sample results for chromium and nickel are not impacted.

4.4 Sensitivity

The reporting limits presented in Section 3.0 appear to be greater than the reporting limits shown in Table 5-1 of the CDAP. This is due to the CDAP reporting limits having been adjusted to reflect the concentration of moisture in each sample. By presenting the concentrations in Section 3.0 on a dry-weight basis, a valid comparison can be made between background and subsoil samples.

The reporting limits specified in the CDAP for the background soil samples were met with two exceptions. The laboratory achieved a reporting limit of 2,000 μg/kg (1,700 μg/kg on an as-received basis) for 2-methyl-4,6-dinitrophenol. This reporting limit is greater than 330 μg/kg, as stated in the CDAP. The reporting limit for 2-methyl-4,6-dinitrophenol should have been presented in the CDAP as 1,700 μg/kg, based on information provided by the laboratory. Because of its chemical properties, 2-methyl-4,6-dinitrophenol is less sensitive to analysis by the gas chromatography/mass spectrometry configuration, provided in Method 8270B, than the other HCOCs analyzed by Method 8270B. Consequently, a higher reporting limit is necessary. The correct reporting limit of 1,700 μg/kg is less than the required PQL of 3,300 μg/kg shown in the CDAP.

For cyanide, the laboratory achieved a reporting limit of 0.5 mg/kg. This reporting limit is greater than 0.1 mg/kg as stated in the CDAP. The reporting limit of 0.1 mg/kg was based on an MDL study performed by the laboratory on an aqueous matrix. Because soil is a more complex matrix compared to laboratory pure water, the reporting limit based on the MDL study is not achievable in a soil matrix; hence, the increase from 0.1 mg/kg to 0.5 mg/kg.

4.5 Comparability

Comparability is a qualitative measure of confidence with which the data sets can be compared. Data comparability for this samples was achieved by following approved, standard analytical procedures and by reporting results in standard units of measure, as required in the specific methods.

4.6 Completeness

Completeness is expressed as the percentage of the amount of valid data (i.e., data which meet the measurement objective) obtained compared to the amount of data planned. Since all samples were collected as planned and the measurement objectives were met for all of the samples, the completeness for this phase of the project was 100 percent.

4.7 Data Usability

Overall, the data generated for the background soil samples can be used for their intended purpose.

5.0 REFERENCES

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Appendix A

CHEMICAL DATA ACQUISITION PLAN

CHEMICAL DATA ACQUISITION PLAN (CDAP)

BIOPLANT EQUALIZATION BASIN CLOSURE

SITE INVESTIGATION/EVALUATION

RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Prepared for:

Norfolk District, U.S. Army Corps of Engineers
Engineering Division
HTRW Branch

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Contract No. DACA65-95-D-0030
U.S. Army Corps of Engineers
Norfolk District

September 1996

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PURPOSE OF DOCUMENT

This Chemical Data Acquisition Plan (CDAP) is for use by field and laboratory personnel during the Bioplant Equalization Basin Closure Site Investigation/Evaluation at Radford Army Ammunition Plant (RAAP). The CDAP details the procedures for sample collection, sample analysis, and quality control measures. Conformance with the plan by field and laboratory personnel will ensure a quality and thorough site investigation.

The success of the closure at RAAP depends upon the field and laboratory personnel closely following guidance provided in the CDAP. Every effort will be made to ensure adherence to the procedures provided in the CDAP.

Radford Army Ammunition Plant Chemical Data Acquisition Plan Approval

This Chemical Data Acquisition Plan was developed for the Bioplant Equalization Basin Site Closure at Radford Army Ammunition Plant, Radford, Virginia. The signatures of key project personnel below indicate concurrence with the procedures specified in the plan and a commitment to communicate the plan and the philosophy of quality to all project personnel.

Torsten Rothman, Contract Manager

Signature: ______ Date: 16 Sept '96

William Hearn, Project Manager

Signature: William Hearn Date: 9-16-96

Steve Falatko, Project QA Coordinator

Signature: Steve Falatko Date: 9/16/96

This plan is approved for use in the Radford Army Ammunition Plant, Bioplant Equalization Basin Site Closure.

Steve Lantz, USACE Project Manager

Signature: Steve M. Lantz Date: 9/13/96

Marc Gutterman, USACE Project Chemist COPY FURNISHED TO MARC - NO COMMENTS

Signature: ______ Date: ______

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1.0 PROJECT DESCRIPTION

This section provides a brief project description, an overview of project objectives, the environmental setting and a site description.

1.1 Background

This Chemical Data Acquisition Plan (CDAP) outlines a site investigation/evaluation for the proposed closure of the Bioplant Equalization (EQ) Basin at Radford Army Ammunition Plant (RAAP), Radford, Virginia. A closure plan has been approved by the Virginia Department of Environmental Quality (VaDEQ). The plan is entitled "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 and SWMU-10" dated 12 December 1995. The basin was originally part of the wastewater treatment system at RAAP, but has been taken out of service.

The EQ Basin received wastewater from various manufacturing processes at the facility. The EQ Basin is constructed of an approximate 12-inch thick bentonite liner overlying compacted soil made up of sand, silt, and clay. This CDAP provides for a site investigation to determine if the subsoil under the liner contains concentrations of the chemicals of concern in excess of background concentrations of those chemicals. The closure plan identifies 70 Hazardous Constituents of Concern (HCOC).

Under contract to the U.S. Army Corps of Engineers, Norfolk District, Radian will perform a site investigation to characterize shallow subsurface soils for the presence of organics, metals, and cyanide. Radian also will characterize the materials comprising the basin liner and the basin's concrete wall for waste disposal purposes. The investigation will be completed according to Delivery Order #10, Contract DACA65-95-D-0030. This document is prepared according to the USACE requirements outlined in

Chemical Data Quality Management for Hazardous Waste Remedial Activities, ER 1110-1-263, 1 October 1990, and in *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, 1 September 1994.

1.2 Objective

The objective of this site investigation/evaluation is to determine if HCOCs have impacted the subsoil below the basin liner in concentrations greater than found in background soil samples in the area of the basin and to determine the proper disposal procedure for the liner and concrete wall. This information will provide input to the type of closure required for the EQ Basin.

1.3 Environmental Setting

This subsection describes the environmental setting of the Radford Army Ammunition Plant (RAAP), Radford, Virginia. Included in the subsection are discussions of the site topography, geology, hydrogeology, and surface water features based on data compiled from existing RAAP records.

1.3.1 Topography

The site is located in the Valley and Ridge Physiographic province of southwestern Virginia. Within the RAAP, the EQ Basin site is located along the upper flood plain of the New River, which makes a horseshoe meander through the plant property. The ground surface elevation of the site generally slopes northward with a relief of 1,707 feet mean sea level (ft MSL) to 1,684 ft MSL at the New River (Norfolk COE, 1977).

1.3.2 Geology

According to Norfolk COE (1977), the site lies on the Pulaski thrust sheet approximately 1 mile from the fault zone. The site is underlain by the Cambrian-age Elbrook formation, which consists of light to dark grey argillaceous limestone. Much of the Elbrook formation beneath the site has been brecciated by mass movement along the fault plain, but has been recommended with a fine-grained limy matrix. Bedrock was encountered in test borings, installed before the EQ basin was constructed, at depths between 16 and 20 feet, and was found to be sloping northward.

The unconsolidated material above the bedrock consists an average of 18 feet of alluvium comprised of two distinct layers. The shallower alluvial layer is composed of brown to orange micaceous silts and very fine to fine-grained sands with traces of quartz gravel and cobbles. The shallower alluvial layer ranges from 10 to 15 feet thick. The deeper alluvial layer is composed of fine to coarse-grained sand and quartz gravel and cobbles. The deeper alluvial layer ranges from 2 to 6 feet thick.

Discontinuous layers of residual soils, typically less than 2-feet thick, are encountered in places between the alluvium and top of bedrock. The residual soils are composed of gravel-size bedrock fragments within a silt matrix.

Fill material was encountered in two test borings previously installed through an earthen dike around an abandoned lagoon. The fill material was composed of fine sand and silt.

1.3.3 Hydrogeology

According to Norfolk COE (1977), the average depth to groundwater, encountered at the time the test borings were drilled, was 15 feet. The water table is

present within the deeper alluvial layer. It is anticipated that groundwater flows northward to the New River.

1.3.4 Surface Water

According to Norfolk COE (1977), surface water drainage at the EQ basin site is northward, towards the New River.

1.4 Site Description

The EQ Basin served as a surge/settling basin for the biological wastewater treatment at RAAP. The basin was operated from 1980 until 1994. The following types of wastewater flowed into the basin:

- Non-acidic wastewater from propellant manufacturing;
- Wastewater from nitroglycerine manufacturing and alcohol rectification; and
- Wastewater from ethyl ether recovery.

Solids (sludge) that settled out over the operating life of the basin were removed in November 1995. The sludge was managed as a hazardous waste, K044.

The equalization basin was constructed over an abandoned nitrocellulose settling basin. All sludge was removed and fill material was placed and compacted. A 12-inch thick bentonite bottom was added onto the compacted fill. For flood protection, a concrete wall was constructed on top of the dike in 1987. The basin is located on the south bank of the New River.

2.0 CHEMICAL DATA QUALITY OBJECTIVES

The primary objective of this CDAP is to ensure that data is of the quality necessary to characterize shallow subsurface soils for the presence or absence of organics, metals, and cyanide, and to determine whether any additional investigation/ remediation work is necessary. Data quality objectives (DQOs) include statements of the acceptable levels of measurement uncertainty in chemical data. Measurement objectives are established in terms of precision and accuracy, completeness, representativeness, and comparability.

The overall project quality objectives are to:

- Collect representative samples specified in Section 4 in an effort to determine the presence or absence of organics, metals, or cyanide at the site;
- Ensure data comparability through the use of standard methods and controlled systems to collect and analyze samples; and
- Provide analytical results of known and acceptable precision and accuracy.

The overall uncertainty in chemical data is a function of sampling design, field procedures, and analytical procedures; therefore, attention to quality is required in all of these aspects of the data gathering effort.

Procedures and methods performed in the laboratories will be documented in the form of standard operating procedures (SOPs) which meet or exceed the requirements specified in the analytical methods. This includes the routine analysis of quality control samples which are described in more detail in Section 6.0. Sampling procedures are described in detail in Section 4.0.

2.1 Precision and Accuracy

Precision is a measure of the reproducibility or agreement among repeated measurements. Precision is typically evaluated by calculating the relative percent difference (RPD) between the results from one or more types of "duplicate" analyses. The formula for calculating RPD is:

$$RPD = \frac{(S - D)}{1/2(S + D)} \times 100$$

where: S = first sample result
D = duplicate sample result

The overall precision of the entire sample collection, handling, preparation, and analysis process will be evaluated through the analyses of field duplicates. For field duplicates, an RPD of ≤50% is the goal of this program. The precision of the laboratory operations will be evaluated through the analyses of duplicate laboratory control samples. Laboratory precision requirements are detailed in Section 6.0.

The evaluation of precision is often combined with an evaluation of accuracy through the use of spiked sample aliquots, or matrix spike/matrix spike duplicate (MS/MSD) pairs. A known amount of the compound of interest is added to each of two aliquots of the field sample prepared in the laboratory. The spiked samples are then treated to the same handling, extraction, cleanup, and analysis steps as the field samples. The RPD for the spiked samples is calculated and used to evaluate the effects of the matrix on precision and accuracy.

Accuracy is a measure of the agreement between a measured value and a reference or "true" value. Because the "true" concentration of an analyte in a field sample is never known, accuracy in field samples is evaluated through the use of spiked

sample pairs (MS/MSD). As noted above, a known amount of the compound of interest is added to each of two aliquots of the field sample prepared in the laboratory. The spiked samples are then treated to the same handling, extraction, cleanup, and analysis steps as the field samples. The accuracy is expressed as percent recovery (%R). The formula for calculating %R is:

$$\%R = \frac{(SSR - SR)}{SA} \times 100$$

where:
SSR = spiked sample result
SR = sample result
SA = spike added

The objective of this investigation is to achieve method-specified acceptance criteria for precision and accuracy which are presented and discussed in Section 6.0. These limits are based primarily on method validation studies as typically measured in matrices developed from laboratory reagent blanks. Recoveries in actual environmental samples may be less than the method-specified requirements because of matrix interferences. Matrix interferences cannot be controlled but will be evaluated and described in the final report.

2.2 Completeness

Completeness is expressed as the percentage of the amount of valid data (i.e., data which meets the measurement objectives) obtained compared to the amount of data planned. The objective of this project is 90% completeness. Conditions which prevent reaching this objective, such as significant sample matrix difficulties, or sample loss will be evaluated and addressed in the final report.

2.3 Representativeness

The purpose of sampling is to obtain data that represent the system being studied. Representativeness is achieved by carefully selecting sampling sites, sample locations, and sampling intervals; and controlling procedures for sample collection, preservation and handling. Detailed sampling procedures are described in Section 4.0.

2.4 Comparability

Comparability is a qualitative measure of the confidence with which data sets can be compared. Data comparability will be achieved by following approved, standard analytical procedures and by reporting results in standard units of measure, as required in the specific methods.

2.5 Quality Control Samples

The following sections describe quality control samples which will be prepared during both field and laboratory activities.

2.5.1 Field Quality Control Samples

The following samples will be used to assess the quality control of field operations. The frequency for field QC sample collection is discussed in Section 6.0.

- **Trip Blanks**--Trip blanks are samples of organic-free water (HPLC-grade water) which have been transported unopened from the sample bottle preparation area to the sampling site and finally to the laboratory, and will be analyzed for volatile organics. Trip blanks identify the potential for sample contamination from sample bottles and transportation.

- **Field Blanks**--Field blanks are samples of organic-free water (HPLC-grade water) which are poured directly into the sample containers in the vicinity of the sampling locations, and will be analyzed for volatile organics. Field blanks identify the potential for sample contamination from the ambient air.

- **Equipment Rinsate Blanks**--Equipment rinsate blanks are samples of organic-free water (HPLC water) which are poured over the sampling equipment after decontamination. They are designed to identify the potential for cross-contamination of samples from improperly decontaminated equipment.

- **Duplicate Field Samples**--Duplicate field samples are used as indicators of overall measurement data precision. The analysis of duplicate samples involves collecting two samples from the same sampling location and handling them as separate samples. Precision estimates based on duplicate sample results incorporate both sampling and analytical variability.

- **QA Duplicate Samples**--The QA samples are duplicate samples which will be sent to EA Laboratories, as specified by the Norfolk COE. The QA field duplicates will be assigned the same sample number as the initial sample so results may be easily correlated and used as an independent assessment of combined sampling and analytical variability.

2.5.2 Laboratory Quality Control Samples

The following QC samples will be used to control and assess data quality in the laboratory.

- **System Blank**--Deionized water will be analyzed after calibration to assess system contamination.

- **Method Blank**--Reagent water will be taken through the extraction process as though it were an actual sample.

- **Calibration Check Sample**--A standard will be used to verify instrument calibration.

- **Laboratory Control Sample (LCS)**--Known concentration of alternate-source reference materials will be spiked into an aliquot of deionized water. This sample is taken through the digestion/ extraction process as though it were an actual sample. The purpose of an LCS analysis is to verify that the analytical system remains in control.

- **Matrix Spike/Matrix Spike Duplicates (MS/MSD)**--Splits from field samples will be spiked with known concentrations of reference materials and taken through the entire extraction and analysis process. The matrix spike allows the laboratory to assess the efficiency of extraction, accuracy of the analysis, and possible matrix effects. Analysis of a duplicate matrix spike, another aliquot of the sample spiked at the same concentration as the MS, allows the laboratory to assess precision at known concentrations.

- **Surrogate Spikes**--Identifiable compounds not present in the sample matrix are added to every field sample to evaluate method accuracy.

3.0 PROJECT ORGANIZATION AND FUNCTIONAL AREA RESPONSIBILITIES

The project team for the RAAP Equalization Basin Site Closure will be composed of a contract manager, a project manager, a quality assurance coordinator (QAC), laboratory coordinator, and a field task leader. Roles and responsibilities of key personnel are discussed below.

3.1 Roles and Responsibilities

Mr. Torsten Rothman will serve as the Contract Manager. In this role Mr. Rothman will have the overall responsibility, authority, and accountability for the project. He will function as the primary interface between the USACE and the project team. In executing these duties, he will:

- Ensure that all contractual requirements are met;
- Initiate work plans in accordance with client directions;
- Keep the USACE project manager informed on all aspects of the program;
- Be available to the Project Manager for action on any problem requiring additional management or technical support; and
- Review technical project outputs prior to issue.

Mr. William Hearn will serve as the Project Manager. In this capacity, he will be responsible for organizing and directing the technical activities of the project and for reporting the results of these activities. He will have day-to-day interaction with the technical staff. In the execution of these duties, Mr. Hearn will:

- Establish technical objectives and direct the preparation and review of work plans;
- Be responsible for responding to work plan revisions;
- Advise the contract manager of technical progress, expenditures, program needs, potential problems, and recommended solutions;
- Ensure technical quality of reports, memoranda, and other communications through review of results; and
- Maintain contact with the USACE project manager in areas that require decisions on technical matters.

Mr. Steve Falatko will serve as the QAC. In this role, he will be responsible for developing and executing quality assurance (QA) activities in all phases of the project. In fulfilling these responsibilities, he will:

- Coordinate any external QA audit activities requested by the USACE;
- Serve as an in-house consultant to the project manager and task leaders in defining data quality goals or requirements;
- Implement any necessary corrective action; and
- Document the results of all QA/QC activities in reports to project management and to clients.

Mr. Todd Church will serve as task leader for the field investigation. His responsibilities include field preparation, supervision of field activities, and preparation of the final report. The general responsibilities of the task leader are as follows:

- Supervise the subcontractor activities;
- Maintain close contact with the project manager so that schedule, budget, and/or technical problems are addressed in a timely manner;

- Coordinate day-to-day QC activities and completion of daily quality control reports (DQCRs), as required as part of the internal QC system;
- Serve as site safety officer during the field investigation and ensure compliance with the SSHP;
- Ensure compliance with all QC acceptance criteria as specified in the CDAD; and
- Keep the QAC and project director advised of any quality problems that arise.

Mr. Church will also supervise the project field staff, and will be responsible for all on-site activities, including any necessary coring activities, sample collection, field analysis, chain of custody, and reporting.

The laboratory client services representative will also be Mr. Steve Falatko. He will have ultimate responsibility for ensuring that all analyses performed at the laboratories adhere to the methods and criteria specified in Section 6.0 of this CDAP.

3.2 Laboratory Qualifications

The RAAP subsurface and background samples will be analyzed by Quanterra Incorporated in West Sacramento, California, and Savannah Laboratories in Tallahassee, Florida, depending on the specified method. Radian's laboratory in Austin, Texas, will perform the liner and concrete sample analyses. All of the laboratories have been certified by the USACE Missouri River Division.

3.3 Subcontractor Qualifications

A Virginia licensed drilling company will be subcontracted to provide all drilling and subsurface sampling for the project. At the time this CDAP was prepared,

the drilling subcontractor was not selected. This plan will be updated at the time the drilling subcontractor is selected.

4.0 FIELD ACTIVITIES

A field sampling program will be conducted at the EQ Basin site at the RAAP in support of the closure plan for the EQ Basin. This plan was part of the document entitled, "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 & SWMU-10, Radford, Virginia", dated December 12, 1995. The field activities include chip sampling of the concrete flood control wall installed around the EQ Basin, sampling of the soil cement liner which served as the floor of the EQ Basin, sampling of the subsoil beneath the soil cement liner, and sampling of background soil similar to the subsoil below the soil cement liner. Chemical analytical data will be used to determine the appropriate procedures for the EQ Basin closure and the disposal options of the wastes generated during closure activities. The required equipment, field procedures, field documentation, and site-specific investigation strategies are discussed in detail in this section.

4.1 List of Equipment, Containers, and Supplies

Table 4-1 summarizes the specific equipment, containers, and supplies required for the collection of the field samples.

4.2 Sampling Locations

The RAAP EQ Basin Closure Plan specifies the number and location of the sample of the concrete flood wall, the soil cement liner and associated subsoil, and the background soil.

Table 4-1

List of Supplies

Sampling Equipment and Supplies:

- Sampling Containers
- Stainless Steel Hand Augers
- Split Spoon Samplers
- Boring Log Forms
- Daily Quality Control Report Sheets
- Camera and Film
- One-gallon Plastic Storage Bags
- Marking Pens
- Hammers and Chisels
- Portable Concrete Corer
- Traffic Cones
- Coolers with Ice
- Stainless Steel Bowls
- Measuring Tape
- Chain of Custody Forms and Seals
- Shipping Airbills
- Field Notebook
- Sample Labels
- Drum Labels
- Trash Bags
- Plastic Sheeting
- Bentonite Pellets

Decontamination Equipment and Supplies:

- Phosphate Free Detergent
- Scrub Brushes
- Steam Cleaner
- Plastic Squirt Bottles
- Trash Bags
- Potable Water
- Distilled/Deionized Water
- Organic-Free Water
- Plastic Wash Tub
- Paper Towels
- Plastic Sheeting
- Five-gallon Buckets
- Aluminum Foil

Safety Equipment:

As specified in Radian's Site-Specific Safety and Health Plan (SSHP). The SSHP will be approved by the Norfolk District Industrial Hygienist prior to beginning any work on site.

4.2.1 Concrete Flood Wall Samples

Chip samples of the concrete flood wall around the EQ Basin will be collected from four representative locations and analyzed for hazardous waste characteristics. The exact locations of these chip samples will be finalized in the field by the supervising geologist in consultation with RAAP personnel. These chip samples will be collected by hand using hammers and chisels. These samples will be analyzed for the toxicity characteristic analytes following the TCLP extraction.

4.2.2 Soil Cement Liner

One composite sample of the 1-foot thick soil cement liner will be collected from the EQ Basin and analyzed for hazardous waste characteristics. Cores of the liner will be collected from seven randomly-selected nodes out of the 15 total nodes shown on Figure 4-1. The final locations of the liner samples may be adjusted in the field in order to collect samples at locations where cracks in the liner may have allowed leakage of wastewater to the subsoils. The liner will be cored using a diamond bit core barrel. Samples will be chipped off each of the seven cores with hammers and chisels, and then composited to make a single composite chip sample. This sample will be analyzed for the toxicity characteristic analytes following the TCLP extraction.

4.2.3 Subsoil

Seven samples of the subsoil below the soil cement liner will be collected from the same locations used to obtain liner samples. Subsoil samples will be collected at a depth of 0-6 inches below the bottom of the liner with a stainless steel hand auger and stainless steel trowels. These soil samples will be analyzed for the HCOCs.

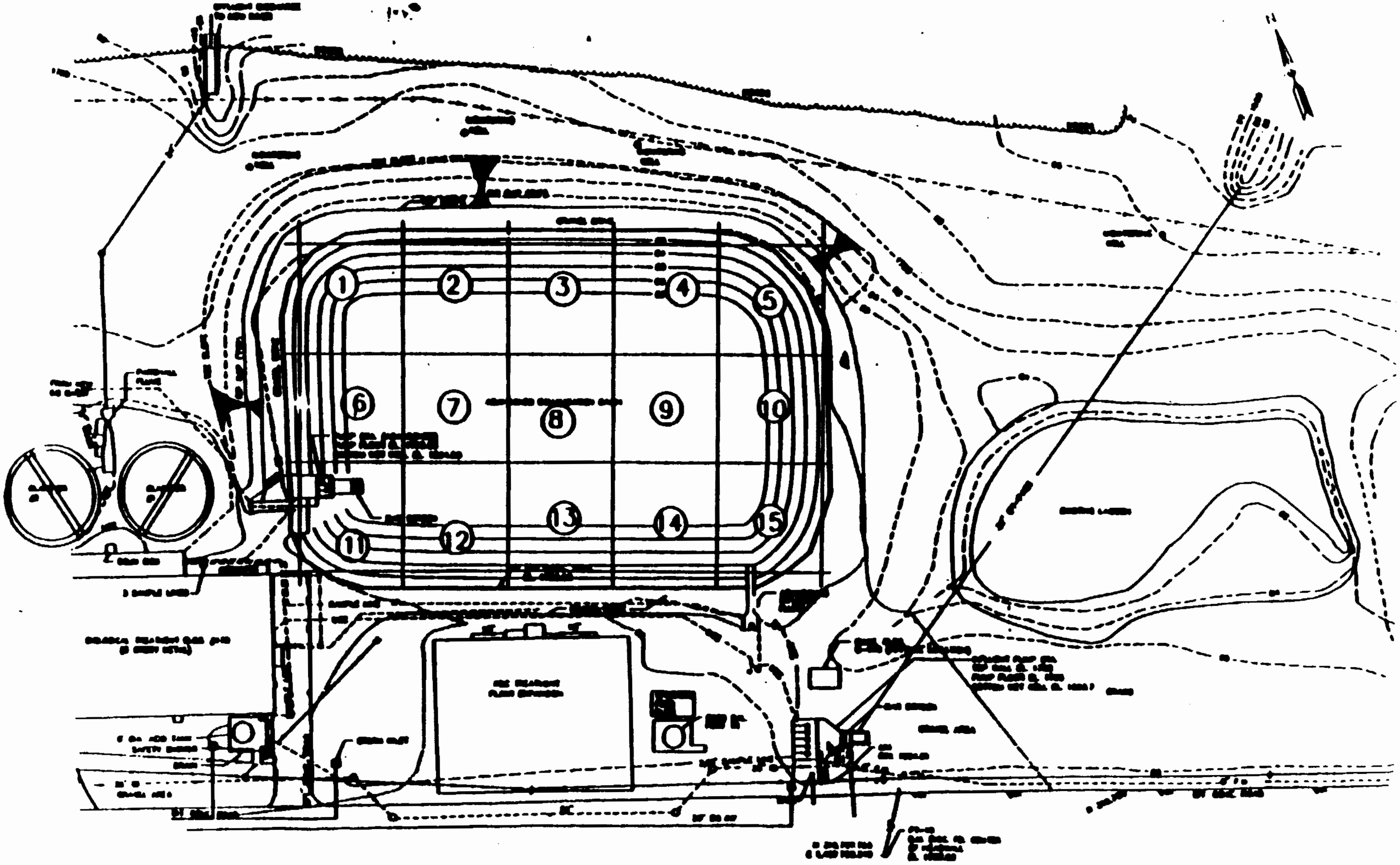


Figure 4-1. Proposed Sampling Locations

4.2.4 Background Soil

Eight soil borings will be drilled at locations upgradient of the EQ Basin in order to obtain soil samples for characterization of background chemical concentrations. These borings will be located in areas that are reasonably expected to be uncontaminated by industrial activities, and will be finalized in the field by the supervising geologist in consultation with RAAP personnel. One sample of background soil will be collected and analyzed per boring, for a total of eight background soil samples. The borings will be drilled with a hollow-stem auger drill rig using a minimum 2-inch diameter, standard split spoon to collect the soil samples. The background soil samples will be collected in soil that is lithologically similar to the subsoil below the liner. These samples will be analyzed for HCOCs.

4.3 General Information and Definitions

4.3.1 Laboratory Information

Laboratory analyses will be conducted by Quanterra Incorporated in Sacramento, California, Savannah Laboratories in Tallahassee, Florida, and by Radian's laboratory in Austin, Texas. EA Laboratories will serve as the COE-designated QA laboratory.

4.3.2 Decontamination Procedures for Drilling and Sampling Equipment

All hand-held sampling tools that will come in contact with samples will be decontaminated by the following:

1. Wash in a phosphate-free detergent and potable water solution;
2. Rinse with potable water;
3. Rinse with distilled water;

4. Final rinse with organic-free water; and
5. Air dry.

Large pieces of equipment, such as the drilling rig and hollow-stem augers, will be decontaminated by steam cleaning with potable water. Decontamination of this equipment will take place on a temporary decontamination pad.

Decontamination procedures will take place at the start of field work and between each sample collection. The subcontractor will supply several split spoon samplers so that a stock of decontaminated split spoons will be available during the background soil sampling effort. Wash and rinse water generated during decontamination activities will be handled in accordance with the procedures outlined in Section 4.3.3 of this plan.

4.3.3 Disposal of Drill Cuttings and Decontamination Water

Drill cuttings will be generated during the background soil sampling effort. Drill cuttings will be containerized in DOT-approved 55-gallon drums. Each drum will be labelled showing its content, origin, and date of generation. The drum contents will be sampled for waste characterization, and disposal options will be coordinated with RAAP personnel following receipt of the analytical results.

Following completion of the subsoil sampling effort, any volume of soil remaining will be placed back into the coreholes.

Following completion of the liner coring and sampling effort, the remaining volume of the liner cores will be temporarily stored in a plastic-lined 55-gallon drum. These cores will be held so that they can be included in the final closure procedures along with the rest of the liner. This drum will also be labelled showing its content and dates of generation.

All decontamination water will be containerized in DOT-approved 55-gallon drums. Each drum will be labelled showing its content, origin, and date of generation. The drum contents will be sampled for waste characterization, and disposal options will be coordinated with RAAP personnel following receipt of the analytical results.

4.3.4 Site Restoration

The EQ Basin will be restored to its original condition following completion of the sampling activities. Coreholes through the liner will be backfilled with hydrated bentonite to seal the holes and prevent any rainwater that may collect in the basin from draining to the subsoil. The background soil borings will be backfilled upon completion with a Portland cement and bentonite grout. The restoration efforts must meet the approval of RAAP personnel.

4.3.5 Utility Clearance

RAAP personnel will conduct site utility clearance investigations following agreement on the location of proposed background soil borings. Utility clearances will be obtained prior to initiating site activities.

4.4 Sampling and Analysis Procedures

A total of 15 soil samples (7 from the subsoil below the liner and 8 from background soil borings) and a total of 5 chip samples (4 from the concrete flood wall and 1 composite from the soil cement liner) will be collected during sampling activities at the site. This section describes the sampling methodologies including sampling and QA/QC procedures; analysis; and sample containers, preservation, and holding times.

4.4.1 Soil Sample Collection

Soil samples, including QA/QC samples, will be collected for laboratory analysis from 15 locations at the site. Seven of the samples are from the basin liner subsoil, and eight are from background soil borings located upgradient of the basin.

Samples of basin liner subsoil will be collected from a depth of 0 to 6 inches below the bottom of the liner with a stainless steel hand auger. Samples will be collected by advancing the hand auger to the 6-inch depth, removing it from the hole, and then initially filling the sample containers for volatile organic analysis directly from the auger bucket. After the volatile organics containers are filled, the remainder of the sample volume will be mixed in a stainless steel bowl before filling the remainder of the sample containers for the other analyses. Basin liner subsoil will be lithologically described by a Radian geologist.

Samples of background soil will be collected from soil borings by the drilling subcontractor using 2-inch or 3-inch diameter, standard split spoons. Background samples will be collected by retrieving the split spoon from the borehole and initially filling the sample containers for volatile organic analysis directly from the opened split spoon. After the volatile organics containers are filled, the remainder of the sample volume will be mixed in a stainless steel bowl before filling the remainder of the sample containers for the other analyses.

Each background soil boring will be continuously sampled and lithologically described in order to determine the depth at which the background soil, lithologically similar to the basin liner subsoil, is first encountered. The background soil borings will be drilled using a maximum 4.25-inch inside diameter hollow-stem auger. All lithologic descriptions will be made by the Radian geologist while on site and recorded on a geologic log, an example of which is shown in Figure 4-2. All soil samples

Figure 4-2 Geologic Log

Radian International, LLC
Herndon, Virginia

LOG OF BORING _____

Page 1 of

DEPTH (ft)	USCS Code	Recovery (%)	Blows/6"	PID (ppm)	Sample Interval	Sample No.	DEPTH (ft)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION
5							5			
10							10			
15							15			
20							20			

PROJECT ____________________
LOCATION ____________________
JOB NUMBER ____________________
GEOLOGIST ____________________
DRILL RIG ____________________

DRILLING COMPANY ____________________
DATE DRILLED ____________________
SURFACE ELEVATION ____________________
TOTAL DEPTH OF HOLE ____________________
WATER LEVEL ____________________

will be visually classified according to the Unified Soil Classification System (ASTM-D-2488). Completed logs will be included in the final report.

Soil samples will also be screened in the field for the presence of total organic vapors by allowing a portion of each sample to volatilize in a sealed plastic bag for a minimum of 15 minutes in a warm location. The probe of an HNu photoionization detector (PID) will be inserted into the bag to measure the organic vapor concentration. These measurements will be recorded on the geologic logs.

Immediately after filling, all soil sample containers will be affixed with sample labels showing field sample number and other required information (see Section 4.7) and cooled to approximately 4°C by placing them in a durable cooler containing regular ice.

4.4.2 Basin Liner/Flood Wall Chip Sample Collection

A total of five chip samples for the purpose of hazardous waste characterization will be collected from 11 locations at the site. One sample will be a composite from seven cores of the soil cement basin liner. The remaining four chip samples are from the concrete flood wall located around the basin.

Samples of the soil cement basin liner will be collected by initially coring the liner in seven locations with a portable concrete coring machine using a minimum 6-inch diameter diamond tip core barrel. After the core barrel penetrates the 1-foot thickness of the liner, the resulting liner core will be removed and placed on plastic sheeting. After all the cores are collected, the sides of each liner core will be chipped with a hammer and chisel along the entire height of the core. The chips from each core will be mixed to create one composite sample.

Four chip samples of the concrete flood wall will be collected from four locations with a hammer and chisel. The concrete chips will be collected on plastic sheeting at the bottom of the wall at each sample location until sufficient sample volume is collected.

Immediately after filling, all chip sample containers will be affixed with sample labels showing field sample number and other required information (see Section 4.7) and cooled to approximately 4°C by placing them in a durable cooler containing regular ice.

Use of the portable coring machine will require an electrical source to power the machine, and a water source to supply water to cool the barrel during coring. The water will be collected at each coring location with a "wet-dry" vacuum and then placed into 55-gallon drums, which will be handled in the same manner outlined in Section 4.3.3.

4.4.3 Analyses

Table 4-2 presents a summary of the analyses to be performed on all soil samples and the chip samples from the basin liner and concrete flood wall. Sample preparation and chemical analysis will be performed according to procedures published in *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846* (EPA, Third Edition, November 1986 and its Updates, September 1994).

4.4.4 Sample Containers, Preservation, and Holding Times

The sample containers, preservation, and holding times are summarized in Table 4-3. All containers used for chemical analyses will be precleaned by the container supplier, in accordance with EPA protocol.

Table 4-2

Sampling and Analysis Summary

Method	Parameters	Primary Sample Location Subsurface/ Background	Field Duplicate Subsurface/ Background	MS/MSD Subsurface/ Background	Equipment Rinsate Blanks[a]	Trip Blank/Field Blank	Total A-E Samples	External QA Dups[b]
Methods 8021 and 8240B	Volatile Organics	7/8	1/0	1/1	1/1	2/2	26	2
Methods 8070, 8090, 8110, 8121, 8151, 8270B, 8310, and 8330	Semivolatile Organics	7/8	1/0	1/1	1/1	0/0	22	2
Method 8080A	Pesticides/PCBs	7/8	1/0	1/1	1/1	0/0	22	2
Methods 6020 and 7471	Metals	7/8	1/0	1/1	1/1	0/0	22	2
Method 9012	Cyanide	7/8	1/0	1/1	1/1	0/0	22	2
Method 1311	Full TCLP Suite	5	0	0	0	0	5	2

[a] Equipment rinsate blanks include one aqueous sample generated from the soil sampling equipment rinsate from the auger used for the subsurface sampling; and one sample generated from the split spoon used for the background sampling equipment rinsate.

[b] QA field duplicate samples submitted to EA Laboratories for analysis, including trip blanks for volatile organics.

Table 4-3

Sample Containers, Preservation, Holding Times, and Laboratory

Reference Method	Container No., Volume, and Type	Preservation and Storage Requirements	Maximum Holding Time (Preparation)/Analysis	Laboratory Performing Analysis
Soil Samples				
8021A	(2) 120-mL glass, Teflon-lined cap	4°C	N/A	Savannah
8240B	(2) 120-mL glass, Teflon-lined cap	4°C	N/A	Savannah
8070	(2) 500 mL glass, wide mouth jar	4°C	7 days/40 days	Savannah
8090				
8110				
8121				
8151				
8270B				
8310				
8330				
8080A				
6020	(1) 500 mL glass, wide mouth jar	4°C	180 days	Quanterra
7471			28 days	Quanterra
9012			N/A	Quanterra
Concrete Samples				
TCLP (1311)	(1) 125 mL glass jar and (1) 500 mL glass, wide mouth jar	4°C	7 days	Radian

4.5 Quality Assurance/Quality Control Samples

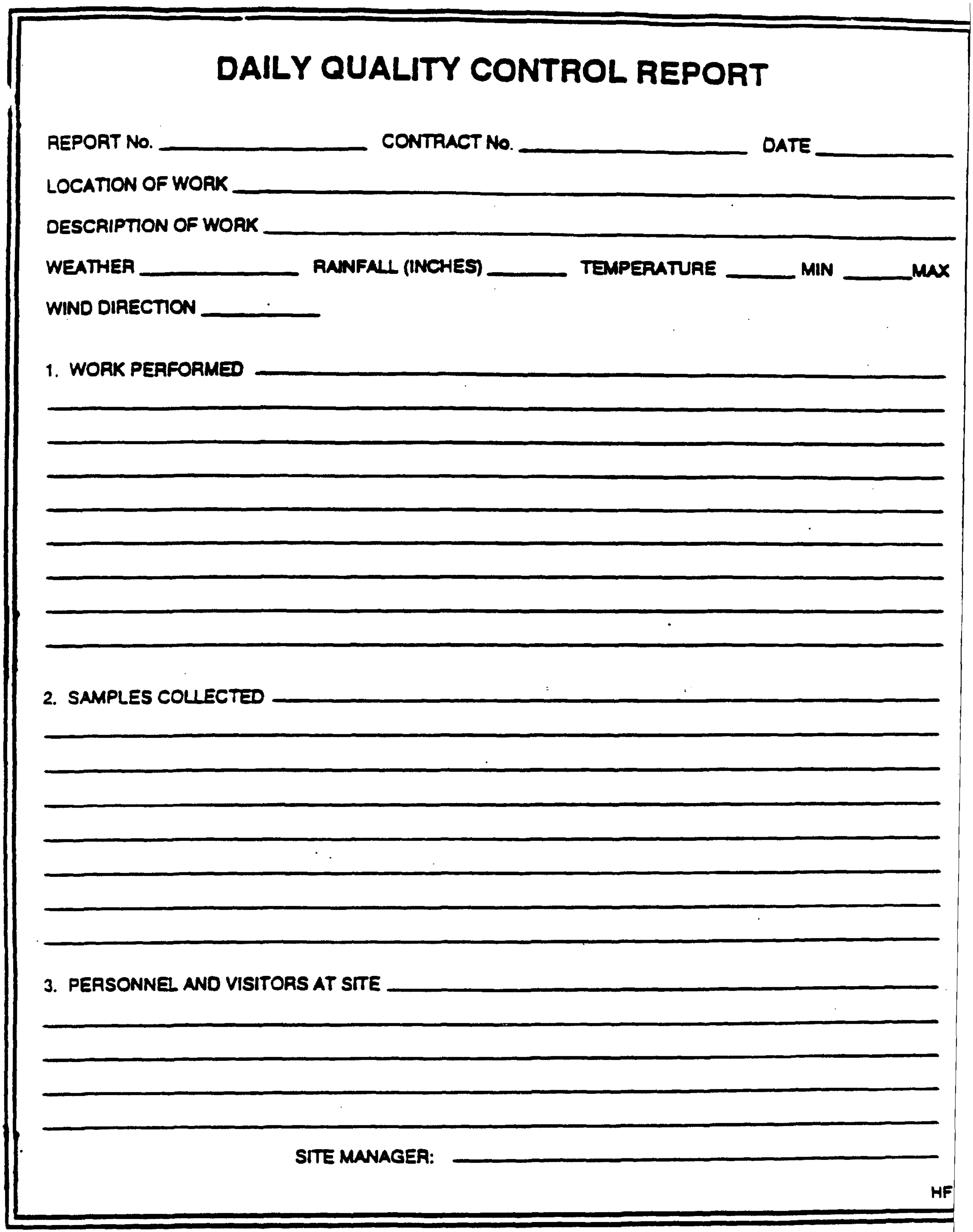
A field QA/QC program will be used to ensure that data quality objectives are met. Sample collection errors will be controlled through the use of standard sample collection methods and field log books. Environmental matrix effects will be estimated by evaluating standard QA/QC samples such as matrix spikes and field duplicates. The following field QA/QC samples will be collected:

- Trip Blanks. One trip blank will accompany each cooler containing volatile organic sample containers, and analyzed only for volatile organics;
- Duplicate Sample. One duplicate soil sample will be collected during this subsurface investigation;
- QA Split Sample. One QA split soil sample will be collected and shipped to the government's QA laboratory;
- Matrix Spike and Matrix Spike Duplicate (MS/MSD). One MS/MSD pair will be collected from both the subsurface investigation and from the background sampling;
- Equipment Rinse Blank. One equipment rinse blank will be collected from the soil sampling equipment; and
- Field Blank. One field blank consisting of organic-free water will be collected from both the subsurface investigation and from the background sampling and analyzed only for volatile organics.

4.6 Field Documentation

A field log book and daily quality control report (DQCR) will be maintained by the supervising Radian geologist. A copy of a DQCR sheet is presented in Figure 4-3. All observations made during field activities will be recorded in indelible ink as necessary to maintain a thorough record of all field activities. The field log book is a bound book with sequentially numbered pages and a unique document control

Figure 4-3. AE Daily QC Report



DAILY QUALITY CONTROL REPORT

REPORT No. ____________ CONTRACT No. ____________ DATE ____________

LOCATION OF WORK ____

DESCRIPTION OF WORK ____

WEATHER ____________ RAINFALL (INCHES) ________ TEMPERATURE ________ MIN ________ MAX

WIND DIRECTION ____________

1. WORK PERFORMED ____

2. SAMPLES COLLECTED ____

3. PERSONNEL AND VISITORS AT SITE ____

SITE MANAGER: ____

HF

number. All corrections will be crossed out with a single line. The Radian field geologist will sign and date the logbook and DQCR sheets at the end of each work day. Radian will submit the DQCRs to the USACE project manager at the conclusion of the field program.

4.7 Sample Chain of Custody, Packing, and Transportation

A sample label and custody seal, shown in Figure 4-4, will be affixed to all sampling containers submitted for laboratory analysis. The labels will document the sample type, matrix, initials of the sampler(s), sampling locations, depth, time, date, and unique number assigned to each sample. Indelible ink will be used to complete all sample labels.

A chain-of-custody record, shown in Figure 4-5, will be used to record the number of samples collected and the corresponding laboratory analyses; indelible ink will be used. Information on this form includes time and date of sample collection, sample number, type of sample, sampler's name, preservatives used, and any special instructions. Samples collected for matrix spike/matrix spike duplicate analysis will be identified on the chain-of-custody form. A copy of the chain-of-custody form will be retained by the field geologist along with other field documentation.

All samples will be kept on ice in a double plastic bag following collection and during shipment. The samples will also be sealed in plastic bags. The samples will be stored upright in a durable ice chest. Sufficient packing material (i.e., vermiculite) will be used to separate the bottles, filling any intervening voids.

The ice will be placed above and around the top of the sample containers. The remaining space will be filled with additional packing material. The chain-of-custody form will be sealed in a plastic Ziploc® bag and affixed to the top lid of the cooler. The cooler will be secured by completely wrapping it with strapping tape around

Figure 4-4. Sample Label and Custody Seal

Field Number ____________________

Sample Type: ____________________

Client: ____________________

Location: ____________________

Preservative: ____________________

Sampler: ____________________

Date: ____________________

Comment: ____________________

6-89-31426

6-89-31426

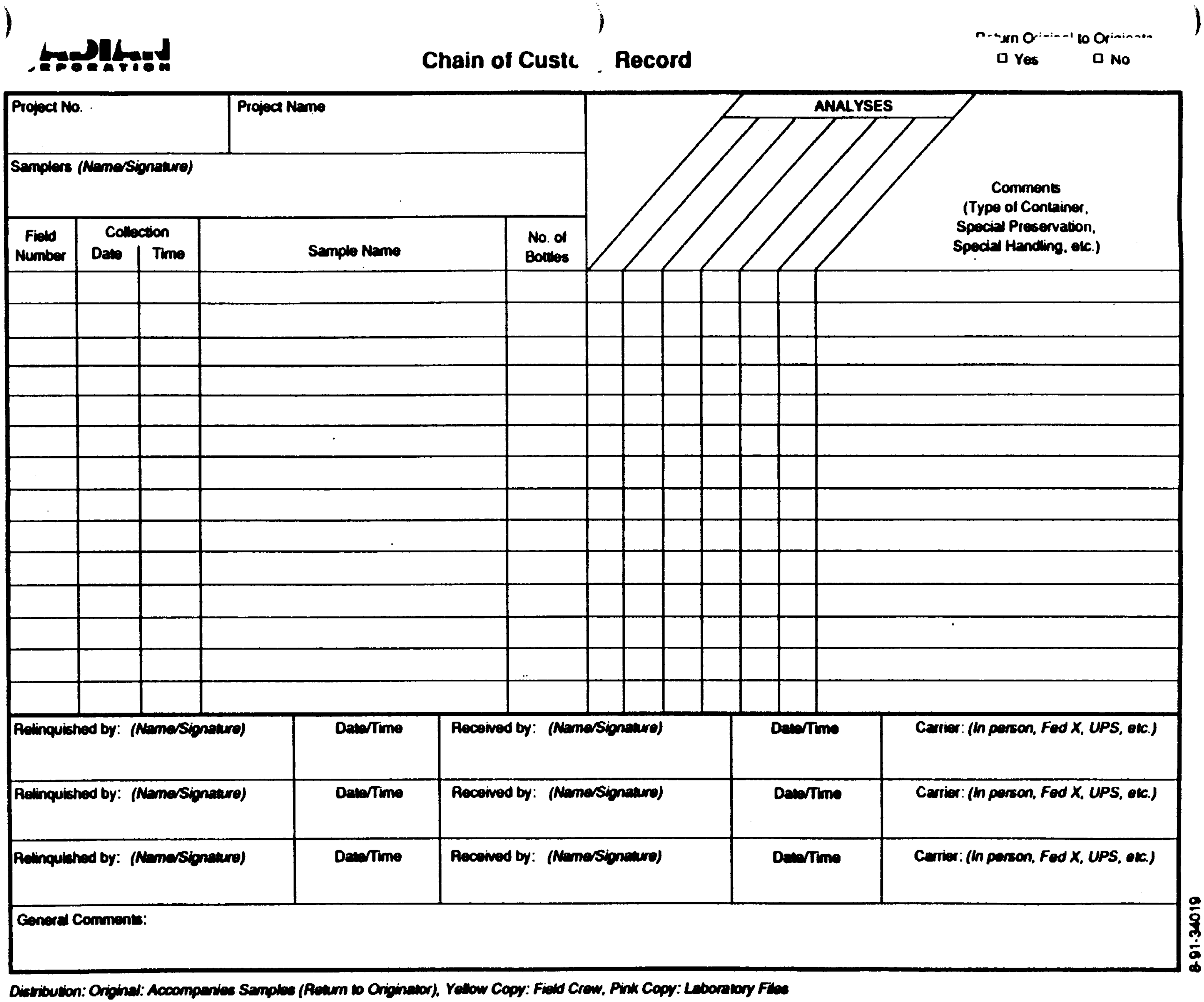
ATTENTION:

BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.

I.D. # ____________________

ATTENTION:

BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.



CORPORATION

Chain of Custody Record

Return Original to Originator
☐ Yes ☐ No

Project No.	**Project Name**							
Samplers *(Name/Signature)*								

Field Number	Collection Date	Collection Time	Sample Name	No. of Bottles	ANALYSES						Comments (Type of Container, Special Preservation, Special Handling, etc.)

Relinquished by: *(Name/Signature)*	**Date/Time**	**Received by:** *(Name/Signature)*	**Date/Time**	**Carrier:** *(In person, Fed X, UPS, etc.)*
Relinquished by: *(Name/Signature)*	**Date/Time**	**Received by:** *(Name/Signature)*	**Date/Time**	**Carrier:** *(In person, Fed X, UPS, etc.)*
Relinquished by: *(Name/Signature)*	**Date/Time**	**Received by:** *(Name/Signature)*	**Date/Time**	**Carrier:** *(In person, Fed X, UPS, etc.)*
General Comments:				

8-91:34019

Distribution: Original: Accompanies Samples (Return to Originator), Yellow Copy: Field Crew, Pink Copy: Laboratory Files

Figure 4-5. Chain-of-Custody Record

both ends. If there is a drain on the cooler, it will be taped shut. Custody seals, shown in Figure 4-4, will also be affixed to coolers to indicate tampering.

Samples will be shipped daily to the laboratory by overnight courier. The laboratory will be notified at least one week before samples are shipped to coordinate delivery. The following address will be used for sample shipment:

Lou Schneider
Savannah Laboratories
2846 Industrial Plaza Drive
Tallahassee, Florida 32317-3056
(904) 878-3994

Nilo Ligi
Quanterra Incorporated
880 Riverside Parkway
West Sacramento, California 95605
(916) 374-4427

Kelly Young
Radian Corporation
14046 Summit Drive, #101
Austin, Texas 78728
(512) 244-0855

Quanterra will perform the soil analyses for the metals and cyanide. Savannah Laboratories will perform the volatiles organics, semivolatile organics, and pesticides/PCBs analyses. Radian will perform the TCLP analyses.

If Saturday delivery is required, samples are to be sent to the same addresses. For coordination of sample delivery on Saturday, mark "Saturday Delivery" on the Federal Express airbill.

External QA Samples will be sent to:

EA Laboratories
19 Loveton Circle
Sparks, Maryland 21152
ATTN: Sample Management Office

5.0 LABORATORY ANALYTICAL PROCEDURES

The methods and procedures that will be used to prepare and analyze samples are discussed in this section. Laboratory-specific SOPs and laboratory protocol specifications are on file at the laboratories and are available for review upon request. Individual parameters, analytical methods, and reporting limits to be used are listed in Table 5-1. Table 5-2 lists the analytical methods by analyte, the preparation technique and method, and the analysis technique and method. All of the tables for this section are presented at the end of the section.

The analytical methods to be used in this project require the measurement system to initially satisfy specific criteria for calibration linearity, reference material recovery, and freedom from contamination. Results of control samples will be used to monitor any changes in the quality of data being produced and indicate which corrective actions are necessary to correct an out-of-control condition. An out-of-control condition is defined as:

- Detection of any compounds of interest in a method blank at concentrations greater than or equal to the reporting limit, with the exception of common laboratory contaminants. The analyte considered a common laboratory contaminants is methylene chloride. Detection of methylene chloride at concentrations greater than or equal to three times the reporting limit will necessitate corrective actions.
- Failure to meet the acceptance criteria for recovery of any compound of interest in a laboratory control sample (LCS).
- Exceeding the acceptance criteria for matrix spike recovery and subsequent failure to meet the acceptance criteria for an LCS for the same parameter(s). Any parameter that fails the matrix spike test but passes the LCS test will be flagged as suspect for the parameter because of matrix effects.

When an out-of-control situation is detected, efforts are undertaken to determine the cause. Routine QC checks and corrective actions are outlined by method in Tables 5-3, 5-4, 5-5, 5-6, and 5-7. Acceptance criteria for the laboratory control samples, matrix spikes, and surrogates are presented in Tables 5-8, 5-9, and 5-10, respectively.

During the course of this project, it will be the responsibility of the laboratory staff and the project team members to ensure that all measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In the event a problem arises, it is imperative that prompt action be taken to correct the problem. Laboratory managers will initiate corrective action in the event that QC results exceed acceptance criteria. Corrective action may be initiated by the laboratory quality officer if, during data review, QC data or other anomalies are noted.

For this project, all soil sample results will be reported on a dry-weight basis. The dry-weight calculation will be based on a moisture analysis.

The data analysis required to calculate sample concentrations will proceed according to method-specified procedures. Data reduction involves converting instrument responses or other raw into calculated concentrations for each target analyte. Data validation involves examining the systems producing the data to be sure they are operating properly and quality objectives have been met. Data will be reviewed and validated by the analyst(s) and/or the laboratory manager. Data will be validated for conformance with method specifications and laboratory protocol specifications, including:

- Calibration;
- Duplicate analysis;
- Blank analysis;
- Spike analysis;

- Sample data calculations; and
- QC sample frequency.

5.1 Analytical Methods

The analytical methods to be used for this project are presented in Table 5-2. All of the methods, both preparatory and analytical, are contained in SW-846. Any deviations performed by the laboratory will be pre-approved by the QAC.

Table 5-1

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
VOLATILES			
METHOD 8021A			
Benzene	0.09	0.37	5
Carbon Tetrachloride	0.03	0.94	5
Chlorobenzene	0.01	0.38	5
Chloroform	0.02	1.1	5
trans-1,2-Dichloroethene	0.02	0.93	5
Hexachlorobutadiene	0.20	1.8	5
Methyl Bromide	0.30	1.7	5
Methyl Chloride	0.10	0.94	5
Methylene Chloride	0.20	1.4	5
Naphthalene	0.60	3.4	5
Tetrachloroethene	0.01	0.21	5
Toluene	0.10	0.34	5
1,2,4-Trichlorobenzene	0.20	1.5	5
1,1,1-Trichloroethane	0.01	1.3	5
1,1,2-Trichloroethane	0.07	0.59	5
Trichloroethene	0.01	0.52	5
Trichlorofluoromethane	0.30	0.50	5
Vinyl Chloride	0.06	0.94	5
METHOD 8240B			
Acrolein	7	21	100
Carbon Disulfide	100	0.98	20
Methyl Ethyl Ketone	100	6.1	100
SEMIVOLATILES			
METHOD 8070			
N-Nitrosodimethylamine	1.5	12	67
METHOD 8090			
2,4-Dinitrotoluene (FID/ECD)	13	82/0.56	330/10
2,6-Dinitrotoluene (FID/ECD)	7	82/0.65	330/10

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
SEMIVOLATILES (Continued)			
METHOD 8110			
Bis(2-chloroethoxy) methane	5	16	30
Bis(2-chloroethyl) ether	3	9.9	30
Bis(2-chloroisopropyl) ether	8	24	30
METHOD 8121			
Hexachlorobenzene	3.8	0.12	3.3
Hexachlorocyclopentadiene	160	0.82	3.3
Hexachloroethane	1.1	0.11	3.3
METHOD 8151			
Pentachlorophenol	1.6	4.3	17
METHOD 8270B			
Bis(2-ethylhexyl) phthalate	180	27	330
Butyl benzyl phthalate	28	26	330
4-Chloro-3-methyl phenol	240	42	330
2-Chlorophenol	210	38	330
Di-n-butyl phthalate	220	27	330
Diethyl phthalate	170	21	330
2,4-Dimethylphenol	210	35	330
Dimethyl phthalate	190	24	330
4,6-Dinitro-2-methylphenol	3,300	27	330
Di-n-octyl phthalate	33	16	330
Phenol	94	38	330
2,4,5-Trichlorophenol	600	34	330
2,4,6-Trichlorophenol	390	33	330
METHOD 8310			
Fluoranthene	140	0.27	10
Fluorene	140	1.0	10
METHOD 8330			
Nitrobenzene	260	12	250
PESTICIDES/PCBs			
METHOD 8080A			

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
Aldrin	3	0.58	1.7
Chlordane	9.4	3.5	17
Dieldrin	1.3	0.35	3.3
Endosulfan I	9.4	0.43	1.7
Endosulfan II	3	2.8	3.3
Endrin	4	0.30	3.3
Heptachlor	2	0.80	1.7
Heptachlor Epoxide	21	0.47	1.7
Methoxychlor	120	3.6	17
PCB 1016	2,500	4.6	33
PCB 1221	2,500	8.8	67
PCB 1232	2,500	13	33
PCB 1242	2,500	15	33
PCB 1248	2,500	5.0	33
PCB 1254	2,500	5.2	33
PCB 1260	2,500	13	33
Toxaphene	57	34	170
METALS			
METHOD 6020			
Arsenic	10	0.85 µg/L[a]	200
Barium	20	0.16 µg/L[a]	100
Beryllium	3	0.15 µg/L[a]	100
Cadmium	1	0.17 µg/L[a]	200
Chromium	10	0.34 µg/L[a]	100
Lead	10	0.36 µg/L[a]	100
Nickel	0.2	0.67 µg/L[a]	100
Selenium	20	0.51 µg/L[a]	200

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
METALS (Continued)			
Silver	2	0.52 µg/L[a]	100
Thallium	10	0.08 µg/L[a]	100
METHOD 7471A			
Mercury	2	0.03 µg/L[a]	100
METHOD 9010A			
Cyanide	20	8 µg/L[a]	100

[a] These detection limits are based on a MDL study of an aqueous matrix.

Table 5-2

Analytical Methods

Parameter	Preparation		Analysis	
	Technique	Method	Technique	Method
METALS				
Arsenic	Acid Digestion	3050	ICPMS	6020
Barium	Acid Digestion	3050	ICPMS	6020
Beryllium	Acid Digestion	3050	ICPMS	6020
Cadmium	Acid Digestion	3050	ICPMS	6020
Chromium	Acid Digestion	3050	ICPMS	6020
Cyanide	Distillation	9012	Colorimetric/UV	9012
Lead	Acid Digestion	3050	ICPMS	6020
Mercury	$KMnO_4$/Acid Digestion	7471A	CVAA	7471A
Nickel	Acid Digestion	3050	ICPMS	6020
Selenium	Acid Digestion	3050	ICPMS	6020
Silver	Acid Digestion	3050	ICPMS	6020
Thallium	Acid Digestion	3050	ICPMS	6020
Pesticides and PCBs				
Aldrin	Extraction	3550	GC	8080A
Chlordane	Extraction	3550	GC	8080A
Dieldrin	Extraction	3550	GC	8080A
Endosulfan I	Extraction	3550	GC	8080A
Endosulfan II	Extraction	3550	GC	8080A
Endrin	Extraction	3550	GC	8080A
Heptachlor	Extraction	3550	GC	8080A
Heptachlor epoxide	Extraction	3550	GC	8080A
Methoxychlor	Extraction	3550	GC	8080A
Toxaphene	Extraction	3550	GC	8080A
PCBs	Extraction	3550	GC	8080A
VOLATILE ORGANICS				
Acrolein	Purge and Trap	5030	GC/MS	8240B
Benzene	Purge and Trap	5030	GC/PID	8021A
Carbon disulfide	Purge and Trap	5030	GC/MS	8240B

Table 5-2 (Continued)

Analytical Methods

Parameter	Preparation		Analysis	
	Technique	Method	Technique	Method
Carbon tetrachloride	Purge and Trap	5030	GC/PID	8021A
Chlorobenzene	Purge and Trap	5030	GC/PID	8021A
Chloroform	Purge and Trap	5030	GC/PID	8021A
trans-1,2-Dichloroethene	Purge and Trap	5030	GC/PID	8021A
Hexachlorobutadiene	Purge and Trap	5030	GC/PID	8021A
Methyl Bromide	Purge and Trap	5030	GC/PID	8021A
Methyl Chloride	Purge and Trap	5030	GC/PID	8021A
Methylene chloride	Purge and Trap	5030	GC/PID	8021A
2-Butanone (MEK)	Purge and Trap	5030	GC/MS	8240B
Naphthalene	Purge and Trap	5030	GC/PID	8021A
Tetrachloroethene	Purge and Trap	5030	GC/PID	8021A
Toluene	Purge and Trap	5030	GC/PID	8021A
1,1,1-Trichloroethane	Purge and Trap	5030	GC/PID	8021A
1,1,2-Trichloroethane	Purge and Trap	5030	GC/PID	8021A
1,2,4-Trichlorobenzene	Purge and Trap	5030	GC/PID	8021A
Trichloroethene	Purge and Trap	5030	GC/PID	8021A
Trichlorofluoromethane	Purge and Trap	5030	GC/PID	8021A
Vinyl chloride	Purge and Trap	5030	GC/PID	8021A
SEMIVOLATILE ORGANICS				
Butyl benzyl phthalate	Extraction	3550	GC/MS	8270B
4-Chloro-3-methylphenol	Extraction	3550	GC/MS	8270B
Bis(2-Chloroethoxy)methane	Extraction	3550	GC	8110
Bis(2-Chloroethyl)ether	Extraction	3550	GC	8110
Bis(2-Chloroisopropyl)ether	Extraction	3550	GC	8110
2-Chlorophenol	Extraction	3550	GC/MS	8270B
Diethylphthalate	Extraction	3550	GC/MS	8270B
2,4-Dimethylphenol	Extraction	3550	GC/MS	8270B
Dimethylphthalate	Extraction	3550	GC/MS	8270B
Di-n-butylphthalate	Extraction	3550	GC/MS	8270B
Di-n-octylphthalate	Extraction	3550	GC/MS	8270B

Table 5-2 (Continued)

Analytical Methods

Parameter	Preparation		Analysis	
	Technique	Method	Technique	Method
2,4-Dinitrotoluene	Extraction	3550	GC	8090
2,6-Dinitrotoluene	Extraction	3550	GC	8090
Bis(2-Ethylhexyl)phthalate	Extraction	3550	GC/MS	8270B
Fluoranthene	Extraction	3550	HPLC	8310
Fluorene	Extraction	3550	HPLC	8310
Hexachlorobenzene	Purge and Trap	5030	GC	8121
Hexachlorocyclopentadiene	Purge and Trap	5030	GC	8121
Hexachloroethane	Purge and Trap	5030	GC	8121
N-Nitrosodimethylamine	Extraction	3550	GC	8070
Nitrobenzene	Extraction	8330	HPLC	8330
Pentachlorophenol	Extraction	3550	GC	8151
Phenol	Extraction	3550	GC/MS	8270B
2,4,5-Trichlorophenol	Extraction	3550	GC/MS	8270B
4,6-Dinitro-2-methylphenol	Extraction	3550	GC/MS	8270B
2,4,6-Trichlorophenol	Extraction	3550	GC/MS	8270B

ICPMS = Inductively Coupled Plasma Mass Spectrometry.
CVAA = Cold Vapor Atomic Absorption.
GC/MS = Gas Chromatography/Mass Spectrometry.
FID = Flame Ionization Detector.
PID = Photo Ionization Detector.
HPLC = High Performance Liquid Chromatography.
UV = Ultraviolet Detector.

Table 5-3

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
6020	ICP/MS Metals Refer to: SW846-3005A[b] SW846-3050A[b]	Initial calibration standard (2 points)	Daily, prior to sample analysis	NA	NA
		Initial Calibration Verification (ICV) (concentration = upscale calibration standard)	Following initial calibration	90 - 110% recovery	1. Repeat ICV 2. Recalibrate if still out
		Continuing calibration verification (CCV)	Following Interference check standards and after every 10 samples and at end of analytical batch	90 - 110% recovery	1. Repeat CCV 2. If still out, identify and correct problem, then re-analyze all samples since last valid CCV.
		Calibration blank (CCB)	Every 10 samples and at end of analytical run	< Quantitation limits	1. Re-analyze CCB 2. If CCB is still contaminated, identify and correct source of contamination, then repeat calibration blank analysis 3. Re-analyze all samples since last valid CCB, if necessary.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action^a
6020 (Continued)	ICP/MS Metals	LCS/LCSD	One LCS/LCSD for each digestion batch and each analytical batch	Recoveries within QC acceptance criteria in Table 5-8.	Accuracy: 1. Re-analyze LCS/LCSD. If recoveries for same analytes are still out, stop, identify and correct problem before proceeding. Redigestion may be necessary. Precision: 2. Reanalyze LCS/LCSD. If recoveries for same analytes are still out, stop, identify and correct problem before proceeding.
		Interference check sample	Daily at beginning and end of analytical run or twice per 8 hour shift	Assess possible interference problems	1. Adjust interference factors or element equations if necessary
		Method blank	One per digestion batch and analytical batch	< quantitation limits (QL)	1. If the sample element concentration is <QL or the sample element concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-digest/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
6020 (Continued)	ICP/MS Metals	MS/MSD	1 MS/MSD per digestion batch	Recovery within QC acceptance criteria in Table 5-9.	1. If either MS or MSD is outside of accuracy or precision tolerances and LCS/LCSD is acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Linearity Check	Semi-annually	Highest point at which the recovery of the standard is within 10% of the expected value	No data will be reported for any element that exceeds the upper limit of the linear range by more than 10%.
7470A/7471A[b]	Mercury Refer to: 7000A	Initial Calibration (5 point and a blank)	Daily before any analysis	Correlation coefficient ≥ 0.995	Identify and repeat outlying point(s); recalculate curve using repeated points
		Initial Calibration Verification (ICV)	Daily before batch one is analyzed	90 - 110% of theoretical value	Accuracy: 1. Repeat calibration verification 2. If still out, identify and correct problem, run calibration verification again; if still out, recalibrate

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
7470A/7471A[b] (Continued)	Mercury	Initial Calibration Blank (ICB)	After ICV	Within ±QL	Re-analyze calibration blank; if still out, recalibrate
		Continuing Calibration Blank (CCB)	Following each CCV and at end of batch	Within ±QL	Re-analyze calibration blank; if still out, correct problem and re-analyze all samples since last valid CCB.
		Method Blank	One per digestion batch and analytical batch	Measured concentrations for all elements must be <quantitation limit (QL)	1. If the sample element concentration is <QL or if the sample element concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-digest/ re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.
		LCS	One LCS per each digestion and analytical batch	QC acceptance criteria in Table 5-8.	1. Accuracy: Re-analyze LCS. If recovery for same analytes are still out, stop, identify, and correct problem before proceeding. Digestion batch may need to be re-prepared. 2. Precision: Re-analyze LCS. If recovery for same analytes are still out, stop, identify, and correct problem before proceeding.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
7470A/7471A[b] (Continued)	Mercury	MS/MSD	One MS/MSD pair per digestion batch	Recoveries within QC acceptance criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and the LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Continuing Calibration Verification (CCV)	After 10th sample and at the end of the batch	80-120% of true value	Accuracy: 1. Repeat calibration verification 2. If still out, identify and correct problem, then reanalyze all samples analyzed since last valid CCV.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action^a
9012	Cyanide	Five-point calibration	Daily, prior to sample analysis	r ≥0.995	Repeat calibration
		ISV (Initial Standard Verification)	Once per multipoint calibration before samples are analyzed	Within ±15% of expected value	1. Reanalyze ISV 2. If still out, identify and correct problem and repeat ISV 3. If still out, repeat initial calibration
		ICV	Once per multipoint calibration before samples are analyzed	Within ±15% of expected value	1. Repeat ICV 2. If still out, identify and correct problem and repeat ICV 3. If still out, repeat initial calibration
		Method blank	One per each preparation batch and analytical batch	<QL	1. If the sample analyte concentration is <QL or the sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-prepare samples if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.
		LCS/LCSD	1 LCS/LCSD pair per batch	QC acceptance criteria in Table 5-8.	1. Reanalyze LCS 2. Identify and correct problem 3. If still out, redigest and reanalyze affected samples

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
9012 (Continued)	Cyanide	MS/MSD	1 MS/MSD per preparation batch	QC acceptance criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and the LCS/LCSD is acceptable, then flag results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
NA = Not Applicable.

Table 5-4

Summary of Calibration and Internal Quality Control Procedures for Volatile and Semivolatile Compounds by Gas Chromatography and by High Performance Liquid Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8021A, 8070, 8090, 8110, 8121, 8310, 8330	Volatile organics and semi-volatile organics Refer to: SW846-8000A[b] SW846-3500A[b]	Initial Calibration	Biannually or when daily calibration fails to meet acceptance criteria	%RSD <20% for average RFs or calibration curve Correlation coefficient (r) ≥0.995	Identify and repeat outlying point(s); recalculate curve using repeated point(s)
		Calibration Verification (ICV/CCV)	At the beginning, following every 10th sample, and at the end of each analytical sequence	Recovery for all analytes of interest must be within ±15% of true value for primary column and ±20% for confirmation column	1. Repeat calibration check 2. If still out, identify and correct problem and repeat calibration check; if still out,repeat multipoint calibration, if necessary.
		LCS/LCSD	One LCS/LCSD pair per extraction batch and analytical batch	Recovery for all analytes within QC Acceptance criteria in Table 5-8.	1. Accuracy: a. If the same analytes are out in both the LCS/LCSD and if the calibration check standard is acceptable, contact CSC for decision to proceed or re-extract. If samples must be analyzed without re-extraction, flag sample data for failed analytes. If analytes in calibration check standard are out, correct instrument problem. b. If one or more analytes is out in either LCS or LCSD, then analyze previously acceptable calibration check standard for the analytes that failed. If analytes in calibration check standard are in, proceed with analyses. If analytes are out, correct instrument problem.

Table 5-4 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile and Semivolatile Compounds by Gas Chromatography and by High Performance Liquid Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action^a
8021A, 8070, 8090, 8110, 8121, 8310, 8330 (Continued)	Volatile organics and semi-volatile organics Refer to: SW846-8000A^b SW846-3500A^b	LCS/LCSD	One LCS/LCSD pair per extraction batch and analytical batch	Recovery for all analytes within QC Acceptance criteria in Table 5-9.	2. Precision: Demonstrate acceptable RPDs on analytes that failed by reanalyzing previously acceptable 3rd LCS. If RPDs are in, proceed with analyses. If analytes are out, correct instrument problem before proceeding.
		MS/MSD	One MS/MSD pair per extraction batch	QC Acceptance criteria Table 2.5-13	1. If either MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences
		Surrogate Spike	All samples, standards, and blanks	Table 5-10 Surrogate limits	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze affected samples 3. If none of the above, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

Table 5-4 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile and Semivolatile Compounds by Gas Chromatography and by High Performance Liquid Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8021A, 8070, 8090, 8110, 8121, 8310, 8330 (Continued)	Volatile organics and semi-volatile organics Refer to: SW846-8000A[b] SW846-3500A[b]	Method Blank	Each extraction batch and each analytical batch	<Quantitation limit (QL)	1. If sample analyte concentration is <QL or if sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER; 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
NA = Not applicable.

Table 5-5

Summary of Calibration and Internal Quality Control Procedures for Pesticides, PCBs, and Herbicides by Gas Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8080, 8151	Pesticides, PCBs, and herbicides Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Five-point calibration (for all analytes)	Biannually or when daily calibration fails to meet acceptance criteria	%RSD < 20% for average RFs or calibration curve correlation coefficient (r) ≥0.995	Identify and repeat outlying point(s); recalculate curve using repeated points
		Initial daily Calibration Verification (ICV)	Daily, before sample analysis	Recovery for any analyte within ±15% of nominal concentration for primary column; ±20% for confirmation column	1. Repeat ICV 2. If still out, identify and correct problem before proceeding 3. Recalibrate if necessary
		LCS\LCSD	One LCS/LCSD pair per extraction batch and analytical batch	Recovery for all analytes within QC acceptance criteria in Table 5-8.	1. Accuracy: a. If the same analytes are out in both the LCS and LCSD, and the calibration check standard is acceptable, contact CSC for decision to proceed or re-extract. If samples must be analyzed without re-extraction, flag sample data for failed analytes. If analytes in calibration check standard are out, correct instrument problem. b. If one or more analytes is out in either LCS or LCSD, then analyze previously acceptable calibration check standard for the analytes that failed. If analytes in calibration check standard are in, proceed with analyses. If analytes are out, correct instrument problem. 2. Precision: Demonstrate acceptable RPDs on analytes that failed by reanalyzing previously acceptable 3rd LCS. If RPDs are in, proceed with analyses. If analytes are out, correct instrument problem.

Table 5-5 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Pesticides, PCBs, and Herbicides by Gas Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8080, 8151 (Continued)	Pesticides, PCBs, and herbicides Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Continuing Calibration Verification (CCV)	Every ten samples and at end of batch.	a)Primary: Recovery of analytes within ±15% of nominal concentration; Confirmation: ±20% of nominal concentration b)Ongoing calibration analytes elute within daily RT windows	1. Repeat CCV. 2. If still out, identify and correct problem. 3. Re-analyze all samples since last valid CCV.
		Breakdown check (Endrin and DDT)	Daily prior to analysis of samples and as needed during analysis	Degradation ≤20% (each)	Perform system maintenance.
		MS/MSD	1 MS/MSD pair for each extraction batch	QC Acceptance Criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences
		Surrogate spike	Every sample, spike, standard, and method blank	Table 5-10 Only one surrogate must meet acceptance criteria.	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze affected samples 3. If none of the above, re-extract/re-analyze samples if still within HT and enough sample volume, otherwise contact CSC for decision.

Table 5-5 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Pesticides, PCBs, and Herbicides by Gas Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8080, 8151 (Continued)	Pesticides, PCBs, and herbicides Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Method blank	Each extraction batch and each analytical batch	< Quantitation limits (QL)	1. If the sample analyte concentration is <QL or the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER; 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
NA = Not applicable.

Table 5-6

Summary of Calibration and Internal Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8240B	Volatile Organic Compounds Refer to: SW846-5030[b] SW846-8000A[b]	BFB Tuning	Analyze at the beginning of each analytical sequence and at the beginning of every subsequent 12 hours (if applicable)	Established criteria in method	1. Repeat BFB analysis. 2. Adjust MS tune until criteria met.
		Five-point calibration (for all analytes) (ICAL)	Annually or when daily calibration check fails to meet acceptance criteria.	1. SPCCs[c,d] 2. %RSD <30% for CCC[e]	Repeat 5-point calibration
		Calibration Verification (CV)	Analyzed at the beginning of each analytical sequence and at the beginning of every subsequent 12 hours (if applicable)	1. SPCCs[c,d] 2. CCC[e] percent difference (%D) <20% recovery relative to ICAL	1. Repeat CV 2. If still out, identify and correct problem, run CV again; if still out recalibrate.
		Internal Standards (IS) Retention Times (RT)	All samples, standards, and method blanks	RT:Must be <30 second change from daily CV IS: EICP[f] area must be within a factor of 2 from daily CV	1. Inspect system for malfunctions. 2. Make appropriate system corrections, if necessary. 3. Reanalyze samples analyzed while system was malfunctioning unless matrix interferences demonstrated.
		LCS/LCSD	One LCS/LCSD pair per analytical batch	Recovery for all analytes within QC Acceptance Criteria in Table 5-8.	1. Accuracy: a. If recoveries for the same analytes are out in both the LCS and LCSD, stop and correct problem. If obtain CSC approval to proceed, write QCER b. If one or more analytes is out in either the LCS or LCSD, analyze a 3rd LCS. If the recoveries for the 3rd LCS are acceptable, proceed with analyses. If same analytes are out, stop and correct instrument problem. If obtain CSC approval to proceed, write QCER

Table 5-6 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8240B (Continued)	Volatile Organic Compounds Refer to: SW846-5030[b] SW846-8000A[b]	LCS/LCSD	One LCS/LCSD pair per analytical batch	Recovery for all analytes within QC Acceptance Criteria in Table 5-8.	2. Precision: Demonstrate acceptable RPDs for analytes that failed by analyzing a 3rd LCS. If RPDs between the 3rd and either LCS or LCSD are acceptable, proceed with analyses. If RPDs are still not acceptable, stop and correct instrument problem. If obtain CSC approval to proceed, write QCER.
		MS/MSD	1 MS/MSD pair for each extraction batch	QC Acceptance Criteria in Table 5-9.	1. If either the MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Surrogate spike	Every sample, spike, standard, and method blank	Table 5-10 acceptance criteria	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze the affected samples 3. If none of the above, re-extract/re-analyze if still within HT and enough sample volume, otherwise contact CSC for decision.

Table 5-6 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8240B (Continued)	Volatile Organic Compounds Refer to: SW846-5030[b] SW846-8000A[b]	Method blank	One per analytical batch	No analytes > quantitation limit (QL)	1. If sample analyte concentration is <QL (except for analytes listed as exceptions) or if the sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
[c] SPCC = System Performance Check Compounds.
[d] SPCC = for 8240B 15ml purge: 1,1-dichloroethane, chloromethane and bromoform avg. RF >/= 0.10, 1,1,2,2-tetrachloroethane avg RF >/= 0.20 and chlorobenzene avg RF >/= 0.30; for 8240B soils and 5ml purge: the same as SW8260A 15ml except 1,1,2,2-tetrachloroethane avg RF >/= 0.30.
[e] CCC = Calibration Check Compounds.
[f] EICP = Extracted Ion Current Profile.
NA = Not applicable.

Table 5-7

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8270B	Semivolatile Organic Compounds Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Check of mass spectral ion intensities using DFTPP, (4,4'-DDT, pentachlorophenol and benzidine also to be included in tuning standard to verify injection port inertness and GC column performance)	At the beginning of each analytical sequence and at the beginning of each subsequent 12 hour period, if applicable.	Ion Abundance criteria in Table 3 of SW846-8270B[b] – Degradation of DDT to DDE and DDD ≤20% – Benzidine and pentachlorophenol must each exceed 7000 area counts with a tailing factor of <3 at 10% peak height.	Ion Abundance: 1. Re-analyze DFTPP. 2. Adjust MS tune until analysis of DFTPP passes criteria Column/Injection Port: 1. Clean injection port, if necessary. 2. Remove first 6 to 12 inches of column, if necessary.
		Five-point calibration for all commercially available analytes[f]	Biannually or when daily calibration check fails to meet acceptance criteria	1. %RSD <30% for each individual CCC[d] 2. SPCCs[e] average RF ≥0.050	Repeat concentrations not meeting criteria.
		Calibration Verification (CV)	At beginning of each analytical sequence and at the beginning of each subsequent 12 hour period, if applicable.(CV standard is prepared from a concentrated cocktail every two weeks).	1. SPCCs[e] RF≥0.050 2. CCC[d] percent difference (%D) <30% from average RF	1. Reanalyze CV standard 2. If still out, identify and correct problem. 3. Reanalyze CV standard again. 4. If still out, perform a new multi-point calibration.
		Internal Standards (IS) and Retention Times (RT)	All samples, standards and blanks	RT: Must be <30 second change from daily CV IS:Extracted ion area counts must be within a factor of 2 from the daily CV.	1. Reanalyze sample if out of specification (unless matrix interference demonstrated). 2. If still out, identify and correct problem. 3. Reanalyze affected samples, if necessary.

Table 5-7 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action*
8270B (Continued)	Semivolatile Organic Compounds	LCS/LCSD	One LCS/LCSD pair for each extraction batch and each analytical batch	Recovery for all analytes within QC Acceptance Criteria in Table 5-8.	1. Accuracy: a. If the same analytes are out in both the LCS and LCSD, then analyze a 3rd previously acceptable LCS for the analytes that failed. If 3rd LCS is acceptable, contact CSC for decision to proceed or re-extract. If samples must be analyzed without re-extraction, flag data for failed analytes. If analytes in 3rd LCS are out, correct instrument problem. b. If one or more analytes is out in either LCS or LCSD, then analyze previously acceptable 3rd LCS for the analytes that failed. If 3rd LCS analytes in, proceed, if out, correct instrument problem. 2. Precision: Demonstrate acceptable RPDs on analytes that failed by reanalyzing previously acceptable 3rd LCS. If RPDs in, proceed, if out, correct instrument problem.

Table 5-7 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
SW8270B (Continued)	Semivolatile Organic Compounds	MS/MSD	1 MS/MSD per extraction batch	QC Acceptance Criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Surrogate spike	Every sample, standard, and blank.	Table 5-10 criteria. Corrective action required only if more than 1 acid and/or 1 base surrogate exceeds criteria.	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze affected samples 3. If none of the above, re-extract/reanalyze samples if still within HT and enough sample volume, otherwise, contact CSC for decision.

Table 5-7 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
SW8270B (Continued)	Semivolatile Organic Compounds	Method blank	Each extraction batch and each analytical batch	All analytes < quantitation limits (QL)	1. If sample analyte concentration is <QL or if the sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER; 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
[c] SPCC = System Performance Check Compounds.
[d] CCC = Calibration Check Compounds.
[e] The following analytes use four point calibration curves to determine the average RF due to erratic behavior of these analytes: benzoic acid, and 2,4-dinitrophenol. The following use a RF obtained from a single analysis of an aliquot of the individual analyte because of erratic response, decomposition or other problems with the analytes: hexachlorophene.
NA = Not applicable.

Table 5-8

Summary of Acceptance Criteria for Laboratory Control Samples

Analyte	Recovery (%)	Precision (PRD)
METALS		
METHOD 6020		
Arsenic	80-120	20
Barium	80-120	20
Beryllium	80-120	20
Cadmium	80-120	20
Chromium	80-120	20
Lead	80-120	20
Nickel	80-120	20
Selenium	80-120	20
Silver	80-120	20
Thallium	80-120	20
METHOD 7470/7471A		
Mercury	80-120	20
METHOD 9012		
Cyanide	75-125	20
PESTICIDES and PCBs		
METHOD 8080		
Aldrin	40-137	38
Chlordane	45-119	40
Dieldrin	42-139	30
Endosulfan I	45-153	40
Endosulfan II	10-202	65
Endrin	44-151	32
Heptachlor	40-136	38
Heptachlor Epoxide	37-142	40
Methoxychlor	34-166	40
Toxaphene	41-126	50
PCB-1016	52-152	44
PCB-1221	15-178	20
PCB-1232	10-215	20
PCB-1242	39-150	20
PCB-1248	38-158	20
PCB-1254	66-122	23
PCB-1260	58-122	40

Table 5-8 (Continued)

Summary of Acceptance Criteria for Laboratory Control Samples

Analyte	Recovery (%)	Precision (PRD)
VOLATILE ORGANICS		
METHOD 8021		
Benzene	61-131	31
Carbon Tetrachloride	42-141	50
Chloroethane	43-158	52
Chlorobenzene	48-143	24
Chloroform	53-134	36
Hexachlorobutadiene	52-145	41
Methylene Chloride	44-150	56
Naphthalene	67-133	42
Toluene	64-144	22
1,2,4-Trichlorobenzene	44-139	53
1,1,1-Trichloroethane	59-136	47
1,1,2-Trichloroethane	64-160	53
Tetrachloroethene	53-150	57
Trichloroethene	51-140	48
Trichlorofluoromethane	58-152	37
Vinyl chloride	44-173	61
METHOD 8240B		
Acrolein	22-164	40
Carbon Disulfide	35-244	65
Methyl Ethyl Ketone	10-111	40
SEMIVOLATILE ORGANICS		
METHOD 8070		
N-Nitrosodimethylamine	40-135	36
METHOD 8090		
2,4-Dinitrotoluene	10-125	40
2,6-Dinitrotoluene	10-126	40
METHOD 8110		
Bis(2-Chloroethoxy)methane	47-152	59
Bis(2-Chloroethyl)ether	46-141	52
Bis(2-Chloroisopropyl)ether	26-121	49

Table 5-8 (Continued)

Summary of Acceptance Criteria for Laboratory Control Samples

Analyte	Recovery (%)	Precision (PRD)
METHOD 8121		
Hexachlorobenzene	23-118	39
Hexachlorocyclopentadiene	5-116	65
Hexachloroethane	9-135	53
METHOD 8151		
Pentachlorophenol	10-150	40
METHOD 8270B		
Bis(2-Ethylhexyl)phthalate	10-158	40
Butyl Benzyl Phthalate	10-152	40
4-Chloro-3-Methylphenol	45-113	25
2-Chlorophenol	45-101	25
Di-n-butylphthalate	10-118	50
Diethylphthalate	10-114	40
2,4-Dimethylphenol	15-151	22
Dimethyl phthalate	10-112	40
4,6-Dinitro-2-methylphenol	10-181	93
Di-n-octylphthalate	10-146	50
Phenol	41-105	24
2,4,5-Trichlorophenol	39-123	27
2,4,6-Trichlorophenol	37-144	40
METHOD 8310		
Fluoranthene	56-136	28
Fluorene	10-142	40
METHOD 8330		
Nitrobenzene	52-152	30

Table 5-9

Summary of Acceptance Criteria for Matrix Spike Analyses

Analyte	Recovery (%)	Precision (PRD)
METALS		
METHOD 6020		
Arsenic	75-125	20
Barium	75-125	20
Beryllium	75-125	20
Cadmium	75-125	20
Chromium	75-125	20
Lead	75-125	20
Nickel	75-125	20
Selenium	75-125	20
Silver	75-125	20
Thallium	75-125	20
METHOD 7470/7471		
Mercury	75-125	20
METHOD 9012		
Cyanide	75-125	20
PESTICIDES and PCBs		
METHOD 8080		
Aldrin	40-137	38
Chlordane	45-119	40
Dieldrin	42-139	30
Endosulfan I	45-153	40
Endosulfan II	10-202	65
Endrin	44-151	32
Heptachlor	40-136	38
Heptachlor Epoxide	37-142	40
Methoxychlor	34-166	40
Toxaphene	41-126	50
PCB-1016	52-152	44
PCB-1221	15-178	20
PCB-1232	10-215	20
PCB-1242	39-150	20
PCB-1248	38-158	20
PCB-1254	66-122	23
PCB-1260	58-122	40

Table 5-9 (Continued)

Summary of Acceptance Criteria for Matrix Spike Analyses

Analyte	Recovery (%)	Precision (RPD)
VOLATILE ORGANICS		
METHOD 8021		
Benzene	61-131	31
Carbon Tetrachloride	42-141	50
Chloroethane	43-158	52
Chlorobenzene	48-143	24
Chloroform	53-134	36
Hexachlorobutadiene	52-145	41
Methylene Chloride	44-150	56
Naphthalene	67-133	42
Toluene	64-144	22
1,2,4-Trichlorobenzene	44-139	53
1,1,1-Trichloroethane	59-136	47
1,1,2-Trichloroethane	64-160	53
Tetrachloroethene	53-150	57
Trichloroethene	51-140	48
Trichlorofluoromethane	58-152	37
Vinyl chloride	44-173	61
METHOD 8240B		
Acrolein	22-164	40
Carbon Disulfide	35-244	65
Methyl Ethyl Ketone	10-111	40
SEMIVOLATILE ORGANICS		
METHOD 8070		
N-Nitrosodimethylamine	40-135	36
METHOD 8090		
2,4-Dinitrotoluene	10-125	40
2,6-Dinitrotoluene	10-126	40
METHOD 8110		
Bis(2-Chloroethoxy)methane	47-152	59
Bis(2-Chloroethyl)ether	46-141	52
Bis(2-Chloroisopropyl)ether	26-121	49

Table 5-9 (Continued)

Summary of Acceptance Criteria for Matrix Spike Analyses

Analyte	Recovery (%)	Precision (PRD)
METHOD 8121		
Hexachlorobenzene	23-118	39
Hexachlorocyclopentadiene	5-116	65
Hexachloroethane	9-135	53
METHOD 8151		
Pentachlorophenol	10-150	40
METHOD 8270B		
Bis(2-Ethylhexyl)phthalate	10-158	40
Butyl Benzyl Phthalate	10-152	40
4-Chloro-3-Methylphenol	45-113	25
2-Chlorophenol	45-101	25
Di-n-butylphthalate	10-118	50
Diethylphthalate	10-114	40
2,4-Dimethylphenol	15-151	22
Dimethyl phthalate	10-112	40
4,6-Dinitro-2-methylphenol	10-181	93
Di-n-octylphthalate	10-146	50
Phenol	41-105	24
2,4,5-Trichlorophenol	39-123	27
2,4,6-Trichlorophenol	37-144	40
METHOD 8310		
Fluoranthene	56-136	28
Fluorene	10-142	40
METHOD 8330		
Nitrobenzene	52-152	30

Table 5-10

Summary of Surrogate Spike Acceptance Criteria

Surrogate Compound	Soil (% Recovery)
METHOD 8080 PESTICIDES AND PCBs	
2,4,5,6-Tetrachloro-m-xylene (TCMX)	19-132
Dibutylchlorendate (DBC)	47-126
Decachlorobiphenyl	45-131
METHOD 8151 HERBICIDES	
2,4-DB	20-160
2,4-DCAA	10-148
METHOD 8021A	
2-Bromo-1-chloropropane	70-130
Fluorobenzene	70-130
VOLATILE ORGANICS	
METHOD 8240B	
Toluene-d_8	68-123
4-Bromofluorobenzene	64-126
Dibromofluoromethane	80-120
1,2-Dichloroethane-d_4	46-143
METHOD 8090	
2,4,5,6-Tetrachloro-m-xylene (ECD)	19-132
SEMIVOLATILE ORGANICS	
METHOD 8270B	
2-Chlorophenol-d_4	20-130
1,2-Dichlorobenzene-d_4	20-130
2-Fluorobiphenyl	35-116
2-Fluorophenol	27-120
2,4,6-Tribromophenol	17-123
Nitrobenzene-d_5	22-124
p-Terphenyl-d_{14}	29-137
Phenol-d_5	32-123
METHOD 8310	
4-Terphenyl-d_{14}	28-106
METHOD 8330	
3,4-Dinitrotoluene	40-140

6.0 CHEMICAL DATA QUALITY MANAGEMENT (CDQM) DELIVERABLES

The following deliverables will be prepared for this project:

- Draft and Final Chemical Data Acquisition Plan (CDAP);
- Draft and Final Site Safety and Health Plan (SSHP);
- A-E Daily Quality Control Reports; and
- Draft, Draft Final, and Final Site Characterization Reports.

7.0 DATA MANAGEMENT AND REPORTING

This section presents the data reporting and management procedures that will be followed for the RAAP Basin Closure.

7.1 Data Management

The data management requirements of this CDAP will facilitate the organizing and reporting of investigation data and results. The Project Director will oversee all aspects of the work and will be responsible for ensuring that proper documentation procedures are followed and that tracking of the accumulated data during the investigation is performed.

There are four goals for the data management task:

- Provide timely access to an organized body of data to facilitate analysis and decision making throughout the investigation;
- Provide a useful index of project information;
- Present project information in tabular and graphic form; and
- Report progress on the project.

7.2 Sample Tracking Record

A bound, numbered field logbook will be used to permanently record all field procedures, sample locations, types, unique identification numbers, and general observations. The specific parameters for which each sample is to be analyzed will also be recorded. A unique sample field identification number will be assigned at the time of sample collection to track each sample. A corresponding laboratory ID number will be

assigned by the laboratory and will be used to track each sample through the analytical process.

All pages of the field logbook will be signed and dated by the supervising geologist who is entering the data. Also, the names and affiliations of all visitors on site will be entered in the notebook, as well as general notes on project progress, problems encountered, and any deviations from plans.

Field sample ID number, along with sample collection point, sample collection date/time, sampler, required analysis, and preservation will be entered on the sample label for each container. Chain-of-custody documentation will also be completed and will accompany all samples to document the chain of possession and track the samples throughout shipping, handling, and analysis.

Samples are received by the Sample Control Area, and all containers and security seals, when appropriate, are inspected for physical damage or evidence of tampering. The samples are unpacked, inspected, and checked against the chain of custody form by the sample custodian. The temperature and pH of the samples are verified. The samples are logged into the laboratory information management system and assigned a unique number. Analytical requirements for each sample are entered into the computer. All sample information, including the date for sample disposal or return, is stored in the laboratory information management system. Labels are printed with sample information and secured to each sample. Work sheets, containing the sample information, storage location, and analytical requirements, are submitted to the appropriate laboratory managers. Following sample log in, the samples are placed in a secure storage area.

7.3 Field Data

Radian will maintain field records in a manner which will allow a reviewer to recreate all sampling and measurement activities. The requirements apply to all measuring and sampling data. The information will be recorded with indelible ink in a permanently-bound logbook with sequentially-numbered pages.

7.4 Laboratory Data

Laboratory data reports will be issued for each work order generated by the laboratory. A work order is generated for a single client's samples, received by the laboratory on the same day, typically including less than 50 samples, and requiring similar analytical procedures. This may result in multiple work orders for a sample. The analyst is responsible for all of the primary calculations, editing of initial quantitative reports, calculation of percent recoveries and RPDs for comparison to applicable tolerance limits, comparison of QC results to acceptance limits, and compiling all data for peer review. The peer reviewer is responsible for checking that calibration and QC results meet applicable tolerance limits and checking a subset of results for analytes from a subset of samples included in each analytical batch. The work order results are reported in both hard copy and electronic format. Radian will maintain records of all laboratory data, including sample IDs, analytical results, detection limits, analytical methods, and other related data.

7.6 Data Analysis and Reporting

Tabular and graphic summarization will be used to present the results of all data collection efforts in the final report. Radian will compile and report the data generated during the project within 45 days following the completion of field sampling.

Tables summarizing field and/or laboratory data will be generated from the project database. Data in the tables will be verified against hard-copy laboratory reports. For laboratory data, both environmental sample and QC sample results will be reported.

Tables will be used in the report as a convenient means of presenting a summary of the analytical results. Approximate sampling locations will be noted on CADD-based figures included in the site characterization report. Contour plots may be generated to pictorially present analytical data. Analytical laboratory reports will be stored at the site for a minimum of five years and will be made available to agency reviewers upon request.

8.0 REFERENCES

1. "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 & SWMU-10," Radford Army Ammunition Plant, 12 December 1995.

2. Chemical Data Quality Management for Hazardous Waste Remedial Activities, ER 1110-1-263, 1 October 1990, U.S. Army Corps of Engineers.

3. Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3, 1 September 1994, U.S. Army Corps of Engineers.

4. "Foundation Analysis for Project No. 33.10B," Norfolk District, U.S. Army Corps of Engineers, 1977.

5. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington, DC, September 1994.

Appendix B

BORING LOGS

Radian Corporation
Herndon, VA

LOG OF BORING BG-0

Page 1 of

DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	MATERIALS DESCRIPTION
							Clayey Sand: fine grained, brown, trace mica, loose, damp.
	RAAP-BG 01-04 01	2.0-4.0	100%	3 4 5 6	2.0	SC	
		4.0-6.0	100%	3 4 8 8	0.0	SC	Clayey Sand: as above, brown to red.
5							
		6.0-8.0	100%	4 7 8 7	0.0	SC	Clayey Sand: as above, trace quartz gravel.
							Bottom of boring at 8.0 feet.
10							
15							

PROJECT RAAP EQ Basin Closure

LOCATION Radford, Virginia

JOB NUMBER 631-210-01

GEOLOGIST RT Church

DRILL RIG Hollow Stem Auger

DRILLING COMPANY Bedford Drilling Services

DATE DRILLED 9/24/96

SURFACE ELEVATION 1704.53 ft MSL

TOTAL DEPTH OF HOLE 8.0 Feet

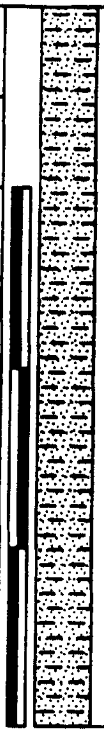
WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-02

Page 1 of 1

DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	DEPTH (ft)	MATERIALS DESCRIPTION
								Clayey Sand: fine grained, brown, trace mica, loose, damp.
	RAAP-BG 02-04 01	2.0-4.0	100%	4 5 4 6	2.0	SC		
		4.0-6.0	100%	5 6 8 8	0.0	SC		Clayey Sand: as above
5							5	
		6.0-8.0	100%	5 7 9 7	0.0	SC		Clayey Sand: as above.
								Bottom of boring at 8.0 feet.
10							10	
15							15	



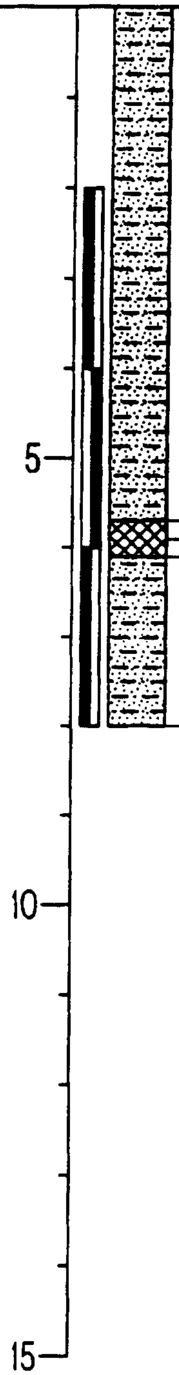
PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger
DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/24/96
SURFACE ELEVATION 1711.11 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-0

Page 1 of

DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	MATERIALS DESCRIPTION
	RAAP-BG 03-04 01	2.0-4.0	100%	4 5 16 21	1.0	SC	Clayey Sand: fine grained, brown to red, trace mica, trace gravel, medium dense to dense, dry.
		4.0-6.0	100%	6 7 21 47	2.0	SC	Clayey Sand: as above
		6.0-8.0	100%	5 7 10 6	1.0	SC	cobble: 5.7 ft. to 6.1 ft. Clayey Sand: as above.
							Bottom of boring at 8.0 feet.



PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger

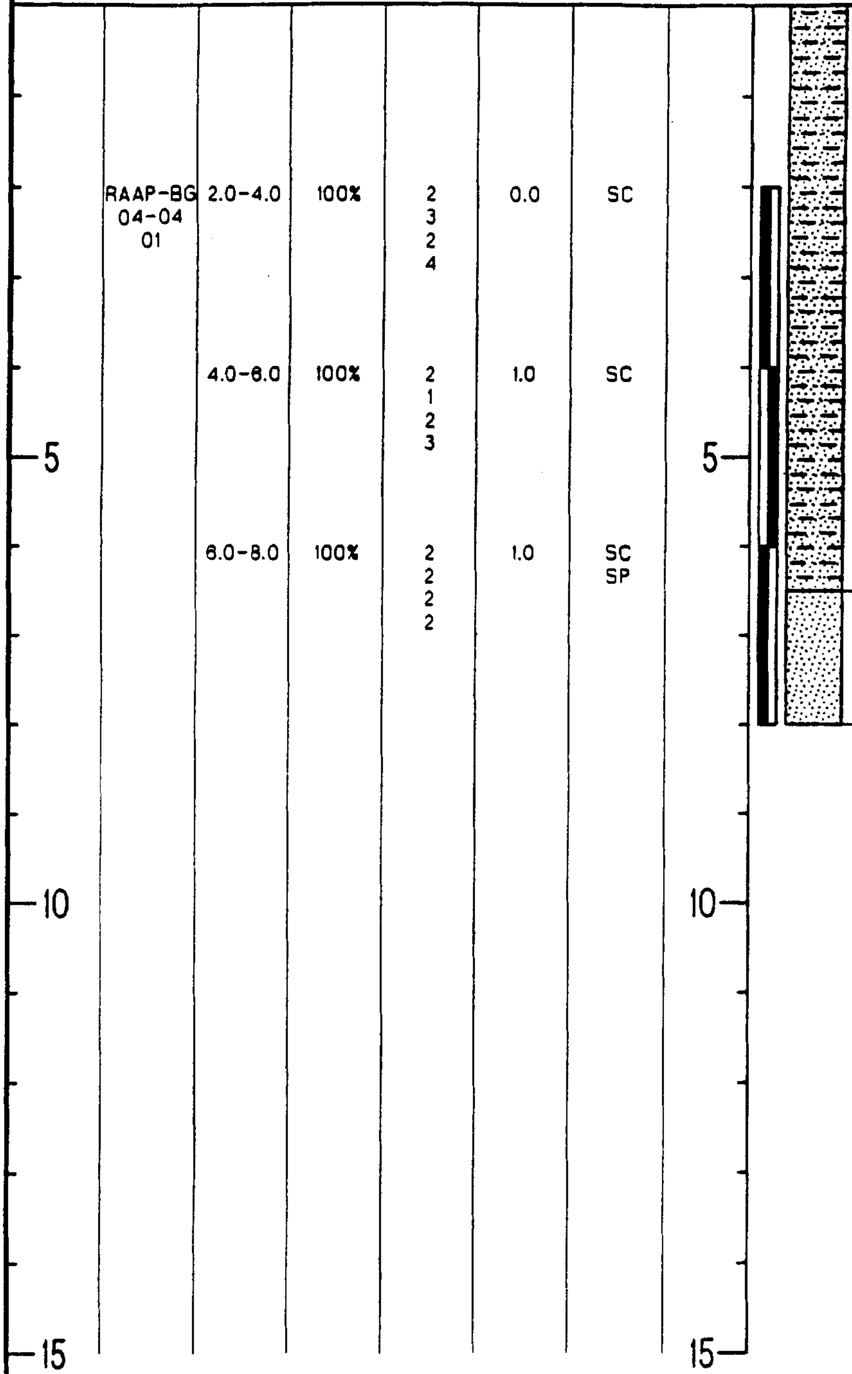
DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/24/96
SURFACE ELEVATION 1710.77 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-04

Page 1 of 1

Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	MATERIALS DESCRIPTION
RAAP-BG 04-04 01	2.0-4.0	100%	2 3 2 4	0.0	SC	Clayey Sand: fine grained, brown, trace mica, loose, damp.
	4.0-6.0	100%	2 1 2 3	1.0	SC	Clayey Sand: as above
	6.0-8.0	100%	2 2 2 2	1.0	SC SP	Sand: fine grained, brown, trace mica, loose, damp.



Bottom of boring at 8.0 feet.

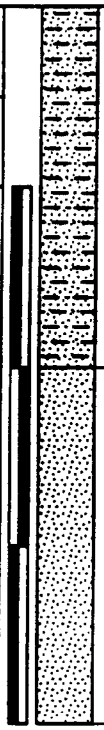
PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger

DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/24/98
SURFACE ELEVATION 1697.57 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-05

Page 1 of



DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	DEPTH (ft)	MATERIALS DESCRIPTION
	RAAP-BG 05-04 01	2.0-4.0	100%	4 4 5 5	0.0	SC		Clayey Sand: fine grained, brown, trace mica, medium dense, dry.
5		4.0-6.0	100%	3 4 3 4	0.0	SP	5	Sand: fine to medium grained, brown to red, trace clay, trace mica, moist to wet at 6.0 ft.
		6.0-8.0	100%	3 3 15 16	0.0	SP		Sand: as above.
								Bottom of boring at 8.0 feet.
10							10	
15							15	

PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger

DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/23/98
SURFACE ELEVATION 1698.58 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL 6.0 Feet

Radian Corporation
Herndon, VA

LOG OF BORING BG-06

Page 1 of 1

DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	MATERIALS DESCRIPTION
	RAAP-BG 06-04 01	2.0-4.0	100%	8 11 10 10	0.0	SC	Clayey Sand: fine grained, brown, trace mica, medium dense, dry.
5		4.0-6.0	100%	8 9 11 10	0.0	SC	Clayey Sand: as above, damp.
		6.0-8.0	100%	13 12 13 18	0.0	SC	Clayey Sand: as above.
10							Bottom of boring at 8.0 feet.
15							

PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger

DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/23/98
SURFACE ELEVATION 1706.89 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-07

Page 1 of 1

DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	DEPTH (ft)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION
	RAAP-BG 07-04 01	2.0-4.0	100%	4 4 5 5	1.0	SC				Clayey Sand: fine grained, brown with red mottling, trace mica, medium dense, damp to dry.
5		4.0-6.0	100%	4 7 9 7	0.0	SC	5			Clayey Sand: as above, trace coarse gravel, damp.
		6.0-8.0	100%	5 9 7 9	0.0	SC				Clayey Sand: as above.
										Bottom of boring at 8.0 feet.
10							10			
15							15			

PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger
DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/23/96
SURFACE ELEVATION 1706.56 ft MSL
TOTAL DEPTH OF HOLE 8.0 Feet
WATER LEVEL

Radian Corporation
Herndon, VA

LOG OF BORING BG-08

Page 1 of 1

DEPTH (ft)	Sample No.	Sample Interval	Recovery	Blow Counts	PID (ppm)	USCS Code	MATERIALS DESCRIPTION
	RAAP-BG 08-04 01	2.0-4.0	100%	4 3 4 4	0.0	SC	Clayey Sand: fine grained, brown, trace mica, loose, damp.
5		4.0-6.0	100%	3 3 2 3	0.0	SP	Sand: fine grained, brown, trace clay, trace mica, loose, damp.
		6.0-8.0	100%	3 2 3 3	0.0	SP	
		8.0-10.0	100%	2 1 2 3	0.0	SP	Sand: as above, wet at 7.5 feet below grade. ▼
10							Bottom of boring at 10.0 feet.
15							

PROJECT RAAP EQ Basin Closure
LOCATION Radford, Virginia
JOB NUMBER 631-210-01
GEOLOGIST RT Church
DRILL RIG Hollow Stem Auger

DRILLING COMPANY Bedford Drilling Services
DATE DRILLED 9/23/98
SURFACE ELEVATION 1702.91 ft MSL
TOTAL DEPTH OF HOLE 10.0 Feet
WATER LEVEL 7.5 Feet

FINAL

Chemical Data Acquisition Plan (CDAP)

Bioplant Equalization Basin Closure
Site Investigation/Evaluation
Radford Army Ammunition Plant
Radford, Virginia

Submitted to:

Norfolk District
U.S. Army Corps of Engineers

CHEMICAL DATA ACQUISITION PLAN (CDAP)
BIOPLANT EQUALIZATION BASIN CLOSURE
SITE INVESTIGATION/EVALUATION
RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Prepared for:

Norfolk District, U.S. Army Corps of Engineers
Engineering Division
HTRW Branch

Prepared by:

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Contract No. DACA65-95-D-0030
U.S. Army Corps of Engineers
Norfolk District

September 1996

MLM/057
0404-01.mlm

PURPOSE OF DOCUMENT

This Chemical Data Acquisition Plan (CDAP) is for use by field and laboratory personnel during the Bioplant Equalization Basin Closure Site Investigation/Evaluation at Radford Army Ammunition Plant (RAAP). The CDAP details the procedures for sample collection, sample analysis, and quality control measures. Conformance with the plan by field and laboratory personnel will ensure a quality and thorough site investigation.

The success of the closure at RAAP depends upon the field and laboratory personnel closely following guidance provided in the CDAP. Every effort will be made to ensure adherence to the procedures provided in the CDAP.

Radford Army Ammunition Plant Chemical Data Acquisition Plan Approval

This Chemical Data Acquisition Plan was developed for the Bioplant Equalization Basin Site Closure at Radford Army Ammunition Plant, Radford, Virginia. The signatures of key project personnel below indicate concurrence with the procedures specified in the plan and a commitment to communicate the plan and the philosophy of quality to all project personnel.

Torsten Rothman, Contract Manager

Signature: ____________________ Date: ________________

William Hearn, Project Manager

Signature: ____________________ Date: ________________

Steve Falatko, Project QA Coordinator

Signature: ____________________ Date: ________________

This plan is approved for use in the Radford Army Ammunition Plant, Bioplant Equalization Basin Site Closure.

Steve Lantz, USACE Project Manager

Signature: ____________________ Date: ________________

Marc Gutterman, USACE Project Chemist

Signature: ____________________ Date: ________________

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1.0 PROJECT DESCRIPTION

This section provides a brief project description, an overview of project objectives, the environmental setting and a site description.

1.1 Background

This Chemical Data Acquisition Plan (CDAP) outlines a site investigation/evaluation for the proposed closure of the Bioplant Equalization (EQ) Basin at Radford Army Ammunition Plant (RAAP), Radford, Virginia. A closure plan has been approved by the Virginia Department of Environmental Quality (VaDEQ). The plan is entitled "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 and SWMU-10" dated 12 December 1995. The basin was originally part of the wastewater treatment system at RAAP, but has been taken out of service.

The EQ Basin received wastewater from various manufacturing processes at the facility. The EQ Basin is constructed of an approximate 12-inch thick bentonite liner overlying compacted soil made up of sand, silt, and clay. This CDAP provides for a site investigation to determine if the subsoil under the liner contains concentrations of the chemicals of concern in excess of background concentrations of those chemicals. The closure plan identifies 70 Hazardous Constituents of Concern (HCOC).

Under contract to the U.S. Army Corps of Engineers, Norfolk District, Radian will perform a site investigation to characterize shallow subsurface soils for the presence of organics, metals, and cyanide. Radian also will characterize the materials comprising the basin liner and the basin's concrete wall for waste disposal purposes. The investigation will be completed according to Delivery Order #10, Contract DACA65-95-D-0030. This document is prepared according to the USACE requirements outlined in

Chemical Data Quality Management for Hazardous Waste Remedial Activities, ER 1110-1-263, 1 October 1990, and in *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, 1 September 1994.

1.2 Objective

The objective of this site investigation/evaluation is to determine if HCOCs have impacted the subsoil below the basin liner in concentrations greater than found in background soil samples in the area of the basin and to determine the proper disposal procedure for the liner and concrete wall. This information will provide input to the type of closure required for the EQ Basin.

1.3 Environmental Setting

This subsection describes the environmental setting of the Radford Army Ammunition Plant (RAAP), Radford, Virginia. Included in the subsection are discussions of the site topography, geology, hydrogeology, and surface water features based on data compiled from existing RAAP records.

1.3.1 Topography

The site is located in the Valley and Ridge Physiographic province of southwestern Virginia. Within the RAAP, the EQ Basin site is located along the upper flood plain of the New River, which makes a horseshoe meander through the plant property. The ground surface elevation of the site generally slopes northward with a relief of 1,707 feet mean sea level (ft MSL) to 1,684 ft MSL at the New River (Norfolk COE, 1977).

1.3.2 Geology

According to Norfolk COE (1977), the site lies on the Pulaski thrust sheet approximately 1 mile from the fault zone. The site is underlain by the Cambrian-age Elbrook formation, which consists of light to dark grey argillaceous limestone. Much of the Elbrook formation beneath the site has been brecciated by mass movement along the fault plain, but has been recommended with a fine-grained limy matrix. Bedrock was encountered in test borings, installed before the EQ basin was constructed, at depths between 16 and 20 feet, and was found to be sloping northward.

The unconsolidated material above the bedrock consists an average of 18 feet of alluvium comprised of two distinct layers. The shallower alluvial layer is composed of brown to orange micaceous silts and very fine to fine-grained sands with traces of quartz gravel and cobbles. The shallower alluvial layer ranges from 10 to 15 feet thick. The deeper alluvial layer is composed of fine to coarse-grained sand and quartz gravel and cobbles. The deeper alluvial layer ranges from 2 to 6 feet thick.

Discontinuous layers of residual soils, typically less than 2-feet thick, are encountered in places between the alluvium and top of bedrock. The residual soils are composed of gravel-size bedrock fragments within a silt matrix.

Fill material was encountered in two test borings previously installed through an earthen dike around an abandoned lagoon. The fill material was composed of fine sand and silt.

1.3.3 Hydrogeology

According to Norfolk COE (1977), the average depth to groundwater, encountered at the time the test borings were drilled, was 15 feet. The water table is

present within the deeper alluvial layer. It is anticipated that groundwater flows northward to the New River.

1.3.4 Surface Water

According to Norfolk COE (1977), surface water drainage at the EQ basin site is northward, towards the New River.

1.4 Site Description

The EQ Basin served as a surge/settling basin for the biological wastewater treatment at RAAP. The basin was operated from 1980 until 1994. The following types of wastewater flowed into the basin:

- Non-acidic wastewater from propellant manufacturing;
- Wastewater from nitroglycerine manufacturing and alcohol rectification; and
- Wastewater from ethyl ether recovery.

Solids (sludge) that settled out over the operating life of the basin were removed in November 1995. The sludge was managed as a hazardous waste, K044.

The equalization basin was constructed over an abandoned nitrocellulose settling basin. All sludge was removed and fill material was placed and compacted. A 12-inch thick bentonite bottom was added onto the compacted fill. For flood protection, a concrete wall was constructed on top of the dike in 1987. The basin is located on the south bank of the New River.

2.0 CHEMICAL DATA QUALITY OBJECTIVES

The primary objective of this CDAP is to ensure that data is of the quality necessary to characterize shallow subsurface soils for the presence or absence of organics, metals, and cyanide, and to determine whether any additional investigation/ remediation work is necessary. Data quality objectives (DQOs) include statements of the acceptable levels of measurement uncertainty in chemical data. Measurement objectives are established in terms of precision and accuracy, completeness, representativeness, and comparability.

The overall project quality objectives are to:

- Collect representative samples specified in Section 4 in an effort to determine the presence or absence of organics, metals, or cyanide at the site;
- Ensure data comparability through the use of standard methods and controlled systems to collect and analyze samples; and
- Provide analytical results of known and acceptable precision and accuracy.

The overall uncertainty in chemical data is a function of sampling design, field procedures, and analytical procedures; therefore, attention to quality is required in all of these aspects of the data gathering effort.

Procedures and methods performed in the laboratories will be documented in the form of standard operating procedures (SOPs) which meet or exceed the requirements specified in the analytical methods. This includes the routine analysis of quality control samples which are described in more detail in Section 6.0. Sampling procedures are described in detail in Section 4.0.

2.1 Precision and Accuracy

Precision is a measure of the reproducibility or agreement among repeated measurements. Precision is typically evaluated by calculating the relative percent difference (RPD) between the results from one or more types of "duplicate" analyses. The formula for calculating RPD is:

$$\mathrm{RPD} = \frac{(S - D)}{1/2(S + D)} \times 100$$

where:
S = first sample result
D = duplicate sample result

The overall precision of the entire sample collection, handling, preparation, and analysis process will be evaluated through the analyses of field duplicates. For field duplicates, an RPD of ≤50% is the goal of this program. The precision of the laboratory operations will be evaluated through the analyses of duplicate laboratory control samples. Laboratory precision requirements are detailed in Section 6.0.

The evaluation of precision is often combined with an evaluation of accuracy through the use of spiked sample aliquots, or matrix spike/matrix spike duplicate (MS/MSD) pairs. A known amount of the compound of interest is added to each of two aliquots of the field sample prepared in the laboratory. The spiked samples are then treated to the same handling, extraction, cleanup, and analysis steps as the field samples. The RPD for the spiked samples is calculated and used to evaluate the effects of the matrix on precision and accuracy.

Accuracy is a measure of the agreement between a measured value and a reference or "true" value. Because the "true" concentration of an analyte in a field sample is never known, accuracy in field samples is evaluated through the use of spiked

sample pairs (MS/MSD). As noted above, a known amount of the compound of interest is added to each of two aliquots of the field sample prepared in the laboratory. The spiked samples are then treated to the same handling, extraction, cleanup, and analysis steps as the field samples. The accuracy is expressed as percent recovery (%R). The formula for calculating %R is:

$$\%R = \frac{(SSR - SR)}{SA} \times 100$$

where:
SSR = spiked sample result
SR = sample result
SA = spike added

The objective of this investigation is to achieve method-specified acceptance criteria for precision and accuracy which are presented and discussed in Section 6.0. These limits are based primarily on method validation studies as typically measured in matrices developed from laboratory reagent blanks. Recoveries in actual environmental samples may be less than the method-specified requirements because of matrix interferences. Matrix interferences cannot be controlled but will be evaluated and described in the final report.

2.2 Completeness

Completeness is expressed as the percentage of the amount of valid data (i.e., data which meets the measurement objectives) obtained compared to the amount of data planned. The objective of this project is 90% completeness. Conditions which prevent reaching this objective, such as significant sample matrix difficulties, or sample loss will be evaluated and addressed in the final report.

2.3 Representativeness

The purpose of sampling is to obtain data that represent the system being studied. Representativeness is achieved by carefully selecting sampling sites, sample locations, and sampling intervals; and controlling procedures for sample collection, preservation and handling. Detailed sampling procedures are described in Section 4.0.

2.4 Comparability

Comparability is a qualitative measure of the confidence with which data sets can be compared. Data comparability will be achieved by following approved, standard analytical procedures and by reporting results in standard units of measure, as required in the specific methods.

2.5 Quality Control Samples

The following sections describe quality control samples which will be prepared during both field and laboratory activities.

2.5.1 Field Quality Control Samples

The following samples will be used to assess the quality control of field operations. The frequency for field QC sample collection is discussed in Section 6.0.

- **Trip Blanks**--Trip blanks are samples of organic-free water (HPLC-grade water) which have been transported unopened from the sample bottle preparation area to the sampling site and finally to the laboratory, and will be analyzed for volatile organics. Trip blanks identify the potential for sample contamination from sample bottles and transportation.

- **Field Blanks**--Field blanks are samples of organic-free water (HPLC-grade water) which are poured directly into the sample containers in the vicinity of the sampling locations, and will be analyzed for volatile organics. Field blanks identify the potential for sample contamination from the ambient air.

- **Equipment Rinsate Blanks**--Equipment rinsate blanks are samples of organic-free water (HPLC water) which are poured over the sampling equipment after decontamination. They are designed to identify the potential for cross-contamination of samples from improperly decontaminated equipment.

- **Duplicate Field Samples**--Duplicate field samples are used as indicators of overall measurement data precision. The analysis of duplicate samples involves collecting two samples from the same sampling location and handling them as separate samples. Precision estimates based on duplicate sample results incorporate both sampling and analytical variability.

- **QA Duplicate Samples**--The QA samples are duplicate samples which will be sent to EA Laboratories, as specified by the Norfolk COE. The QA field duplicates will be assigned the same sample number as the initial sample so results may be easily correlated and used as an independent assessment of combined sampling and analytical variability.

2.5.2 Laboratory Quality Control Samples

The following QC samples will be used to control and assess data quality in the laboratory.

- **System Blank**--Deionized water will be analyzed after calibration to assess system contamination.

- **Method Blank**--Reagent water will be taken through the extraction process as though it were an actual sample.

- **Calibration Check Sample**--A standard will be used to verify instrument calibration.

- **Laboratory Control Sample (LCS)**--Known concentration of alternate-source reference materials will be spiked into an aliquot of deionized water. This sample is taken through the digestion/ extraction process as though it were an actual sample. The purpose of an LCS analysis is to verify that the analytical system remains in control.

- **Matrix Spike/Matrix Spike Duplicates (MS/MSD)**--Splits from field samples will be spiked with known concentrations of reference materials and taken through the entire extraction and analysis process. The matrix spike allows the laboratory to assess the efficiency of extraction, accuracy of the analysis, and possible matrix effects. Analysis of a duplicate matrix spike, another aliquot of the sample spiked at the same concentration as the MS, allows the laboratory to assess precision at known concentrations.

- **Surrogate Spikes**--Identifiable compounds not present in the sample matrix are added to every field sample to evaluate method accuracy.

3.0 PROJECT ORGANIZATION AND FUNCTIONAL AREA RESPONSIBILITIES

The project team for the RAAP Equalization Basin Site Closure will be composed of a contract manager, a project manager, a quality assurance coordinator (QAC), laboratory coordinator, and a field task leader. Roles and responsibilities of key personnel are discussed below.

3.1 Roles and Responsibilities

Mr. Torsten Rothman will serve as the Contract Manager. In this role Mr. Rothman will have the overall responsibility, authority, and accountability for the project. He will function as the primary interface between the USACE and the project team. In executing these duties, he will:

- Ensure that all contractual requirements are met;
- Initiate work plans in accordance with client directions;
- Keep the USACE project manager informed on all aspects of the program;
- Be available to the Project Manager for action on any problem requiring additional management or technical support; and
- Review technical project outputs prior to issue.

Mr. William Hearn will serve as the Project Manager. In this capacity, he will be responsible for organizing and directing the technical activities of the project and for reporting the results of these activities. He will have day-to-day interaction with the technical staff. In the execution of these duties, Mr. Hearn will:

- Establish technical objectives and direct the preparation and review of work plans;
- Be responsible for responding to work plan revisions;
- Advise the contract manager of technical progress, expenditures, program needs, potential problems, and recommended solutions;
- Ensure technical quality of reports, memoranda, and other communications through review of results; and
- Maintain contact with the USACE project manager in areas that require decisions on technical matters.

Mr. Steve Falatko will serve as the QAC. In this role, he will be responsible for developing and executing quality assurance (QA) activities in all phases of the project. In fulfilling these responsibilities, he will:

- Coordinate any external QA audit activities requested by the USACE;
- Serve as an in-house consultant to the project manager and task leaders in defining data quality goals or requirements;
- Implement any necessary corrective action; and
- Document the results of all QA/QC activities in reports to project management and to clients.

Mr. Todd Church will serve as task leader for the field investigation. His responsibilities include field preparation, supervision of field activities, and preparation of the final report. The general responsibilities of the task leader are as follows:

- Supervise the subcontractor activities;
- Maintain close contact with the project manager so that schedule, budget, and/or technical problems are addressed in a timely manner;

- Coordinate day-to-day QC activities and completion of daily quality control reports (DQCRs), as required as part of the internal QC system;
- Serve as site safety officer during the field investigation and ensure compliance with the SSHP;
- Ensure compliance with all QC acceptance criteria as specified in the CDAD; and
- Keep the QAC and project director advised of any quality problems that arise.

Mr. Church will also supervise the project field staff, and will be responsible for all on-site activities, including any necessary coring activities, sample collection, field analysis, chain of custody, and reporting.

The laboratory client services representative will also be Mr. Steve Falatko. He will have ultimate responsibility for ensuring that all analyses performed at the laboratories adhere to the methods and criteria specified in Section 6.0 of this CDAP.

3.2 Laboratory Qualifications

The RAAP subsurface and background samples will be analyzed by Quanterra Incorporated in West Sacramento, California, and Savannah Laboratories in Tallahassee, Florida, depending on the specified method. Radian's laboratory in Austin, Texas, will perform the liner and concrete sample analyses. All of the laboratories have been certified by the USACE Missouri River Division.

3.3 Subcontractor Qualifications

A Virginia licensed drilling company will be subcontracted to provide all drilling and subsurface sampling for the project. At the time this CDAP was prepared,

the drilling subcontractor was not selected. This plan will be updated at the time the drilling subcontractor is selected.

4.0 FIELD ACTIVITIES

A field sampling program will be conducted at the EQ Basin site at the RAAP in support of the closure plan for the EQ Basin. This plan was part of the document entitled, "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 & SWMU-10, Radford, Virginia", dated December 12, 1995. The field activities include chip sampling of the concrete flood control wall installed around the EQ Basin, sampling of the soil cement liner which served as the floor of the EQ Basin, sampling of the subsoil beneath the soil cement liner, and sampling of background soil similar to the subsoil below the soil cement liner. Chemical analytical data will be used to determine the appropriate procedures for the EQ Basin closure and the disposal options of the wastes generated during closure activities. The required equipment, field procedures, field documentation, and site-specific investigation strategies are discussed in detail in this section.

4.1 List of Equipment, Containers, and Supplies

Table 4-1 summarizes the specific equipment, containers, and supplies required for the collection of the field samples.

4.2 Sampling Locations

The RAAP EQ Basin Closure Plan specifies the number and location of the sample of the concrete flood wall, the soil cement liner and associated subsoil, and the background soil.

Table 4-1

List of Supplies

Sampling Equipment and Supplies:

- Sampling Containers
- Stainless Steel Hand Augers
- Split Spoon Samplers
- Boring Log Forms
- Daily Quality Control Report Sheets
- Camera and Film
- One-gallon Plastic Storage Bags
- Marking Pens
- Hammers and Chisels
- Portable Concrete Corer
- Traffic Cones
- Coolers with Ice
- Stainless Steel Bowls
- Measuring Tape
- Chain of Custody Forms and Seals
- Shipping Airbills
- Field Notebook
- Sample Labels
- Drum Labels
- Trash Bags
- Plastic Sheeting
- Bentonite Pellets

Decontamination Equipment and Supplies:

- Phosphate Free Detergent
- Scrub Brushes
- Steam Cleaner
- Plastic Squirt Bottles
- Trash Bags
- Potable Water
- Distilled/Deionized Water
- Organic-Free Water
- Plastic Wash Tub
- Paper Towels
- Plastic Sheeting
- Five-gallon Buckets
- Aluminum Foil

Safety Equipment:

As specified in Radian's Site-Specific Safety and Health Plan (SSHP). The SSHP will be approved by the Norfolk District Industrial Hygienist prior to beginning any work on site.

4.2.1 Concrete Flood Wall Samples

Chip samples of the concrete flood wall around the EQ Basin will be collected from four representative locations and analyzed for hazardous waste characteristics. The exact locations of these chip samples will be finalized in the field by the supervising geologist in consultation with RAAP personnel. These chip samples will be collected by hand using hammers and chisels. These samples will be analyzed for the toxicity characteristic analytes following the TCLP extraction.

4.2.2 Soil Cement Liner

One composite sample of the 1-foot thick soil cement liner will be collected from the EQ Basin and analyzed for hazardous waste characteristics. Cores of the liner will be collected from seven randomly-selected nodes out of the 15 total nodes shown on Figure 4-1. The final locations of the liner samples may be adjusted in the field in order to collect samples at locations where cracks in the liner may have allowed leakage of wastewater to the subsoils. The liner will be cored using a diamond bit core barrel. Samples will be chipped off each of the seven cores with hammers and chisels, and then composited to make a single composite chip sample. This sample will be analyzed for the toxicity characteristic analytes following the TCLP extraction.

4.2.3 Subsoil

Seven samples of the subsoil below the soil cement liner will be collected from the same locations used to obtain liner samples. Subsoil samples will be collected at a depth of 0-6 inches below the bottom of the liner with a stainless steel hand auger and stainless steel trowels. These soil samples will be analyzed for the HCOCs.

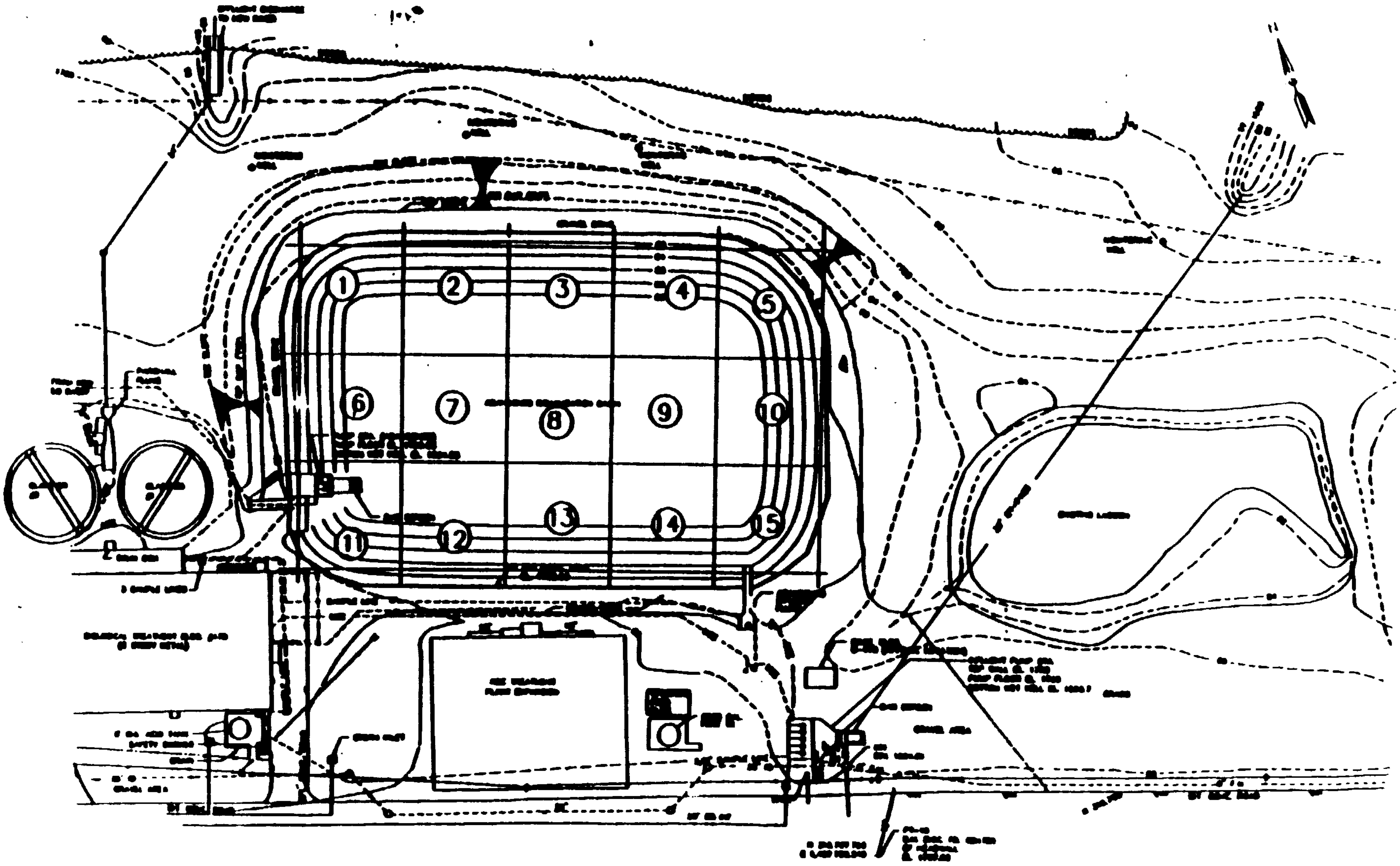


Figure 4-1. Proposed Sampling Locations

4.2.4 Background Soil

Eight soil borings will be drilled at locations upgradient of the EQ Basin in order to obtain soil samples for characterization of background chemical concentrations. These borings will be located in areas that are reasonably expected to be uncontaminated by industrial activities, and will be finalized in the field by the supervising geologist in consultation with RAAP personnel. One sample of background soil will be collected and analyzed per boring, for a total of eight background soil samples. The borings will be drilled with a hollow-stem auger drill rig using a minimum 2-inch diameter, standard split spoon to collect the soil samples. The background soil samples will be collected in soil that is lithologically similar to the subsoil below the liner. These samples will be analyzed for HCOCs.

4.3 General Information and Definitions

4.3.1 Laboratory Information

Laboratory analyses will be conducted by Quanterra Incorporated in Sacramento, California, Savannah Laboratories in Tallahassee, Florida, and by Radian's laboratory in Austin, Texas. EA Laboratories will serve as the COE-designated QA laboratory.

4.3.2 Decontamination Procedures for Drilling and Sampling Equipment

All hand-held sampling tools that will come in contact with samples will be decontaminated by the following:

1. Wash in a phosphate-free detergent and potable water solution;
2. Rinse with potable water;
3. Rinse with distilled water;

4. Final rinse with organic-free water; and
5. Air dry.

Large pieces of equipment, such as the drilling rig and hollow-stem augers, will be decontaminated by steam cleaning with potable water. Decontamination of this equipment will take place on a temporary decontamination pad.

Decontamination procedures will take place at the start of field work and between each sample collection. The subcontractor will supply several split spoon samplers so that a stock of decontaminated split spoons will be available during the background soil sampling effort. Wash and rinse water generated during decontamination activities will be handled in accordance with the procedures outlined in Section 4.3.3 of this plan.

4.3.3 Disposal of Drill Cuttings and Decontamination Water

Drill cuttings will be generated during the background soil sampling effort. Drill cuttings will be containerized in DOT-approved 55-gallon drums. Each drum will be labelled showing its content, origin, and date of generation. The drum contents will be sampled for waste characterization, and disposal options will be coordinated with RAAP personnel following receipt of the analytical results.

Following completion of the subsoil sampling effort, any volume of soil remaining will be placed back into the coreholes.

Following completion of the liner coring and sampling effort, the remaining volume of the liner cores will be temporarily stored in a plastic-lined 55-gallon drum. These cores will be held so that they can be included in the final closure procedures along with the rest of the liner. This drum will also be labelled showing its content and dates of generation.

All decontamination water will be containerized in DOT-approved 55-gallon drums. Each drum will be labelled showing its content, origin, and date of generation. The drum contents will be sampled for waste characterization, and disposal options will be coordinated with RAAP personnel following receipt of the analytical results.

4.3.4 Site Restoration

The EQ Basin will be restored to its original condition following completion of the sampling activities. Coreholes through the liner will be backfilled with hydrated bentonite to seal the holes and prevent any rainwater that may collect in the basin from draining to the subsoil. The background soil borings will be backfilled upon completion with a Portland cement and bentonite grout. The restoration efforts must meet the approval of RAAP personnel.

4.3.5 Utility Clearance

RAAP personnel will conduct site utility clearance investigations following agreement on the location of proposed background soil borings. Utility clearances will be obtained prior to initiating site activities.

4.4 Sampling and Analysis Procedures

A total of 15 soil samples (7 from the subsoil below the liner and 8 from background soil borings) and a total of 5 chip samples (4 from the concrete flood wall and 1 composite from the soil cement liner) will be collected during sampling activities at the site. This section describes the sampling methodologies including sampling and QA/QC procedures; analysis; and sample containers, preservation, and holding times.

4.4.1 Soil Sample Collection

Soil samples, including QA/QC samples, will be collected for laboratory analysis from 15 locations at the site. Seven of the samples are from the basin liner subsoil, and eight are from background soil borings located upgradient of the basin.

Samples of basin liner subsoil will be collected from a depth of 0 to 6 inches below the bottom of the liner with a stainless steel hand auger. Samples will be collected by advancing the hand auger to the 6-inch depth, removing it from the hole, and then initially filling the sample containers for volatile organic analysis directly from the auger bucket. After the volatile organics containers are filled, the remainder of the sample volume will be mixed in a stainless steel bowl before filling the remainder of the sample containers for the other analyses. Basin liner subsoil will be lithologically described by a Radian geologist.

Samples of background soil will be collected from soil borings by the drilling subcontractor using 2-inch or 3-inch diameter, standard split spoons. Background samples will be collected by retrieving the split spoon from the borehole and initially filling the sample containers for volatile organic analysis directly from the opened split spoon. After the volatile organics containers are filled, the remainder of the sample volume will be mixed in a stainless steel bowl before filling the remainder of the sample containers for the other analyses.

Each background soil boring will be continuously sampled and lithologically described in order to determine the depth at which the background soil, lithologically similar to the basin liner subsoil, is first encountered. The background soil borings will be drilled using a maximum 4.25-inch inside diameter hollow-stem auger. All lithologic descriptions will be made by the Radian geologist while on site and recorded on a geologic log, an example of which is shown in Figure 4-2. All soil samples

Figure 4-2 Geologic Log

Radian International, LLC
Herndon, Virginia

LOG OF BORING _____

Page 1 of

DEPTH (ft)	USCS Code	Recovery (%)	Blows/6"	PID (ppm)	Sample Interval	Sample No.	DEPTH (ft)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION
5							5			
10							10			
15							15			
20							20			

PROJECT ______________________
LOCATION ______________________
JOB NUMBER ______________________
GEOLOGIST ______________________
DRILL RIG ______________________
DRILLING COMPANY ______________________
DATE DRILLED ______________________
SURFACE ELEVATION ______________________
TOTAL DEPTH OF HOLE ______________________
WATER LEVEL ______________________

will be visually classified according to the Unified Soil Classification System (ASTM-D-2488). Completed logs will be included in the final report.

Soil samples will also be screened in the field for the presence of total organic vapors by allowing a portion of each sample to volatilize in a sealed plastic bag for a minimum of 15 minutes in a warm location. The probe of an HNu photoionization detector (PID) will be inserted into the bag to measure the organic vapor concentration. These measurements will be recorded on the geologic logs.

Immediately after filling, all soil sample containers will be affixed with sample labels showing field sample number and other required information (see Section 4.7) and cooled to approximately 4°C by placing them in a durable cooler containing regular ice.

4.4.2 Basin Liner/Flood Wall Chip Sample Collection

A total of five chip samples for the purpose of hazardous waste characterization will be collected from 11 locations at the site. One sample will be a composite from seven cores of the soil cement basin liner. The remaining four chip samples are from the concrete flood wall located around the basin.

Samples of the soil cement basin liner will be collected by initially coring the liner in seven locations with a portable concrete coring machine using a minimum 6-inch diameter diamond tip core barrel. After the core barrel penetrates the 1-foot thickness of the liner, the resulting liner core will be removed and placed on plastic sheeting. After all the cores are collected, the sides of each liner core will be chipped with a hammer and chisel along the entire height of the core. The chips from each core will be mixed to create one composite sample.

Four chip samples of the concrete flood wall will be collected from four locations with a hammer and chisel. The concrete chips will be collected on plastic sheeting at the bottom of the wall at each sample location until sufficient sample volume is collected.

Immediately after filling, all chip sample containers will be affixed with sample labels showing field sample number and other required information (see Section 4.7) and cooled to approximately 4°C by placing them in a durable cooler containing regular ice.

Use of the portable coring machine will require an electrical source to power the machine, and a water source to supply water to cool the barrel during coring. The water will be collected at each coring location with a "wet-dry" vacuum and then placed into 55-gallon drums, which will be handled in the same manner outlined in Section 4.3.3.

4.4.3 Analyses

Table 4-2 presents a summary of the analyses to be performed on all soil samples and the chip samples from the basin liner and concrete flood wall. Sample preparation and chemical analysis will be performed according to procedures published in *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846* (EPA, Third Edition, November 1986 and its Updates, September 1994).

4.4.4 Sample Containers, Preservation, and Holding Times

The sample containers, preservation, and holding times are summarized in Table 4-3. All containers used for chemical analyses will be precleaned by the container supplier, in accordance with EPA protocol.

Table 4-2

Sampling and Analysis Summary

Method	Parameters	Primary Sample Location Subsurface/ Background	Field Duplicate Subsurface/ Background	MS/MSD Subsurface/ Background	Equipment Rinsate Blanks[a]	Trip Blank/Field Blank	Total A-E Samples	External QA Dups[b]
Methods 8021 and 8240B	Volatile Organics	7/8	1/0	1/1	1/1	2/2	26	2
Methods 8070, 8090, 8110, 8121, 8151, 8270B, 8310, and 8330	Semivolatile Organics	7/8	1/1	1/1	1/1	0/0	22	2
Method 8080A	Pesticides/PCBs	7/8	1/0	1/1	1/1	0/0	22	2
Methods 6020 and 7471	Metals	7/8	1/0	1/1	1/1	0/0	22	2
Method 9012	Cyanide	7/8	1/0	1/1	1/1	0/0	22	2
Method 1311	Full TCLP Suite	5	0	0	0	0	5	2

[a] Equipment rinsate blanks include one aqueous sample generated from the soil sampling equipment rinsate from the auger used for the subsurface sampling; and one sample generated from the split spoon used for the background sampling equipment rinsate.

[b] QA field duplicate samples submitted to EA Laboratories for analysis, including trip blanks for volatile organics.

Table 4-3

Sample Containers, Preservation, Holding Times, and Laboratory

Reference Method	Container No., Volume, and Type	Preservation and Storage Requirements	Maximum Holding Time (Preparation)/Analysis	Laboratory Performing Analysis
Soil Samples				
8021A	(2) 120-mL glass, Teflon-lined cap	4°C	N/A	Savannah
8240B	(2) 120-mL glass, Teflon-lined cap	4°C	N/A	Savannah
8070	(2) 500 mL glass, wide mouth jar	4°C	7 days/40 days	Savannah
8090				
8110				
8121				
8151				
8270B				
8310				
8330				
8080A				
6020	(1) 500 mL glass, wide mouth jar	4°C	180 days	Quanterra
7471			28 days	Quanterra
9012			N/A	Quanterra
Concrete Samples				
TCLP (1311)	(1) 125 mL glass jar and (1) 500 mL glass, wide mouth jar	4°C	7 days	Radian

4.5 Quality Assurance/Quality Control Samples

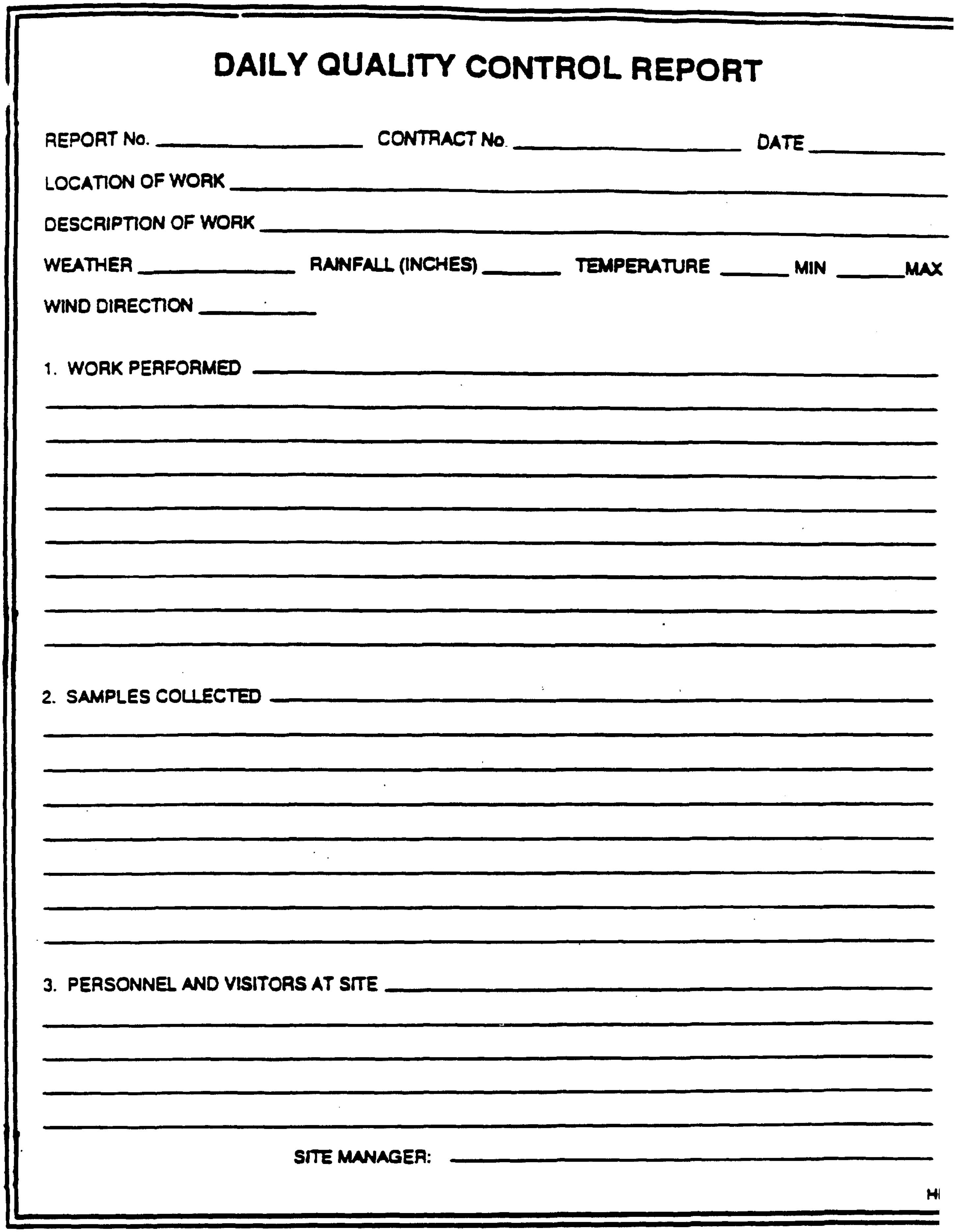
A field QA/QC program will be used to ensure that data quality objectives are met. Sample collection errors will be controlled through the use of standard sample collection methods and field log books. Environmental matrix effects will be estimated by evaluating standard QA/QC samples such as matrix spikes and field duplicates. The following field QA/QC samples will be collected:

- Trip Blanks. One trip blank will accompany each cooler containing volatile organic sample containers, and analyzed only for volatile organics;
- Duplicate Sample. One duplicate soil sample will be collected during this subsurface investigation;
- QA Split Sample. One QA split soil sample will be collected and shipped to the government's QA laboratory;
- Matrix Spike and Matrix Spike Duplicate (MS/MSD). One MS/MSD pair will be collected from both the subsurface investigation and from the background sampling;
- Equipment Rinse Blank. One equipment rinse blank will be collected from the soil sampling equipment; and
- Field Blank. One field blank consisting of organic-free water will be collected from both the subsurface investigation and from the background sampling and analyzed only for volatile organics.

4.6 Field Documentation

A field log book and daily quality control report (DQCR) will be maintained by the supervising Radian geologist. A copy of a DQCR sheet is presented in Figure 4-3. All observations made during field activities will be recorded in indelible ink as necessary to maintain a thorough record of all field activities. The field log book is a bound book with sequentially numbered pages and a unique document control

Figure 4-3. AE Daily QC Report



DAILY QUALITY CONTROL REPORT

REPORT No. ____________ CONTRACT No. ____________ DATE ____________

LOCATION OF WORK ____________

DESCRIPTION OF WORK ____________

WEATHER ____________ RAINFALL (INCHES) ________ TEMPERATURE ________ MIN ________ MAX

WIND DIRECTION ____________

1. WORK PERFORMED ____________

2. SAMPLES COLLECTED ____________

3. PERSONNEL AND VISITORS AT SITE ____________

SITE MANAGER: ____________

HI

number. All corrections will be crossed out with a single line. The Radian field geologist will sign and date the logbook and DQCR sheets at the end of each work day. Radian will submit the DQCRs to the USACE project manager at the conclusion of the field program.

4.7 Sample Chain of Custody, Packing, and Transportation

A sample label and custody seal, shown in Figure 4-4, will be affixed to all sampling containers submitted for laboratory analysis. The labels will document the sample type, matrix, initials of the sampler(s), sampling locations, depth, time, date, and unique number assigned to each sample. Indelible ink will be used to complete all sample labels.

A chain-of-custody record, shown in Figure 4-5, will be used to record the number of samples collected and the corresponding laboratory analyses; indelible ink will be used. Information on this form includes time and date of sample collection, sample number, type of sample, sampler's name, preservatives used, and any special instructions. Samples collected for matrix spike/matrix spike duplicate analysis will be identified on the chain-of-custody form. A copy of the chain-of-custody form will be retained by the field geologist along with other field documentation.

All samples will be kept on ice in a double plastic bag following collection and during shipment. The samples will also be sealed in plastic bags. The samples will be stored upright in a durable ice chest. Sufficient packing material (i.e., vermiculite) will be used to separate the bottles, filling any intervening voids.

The ice will be placed above and around the top of the sample containers. The remaining space will be filled with additional packing material. The chain-of-custody form will be sealed in a plastic Ziploc® bag and affixed to the top lid of the cooler. The cooler will be secured by completely wrapping it with strapping tape around

Figure 4-4. Sample Label and Custody Seal

Field Number ____________________

Sample Type: ____________________

Client: ____________________

Location: ____________________

Preservative: ____________________

Sampler: ____________________

Date: ____________________

Comment: ____________________

6-89-31426

ATTENTION:
BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.

I.D. # ____________________

ATTENTION:
BEFORE OPENING
NOTE IF CONTAINER
WAS TAMPERED WITH.

6-89-31426

ADIAN
RPORATION

Chain of Custc Record

Return Original to Originatr
☐ Yes ☐ No

Project No.	Project Name
Samplers *(Name/Signature)*	

Field Number	Collection Date	Collection Time	Sample Name	No. of Bottles	ANALYSES						Comments (Type of Container, Special Preservation, Special Handling, etc.)

Relinquished by: *(Name/Signature)*	Date/Time	Received by: *(Name/Signature)*	Date/Time	Carrier: *(In person, Fed X, UPS, etc.)*
Relinquished by: *(Name/Signature)*	Date/Time	Received by: *(Name/Signature)*	Date/Time	Carrier: *(In person, Fed X, UPS, etc.)*
Relinquished by: *(Name/Signature)*	Date/Time	Received by: *(Name/Signature)*	Date/Time	Carrier: *(In person, Fed X, UPS, etc.)*

General Comments:

6-91-3C019

Distribution: Original: Accompanies Samples (Return to Originator), Yellow Copy: Field Crew, Pink Copy: Laboratory Files

Figure 4-5. Chain-of-Custody Record

both ends. If there is a drain on the cooler, it will be taped shut. Custody seals, shown in Figure 4-4, will also be affixed to coolers to indicate tampering.

Samples will be shipped daily to the laboratory by overnight courier. The laboratory will be notified at least one week before samples are shipped to coordinate delivery. The following address will be used for sample shipment:

Lou Schneider
Savannah Laboratories
2846 Industrial Plaza Drive
Tallahassee, Florida 32317-3056
(904) 878-3994

Nilo Ligi
Quanterra Incorporated
880 Riverside Parkway
West Sacramento, California 95605
(916) 374-4427

Kelly Young
Radian Corporation
14046 Summit Drive, #101
Austin, Texas 78728
(512) 244-0855

Quanterra will perform the soil analyses for the metals and cyanide. Savannah Laboratories will perform the volatiles organics, semivolatile organics, and pesticides/PCBs analyses. Radian will perform the TCLP analyses.

If Saturday delivery is required, samples are to be sent to the same addresses. For coordination of sample delivery on Saturday, mark "Saturday Delivery" on the Federal Express airbill.

External QA Samples will be sent to:

EA Laboratories
19 Loveton Circle
Sparks, Maryland 21152
ATTN: Sample Management Office

5.0 LABORATORY ANALYTICAL PROCEDURES

The methods and procedures that will be used to prepare and analyze samples are discussed in this section. Laboratory-specific SOPs and laboratory protocol specifications are on file at the laboratories and are available for review upon request. Individual parameters, analytical methods, and reporting limits to be used are listed in Table 5-1. Table 5-2 lists the analytical methods by analyte, the preparation technique and method, and the analysis technique and method. All of the tables for this section are presented at the end of the section.

The analytical methods to be used in this project require the measurement system to initially satisfy specific criteria for calibration linearity, reference material recovery, and freedom from contamination. Results of control samples will be used to monitor any changes in the quality of data being produced and indicate which corrective actions are necessary to correct an out-of-control condition. An out-of-control condition is defined as:

- Detection of any compounds of interest in a method blank at concentrations greater than or equal to the reporting limit, with the exception of common laboratory contaminants. The analyte considered a common laboratory contaminants is methylene chloride. Detection of methylene chloride at concentrations greater than or equal to three times the reporting limit will necessitate corrective actions.
- Failure to meet the acceptance criteria for recovery of any compound of interest in a laboratory control sample (LCS).
- Exceeding the acceptance criteria for matrix spike recovery and subsequent failure to meet the acceptance criteria for an LCS for the same parameter(s). Any parameter that fails the matrix spike test but passes the LCS test will be flagged as suspect for the parameter because of matrix effects.

When an out-of-control situation is detected, efforts are undertaken to determine the cause. Routine QC checks and corrective actions are outlined by method in Tables 5-3, 5-4, 5-5, 5-6, and 5-7. Acceptance criteria for the laboratory control samples, matrix spikes, and surrogates are presented in Tables 5-8, 5-9, and 5-10, respectively.

During the course of this project, it will be the responsibility of the laboratory staff and the project team members to ensure that all measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In the event a problem arises, it is imperative that prompt action be taken to correct the problem. Laboratory managers will initiate corrective action in the event that QC results exceed acceptance criteria. Corrective action may be initiated by the laboratory quality officer if, during data review, QC data or other anomalies are noted.

For this project, all soil sample results will be reported on a dry-weight basis. The dry-weight calculation will be based on a moisture analysis.

The data analysis required to calculate sample concentrations will proceed according to method-specified procedures. Data reduction involves converting instrument responses or other raw into calculated concentrations for each target analyte. Data validation involves examining the systems producing the data to be sure they are operating properly and quality objectives have been met. Data will be reviewed and validated by the analyst(s) and/or the laboratory manager. Data will be validated for conformance with method specifications and laboratory protocol specifications, including:

- Calibration;
- Duplicate analysis;
- Blank analysis;
- Spike analysis;

- Sample data calculations; and
- QC sample frequency.

5.1 Analytical Methods

The analytical methods to be used for this project are presented in Table 5-2. All of the methods, both preparatory and analytical, are contained in SW-846. Any deviations performed by the laboratory will be pre-approved by the QAC.

Table 5-1

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
VOLATILES			
METHOD 8021A			
Benzene	0.09	0.37	5
Carbon Tetrachloride	0.03	0.94	5
Chlorobenzene	0.01	0.38	5
Chloroform	0.02	1.1	5
trans-1,2-Dichloroethene	0.02	0.93	5
Hexachlorobutadiene	0.20	1.8	5
Methyl Bromide	0.30	1.7	5
Methyl Chloride	0.10	0.94	5
Methylene Chloride	0.20	1.4	5
Naphthalene	0.60	3.4	5
Tetrachloroethene	0.01	0.21	5
Toluene	0.10	0.34	5
1,2,4-Trichlorobenzene	0.20	1.5	5
1,1,1-Trichloroethane	0.01	1.3	5
1,1,2-Trichloroethane	0.07	0.59	5
Trichloroethene	0.01	0.52	5
Trichlorofluoromethane	0.30	0.50	5
Vinyl Chloride	0.06	0.94	5
METHOD 8240B			
Acrolein	7	21	100
Carbon Disulfide	100	0.98	20
Methyl Ethyl Ketone	100	6.1	100
SEMIVOLATILES			
METHOD 8070			
N-Nitrosodimethylamine	1.5	12	67
METHOD 8090			
2,4-Dinitrotoluene (FID/ECD)	13	82/0.56	330/10
2,6-Dinitrotoluene (FID/ECD)	7	82/0.65	330/10

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
SEMIVOLATILES (Continued)			
METHOD 8110			
Bis(2-chloroethoxy) methane	5	16	30
Bis(2-chloroethyl) ether	3	9.9	30
Bis(2-chloroisopropyl) ether	8	24	30
METHOD 8121			
Hexachlorobenzene	3.8	0.12	3.3
Hexachlorocyclopentadiene	160	0.82	3.3
Hexachloroethane	1.1	0.11	3.3
METHOD 8151			
Pentachlorophenol	1.6	4.3	17
METHOD 8270B			
Bis(2-ethylhexyl) phthalate	180	27	330
Butyl benzyl phthalate	28	26	330
4-Chloro-3-methyl phenol	240	42	330
2-Chlorophenol	210	38	330
Di-n-butyl phthalate	220	27	330
Diethyl phthalate	170	21	330
2,4-Dimethylphenol	210	35	330
Dimethyl phthalate	190	24	330
4,6-Dinitro-2-methylphenol	3,300	27	330
Di-n-octyl phthalate	33	16	330
Phenol	94	38	330
2,4,5-Trichlorophenol	600	34	330
2,4,6-Trichlorophenol	390	33	330
METHOD 8310			
Fluoranthene	140	0.27	10
Fluorene	140	1.0	10
METHOD 8330			
Nitrobenzene	260	12	250
PESTICIDES/PCBs			
METHOD 8080A			

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
Aldrin	3	0.58	1.7
Chlordane	9.4	3.5	17
Dieldrin	1.3	0.35	3.3
Endosulfan I	9.4	0.43	1.7
Endosulfan II	3	2.8	3.3
Endrin	4	0.30	3.3
Heptachlor	2	0.80	1.7
Heptachlor Epoxide	21	0.47	1.7
Methoxychlor	120	3.6	17
PCB 1016	2,500	4.6	33
PCB 1221	2,500	8.8	67
PCB 1232	2,500	13	33
PCB 1242	2,500	15	33
PCB 1248	2,500	5.0	33
PCB 1254	2,500	5.2	33
PCB 1260	2,500	13	33
Toxaphene	57	34	170
METALS			
METHOD 6020			
Arsenic	10	0.85 µg/L[a]	200
Barium	20	0.16 µg/L[a]	100
Beryllium	3	0.15 µg/L[a]	100
Cadmium	1	0.17 µg/L[a]	200
Chromium	10	0.34 µg/L[a]	100
Lead	10	0.36 µg/L[a]	100
Nickel	0.2	0.67 µg/L[a]	100
Selenium	20	0.51 µg/L[a]	200

Table 5-1 (Continued)

Analytical Limits for the RAAP Bioplant Equalization Basin Closure

Analyte	Required PQL (µg/kg)	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
METALS (Continued)			
Silver	2	0.52 µg/L[a]	100
Thallium	10	0.08 µg/L[a]	100
METHOD 7471A			
Mercury	2	0.03 µg/L[a]	100
METHOD 9010A			
Cyanide	20	8 µg/L[a]	100

[a] These detection limits are based on a MDL study of an aqueous matrix.

Table 5-2

Analytical Methods

Parameter	Preparation		Analysis	
	Technique	Method	Technique	Method
METALS				
Arsenic	Acid Digestion	3050	ICPMS	6020
Barium	Acid Digestion	3050	ICPMS	6020
Beryllium	Acid Digestion	3050	ICPMS	6020
Cadmium	Acid Digestion	3050	ICPMS	6020
Chromium	Acid Digestion	3050	ICPMS	6020
Cyanide	Distillation	9012	Colorimetric/UV	9012
Lead	Acid Digestion	3050	ICPMS	6020
Mercury	$KMnO_4$/Acid Digestion	7471A	CVAA	7471A
Nickel	Acid Digestion	3050	ICPMS	6020
Selenium	Acid Digestion	3050	ICPMS	6020
Silver	Acid Digestion	3050	ICPMS	6020
Thallium	Acid Digestion	3050	ICPMS	6020
Pesticides and PCBs				
Aldrin	Extraction	3550	GC	8080A
Chlordane	Extraction	3550	GC	8080A
Dieldrin	Extraction	3550	GC	8080A
Endosulfan I	Extraction	3550	GC	8080A
Endosulfan II	Extraction	3550	GC	8080A
Endrin	Extraction	3550	GC	8080A
Heptachlor	Extraction	3550	GC	8080A
Heptachlor epoxide	Extraction	3550	GC	8080A
Methoxychlor	Extraction	3550	GC	8080A
Toxaphene	Extraction	3550	GC	8080A
PCBs	Extraction	3550	GC	8080A
VOLATILE ORGANICS				
Acrolein	Purge and Trap	5030	GC/MS	8240B
Benzene	Purge and Trap	5030	GC/PID	8021A
Carbon disulfide	Purge and Trap	5030	GC/MS	8240B

Table 5-2 (Continued)

Analytical Methods

Parameter	Preparation		Analysis	
	Technique	Method	Technique	Method
Carbon tetrachloride	Purge and Trap	5030	GC/PID	8021A
Chlorobenzene	Purge and Trap	5030	GC/PID	8021A
Chloroform	Purge and Trap	5030	GC/PID	8021A
trans-1,2-Dichloroethene	Purge and Trap	5030	GC/PID	8021A
Hexachlorobutadiene	Purge and Trap	5030	GC/PID	8021A
Methyl Bromide	Purge and Trap	5030	GC/PID	8021A
Methyl Chloride	Purge and Trap	5030	GC/PID	8021A
Methylene chloride	Purge and Trap	5030	GC/PID	8021A
2-Butanone (MEK)	Purge and Trap	5030	GC/MS	8240B
Naphthalene	Purge and Trap	5030	GC/PID	8021A
Tetrachloroethene	Purge and Trap	5030	GC/PID	8021A
Toluene	Purge and Trap	5030	GC/PID	8021A
1,1,1-Trichloroethane	Purge and Trap	5030	GC/PID	8021A
1,1,2-Trichloroethane	Purge and Trap	5030	GC/PID	8021A
1,2,4-Trichlorobenzene	Purge and Trap	5030	GC/PID	8021A
Trichloroethene	Purge and Trap	5030	GC/PID	8021A
Trichlorofluoromethane	Purge and Trap	5030	GC/PID	8021A
Vinyl chloride	Purge and Trap	5030	GC/PID	8021A
SEMIVOLATILE ORGANICS				
Butyl benzyl phthalate	Extraction	3550	GC/MS	8270B
4-Chloro-3-methylphenol	Extraction	3550	GC/MS	8270B
Bis(2-Chloroethoxy)methane	Extraction	3550	GC	8110
Bis(2-Chloroethyl)ether	Extraction	3550	GC	8110
Bis(2-Chloroisopropyl)ether	Extraction	3550	GC	8110
2-Chlorophenol	Extraction	3550	GC/MS	8270B
Diethylphthalate	Extraction	3550	GC/MS	8270B
2,4-Dimethylphenol	Extraction	3550	GC/MS	8270B
Dimethylphthalate	Extraction	3550	GC/MS	8270B
Di-n-butylphthalate	Extraction	3550	GC/MS	8270B
Di-n-octylphthalate	Extraction	3550	GC/MS	8270B

Table 5-2 (Continued)

Analytical Methods

Parameter	Preparation		Analysis	
	Technique	Method	Technique	Method
2,4-Dinitrotoluene	Extraction	3550	GC	8090
2,6-Dinitrotoluene	Extraction	3550	GC	8090
Bis(2-Ethylhexyl)phthalate	Extraction	3550	GC/MS	8270B
Fluoranthene	Extraction	3550	HPLC	8310
Fluorene	Extraction	3550	HPLC	8310
Hexachlorobenzene	Purge and Trap	5030	GC	8121
Hexachlorocyclopentadiene	Purge and Trap	5030	GC	8121
Hexachloroethane	Purge and Trap	5030	GC	8121
N-Nitrosodimethylamine	Extraction	3550	GC	8070
Nitrobenzene	Extraction	8330	HPLC	8330
Pentachlorophenol	Extraction	3550	GC	8151
Phenol	Extraction	3550	GC/MS	8270B
2,4,5-Trichlorophenol	Extraction	3550	GC/MS	8270B
4,6-Dinitro-2-methylphenol	Extraction	3550	GC/MS	8270B
2,4,6-Trichlorophenol	Extraction	3550	GC/MS	8270B

ICPMS = Inductively Coupled Plasma Mass Spectrometry.
CVAA = Cold Vapor Atomic Absorption.
GC/MS = Gas Chromatography/Mass Spectrometry.
FID = Flame Ionization Detector.
PID = Photo Ionization Detector.
HPLC = High Performance Liquid Chromatography.
UV = Ultraviolet Detector.

Table 5-3

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
6020	ICP/MS Metals	Initial calibration standard (2 points)	Daily, prior to sample analysis	NA	NA
	Refer to: SW846-3005A[b] SW846-3050A[b]	Initial Calibration Verification (ICV) (concentration = upscale calibration standard)	Following initial calibration	90 - 110% recovery	1. Repeat ICV 2. Recalibrate if still out
		Continuing calibration verification (CCV)	Following Interference check standards and after every 10 samples and at end of analytical batch	90 - 110% recovery	1. Repeat CCV 2. If still out, identify and correct problem, then re-analyze all samples since last valid CCV.
		Calibration blank (CCB)	Every 10 samples and at end of analytical run	< Quantitation limits	1. Re-analyze CCB 2. If CCB is still contaminated, identify and correct source of contamination, then repeat calibration blank analysis 3. Re-analyze all samples since last valid CCB, if necessary.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
6020 (Continued)	ICP/MS Metals	LCS/LCSD	One LCS/LCSD for each digestion batch and each analytical batch	Recoveries within QC acceptance criteria in Table 5-8.	Accuracy: 1. Re-analyze LCS/LCSD. If recoveries for same analytes are still out, stop, identify and correct problem before proceeding. Redigestion may be necessary. Precision: 2. Reanalyze LCS/LCSD. If recoveries for same analytes are still out, stop, identify and correct problem before proceeding.
		Interference check sample	Daily at beginning and end of analytical run or twice per 8 hour shift	Assess possible interference problems	1. Adjust interference factors or element equations if necessary
		Method blank	One per digestion batch and analytical batch	< quantitation limits (QL)	1. If the sample element concentration is <QL or the sample element concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-digest/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
6020 (Continued)	ICP/MS Metals	MS/MSD	1 MS/MSD per digestion batch	Recovery within QC acceptance criteria in Table 5-9.	1. If either MS or MSD is outside of accuracy or precision tolerances and LCS/LCSD is acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Linearity Check	Semi-annually	Highest point at which the recovery of the standard is within 10% of the expected value	No data will be reported for any element that exceeds the upper limit of the linear range by more than 10%.
7470A/7471A[b]	Mercury Refer to: 7000A	Initial Calibration (5 point and a blank)	Daily before any analysis	Correlation coefficient ≥0.995	Identify and repeat outlying point(s); recalculate curve using repeated points
		Initial Calibration Verification (ICV)	Daily before batch one is analyzed	90 - 110% of theoretical value	Accuracy: 1. Repeat calibration verification 2. If still out, identify and correct problem, run calibration verification again; if still out, recalibrate

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
7470A/7471A[b] (Continued)	Mercury	Initial Calibration Blank (ICB)	After ICV	Within ±QL	Re-analyze calibration blank; if still out, recalibrate
		Continuing Calibration Blank (CCB)	Following each CCV and at end of batch	Within ±QL	Re-analyze calibration blank; if still out, correct problem and re-analyze all samples since last valid CCB.
		Method Blank	One per digestion batch and analytical batch	Measured concentrations for all elements must be <quantitation limit (QL)	1. If the sample element concentration is <QL or if the sample element concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-digest/ re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.
		LCS	One LCS per each digestion and analytical batch	QC acceptance criteria in Table 5-8.	1. Accuracy: Re-analyze LCS. If recovery for same analytes are still out, stop, identify, and correct problem before proceeding. Digestion batch may need to be re-prepared. 2. Precision: Re-analyze LCS. If recovery for same analytes are still out, stop, identify, and correct problem before proceeding.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
7470A/7471A[b] (Continued)	Mercury	MS/MSD	One MS/MSD pair per digestion batch	Recoveries within QC acceptance criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and the LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Continuing Calibration Verification (CCV)	After 10th sample and at the end of the batch	80-120% of true value	Accuracy: 1. Repeat calibration verification 2. If still out, identify and correct problem, then reanalyze all samples analyzed since last valid CCV.

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
9012	Cyanide	Five-point calibration	Daily, prior to sample analysis	r ≥0.995	Repeat calibration
		ISV (Initial Standard Verification)	Once per multipoint calibration before samples are analyzed	Within ±15% of expected value	1. Reanalyze ISV 2. If still out, identify and correct problem and repeat ISV 3. If still out, repeat initial calibration
		ICV	Once per multipoint calibration before samples are analyzed	Within ±15% of expected value	1. Repeat ICV 2. If still out, identify and correct problem and repeat ICV 3. If still out, repeat initial calibration
		Method blank	One per each preparation batch and analytical batch	<QL	1. If the sample analyte concentration is <QL or the sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-prepare samples if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.
		LCS/LCSD	1 LCS/LCSD pair per batch	QC acceptance criteria in Table 5-8.	1. Reanalyze LCS 2. Identify and correct problem 3. If still out, redigest and reanalyze affected samples

Table 5-3 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Metals and Cyanide

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
9012 (Continued)	Cyanide	MS/MSD	1 MS/MSD per preparation batch	QC acceptance criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and the LCS/LCSD is acceptable, then flag results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.

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[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.

[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.

NA = Not Applicable.

Table 5-4

Summary of Calibration and Internal Quality Control Procedures for Volatile and Semivolatile Compounds by Gas Chromatography and by High Performance Liquid Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8021A, 8070, 8090, 8110, 8121, 8310, 8330	Volatile organics and semi-volatile organics Refer to: SW846-8000A[b] SW846-3500A[b]	Initial Calibration	Biannually or when daily calibration fails to meet acceptance criteria	%RSD <20% for average RFs or calibration curve Correlation coefficient (r) ≥0.995	Identify and repeat outlying point(s); recalculate curve using repeated point(s)
		Calibration Verification (ICV/CCV)	At the beginning, following every 10th sample, and at the end of each analytical sequence	Recovery for all analytes of interest must be within ±15% of true value for primary column and ±20% for confirmation column	1. Repeat calibration check 2. If still out, identify and correct problem and repeat calibration check; if still out,repeat multipoint calibration, if necessary.
		LCS/LCSD	One LCS/LCSD pair per extraction batch and analytical batch	Recovery for all analytes within QC Acceptance criteria in Table 5-8.	1. Accuracy: a. If the same analytes are out in both the LCS/LCSD and if the calibration check standard is acceptable, contact CSC for decision to proceed or re-extract. If samples must be analyzed without re-extraction, flag sample data for failed analytes. If analytes in calibration check standard are out, correct instrument problem. b. If one or more analytes is out in either LCS or LCSD, then analyze previously acceptable calibration check standard for the analytes that failed. If analytes in calibration check standard are in, proceed with analyses. If analytes are out, correct instrument problem.

Table 5-4 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile and Semivolatile Compounds by Gas Chromatography and by High Performance Liquid Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8021A, 8070, 8090, 8110, 8121, 8310, 8330 (Continued)	Volatile organics and semi-volatile organics Refer to: SW846-8000A[b] SW846-3500A[b]	LCS/LCSD	One LCS/LCSD pair per extraction batch and analytical batch	Recovery for all analytes within QC Acceptance criteria in Table 5-9.	2. Precision: Demonstrate acceptable RPDs on analytes that failed by reanalyzing previously acceptable 3rd LCS. If RPDs are in, proceed with analyses. If analytes are out, correct instrument problem before proceeding.
		MS/MSD	One MS/MSD pair per extraction batch	QC Acceptance criteria Table 2.5-13	1. If either MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences
		Surrogate Spike	All samples, standards, and blanks	Table 5-10 Surrogate limits	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze affected samples 3. If none of the above, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

Table 5-4 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile and Semivolatile Compounds by Gas Chromatography and by High Performance Liquid Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8021A, 8070, 8090, 8110, 8121, 8310, 8330 (Continued)	Volatile organics and semi-volatile organics Refer to: SW846-8000A[b] SW846-3500A[b]	Method Blank	Each extraction batch and each analytical batch	<Quantitation limit (QL)	1. If sample analyte concentration is <QL or if sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER; 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
NA = Not applicable.

Table 5-5

Summary of Calibration and Internal Quality Control Procedures for Pesticides, PCBs, and Herbicides by Gas Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8080, 8151	Pesticides, PCBs, and herbicides Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Five-point calibration (for all analytes)	Biannually or when daily calibration fails to meet acceptance criteria	%RSD < 20% for average RFs or calibration curve correlation coefficient (r) ≥0.995	Identify and repeat outlying point(s); recalculate curve using repeated points
		Initial daily Calibration Verification (ICV)	Daily, before sample analysis	Recovery for any analyte within ±15% of nominal concentration for primary column; ±20% for confirmation column	1. Repeat ICV 2. If still out, identify and correct problem before proceeding 3. Recalibrate if necessary
		LCS\LCSD	One LCS/LCSD pair per extraction batch and analytical batch	Recovery for all analytes within QC acceptance criteria in Table 5-8.	1. Accuracy: a. If the same analytes are out in both the LCS and LCSD, and the calibration check standard is acceptable, contact CSC for decision to proceed or re-extract. If samples must be analyzed without re-extraction, flag sample data for failed analytes. If analytes in calibration check standard are out, correct instrument problem. b. If one or more analytes is out in either LCS or LCSD, then analyze previously acceptable calibration check standard for the analytes that failed. If analytes in calibration check standard are in, proceed with analyses. If analytes are out, correct instrument problem. 2. Precision: Demonstrate acceptable RPDs on analytes that failed by reanalyzing previously acceptable 3rd LCS. If RPDs are in, proceed with analyses. If analytes are out, correct instrument problem.

Table 5-5 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Pesticides, PCBs, and Herbicides by Gas Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8080, 8151 (Continued)	Pesticides, PCBs, and herbicides Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Continuing Calibration Verification (CCV)	Every ten samples and at end of batch.	a)Primary: Recovery of analytes within ±15% of nominal concentration; Confirmation: ±20% of nominal concentration b)Ongoing calibration analytes elute within daily RT windows	1. Repeat CCV. 2. If still out, identify and correct problem. 3. Re-analyze all samples since last valid CCV.
		Breakdown check (Endrin and DDT)	Daily prior to analysis of samples and as needed during analysis	Degradation ≤20% (each)	Perform system maintenance.
		MS/MSD	1 MS/MSD pair for each extraction batch	QC Acceptance Criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences
		Surrogate spike	Every sample, spike, standard, and method blank	Table 5-10 Only one surrogate must meet acceptance criteria.	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze affected samples 3. If none of the above, re-extract/re-analyze samples if still within HT and enough sample volume, otherwise contact CSC for decision.

Table 5-5 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Pesticides, PCBs, and Herbicides by Gas Chromatography

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8080, 8151 (Continued)	Pesticides, PCBs, and herbicides Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Method blank	Each extraction batch and each analytical batch	< Quantitation limits (QL)	1. If the sample analyte concentration is <QL or the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER; 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.
[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.
NA = Not applicable.

Table 5-6

Summary of Calibration and Internal Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8240B	Volatile Organic Compounds Refer to: SW846-5030[b] SW846-8000A[b]	BFB Tuning	Analyze at the beginning of each analytical sequence and at the beginning of every subsequent 12 hours (if applicable)	Established criteria in method	1. Repeat BFB analysis. 2. Adjust MS tune until criteria met.
		Five-point calibration (for all analytes) (ICAL)	Annually or when daily calibration check fails to meet acceptance criteria.	1. SPCCs[c,d] 2. %RSD <30% for CCC[e]	Repeat 5-point calibration
		Calibration Verification (CV)	Analyzed at the beginning of each analytical sequence and at the beginning of every subsequent 12 hours (if applicable)	1. SPCCs[c,d] 2. CCC[e] percent difference (%D) <20% recovery relative to ICAL	1. Repeat CV 2. If still out, identify and correct problem, run CV again; if still out recalibrate.
		Internal Standards (IS) Retention Times (RT)	All samples, standards, and method blanks	RT:Must be <30 second change from daily CV IS: EICP[f] area must be within a factor of 2 from daily CV	1. Inspect system for malfunctions. 2. Make appropriate system corrections, if necessary. 3. Reanalyze samples analyzed while system was malfunctioning unless matrix interferences demonstrated.
		LCS/LCSD	One LCS/LCSD pair per analytical batch	Recovery for all analytes within QC Acceptance Criteria in Table 5-8.	1. Accuracy: a. If recoveries for the same analytes are out in both the LCS and LCSD, stop and correct problem. If obtain CSC approval to proceed, write QCER b. If one or more analytes is out in either the LCS or LCSD, analyze a 3rd LCS. If the recoveries for the 3rd LCS are acceptable, proceed with analyses. If same analytes are out, stop and correct instrument problem. If obtain CSC approval to proceed, write QCER

Table 5-6 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8240B (Continued)	Volatile Organic Compounds Refer to: SW846-5030[b] SW846-8000A[b]	LCS/LCSD	One LCS/LCSD pair per analytical batch	Recovery for all analytes within QC Acceptance Criteria in Table 5-8.	2. Precision: Demonstrate acceptable RPDs for analytes that failed by analyzing a 3rd LCS. If RPDs between the 3rd and either LCS or LCSD are acceptable, proceed with analyses. If RPDs are still not acceptable, stop and correct instrument problem. If obtain CSC approval to proceed, write QCER.
		MS/MSD	1 MS/MSD pair for each extraction batch	QC Acceptance Criteria in Table 5-9.	1. If either the MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Surrogate spike	Every sample, spike, standard, and method blank	Table 5-10 acceptance criteria	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze the affected samples 3. If none of the above, re-extract/re-analyze if still within HT and enough sample volume, otherwise contact CSC for decision.

Table 5-6 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8240B (Continued)	Volatile Organic Compounds Refer to: SW846-5030[b] SW846-8000A[b]	Method blank	One per analytical batch	No analytes > quantitation limit (QL)	1. If sample analyte concentration is <QL (except for analytes listed as exceptions) or if the sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

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[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.

[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.

[c] SPCC = System Performance Check Compounds.

[d] SPCC = for 8240B 15ml purge: 1,1-dichloroethane, chloromethane and bromoform avg. RF >/= 0.10, 1,1,2,2-tetrachloroethane avg RF >/= 0.20 and chlorobenzene avg RF >/= 0.30; for 8240B soils and 5ml purge: the same as SW8260A 15ml except 1,1,2,2-tetrachloroethane avg RF >/= 0.30.

[e] CCC = Calibration Check Compounds.

[f] EICP = Extracted Ion Current Profile.

NA = Not applicable.

Table 5-7

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
8270B	Semivolatile Organic Compounds Refer to: SW846-3500A[b] SW846-3600B[b] SW846-8000A[b]	Check of mass spectral ion intensities using DFTPP, (4,4'-DDT, pentachlorophenol and benzidine also to be included in tuning standard to verify injection port inertness and GC column performance)	At the beginning of each analytical sequence and at the beginning of each subsequent 12 hour period, if applicable.	Ion Abundance criteria in Table 3 of SW846-8270B[b] – Degradation of DDT to DDE and DDD ≤20% – Benzidine and pentachlorophenol must each exceed 7000 area counts with a tailing factor of <3 at 10% peak height.	Ion Abundance: 1. Re-analyze DFTPP. 2. Adjust MS tune until analysis of DFTPP passes criteria Column/Injection Port: 1. Clean injection port, if necessary. 2. Remove first 6 to 12 inches of column, if necessary.
		Five-point calibration for all commercially available analytes[f]	Biannually or when daily calibration check fails to meet acceptance criteria	1. %RSD <30% for each individual CCC[d] 2. SPCCs[e] average RF ≥0.050	Repeat concentrations not meeting criteria.
		Calibration Verification (CV)	At beginning of each analytical sequence and at the beginning of each subsequent 12 hour period, if applicable.(CV standard is prepared from a concentrated cocktail every two weeks).	1. SPCCs[e] RF≥0.050 2. CCC[d] percent difference (%D) <30% from average RF	1. Reanalyze CV standard 2. If still out, identify and correct problem. 3. Reanalyze CV standard again. 4. If still out, perform a new multi-point calibration.
		Internal Standards (IS) and Retention Times (RT)	All samples, standards and blanks	RT: Must be <30 second change from daily CV IS:Extracted ion area counts must be within a factor of 2 from the daily CV.	1. Reanalyze sample if out of specification (unless matrix interference demonstrated). 2. If still out, identify and correct problem. 3. Reanalyze affected samples, if necessary.

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Table 5-7 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action*
8270B (Continued)	Semivolatile Organic Compounds	LCS/LCSD	One LCS/LCSD pair for each extraction batch and each analytical batch	Recovery for all analytes within QC Acceptance Criteria in Table 5-8.	1. Accuracy: a. If the same analytes are out in both the LCS and LCSD, then analyze a 3rd previously acceptable LCS for the analytes that failed. If 3rd LCS is acceptable, contact CSC for decision to proceed or re-extract. If samples must be analyzed without re-extraction, flag data for failed analytes. If analytes in 3rd LCS are out, correct instrument problem. b. If one or more analytes is out in either LCS or LCSD, then analyze previously acceptable 3rd LCS for the analytes that failed. If 3rd LCS analytes in, proceed, if out, correct instrument problem. 2. Precision: Demonstrate acceptable RPDs on analytes that failed by reanalyzing previously acceptable 3rd LCS. If RPDs in, proceed, if out, correct instrument problem.

Table 5-7 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
SW8270B (Continued)	Semivolatile Organic Compounds	MS/MSD	1 MS/MSD per extraction batch	QC Acceptance Criteria in Table 5-9.	1. If either MS or MSD is outside of either accuracy or precision tolerances and LCS/LCSD results are acceptable, then flag MS/MSD results and write QCER 2. Contact CSC to determine if special measures should be performed in an attempt to resolve matrix interferences.
		Surrogate spike	Every sample, standard, and blank.	Table 5-10 criteria. Corrective action required only if more than 1 acid and/or 1 base surrogate exceeds criteria.	1. Check chromatogram for interferences; if found and LCS passing, flag data and write QCER 2. If no assignable cause, check instrument performance; if problem found, correct and re-analyze affected samples 3. If none of the above, re-extract/reanalyze samples if still within HT and enough sample volume, otherwise, contact CSC for decision.

Table 5-7 (Continued)

Summary of Calibration and Internal Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
SW8270B (Continued)	Semivolatile Organic Compounds	Method blank	Each extraction batch and each analytical batch	All analytes < quantitation limits (QL)	1. If sample analyte concentration is <QL or if the sample analyte concentration is >10 times the concentration in the method blank, then report results and write QCER; 2. Otherwise, re-extract/re-analyze if still within HT and enough sample volume; if not within HT or enough sample, contact CSC for decision.

[a] All corrective actions associated with project work shall be documented and the records maintained by the laboratory.

[b] Test Methods for Evaluating Solid Waste, U.S. EPA, SW846, Final Update II,9/94.

[c] SPCC = System Performance Check Compounds.

[d] CCC = Calibration Check Compounds.

[e] The following analytes use four point calibration curves to determine the average RF due to erratic behavior of these analytes: benzoic acid, and 2,4-dinitrophenol. The following use a RF obtained from a single analysis of an aliquot of the individual analyte because of erratic response, decomposition or other problems with the analytes: hexachlorophene.

NA = Not applicable.

Table 5-8

Summary of Acceptance Criteria for Laboratory Control Samples

Analyte	Recovery (%)	Precision (PRD)
METALS		
METHOD 6020		
Arsenic	80-120	20
Barium	80-120	20
Beryllium	80-120	20
Cadmium	80-120	20
Chromium	80-120	20
Lead	80-120	20
Nickel	80-120	20
Selenium	80-120	20
Silver	80-120	20
Thallium	80-120	20
METHOD 7470/7471A		
Mercury	80-120	20
METHOD 9012		
Cyanide	75-125	20
PESTICIDES and PCBs		
METHOD 8080		
Aldrin	40-137	38
Chlordane	45-119	40
Dieldrin	42-139	30
Endosulfan I	45-153	40
Endosulfan II	10-202	65
Endrin	44-151	32
Heptachlor	40-136	38
Heptachlor Epoxide	37-142	40
Methoxychlor	34-166	40
Toxaphene	41-126	50
PCB-1016	52-152	44
PCB-1221	15-178	20
PCB-1232	10-215	20
PCB-1242	39-150	20
PCB-1248	38-158	20
PCB-1254	66-122	23
PCB-1260	58-122	40

Table 5-8 (Continued)

Summary of Acceptance Criteria for Laboratory Control Samples

Analyte	Recovery (%)	Precision (PRD)
VOLATILE ORGANICS		
METHOD 8021		
Benzene	61-131	31
Carbon Tetrachloride	42-141	50
Chloroethane	43-158	52
Chlorobenzene	48-143	24
Chloroform	53-134	36
Hexachlorobutadiene	52-145	41
Methylene Chloride	44-150	56
Naphthalene	67-133	42
Toluene	64-144	22
1,2,4-Trichlorobenzene	44-139	53
1,1,1-Trichloroethane	59-136	47
1,1,2-Trichloroethane	64-160	53
Tetrachloroethene	53-150	57
Trichloroethene	51-140	48
Trichlorofluoromethane	58-152	37
Vinyl chloride	44-173	61
METHOD 8240B		
Acrolein	22-164	40
Carbon Disulfide	35-244	65
Methyl Ethyl Ketone	10-111	40
SEMIVOLATILE ORGANICS		
METHOD 8070		
N-Nitrosodimethylamine	40-135	36
METHOD 8090		
2,4-Dinitrotoluene	10-125	40
2,6-Dinitrotoluene	10-126	40
METHOD 8110		
Bis(2-Chloroethoxy)methane	47-152	59
Bis(2-Chloroethyl)ether	46-141	52
Bis(2-Chloroisopropyl)ether	26-121	49

Table 5-8 (Continued)

Summary of Acceptance Criteria for Laboratory Control Samples

Analyte	Recovery (%)	Precision (PRD)
METHOD 8121		
Hexachlorobenzene	23-118	39
Hexachlorocyclopentadiene	5-116	65
Hexachloroethane	9-135	53
METHOD 8151		
Pentachlorophenol	10-150	40
METHOD 8270B		
Bis(2-Ethylhexyl)phthalate	10-158	40
Butyl Benzyl Phthalate	10-152	40
4-Chloro-3-Methylphenol	45-113	25
2-Chlorophenol	45-101	25
Di-n-butylphthalate	10-118	50
Diethylphthalate	10-114	40
2,4-Dimethylphenol	15-151	22
Dimethyl phthalate	10-112	40
4,6-Dinitro-2-methylphenol	10-181	93
Di-n-octylphthalate	10-146	50
Phenol	41-105	24
2,4,5-Trichlorophenol	39-123	27
2,4,6-Trichlorophenol	37-144	40
METHOD 8310		
Fluoranthene	56-136	28
Fluorene	10-142	40
METHOD 8330		
Nitrobenzene	52-152	30

Table 5-9

Summary of Acceptance Criteria for Matrix Spike Analyses

Analyte	Recovery (%)	Precision (PRD)
METALS		
METHOD 6020		
Arsenic	75-125	20
Barium	75-125	20
Beryllium	75-125	20
Cadmium	75-125	20
Chromium	75-125	20
Lead	75-125	20
Nickel	75-125	20
Selenium	75-125	20
Silver	75-125	20
Thallium	75-125	20
METHOD 7470/7471		
Mercury	75-125	20
METHOD 9012		
Cyanide	75-125	20
PESTICIDES and PCBs		
METHOD 8080		
Aldrin	40-137	38
Chlordane	45-119	40
Dieldrin	42-139	30
Endosulfan I	45-153	40
Endosulfan II	10-202	65
Endrin	44-151	32
Heptachlor	40-136	38
Heptachlor Epoxide	37-142	40
Methoxychlor	34-166	40
Toxaphene	41-126	50
PCB-1016	52-152	44
PCB-1221	15-178	20
PCB-1232	10-215	20
PCB-1242	39-150	20
PCB-1248	38-158	20
PCB-1254	66-122	23
PCB-1260	58-122	40

Table 5-9 (Continued)

Summary of Acceptance Criteria for Matrix Spike Analyses

Analyte	Recovery (%)	Precision (PRD)
VOLATILE ORGANICS		
METHOD 8021		
Benzene	61-131	31
Carbon Tetrachloride	42-141	50
Chloroethane	43-158	52
Chlorobenzene	48-143	24
Chloroform	53-134	36
Hexachlorobutadiene	52-145	41
Methylene Chloride	44-150	56
Naphthalene	67-133	42
Toluene	64-144	22
1,2,4-Trichlorobenzene	44-139	53
1,1,1-Trichloroethane	59-136	47
1,1,2-Trichloroethane	64-160	53
Tetrachloroethene	53-150	57
Trichloroethene	51-140	48
Trichlorofluoromethane	58-152	37
Vinyl chloride	44-173	61
METHOD 8240B		
Acrolein	22-164	40
Carbon Disulfide	35-244	65
Methyl Ethyl Ketone	10-111	40
SEMIVOLATILE ORGANICS		
METHOD 8070		
N-Nitrosodimethylamine	40-135	36
METHOD 8090		
2,4-Dinitrotoluene	10-125	40
2,6-Dinitrotoluene	10-126	40
METHOD 8110		
Bis(2-Chloroethoxy)methane	47-152	59
Bis(2-Chloroethyl)ether	46-141	52
Bis(2-Chloroisopropyl)ether	26-121	49

Table 5-9 (Continued)

Summary of Acceptance Criteria for Matrix Spike Analyses

Analyte	Recovery (%)	Precision (PRD)
METHOD 8121		
Hexachlorobenzene	23-118	39
Hexachlorocyclopentadiene	5-116	65
Hexachloroethane	9-135	53
METHOD 8151		
Pentachlorophenol	10-150	40
METHOD 8270B		
Bis(2-Ethylhexyl)phthalate	10-158	40
Butyl Benzyl Phthalate	10-152	40
4-Chloro-3-Methylphenol	45-113	25
2-Chlorophenol	45-101	25
Di-n-butylphthalate	10-118	50
Diethylphthalate	10-114	40
2,4-Dimethylphenol	15-151	22
Dimethyl phthalate	10-112	40
4,6-Dinitro-2-methylphenol	10-181	93
Di-n-octylphthalate	10-146	50
Phenol	41-105	24
2,4,5-Trichlorophenol	39-123	27
2,4,6-Trichlorophenol	37-144	40
METHOD 8310		
Fluoranthene	56-136	28
Fluorene	10-142	40
METHOD 8330		
Nitrobenzene	52-152	30

Table 5-10

Summary of Surrogate Spike Acceptance Criteria

Surrogate Compound	Soil (% Recovery)
METHOD 8080 PESTICIDES AND PCBs	
2,4,5,6-Tetrachloro-m-xylene (TCMX)	19-132
Dibutylchlorendate (DBC)	47-126
Decachlorobiphenyl	45-131
METHOD 8151 HERBICIDES	
2,4-DB	20-160
2,4-DCAA	10-148
METHOD 8021A	
2-Bromo-1-chloropropane	70-130
Fluorobenzene	70-130
VOLATILE ORGANICS	
METHOD 8240B	
Toluene-d$_8$	68-123
4-Bromofluorobenzene	64-126
Dibromofluoromethane	80-120
1,2-Dichloroethane-d$_4$	46-143
METHOD 8090	
2,4,5,6-Tetrachloro-m-xylene (ECD)	19-132
SEMIVOLATILE ORGANICS	
METHOD 8270B	
2-Chlorophenol-d$_4$	20-130
1,2-Dichlorobenzene-d$_4$	20-130
2-Fluorobiphenyl	35-116
2-Fluorophenol	27-120
2,4,6-Tribromophenol	17-123
Nitrobenzene-d$_5$	22-124
p-Terphenyl-d$_{14}$	29-137
Phenol-d$_5$	32-123
METHOD 8310	
4-Terphenyl-d$_{14}$	28-106
METHOD 8330	
3,4-Dinitrotoluene	40-140

6.0 CHEMICAL DATA QUALITY MANAGEMENT (CDQM) DELIVERABLES

The following deliverables will be prepared for this project:

- Draft and Final Chemical Data Acquisition Plan (CDAP);
- Draft and Final Site Safety and Health Plan (SSHP);
- A-E Daily Quality Control Reports; and
- Draft, Draft Final, and Final Site Characterization Reports.

7.0 DATA MANAGEMENT AND REPORTING

This section presents the data reporting and management procedures that will be followed for the RAAP Basin Closure.

7.1 Data Management

The data management requirements of this CDAP will facilitate the organizing and reporting of investigation data and results. The Project Director will oversee all aspects of the work and will be responsible for ensuring that proper documentation procedures are followed and that tracking of the accumulated data during the investigation is performed.

There are four goals for the data management task:

- Provide timely access to an organized body of data to facilitate analysis and decision making throughout the investigation;
- Provide a useful index of project information;
- Present project information in tabular and graphic form; and
- Report progress on the project.

7.2 Sample Tracking Record

A bound, numbered field logbook will be used to permanently record all field procedures, sample locations, types, unique identification numbers, and general observations. The specific parameters for which each sample is to be analyzed will also be recorded. A unique sample field identification number will be assigned at the time of sample collection to track each sample. A corresponding laboratory ID number will be

assigned by the laboratory and will be used to track each sample through the analytical process.

All pages of the field logbook will be signed and dated by the supervising geologist who is entering the data. Also, the names and affiliations of all visitors on site will be entered in the notebook, as well as general notes on project progress, problems encountered, and any deviations from plans.

Field sample ID number, along with sample collection point, sample collection date/time, sampler, required analysis, and preservation will be entered on the sample label for each container. Chain-of-custody documentation will also be completed and will accompany all samples to document the chain of possession and track the samples throughout shipping, handling, and analysis.

Samples are received by the Sample Control Area, and all containers and security seals, when appropriate, are inspected for physical damage or evidence of tampering. The samples are unpacked, inspected, and checked against the chain of custody form by the sample custodian. The temperature and pH of the samples are verified. The samples are logged into the laboratory information management system and assigned a unique number. Analytical requirements for each sample are entered into the computer. All sample information, including the date for sample disposal or return, is stored in the laboratory information management system. Labels are printed with sample information and secured to each sample. Work sheets, containing the sample information, storage location, and analytical requirements, are submitted to the appropriate laboratory managers. Following sample log in, the samples are placed in a secure storage area.

7.3 Field Data

Radian will maintain field records in a manner which will allow a reviewer to recreate all sampling and measurement activities. The requirements apply to all measuring and sampling data. The information will be recorded with indelible ink in a permanently-bound logbook with sequentially-numbered pages.

7.4 Laboratory Data

Laboratory data reports will be issued for each work order generated by the laboratory. A work order is generated for a single client's samples, received by the laboratory on the same day, typically including less than 50 samples, and requiring similar analytical procedures. This may result in multiple work orders for a sample. The analyst is responsible for all of the primary calculations, editing of initial quantitative reports, calculation of percent recoveries and RPDs for comparison to applicable tolerance limits, comparison of QC results to acceptance limits, and compiling all data for peer review. The peer reviewer is responsible for checking that calibration and QC results meet applicable tolerance limits and checking a subset of results for analytes from a subset of samples included in each analytical batch. The work order results are reported in both hard copy and electronic format. Radian will maintain records of all laboratory data, including sample IDs, analytical results, detection limits, analytical methods, and other related data.

7.6 Data Analysis and Reporting

Tabular and graphic summarization will be used to present the results of all data collection efforts in the final report. Radian will compile and report the data generated during the project within 45 days following the completion of field sampling.

Tables summarizing field and/or laboratory data will be generated from the project database. Data in the tables will be verified against hard-copy laboratory reports. For laboratory data, both environmental sample and QC sample results will be reported.

Tables will be used in the report as a convenient means of presenting a summary of the analytical results. Approximate sampling locations will be noted on CADD-based figures included in the site characterization report. Contour plots may be generated to pictorially present analytical data. Analytical laboratory reports will be stored at the site for a minimum of five years and will be made available to agency reviewers upon request.

8.0 REFERENCES

1. "Closure, Contingent Closure, and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Equalization Basin HWMU-10 & SWMU-10," Radford Army Ammunition Plant, 12 December 1995.

2. Chemical Data Quality Management for Hazardous Waste Remedial Activities, ER 1110-1-263, 1 October 1990, U.S. Army Corps of Engineers.

3. Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3, 1 September 1994, U.S. Army Corps of Engineers.

4. "Foundation Analysis for Project No. 33.10B," Norfolk District, U.S. Army Corps of Engineers, 1977.

5. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington, DC, September 1994.

Final

Site-Specific Safety and Health Plan (SSHP)

Site Investigation/Evaluation
Bioplant Equalization Basin
Radford Army Ammunition Plant
Radford, Virginia

Prepared for:

Norfolk District
U.S. Army Corps of Engineers
803 Front Street
Norfolk, Virginia 23510-1096

Prepared by:

Radian Corporation
2455 Horsepen Road, Suite 250
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10 September 1996

Steven M. Lantz, P.E.
Civil Engineer
GeoEnvironmental Branch
Norfolk District, Corps of Engineers
803 Front Street
Norfolk, Virginia 23510-1096

Subject: Delivery Order #10, Contract DACA65-95-D-0030

Dear Mr. Lantz:

Enclosed is the Final SSHP for the Bioplant Equalization Basin Site Investigation/Evaluation at Radford Army Ammunition Plant, Virginia, in accordance with the subject delivery order. This document has been revised in response to the comments we received on the Draft SSHP.

If you have any questions or would like additional information, please give me, 703-713-6420, or Bob Hearn, 703-713-6410, a call.

Sincerely,

Torsten Rothman, P.E., DEE
Project Manager

Enclosure (Final SSHP)

FINAL

SITE-SPECIFIC SAFETY AND HEALTH PLAN (SSHP)

Site Investigation/Evaluation
Bioplant Equalization Basin
Radford Army Ammunition Plant
Radford, Virginia

Prepared for:

Norfolk District
U.S. Army Corps of Engineers
803 Front Street
Norfolk, Virginia 23510-1096

Prepared by:

Radian Corporation
2455 Horsepen Road, Suite 250
Herndon, Virginia 20171

September 1996

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1.0 INTRODUCTION

This document has been prepared by Radian Corporation (Radian), to provide a site-specific Site Safety and Health Plan (SSHP) for environmental activities at Radford Army Ammunition Plant (RAAP) located near Radford, Virginia. The SSHP was requested by the Norfolk District, U.S. Army Corps of Engineers (Corps) prior to performing any environmental activities at the site. The purpose of this document is to establish standard health and safety procedures for project personnel in the performance of this work. Site activities shall be performed in accordance with Radian and Corps safety and health policy and procedures; EM 385-1-1, "Safety and Health Requirements Manual"; applicable Occupational Safety and Health Administration (OSHA) Standards 29 CFR 1910 and 1926; applicable Environmental Protection Agency (EPA) requirements; and consensus standards. Where the word "shall" is used, the provisions of this plan are mandatory.

The levels of personal protection and the procedures specified in this plan are based on the best information available from reference documents and previous site characterization data. Therefore, these recommendations represent the minimum health and safety requirements to be observed by all personnel engaged in this project. Unforeseeable site conditions or changes in the scope of work may warrant a reassessment of protection levels and controls stated. All adjustments to SSHP must have prior approval of the Corps Project Safety and Health Manager (SHM), Site Safety and Health Officer (SSHO), Radian's Safety and Health Manager (RSHM), and other authorities as designated.

All personnel involved in this project must read this document carefully. If you have any questions or concerns which you feel are not adequately addressed, contact the SSHO or RSHM. Personnel on site shall: (1) follow all established safety and health procedures; (2) be alert to the hazards associated with environmental activities planned at the site; and (3) exercise reasonable caution at all times.

All site visitors must receive prior approval from the SSHO and may visit only for the purpose of observing site conditions or operations. Visitors to the work site will report to the SSHO where they will undergo an initial site safety orientation. Orientation includes reading this site safety and health plan and signing the "Visitors Notice" form (see Attachment 1). Visitors will be expected to comply with any relevant OSHA requirements determined by the SSHO. Visitors who do not comply with the SSHP will be required to leave the work area.

Radian will be subcontracting a drilling company to collect the background samples. We will require the subcontractor to prepare a health and safety plan which will meet Norfolk District requirements to address the hazards associated with their work as a part of the bid specification.

2.0 SITE DESCRIPTION AND FEATURES

2.1 General Information

This SSHP covers activities for a site investigation being conducted at the Bioplant Equalization Basin at Radford Army Ammunition Plant (RAAP).

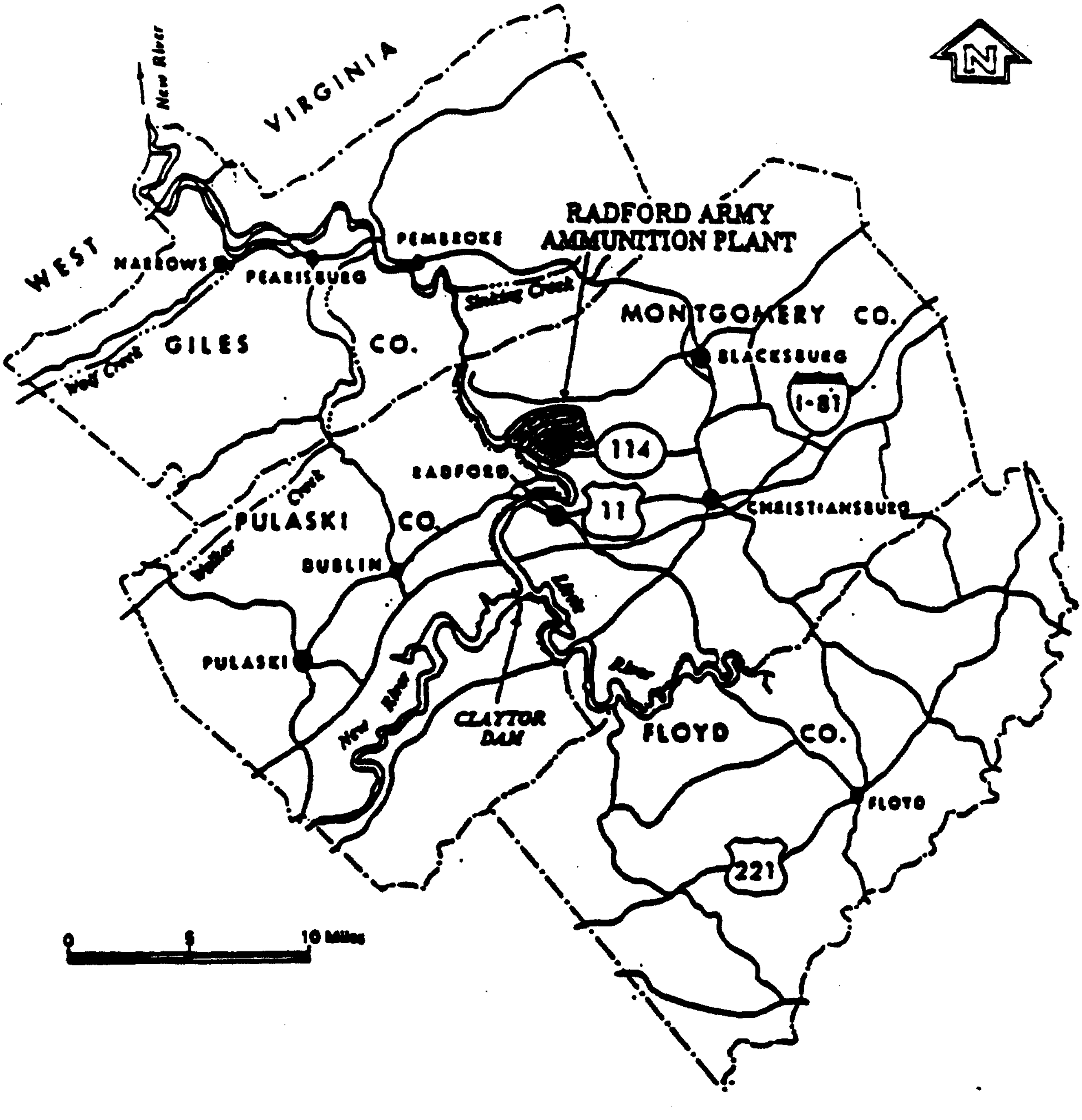
Site Activities to be conducted by Radian will include coring through a concrete liner, mechanical drilling and hand augering to collect soil samples, and surveying borehole locations. Field activities are anticipated to begin in April 1996 and conclude in June 1996.

2.2 Site Description and Previous Site Investigation

The project sites are located in the main manufacturing area of RAAP, along the New River (Figures 2-1 and 2-2). Radian is proposing establishing work zones and dedicated access points as shown in Figure 2-3. Radian will not be installing any additional site security measures; measures already in place at the site (i.e., fence around exclusion zone), are judged more than adequate for this project.

The EQ Basin was operated from 1980 until March 28, 1994, and was the first of nine components that make up the biological wastewater treatment system at Radford. The EQ basin received wastewater of widely varying characteristics, including non-acidic wastewaters from propellant manufacturing (on both a batch and continuous basis); pre-treated wastewater from nitroglycerine (NG) manufacturing and alcohol rectification; and wastes from recovery of ethyl ether. The basin was originally constructed in the location of a nitrocellulose (NC) fines settling lagoon.

Figure 2-1. Vicinity Map, Radford Army Ammunition Plant, Virginia



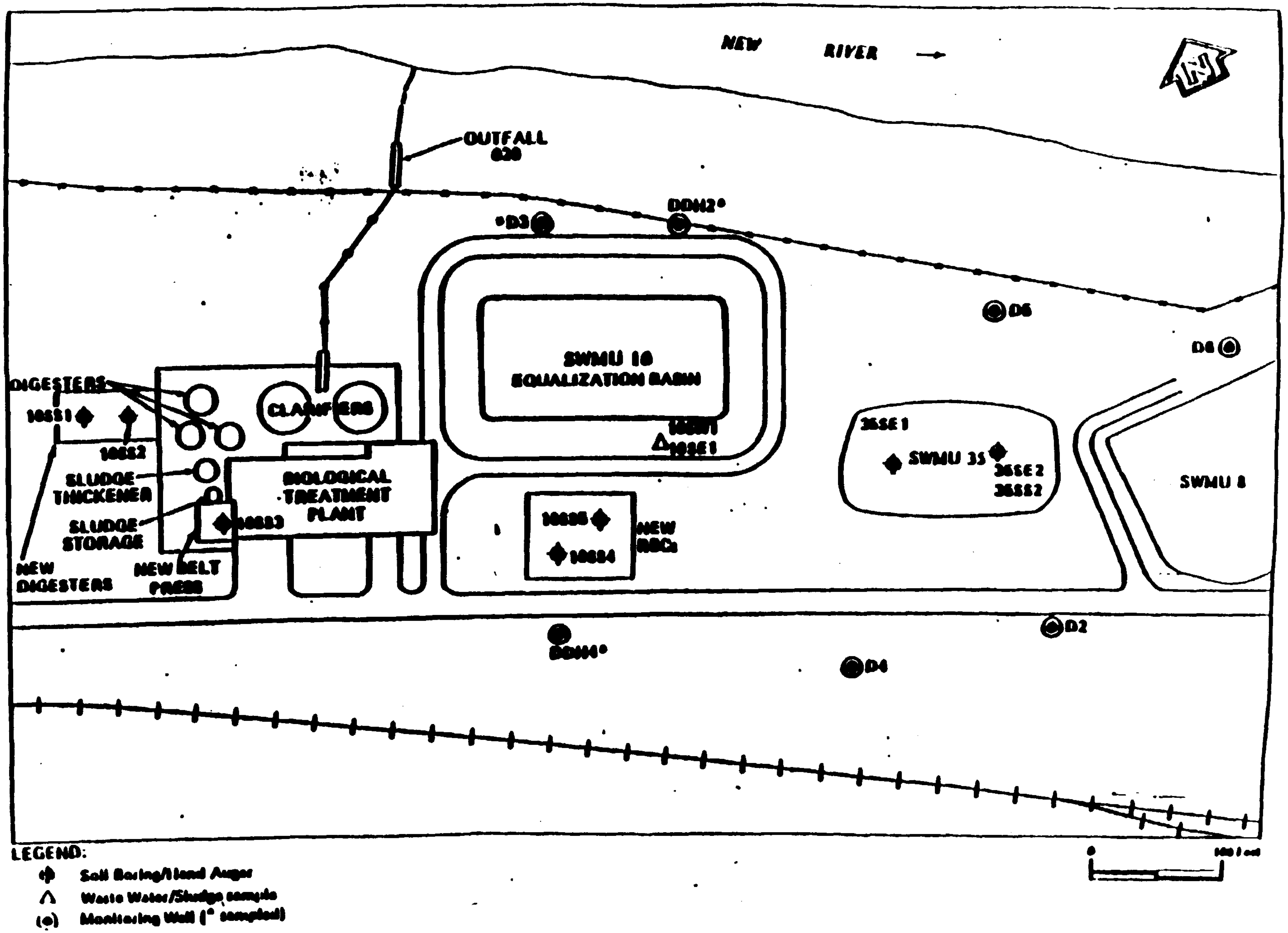


Figure 2-2. Site Characterization Program, Radford Army Ammunition Plant, Virginia

RADFORD3.DWG DC-RTG 4/25/96

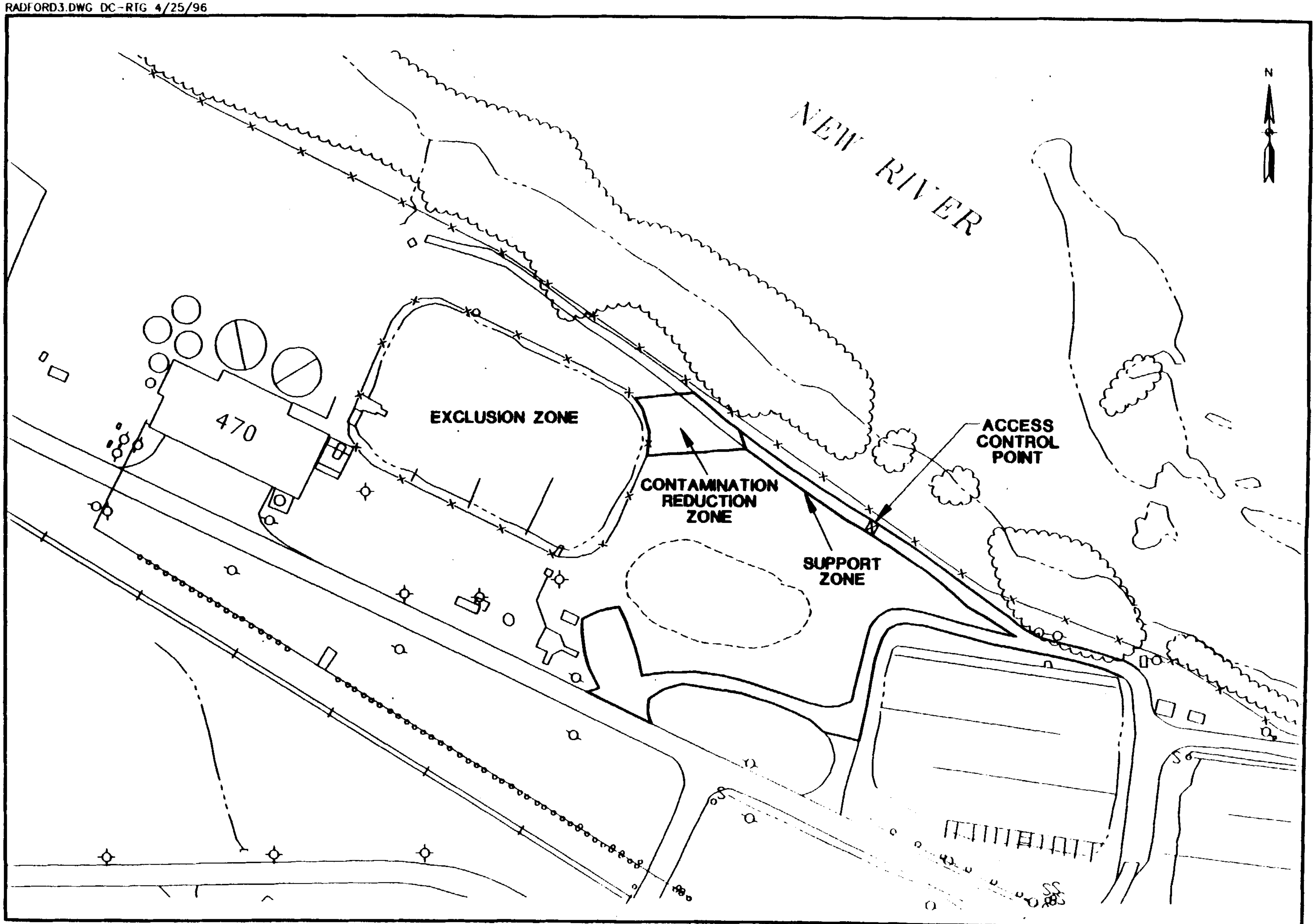


Figure 2-3. Work Zones
Radford Army Ammunition Plant, Radford, Virginia

The 1980 construction plans show that, prior to expanding the nitrocellulose fines lagoon, approximately 4' of very soft, wet sludge had to be removed. The new lagoon was expanded to its present dimension of 255 feet by 160 feet with a 10.5-foot dike and a 12-inch cement bottom. In 1986/87, a concrete perimeter wall was constructed to provide an additional 2 feet of freeboard.

In 1995, the lagoon was drained, the sludge removed, and the cement liner cleaned. Radian analyzed sludge samples. With the sludge removed during the liner installation in 1980 and again when the lagoon was cleaned out in 1995, Radian believes the potential for contamination beneath the liner will be minimal. The list of analytes has been reduced to 70 targeted compounds (list is given in the CDAP). This list has been based on compounds that may have been present in the wastewater, as well as compounds in which the Virginia DEQ is interested.

Rainwater has collected in the lagoon and will be pumped out by the facility before Radian begins work.

Radian is in the process of identifying locations for collecting background samples. These locations are not expected to have levels of contamination of concern.

3.0 SITE ORGANIZATION AND COORDINATION

Radian will have overall responsibility for field activities. The following section details the organizational structure for this project. Key personnel and their project responsibilities are listed in Table 3-1 - Site Organization.

Table 3-1

Site Organization

Name	Project Role	Phone Number
Corps of Engineers		
Steve Lantz	Project Manager	(804) 441-7519
Kent Balden	Project SHM	(804) 441-7677
Radian Corporation		
Tor Rothman	Contract Manager	(703) 713-6420
Bob Hearn	Project Manager & SSHO	(703) 713-6410
Tom Weeda, CIH	Project SHM	(919) 466-1232
Todd Church	Lead Investigator & Alternate SSHO	(703) 713-6461
Mark Johnson	Investigator and Alternate SSHO	(703) 713-6400
Bedford Environmental Drilling Services		
Jim Stevens	Safety Administrator	(540) 586-1449
Draper Aden Assoc. Surveying Company		
Thom Rutledge	Assistant Survey Manager	(540) 552-0444
RAAP		
Jerry Redder	Project Officer	(540) 639-7536

3.1 Corps Project Manager Role

The Corps Project Manager is responsible for approving and coordinating Radian's field efforts and the review and approval of all documents including SSHP. The Manager will also issue the notice to proceed for Radian on-site activities after approval of the SSHP.

3.2 Corps Safety and Health Manager Role

The Corps SHM is responsible for the approval of the Radian Safety and Health Program (SHP) and SSHP and coordinating the execution of project safety and health procedures. The Corps SHM is also responsible for the approval of all changes to the approved Radian SSHP.

3.3 Radian Project Manager Role

The Radian Project Manager is responsible for approving and coordinating all field efforts and reviewing and approving all Radian documents pertaining to the environmental investigation activities at the site. The Radian Project Manager is responsible for oversight and management of all of Radian's field activities in completing the site characterization. He will coordinate with Radian's Safety & Health Manager for approval of SSHP.

3.4 Radian Safety and Health Manager Role

The Radian SHM is responsible for reviewing and approving the Radian SSHP. The Radian SHM is also responsible for the reviewing and approving of all changes to the Corps' approved Radian SSHP.

3.5 Radian Site Safety and Health Officer (SSHO) Role

The Radian SSHO reports to the Corps Project Manager, Corps SHM, Radian Project Manager, and Radian SHM for all aspects of the project. The SSHO serves as primary on-site contact for safety and health during field activities, implements and oversees the on-site execution of all field activities regarding safety and health procedures and subcontractor operations, and has the authority to stop all work if conditions are judged to be hazardous to on-site personnel or to the public. The SSHO also has the authority to temporarily suspend workers from the job site for serious violations of the SSHP. Other specific responsibilities are as follows:

1. Conduct daily "tailgate safety meetings" to review planned field activities, highlight any specific hazards or coordination issues and record each meeting in the site logbook.
2. Establish site work areas and the level of protection, as necessary.
3. Perform monitoring/sampling of site hazards for exposure and hazard evaluations.
4. May order: work to cease; evacuation of the work area by all personnel; and re-establishment of safe working conditions.
5. Require any workers, visitors, and subcontractor's personnel to obtain immediate medical attention in the case of a work-related injury or illness.
6. Advise emergency response personnel in an emergency.
7. Immediately advise any Corps, RAAP, Radian, or other contractor's employees of hazards detected during or caused by the field activities.
8. Control access to the work area entry by visitors.

The Radian SSHO for this project is William R. Hearn. Mr. Hearn has successfully completed the 40-hour HAZWOPER Training and is current on the supervisory and annual update requirements. Mr. Hearn is a registered Professional Engineer with greater than 20 years of experience in environmental projects. He has served as a SSHP for several projects. The alternate SSHO for this project is Todd Church. Mr. Church is a staff geologist and is very experienced with environmental drilling and sampling. He has served as an on-site safety officer on many projects. He has completed his 40-hour HAZWOPER Training and supervisory training and is current on the annual update requirements.

3.6 Field Personnel

All Corps, Radian, and subcontract personnel who will be involved in the execution of the field activities are responsible for:

1. Complying with the SSHP.
2. Taking all reasonable precautions to prevent injury to themselves and to their fellow employees; being alert to potentially harmful situations.
3. Performing only those tasks that they believe they can do safely and immediately reporting any accidents and/or unsafe conditions to the SSHO and/or the Radian SHM.
4. Notifying the SSHO of any special medical conditions (e.g., allergies, contact lenses, pregnancy, diabetes). Such conditions should also include the use of any prescription and/or non-prescription medication which might cause drowsiness, anxiety or other unfavorable side effects, or may interfere with administration of medical treatment in the unlikely occurrence of an emergency or potential overexposure.
5. Practicing good housekeeping by keeping the work area neat, clean, and orderly to the extent possible.
6. Reporting all injuries, no matter how minor.
7. Reporting any unauthorized personnel in the work area.

3.7 Radian Corporate Occupational Health Physician[a]

Review and oversight of the Radian medical surveillance program is provided by:

Dr. Virginia J. Derbery, MD
11149 Research Blvd., Suite 300
Austin, Texas 78759

Dr. Derbery is Board Certified in Occupational Medicine.

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[a] Radian also contracts with an occupational medicine group locally.

4.0 SCOPE OF WORK/PLANNED SITE ACTIVITIES

The purpose of this project is to determine the extent of subsoil contamination beneath the Bioplant Equalization Basin (EB) as a part of the proposed clean closure of the EB at Radford Army Ammunition Plant (RAAP) near Radford, Virginia. A comparison to background levels is a part of this process. The field activities will include the following:

- Establishing a grid on the EB and randomly selecting seven locations for sampling of the cement liner and the soil beneath (maximum depth of 12 inches);
- Collecting samples in the EB using a concrete coring device and hand augers;
- Collecting concrete chip samples from the basin wall;
- Collecting eight background samples in areas of similar geology to soil under EB, but not impacted by the EB activities (depth of up to 15'). These will be collected with a split spoon from a soil boring drilled by a drilling rig; and
- Samples will be packaged, manifested, and shipped following U.S. EPA and Corps of Engineers protocols, spelled out in the project CDAP.

Analysis of the samples for the 70 compounds identified in the Closure plan will be conducted by three non Radian laboratories. Once complete, Radian will prepare a report of the results.

5.0 WASTE CHARACTERIZATION

Waste Types: *(Check all that apply)*

( ) Liquid
( ) Sludge
(X) Solid
( ) Unknown
( ) Gas

Waste Characteristics: *(Check all that apply)*

( ) Flammable
( ) Reactive
( ) Carcinogenic
( ) Corrosive
( ) Volatile
( ) Inert
( ) Toxic
( ) Radioactive
(X) Unknown

Sludges: *(Check all that apply)*

( ) Asbestos
( ) Other:
( ) Petroleum sludges
( ) Septic

Solids: *(Check all that apply)*

( ) Asbestos
( ) Other:
( ) Landfill sludges
( ) Tailings

Hazardous Materials Summary: *(Check all that apply)*

Chemicals:

( ) Acids
( ) Caustics
( ) Halogens
(X) Other: Multiple - see Section 6.2
( ) Metals
( ) Pesticides
( ) PCBs
( ) Phenols
( ) Paints
( ) Solvents

Fuels/Oils:

( ) Fuel Oil
( ) Other: Petroleum Hydrocarbons/Unidentified Source
( ) Gasoline
( ) Diesel

6.0 PROJECT HAZARD EVALUATION

6.1 Hazard Analysis of Work Tasks

6.1.1 Task: Mobilization/Demobilization/Surveying/Drilling

Potential Hazards: *(Check all that apply to either existing conditions or are a result of site operations)*

(X) Rotating Machinery
( ) Confined Space
( ) Biological
(X) Noise (>85 dBA)
( ) Vehicle Traffic
(X) Walking/Working Surfaces
( ) Projectiles
(X) Physical Exertion
(X) Chemical
( ) Fire/Explosion
(X) Heavy Equipment
(X) Slips, Trips, and Falls
(X) Heat Stress
(X) Cold Stress
( ) Electrical
( ) Excavation

Control Measures: *(Check all that apply)*

(X) Tailgate Meetings
(X) Decontamination
( ) Engineering Controls:
(X) Safe Work Practices
(X) Operator Training
(X) PPE
(X) Site Control

Anticipated Level of Protection for Assigned Task: Initial levels of PPE have been assigned for this work task with consideration given to the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, and as deemed necessary by the SSHO.

Level of Protection: ( ) A ( ) B ( ) Modified
( ) C (X) D

Respirator: (Level C or above)
( ) SCBA
( ) PAPR
( ) Half Mask
( ) Other Cart:
( ) Airline/Emerg. Egress
( ) Full face
( ) OV/HEPA Combo Cart.

Protective Clothing:
( ) Tyvek
( ) PE Tyvek
( ) Other:
( ) Saranax
( ) Splash

Head/Eye/Hearing:
(X) Hard Hat
( ) Goggles
(X) Ear Plugs/Muff
(X) Safety Glasses
( ) Face Shield

Gloves:
(Outer/Inner)

( ) Nitrile
( ) PVA
( ) Butyl Rubber
(X) Work Gloves (cotton/leather)
( ) Other:

( ) Neoprene
( ) Latex (inner)
( ) Vinyl

Footwear:

(X) Steel-toed Leather
( ) Chemical Overboots
( ) Other:

6.1.2 Task: Sample Collection

Potential Hazards: *(Check all that apply to either existing conditions or are a result of site operations)*

(X) Rotating Machinery
( ) Confined Space
( ) Biological
(X) Noise (>85 dBA)
( ) Vehicle Traffic
(X) Walking/Working Surfaces

( ) Projectiles
(X) Physical Exertion
(X) Chemical
( ) Fire/Explosion
( ) Heavy Equipment
(X) Slips, Trips, and Falls

(X) Heat Stress
(X) Cold Stress
( ) Electrical
( ) Excavation

Control Measures: *(Check all that apply)*

(X) Tailgate Meetings
(X) Decontamination
( ) Engineering Controls:

(X) Safe Work Practices
(X) Operator Training

(X) PPE
(X) Site Control

Anticipated Level of Protection for Assigned Task: Initial levels of PPE have been assigned for this work task with consideration given to the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, and as deemed necessary by the SSHO.

Level of Protection:

( ) A
( ) C

( ) B
( ) D

(X) Modified D

Respirator:
(Level C. Or above)

( ) SCBA
( ) PAPR
( ) Half Mask
( ) Other Cart:

( ) Airline/Emerg.Egress
( ) Full face
( ) OV/HEPA Combo Cart.

Protective Clothing:	( )	Tyvek	( )	Saranax
	( )	PE Tyvek	( )	Splash Suit
	( )	Other:		
Head/Eye/Hearing:	(X)	Hard Hat	(X)	Safety Glasses
	( )	Goggles	( )	Face Shield
	(X)	Ear Plugs/Muff		
Gloves:				
	(X)	PVC, Nitrile or Neoprene		
	( )	Latex (inner)	( )	Butyl Rubber
	( )	Vinyl	( )	Other:
	( )	Work Gloves (cotton/leather)		
Footwear:	(X)	Steel-toed Leather		
	( )	Steel-toed Rubber/PVC/Neoprene		
	( )	Chemical Overboots		
	( )	Other:		

6.2 Chemical Hazards

The potential for exposure to chemical hazards is expected to be minimal during field activities. Sludge sample results are summarized in Table 6-1 and show compounds present only in low concentrations. The actual analytical results are presented in Attachment 2 to this plan. Many of these compounds are pesticides and have a low volatility. It will be most important to prevent skin contact and the potential for ingestion of the contaminants.

The target list for the subsoil samples is 70 compounds, a number of which are volatile. Presumably, there is reason to suspect these may be present; therefore, air monitoring will be conducted to evaluate the potential inhalation hazard. (See exposure monitoring in Section 11.0.) Another potential inhalation source is the liner coring. The liner will be wetted during coring to minimize the potential for dust and inhaling contaminants.

Table 6-1

Chemical Substances Summary[a]

CHEMICAL	TLV	NOTES
antimony	0.5 mg/m^3	Trioxide is suspected carcinogen
coal tar pitch volatiles[b]	0.2 mg/m^3	Confirmed carcinogen
beryllium	0.002 mg/m^3	Suspected carcinogen
bis(2-chloroethyl)ether		Bis(2-chloromethyl)ether is a confirmed carcinogen, TLV 0.001 mg/m^3
bis(2-chloroisopropyl)ether		Bis(2-chloromethyl)ether is a confirmed carcinogen, TLV 0.001 mg/m^3
bis(2-ethylhexyl)phthalate[c]		No information located
chlordane	0.5 mg/m^3	Additional exposure via skin, mucous membranes, eyes
4-chloro-3-methylphenol		No information located
2,4-dichlorophenol		No information located
dieldrin	0.25 mg/m^3	Additional exposure via skin, mucous membranes, eyes
2,4-dimethylphenol		No information located
4,6-dinitro-2-methylphenol[d]	0.2 mg/m^3	Additional exposure via skin, mucous membranes, eyes
2,4-dinitrophenol		No information located
endosulfan II	0.1 mg/m^3	Additional exposure via skin, mucous membranes, eyes
endrin	0.1 mg/m^3	Additional exposure via skin, mucous membranes, eyes
heptachlor epoxide[e]	0.05 mg/m^3	Animal carcinogen
hexachlorobenzene	0.025 mg/m^3	Animal carcinogen; additional exposure via skin, mucous membranes, eyes

Table 6-1

Continued

CHEMICAL	TLV	NOTES
hexachlorobutadiene	0.02 ppmv	Suspected carcinogen; additional exposure via skin, mucous membranes, eyes
hexachlorocyclopentadiene	0.01 ppmv	
hexachloroethane	1 ppmv	Suspected carcinogen; additional exposure via skin, mucous membranes, eyes
methoxychlor	10 mg/m^3	
N-nitrosodimethylamine		Suspected carcinogen; additional exposure via skin, mucous membranes, eyes
toxaphene	0.5 mg/m^3	Additional exposure via skin, mucous membranes, eyes
1,2,4-trichlorobenzene	5 ppmv ceiling[f]	
2,4,5-trichlorophenol		No information located
2,4,6-trichlorophenol		No information located

[a] Based on 3 sludge samples collected in 9/95. Concentrations of the listed compounds were all less than 5 ppmw except for bis(2-ethylhexyl)phthalate and heptachlor epoxide.

[b] Includes benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene

[c] Concentrations of bis(2-ethylhexyl)phthalate ranged 23-46 ppmw.

[d] Dinitro-o-cresol = synonym.

[e] Concentrations of heptachlor epoxide ranged 254-337 ppmw.

[f] Not to be exceeded.

Although the locations for the background samples are expected to be uncontaminated, periodic air monitoring of the open boreholes with an OVA will be conducted as a precaution (see Section 11.0).

No radioactive compounds are expected to be present.

Protective work practices and personal protective equipment to be worn are described in Sections 12.0 and 13.0, respectively. Field personnel should avoid coming into contact with potentially contaminated soil and liner material. Nitrile gloves will be worn where any contact with soils or liner material is necessary. Nitrile gloves, preferably Best NDEX™, have been selected because nitrile provides protection against a broad range of chemicals. Samples are not expected to be very wet, so the primary concern is providing protection against contact with soil and coring material. Gloves should be double-gloved if the samples are wet, and changes of at least the outer layer made if they become wet. Regular changes of the gloves will be done regardless, to prevent cross-contamination of the samples--this protective practice will also minimize the potential for skin contact. In the case of the NDEX™ gloves, these also afford manual dexterity and good puncture resistance. Depending on working conditions, field personnel should consider wearing coveralls to prevent contaminating clothing.

6.3 Fire Protection

Although sparks may result during the coring operations, Radian does not have reason to believe explosive materials have accumulated in the liner or the subsoil, or that conditions conducive to a fire or explosion will exist or be created. As a precaution, additional ignition sources such as smoking or open flames will not be permitted in the work areas.

In the unlikely event that a fire should occur while on-site, personnel will evacuate the area immediately, and contact the local fire department by dialing 16. A fire extinguisher will be available in the work area, but is only to be used by persons who have been trained in the use of fire extinguisher on small incipient fires.

6.4 Physical Hazards

6.4.1 General

A summary of the hazards is provided in Section 6.1. Hazards associated with the drilling, coring and mechanical boring include being crushed or caught in machinery and noise. Personnel shall keep clear of the equipment and loose clothing, and jewelry removed to prevent entanglement. Hearing protection will be required where conversations are difficult at a distance of three feet.

Although the site is active, vehicle traffic is not expected to be excessive in the work areas, therefore, no additional precautionary measures are planned.

Slips, trips and falls are hazards common to field work and are familiar to all personnel. Being aware of your environment, maintaining clear, dry access and good footwear are key to reducing the potential for an incident.

Moving equipment into the EB introduces the potential for back strain. Mechanical devices will be used where personnel cannot reasonably manage to move this equipment.

~~Drilling for the background samples will require an assessment of buried pipe and conduit locations. Locations of pipes and conduit will be visibly marked to prevent accidental contact during drilling. Drill rigs also have the potential for coming into contact with overhead power lines. A minimum distance of ten feet will be maintained at all times from these lines.~~

6.4.2 Temperature Extremes

At the start of the project, ambient conditions are expected to be mild. However conditions may occur that produce cold stress. As the project moves into the summer months, the heat stress potential will increase.

Heat Stress

Heat-related illness ranges from cramps to heat stroke, a life threatening condition. Early symptoms may involve cramps, headaches, flushed skin. Heat stress can progress to heat exhaustion (cool, moist pale skin, nausea, dizziness, weakness) if unattended. Heat stroke symptoms include red, hot, dry skin, changes in consciousness, rapid, weak pulse and rapid, shallow breathing. Seek medical assistance immediately in cases of heat stroke.

The likelihood of heat-related illness can be reduced by taking adequate breaks and drinking water.

Another consequence of heat stress is sunburn. Personnel should take measures to reduce the potential for sunburn by wearing hats and long sleeves, and using suntan lotions.

Cold Stress

Factors that can contribute to cold stress on the body are exposure to temperatures below 40°F, high winds, and humidity or dampness. The most severe form of cold stress is hypothermia (the body's inability to maintain proper temperature). The early signs of hypothermia are excessive shivering and drowsiness. Frostbite is another injury caused by exposure to low temperatures. Frostbite occurs when ice crystals form in body tissues, usually the nose, ears, chin, cheeks, fingers, or toes. Frostbite symptoms begin with a flushing of the skin. The color of the affected area will then change to white or grayish-blue. The frostbitten area may feel very cold and numb. If symptoms of hypothermia or frostbite occur, seek medical attention immediately.

Cold stress can be prevented by using good common sense. All personnel should wear appropriate, water-resistant clothing in cold, damp weather. Special attention must be given to parts of the body subject to frostbite. Wearing several layers of clothing is the best method for reducing exposure. Head liners under hard hats will be used for ear protection and to reduce heat loss from the head. Each employee is advised to bring extra clothing to the site to ensure that additional layers will be available if needed or that damp clothing can be changed.

7.0 HAZARD COMMUNICATION AND TRAINING ASSIGNMENTS

7.1 Hazard Communication Training

All site personnel shall be trained in the chemical hazards associated with this project prior to commencement of work activities. MSDSs for any chemicals anticipated to be present in the samples will be kept on site and available to all workers at all times. The SSHO will identify where site MSDSs are maintained and notify personnel of the location(s). The SSHO shall be responsible for acquiring any additional MSDSs not available at site, and for the upkeep of these additional MSDSs.

7.2 Hazardous Waste Worker Training

All site staff will have completed the OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Training, 24 hours of on-site supervised training, and appropriate annual updates. Additionally, the SSHO will have completed the 8-hour supervisor training as required by the OSHA HAZWOPER standard. Documentation from subcontractors and any visitors that training assignments have been met will be required prior to initiation of field activities and visits, respectively.

7.3 First Aid/CPR Training

The following table documents the first aid/CPR training for the proposed field crew:

First Aid CPR Attendants	Certification Dates	Certifying Organization
Todd Church	23 April 1996	Red Cross
Mark Johnson	May 1996	Red Cross

7.4 Respiratory Protection Training

Although Radian does not anticipate the need for respiratory protection on this project, personnel will be prepared to don air-purifying respirators. The OSHA respirator standard requires training and all personnel will be current on this training.

8.0 MEDICAL SURVEILLANCE REQUIREMENTS

All personnel working at the project location shall participate in a medical surveillance program which is consistent with the requirements of 29 CFR 1910.120 for hazardous waste site operations. The purpose of the program is to assess and monitor employee health prior to, during the course of, and at the termination of employment. Personnel will have received a physician's approval to conduct work at hazardous waste sites, including the use of air-purifying respirators.

9.0 SITE COMMUNICATIONS

The "buddy system" will be enforced during all field activities. Each person will observe their partner for symptoms of chemical exposure or heat/cold stress and provide emergency assistance when warranted.

The following emergency signals shall be used:

Thumbs up	OK; understand
Thumbs down	No; negative
Grasping buddy's wrist	Leave site now
Hands on top of head	Need assistance

Where assistance is needed by any worker who is more than 100 feet from the next closest person or by anyone out of line of sight of another, the vehicle horn shall be used. The site will also have emergency procedures that will be determined by the SSHO upon arrival at the site and reviewed with the field crew.

10.0 SANITATION AND ILLUMINATION

To minimize the potential for ingestion of contaminants and transfer of contaminants to areas outside the work areas, washing facilities shall be available on site for use on this project. All personnel are to wash their hands and face before drinking, eating, smoking, or applying cosmetics.

Work before or after daylight hours in not anticipated. If early morning or night work is required, illumination within all general site areas will be maintained at or above 30 footcandles.

11.0 EXPOSURE MONITORING

Before beginning any new phase of work, at the beginning of each shift, and any time there is reason to believe ambient concentrations may have changed, the SSHO will conduct an area survey with an organic vapor analyzer and a photoionization detector to assess hazards and determine appropriate control measures. The monitoring results will be documented in the site logbook. All instruments used on site shall be calibrated and/or field checked in accordance with the manufacturer's recommendations on each day that field operations require their use. These data shall be recorded in the site logbook.

11.1 Exposure Monitoring Schedule

Based on the nature of the field activities to be completed and earlier characterization data (sludge samples), it is unlikely that any chemical vapors will be present above OSHA Permissible Exposure Limits or ACGIH Threshold Limit Values. The levels of protection outlined in Section 6.1 - Hazard Analysis of Worker Tasks have been assigned in accordance with expected levels of exposure to the chemicals. Typical work clothing (see Section 13.1) will be used for much of the work; modified Level D protection (see Section 13.2) has been assigned for all tasks involving possible contact with contaminated soils.

The guidelines in Sections 11.1.1 and 11.1.2 represent the minimum air monitoring requirements and monitoring frequency will be escalated based upon the results of previous monitoring and/or other signs or indicators (odors, etc). If monitoring in the breathing zone is indicated, it will be conducted with the primary emphasis on those employees with the highest anticipated potential for exposure.

11.1.1 Work Site Area Monitoring

Area monitoring with an organic vapor analyzer and a photoionization detector will be done at the beginning of each day and whenever conditions or tasks change which may affect airborne concentrations (e.g., at each stage of drilling). The goal in area monitoring is to assess the concentration at the source of contamination (e.g., at the hole left by removing the liner core sample). A minimum of two monitoring events during the day will be conducted.

11.1.2 Worker Breathing Zone Sampling

Monitoring will be conducted in the breathing zone, using the direct reading instruments, based on the results of the area monitoring. If concentrations at the source approach 100 ppmv, monitoring in the breathing zone shall be conducted.

11.2 Equipment to be Used

One of the following direct reading instruments will be used to monitor vapor concentrations in this work area.

Type	Make/Model	Contamination
Organic Vapor Analyzer	Foxboro OVA-108	Organic vapors
Photoionization Detector	HNu Systems - HW-101 w/11.7eV lamp	Organic vapors

The direct reading instrument will be calibrated daily. The results of the calibration will be recorded in the field log book.

11.3 Action Levels

When direct reading instrument results reach 100 ppmv at the source, the SSHO should begin sampling the personnel breathing zones. If concentrations in the breathing zone are detectable, the SSHO should stop work to determine the cause and likely contaminant(s). The SSHO will consult with the Radian SHM to decide the appropriate course of action, including upgrading PPE to Level C.

12.0 SAFE WORK PRACTICES

Employees and visitors will be required to follow good hygiene/work practices that include:

1. Unauthorized personnel are not allowed on site.
2. Personnel under the obvious influence of alcohol or controlled substances are not allowed on site.
3. Ignition sources such as matches and cigarette lighters are only allowed in designated areas.
4. Smoking, eating, drinking, chewing gum or tobacco, taking medication, and applying cosmetics will not be permitted in the work areas. Thoroughly wash hands, arms, and face before breaks or any hand-to-mouth activity such as eating, drinking, smoking/use of chewing tobacco or application of cosmetics.
5. Discard and replace any damaged or heavily soiled protective clothing. Minimize the potential for contaminating clothing and skin.
6. Prevent heat stress by taking breaks and drinking water during these breaks. Prevent cold stress by dressing adequately and taking breaks. Drink warm beverages during these breaks.
7. Notify the SSHO of any defective monitoring, emergency, or other safety equipment.
8. Work upwind of the contamination source wherever possible.
9. Become familiar with your environment to prevent slips, trips, falls, and vehicle incidents.

13.0 PERSONAL PROTECTIVE EQUIPMENT

All personnel working at this project will be required to be in the level of protection specified in Section 6.1.

For tasks not covered in the SSHP, personnel shall wear a level which is deemed necessary by the SSHO and the Radian SHM. All PPE for varied activities and tasks are based upon the potential site-specific contaminants recognized at the time the SSHP is prepared. The SSHO should periodically re-assess the need to upgrade or downgrade the PPE. The anticipated levels of protection are given below. Reference Section 6.1 for which level is needed for what task. Although Radian does not anticipate conditions requiring tyvek coveralls or respiratory protection, the field crew is prepared to don Level C.

13.1 Level D

1. Safety glasses/goggles.
2. Steel-toed safety shoes.
3. Work gloves.
4. Hearing protection (as required).
5. Hard hat.

13.2 Modified Level D

1. Safety glasses/goggles.
2. Steel-toed safety shoes.
3. PVC, neoprene or nitrile gloves.
4. Hearing protection (as required).
5. Hard hat.
6. Chemical overboots (optional based on wetness of the environment).
7. Coveralls (optional based on wetness of the environment).

13.3 Level C

Where monitoring results require an upgrade of PPE to Level C (see Section 11.3) the following equipment will be worn by personnel potentially exposed.

1. Safety glasses/goggles, unless full-face respirator is required.
2. Steel-toed safety shoes.
3. Nitrile gloves (double).
4. Hearing protection (as required).
5. Hard hat.
6. Chemical overboots.
7. Tyvek coveralls (uncoated or coated).
8. Respirator (full or half-face), appropriate cartridges.

The SSHO will decide on the type of coverall and the degree of respiratory protection based on the monitoring results.

14.0 PROTECTIVE CLOTHING DONNING/DOFFING PROCEDURE

The following donning/doffing procedures are given as a guide for donning and doffing Level C ensembles. The purpose of the protective clothing donning/doffing procedures is to give on-site personnel a reference for and a means of review of the proper way to don/doff protective clothing. Failure to adhere to these procedures may result in the protective clothing being ineffective against potential contaminants.

If Level C PPE is required, the SSHO will need to establish work zones to minimize the potential for spreading contamination. Locations for donning/doffing will need to be identified relative to the work zones by the SSHO. Decontamination procedures are described more completely in Section 15.0.

14.1 Protective Clothing Donning Procedure

1. Inspect PPE equipment before donning and prior to initial sample collection.
2. Dress in coveralls, inner gloves, outer gloves, and overboots. Tape outer gloves to the coveralls using duct tape. Tape the coverall to the overboots.

14.2 Protective Clothing Doffing Procedure

1. Remove excess mud or other debris from outer gloves, overboots, and clothing prior to leaving immediate work area by scraping, then rinsing the items.
2. Remove tape and the outer layer of clothing. Place disposable PPE in designated receptacles that are adequately labeled and reusable PPE in bags.

3. As the last step, remove your respirator then remove your inner gloves.

4. Thoroughly wash your hands and face with soap and water prior to eating, drinking, smoking, or other hand-to-mouth contact.

15.0 DECONTAMINATION

The purpose of decontamination is to prevent contaminants that may be present on protective clothing and equipment from coming into contact with personnel as they remove the PPE. Also, decontamination protects workers from hazardous substances that may contaminate and eventually permeate the PPE used on site. Finally, decontamination protects personnel by minimizing the tracking of harmful materials into clean areas. Decontamination procedures physically remove contaminants or change the chemicals to innocuous substances. Combining decontamination with the correct sequence of removing personnel protective equipment will prevent exposure to personnel leaving the work area as well as minimize the off-site migration of contaminants.

Decontamination begins with the first step of doffing PPE which involves the most heavily contaminated item and progresses to the last doffing step with the least contaminated item.

The purpose of equipment decontamination is to prevent exposure to personnel during the loading, transporting and unloading of equipment at another site. It is also to prevent off-site migration of contaminants from one site to another or during transporting the equipment. All decontamination will be observed by the SSHO, who will ensure its effectiveness and make changes as necessary.

15.1 Personnel Decontamination

Removal of loose mud or other material from personnel and equipment will be performed before leaving the work area. Additional material will be removed in the work area by brushing, wiping, or washing as necessary. Personnel will remove any disposable PPE and dispose of equipment in containers provided before leaving the work area. If respirators are used, they will be cleaned, disinfected, and stored properly. Personnel shall thoroughly wash hands and face before leaving the area. A shower is not required for personal decontamination at this site. It is anticipated that decontamination wastewater will be disposed of on site. The SSHO will confirm the arrangements prior to start of work. Discarded PPE will be collected, drummed, labeled, and disposed of by Radian.

15.2 Equipment Decontamination

All equipment (hand tools, monitoring equipment, sample containers) shall be decontaminated in the work area prior to removal from the work area. This can be accomplished by wiping equipment off thoroughly with a damp cloth, or pressure washing of equipment. Wastewater generated from the decontamination of sampling equipment and tools will be collected, drummed, labeled, and disposed of on site. Each piece of decontaminated equipment will be visually inspected to ensure that visible contamination has been removed.

16.0 EMERGENCY RESPONSE

The purpose of this section is to safeguard human health and the environment in the event of an emergency. This section presents the actions to be taken in response to an emergency. During an emergency, the SSHO will serve as the Emergency Coordinator.

16.1 Pre-emergency Planning

The SSHO will perform the following pre-emergency tasks before starting field activities and will coordinate emergency response with all field personnel:

1. Locate nearest telephone and/or alarm station.
2. Confirm and post emergency contacts and telephone numbers.
3. Post a site map marked with site evacuation routes, refuge areas, and the location of on-site emergency equipment, supplies, and on-site medical services. Also post the route to the designated off-site emergency medical facility. Review this information with all personnel.
4. Inform personnel of the nature of the project hazards and potential emergencies. Discuss response procedures.
5. Inventory the on-site emergency equipment and supplies.
6. Determine facility emergency action plans and review this with field personnel.

The SSHO will review and revise the emergency response plan in the event of a failure of the plan, site condition changes, and changes in the scope of work or available personnel.

16.2 Lines of Authority

The SSHO has primary responsibility for responding to and correcting emergency situations, as conditions allow. The SSHO has the authority to stop any site activities posing an immediate health and safety hazard to site personnel and/or the public. In an emergency, the SSHO will immediately advise any USACE personnel, RAAD personnel, Radian personnel, subcontractor personnel, and site visitors of the hazard and the appropriate action to be taken.

16.3 Emergency Prevention and Recognition

Effective implementation of the SSHP, personnel awareness and training, contingency planning, and the briefings held with personnel at the beginning and during the execution of the field activities will help to prevent emergencies.

16.4 Notification

In the event of an emergency, the SSHO will issue a verbal instruction or a site alarm will be sounded to notify all on-site personnel. Personnel shall:

1. Stop work activities.
2. Lower noise levels to facilitate communications (e.g., stop drilling or coring).
3. Begin emergency procedures.

16.5 Evacuation Routes and Procedures

In the event of an emergency that requires an evacuation of the site, a site alarm will be sounded or verbal instruction given by the SSHO to evacuate the area. Personnel will exit the area to the upwind, pre-designated area. At this point, the SSHO will account for all personnel, ascertain information about the emergency, and provide further instructions to the on-site personnel. The SSHO in conjunction with the COE SHM will also apprise the off-site emergency personnel of the situation, if necessary. In all situations that require evacuation, personnel shall not re-enter the work area until the conditions causing the emergency have been corrected, the hazard reassessed, the SSHP revised, if necessary, and reviewed with on-site personnel, and instructions given for authorized re-entry by the SSHO.

16.6 Emergency Medical Treatment and First Aid

In the event of an emergency involving injury or illness, first aid should be rendered by a certified First Aid/CPR trained attendant. Personnel with injury or illness will be decontaminated to the extent possible without further injury. However, in consideration of the anticipated site contaminants, life saving and first aid procedures should take priority over personnel decontamination efforts. The SSHO will have final authority on the decision to seek additional medical services.

16.7 Fire or Explosion

In the event of fire or explosion, the local Fire Department shall be summoned immediately. Small incipient fires may be handled by trained staff using fire extinguishers (see Section 6.4).

16.8 Environmental Release

Since Radian's activities do not involve liquids, liquid spills are not expected. If personnel suspect the project activities have caused a release to the environment, the SSHO should be immediately notified. The SSHO will take the following steps:

1. Inform the COE Project Manager so that the facility SPCC Plan can be implemented if necessary.
2. Locate the source of the release and stop or reduce the rate of release if it is safe to do so.
3. Begin containment and/or recovery of the released material if it is safe to do so.

16.9 Emergency Contacts

The following resources may be contacted in the event of an emergency:

Fire Department:	16
Police:	7325
Hospital (ambulance):	7163
National Response Center	(800) 764-6800
Region III, EPA	(215) 597-9058
VaDEQ (24 Hr)	(804) 527-5200
Poison Control Hotline	(800) 552-6337
Corps Project Manager (Steven Lantz)	(804) 441-7519

16.10 Route to Nearest Medical Treatment Facility

The transportation of any personnel needing medical treatment will be done by RAAP personnel. They will be contacted by dialing 639-7163 on a cellular phone or 7163 on a plant phone. According to RAAP safety personnel, it is advisable to rely completely on plant emergency response rather than attempt driving to on-site medical facilities. Therefore, no map to the medical facility is included in this SSHP.

16.11 Emergency Equipment

If shall be the responsibility of the SSHO to maintain the site emergency equipment in good working order. An inventory and inspection of the project required emergency equipment and supplies shall be performed prior to the start of the project and on a weekly basis.

The emergency equipment shall be readily available. The SSHO shall review the location and use of the equipment with workers prior to the start of work. The following emergency equipment is to be immediately available to on-site personnel:

- First Aid Kit
- Portable Eyewash
- Fire Extinguisher

17.0 STANDARD PROCEDURE FOR REPORTING EMERGENCIES

The following information should also be provided to the Norfolk District office for occupational safety and health in the event of an emergency. The telephone number is (804) 441-7671. The caller should provide the following:

1. Name of the person making call.
2. Telephone number at location of the person making call.
3. Name of the person(s) exposed or injured.
4. Nature of the emergency.
5. Actions already taken.

17.1 Incident Follow-up and Documentation

Before normal activities are resumed, on-site personnel must be prepared and equipped to handle another emergency. The follow-up activities should be completed under the direction of the SSHO:

1. Notify appropriate government agencies as required (reminder: OSHA must be notified within 8 hours if there have been any fatalities or three or more injuries requiring hospitalization.

2. Restock all equipment and supplies.

3. Review and revise all aspects of the SSHP as necessary to address future emergencies of this type and new site conditions.

Investigation and documentation of any emergency response shall be initiated by the SSHO. The documentation will be in the form of a written report and will be:

1. Accurate: All information must be recorded objectively.

2. Authentic: Each person making an entry must sign and date that entry. Nothing is to be removed or erased. If details are changed

or revised, the person making the change should strike out the old material and initial and date the change.

3. Descriptive:

   - Titles and names of personnel involved.
   - Actions taken, decisions made, orders given, to whom, by whom, when, what, where, and how as appropriate.
   - Summary of data available (air monitoring, chemical concentrations, etc.).
   - Possible exposure of personnel.

This report shall also include copies of the Accident Investigation Report (ENG Form 3394), and Employer's first Report of Injury that is sent to the worker's compensation insurance carrier.

The SSHO shall also complete the Radian Incident Report Form within 48 hours of the incident and send it to the local Radian Human Resources Administrator.

18.0 PROJECT DOCUMENTATION

Information and data collected as a result of this SSHP shall be documented in field log books. The logs are the ultimate responsibility of the SSHO and shall be maintained on site for review. However, all personnel shall be individually responsible for completion of the information required by the logs.

In addition to the information in the log books, a plan approval signature sheet and all visitors notice forms are to be completed and maintained as a part of the project documentation. A complete list of all the items to be documented is given below.

Plan Approval Signature Sheet	Section 19.0
Visitors Notice	Attachment 1
Daily Project Log	On-site Logbook
Daily Sign-in Log - Employees	On-site Logbook
Daily Sign-in Log - Visitors	On-site Logbook
Site Monitoring Data	On-site Logbook
Training/Safety Briefing Log	On-site Logbook

All project documentation shall be kept on record for a period of no less than 30 years by USACE.

19.0 PLAN APPROVAL

This SSHP has been written for the use of Radian Corporation employees and will be provided for informational purposes only to subcontractors and Corps employees. Radian Corporation claims no responsibility for its use by others. The SSHP is written for the specific site conditions, purposes, dates and personnel specified and must be amended if these conditions change.

Radian Project Manager

, CIH
Radian Safety & Health Manager

USACE Project Manager

USACE Safety & Health Manager (SHM)

Attachment 1

VISITORS NOTICE FORM

Project: Contaminant/Evaluation for Closure of the Equalization Basin, Radford Army Ammunition Plant, Virginia

Site visitors requesting access to the work areas are required to receive a site orientation of the hazards associated with the site and a briefing of the emergency response and evacuation plan.

All visitors including subcontractors shall have received the appropriate on- and off-site training and medical evaluation, and shall provide Radian with corresponding documentation prior to entering the work areas.

Your signature below indicates that you are aware of and have complied with the above requirements, that you understand the potential hazards associated with this site and the planned on-site activities to be performed, and that you will abide by the safety and health requirements (as established in the site-specific safety and health plan for this site), as they pertain to the area in which you plan to enter.

Name	Company	Date/Time	Signature

Attachment 2

Analytical Results of the Radford Army Ammunition Plant Sludge Samples Collected on September 8, 1995

Constituent	SW-846 Method	Sample 1[a] (µg/kg)	Sample 2[a] (µg/kg)	Sample 3[a] (µg/kg)
Moisture (percent)	D2216	53.5%	67.4%	64.1%
Acrylonitrile	8260	<4.54	<6.38	<5.81
Antimony	7041	2,820	4,120	5,500
Benz(a)anthracene[b]	8310/8270	1.55/3,520	1.55/1,490 J	2.47/1,700
Benzo(b)fluoranthene[b]	8310/8270	1.50/10,400	1.81/3,010 J	2.77/2,870 J
Benzo(k)fluoranthene[b]	8310/8270	0.792/10,400	0.971/3,010 J	1.58/2,870 J
Benzo(a)pyrene	8310/8270	1.42/4,230	1.76/1,330 J	3.44/1,550
Beryllium	6010	312	301	359
Bis(2-chloroethoxy)methane	8270	<559	<786	<721
Bis(2-chloroethyl)ether	8270	<872	<1,230	<1,130
Bis(2-chloroisopropyl)ether	8270	<834	<1,170	<1,080
Bis(2-ethylhexyl)phthalate	8270	23,400	46,000	35,100
Bromoform	8260	<1.30	<1.83	<1.67
Bromomethane	8260	<2.22	<3.13	<2.85
Butylbenzylphthalate	8270	<483	<679	<623
Carbon tetrachloride	8260	<1.77	<2.49	<2.27
Chlordane	8081	<1,030	<1,480	<1,360
Chlorobenzene	8260	<1.61	<2.27	<2.07
4-Chloro-3-methylphenol	8270	<1,370	<1,930	<1,770
Chloroform	8260	<2.18	<3.07	<2.80
Chloromethane	8260	2.23	15.3	<2.52
2-Chlorophenol	8270	<646	<908	<833
Chrysene[b]	8310/8270	1.13/6,160	1.29/2,480	1.52/2,360
Dibenz(a,h)anthracene[b]	8310/8270	0.312/<1,580	0.436/<2,220	0.523/<2,040
1,2-Dichlorobenzene	8260	<0.946	<1.33	<1.21

Attachment 2 (Continued)

Analytical Results of the Radford Army Ammunition Plant Sludge Samples Collected on September 8, 1995

Constituent	SW-846 Method	Sample 1[a] (µg/kg)	Sample 2[a] (µg/kg)	Sample 3[a] (µg/kg)
1,3-Dichlorobenzene	8260	<1.22	<1.72	<1.57
1,4-Dichlorobenzene	8620	<1.62	<2.28	<2.08
3,3'-Dichlorobenzidine	8270	<1,380	<1,950	<1,790
2,4-Dichlorophenol	8270	<769	<1,080	<991
1,2-Dichloropropane	8260	<1.27	<1.78	<1.63
Dieldrin	8081	1,680	1,420	1,180
2,4-Dimethylphenol	8270	1,700	2,390	2,190
4,6-Dinitro-2-methylphenol	8270	<767	<1,080	<989
2,4-Dinitrophenol	8270	<2,880	<4,050	<3,710
Endosulfan I	8081	46.3 J	<740	<672
Endosulfan II	8081	<953	<1,370	<1,240
Endrin	8081	<1,370	<1,970	<1,790
Fluorene[b]	8310/8270	2.2/<1,230	7.22/<1,740	5.76/<1,590
Heptachlor	8081	89.6 J	<456	<414
Heptachlor epoxide	8081	337,000	291,000	254,000
Hexachlorobenzene	8270	<1,640	<2,310	<2,120
Hexachlorobutadiene	8270	<1,260	<1,770	<1,620
Hexachlorocyclopentadiene	8270	<6,730	<9,470	<8,680
Hexachloroethane	8270	<1,770	<2,480	<2,280
Indeno(1,2,3-cd)pyrene[b]	8310/8270	0.371/2,960	0.633/<2,570	0.70/<2,350
Methoxychlor	8081	<4,800	<6,880	<6,250
Methylene chloride	8260	0.916 BJ	3.03 B	1.61 BJ
Naphthalene	8270	<1,120	<1,580	<1,450
N-Nitrosodimethylamine	8270	<2,000	<2,820	<2,580
Thallium	6010	528 J	467 J	671 J
Toxaphene	8081	<1,980	<2,840	<2,580

Attachment 2 (Continued)

Analytical Results of the Radford Army Ammunition Plant Sludge Samples Collected on September 8, 1995

Constituent	SW-846 Method	Sample 1[a] (µg/kg)	Sample 2[a] (µg/kg)	Sample 3[a] (µg/kg)
1,2,4-Trichlorobenzene	8270	<970	<1,360	<1,250
1,1,2-Trichloroethane	8260	<1.70	<2.40	<2.18
Trichlorofluoromethane	8260	<7.13	<10	<9.14
2,4,5-Trichlorophenol	8270	<963	<1,360	<1,240
2,4,6-Trichlorophenol	8270	<684	<962	<882

[a]< - The value following the "<" symbol indicates the detection limit for a specific compound in that particular sample. The detection limit is influenced by several factors, including initial sample size, dilution factor, moisture content, matrix interferences, and instrument response; therefore, the detection limit may vary from sample to sample.

b - Methods 8310 and 8270 were both used to quantitate these compounds; the 8270 result is more accurate than the 8310 result because interferences (non-target compounds) were noted during the 8310 analyses; and because 8270 utilized mass spectrometry to identify the compounds.

J - This result is less than the sample-specific detection limit, but greater than or equal to the specific reporting limit (zero).

B - This analyte detected in the method blank at a concentration greater than the reporting limit (zero). Methylene chloride was detected in the method blank at 0.813 µg/kg.