DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

file GW 1986

REPLY TO ATTENTION OF

HSHB-ES-G

06 JAN 1986

452-33

SUBJECT: Ground-water Monitoring Results for Seneca Army Depot, NY

Commander
Seneca Army Depot
ATTN: SDSSE-~~AD~~
Romulus, NY 14541-5000

1. Reference:

a. U.S. Army Management Plan for the RCRA Ground-water Monitoring and Assessment Program, June 1981.

b. Letter, this Agency, HSHB-ES-G, 1 June 1984, SAB.

c. Letter, this Agency, HSHB-ES-G, 11 December 1984, SAB.

d. Letter, this Agency, HSHB-ES-G, 23 May 1985, SAB.

e. New York Water Classification and Quality Standards, Part 703, Ground-water Classifications, Quality Standards, and Effluent Standards and/or Limitations (Amended 2 August 1978; effective September 1978).

2. Enclosures 1 and 2 are tables reporting results of chemical analyses of ground-water samples collected on 13 September 1985 from monitoring wells around the Demolition Area and Landfill at Seneca Army Depot, NY. Field pH, specific conductivity, and water level measurements were made by installation personnel. These data constitute the second semiannual set of results for 1985. All 1984 data were reported in references 1b and 1c. The first set of 1985 data was reported in reference 1d.

3. Concentrations of certain parameters are compared to the New York standards in reference 1e. Certain other parameter concentrations are compared to the National Secondary Drinking Water Regulation criteria which address the aesthetic quality of the water. Any concentrations exceeding the standards or criteria are noted in the enclosures.

4. The concentration of sulfate in the sample from well PT-12 continues to exceed the state standard. The concentration of chloride in the same well sample exceeds the state standard and is significantly higher than the past reported concentrations for that well. In addition, the high values for specific

06 JAN 1986

conductivity for the same well indicate that the National Secondary Drinking Water Regulation criterion for total dissolved solids would be exceeded. In general, the results are similar to those reported previously.

5. No results are reported for wells W4 and W7 because they were dry. Well PT-13 was destroyed prior to the September 1984 sampling and has not been replaced.

6. Questions regarding these data may be referred to Ms. Kim M. Fleischmann or Mrs. Beth A. Martin, this Agency, AUTOVON 584-2024.

FOR THE COMMANDER:

2 Encls

FREDERICK W. BOECHER
LTC, MS
Chief, Waste Disposal Engineering Division

CF (w/encls):
Cdr, HSC (HSCL-P)
Cdr, AMC (AMCSG-S)
Cdr, AMC (AMCEN-A)
Cdr, DESCOM (AMSDS-RM-EF-D)
Cdr, USATHAMA (AMXTH-AS)

RUN DATE: 12 DEC 85

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B W5	W4	W6	W1	W3	W2	W7
WATER										
LEVELS (A)	12 SEP 85		FT	113.1		104.3	106.3	99.4	92.3	
PH(FIELD)	13 SEP 85		PH	7.1		7.1	7.1	7.1	7.0	
SPEC COND	13 SEP 85	1.	UMC	720.		600.	880.	840.	830.	
SPEC COND	13 SEP 85	1.	UMC	720.		600.	870.	830.	840.	
SPEC COND	13 SEP 85	1.	UMC	730.		610.	880.	840.	840.	
SPEC COND	13 SEP 85	1.	UMC	730.		600.	880.	830.	840.	
TOC	13 SEP 85	.1	MGL	3.4		2.9	2.5	3.2	3.1	
TOC	13 SEP 85	.1	MGL	3.4		2.8	2.7	3.3	3.1	
TOC	13 SEP 85	.1	MGL	3.4		3.0	2.5	3.3	3.5	
TOC	13 SEP 85	.1	MGL	3.4		2.7	2.6	3.3	3.3	
TOX	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	
TOX	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	
TOX	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	
TOX	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	
2,4,6-TNT	13 SEP 85	.001	MGL	ND		ND	ND	ND	ND	
2,4-DNT	13 SEP 85	.001	MGL	ND		ND	ND	ND	ND	
2,6-DNT	13 SEP 85	.001	MGL	ND		ND	ND	ND	ND	
RDX	13 SEP 85	.030	MGL	ND		ND	ND	ND	ND	
HMX	13 SEP 85	.100	MGL	ND		ND	ND	ND	ND	
TETRYL	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	

Encl 1

RUN DATE: 12 DEC 85

INSTALLATION: SENECA AD, NY SITE: DEMOLITION GROUNDS

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.
A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 12 DEC 85

INSTALLATION: SENECA AD, NY

SITE: LANDFILL

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B PT-10	PT-11	PT-12	PT-14	PT-15
WATER LEVELS (A)	12 SEP 85		FT	670.0	652.3	642.0	630.1	630.6
CHLORIDE	13 SEP 85	1.0	MGL	69.0	52.0	692.0&	46.0	13.0
IRON	13 SEP 85	.10	MGL	ND	ND	ND	ND	ND
SULFATE	13 SEP 85	2.0	MGL	13.0	114.0	487.0&	97.0	44.0
PH(FIELD)	13 SEP 85		PH	7.5	7.4	6.9	7.1	7.4
PH(LAB)	13 SEP 85		PH	7.8	7.8	7.4	7.6	8.0
SPEC COND	13 SEP 85	1.	UMC	830.	830.	3800.	700.	510.
SPEC COND	13 SEP 85	1.	UMC	830.	840.	3800.	700.	520.
SPEC COND	13 SEP 85	1.	UMC	830.	840.	3800.	690.	520.
SPEC COND	13 SEP 85	1.	UMC	820.	840.	3800.	700.	520.
TOC	13 SEP 85	.1	MGL	1.4	2.6	3.5	3.3	1.8
TOC	13 SEP 85	.1	MGL	1.3	2.5	3.4	3.3	1.9
TOC	13 SEP 85	.1	MGL	1.3	2.6	3.4	3.2	1.9
TOC	13 SEP 85	.1	MGL	1.3	2.7	3.5	3.3	1.8

Encl 2

RUN DATE: 12 DEC 85

INSTALLATION: SENECA AD, NY SITE: LANDFILL

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA
& VALUE EXCEEDS A NEW YORK STATE GROUND-WATER STANDARD
MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

DEPARTMENT OF THE ARMY
HEADQUARTERS, U. S. ARMY MATERIEL COMMAND
5001 EISENHOWER AVENUE, ALEXANDRIA, VA 22333-0001

AMCEN-A

15 MAY 1986

SUBJECT: Proposed Modification to the U.S. Army Groundwater Monitoring Program - Request for Comments

HQDA (DAEN-ZCE)
WASH DC 20310-2600

1. Reference letter, HQDA, DAEN-ZCE, 22 Apr 86, subject as above.

2. This command has reviewed the subject document and provides the following comments:

a. Implementation of the proposed modification in FY 87 is too soon unless HQDA centrally funds and contracts for the analytical support in the interim. The earliest AMC could program funds to assume this new mission would likely be FY 88.

b. Some AMC installations may be able to perform the routine monitoring analytical requirement by expanding existing laboratory capabilities. However, adequate set-up time must be alloted, and USAEHA technical support must be available to establish QA/QC procedures, analytical methods, chain of custody requirements, and data reporting. Such labs may also require state-certification before any analytical data would be acceptable. Consequently, in-house analytical capability will take some time to develop and may be anticipated in FY 88.

c. Another option for addressing the subject modification is for this command or its installations to contract for the analytical support. Execution of this option in FY 87 depends upon the availability of funds for this program from HQDA.

d. USAEHA analytical support must be available until AMC has the capability to take over the workload on the routine monitoring. Guidance is requested from HQDA so that adequate programming and budgeting for funds can be pursued.

AMCEN-A
SUBJECT: Proposed Modification to U.S. Army Groundwater Monitoring Program - Request for Comments

3. Point of Contact, this headquarters, is MAJ Jessie B. Cabellon, AMCEN-A, 274-9016.

4. AMC - Providing Leaders the Decisive Edge.

FOR THE COMMANDER:

JERRY A. HUBBARD
Colonel, GS
Deputy Chief of Staff,
Engineer

CF:
COMMANDERS
AMCCOM (AMSMC-ISE)
DESCOM (AMSDS-RM-EFD)
TECOM (AMSTE-ST-E)
USAEHA (HSHB-ES)
USAEDH (HNDED-PM)

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20310-2600

22 APR 1986

REPLY TO
ATTENTION OF:

DAEN-ZCE

SUBJECT: Proposed Modification to the US Army Ground-Water Monitoring Program - Request for Comments

SEE DISTRIBUTION

1. References:

a. Letter, Office of the Chief of Engineers, DAEN-ZCE, 31 March 1981, subject: Sampling and Analysis of Ground Water from Resource Conservation and Recovery Act (RCRA) Monitoring Wells (Enclosure 1).

b. Letter, Huntsville Division, Corps of Engineers, HNDED-PM, 11 June 1981, subject: US Army Management Plan for the Ground-Water Monitoring and Assessment Program (Enclosure 2).

2. The Resource Conservation and Recovery Act (RCRA) focused attention on protection of ground-water resources. RCRA and implementing state laws require a significant amount of sampling and analysis of ground-water around hazardous and solid waste land disposal facilities. In March, 1981, DA implemented a centrally managed ground-water monitoring and assessment program (references 1a and 1b). This program has been in continuous implementation since 1981 under the direction of the US Army Environmental Hygiene Agency (USAEHA). The present level of support is summarized in Enclosure 3. Currently, 87 waste disposal facilities among 29 installations are supported through quarterly and semiannual sampling and analysis of over 500 monitoring wells. During FY85, approximately 1,500 samples were collected and 25,000 analyses performed.

3. The purpose of this letter is to request comments on a proposed modification to the ground-water monitoring program. Under this modification, USAEHA would discontinue routine analytical support for the program. However, USAEHA would continue to serve as central program manager as it has in the past. Enclosure 4 is a revised management plan for the ground-water monitoring program and addresses in detail this proposed change.

4. Routine analytical support by USAEHA is proposed to be terminated for two reasons.

a. The routine collection of ground-water quality data in response to regulatory requirements is not an Army Medical Department (AMEDD) responsibility, but rather an ongoing operational responsibility of the installations. USAEHA analytical support during the first half of this decade provided a valuable resource because competent private laboratory services were few, and those willing to accept RCRA ground-water samples were generally overloaded. Many capable private laboratories are now available to do this type of work.

b. The ground-water monitoring program constitutes a significant drain on both mission funding and laboratory services of USAEHA. The analytical portion of this program is having an adverse impact on USAEHA's ability to support other priority mission services which are clearly AMEDD responsibilities. Special funds were never provided to support this particular program. Funding constraints are particularly severe this year and are expected to be the same for FY87 and out years.

5. USAEHA proposes to continue its role as central program manager and to continue to provide services through the program which are considered valid AMEDD responsibilities. These services would include the provision of technical guidance to participating installations to assure that proper sampling and sample preparation procedures are being used. In addition, contracted ground-water quality data would continue to be technically reviewed by a professional experienced in the evaluation of ground-water quality data. Interpretive letters, to include recommendations where appropriate, would continue to be generated to help installation personnel understand the health significance, regulatory compliance status, and trends in their ground-water quality results. The centralized data base, which currently contains approximately one-quarter of a million individual water quality data entries, would continue to be maintained. The capability exists for statistical comparisons of these historical data by AMEDD and MACOM personnel to evaluate various types of trends among Army facilities. USAEHA would continue to provide (on request) limited short-term analytical support for special case situations to facilitate rapid response to regulatory changes and other special requirements.

6. Enclosure 5 presents a summary of the estimated cost of contracting laboratory services for ground-water analyses in support of the 29 installations presently participating in this program. The total cost is estimated to be about $300,000; 80 percent of which is in support of AMC.

7. To assist activities selected to develop and administer analytical support contracts, USAEHA would prepare (during 3rd Quarter, FY86) a generic statement of work to include technical specifications for analytical methods, quality assurance/quality control (QA/QC) procedures, chain of custody requirements, and data reporting instructions. Addressees may want to consider centralized MACOM contracts. Centralized contracts have advantages in cost savings, provide better control and management, facilitate contract administration, and most importantly, provide greater confidence in the quality of data generated through close scrutiny of laboratory QA/QC procedures.

8. The implementation time frame for this proposed modification is FY87. Request addressees provide comments to this office NLT 15 May 86 on the proposed modification, and, if applicable, the estimated earliest date for completely assuming responsibility for routine analysis.

9. POC, this Office, is LTC James Stratta, AV 224-3434; POC, DASG-PSP is LTC Hugh McAlear AV 289-0129; and POC, USAEHA is Mr. John Bauer, AV 583-2024.

FOR THE CHIEF OF ENGINEERS:

Encl

THOMAS H. MAGNESS, III
Colonel, Corps of Engineers
Chief, Army Environmental Office

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CF:

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DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20310

REPLY TO ATTENTION OF:

DAEN-ZCE

31 MAR 1981

SUBJECT: Sampling and Analysis of Groundwater from Resource Conservation and Recovery Act (RCRA) Monitoring Wells

SEE DISTRIBUTION

1. US Environmental Protection Agency (EPA) regulation 40 CFR 265.90-265.94 published in Federal Register, VOL. 45, pp. 33239-42 (19 May 1980), requires all owners and operators of active hazardous waste disposal facilities to implement a ground-water monitoring program not later than 19 November 1981. In addition, some states are requiring a similar program for active sanitary disposal facilities. This monitoring program must sample the groundwater on a quarterly basis during the first year to establish a baseline and then less frequently (annually or semi-annually, depending upon the parameters analyzed) for the remaining life of the disposal site and 30 years after closure.

2. Although the total number of wells to be sampled Army-wide is unknown at this time, current projections indicate that at least 12,000 samples will be collected for analysis the first year. This analytical workload will exceed the capacity of inhouse resources and will require contract support for this initial year. Routine analyses for subsequent years (beginning November 1982) are planned to be performed by the US Army Environmental Hygiene Agency (USAEHA).

3. All installations with RCRA monitoring wells will have similar analytical requirements. Economies of scale dictate that a small number of requirements-type contracts should be utilized for this support the initial year. This approach will be cost-effective, reduce quality control problems, simplify data evaluation, provide better control of laboratory workload and improve response time. Preliminary estimates indicate that over $2 million in savings may result from central management of this effort. Huntsville Division (USAEDH) will award the basic contracts and centrally manage them with AEHA providing technical monitorship of contract performance. Work against these contracts will be

ENCL 1

ordered by USAEDH, based upon requirements identified by the installation/MACOM. Funding will be on a reimbursable basis from the installation/MACOM.

4. A detailed implementation plan is being prepared jointly by USAEDH and USAEHA and should be available by 30 April 1981. Basic features of this plan include:

a. USAEHA primary responsibility through a preliminary groundwater assessment plan, if necessary, with centralized analytical contract support by USAEDH.

b. Sample collection, preservation and shipment by installation personnel using sample containers and instructions furnished by USAEHA.

c. Evaluation of analytical data by USAEHA and reports provided to installation/MACOM.

d. Follow-up actions for identified problems:

(1) Resampling and retesting for confirmation.

(2) Development of preliminary groundwater assessment plan by USAEHA.

(3) Implementation of above plan by either USAEHA (workload and capability permitting) or other agency such as USATHAMA, USACE FOA (Corps support is on a reimbursable basis), or installation.

(4) Development of functional criteria and corrective projects by installation/MACOM.

(5) Programming appropriate OMA/MMCA/MCA projects by installation/MACOM.

NOTE: The above sequence applies if a construction fix is required. Depending upon the results obtained, it may not be necessary to go beyond step (1) or step (3).

5. Request addressees take the following actions:

a. Provide to USAEDH (ATTN: HNDED-PM) the following information not later than 17 April 1981:

DAEN-ZCE
SUBJECT: Sampling and Analysis of Groundwater from Resource Conservation and Recovery Act (RCRA) Monitoring Wells

(1) Total number of wells, by installation, around hazardous waste disposal sites which will require sampling and analysis.

(2) Total number of wells, by installation, around sanitary landfill sites which must be monitored according to state permit. Include frequency of sampling required and parameters to be monitored.

NOTE: This information is required to scope the support contracts and must be available prior to initiation of procurement announcement.

b. Initiate programming and procurement actions to obtain necessary sampling and limited analytical equipment (e.g. temperature and pH probes) needed by installations to support this program. By separate correspondence, USAEHA will provide a suggested list of items needed.

c. Program funding in the FY82 budget to support the analytical support contracts and identify any FY81 funds which might be obligated in FY81 for analytical work in October-November ~~1982~~. USAEDH will assist in determining appropriate funding requirements.

6. Your support of this plan is essential to ensure full compliance with applicable regulations while realizing substantial cost savings to the Army. POC this HQ is LTC Dennis Gilson, DAEN-ZCE, AV 224-4269/3434.

FOR THE CHIEF OF ENGINEERS:

N.G. DELBRIDGE, JR.
Brigadier General, USA
Assistant Chief of Engineers

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DAEN-ZCE
SUBJECT: Sampling and Analysis of Groundwater from Resource Conservation and Recovery Act (RCRA) Monitoring Wells

DISTRIBUTION CONTINUED:
US ARMY TRAINING AND DOCTRINE COMMAND
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SUPERINTENDENT
US MILITARY ACADEMY

DEPARTMENT OF THE ARMY
HUNTSVILLE DIVISION, CORPS OF ENGINEERS
P.O. BOX 1600
HUNTSVILLE, ALABAMA 35807

REPLY TO ATTENTION OF

HNDED-PM

11 June 1981

SUBJECT: US Army Management Plan for the Groundwater Monitoring and Assessment Program

ORIGINAL TKHP
ACTION DEO CAB ~~AHTPO~~
~~INFO~~ A-WDE!

SEE DISTRIBUTION

1. Reference letter, DAEN-ZCE, OCE, 31 March 1981, subject: Sampling and Analysis of Groundwater from Resource Conservation and Recovery Act (RCRA) Monitoring Wells which indicated that USAEHA and USAEDE would prepare a detailed implementation plan for managing the task of monitoring and assessing groundwater around Army hazardous wastes disposal facilities. The monitoring is required by the US Environmental Protection Agency (USEPA) to comply with RCRA.

2. The subject plan is inclosed for your information and appropriate action. The MACOMs may desire to supplement the plan with specific instructions to their installations.

3. Points of contact for information are:

a. US Army Environmental Hygiene Agency - Mr. Gary Nemeth
AUTOVON 584-2024 or
Commercial (301) 671-2024

b. US Army Engineer Division, Huntsville - Mr. Ron Foreman
AUTOVON 742-5530,
FTS 873-5530 or
Commercial (205) 895-5530

FOR THE COMMANDER:

1 Incl
as

R. PETERSON
Chief, Engineering Division

DISTRIBUTION:

(Continuation page 2)

ENCL 2

HNDED-PM 11 June 1981
SUBJECT: US Army Management Plan for the Groundwater Monitoring and Assessment Program

DISTRIBUTION: (Continued)
Commanders
US Army Materiel Development and Readiness Command, ATTN: DRCIS-A, Alexandria, VA 22333
US Army Intelligence and Security Command, ATTN: IALOG-IF, Arlington Hall Station, VA 22212
US Army Communications Command, Ft. Huachuca, AZ 85613
US Army Military Traffic Management Command, ATTN: MT-SA, Falls Church, VA 22041
US Army Military District of Washington, ATTN: ANEN-PP, Washington, DC 20319
US Army Health Services Command, ATTN: HSLO-F. Ft. Sam Houston, TX 78234
US Army Forces Command, ATTN: AFEN-FE, Ft. McPherson, GA 30330
US Army Training and Doctrine Command, ATTN: ATEN-FN, Ft. Monroe, VA 23651
US Army Western Command, ATTN: APEN-FE, Ft. Shafter, HI 96858
US Army Corps of Engineers, ATTN: DAEN-ZCE/DAEN-MPC-I/DAEN-MPO-U, Washington, DC 20314
US Army Environmental Hygiene Agency, ATTN: HSE-EP-L, Aberdeen Proving Ground, MD 21010
US Army Toxic and Hazardous Materials Agency, ATTN: DRXTH-FS, Aberdeen Proving Ground, MD 21010
Superintendent, US Military Academy, ATTN: MAEN-A, West Point, NY 10996

TABLE. PARTICIPANTS IN THE GROUND-WATER MONITORING PROGRAM - JANUARY 1986

Major Command	Installation	Number of Hazardous Waste Facilities	Number of Solid Waste Facilities	Number of Monitoring Stations
AMC:				
AMCCOM	Badger AAP	6	1	76
	Hawthorne AAP	1	-	7
	Holston AAP	2	6	23
	Iowa AAP	2	-	9
	Joliet AAP	-	1	8
	Lone Star AAP	2	-	12
	Longhorn AAP	1	-	9
	Louisiana AAP	1	-	7
	Milan AAP	1	-	8
	Newport AAP	3	1	26
	Pine Bluff Arsenal	18	-	98
	Radford AAP	4	2	42
	Sunflower AAP	2	-	20
	Watervliet Arsenal	1	-	4
DESCOM	Anniston AD	4	1	25
	Lexington-Blue Grass AD	4	2	23
	Red River AD	5	1	33
	Savanna ADA	-	1	6
	Seneca AD	1	1	12
TECOM	Jefferson Proving Ground	-	1	3
DLA:	Defense Depot Ogden	1	-	4
FORSCOM:	Fort Drum	-	2	6
	Fort Indiantown Gap	-	1	11
	Fort McCoy	-	1	9
	Fort Polk	-	2	17
	Fort Riley	-	1	6
	Fort Stewart	-	1	6
TRADOC:	Fort Benjamin Harrison	-	1	5
USMA:	West Point	-	1	9
		59	28	524

some conspicuous absences. such as Toelle who has real problems

ENCL 3

Revised
U.S. Army Management Plan
for the
RCRA Ground-Water Monitoring and Assessment Program
February 1986

I. INTRODUCTION.

A. Background.

1. The Resource Conservation and Recovery Act of 1976 (RCRA) required the U.S. Environmental Protection Agency (EPA) to promulgate regulations to protect human health and the environment from improper management of solid and hazardous wastes. EPA has promulgated requirements for sanitary landfills and interim status standards for owners and operators of hazardous waste treatment, storage, and disposal facilities. The main thrust of these standards is the protection of ground water from contamination by hazardous solid wastes.

2. To comply with the RCRA regulations, owners/operators of hazardous waste treatment, storage and disposal facilities should have applied for and received interim status to continue operating. Owners/operators of facilities which continued to receive waste after 26 July 1982, should have applied for a final permit by 8 November 1985. Retention of the interim status and final EPA approval to continue operating is contingent upon, among other things, monitoring the ground water around the disposal facilities.

3. To perform ground-water monitoring, sampling wells must be installed, ground water samples extracted and chemical analysis performed on these samples. This document addresses the Army's management plan for accomplishing the expected heavy workload of sampling and analysis associated with this program.

B. Purpose and Scope.

1. The purpose of this management plan is to present the organization of a centralized Army program to support installation commanders in meeting the ground-water monitoring and assessment requirements of RCRA. This plan identifies the actions and schedule required for implementation, funding requirements, and performing organizations and responsibilities.

2. Although this document and the support program address primarily hazardous waste disposal sites, support of monitoring requirements for sanitary landfills is also included.

Encl 4

3. This plan does not include installation of monitoring wells, development of waste management plans, security requirements, contingency plans, personnel training and closure and post-closure care. All these are requirements under RCRA but have either been addressed by separate actions or are site specific requirements which must be accomplished by the installation.

C. Change in the Ground-Water Monitoring Program. It is the intent of the U.S. Army Environmental Hygiene Agency (USAEHA) to continue operating the RCRA Ground-water Monitoring and Assessment Program largely as it has been for the past 4 years. The primary change, addressed in this revision, is the shifting of responsibility for routine sample analyses from USAEHA to the installation. The discontinuation of routine analytical support by USAEHA will enable the Agency's laboratory to better support project work. It is not in the Army's best interest for this Agency to provide analytical support for long-term routine monitoring. In addition, with a contract laboratory sending data directly to the installation, reporting turnaround times could be significantly improved. This Agency will continue to provide analytical support for special cases and under certain circumstances as described in paragraphs III C and D. Other details pertaining to the changes are also provided herein.

D. Reference Documents.

1. 40 CFR Part 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities (Federal Register, dated 19 May 1980).

2. 40 CFR Part 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, revised, July 1984.

3. 40 CFR Part 257, Criteria for Classification of Solid Waste Disposal Facilities and Practices. (Federal Register, dated 13 September 1979).

E. Organizational Responsibilities.

1. Office of the Chief of Engineers (OCE).

As the primary DA staff element responsible for attaining Army compliance with environmental laws and regulations, OCE will provide oversight to insure Army-wide consistency and overall effectiveness of this sampling and analysis program.

2. Major Army Commands (MACOMs).

The MACOMs have the responsibility to assist their installations in achieving compliance with environmental laws and

regulations. Within the scope of this plan, the MACOMs are responsible for assisting the installations in obtaining the resources necessary to support this program, including funding for analytical support. (Department of the Army may choose to centrally fund this contract support).

3. U.S. Army Environmental Hygiene Agency (USAEHA).

USAEHA has the responsibility to support the MACOMs and installations to help ensure compliance with health and environmental requirements. This agency will be the central coordinating activity and technical manager for this sampling and analysis program. The following tasks will be the responsibility of USAEHA:

a. Develop and distribute detailed guidance to the Army installations regarding sampling equipment requirements, sampling procedures, sample preservation and shipment, and chain of custody.

b. Evaluate analytical data and distribute a report of such evaluation to the MACOM and installation.

c. Monitor from a technical standpoint all hydrogeologic investigations that were initiated as a result of evidence of ground-water contamination observed in the routine ground-water monitoring program.

d. Maintain a centralized database.

e. Provide technical oversight of overall monitoring program to include water quality data interpretation, evaluation of well network adequacy, and periodic site visits to ensure the use of proper sampling equipment and procedures.

f. Provide short-term analytical support for new facilities or for installations with a special monitoring requirement.

4. Installations.

The installation commander has the final responsibility to comply with the requirements of the regulations cited in paragraph ID above and permits issued thereunder. Gathering the data necessary to satisfy these requirements is also an installation responsibility. However, because of the Army-wide impact of this program, other Army elements have responsibilities as

identified above to assist the installation commander in meeting these requirements. Within the scope of this plan, the installation will be responsible for performing the following tasks:

a. Identify installation-specific sampling and analysis requirements.

b. Procure or otherwise make available sampling equipment unless sampling will be accomplished by a contractor.

c. Collect, preserve, and ship samples in accordance with instructions furnished by USAEHA.

d. Report the well monitoring results to regulatory agencies as required in regulations and permits.

e. Procure and monitor contract(s) for analytical support.

f. Develop and maintain a sampling and analysis plan.

g. Maintain an adequate well network.

h. Maintain thorough records of all monitoring activities.

II. REQUIREMENTS.

A. Hazardous Waste Disposal Sites. Subpart F of Part 265 requires that ground-water monitoring be performed at hazardous waste landfills, surface impoundments, and land treatment facilities beginning in November 1981. For those sites where the monitoring indicates possible contaminant migration from the site, an assessment must be performed to determine if contamination has occurred and, if so, the extent and concentration of contaminants in the ground water. Any hazardous waste disposal facility which received waste after 26 July 1982 was required to submit a Part B permit application to EPA by 8 November 1985. Upon receipt of a final permit, the owner/operator is subject to the ground-water monitoring requirements of 40 CFR Part 264, Subpart F, as will be so stipulated in the permit.

1. Ground-Water Monitoring at Interim Status Facilities (Part 265).

a. Background Monitoring.

During the first 12 months of monitoring, samples must be taken quarterly and analyzed for the 30 parameters listed in the accompanying table. Twenty are measured to characterize the suitability of the ground water as a drinking water supply (National Interim Primary Drinking Water Regulation [NIPDWR] parameters). Six others are for determining general ground-water quality. The remaining four parameters are to be used as indicators of ground-water contamination. The ground-water elevation in the wells must be measured each time a sample is taken. During the first 12 months of monitoring, the data must be submitted to the regulatory authority within 15 days of completing each quarterly analysis.

TABLE

OF

HAZARDOUS WASTE SITE MONITORING PARAMETERS

Group 1 - Parameters characterizing suitability as a drinking water supply:

arsenic	endrin
barium	lindane
cadmium	methoxyclor
chromium	toxaphene
fluoride	2,4-D
lead	2,4,5-TP
mercury	radium
nitrate	gross alpha
selenium	gross beta
silver	coliform bacteria

Group II - Parameters establishing ground-water quality:

chloride

iron

manganese

phenols

sodium

sulfate

Group III - Parameters used as indicators of ground-water contamination:

pH

specific conductance

total organic carbon

total organic halogen

b. Routine Monitoring.

(1) After the first 12 months, the frequency of sampling and analysis will be annual for chloride, iron, manganese, phenols, sodium, and sulfate, and semiannual for pH, specific conductance, total organic carbon, and total organic halogen. Ground-water elevations must also be determined when samples are taken. This routine monitoring will be performed at active facilities and for closed disposal facilities during the 30-year post-closure period.

(2) For each well and indicator parameter, the statistical Student's t-test will be used to compare the routine monitoring results to the site's background data which will have been gathered in the first 12 months of monitoring.

(3) For those sites where the statistical test does not indicate the possibility of ground-water contamination, the installations need only provide monitoring results to the regulatory authority as part of the annual report. The annual report must also include an evaluation of the water table elevation data

which determines whether the monitoring well system still meets the requirements of 40 CFR 265.91(a).

(4) In those cases where the statistical test indicates possible ground-water contamination, resampling and analysis must be performed immediately, and if the problem indication is confirmed, the regulatory authority must be notified in writing within 7 days. A ground-water quality assessment must then be performed. The requirements for planning and conducting these assessments are discussed below.

2. Ground-Water Quality Assessments.

a. The purpose of this assessment is to determine:

(1) Whether any hazardous waste or hazardous waste constituents have entered the ground water;

(2) The rate and extent of migration of hazardous waste or hazardous waste constituents in the ground water; and

(3) The concentrations of hazardous wastes or hazardous waste constituents in the ground water.

b. Planning.

The Assessment Plan identifies to the regulator the procedure that the installation plans to utilize to assess the magnitude of the ground-water contamination. This assessment plan must be prepared and submitted to the regulatory authority within 15 days of the time that they are notified of the confirmed problem indication. The assessment plan must be certified by a qualified geologist or geotechnical engineer and shall include:

(1) The number, location, and depth of wells;

(2) Sampling and analytical methods for those hazardous wastes or hazardous waste constituents in the facility;

(3) Evaluation procedures, including any use of previously gathered ground-water quality information; and

(4) A schedule of implementation.

c. Field and Lab Work.

The ground-water quality assessment must be implemented as soon as technically feasible. The first determination of an assessment consists of defining whether ground-water contamination is occurring and can be made by analyzing water from existing

wells. If contamination is detected, the installation of additional wells and detailed hydrogeologic studies will likely be required. When the assessment work is complete, a written report must be submitted to the regulatory authority within 15 days.

3. Remedial Actions.

Remedial action will be required at facilities which are determined to be significant ground-water contamination sources. This may involve either closure or upgrading of the facility.

4. Ground-Water Monitoring at Permitted Facilities (Part 264) (The following information is only a summary. Installations required to monitor under 40 CFR Part 264, Subpart F, should refer to that regulation to fully understand the details of the requirements).

a. Background Monitoring. For the purpose of determining background ground-water quality, each well at a facility must be sampled four times and analyzed for the parameters which are required by the Regional Administrator for detection monitoring. This will provide a database for statistical comparison with future analytical results. If the appropriate parameters were analyzed during Part 265 monitoring, the results of those analyses may be used for background data.

b. Detection Monitoring. Sampling and analysis are conducted semiannually. The parameters to be monitored are specific in the permit and will vary from facility to facility. For each sampling event, all data must be evaluated to determine if there has been a statistically significant increase over background values. The Cochran's Approximation to the Behrens-Fisher Student's t-test is the statistical test to be used for this evaluation. If a statistically significant increase is found, the following actions must be taken:

(1) Notify the Regional Administrator within 7 days.

(2) Sample all wells and analyze for Appendix VIII constituents.

(3) Establish background values for each Appendix VIII constituent at the compliance point.

(4) Apply for a permit modification to establish a compliance monitoring program within 90 days.

(5) Within 180 days, submit the data to justify a variance or submit an engineering feasibility plan for a corrective action program. Lastly, the ground-water flow rate and direction must be determined annually.

c. Compliance Monitoring. Wells are sampled and analyzed quarterly to determine whether the facility is in compliance with the ground-water protection standard specified in the permit. Concentrations of all parameters must be expressed in the form necessary to perform the statistical test (i.e., four replicates). Samples must be analyzed for all Appendix VIII constituents annually. If any constituents not specified in the permit are detected, the owner/operator must notify the Regional Administrator within 7 days. Statistical testing is performed on all quarterly results. If a statistically significant increase has occurred, the following actions must be taken:

(1) Notify the Regional Administrator within 7 days. The notification must indicate which concentration limits have been exceeded.

(2) Apply for a permit modification to establish a corrective action program within 180 days, or within 90 days if an engineering feasibility study was submitted during detection monitoring.

(3) As an alternative to proceeding with corrective action, the owner/operator may demonstrate that a source other than the regulated unit caused the non-compliance or that a standard was exceeded due to an error in sampling, analysis, or evaluation. If this option is chosen the owner/operator must:

(a) Notify the Regional Administrator within 7 days. The notification must indicate which concentration limits have been exceeded.

(b) Within 90 days, submit a report which demonstrates that a source other than the regulated unit caused the non-compliance or if a standard was exceeded due to an error in sampling, analysis, or evaluation.

(c) Also within 90 days, apply for a permit modification to make appropriate changes to the compliance monitoring program.

(d) Continue to monitor in accord with the compliance monitoring program.

d. Corrective Action. The owner/operator must take corrective actions to ensure that the regulated unit is in compliance with the standards set forth in the permit. The modified permit will specify actions to be taken, i.e., removal or treatment of waste constituents. A ground-water monitoring program to demonstrate the effectiveness of the corrective actions must be implemented. Corrective actions must be continued to the extent necessary to ensure compliance with the ground-water protection standards. A report on the effectiveness of the corrective action program must be submitted semiannually.

B. Sanitary Landfill Sites.

1. Routine Monitoring.

The frequency of sampling and the parameters to be routinely monitored at sanitary landfill sites are highly variable and are specified in the operating permit issued by the state. Many permits require no ground-water monitoring but others require sampling frequencies varying from quarterly to annually and lists of parameters varying from simply chlorides and total dissolved solids to the total RCRA list or all those listed in the Primary Drinking Water Standards. This plan cannot list in detail the requirements at every installation. However, those installations with ground-water monitoring requirements for sanitary landfills will be included in this routine monitoring program if so desired by the installation.

2. Ground-water Quality Assessments.

Required response to evidence of ground-water contamination from sanitary landfill sites is not as uniform as that specified for hazardous waste sites. The general approach must be the same, i.e., confirmation of contamination must be obtained, an assessment of extent and amount of contamination performed (which may involve some subsurface hydrogeologic investigation), and appropriate corrective action programmed. In each case the details and scope of the assessment and corrective actions will be specified by the state involved.

III. MANAGEMENT PROCEDURES.

A. General.

Many installations are currently involved in a ground-water monitoring program as required in 40 CFR Part 265, Subpart F. Most of those installations participate in the U.S. Army Ground-water Monitoring and Assessment Program. This centralized program was initiated in November 1981 and has assisted installations in

meeting RCRA ground-water monitoring requirements. Many of the installations in the program have been monitoring for 4 years and will continue to monitor for many years (generally 30 or more). For this type of established, routine monitoring, USAEHA will no longer provide analytical support. The monitoring program will continue; however, certain functions will change as described below.

B. Routine Monitoring.

1. The Figure portrays a diagram of the interactions of participating organizations in accomplishing routine monitoring. Specific responsibilities under the new management system are delineated below.

2. Sampling will be accomplished by installation personnel or by a firm under contract to the installation. All analytical work will be performed by a laboratory under contract to DA, the MACOM, or the installation. USAEHA will provide a generic statement of work to use in preparing a laboratory contract(s). This statement of work will include QA/QC procedures, analytical methods, chain of custody requirements, and data reporting instructions. Analytical data will be reported directly to the installation; however, the contract should also include a requirement to send the data to USAEHA. The statement of work provided by USAEHA will include the specifications for the data to be sent to USAEHA. These specifications will include details describing data hardware (i.e., types of discs acceptable) and software (i.e., format, filenames). This method of data reporting will allow USAEHA to maintain a comprehensive ground-water quality database. To maintain complete records, installations should continue to send field data logsheets to USAEHA. These forms provide needed pH and water level data. USAEHA will then re-submit the data to the installation in tabular form with a letter providing a technical interpretation of the data.

3. In addition to providing the types of support described in paragraph 2 above, USAEHA will also provide technical information, guidance, and training. USAEHA will provide training on sampling monitoring wells when needed. USAEHA will also conduct periodic site visits to evaluate sampling procedures to ensure that proper equipment and methods are being used. Information and guidance will be provided on regulatory issues as well. Generally, information and guidance will be provided on all aspects of ground-water monitoring (i.e., sampling, sampling equipment, and analyses).

C. Monitoring at New Facilities. USAEHA can, on request, provide analytical support to new facilities and facilities with a new requirement to monitor the ground-water quality for a limited

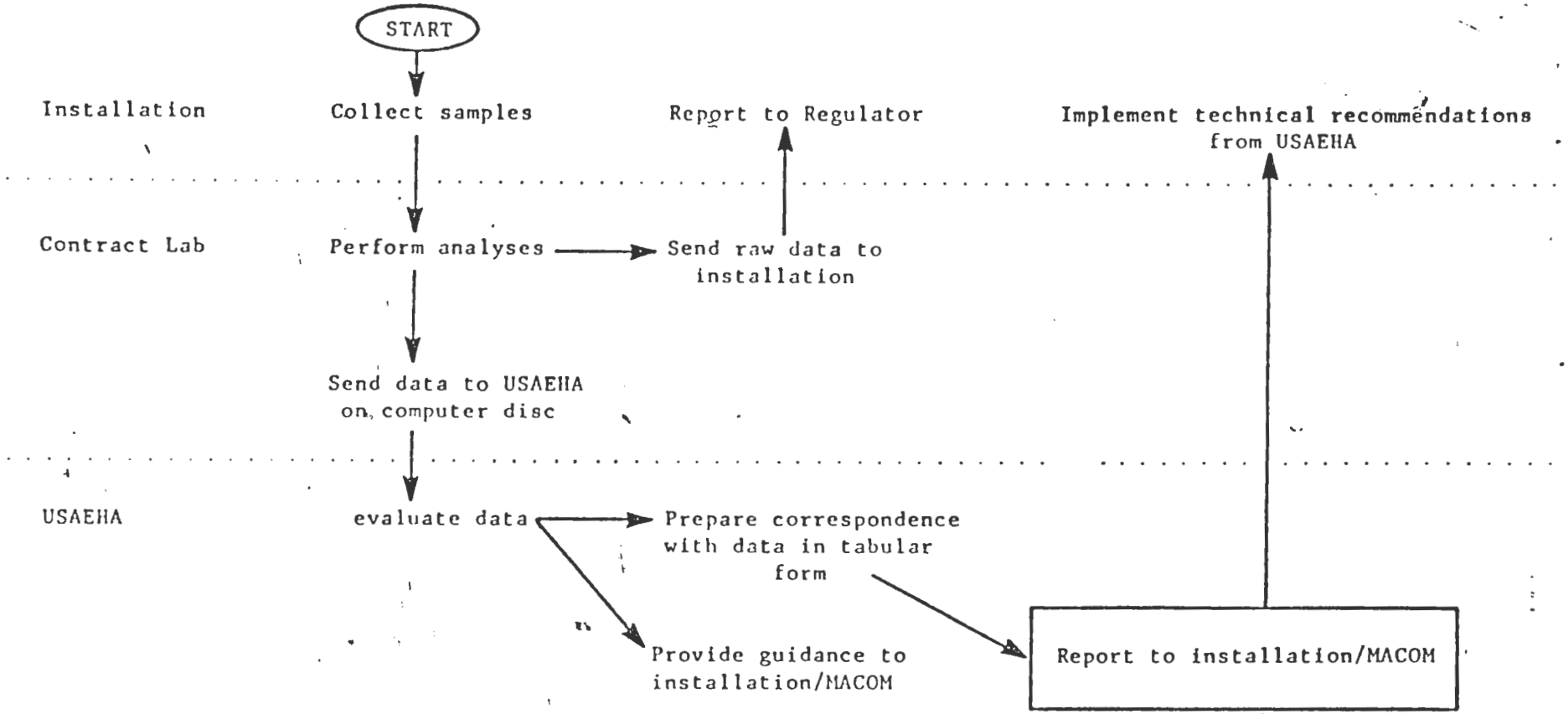


FIGURE. RCRA GROUND-WATER MONITORING PROGRAM SEQUENCE

time period. This will give the installation time to procure the services of a contract laboratory. Also, the increased level of USAEHA involvement in the early stage of monitoring will help to establish communication and a strong working relationship between USAEHA and the installation. This initial support will also assist USAEHA in developing a complete file on the facility to include background information and all available data. After the short-term USAEHA analytical support is discontinued, analytical support will be the responsibility of the installation, and USAEHA support will continue in the manner described in paragraph III.B.

D. Special Cases. Under certain circumstances, USAEHA can provide analytical support for installations with a special monitoring requirement, on request by the MACOM. Special cases may include, but are not limited to: special short-term regulatory requirements; installation in need of support due to gross contractor failure; and split sampling, if a problem with the laboratory is suspected. When short-term requirements end or problems are corrected, routine ground-water monitoring should continue under the management format described in paragraph III.B.

IV. IMPLEMENTATION.

The schedule for implementation of the revised Management Plan for the U.S. Army Ground-water Monitoring and Assessment Program is provided in the following Table.

TABLE

SCHEDULE OF IMPLEMENTATION

Provide revised management plan to Department of the Army	Winter 86
Develop generic statment of work for use in establishing laboratory contract(s)	Spring 86
Implement revised management plan	Fiscal Year 87

ESTIMATED COST OF CONTRACTING LABORATORY SERVICES FOR GROUND-WATER ANALYSES

Calculations based on 1986 Fee schedule for Lancaster Laboratories, Inc., Lancaster, PA. Note that discounts were applied for installations with significant workloads. Estimated discounts were based on a telephone conversation between Mrs. Beth Martin, USAEHA, and a customer service representative from Lancaster Laboratories, Inc.

A 20% discount was used for 7 installations which submit a significant volume of samples. The discounts applied are considered conservative. All other prices came directly from brochures.

The number of samples to be submitted for each parameter during 1986 were tabulated by a computer program. Therefore, the numbers used to calculate analytical costs for 1986 are considered accurate.

	ANALYTICAL COSTS	ADDITIONAL 25% FOR QA/QC AND DATA TRANSFER	COST OF CONTAINERS	TOTAL COST
AMCCOM	$133,800	$33,500	$21,300	$188,600
FORSCOM	34,300	8,600	5,400	48,300
DESCOM	33,200	8,300	5,000	46,500
DLA (DD Ogden)	6,000	1,500	900	8,400
TECOM (JPG)	4,000	1,000	600	5,600
USMA (West Point)	1,800	500	300	2,600
	$213,100	$53,400	$33,500	$300,000

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

Ms. Fleischmann/kb/AUTOVON
584-2024

REPLY TO
ATTENTION OF

HSHB-ES-G

25 MAY 1985

SUBJECT: Ground-water Monitoring Results for Seneca Army Depot, NY

Commander
Seneca Army Depot
ATTN: SDSSE-AD
Romulus, NY 14541-5000

1. Reference:

a. U.S. Army Management Plan for the RCRA Ground-water Monitoring and Assessment Program, June 1981.

b. Letter, this Agency, HSHB-ES-G, 1 June 1984, SAB.

c. Letter, this Agency, HSHB-ES-G, 11 December 1984, SAB.

d. New York Water Classification and Quality Standards, Part 703, Ground-water Classifications, Quality Standards, and Effluent Standards and/or Limitations (Amended 2 August 1978; effective September 1978).

2. Enclosures 1 and 2 are tables reporting results of chemical analyses of ground-water samples collected on 20 March 1985 from monitoring wells around the Demolition Area and Landfill at Seneca Army Depot, NY. Field pH, specific conductivity, and water level measurements were made by installation personnel. These data constitute the annual and first semiannual set of results for 1985. All 1984 data were reported in references 1b and 1c.

3. Concentrations of certain parameters are compared to the New York standards in reference 1d. Certain other parameter concentrations are compared to the National Secondary Drinking Water Regulation criteria which address the aesthetic quality of the water. Any concentrations exceeding the standards or criteria are noted in the enclosures.

4. At both sites, the sulfate concentrations are elevated in most well samples, and exceed the state standards in two well samples (PT-12 and W4). The concentration of manganese in the sample from well W4 exceeds the National Secondary Drinking Water Regulation criterion of 0.05 mg/L,

but does not exceed the state standard of 0.3 mg/L. Although iron was detected in most of the samples collected in September 1984 (reference 1b), no iron is detected during this sampling period. All other results are similar to those reported in references 1b and 1c.

5. No results are reported for well W5 because it was dry. Well PT-13 was destroyed prior to the September 1984 sampling and has not been replaced.

6. Questions regarding these data may be referred to Ms. Kim M. Fleischmann or Mrs. Beth A. Martin, this Agency, AUTOVON 584-2024.

FOR THE COMMANDER:

2 Encls

FREDERICK W. BOECHER
LTC, MS
Chief, Waste Disposal Engineering Division

CF (w/encls):
Cdr, HSC (HSCL-P)
Cdr, AMC (AMCSG/AMCEN-A)
Cdr, DESCOM (AMSDS-RM-EF-D)
Cdr, USATHAMA (AMXTH-AS)

RUN DATE: 17 MAY 85

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B W5		W4	W6	W1	W3	W2	W7
WATER LEVELS (A)	19 MAR 85		FT		D	110.2	110.3	110.5	105.3	93.7	103.6
CHLORIDE	20 MAR 85	1.0	MGL			6.0	12.0	7.0	15.0	4.0	3.0
IRON	20 MAR 85	.10	MGL			ND	ND	ND	ND	ND	ND
MANGANESE	20 MAR 85	.030	MGL			.085#	.045	ND	ND	.038	ND
PHENOL	20 MAR 85	.01	MGL			ND	ND	ND	ND	ND	ND
SODIUM	20 MAR 85	1.	MGL			23.	24.	9.	7.	9.	2.
SULFATE	20 MAR 85	2.0	MGL			306.0&	231.0	231.0	194.0	180.0	47.0
COND-FIELD	20 MAR 85	1.	UMC			680.	440.	540.	550.	490.	270.
PH(FIELD)	20 MAR 85		PH			6.8	6.9	6.7	6.8	7.0	7.0
SPEC COND	20 MAR 85	1.	UMC			990.	700.	760.	760.	750.	400.
SPEC COND	20 MAR 85	1.	UMC			990.	700.	750.	760.	740.	390.
SPEC COND	20 MAR 85	1.	UMC			1000.	700.	750.	760.	740.	390.
SPEC COND	20 MAR 85	1.	UMC			1000.	700.	750.	760.	740.	390.
TOC	20 MAR 85	.1	MGL			5.8	8.8	5.9	6.0	4.1	9.5
TOC	20 MAR 85	.1	MGL			5.7	8.8	5.9	6.0	4.1	9.5
TOC	20 MAR 85	.1	MGL			5.7	8.7	5.8	6.0	4.0	9.4
TOC	20 MAR 85	.1	MGL			5.9	8.8	6.1	6.0	4.1	9.6
TOX	20 MAR 85	.010	MGL			ND	ND	ND	ND	ND	.014
TOX	20 MAR 85	.010	MGL			ND	ND	ND	ND	ND	.013
TOX	20 MAR 85	.010	MGL			NO	ND	ND	ND	ND	.012
TOX	20 MAR 85	.010	MGL			ND	ND	ND	ND	ND	.014
2,4,6-TNT	20 MAR 85	.001	MGL			ND	ND	ND	ND	ND	ND
2,4-DNT	20 MAR 85	.001	MGL			ND	ND	ND	ND	ND	ND
2,6-DNT	20 MAR 85	.001	MGL			ND	ND	ND	ND	ND	ND
RDX	20 MAR 85	.030	MGL			ND	ND	ND	ND	ND	ND
HMX	20 MAR 85	.100	MGL			ND	ND	ND	ND	ND	ND
TETRYL	20 MAR 85	.010	MGL			ND	ND	ND	ND	ND	ND

RUN DATE: 17 MAY 85

INSTALLATION: SENECA AD, NY SITE: DEMOLITION GROUNDS

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.
A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA
& VALUE EXCEEDS A STATE WATER QUALITY STANDARD OR CRITERIA
D - WELL WAS DRY

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 17 MAY 85

INSTALLATION: SENECA AD, NY

SITE: LANDFILL

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B PT-10	PT-11	PT-12	PT-13	PT-14	PT-15
WATER LEVELS (A)	19 MAR 85		FT	676.6	652.1	647.1		635.4	633.7
CHLORIDE	20 MAR 85	1.0	MGL	69.0	57.0	16.0		23.0	7.0
IRON	20 MAR 85	.10	MGL	ND	ND	ND		ND	ND
SULFATE	20 MAR 85	2.0	MGL	19.0	163.0	275.0&		64.0	37.0
COND-FIELD	20 MAR 85	1.	UMC	580.	700.	800.		490.	350.
PH(FIELD)	20 MAR 85		PH	7.2	6.9	6.9		7.0	7.1
SPEC COND	20 MAR 85	1.	UMC	960.	800.	1110.		660.	450.
SPEC COND	20 MAR 85	1.	UMC	960.	810.	1110.		660.	460.
SPEC COND	20 MAR 85	1.	UMC	950.	800.	1120.		660.	460.
SPEC COND	20 MAR 85	1.	UMC	950.	800.	1100.		660.	460.
TOC	20 MAR 85	.1	MGL	3.1	6.5	7.2		3.9	5.2
TOC	20 MAR 85	.1	MGL	3.0	6.5	7.2		4.1	5.1
TOC	20 MAR 85	.1	MGL	3.0	6.5	7.2		4.0	5.3
TOC	20 MAR 85	.1	MGL	3.0	6.5	7.2		4.0	5.3

RUN DATE: 17 MAY 85

INSTALLATION: SENECA AD, NY SITE: LANDFILL

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.
A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
& VALUE EXCEEDS A STATE WATER QUALITY STANDARD OR CRITERIA

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

New York State Department of Environmental Conservation
6274 East Avon-Lima Road, Avon, New York 14414
TELEPHONE: 716/226-2466

Henry G. Williams
Commissioner

Eric A. Seiffer
Regional Director

CONFIDENTIAL INFORMATION

March 7, 1986

Commander
Seneca Army Depot
ATTN: SESSE-AD
Romulus, New York 14541-5001

Dear Sir:

RE: 1985 Groundwater Monitoring of Landfill

This letter is to request copies of 1985 groundwater monitoring data for the wells located around the Seneca Army Depot old landfill. Data for 1984 was provided at this time last year to Deborah Jackson of this office by your Stephen M. Absolm.

A review of the 1984 data suggests that leachate is exiting the landfill and is intercepted by wells #13, 14 and 15 as indicated by elevated parameters chloride, sulfate and specific conductivity. If you have not already done so, it is requested that you expand the parameter list in future analyses to include:

1) a more complete metals scan, including heavy metals (under EPA Interim Drinking Water Standards);

2) potassium, sodium, nitrate;

3) total organic halogens (TOX).

For test methods employed please refer to:

Test Methods for Evaluating Solid Waste - Physical/Chemical Methods. EPA - SW-846, 1982;

Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020;

Standard Methods for the Examination of Water and Wastewater. 16th edition, 1985.

Your response by March 30, 1986 would be appreciated. It may be directed to either Ms. Jackson or me at the address listed above.

MPR called 3/28/86 CFT, NSG ~~req~~ coordination more time to respond

S: 14th APR 86 per FONECON V. Dick returned my call

Please call me if you have questions. Thank you in advance for your help.

Very truly yours,

Vincent B. Dick
Assistant Engineering Geologist
Division of Solid & Hazardous Waste

VBD:vv

communities serving 10,000 to 74,999 individuals.

[141.6(c) corrected by 47 FR 10998, March 12, 1982]

(c) The regulations set forth in 141.11(a), (d) and (e); 141.14(a)(1); 141.14(b)(1)(i); 141.14(b)(2)(i); 141.14 (d); 141.21(a),(c) and (i); 141.22(a) and (e); 141.23(a)(3) and (a)(4); 141.23(f); 141.24(a)(3); 141.24(e) and (f); 141.25 (e); 141.27(a); 141.28(a) and (b); 141.31(a), (d) and (e); 141.32(b)(3); and 141.32(d) shall take effect immediately upon promulgation.

(d) The regulations set forth in 141.41 shall take effect 18 months from the date of promulgation. Suppliers must complete the first round of sampling and reporting within 12 months following the effective date.

(e) The regulations set forth in 141.42 shall take effect 18 months from the date of promulgation. All requirements in 141.42 must be completed within 12 months following the effective date.

Subpart B—Maximum Contaminant Levels

§ 141.11 Maximum contaminant levels for inorganic chemicals.

(a) The MCL for nitrate is applicable to both community water systems and non-community water systems except as provided by in paragraph (d). The levels for the other inorganic chemicals apply only to community water systems. Compliance with MCLs for inorganic chemicals is calculated pursuant to § 141.23.

[141.11(a) amended by 45 FR 57342, August 27, 1980; corrected by 47 FR 10998, March 12, 1982]

(b) The following are the maximum contaminant levels for inorganic chemicals other than fluoride:

Contaminant	Level, milligrams per liter
Arsenic	0.05
Barium	1.
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as N)	10.
Selenium	0.01
Silver	0.05

(c) When the annual average of the maximum daily air temperatures for the location in which the community water system is situated is the following, the maximum contaminant levels for fluoride are:

Temperature degrees Fahrenheit	Degrees Celsius	Level, milligrams per liter
53.7 and below	12.0 and below	2.4
53.8 to 58.3	12.1 to 14.6	2.2
58.4 to 63.8	14.7 to 17.6	2.0
63.9 to 70.6	17.7 to 21.4	1.8
70.7 to 79.2	21.5 to 26.2	1.6
79.3 to 90.5	26.3 to 32.5	1.4

Fluoride at optimum levels in drinking water has been shown to have beneficial effects in reducing the occurrence of tooth decay.

[141.11(c) corrected by 47 FR 10998, March 12, 1982]

(d) At the discretion of the State, nitrate levels not to exceed 20 mg/l may be allowed in a non-community water system if the supplier of water demonstrates to the satisfaction of the State that:

(1) Such water will not be available to children under 6 months of age; and

(2) There will be continuous posting of the fact that nitrate levels exceed 10 mg/l and the potential health effects of exposure; and

(3) Local and State public health authorities will be notified annually of nitrate levels that exceed 10 mg/l; and

(4) No adverse health effects shall result.

§ 141.12 Maximum contaminant levels for organic chemicals.

The following are the maximum contaminant levels for organic chemicals. The maximum contaminant levels for organic chemicals in paragraphs (a) and (b) of this section apply to all community water systems. Compliance with the maximum contaminant levels in paragraphs (a) and (b) is calculated pursuant to § 141.24. The maximum comtaminant level for total trihalomethanes in paragraph (c) of this section applies only to community water systems which serve a population of 10,000 or more

det. limit reg. limit
Cd .0001 .01
Pb .013 .05

ASHB-ME-SG

Call to Kim Fleischman

→ add'l parameters

will do: March / Sept

1 OCT 87 – no more analytical support for GWM

(AMC may have a centralized contract!)

↓

no word from AMC

Call Fri

2024

~~Sampling~~ w/k of

March	~~2 March~~ 2, 3 March
Sept	8, 9 Sept

CF to Kim copy of State LTR — done 6 JAN 88

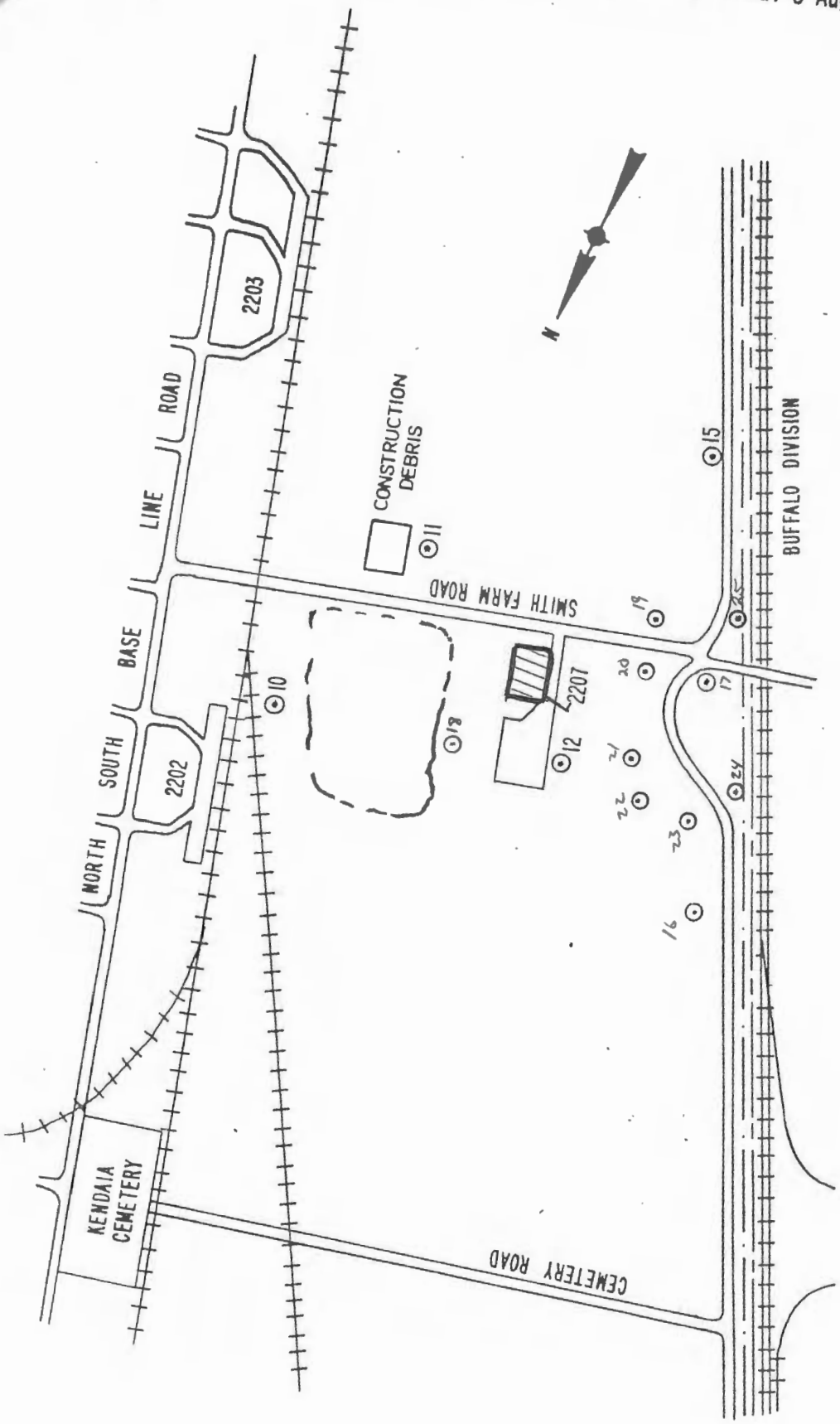


FIGURE EXISTING SANITARY LANDFILL SITE

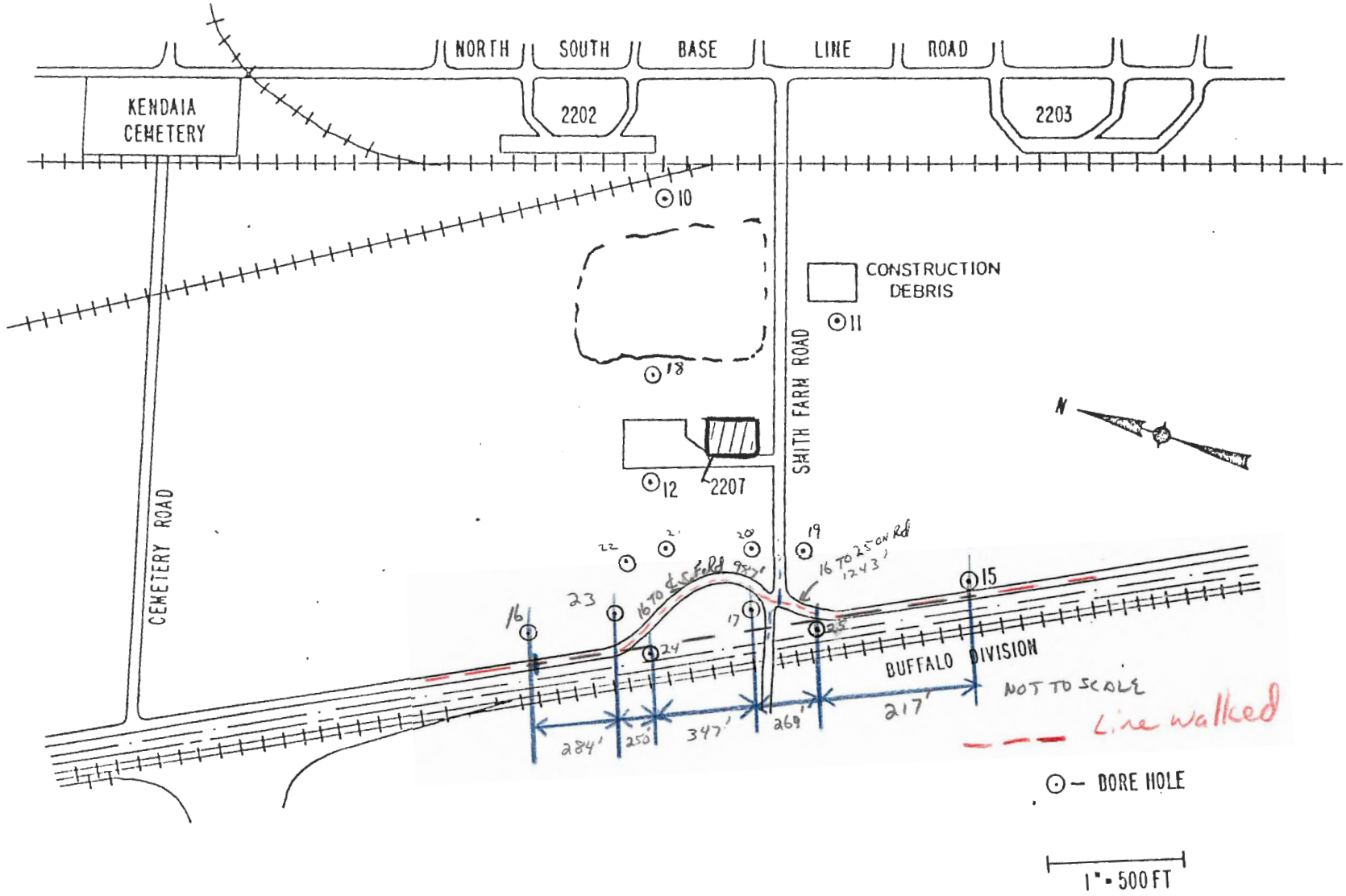


FIGURE EXISTING SANITARY LANDFILL SITE

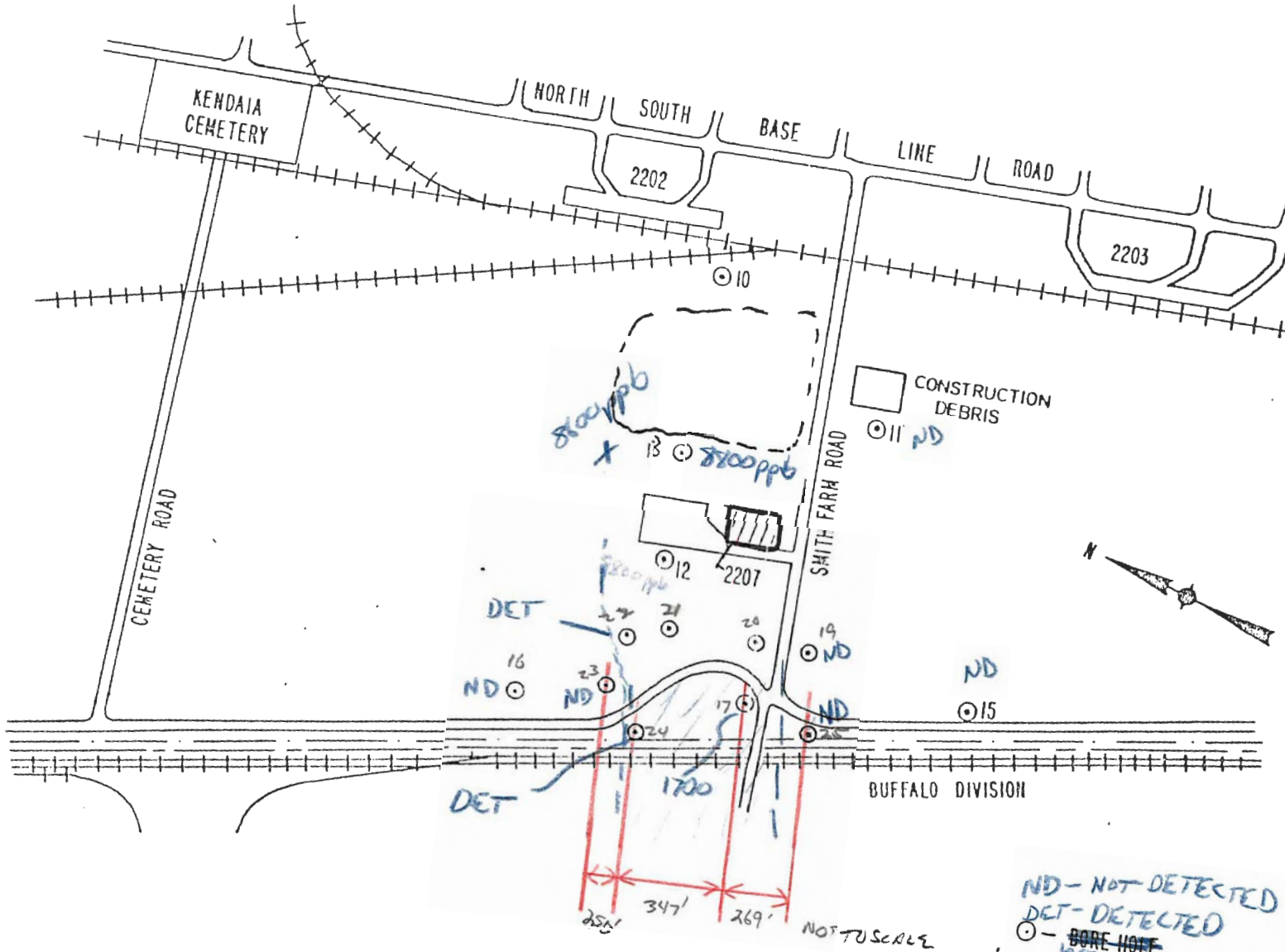


FIGURE EXISTING SANITARY LANDFILL SITE

ROUTING AND TRANSMITTAL SLIP

Date: 5 JAN 88

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. DEH Kutis		
2. CEA AJP		
3. CO		
4. DEH		
5.		

	Action		File		Note and Return
	Approval		For Clearance		Per Conversation
	As Requested		For Correction		Prepare Reply
	Circulate		For Your Information		See Me
	Comment		Investigate		Signature
	Coordination		Justify		

OK

GOOD Thanx

BJ 1/07

REMARKS OLD LANDFILL STATUS

1. AEHA GAVE ME A "FIRM VERBAL" THAT CONTAMINATION IS OFF-POST.
2. AEHA WILL NOT SAY HOW FAR OFF-POST OR EXACT DIRECTION (SEE MAP).
3. Note AT FENCE LINE, NOT DETECTED AT 23, 25, DETECTED AT 24, AND HIGH AT 17.

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)	Room No.—Bldg.
Randy Bittag [illegible]	Phone No.

5041-102

GPO : 1987 0 - 170-636

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

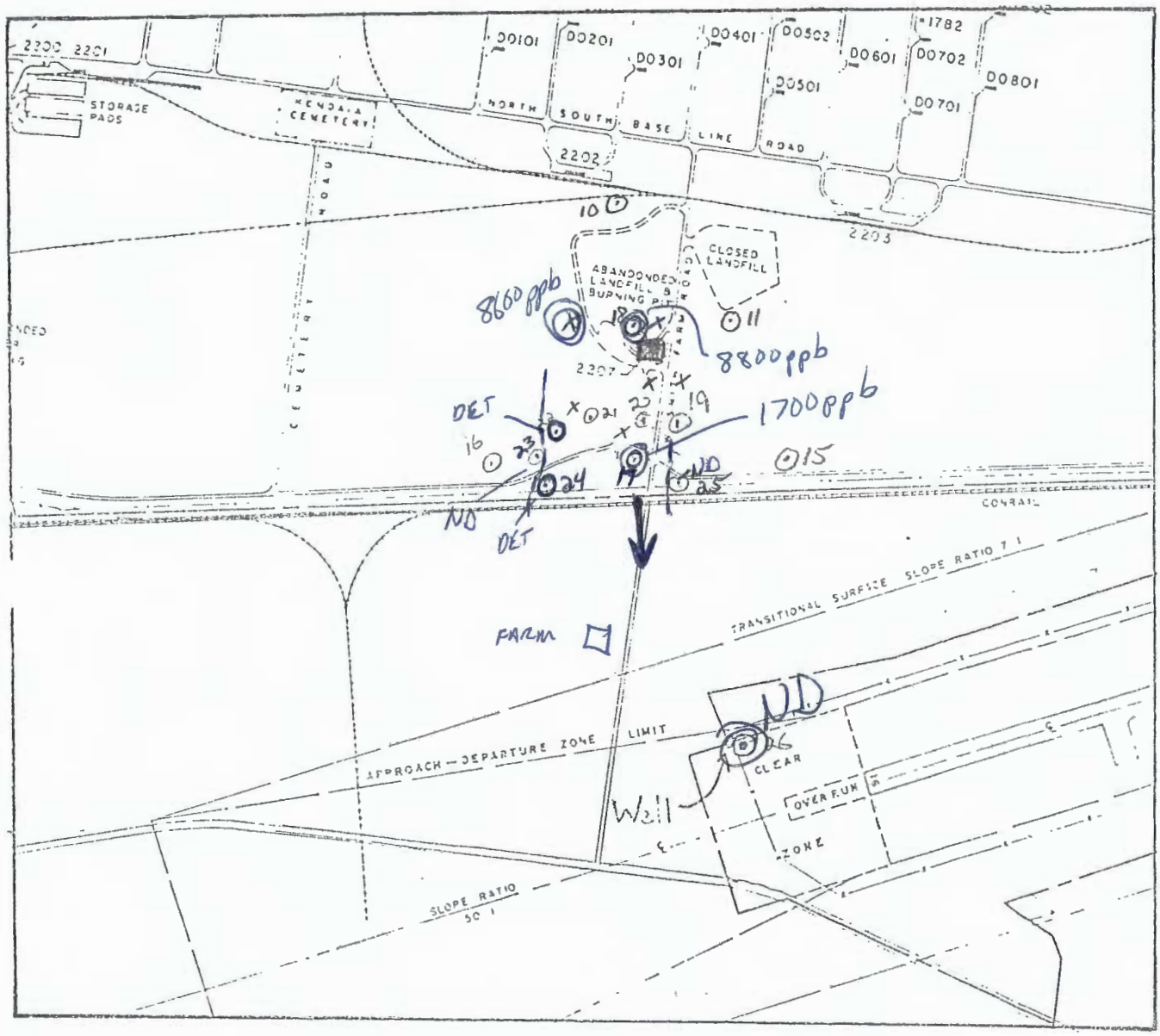
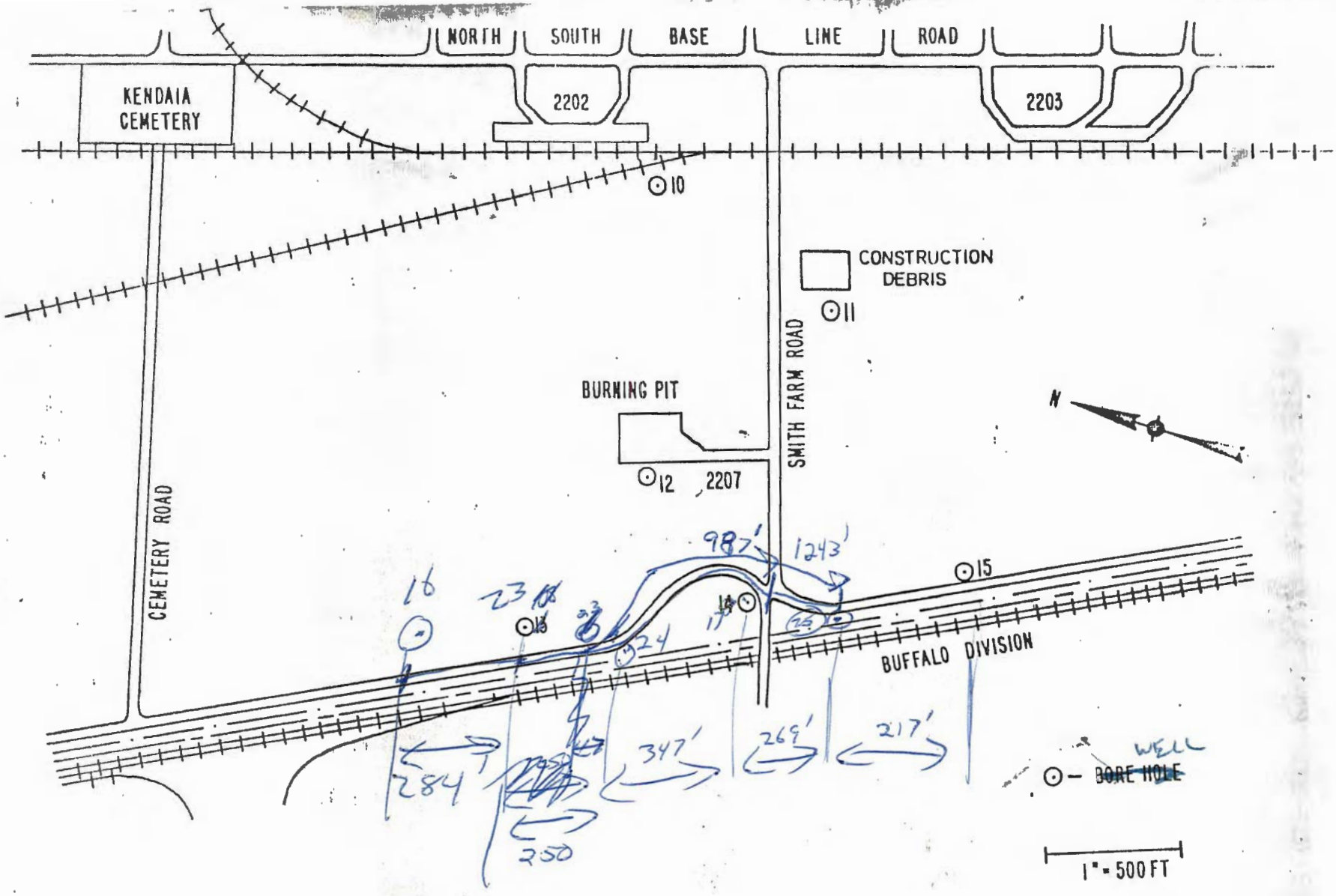


FIGURE 3 MAP SHOWING LOCATION OF AIRPORT WELL.

DET – DETECTED
ND – NOT DETECTED
ppb – part per billion
→ DIRECTION OF HIGHEST CONCENTRATIONS

encl



ABANDONED LANDFILL

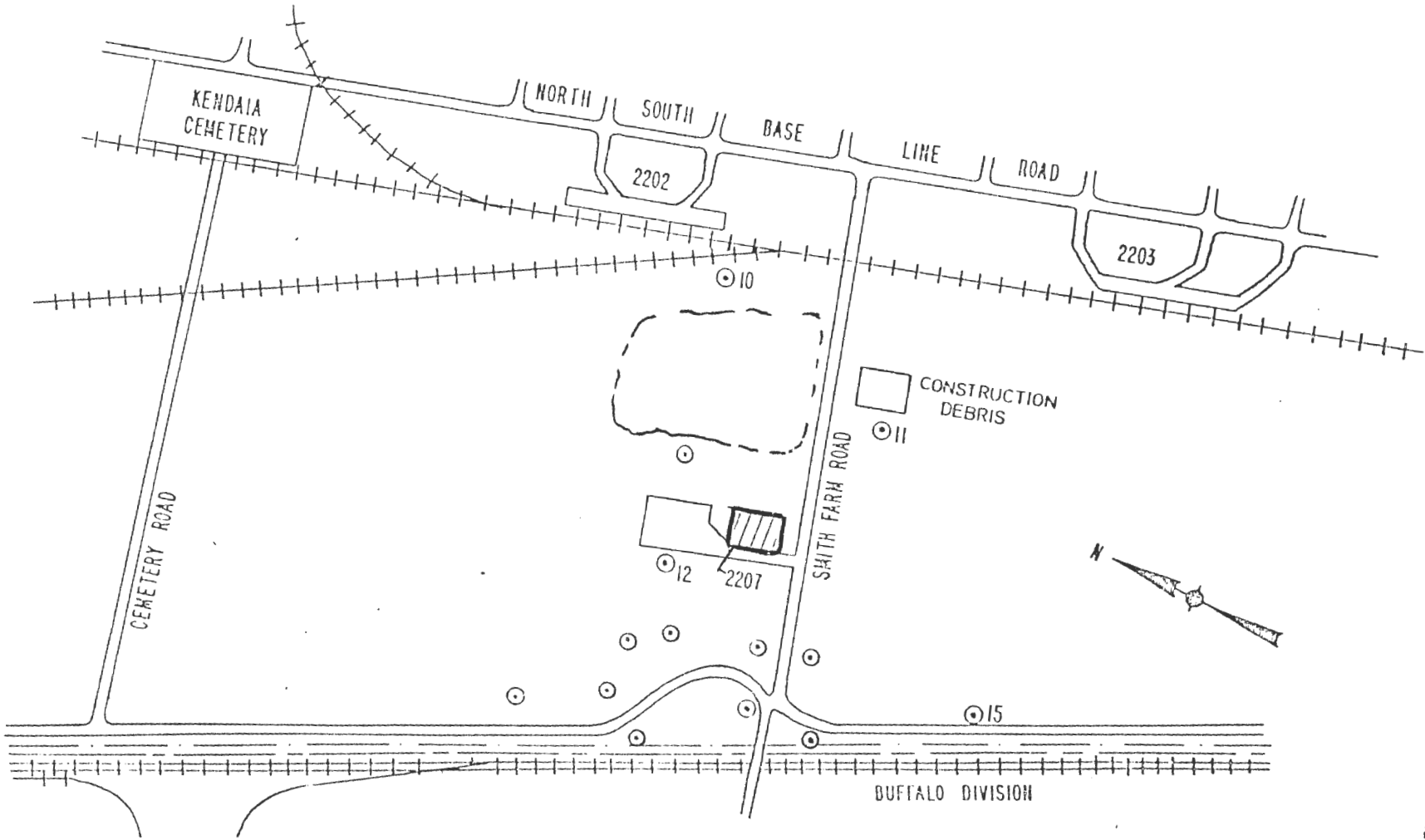


FIGURE EXISTING SANITARY LANDFILL SITE

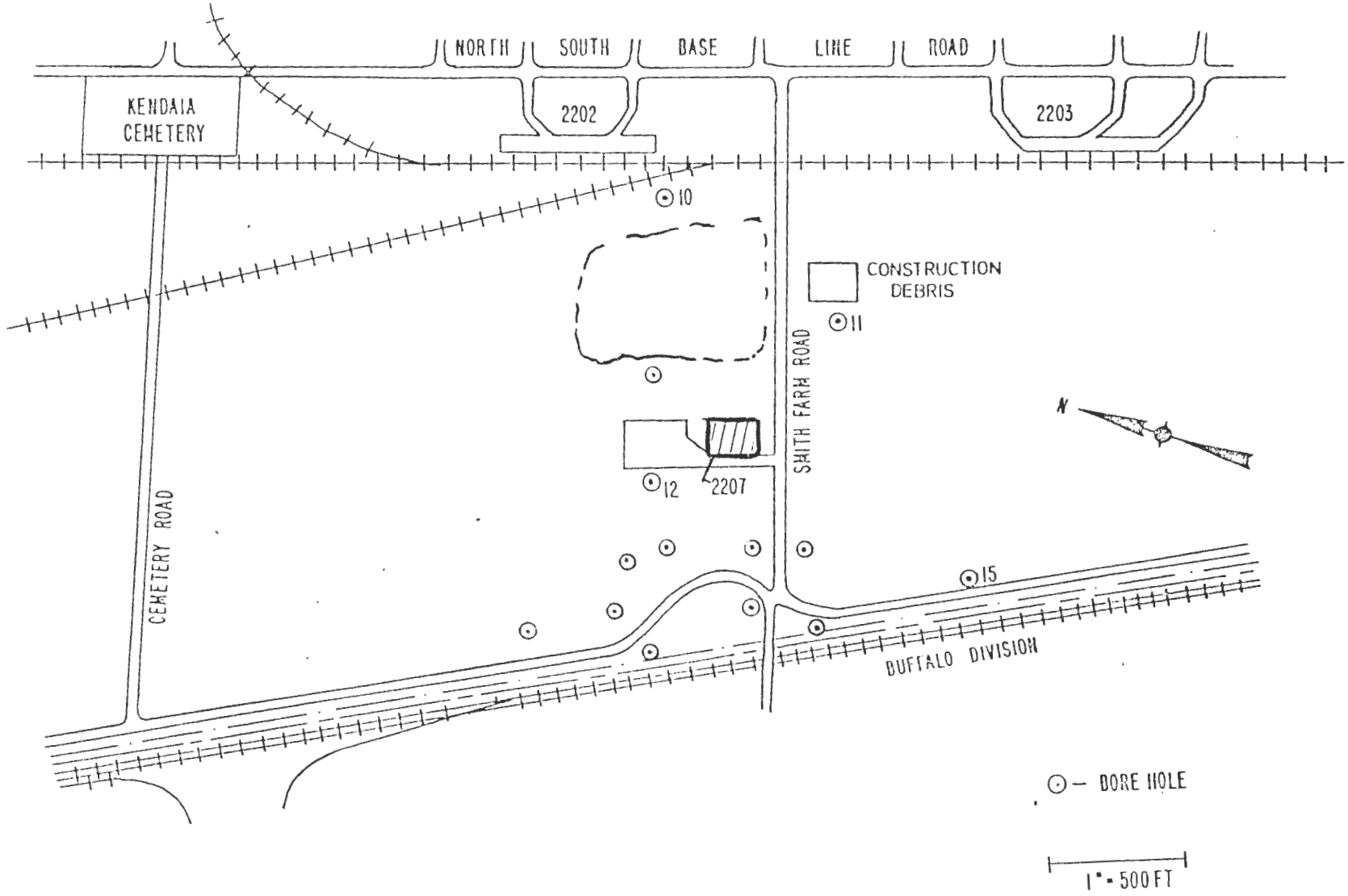
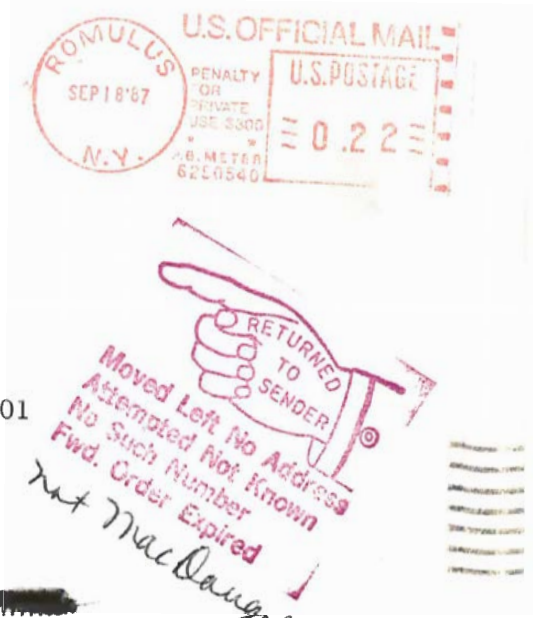


FIGURE EXISTING SANITARY LANDFILL SITE

DEPARTMENT OF THE ARMY
SENECA ARMY DEPOT
ROMULUS, N.Y. 14541

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300
SDSE-H (1200)

AN EQUAL OPPORTUNITY EMPLOYER



Mr. Joseph Nogle
East Lake Road
MacDougall, New York 14501

87

Date

ROUTING AND TRANSMITTAL SLIP

TO: *(Name, office symbol, room number, building, Agency/Post)*	Initials	Date
1.		
2.		
3.		
4.		
5.		

	Action		File		Note and Return
	Approval		For Clearance		Per Conversation
	As Requested		For Correction		Prepare Reply
	Circulate		For Your Information		See Me
	Comment		Investigate		Signature
	Coordination		Justify		

REMARKS

Mr. Joseph Nogle
RD. East Lake Rd.
Geneva, New York
14456

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: *(Name, org. symbol, Agency/Post)*	Room No.—Bldg.
	Phone No.

5041-102
GPO : 1987 0 - 170-636

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

10 MAY 1988

Office of Commander

Mr. Joseph Nogle
RD East Lake Road
Geneva, New York 14456

Dear Mr. Nogle:

Enclosed is a copy of the laboratory results for our March 17, 1988 sampling of the three wells on your Smith Vineyard Road property.

As shown in the laboratory report, none of the suspected chemicals were detected in any of your wells.

If you have any further questions, please feel free to contact Randall W. Battaglia at (607) 869-1450.

Sincerely,

William R. Holmes
Colonel, U.S. Army
Commanding

Enclosure

Copies Furnished:

Mr. and Mrs. Thomas Shaw, Smith Vineyard Road, MacDougall, NY 14541

Mr. Charles Carroll, Seneca County Health Department, Thurber Drive, Waterloo, NY 13165

Mr. John J. Nicit, Attorney at Law, 20 W. Main Street, Waterloo, NY 13165

RANDY BATTAGLIA

Case type: Bid Protest

Case name: Sony Corporation of America v. Department of the Army

Court: DNJ

Summary of complaint
Plaintiff seeks to enjoin performance of the CECOM contract for the Electronic Information Delivery System (EIDS). This computer based audio-visual system is to be the core of the Army training mission. The contract is valued at $200 million. Plaintiff objects to the award alleging that the successful offeror's proposal was not responsive and the Army engaged in technical leveling. On 10 Mar 87, GAO denied a protest filed by plaintiff concerning the same issues.

Significant developments (YR/MO/DAY)
870414 Plaintiff's discovery request received.
870422 Our discovery request to plaintiff.
870515 Our discovery response to plaintiff.
870624 Hearing on protective order.

Litigation Division attorney: France

* * * * *

Case type: CERCLA

Case name: City of New Brighton v. United States

Court: DMN

Summary of complaint
Plaintiff has sued for CERCLA response costs, injunctive relief and damages based on contamination of city water wells. The source of the contamination is alleged to be the migration of groundwater contaminated with trichloroethylene (TCE) from the Twin Cities Army Ammunition Plant. TCE is a suspected carcinogen. In Werlein v. United States, individual plaintiffs have filed a class action upon the same allegations, seeking punitive damages in addition to the relief set forth above.

Significant developments (YR/MO/DAY)
851224 Motion to stay denied.
860421 Settlement discussions initiated.
860826 Fourth Request for Response Action issued by MPCA.
870224 Settlement offer made to plaintiff.

Litigation Division attorney: Connor

* * * * *

Remedial Investigation

RIFS

Inst. Restoration

Feasibility Study

IRFS

TIME FRAMES

Study - 1 yr
date completed + 6 months - 1 yr Rem. actn going
Funding -
Const. - contracts -

15 months
Sr design contracts
MOA NPL — may end up on it — now are not yet see SARA amendments
EPA lead
consults state + does what they want
Rem. actn then chozen by EPA
not [redacted] us

AENA probably will turn down
USATHAMA does it
CERCLA

RCV MSG # TIME RADAY
SD241 1725 216/87

CF: Legal Ofc
Sandy / Tom
AB

PRIORITY

CDR __✓CEA___CDM___DAO___DRM___SUP___DOA___DEH✓___DSW___DIM___DPCA___DLOG___DLES__
SEAD___MCL___VET___RGP___CPO___TSP___COB___SUR___MIS___COM___633___143___CDOC___
HRSD___LGL___CSY___PAO___NEFD___SFT___CFA___ED___ADJ___IG___TCC________________

1/c 9978

PTIUZYUW RUEPSRA1764 2161722-UUUU--RUEDAGA.
ZNR UUUUU
P 041B30Z AUG 87
FM CDRDESCOM CHAMBERSBURG PA//AMSDS-RM-EFD//
TO RUKLDAR/CDRAMC ALEXANDRIA VA//AMCEN-A//
INFO RUEDAGA/CDRSEAD ROMULUS NY//SDSSE-C/SDSSE-HE// ✓
BT
UNCLAS
SUBJECT: REQUEST FOR PROVISION OF ALTERNATIVE WATER SUPPLY
A. MEMORANDUM USAEHA HSHB-ME-SG 19 JUN 87 SUBJECT: GROUNDWATER MONITORING RESULTS FOR SENECA ARMY DEPOT, NY.
1. REFERENCE REPORTS ORGANIC CONTAMINATION OF GROUNDWATER IN MONITORING WELLS AT THE DEPOT BOUNDARY. CONTAMINATION LEVELS EXCEED MAXIMUM CONTAMINANT LEVELS (MCL) FOR THESE CONSTITUENTS.
2. SEAD IS CONFIRMING REFERENCE RESULTS VIA EXPEDITED CONTRACT. SEAD HAS ALSO IDENTIFIED AN INDIVIDUAL'S POTABLE WATER WELL ABOUT 0.3 MILES DOWNGRADIENT.
3. IN ACCORDANCE WITH CG DESCOM DIRECTION, SEAD WILL NOTIFY REGULATORY AGENCIES AND REQUEST ACCOMPANIMENT TO THE DOWNGRADIENT RESIDENT TO SOLICIT APPROVAL FOR SAMPLING AND ANALYSIS OF HIS POTABLE WATER SUPPLY.
4. IN THE EVENT THE POTABLE WATER SUPPLY (IES) OFFPOST HAVE BEEN

CONTAMINATED BEYOND HEALTH LEVELS REQUEST AUTHORITY TO PROVIDE ALTERNATIVE WATER SUPPLY (IES) TO THE AFFECTED INDIVIDUALS. CG DESCOM REQUESTS RECEIPT OF THIS AUTHORITY IN ORDER TO PROVIDE NOTICE TO AFFECTED RESIDENTS, IF NECESSARY, CONCURRENT WITH REPORTING ANALYTICAL RESULTS FROM RESIDENT SAMPLES.
5. IT IS UNDERSTOOD THAT ALTERNATIVE WATER SUPPLIES WILL BE FURNISHED ONLY IF CONTAMINATION IN PRIVATE WELLS CORRELATES TO CONTAMINATION FOUND AT SEAD.
6. IN ORDER TO MAINTAIN AN HISTORIC GOOD NEIGHBOR RELATIONSHIP AND PROACTIVE POSTURE, ACCESS TO ONPOST WATER SUPPLIES WILL BE AFFORDED TO RESIDENT(S) AT RISK.
7. YOUR SUPPORT IN THIS MATTER WILL BE APPRECIATED. THE POC AT THIS OFFICE IS MR. VILLINGER, AMSDS-RM-EFD, AV 570-5531.
BT
#1764

NNNN

DEPARTMENT OF THE ARMY

HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND

5001 EISENHOWER AVENUE, ALEXANDRIA, VA. 22333

S: 21 November 1986

AMCEN-A

17 OCT 1986

SUBJECT: Modification of the U.S. Army Groundwater Monitoring Program

SEE DISTRIBUTION

1. Reference.

a. Letter, HQDA, DAEN-ZCE, 23 Jun 86, subject as above.

b. Letter, HQ AMC, AMCEN-A, 14 Jul 86, subject as above.

c. Letter, HQ AMC, AMCRM-PP, 26 Sep 86, subject: Program and Budget Guidance (PBG) Document, FY87, FY88, FY89 - September 1986.

2. In accordance with reference 1a, the U.S. Army Environmental Hygiene Agency (USAEHA) will discontinue the routine analytical support currently provided under the Groundwater Monitoring Program not later than 1 October 1987. By reference 1b, major subordinate commands (MSC's) were directed to program for costs of the Groundwater Monitoring Program at respective installations. Program and budget guidance is provided in reference 1c [see pg 1-9, chapter 1, para c (7)].

3. This headquarters is considering establishment of a centralized analytical support contract (through U.S. Army Engineer Division or other) to execute the revised program. Centralized contracts have advantages in cost savings, provide better control and management, facilitate contract administration, and most importantly, provide greater confidence in the quality of data generated through close scrutiny of laboratory quality assurance/quality control (QA/QC) procedures.

4. Request your concurrence/concerns with this approach or your alternative plan to implement the program. Under any option, USAEHA will continue to serve as central program manager and perform the services described in reference 1a. Request your response by 21 November 1986 so that we can initiate any necessary procurement action thereafter.

5. Funding issues will be discussed at a later date. However, it is envisioned, as stated in reference 1c, that the MSCs will be expected to fund the program from operating accounts.

6. A technical statement of work for groundwater sample analysis is enclosed for your information and appropriate action.

7. Point of Contact, at this headquarters, is Major Jessie B. Cabellon, AMCEN-A, AUTOVON 284-9016/9386.

ENCL

AMCEN-A 17 OCT 1986
SUBJECT: Modification of the U.S. Army Groundwater monitoring Program

8. AMC - Providing Leaders the Decisive Edge.

FOR THE COMMANDER:

Encl

WILLIAM A. HASSELKUS
Chief, Environmental Quality Division
Office of the Deputy Chief
of Staff, Engineer

DISTRIBUTION:

Commander:
AMCCOM (AMSMC-ISE)
AVSCOM (SAVAI-F)
CECOM (SELHI-EH-EV)
DESCOM (AMSDS-RM-EFD)
LABCOM (AMSLC-IS-E)
MICOM (AMSMI-RA-FE-MP)
TACOM (AMSTA-CZ)
TECOM (AMSTE-ST-E)
TROSCOM (AMSTR-X)
USAEDH (HNDED-PM)

CF: w/o encl

Cdr, USAEHA (HSHB-ME-S)
HQDA (DAEN-ZCE/DAEN-ZCF-U)

TECHNICAL STATEMENT OF WORK FOR

GROUND-WATER SAMPLE ANALYSES

Developed by:

The U.S. Army Environmental Hygiene Agency
Aberdeen Proving Ground, MD 21010-5422

June 1986

ENCLOSURE
2

CONTENTS

ATTACHMENT 1

Attachment 1 details analytical methodologies which should be used by contract laboratory for analyses of RCRA ground-water samples for inorganic, organic, and radiochemical contaminants. Attachment 1 also lists detection limits obtained by USAEHA in-house laboratories for respective analytical methodologies.

TABLE 1-1. REQUIRED CHEMICAL MEASUREMENTS, METHODOLOGY, AND DETECTION LIMITS FOR INORGANIC NONMETALS

Parameter	Required Methodology	Required Method Reference	Detection Limit[1]
Acidity	Titrametric	EPA 305.1[2]	1.0 mg/L as $CaCO_3$
Alkalinity	Titrametric	EPA 310.1[2]	1.0 mg/L as $CaCO_3$
Chloride	Titrametric	EPA 325.2[2]	1.0 mg/L
Hardness	Titrametric, EDTA	EPA 130.2[2]	1.0 mg/L as $CaCO_3$
pH	Electrochemical	EPA 150.1[2]	0.1 pH units
Total Dissolved Solids (TDS)	Gravimetric, 180 °C	EPA 160.1[2]	1.0 mg/L
Total Solids (TS)	Gravimetric, 105 °C	EPA 160.3[2]	1.0 mg/L
Total Suspended Solids (TSS)	Gravimetric, 105 °C	EPA 160.2[2]	1.0 mg/L
Total Volatile Dissolved Solids (TVDS)	Gravimetric, 550 °C	EPA 160.4[2]	1.0 mg/L
Total Volatile Solids (TVS)	Gravimetric, 550 °C	EPA 160.4[2]	1.0 mg/L
Total Volatile Suspended Solids (TVSS)	Gravimetric, 550 °C	EPA 160.4[2]	1.0 mg/L
Turbidity	Nephelometric	EPA 180.1[2]	0.2 NTU
Settleable Solids	Gravimetric	EPA 160.5[2]	1.0 mg/L
Nitrite Nitrogen	Spectrophotometric	EPA 300.0[2]	0.01 mg/L
Orthophosphate Phosphorus	Colorimetric	EPA 365.2[2]	0.02 mg/L
BOD	Bioassay	EPA 405.1[2]	1.0 mg/L
MBAS	Colorimetric	EPA 425.1[2]	0.05 mg/L

See footnotes, page 4.

Parameter	Required Methodology	Required Method Reference	Detection Limit[1]
Color	Spectrophotometric	EPA 110.3[2]	5 Color units
Sulfide	Colorimetric	EPA 376.2[2]	0.05 mg/L
Hexavalent Chromium	Atomic Absorption Chelation/Extraction	EPA 218.4[2]	0.025 mg/L
Silica	Colorimetric	EPA 370.1[2]	0.02 mg/L
2,4,6-TNT	Gas Chromatography	AEHA In-House Procedure	0.001 mg/L
2,4-DNT	Gas Chromatography	AEHA In-House Procedure	0.001 mg/L
2,6-DNT	Gas Chromatography	AEHA In-House Procedure	0.001 mg/L
RDX	Liquid Chromatography	AEHA In-House Procedure	0.03 mg/L
HMX	Liquid Chromatography	AEHA In-House Procedure	0.1 mg/L
Tetryl	Gas Chromatography	AEHA In-House Procedure	0.005 mg/L
Ammonium Picrate (Picric Acid)	Liquid Chromatography	AEHA In-House Procedure	0.5 mg/L
Urea	Ion Chromatography	AEHA In-House Procedure	0.1 mg/L
Melamine	Liquid Chromatography	AEHA In-House Procedure	0.5 mg/L
Nitroguanidine	Liquid Chromatography	AEHA In-House Procedure	0.1 mg/L
Specific Conductance	Wheatstone Bridge at 25 °C	USEPA Method Manual[2] Method #120.1	0.1 micromhos/cm

See footnotes, page 4.

Parameter	Required Methodology	Required Method Reference	Detection Limit[1]
Total Organic Carbon	Ultra-Violet Promoted Persulfate Oxidation	USEPA Method Manual[2] Method #415.2	50 micrograms/liter
	- OR -		
	Catalytic Combustion	EPA 415.1[2]	0.1 mg/L
Total Organic Halogen	Carbon Adsorption, Pyrolysis and Microcoulemetric Titration	USEPA Method #450.1[7]	10 micrograms/liter
Ammonia	Manual distillation followed by Nesslerization or Automated Phenate Color Development.	EPA 350.1[2] SM 417A & B[3]	0.10 mg/L as N
Chemical Oxygen Demand	Dichromate reflex followed by Titration or Sealed Tube Digestion.	EPA 410.4[2] SM 508[3]	15.0 mg/L
Cyanide	Distillation followed by Pyridine/Barbituric Acid Color Development	EPA 335.2[2]	0.01 mg/L
Fluoride	Distillation followed measurement by specific ion electrode	EPA 340.2[2] SM 413A & B[3]	0.10 mg/L
Grease & Oil	Liquid/Liquid Extraction with Freon	EPA 413.1[2] SM 503 A[3]	1.0 mg/L
Nitrate-Nitrite	Automated Cadmium Reduction	EPA 353.2[2]	0.01 mgL as N
Total Kjeldahl Nitrogen	Manual Kjeldahl Digestion followed by Manual Distillation and Nesslerization	EPA 351.3[2]	0.1 mg/L as N
Phenol	Manual Distillation followed by Chlorcform Extraction/4AAP Color Development	EPA 420.1[2] SM 510 A & B[3]	0.01 mg/L

See footnotes, page 4.

Parameter	Required Methodology	Required Method Reference	Detection Limit[1]
Phosphate	Manual Perchloric Acid Digestion followed by Asorbic Acid Color Development	SM 424C(III) & F[3]	0.02 mg/L as P
Sulfate	Automated, Methyl Thymol Blue or Turbimetric	EPA 378.2[2]	2.0 mg/L

[1] Detection limit is defined as the lowest concentration for which results are obtainable within the accuracy and precision requirements detailed in Attachment 2.

[2] "Methods for Chemical Analysis of Water and Wastes," March 1979, US Environmental Protection Agency, Cincinnati, Ohio 45265.

[3] "Standard Methods for the Examination of Water and Wastewater," 15th Edition, 1980, American Public Health Association, American Water Works Association, Water Pollution Contr Federation, Washington, DC 20005.

[4] "Methods of Soil Analysis," 1965, American Society of Agronomy, Madison, Wisconsin.

[5] "Test Methods for Evaluating Solid Wastes," July 1982, US Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC 20460.

[6] "Chemistry of the Soil," 1964, Firman Bear, Van Nostrand Reinhold Co., New York, New York

[7] Unpublished procedure copies of which are available from US Environmental Protection Agency, Cincinnati, Ohio upon telephonic or written request.

TABLE 1-2. REQUIRED CHEMICAL MEASUREMENTS, METHODOLOGY AND DETECTION LIMITS FOR METALS

Parameter	Required Methodology	Required Method Reference EPA Method Manual[1]	Required Detection Limit[2]
Aluminum	Digestion, Direct Aspiration or Furnace Technique Atomic Absorption, ICPES[3]	200.0 200.7 202.1 202.2	1.000 mg/L
Antimony	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 204.1 204.2	0.500 mg/L
Arsenic	Oxadative Digestion, Gaseous Hydride, or Furnace Technique Atomic Absorption, ICPES[3]	200.0 200.7 206.2 206.3	0.010 mg/L
Barium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 208.1 208.2	0.300 mg/L
Beryllium	Digestion, Direct Aspiration or Furnace Technique Atomic Absorption, ICPES[3]	200.0 200.7 210.1 210.2	0.050 mg/L
Boron	Digestion, ICPES[3] Colorimetric, Curcumin	200.0 200.7 212.3	10.00 mg/L
Cadmium	Digestion, Direct Aspiration or Furnace Technique Atomic Absorption, ICPES[3]	200.0 200.7 213.1 213.2	0.001 mg/L
Calcium	Digestion, Direct Aspiration Atomic Absorption, ICPES[3] Titrimetric, EDTA	200.0 200.7 215.1 215.2	1.000 mg/L
Chromium	Digestion, Direct Aspiration or Furnace Technique Chelation extraction Coprecipitation Atomic Absorption, ICPES[3]	200.0 200.7 218.1 218.2 218.3 218.4 218.5	0.001 mg/L

See footnotes, page 3.

Parameter	Required Methodology	Required Method Reference EPA Method Manual[1]	Required Detection Limit[2]
Cobalt	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 219.1 219.2	0.200 mg/L
Copper	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 220.1 220.2	0.025 mg/L
Iron	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 236.1 236.2	0.100 mg/L
Lead	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 239.1 239.2	0.005 mg/L
Magnesium	Digestion, Direct Aspiration Atomic Absorption, ICPES[3]	200.0 200.7 242.1	0.500 mg/L
Manganese	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 243.1 243.2	0.030 mg/L
Mercury	Digestion, Manual or Automated Cold Vapor Technique, ICPES[3]	200.0 245.1 245.2 245.5	0.0002 mg/L
Molybdenum	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 246.1 246.2	0.500 mg/L
Nickel	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 249.1 249.2	0.100 mg/L
Potassium	Digestion, Direct Aspiration Atomic Absorption, ICPES[3]	200.0 200.7 258.1	0.500 mg/L

See footnotes, page 3.

Parameter	Required Methodology	Required Method Reference EPA Method Manual[1]	Required Detection Limit[2]
Selenium	Oxidative Digestion, Gaseous Hydride or Furnace Technique Atomic Absorption ICPES[3]	200.0 200.7 270.2 270.3	0.005 mg/L
Silver	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 272.1 272.2	0.025 mg/L
Sodium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 273.1 273.2	1.000 mg/L
Thallium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 279.1 279.2	1.000 mg/L
Tin	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 282.1 282.2	1.000 mg/L
Titanium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 283.1 283.2	1.000 mg/L
Vanadium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 286.1 286.2	2.000 mg/L
Zinc	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 289.1 289.2	0.015 mg/L

[1] "Methods for Chemical Analysis of Water and Wastes," March 1979, US Environmental Protection Agency, Cincinnati, Ohio 45265.

[2] Detection limit is defined as the lowest concentration for which results are obtained within accuracy and precision requirements detailed in Attachment 2. Lower limits may be requested for some samples, which will be submitted in the request for analysis.

[3] Inductively Coupled Plasma Emission spectroscopy.

TABLE 1-3. REQUIRED CHEMICAL MEASUREMENTS, METHODOLOGY AND DETECTION LIMITS FOR ORGANICS

Parameter	Methodology Description	Required Method Reference[1]	Required Detection Limit (micrograms/liter)
Volatile Organic Compounds	Gas Chromatography Mass Specfrometry	624	3
benzene	"	624	3
carbon tetrachloride	"	624	3
chlorobenzene	"	624	3
1,2-dichloroethane	"	624	3
1,1,1-trichloroethane	"	624	3
1,1-dichloroethane	"	624	3
1,1,2-trichloroethane	"	624	3
1,1,2,2-tetrachloroethane	"	624	3
chloroethane	"	624	3
2-chloroethyl vinyl ether	"	624	3
chloroform	"	624	3
1,1-dichloroethene	"	624	3
trans-1,2-dichloroethene	"	624	3
1,2-dichloropropane	"	624	3
trans-1,3-dichloropropene	"	624	3
cis-1,3-dichloropropene	"	624	3
ethylbenzene	"	624	3
methylene chloride	"	624	3
chloromethane	"	624	3
bromomethane	"	624	3
bromoform	"	624	3
bromodichloromethane	"	624	3
chlorodibromomethane	"	624	3
tetrachloroethane	"	624	3
toluene	"	624	3
trichloroethane	"	624	3
vinyl chloride	"	624	3
fluorotrichloromethane	"	624	3
Base/Neutral and Acid Extractable Organic Compounds	Gas Chromatography Mass Spectrometry		
acenaphthene	"	625	10
1,2,4-trichlorobenzene	"	625	10
hexachlorobenzene	"	625	10
hexachloroethane	"	625	10
bis (2-chloroethyl) ether	"	625	10
2-chloronaphthalene	"	625	10
2,4,6-trichlorophenol	"	625	25
4-chloro-3-methylphenol	"	625	25
2-chlorophenol	"	625	25
1,2-dichlorobenzene	"	625	25

See footnotes, page 3.

Parameter	Methodology Description	Required Method Reference[1]	Required Detection Limit (micrograms/liter)
	Gas Chromatography		
1,3-dichlorobenzene	Mass Spectrometry	625	10
1,4-dichlorobenzene	"	625	10
2,4-dichlorophenol	"	625	25
2,4-dimethylphenol	"	625	25
2,4-dinitrotoluene	"	625	10
2,6-dinitrotoluene	"	625	10
fluoranthene	"	625	10
4-chlorophenyl phenyl ether	"	625	10
4-bromophenyl phenyl ether	"	625	10
bis (2-chloroisopropyl) ether	"	625	10
bis (2-chlorothoxy) methane	"	625	10
hexachlorobutadiene	"	625	10
isophorone	"	625	10
naphthalene	"	625	10
nitrobenzene	"	625	10
2-nitrophenol	"	625	25
4-nitrophenol	"	625	25
2,4-dinitrophenol	"	625	250
4,6-dinitro-2-methylphenol	"	625	250
N-nitrosodipropylamine	"	625	10
pentachlorophenol	"	625	25
phenol	"	625	25
bis (2-ethylhexyl) phthalate	"	625	10
benzyl butyl phthalate	"	625	10
di-n-butyl phthalate	"	625	10
di-n-octyl phthalate	"	625	10
diethyl phthalate	"	625	10
dimethyl phthalate	"	625	10
benzo(a)anthracene	"	625	10
benzo(a)pyrene	"	625	10
benzo(b)fluoranthene	"	625	10
benzo(k)fluoranthene	"	625	10
chrysene	"	625	10
acenaphthylene	"	625	10
anthracene	"	625	10
benzo(ghi)perylene	"	625	25
fluorene	"	625	10
phenanthrene	"	625	10
dibenzo(ah)anthracene	"	625	25
indeno(1,2,3-cd)pyrene	"	625	25
pyrene	"	625	10
PCB 1016	"	625	50
PCB 1221	"	625	50
PCB 1232	"	625	50
PCB 1242	"	625	50
PCB 1248	"	625	50

See footnotes, page 3.

Parameter	Methodology Description	Required Method[1] Reference	Required Detection Limit (micrograms/liter)
PCB 1254	"	625	50
PCB 1260	"	625	50
	Gas Chromatography		
Benzidine[2]	Mass Spectrometry	625	10
3,3'-dichlorobenzidine[2]	"	625	10
hexachlorocyclopentadiene[2]	"	625	10
N-nitrosodimethylamine[2]	"	625	10
N-nitrosodiphenylamine[2]	"	625	10
Pesticide Organic Compounds	Gas Chromatography/ Electron Capture Detection	608	
aldrin	"	608	0.16
dieldrin	"	608	0.24
chlordane	"	608	1.20
4,4'-DDT	"	608	0.60
4,4'-DDE	"	608	0.40
4,4'-DDD	"	608	0.40
endosulfan I	"	608	0.14
endosulfan II	"	608	0.14
endosulfan sulfate	"	608	0.066
endrin	"	608	0.04
endrin aldehyde	"	608	0.23
heptachlor	"	608	0.06
heptachlor epoxide	"	608	0.16
a-BHC	"	608	0.20
b-BHC	"	608	0.20
d-BHC	"	608	0.20
g-BHC	"	608	0.08
toxaphene	"	608	1.60
PCB 1016	"	608	1.00
PCB 1221	"	608	1.00
PCB 1232	"	608	1.00
PCB 1242	"	608	1.00
PCB 1248	"	608	1.00
PCB 1254	"	608	1.00
PCB 1260	"	608	1.00
Methoxychlor	"	608	1.60
2,4-D	"	SM 509B[2]	3.80
Silvex	"	SM 509B[2]	0.50

[1] "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," July 1982, US Environmental Protection Agency, Cincinnati, Ohio 45268.

[2] These compounds have been identified by USEPA as being labile with respect to Method 625. Accuracy and precision requirements as identified in Table in Attachment 2 will not pertain to these compounds.

[3] "Standard Methods for the Examination of Water and Wastewater", 16th Edition, 1985, American Public Health Association, American Water Works Association, Water Pollution Contr Federation, Washington DC 20005.

TABLE 1-4. REQUIRED CHEMICAL MEASUREMENTS, METHODOLOGY AND DETECTION LIMITS FOR RADIOCHEMICALS

No.	Parameter	Methodology	Method Reference	Detection Limit
1	Screening Procedure/Aliq. Size	Gravimetric Analysis	1(Enclosure 2)	NA
2	Gross Alpha (<500 mg/L Dissolved Solids)	Proportional	EPA 900.0[1]	1.0 pCi/L
3	Gross Beta (<500 mg/L Dissolved Solids)	Proportional Counting	EPA 900.0[1]	4.0 pCi/L
4	Gross Alpha (>500 mg/L Dissolved Solids)	Proportional Counting	EPA Method A (Enclosure 1)	1.0 pCi/L
5	Gross Beta (>500 mg/L Dissolved Solids)	Proportional Counting	EPA Method 900.0[2]	[3]
6	Gross Alpha	Proportional Counting	2(Enclosure 3)	1.0 pCi/L
7	Gross Beta	Proportional Counting	2(Enclosure 3)	4.0 pCi/L

[1] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water" August, 1980, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268.

[2] Due to the presence of high dissolved solids content, a smaller aliquot size will be taken for analysis.

[3] Detection limit dependent on aliquot size taken for analysis.

EPA METHOD A

DETERMINATION OF GROSS ALPHA ACTIVITY IN DRINKING WATER BY COPRECIPITATION

1. Scope and Application

   1.1 Many drinking water supplies contain dissolved solids at such high concentrations (>500 mg/liter) that measurement of gross alpha activity, by evaporating an aliquot of a sample and counting for alpha activity, seriously lacks sensitivity and reproducibility. The nitrated salts (formed by evaporation of sample aliquot containing nitric acid) of some water samples are hygroscopic and must be converted to the oxides by heating to get a stable sample residue.

   1.2 This method provides for the separation of all actinide alpha emitting radionuclides by coprecipitation with barium sulfate and iron hydroxide from liter samples of drinking water. Dissolved solids problems are eliminated. Sensitivity can be increased by using larger sample aliquots. Reproducibility is improved by the use of constant amounts of carrier (barium and iron).

   1.3 This method provides for a screening measurement to indicate whether specific radium-226 and/or uranium analysis is required for a drinking water supply.

2. Summary of Method

   2.1 An aliquot of a drinking water sample is acidified with sulfuric acid and boiled vigorously for 10 minutes to outgas carbon dioxide and radon-222 from the sample. Barium carrier is added and the aliquot is stirred for about 30 minutes to coprecipitate radium with barium sulfate.

   2.2 Iron carrier is added to the aliquot, is then neutralized with ammonium hydroxide, and is continued to be heated and stirred for another 30 minutes to coprecipitate other alpha emitters with iron hydroxide carrier.

   2.3 The coprecipitate is filtered, dried, and counted for alpha activity.

3. Sampling Handling and Preservation

   3.1 A representative sample must be collected from a monitoring well and should be large enough so that meaningful aliquots can be taken.

3.2 To minimize adsorption losses to the walls of the sample container, it is recommended that samples be preserved at the time of collection by the addition of 5 ml of 70 percent HNO_3 (concentrated) per liter of sample, making the samples 0.35% HNO_3 solutions. Samples can be acid-preserved when they arrive at the laboratory. They should then be stored (after acid addition) for at least 16 hours (overnight) before aliquots are taken for analysis.

4. Interferences

4.1 Since gross alpha screening of ground water samples is primarily addressing radium concentrations (especially radium-226), and since the radium isotopes decay to short-lived progeny, standards and samples should be counted at as nearly the same elapsed time as possible after alpha activity precipitation. If there are wide differences in the elapsed times for standards and samples in the elapsed time range of 0-20 days, there will be significant errors in the counting efficiencies used. It is recommended that a short time be allowed between the alpha activity precipitation and the mid-point of the alpha count. However, three hours should be allowed for the decay of the radon-222 progeny before starting the alpha count.

4.2 Samples that contain sulfate and/or hydroxide insoluble precipitates will have greater total precipitates than from the added barium and iron carriers, and therefore will have counting efficiencies that are biased low.

4.3 Iron hydroxide precipitate collected on membrane filters without a holding agent will flake when dried and easily separate from the filter. Five (5) mg of paper pulp fiber added to the sample will greatly help to secure the iron hydroxide to the filter. Glass fiber filters are recommended over membrane filters because the surface glass fibers also help to secure the precipitate to the filter.

5. Apparatus

5.1 Hotplate/magnetic stirrer and stirring bars.

5.2 Glassware.

5.3 Filter membranes, 47 mm diameter, 0.45 micrometer pore size or glass fiber filters, such as Gelman type A/E or Millipore Type AP.

5 4 Drying lamp.

5.5 Planchets, stainless steel, 2 inch diameter.

5.6 Alpha scintillation counter or low background proportional alpha counter.

6. Reagents

6.1 Ammonium hydroxide, 6M. Dilute 400 ml reagent grade HN_4OH to 1 liter with distilled water.

6.2 Barium carrier, 5 mg Ba^{+2}/ml. Dissolve 4.4 g $BaCL_2 \cdot 9H_2O$ in 500 ml distilled water.

6.3 Bromocresol purple, 0.1 percent. Dissolve 100 mg of the water soluble reagent in 100 ml distilled water.

6 4 Iron carrier, 5 mg Fe^{+3}/ml. Dissolve 17.5 g $Fe(NO_3)_3, \cdot 9H_2O$ in 200 ml distilled water containing 2 ml 16M HNO_3. Dilute to 500 ml.

6.5 Sulfuric acid, 1M. Dilute 55 ml of the 96 percent reagent grade H_2SO_4 to 1 liter with distilled water.

6.6 Paper pulp/water mixture - add a 0.5 g paper pulp pellet to 500 ml of distilled water plus 5 drops of a (1+4) detergent plus water solution in a plastic bottle. Cap the bottle and stir vigorously for three hours before using. This mixture should be stirring when an aliquot is taken.

6.7 Five drops of a (1+4) detergent plus water solution added to the sample will prevent the precipitate from collecting on the beaker wall and will assist in filtering the precipitate. (Examples of wetting agents: Rohm and Haas Triton N101 or Triton X100.)

7. Calibration

7.1 Thorium-230 is a recommended pure alpha emitter for gross alpha efficiency calibration especially if the alpha contribution to the beta channel is to be determined. If only gross alpha measurements are to be made on samples, natural uranium is an adequate standard for gross alpha counting efficiency calibration.

7.2 Spike 500 ml portions of tap water in separate beakers (at least 100 pCi) of standard alpha emitter activity. Add 2.5 ml of HNO_3 (Conc.) to each spiked sample. With these spiked samples, determine a counting efficiency (cpm/pCi) for the alpha emitter by taking the samples through the procedure (parts 8.1 - 8.10).

7.3 Unspiked tap water portions (500 ml) should be taken through the procedure for blank corrections of alpha activity in the tap water plus the reagents used.

7.4 Calculations

$$\text{Efficiency, cpm/pCi} = \frac{C_s - C_b}{\text{pCi}}$$

C_s = mean spiked sample counts per minute
C_b = mean blank counts per minute
pCi = spike activity

8. Procedure (the following method was presented by Robert Lieberman of the Eastern Environmental Radiation Facility, Montgomery, Alabama, at the Health Physics Society meeting in Las Vegas, Nevada, August, 1982. Some minor changes were made as a result of a single laboratory test of the method by the EMSL-Las Vegas, Quality Assurance Division).

8.1 Use a measured aliquot of water sample. If the sample is less than 500 ml, dilute to 500 ml with distilled water. Samples of 500 ml to 1 liter use as is.

8.2 Add 5 drops of the (1+4) detergent plus water reagent.

8.3 Place the sample on a magnetic stirrer/hot plate and, while stirring, gently add 20 ml of 1M H_2SO_4 and boil for 10 minutes to flush carbon dioxide (from carbonates and bicarbonates) from the sample. Radon will also be flushed from the sample.

8.4 Lower the hot plate temperature to below sample boiling, continue stirring and add 1 ml of barium carrier solution (5 mg Ba/ml). Continue stirring for 30 minutes.

8.5 Add 1 ml of bromocresol purple indicator solution, 1 ml of iron carrier solution, and 5 ml of paper pulp/water reagent (aliquot taken while the paper pulp/water mixture is stirring).

8.6 Continue stirring and add 6M HN_4OH dropwise to the sample until there is a distinct color change (yellow to purple). Continue warming and stirring for 30 minuest.

8.7 Filter the sample through a glass fiber filter (or membrane filter if further analysis is to be done), rinsing all precipitate from the beaker to the filter. Wash the precipitate with 25 ml of distilled water.

8.8 Allow 3 hours for the collected radon progeny to decay and dry the filter at 105°C or under a mild heat lamp.

8.9 Count the filters for gross alpha activity. An early count of the gross alpha activity, after the three hour decay period, is recommended to minimize additional radon ingrowth which is not easily corrected for when there are other alpha emitters in the sample.

8.10 Store samples in a desiccator if they are to be recounted at a later date.

8.11 Prepare a reagent blank precipitate to determine the reagent alpha activity background.

9. Calculations

9.1 Gross alpha activity, pCi/liter $= \dfrac{C_1 - C_B}{EV}$

E = counter efficiency, cpm/pCi
V = volume analyzed, liters
C_1 = sample, counts per minute
C_B = reagent blank, counts per minute

9.2 Lower Limit of Detection, LLD

$$\text{LLD, Gross alpha, pCi/liter} = \frac{4.66\ C_B}{E\ V\ T}$$

C_B = reagent background, counts per minute
T = counting time
E = counter efficiency cpm/pCi
V = reagent blank, counts per minute

This LLD calculation is valid if the sample counting time is equal to the background counting time.

10. Precision and Accuracy

(To be added from single laboratory and multilab tests of the method.)

APPENDIX A

Total alpha factors for radium-226 with change in elapsed time between alpha activity precipitation and the midpoint of the alpha count (from Kirby's tables, "Decay and Growth Tables for the Naturally Occurring Radioactive Series, AEC Research and Development Report MLM-2042)."

Elapsed Time #t = hrs, (days)	Total Alpha Factor Ra-226 Parent Only* Alpha Factor	% Increase	Ra-226 plus Po-210 Fraction** Alpha Factor	% Increase
0	1.0000	0.0	1.5100	0.0
4	1.0800	8.0	1.5900	5.3
8	1.1668	16.7	1.6768	11.0
12	1.2511	25.1	1.7611	16.6
16	1.3329	33.3	1.8429	22.0
20	1.4123	41.2	1.9223	27.3
24 (1)	1.4893	48.9	1.9993	32.4
36	1.7068	70.7	2.2168	46.8
48 (2)	1.9055	90.5	2.4155	60.0
60	2.0870	109	2.5970	72.0
72 (3)	2.2528	125	2.7628	83.0
84	2.4042	140	2.9142	93.0
96 (4)	2.5424	154	3.0524	102
(5)	2.7841	178	3.2941	118
(6)	2.9856	198	3.4956	131
(7)	3.1538	215	3.6638	143
(8)	3.2941	229	3.8041	152
(10)	3.5087	251	4.0187	166
(15)	3.8015	280	4.3115	185
(20)	3.9198	292	4.4298	193
(25)	3.9675	297	4.4775	196
(30)	3.9869	299	4.4969	198

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* This data, from Kirby's tables, assumes a pure parent at #t=0.

* This data is (*) plus a 0.51 fraction of Po-210 which is also an alpha emitter. The ratio of Po-210 to Ra-226 in the EMSL-LV Ra-226 standard (March 23, 1984) is 0.51.

APPENDIX B

Elapsed Time #t hours	Total Alpha	Ingrowth Factor	Estimated Ra-226 % bias (-)
0	1.000	0 000	
1	1.016	0.016	
2	1.036	0.036	
3	1.058	0.058	
4	1.080	0.080	3
5	1.102	0.102	4
6	1.124	0.124	5
7	1.145	0.145	6
8	1.166	0.166	7
9	1.188	0.188	8.5
10	1.209	0.209	10
11	1.230	0.230	11
12	1.251	0.251	12
13	1.271	0.271	13
14	1.292	0.292	14
15	1.313	0.313	14.4
16	1.333	0.333	15
17	1.353	0.353	16
18	1.373	0.373	17
19	1.392	0.392	18
20	1.412	0.412	19
21	1.432	0.432	20
22	1.451	0.451	21
23	1.470	0.470	22
24	1.489	0.489	23

Estimation of the Ra-226 alpha contribution to the gross alpha count

The Ra-226 concentration (pCi/l) at #t = D is estimated by the following equation:

Estimated Ra-226 = Alpha count at #t = 7 days - Alpha Count at #t = 0, or early time after separation ÷ counting efficiency (cpm/pCi) x 7 day ingrowth factor* (see Appendices A and B).

* While the total Alpha factor for Ra-226 at 7 days ingrowth time is 3.1538, the alpha ingrowth factor is 3.1538 - 1.000 or 2.1538.

Example:

Assume a sample contains

Ra-226	=	10.0 pCi/l
Po-210	=	5.1 pCi/l
Natural Uranium	=	20.0 pCi/l
Total Alpha		35.1 pCi/l at #t = 0

Assume counting efficiency = 0.20 cpm/dpm or 0.444 cpm/pCi.

The alpha count at #t = 0 would be 0.444 cpm/pCi x 35.1 pCi/l = 15.6 cpm/l.

At 7 days of ingrowth the 10.0 pCi/l Ra-226 alpha component would increase to a total of 10.0 pCi/l x 3.1538 = 31.58 pCi/l.

At #t = 7 days the total gross alpha would be

Ra=226 plus progency	=	31.58 pCi/l
Po-210	=	5.1 pCi/l
Natural Uranium	=	20.0 pCi/l
		56.6 pCi/l

The #t = 7 days, alpha count rate would be 0.444 cpm/pCi x 56.5 pCi/l = 25.1 cpm/l

then:

$$\text{Estimated Ra-226} = \frac{25.1 \text{ cpm/l} - 15.6 \text{ cpm/l}}{0.44 \text{ cpm/pCi} \times 2.1538}$$

= 9.93 pCi/l, compared to the 10.0 pCi/l given above.

Since the early alpha count is taken at some time after 3 hours from coprecipitation of the alpha emitters, the estimated Ra-226 component of the sample will be biased low. The percent of bias for early alpha counts of #t = 4 to 24 hours is shown in Appendix B. Estimated Ra-226 results can be normalized to #t = 0, using the percent bias values in Appendix B.

In the example above, if the early alpha count had been as late as #t = 24 hours, the calculations would be as follows:

At #t = 24 hours the total gross alpha would be:

Ra-226 plus progeny	=	10.0 pCi/l x 1.489	=	14.9 pCi/l
		Po-210	=	5.1 pCi/l
		Natural Uranium	=	20.0 pCi/l
				40.0 pCi/l

and the alpha count would be

$$0.444 \text{ cpm/pCi} \times 40.0 \text{ pCi/l} = 17.8 \text{ cpm/l}$$

then the estimated Ra-226 $= \dfrac{25.1 - 17.8}{0.444 \times 2.1538} = 7.63$ pCi/l, which is biased low by 23 percent.

Normalized to #t = 0, $\dfrac{7.63}{1.0 - 0.23} = 9.92$ pCi/l compared to 10.0 pCi/l.

9. Calculations.

9.1 When counting for only alpha calculate the alpha radioactivity by the following equation:

$$\text{Alpha activity } (\mu\text{Ci/g}) = \frac{\text{ACPM}_{NET}}{(2.2 \times 10^6)(CE)(A)}$$

Where:

ACPM_{NET} = net alpha count rate (gross alpha count rate minus the alpha background rate) on the alpha voltage plateau

CE = alpha efficiency factor, read from graph of efficiency versus mg of water solids per cm^2 of planchet area, (cpm/dpm)

A = sample aliquot in grams

2.2×10^6 = conversion factor from dpm to µCi

9.2 When counting beta radioactivity in the presence of alpha radioactivity by gas flow proportional counting systems (on the beta plateau) alpha particles are also counted. Since alpha particles are more readily absorbed by increasing sample thickness than beta particles, the alpha/beta count ratios vary with increasing sample thickness. Therefore, it is necessary to prepare a calibration curve by counting standards containing americium-241 with increasing thickness of solids on the alpha plateau and then on the beta plateau, plotting the ratios of the two counts vs sample thickness. The alpha into beta cross talk from that curve is used to correct the amplified alpha count on the beta plateau. (See Appendix A.) When significant alpha activity is indicated by the sample, count at the alpha voltage plateau, the beta activity of the sample can be determined by counting the sample at the beta voltage plateau and calculating the activity from the following equation:

$$\text{Beta activity } (\mu Ci/g) = \frac{[BCPM_{NET} - (ACPM_{NET} \times X\text{-TALK})]}{(2.22 \times 10^6)(CE)(A)}$$

Where:

$BCPM_{NET}$ = net beta count rate (gross beta count rate minus the beta background count rate) at the beta voltage plateau

CE = beta efficiency factor, read from graph of efficiency versus mg of water solids per cm^2 of planchet, area (cpm/dpm)

$ACPM_{NET}$ = net alpha count rate

X-TALK = alpha into beta cross-talk, read from the graph of the ratio of alpha counted at the beta voltage/alpha counted at the alpha voltage vs sample density thickness

A = sample aliquot in grams

2.22×10^6 = conversion factor from dpm to µCi

9.3 Results are reported in microcurie per gram (µCi/g) of soil and in one of the following ways:

a. If the activity is greater than the LLD, it is reported with a 1.96 sigma error (i.e., 1.7 +- 0.1 µCi/g)

b. If the calculated activity is less than the LLD, the results are reported as less than the LLD.

For more detailed information on reporting results see the section entitled "Reporting of Results" in the RAB Standing Operating Procedure Manual.

$$\text{LLD } (\mu Ci/g) = \frac{4.65 \sqrt{\frac{CPM_B}{T}}}{(2.22 \times 10^6)(CE)(A)}$$

$$\text{STANDARD DEVIATION} = +/- \frac{\sqrt{\frac{CPM_{S+B}}{T} + \frac{CPM_B}{T}}}{(2.2 \times 10^6)(CE)(A)}$$

Where :

LLD	=	lower limit of detection
CPM_{S+B}	=	count rate of sample plus background
CPM_B	=	count rate of background
CE	=	counting efficiency
A	=	aliquot in grams
T	=	counting time in minutes
µCi/g	=	microcurie per gram

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3. Simultaneous Determination of Alpha-Emitting Nuclides of Radium Through Californium in Large Environmental and Biological Samples, Claude W. Sill, Forest D. Hindman, and Jesse I. Anderson, USAEC, Idaho Falls, Idaho, (prepublication copy).

4. Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980, Method 900.0, paragraph 4.3.

Screening Procedure to Determine Aliquot Size for Analyses of Water Samples for Gross Alpha and Gross Beta.

1. Introduction.

Water samples contain low concentrations of radioactivity. It is therefore essential to analyze as large a sample aliquot as is needed to meet required detection limits specified in Table 1-4 in Attachment 1. Therefore, this screening procedure must be performed before analyses of samples for Gross Alpha and Gross Beta.

2. Procedure.

To screen water samples for determination of aliquot size weigh a 5/16" stainless steel planchet. Place a 3 ml aliquot of sample on the planchet and place the planchet on a hot plate. Heat the sample to dryness for approximately 30 minutes. Remove from the hot plate and place in a desiccator until cool. Reweigh the sample to obtain amount of solids in the sample and use the following formula to determine an aliquot size for the sample:

$$\frac{M \times SA \times A}{\text{mg solids found}} = \text{aliquot size in ml}$$

where: $M = 5.00\ mg/cm^2$, the maximum solids density thickness required.
$SA = 19.3\ cm^2$, the area of the planchet
$A = 3$ ml, the volume of the aliquot

Result obtained will give the maximum amount of aliquot needed to produce 5 mg/cm^2 solids on a planchet. The maximum volume of aliquot calculated in this procedure is 300 ml. If calculated volumes are less than 300 ml, the volume closest to the next lowest 50 ml increment will be used (i.e. for 222 ml use 200 ml, for 185 ml use 150 ml).

Upon completion of screening procedure, analyze water samples for Gross Alpha and Gross Beta using required methodology specified in Table 1-4 in Attachment 1.

Analysis of Ground Water, Surface Water and Wastewater Samples for Gross Alpha and Gross Beta Radiation

1. For determination of Gross Alpha and Gross Beta activity of samples containing dissolved and suspended solids (< 500 mg/L dissolved solids) use EPA Method 900.0.

2. For determination of Gross Alpha activity of samples containing dissolved and suspended solids (>500 mg/L dissolved solids) use EPA Method A.

3. For determination of Gross Beta activity of samples containing dissolved and suspended solids (>500 mg/L dissolved solids) use EPA Method 900.0. Note: Due to the presence of high dissolved solids content, a smaller aliquot size (five or tens mls) will be taken for analysis.

4. For determination of Gross Alpha and Gross Beta activity of filtered samples (less than 500 mg/L dissolved solids), first filter sample through a 0.45 micron filter and then analyze filtrate by EPA Methode 900.0.

5. For determination of Gross Alpha activity of filtered samples (greater than 500 mg/L dissolved solids), first filter sample through a 0.45 micron filter and analyze filtrate by EPA Method A.

6. For determination of Gross Beta activity of filtered samples (greater than 500 mg/L dissolved solids), first filter sample through a 0.45 micron filter and analyze filtrate by EPA Method 900.0. Note: Due to the presence of high dissolved solids content, a smaller aliquot size (five or ten mls) will taken for analysis.

End 3

ATTACHMENT 2

Attachment 2 details quality assurance/quality control guidelines which are to be strictly followed by contract laboratory to assure generation of good quality data during administration of contract.

I. GENERAL QUALITY CONTROL REQUIREMENTS

The purpose of this document is to provide a uniform set of procedures for the performance of chemical analyses of samples, and verification of the sample data generated. The program will also assist laboratory personnel in recalling and defending their actions under cross examination if required to present court testimony in litigation. The contract laboratory must adhere to the quality control/quality assurance requirements of the contract. For a discussion and a description of analytical quality control, the following references are offered:

1. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", US Environmental Protection Agency, Environmental Monitoring and Support Laboratory EPA-600/4-79-019, March 1979, Cincinnati, OH 45268.

2. "Manual of Analytical Quality Control for Pesticides in Human and Environmental Media", US Environmental Protection Agency, Health Effects Research Laboratory, EPA-600/1-76-017, January 1979, Research Triangle Park, NC 27711.

3. "Industrial Hygiene Laboratory Quality Control Manual", Technical Report No. 78, revised Dec 31, 1976 and July 31, 1979, Division of Physical Sciences and Engineering, National Institute for Occupational Safety and Health, Cincinnati, OH 45226.

The laboratory must adhere to good laboratory practices for laboratory cleanliness as applied to glassware, apparatus and facilities in general; and for reagent preparation and solvent and/or gas usage. Additional guidelines are found in reference 1 listed above. The cost of performing all quality control procedures specified in this attachment is to be included in the price of performing the requested chemical analyses.

II. QUALITY CONTROL REQUIREMENTS

The contract laboratory is encouraged to follow all quality control guidelines and procedures listed in above references. Specific analytical quality control, as well as accuracy and precision requirements are provided as Enclosure 1. Strict adherence to these requirements must be maintained. Nonadherence to the requirements may be grounds for termination of the contract. When additional quality control procedures are specified in the analytical methods, the contractor must also follow these procedures.

Examples of quality control requirements which will be included in contracts follow. Examples of forms for required documentation of QC data are also included as Enclosures 2-4.

A. Inorganics.

The following quality control operations for inorganic analytes must be performed during each daily analytical run:

1. Initial Calibration Verification.

2. Blank Analysis.

3. Duplicate Sample Analysis.

4. Spiked Sample Analysis.

1. Initial Calibration Verification.

Guidelines for instrumental calibration are given in EPA 600/4-79-020. After the systems have been calibrated, the accuracy of the initial calibrating solutions shall be documented for every analyte by the analysis of EPA Reference Standard Solutions [available from EPA, telephone (513) 684-7325], or trace element standard reference material available from National Bureau of Standards, telephone (301) 921-2045).

When measurements for the certified components differ statistically from the accepted value (i.e., exceed the combined accuracy and precision limits in Enclosure 1) and the discrepancy cannot be resolved by using prepared, properly diluted and preserved calibrating standards, the concentration for the calibrating standard stock solution shall be adjusted in acceptable measurements for the certified solution components.

The values for the initial calibration verification shall be recorded on the QC Report form provided as Enclosure 2.

Fresh stock calibrating solutions for each analyte shall be prepared monthly and before each set of existing stock calibration standards is consumed. In order to maintain traceability to the reference standards, old and new sets of calibration standards for each analyte must agree (based on conventional t-test analysis) using data from five(5) alternating measurements on the old and new diluted standards before a new set of calibrating standards is accepted for use.

2. A calibration blank must be analyzed each time an instrument is calibrated.

3. Duplicate Sample Analysis.

At least one duplicate sample analysis shall be performed with each group of samples. If possible, the duplicate analysis should be performed on a sample for which the original result is above the detection limit. The relative percent differences (RPD) for each component are calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

Where RPD = Relative Percent Difference
D_1 = First Sample Value
D_2 = Second Sample Value (duplicate)

The results of the duplicate analysis must be reported on the QC Report Form (Enclosure 2).

If duplicate sample results fail to meet precision criteria, the contractor must implement a previously written contingency plan and resolve the discrepancy. The plan must include the following:

1. Checking of data for calculation and/or transcription errors.

2. Preparation of new standards.

3. Recalibration of instruments.

4. Reanalysis of duplicate samples. If upon reanalysis, results do not meet precision specifications, the contractor is required to contact the COR immediately by telephone for further guidance. If reanalysis of duplicate samples falls within precision specifications, the suspicion exists that the precision specification is not met for the other samples in that group. The contractor is then required to run duplicate analyses of 10 percent of samples or all (whichever is smaller) samples of the group in question. If these duplicate results fall within the precision specification, no further action is needed except to report results. (Note that Contractor is required to report all results, including those that did not fall within the precision specification). If the duplicate results from reanalysis do not fall within the precision specification (taking into consideration the original sample results) then all the samples in the group in question must be reanalyzed.

4. Spiked Sample Analysis.

The spiked sample analysis is designed to provide information about the effect of the sample matrix on the measurement methodology. The spike is added after the digestion. Spiking prior to digestion can be complicated by absorption characteristics of the sample that can confound interpretation of the recovery data; thus, it is added as stated above. At least one spiked sample analysis shall be performed on each group of samples of a similar matrix for each batch of samples received. The analyte spike should be added to obtain one-half to twice the endogenous level. If the sample to be spiked is found to be below the detection limit for analyte of interest, then the sample should be spiked to obtain a minimum of ten times the detection limit. Individual component percent recoveries are calculated as follows:

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

Where: SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

The results of the spiked sample analysis must be reported on the QC Report Form (Enclosure 2). If spiked sample results fail to meet accuracy criteria, the contractor must employ a previously written contingency plan and resolve the discrepancy. The plan must include the following:

1. Checking of data for calculation and/or transcription errors.

2. Preparation of new standards.

3. Recalibration of instruments.

4. Reanalysis of spiked sample.

If upon reanalysis, the spike recovery does not meet accuracy specification, the contractor is required to contact the COR immediately by telephone for further guidance. If upon reanalysis, the spike recovery falls within the accuracy specifications (Enclosure 1), the suspicion exists that the accuracy specification is not met for the other samples of the respective matrix. The contractor is then required to reanalyze 10 percent of the samples or all (whichever is smaller) samples of the matrix in question. If agreement of these results of reanalyses with the original results is within the precision specification (Enclosure 1), no further action is needed except to report results. (Note that contractor is required to report all results including those that did not fall within the accuracy and/or precision specifications). If agreement is not within the precision specification, then all the samples of the matrix in question must be reanalyzed.

NOTE: Cost for all reanalyses brought about by breakdown in internal quality control will be borne by the contractor.

B. ORGANICS.

The following quality control operations for organic analytes must be performed during each daily analytical run:

1. Instrument calibration.

2. GC/MS Performance Tests (Method 624 and 625 only).

3. Reagent Blank Analysis.

4. Surrogate Recovery Analysis (Method 624 and 625 only).

5. Matrix Spiked Duplicate Analysis.

1. Guidelines for instrument calibration are given in Section 7 of EPA Methods 608, 624 and 625.

2. Guidelines for GC/MS Performance Tests are given in Section 10 of EPA Method 624 and Section 12 of EPA Method 625.

3. A reagent blank is a volume of distilled water carried through the entire analytical scheme. The reagent blank volume should be approximately equal to the sample volumes being processed. Reagent blank analysis must be performed with every batch of samples analyzed. The reagent blank is used in all analyses to verify that the determined concentrations do not reflect contamination.

If an organic analyte is detected in the blank, the blank value is utilized in the calculation of the sample according to the following options:

a. If the concentration in the blank is equal to the method detection limit specified in Task Order, the blank value is ignored.

b. If the concentration in the blank is less than or equal to one-half the concentration detected in a sample, the sample value shall be corrected accordingly, for the blank value, and the reported value noted with a "C" in the "Measured Value" column of the reporting form.

c. If the concentration in the blank is greater than one-half the concentration detected in a sample, the compound should be reported as "ND" but with a "B" in the "Measured Value" column of the reporting form. The cause of this high blank should be determined and corrected. After the problem is corrected, the batch of samples which was analyzed with the blank shall be reanalyzed at the contractor's expense.

4. Surrogate standard determinations must be performed on all samples and blanks. All samples and blanks must be fortified before purging or extraction with only those spiking compounds listed in Enclosure 3 to monitor preparation and analysis of sample. Surrogate recovery results will be reported on form (Enclosure 3) and will be evaluated for acceptance by determining whether the measured concentrations fall inside the quality control limits given on form. The surrogate recovery for each component is calculated as follows:

$$\text{Surrogate Recovery} = \frac{Q_d}{Q_a} \times 100\%$$

where: Q_d = quantity determined by analysis

Q_a = quantity added to the sample

Treatment of surrogate recovery information is as follows:

a. If surrogate recovery for a reagent blank is outside the quality control limits, the reagent blank should be reinjected or repurged. If this fails to correct the problem, the analytical system is out of control and must be corrected before continuing.

b. If the sample surrogate recovery is outside the quality control limits listed in Enclosure 3, this must be so noted by an asterisk in the appropriate portion of the form.

c. When the recovery of any one surrogate spiking compound exceeds the quality control limits listed on form, the contractor must employ a previously written contingency plan to identify and resolve the discrepancy. This plan must include the following:

(1) Checking calculation of final results.

(2) Preparation of new internal and surrogate standards.

(3) Recalibration of instrumentation.

(4) Reanalysis of samples. Duplicate samples will be collected by this installation and submitted for this purpose. Cost of reanalysis will be borne by the contract laboratory.

5. Matrix spiked duplicate analysis must be performed on at least one sample from each batch or 5 percent of all samples, whichever is larger. To accomplish this, three additional duplicate samples (one to be held in reserve should reanalysis of the matrix spiked duplicate be necessary) will be collected, submitted, and designated for matrix spiked duplicate analysis. The matrix spike will consist of a standard mix of specific organic compounds. The recoveries of compounds in the spiking mix will provide information about the matrix effect of the sample on the analytical methodology. The results of the matrix spiked duplicate analysis should be reported on a form such as the example given in Enclosure 4. Recoveries for individual components of the matrix spike are calculated as follows:

$$\% \text{ Recovery} = \frac{A - B}{C} \times 100$$

where: A = Spiked Sample Result (ppb)
B = Sample Result (ppb)
C = Spike Added (ppb) from spiking solution

The relative percent differences (RPD) for each component are calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100\%$$

where: RPD = Relative Percent Difference
D_1 = First Spiked Sample Value
D_2 = Second Spiked Sample Value (duplicate)

Treatment of matrix spiked duplicate information is as follows:

a. If matrix spiked recoveries and/or RPD's are outside the quality control limits listed on form (Enclosure 4), this must be so noted by an asterisk in the appropriate portion (% Rec or RPD) of this form.

b. When the recovery and/or RPD of any one compound of the matrix spiking solution exceeds the quality control limits listed on Enclosure 4, the contractor must employ a previously written contingency plan to identify and resolve the discrepancy. This plan must include the following:

(1) Checking calculation of final results.

(2) Preparation of new internal and surrogate standards.

(3) Recalibration of instrumentation.

(4) Reanalysis of matrix spike duplicate.

(5) Reanalysis of all samples analyzed with matrix spike duplicate.

Preparation of Matrix Spike Standard Mix.

Specific volatile, acid, base/neutral and pesticide organic compounds should be weighed out and dissolved in methanol and acetone. The concentration of each compound in the base/neutral, acid and volatile standard mixes should be 5 mg/ml in methanol. The concentration of each compound in the pesticide standard mix should be .5 mg/ml in acetone. The compounds listed below should be used to prepare the standard mixes:

Base/Neutrals Standard Mix

1,2,3-Trichlorobenzene
Acenaphthene
2,6-Dinitrotoluene
Di-n-butyl phthalate
Pyrene
N-Nitroso-di-n-propylamine
1,2-Dichlorobenzene

Acids Standard Mix

Pentachlorophenol
2,Methyl-4,6-Dinitrophenol
2-Chlorophenol
4-Chloro-3-Methylphenol
2-Nitrophenol

Pesticides Standard Mix

Heptachlor	Lindane
Aldrin	Endrin
Dieldrin	PP'DDT

Volatile Standard Mix

Chlorobenzene
1-1-Dichloroethylene
Trichloroethylene
Toluene
Benzene

Preparation of Matrix Spiking Solutions

Base Neutrals

To prepare the matrix spiking solution for the base/neutrals, first prepare a stock solution, then the spiking solution as follows:

Stock Solution: Transfer 1.0 mL of each of the base/neutral compounds listed to the same 10-mL volumetric flask. When the transfer is complete, bring up to volume with methanol and mix well.

Spiking Solution: Transfer 1.0 mL of the stock solution to a 10-mL volumetric flask and bring up to volume with methanol. This will provide a matrix spiking solution of 50 µg/mL. Add 1.0 mL of this solution to each sample replicate that has been designated as a base/neutral matrix spike.

Acids

To prepare the matrix spiking solution for the acid compounds, follow the same protocol as that for the base/neutrals. This will provide a matrix

spiking solution of 50 µg/ml. Add 1.0 mL of this solution to each sample replicate that has been designated as an acid matrix spike.

Volatiles:

To prepare the matrix spiking solution for the volatiles, first prepare a stock solution, then the spiking solution as follows:

Stock Solution: Transfer 0.5 mL of each of the volatiles listed to a 10-mL volumetric flask and bring up to volume with methanol and mix well.

Spiking Solution: Transfer 1.0 mL of the stock solution to a 10 ml volumetric flask and bring up to volume with methanol and mix well. This solution will provide a matrix spiking solution of 25 µg/mL. Spike each sample replicate designated as a volatile matrix spike with 50 µl of this solution.

Pesticides

To prepare the matrix spiking solution for the pesticides, first prepare a stock solution, then the spiking solution as follows:

Stock Solution: Transfer 1.0 mL of each of the pesticides listed to a 10-mL volumetric flask and bring up to volume with methanol and mix well.

Spiking solution: Transfer 1.0 mL of the stock solution to a 10 mL volumetric flask and bring up to volume and mix well. This will provide a matrix spiking solution of 5 µg/mL. Add 1.0 mL of this solution to each sample replicate that has been designated as a pesticide matrix spike.

1. Contractor must be certified by the US Environmental Protection Agency or at least one State Government to conduct radiochemical analyses of drinking water in accordance with the Safe Drinking Water Act (Public Law 93-523). Contractor shall abide by all critical elements and recommended practices for radiochemistry which are identified in Manual for the Certification of Laboratory Analyzing Drinking Water, Criteria and Procedures, Quality Assurance, US Environmental Protection Agency Office of Drinking Water (WH-550), Washington, D.C. 20460, October 1982, EPA-570/9-82-D02. Contractor must participate in the USEPA proficiency testing program conducted by the USEPA Environmental Monitoring and Support Laboratory, Las Vegas, Nevada for those radiochemical procedures included in this contract. Exceptions will be made for those procedures not available in the USEPA program. The proficiency testing program must consist of analyses of both the intercomparison samples and blind performance samples. Contractor must successfully meet USEPA criteria for proficiency testing. Contractor's identification code for the USEPA Proficiency Testing Program must be revealed to COR for monitoring of performance.

2. For analytical quality control procedures the contractor is referred to Handbook For Analytical Quality Control In Radioanalytical Laboratories, US Environmental Protection Agency, Office of Research and Development, Washington, D.C. 20460, August 1977, EPA-600/7-77-088. It is recommended that the contractor follow all the procedures described in this handbook in order to form the basis of an effective quality control system.

3. Accomplishment of the following quality control procedures is mandatory:

a. To minimize cross contamination of samples the contract laboratory must be arranged so that radioactive materials are confined to one area clearly designated as a "Hot" area, to which access is restricted to authorized users of radioactive materials.

b. All dilution of radioactive materials to working concentrations must be performed in an isolated area.

c. Counting instruments must be located in a room isolated from all other laboratory activities. To reduce fluctuations and stabilize background radiation contributions, shielding of all counting instruments is necessary. Thick shields of selected lead or steel with graded liners must be used to reduce measurably the background radiation arising from environmental radioactivity. Background must be reduced further by using anti-coincidence counting techniques. The temperature of the counting room must be kept below 30°C and must not vary by no more than $\pm$3°C. Humidity must be kept between 35 and 70 percent.

d. The contract laboratory must be able to generate, in its own facility, reagent water that meets the requirements to qualify as American Society of Testing and Materials (ASIM), Type II water as described in 1983 Annual Book of ASIM Standards, Part 31, Designation D1193-77, "Standard Specification for Reagent Water." Water of this quality must be used for

all radiochemical procedures included in this contract. Contractor must analyze the reagent water at least weekly and document results to reflect adherence to ASIM requirements. Documentation must be made available to COR during site visits. COR may elect to perform analyses on-site to verify quality of reagent water.

e. Instrument logbooks containing records of usage and servicing must be maintained and kept up-to-date for counting and other laboratory instruments.

f. Standards must be considered invalid and disposed of after passing through 4 half lives from date of certification.

g. A specific check source should be used with each counting system. A source chosen as a check will contain a nuclide or nuclides whose energy of radiation corresponds to the type of analysis for which the counting system is to be used. This source will be counted for a predetermined time before each use of the counting system to determine general performance of the system and to ensure that the efficiency of the system has not changed. The check source must be sealed or encapsulated to prevent loss of the source and contamination of the counting system. The check source-to-detector geometry must be known and held constant. The count rate must be entered in the instrument's logbook and plotted on a statistical quality control chart established for the specific system. This value is compared with the ± 2 sigma (warning) limits and the ± 3 sigma (out-of-control) limits, and the procedure is repeated if the ± 3 sigma boundary is exceeded. Sustained values above the warning levels require appropriate action. A contingency plan must be in place and documented, for all analysts to follow in the event plotted points fall outside ± 2 sigma and/or ± 3 sigma limits.

h. Before each use of a counting system, background for the system must be counted for the same counting time for which samples normally are counted. This value must be entered in the logbook and plotted on a statistical quality control chart established for the specific system. The value is to be compared with established ± 2 and ± 3 sigma limits. A contingency plan must be in place and documented, for all analysts to follow in the event plotted points fall outside the ± 2 sigma and/or ± 3 sigma limits.

i. For alpha and beta counting systems, on a quarterly basis or after electronic repair or modification, the detector plateau for gas-discharge devices must be determined and plotted. All pertinent instrument settings, the source used, and the rate of gas flow must be recorded on the plateau graph which must be attached permanently to the logbook. From this plateau, the operating voltage is selected or verified and the plateau slope at the operating point is calculated. The slope must not exceed 2 percent per 100 volts for a Strontium-90 source. The operating potential is selected as the midpoint of the plateau. Thereafter, the high voltage setting must be checked for drift once every two months.

j. For multichannel gamma spectrometers, the instrument must have a proper energy calibration before instrument efficiency or background counting rates are determined. A multiline reference source must be counted

for a time sufficient to provide acceptable statistics (<1% counting error at 1 sigma). After energy calibration, the check source must be counted for a predetermined time before each use by using a selected energy window.

k. For gamma spectrometry, an energy efficiency curve must be determined annually for each germanium detector system for each geometry with a multiline reference source calibrated by the National Bureau of Standards. The curve for the most frequently used geometry must be checked before each use during the year.

l. All calibration standard solutions must be obtained from the US Environmental Protection Agency or the National Bureau of Standards. Standards must not be used beyond four half-lives of the radionuclides. All reagents must be at least ACS grade or better.

m. At least one duplicate sample analysis must be performed with each group of radiological samples of a specific matrix which are submitted to the contract laboratory for analyses. If possible the duplicate sample analysis should be performed on a sample for which the original result is above the detection limit. The relative percent difference (RPD) is then calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

where RPD = Relative Percent Difference
D_1 = First Sample Value
D_2 = Second Sample Value

The results for the duplicate analysis must be reported on QC form (Enclosure 2). If results for duplicate analyses exceed precision criteria specified in Table (Enclosure 1), the contract laboratory must implement a previously written contingency plan and resolve the discrepancy. The plan must include the following:

a. Check of data for calculation and/or transcription errors.

b. Preparation of new standards.

c. Recalibration of instrumentation.

d. Reanalysis of duplicate samples.

If upon reanalysis results exceed precision criteria, the contractor is required to contact the COR immediately by telephone for further guidance. If reanalysis of duplicate samples generates results which are within precision criteria, the suspicion exists that the precision criteria is not met for the other samples of the respective matrix. The contract laboratory is then required to perform duplicate analyses of 10 percent of

radiological samples or all (whichever is smaller) radiological samples of the sample matrix in question. If these duplicate results are within precision criteria, no further action is required except to report the results. If the duplicate results from reanalysis are not within the precision criteria, then all radiological samples of the matrix in question must be reanalyzed.

n. Internal quality control (QC) samples must be prepared by the Quality Control Coordinator and submitted concurrently with radiological samples of each matrix for analyses. The contract laboratory is required to analyze one QC sample per 10 radiological samples submitted or one QC sample per batch of radiological samples submitted (whichever is smaller) to the contract laboratory. The recoveries for the QC samples must be reported on QC form (Enclosure 2). Results for these recoveries must also be plotted on control charts to visually monitor trends and to visually identify out of control situations. The COR reserves the right to inspect control charts during on site visits. For information on the construction of control charts consult the following reference: "Handbook for Analytical Quality Control in Radioanalytical Laboratories". EPA-600/7-77-088, August, 1977, US Environmental Protection Agency, Washington, D.C. 20460. When recoveries of QC samples exceed accuracy criteria stated in the Table, provided as Enclosure 1, the contract laboratory must employ a previously written contingency plan to resolve the discrepancy. This plan includes the following:

a. Check of data for calculation and/or transcription errors.

b. Preparation of new standards.

c. Recalibration of instrumentation.

d. Reanalysis of QC samples.

If upon reanalysis of the QC sample the recovery exceeds the accuracy criteria, the contract laboratory is required to contact the COR immediately by telephone for further guidance. If upon reanalysis of the QC sample the recovery is within the accuracy criteria, the suspicion exists that the accuracy criteria is not met for the other radiological samples in the batch. The contract laboratory is then required to reanalyze 10 percent of the samples or all (whichever is smaller) radiological samples in question. If agreement of these results for reanalyses with the original results is within the precision criteria stated in Table, no further action is needed except to report results. If agreement is not within the precision criteria, then all radiological samples must be reanalyzed and results reported accordingly.

Cost for all reanalyses caused by breakdown in the internal quality control system will be borne by the contract laboratory.

TABLE. REQUIRED ACCURACY AND PRECISION FOR ANALYSIS

Chemical Analysis	Range of Concentration (mg/l)	Combined Accuracy and Precision Required (+ %)
Aluminum	1.00-100	30
Antimony	0.5-2.0	45
Arsenic	0.01-1.00	30
Barium	0.30-1.00	30
Beryllium	0.05-1.00	21
Boron	10.0-100	45
Cadmium	0.001-1.00	30
Calcium	1.00-100	24
Chromium	0.001-5.00	24
Cobalt	0.20-2.00	30
Copper	0.025-2.00	27
Iron	1.0-50	18
Lead	0.005-5.00	30
Magnesium	0.50-50.0	15
Manganese	0.03-2.00	21
Mercury	0.0002-0.0040	30
Molybdenum	0.50-10	45
Nickel	0.10-2.00	30
Potassium	0.50-5.00	15
Selenium	0.005-0.050	45
Silver	0.025-0.500	30
Sodium	1.00-250	21
Thallium	1.00-10.0	30
Tin	1.00-10.0	30
Titanium	1.00-10.0	30
Vanadium	2.00-10.0	30
Zinc	0.015-10.0	27
Ammonia	0.10 - 50.0	24
Chemical Oxygen Demand	15.0 - 1000	30
Cyanide, Total and Amenable to Chlorination	0.01 - 100	30
Fluoride	0.1 - 10	24
Grease & Oil	1.00 - 1000	18
Moisture	0.1% - 100%	15
Nitrate-Nitrite	0.01 - 100	15
Total Kjeldahl Nitrogen	0.10 - 100	36
Phenol	0.01 - 100	24
Phosphate	0.02 - 1000	24
Sulfate	2.0 - 1000	30
Total Organic Carbon	0.10 - 100	27
Volatile Acids	5 - 100	30

* The accuracy and precision values are given for water samples only at this time, except for moisture, because they do not exist for soil and sludge at present. USAEHA reserves the right to hold contract laboratory to accuracy and precision requirements for soil and sludge as they become available.

Chemical Analysis	Range of Concentration	Combined Accuracy and Precision Required (+%)
Specific Conductance	0.1 - 100,000 µmhos/cm	10
T. Organic Carbon	50 - 100,000 µg/l	18
T. Organic Halogen	10 - 1000 µg/l	20
Acidity	1.0 - 1000	15
Alkalinity	1.0 - 5000	24
Chloride	1.0 - 5000	15
Hardness	1.0 - 500	15
pH	1 - 14 pH units	.2 units
TDS	1 - 100,000	30
TS	1 - 100,000	30
TSS	1 - 100,000	30
TVDS	1 - 100,000	30
TVS	1 - 100,000	30
TVSS	1 - 100,000	30
Turbidity	0.2-200 NTU	30
Settleable Solids	1.0-1000 mg/L	30
Nitrite Nitrogen	0.01-10 mg/L	15
Orthophosphate Phosphorus	0.02-20 mg/L	30
BOD	1.0-1000 mg/L	45
MBAS	0.05-50 mg/L	45
Color	5-500 Color Units	45
Sulfide	0.05-50 mg/L	30
Hexavalent Chromium	0.025-25 mg/L	30
Silica	0.2-200 mg/L	21
2,4,6-TNT	0.001-1.0 mg/L	30
2,4-DNT	0.001-1.0 mg/L	30
2,6-DNT	0.001-1.0 mg/L	30
RDX	0.03-30 mg/L	30
HMX	0.1-100 mg/L	30
Tetryl	0.005-5.0 mg/L	30
Ammonium Picrate (Picric Acid)	0.5-500 mg/L	30
Urea	0.1-100 mg/L	30
Melamine	0.5-500 mg/L	30
Nitroguanidine	0.1-100 mg/L	30

TABLE. REQUIRED ACCURACY AND PRECISION FOR ANALYSIS

Analysis	Range of Concentration (mg/l)	Accuracy Required (%)	Precision Required (%)
Volatile Organic Compounds	0.01 - 100	± 36	± 24
Acid/Base/Neutral Extractable Organic Compounds	0.01 - 100	± 60	± 40
Pesticide Organic Compounds	0.0001 - 100	± 30	± 20

TABLE. REQUIRED ACCURACY AND PRECISION FOR ANALYSIS

Chemical Parameter	Precision*	Accuracy**
Gross Alpha	24	30
Gross Beta	10	20
Tritium	10	20
Strontium 89 & 90	20	30
Radium 226 & 228	20	30
Iodine 131	10	20
Gamma Emitters	10	30
Uranium	24	30
Other Actinides	30	45

* Precision is expressed as two times the Relative Standard Deviation.
** Accuracy is expressed as three times the method Bias.

Lab Name: _____ QC Report No. _____

Sample No's: _____ To _____

Number of Samples: _____

QC REPORT FORM I

Analyte: _____

Method: _____

Unit

Initial Calibration Verification	Reference Standard Source _____	Found: _____ True Value: _____ % Recovery: _____
Duplicate Sample Results	Sample No.: _____	Sample Result: _____ Duplicate Result: _____ RPD% _____
Spiked Sample Results	Sample No: _____	Sample Result: _____ Spike Result: _____ Spike Added: _____ % Recovery: _____

Comments:

Analyst Signature: _____

Date: _____

Data Reviewed and Validated by: _____

Date: _____

Encl 2

QC FORM II

WATER/WASTEWATER SURROGATE RECOVERY +

LAB NAME _____ DATA REVIEWED AND VALIDATED BY _____

ANALYST SIGNATURE _____ DATE _____

	Volatile	Acid/Base/Neutral				
USAEHA SAMPLE NO.	D_8 TOLUENE (84-114)	D_5 NITROBENZENE (42-131)	2-FLUORO BIPHENYL (50-154)	D_5 PHENOL (15-90)	2-FLUORO PHENOL (25-115)	REMARKS

+ Control limits are listed in parentheses for each surrogate compound and are listed in units of percent recovery. These limits are established by the Environmental Protection Agency and are to be used only for monitoring surrogate recovery.

OC FORM III

MATRIX SPIKED DUPLICATE ANALYSIS

LAB NAME _____ DATA REVIEWED AND VALIDATED BY _____

ANALYST SIGNATURE _____ DATE _____

Instrument Group	Compound	Matrix Spike #1 C Concentration Spike Added(ppb)	A Spiked Sample Result (ppb)	B Sample Result (ppb)	A-B Spike Result (ppb)	% Rec	Matrix Spike #2 C Concentration Spike Added(ppb)	A Spiked Sample Result (ppb)	B Sample Result (ppb)	A-B Spike Result (ppb)	% Rec	Ave % Rec	QC Limit Ave % Rec
Volatile Organic Compounds	1, 1 Dichloroethylene												± 36
	Trichloroethylene												± 36
	Chlorobenzene												± 36
	Toluene												± 36
	Benzene												± 36
Base/Neutral Extractable Organic Compounds	1,2,4-Trichlorobenzene												± 60
	Acenaphthene												± 60
	2,6 Dinitrotoluene												± 60
	Di-N-Butylphthalate												± 60
	Fluorene												± 0
	N-Nitrosodiphenylamine												± 60
	1,2 Dichlorobenzene												± 60
	Pentachlorophenol												± 60
Acid Extractable Organic Compounds	2, Ethyl-4, 6 Dinitrophenol												± 60
	2, Chlorophenol												± 60
	4,Chloro-3-Methylphenol												± 60
	2, Nitrophenol												± 60
Pesticide Compounds	Lindane												± 30
	Heptachlor												± 30
	Aldrin												± 30
	Dieldrin												± 30
	Endrin												± 30
	p,p' - DDT												± 30

NOTE: Tabulated values which are outside of QC limit should be indicated by an asterisk.

PART 1

OC FORM III

MATRIX SPIKED DUPLICATE ANALYSIS

LAB NAME _____ DATA REVIEWED AND VALIDATED BY _____

ANALYST SIGNATURE _____ DATE _____

Contaminant Group	Compound	D1 Matrix Spike # 1 Spiked Sample Result	D2 Matrix Spike # 2 Spiked Sample Result	RPD	QC Limit RPD
Volatile Organic Compounds	1,1 Dichloroethylene				± 24
	Trichloroethylene				± 24
	Chlorobenzene				± 24
	Toluene				± 24
	Benzene				± 24
Base/Neutral Extractable Organic Compounds	1,2,4-Trichlorobenzene				± 40
	Acenaphthene				± 40
	2,6 Dinitrotoluene				± 40
	Di-N-Butylphthalate				± 40
	Pyrene				± 40
	N-Nitroso-Di-N-Propylamine				± 40
	1,2 Dichlorobenzene				± 40
Acid Extractable Organic Compounds	Pentachlorophenol				± 40
	2, Methyl-4,6 Dinitrophenol				± 40
	2, Chlorophenol				± 40
	4, Chloro-3-Methylphenol				± 40
	2, Nitrophenol				± 40
Pesticide Organic Compounds	Lindane				± 20
	Heptachlor				± 20
	Aldrin				± 20
	Dieldrin				± 20
	Endrin				± 20
	p,p' - DDT				± 20
	[illegible]				[illegible]

NOTE: Tabulated values which are outside of QC limit should be indicated by an asterisk.

ATTACHMENT 3

Attachment 3 details chain-of-custody procedures which contract laboratory must adhere to during administration of contract.

Specifications for Chain-of-Custody and Document Control Procedures

The Contractor must have written standing operating procedures (SOP) for receipt of samples, maintenance of custody, tracking the analysis of samples and assembly of completed data. These procedures are necessary to ensure that analytical data collected under this contract are acceptable for use in litigation. The Contractor's SOP shall provide mechanisms and documentation to meet each of the following specifications and shall be used by the COR for the basis for laboratory evidence audits.

1. The Contractor shall have a designated sample custodian responsible for receipt of the samples.

2. The Contractor shall have written SOP's for receiving and logging in of the samples. The procedures shall include documentation of the sample condition, maintenance of custody and sample security and documentation of verification of sample tag information against custody records.

3. The Contractor shall have written SOP's for maintenance of the security of the samples after log in and shall demonstrate security of the sample storage and laboratory areas.

4. The Contractor shall have written SOP's for tracking the work performed on any particular sample. The tracking system shall include standard logging formats, logbook entry procedures and a means of controlling logbook pages, computer printouts, and other written or printed documents relevant to the samples. Logbooks, printed forms or other written documentation must be available to describe the work performed in each of the following stages of analysis:

   a. Sample Receipt
   b. Sample Analysis
   c. Data Reduction
   d. Data Reporting

5. The Contractor shall have written SOP's for organization and assembly of all documents relating to analyses of samples for this contract. Documents shall be filed according to sample label numbers. The procedures must ensure that all documents including logbook pages, sample tracking records, measurement readout records, computer printouts, raw data summaries, correspondence and any other written documents having reference to the samples are compiled in one location for submission to the installation. The system must include a document numbering and inventory procedure.

6. Document control and chain-of-custody records include but are not limited to: sample tags, custody records, sample tracking records, analysts logbook pages, bench sheets, measurement readout records, analysis chronicles, computer printouts, raw data summaries, instrument logbook pages, correspondence, and the document inventory.

Chain-of-Custody and Document Control Procedures
for Designated Samples Requiring Such

Sample Control

A sample is physical evidence collected from a facility or from the environment. An essential part of this investigations effort is the control of the evidence gathered. To accomplish this, the following chain-of-custody and document control procedure have been established.

Sample Identification

Each sample bottle shall be labeled with a tag containing the sample number and sample description to identify the contents of the bottle. Additionally, the sample number shall be marked on the outside of any special packaging container to facilitate identification.

Chain-of-Custody Procedures

Because of the nature of the data being collected, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. To maintain and document sample custody, the chain-of-custody procedures described herein are followed.

A sample is under custody if:

1. It is your actual possession, or

2. It is in your view, after being in your physical possession, or

3. It was in your possession and they you locked or sealed it up to prevent tampering, or

4. It is in a secure area.

To assure custody of samples during transport and shipping, each sample within a packaging container is recorded on a chain-of-custody records shown in enclosure 1. Each sample number is recorded, and the number of containers shipped is recorded on the sheets. Also, record the other information regarding the project, samples (or shipper if returning empty bottles), method of shipment and remember to sign and date the sheet. The original custody sheet is then placed inside the package (protected from damage) and the package sealed.

Sample containers, shipping boxes, coolers or other packages will be sealed. The seal must be placed so the container cannot be opened without breaking the seal.

Upon receipt of samples in custody, inspect the package and note any damage to the sealing tape or custody seals. Note on the custody record or other logbook that the seals or locks were intact upon receipt if no tampering or damage appears to have occurred. Open the packages and verify that each

item listed on the sheet is present and correctly identified. If all data and samples are correct, sign and date the "received by Laboratory by" box. In the event errors are noted, record the discrepancies in the remarks column (initial and date each comment) then sign the chain-of-custody record.

Laboratory Document Control

The goal of the Document Control Program is to assure that all documents for a specified group of samples will be accounted for when the group is completed. The program includes a document numbering and inventory procedure for preparation of the specified documentation packages for each case.

Logbooks

All observations and results recorded by the Laboratory but not on pre-printed data sheets are entered into permanent laboratory logbooks. Data recorded are referenced with the sample numbers, date and analyst's signature at the top of the page. Data from only one group or batch of samples are recorded per page. When all the data from a batch is compiled, copies of all logbook entries must be included in the documentation package.

Instrument logs are also limited to one sample group per page with the group sample numbers recorded at the top of each page. Copies of these logs must also be included in the final documentation package.

Corrections to Documentation

All documentation in logbooks and other documents shall be in ink. If an error is made in a logbook assigned to one individual, that person should make corrections simply by crossing a line through the error and entering the correct information. Changes made subsequently are dated and initialed. Corrections made to other data records or nonpersonal logbooks are made by crossing a single line through the error, entering the correct information and initialing and dating the correction.

Consistency of Documentation

Before releasing analytical results, the laboratory assembles and cross checks the information on sample tags, custody records, lab bench sheets, personal and instrument logs and other relevant data to ensure that data pertaining to each particular sample or group of samples is consistent throughout the record.

Document Numbering and Inventory Procedure

In order to provide document accountability of the completed analysis records, each item is inventoried and assigned an identifier associating it to sample label numbers.

All documents relevant to each sample group including: logbook pages, bench sheets, custody records, etc., are inventoried. Each data generator (analyst) is responsible for ensuring that all documents generated are placed in the file for inventory and returned to the installation. Enclosure 2 is an example of a document inventory.

CHAIN OF CUSTODY RECORD

INSTALLATION			COLLECTION DATE/TIME			TYPE OF SAMPLE
SITE IDENTIFICATION			ANALYTICAL QUALITY ASSURANCE OFFICE NUMBER			LABORATORY NUMBER
RELINQUISHED BY SIGNATURE	DATE	TIME	RECEIVED BY SIGNATURE	DATE	TIME	ANALYSES PERFORMED BY RECEIVER

3.5

Exhibit

1. Sample traffic records, weekly reports.

2. Custody records, sample tags, sample loop.

3. Laboratory logbooks, personal logbooks, instrument logbooks.

4. Laboratory data (sorted by sample), calibration and quality control results.

5. Data summaries and reports.

6. All other documents, forms or records referencing the samples.

ATTACHMENT 4

Attachment 4 delineates data reporting procedures to be used by the contract laboratory(s).

The contract laboratory(s) shall report data to the installation and to USAEHA. Data reports shall include both hard copy and soft copy as described below. Note that some installations may not wish to receive soft copy data.

1. HARD COPY DATA PACKAGE. Data report package for analyses of each sample (including all required QC-Attachment 2) shall include:

a. Tabulated results in appropriate units of the analytes specified in the contract, validated and signed in original signature by the Laboratory Manager. *Data are to be identified by sample numbers.

b. Analytical results for quality control samples.

c. Tabulation of current calculated instrument detection limits as determined by the laboratory.

d. Legible photocopy of raw data (measurement readout record) with sufficient information to unequivocally identify:

(1) calibration standards (including prep date)

(2) laboratory reagent blanks

(3) samples and any atypical dilution

(4) quality control samples

(5) any instrument adjustments or apparent anomalies on the measurement record. Information shall include a key to abbreviations, with response units stated.

2. SOFT COPY DATA PACKAGE.

a. Hardware. All results for field samples shall be reported to the installation (where requested) and USAEHA on 5 1/4-inch floppy disks. The laboratory shall maintain the original disk and at least one backup disk, in addition to the disks used for reporting. Disks shall be mailed in packaging that will protect them from bending or scratching. If a disk is damaged in transport, another copy of that disk shall be provided by the laboratory. All disks submitted to USAEHA will be returned to the laboratory for reuse.

* In the event the Laboratory Manager cannot validate all data reported for each sample, he/she will provide a detailed description of the problems associated with the sample.

b. Software. The data shall be entered into ASCII files only. Each result shall comprise one data record. The format to be used for chemical data records is as follows:

Chemical Data Records

Card Columns	Field Width	Type Spec	Just	Entry
1-6	6	I6	L	Installation number (see enclosure 1 for installation codes).
7-12	6	I6	L	Parameter code (see enclosure 2 for parameter codes and numbers).
		or		
		I6	R	Parameter number The parameter code and number are as defined in file RG2GN$D.PARAM (enclosure 2).
13-20	8	A6,A2	L	Entry to identify method of analysis.
21-22	2	A2	L	Code to identify performing laboratory: XX - lab codes to be designated by COR For example, EH - Army Environmental Hygiene Agency
23-25	3	A3	L	Units code as defined in file RG2GN$D.PARAM.
26-27	2	A2	L	Filtering coded (0.45 micron filter size): U - unfiltered F - filtered FP - filtered with pressure apparatus FV - filtered with vacuum apparatus
28-29	2	A2	L	Sample type: GW - ground water SW - surface water
30-31	2	A2	L	Sampling method code (to be added by installation if desired).
32-36	5	I5		Sampling date (Julian)
37-41	5	A5	L	Well ID (Sampling site ID)
42	1	A1		Detection code; b if parameter detected, otherwise "<".
43-51	9	F9.3		Value detected or detection limit if none detected.
52-80	29	4A6,A5	L	Comments as appropriate.

FILE RG2GN$D.NAME
FILE FORMAT SPECIFICATIONS ARE PROVIDED AS PAGE 3 OF THIS ENCLOSURE

```
 1:109804CTSTRATFORD AEP, CT
 2:121478KYFT KNOX, KY
 3:121506KYLEXINGTON-BLUE GRASS AD, KY
 4:124004MDABERDEEN PROVING GROUND, MD
 5:125176MAFT DEVENS, MA
 6:134201NJFT DIX, NJ
 7:134693NJPICATINNY ARSENAL, NJ
 8:136216NYFT ORUM, NY
 9:136794NYSENECA AD, NY
10:136939NYWATERVLIET ARSENAL, NY
11:136953NYWEST POINT MILITARY ACADEMY, NY
12:139729OHRAVENNA AAP, OH
13:142394PAFT INDIANTOWN GAP, PA
14:142461PALETTERKENNY AD, PA
15:151389VAFT AP HILL, VA
16:151693VAFT PICKETT, VA
17:151724VARADFORD AAP, VA
18:301035ALANNISTON AD, AL
19:301750ALREDSTONE ARSENAL, AL
20:301767ALFT RUCKER, AL
21:313048GAFT GILLEM, GA
22:313355GAFT GORDON, GA
23:313834GAFT STEWART, GA
24:321128KYFT CAMPBELL, KY
25:347408TNHOLSTON AAP, TN
26:347580TNMILAN AAP, TN
27:347927TNVOLUNTEER AAP, TN
28:417432ILJOLIET AAP, IL
29:417800ILSAVANNA ADA, IL
30:418173INCRANE NWSC, IN
31:418351INFT BENJAMIN HARRISON, IN
32:418393ININDIANA AAP, IN
33:418403INJEFFERSON PROVING GROUND, IN
34:418611INNEWPORT AAP, IN
35:419422IAIOWA AAP, IA
36:420736KSFT RILEY, KS
37:420785KSSUNFLOWER AAP, KS
38:427887MNTWIN CITIES AAP, MN
39:429494MOLAKE CITY AAP, MO
40:455057WIBADGER AAP, WI
41:455533WIFT MCCOY, WI
42:505698ARPINE BLUFF ARSENAL, AR
43:522543LALOUISIANA AAP, LA
44:522722LAFT POLK, LA
45:540548OKMCALESTER AAP, OK
46:540801OKFT SILL, OK
47:548513TXLONE STAR AAP, TX
48:548515TXLONGHORN AAP, TX
49:548733TXRED RIVER AD, TX
50:602736AKFT RICHARDSON, AK
51:602955AKFT WAINWRIGHT, AK
52:606742CARIVERBANK AAP, CA
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53:606886CADEFENSE DEPOT TRACY, CA
54:608135COFT CARSON, CO
55:608728COPUEBLO AD, CO
56:608760COROCKY MOUNTAIN ARSENAL, CO
57:632350NVHAWTHORNE AAP, NV
58:641899ORUMATILLA ADA, OR
59:649150UTDEFENSE DEPOT OGDEN, UT
60:649878UTTOOELE AD, UT

RG2GN$D.NAME

Card Columns	Field Width	Type Spec	Just	Entry
1-6	6	I6		Installation number (region code + ARLOC).
7-8	2	A2		State abbreviation.
9-80	72	12A6	L	Installation name.

FILE RG2GN$D.PARAM
FILE FORMAT SPECIFICATIONS ARE PROVIDED AS PAGE 8 OF THIS ENCLOSURE.

```
 1:000101AS     ARSENIC      F9.3      .01 MGLF 1. 6M ARSENIC
 2:000102BA     BARIUM       F9.2      .05 MGLF 1. 6M BARIUM
 3:000103CD     CADMIUM      F9.3      .001MGLF 1. 6M CADMIUM
 4:000104CR     CHROMIUM     F9.3      .001MGLF 1. 6M CHROMIUM
 5:000105F      FLUORIDE     F9.1      .1  MGL 28.28D FLUORIDE
 6:000106PB     LEAD         F9.3      .005MGLF 1. 6M LEAD
 7:000107HG     MERCURY      F9.1      .2  UGLF 5.28D MERCURY
 8:000108NO2NO3NO2+NO3 AS NF9.2        .01 MGL 20.28D NITRATE + NITRITE AS NITRDGEN
 9:000109SE     SELENIUM     F9.3      .005MGLF 1. 6M SELENIUM
10:000110AG     SILVER       F9.3      .001MGLF 1. 6M SILVER
11:000111ENDRINENDRIN        F9.2      .04 UGLF 2. 7D ENDRIN
12:000112LINDANLINDANE       F9.2      .08 UGLF 2. 7D LINDANE
13:000113TOXAPHTOXAPHENE     F9.1     1.6  UGLF 2. 7D TOXAPHENE
14:000114METHOXMETHOXYCHLORF9.1        1 6  UGLF 2. 7D METHOXYCHLOR
15:00011524D    2,4-D        F9.1      3 8  UGLF 2. 7D 2,4-D
16:000116SILVEXSILVEX        F9.1        5  UGLF 2. 7D SILVEX
17:000117GALPHAGROSS ALPHA   F9.2      0 4  PCLF 4  6M GROSS ALPHA
18:000118RAD226RADIUM 226    F9.2        05 PCLF 4  6M RADIUM-226
19:000119RAD228RADIUM 228    F9.2        70 PCLF 4  6M RADIUM-228
20:000120GBETA GROSS BETA    F9.2      1 1  PCLF 4. 6M GROSS BETA
21:000121STRN90STRONTIUM 90F9.1        0 7  PCLF 4     STRONTIUM-90
22:000122TRITIUTRITIUM       F9.0    550.   PCLF 4     TRITIUM
23:000123URAN   URANIUM      F9.2      0.3  PCLF 4  6M URANIUM
24:000124TH-234THORIUM 234   F9.2      0.3  PCLF       THORIUM-234
25:000126TURB   TURBIDITY    F9.0      1.0  NTUU25 48H TURBIDITY
26:000127TCBACTTOTCOLBACT    F9.0      1.   PHMU   6H TOTAL COLOFORM BACTERIA
27:000128FCBACTFECCOLBACT    F9.0      1.   PHMU   6H FECAL COLOFORM BACTERIA
28:000151CL     CHLORIDE     F9.1      1.0  MGL 14.28D CHLORIDE
29:000152FE     IRON         F9.2       .02 MGLF 1. 6M IRON
30:000153MN     MANGANESE    F9.3       .001MGLF 1. 6M MANGANESE
31:000154PHENOLPHENOL        F9.2       .01 MGLF19.28D TOTAL RECOVERABLE PHENOLICS
32:000155NA     SODIUM       F9.0      1.   MGLF 1. 6M SODIUM
33:000156SO4    SULFATE      F9.1      2.0  MGL 14.28D SULFATE
34:000169CONDFDCOND(FIELD)   F9.0      1.0  UMCU    2H SPECIFIC CONDUCTIVITY(FIELD)
35:000170PH     PH(FIELD)    F9.1           PH U    2H PH(FIELD)
36:000171PH-LABPH(LAB)       F9.1           PH U22     PH(LAB)
37:000172COND   SPEC COND    F9.0      1.0  UMCU22.28D SPECIFIC CONDUCTIVITY
38:000173TOC    TOC          F9.1       .1  MGLF17.28D TOTAL ORGANIC CARBON
39:000174TOX    TOX          F9.3     0.01  MGLU 3. 7D TOTAL ORGANIC HALIDE
40:000175POX    POX          F9.3     0.01  MGLU 3  7D PURGEABLE ORGANIC HALIDE
41:000176NPOX   NPOX         F9.3     0.01  MGLU 3  7D NON-PURGEABLE ORGANIC HALIDE
42:000177TOC-UFTOC(UNFILT)   F9.1      1.   MGLU18 28D TOTAL ORGANIC CARBON(UNFILTERED SAMPLE)
43:000181COD    COD          F9.0     13.   MGL 20 28D CHEMICAL OXYGEN DEMAND
44:000182TEMP   TEMPERATURE  F9.0           C  U    OH TEMPERATURE
45:000183TDS    TDS          F9.0      1.   MGLU24 14D TOTAL DISSOLVED SOLIDS
46:000184TSS    SUSP SOLIDS  F9.0      1.   MGLU23  7D TOTAL SUSPENDED SOLIDS
47:000185TS     TOT SOLIDS   F9.0      1.   MGLU24 14D TOTAL SOLIDS
48:000186ACID   ACIDITY                    U26 14D ACIDITY
49:000187T-ALK  TOTAL ALK    F9.0      2.   MGLU26 14D TOTAL ALKALINITY
50:000188HARD   HARDNESS     F9.0      2.   MGLF27  6M HARDNESS
51:000189RCL    CHLORINE     F9.1       .05         2H TOTAL RESIDUAL CHLORINE
52:000190HARD-CHARD(CALCUL)F9.1        0.3  MGLF 1  6M CALCULATED HARDNESS
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53:000191SETSOL	SET SOLIDS	F9.0	1.	MGLU25	7D	SETTLEABLE SOLIDS
54:000192P-ALK	PHENTHLN ALK	F9.0	1.	MGLU	14D	PHENOLPHTHALEIN ALKALINITY
55:000201N03-N	NITRATE-N	F9.2	.01	MGL 15	48H	NITRATE AS NITROGEN
56:000202N02-N	NITRITE-N	F9.2	.01	MGL 15	48H	NITRITE AS NITROGEN
57:000203NH3-N	AMMONIA-N	F9.2	.05	MGL 20	28D	AMMONIA AS NITROGEN
58:000204TKN	TOT KJEL N	F9.2	.1	MGL 20	28D	TOTAL KJELDAHL NITROGEN
59:000211P04-P	PHOSPHATE-P	F9.2	.02	MGL 20	28D	TOTAL PHOSPHATE AS PHOSPHORUS
60:000212OP04-P	ORTHO PHOS-P	F9.2	.02	MGL 15	48H	ORTHOPHOSPHATE AS PHOSPHORUS
61:000221BOD-5	BOD-5 DAY	F9.0	1.	MGLF10	48H	5-DAY BIOCHEMICAL OXYGEN DEMAND
62:000225OG	GREASE + OIL	F9.1	.2	MGLU 9	28D	OIL AND GREASE
63:000226MBAS	SURFACTANTS	F9.2	.05	MGLF16	48H	SURFACTANTS
64:000231COLOR	COLOR	F9.0	5.	CU F16	48H	COLOR
65:000232ODOR	ODOR	F9.0	1.	TONU		ODOR
66:000233TASTE	TASTE			U		TASTE
67:000251CN	CYANIDE	F9.2	.01	MGL 7	14D	TOTAL CYANIDE
68:000261S	SULFIDE	F9.2	.05	MGL 8	28D	SULFIDE
69:000281CU	COPPER	F9.3	.025	MGLF 1	6M	COPPER
70:000282ZN	ZINC	F9.2	.015	MGLF 1	6M	ZINC
71:000283HEXCR	HEX CHROMIUM	F9.2	.05	MGLF 6	48H	HEXAVALENT CHROMIUM
72:000284K	POTASSIUM	F9.2	.1	MGLF 1	6M	POTASSIUM
73:000285MG	MAGNESIUM	F9.2	.02	MGLF 1	6M	MAGNESIUM
74:000286CA	CALCIUM	F9.1	.1	MGLF 1	6M	CALCIUM
75:000287NI	NICKEL	F9.2	.01	MGLF 1	6M	NICKEL
76:000288V	VANADIUM	F9.1	.025	MGLF 1	6M	VANADIUM
77:000289SB	ANTIMONY	F9.3	.003	MGLF 1	6M	ANTIMONY
78:000290BE	BERYLLIUM	F9.2	.001	MGLF 1	6M	BERYLLIUM
79:000291TL	THALLIUM	F9.2	.001	MGLF 1	6M	THALLIUM
80:000292B	BORON	F9.2	0.05	MGLF 1	6M	BORON
81:000293CO	COBALT	F9.1	.1	MGLF 1	6M	COBALT
82:000294AL	ALUMINUM	F9.1	.01	MGLF 1	6M	ALUMINUM
83:000295SIO2	SILICA	F9.2	.20	MGLF11	28D	SILICA
84:000296SN	TIN	F9.2	.50	MGLF 1	6M	TIN
85:000297MO	MOLYBDENUM	F9.2	.50	MGLF 1	6M	MOLYBDENUM
86:000401246TNT	2,4,6-TNT	F9.3	.001	MGLF12		2,4,6-TRINITROTOLUENE
87:000402246DNT	2,4-DNT	F9.3	.001	MGLF12		2,4-DINITROTOLUENE
88:000403246DNT	2,6-DNT	F9.3	.001	MGLF12		2,6-DINITROTOLUENE
89:000404RDX	RDX	F9.3	.03	MGLF12		RDX
90:000405HMX	HMX	F9.3	.10	MGLF12		HMX
91:000406TETRYL	TETRYL	F9.3	.01	MGLF12		TETRYL
92:000407TNR	TNR	F9.0	.	MGLF12		TRINITRORESORCINOL
93:000408NH4PIC	AMMONPICRATE	F9.0	10.	UGLF12		AMMONIUM PICRATE
94:000409NQ	NQ	F9.1	0.5	MGL 37		NITROGUANIDINE
95:000410GUANN	GUAN NITRATE	F9.1	1.0	MGL 37		GUANIDINE NITRATE
96:000420THIODG	THIODIGLYCOL	F9.1	15.0	MGL 13		THIODIGLYCOL
97:000430UREA	UREA	F9.2		MGL 36		UREA
98:000431MELAMN	MELAMINE	F9.2		MGL 37		MELAMINE
99:000432FORM	FORMALDEHYDE	F9.2		MGL 38		FORMALDEHYDE
100:000501METHAN	METHANOL	F9.0	40.	UGLU		METHANOL
101:000502ETHAN	ETHANOL	F9.0	200.	UGLU		ETHANOL
102:000503ETHER	ETHER	F9.0	1.	UGLU		ETHER
103:000504ACETO	ACETONE	F9.0	5.	UGLU		ACETONE
104:000505A505	ETHYL HEXAN	F9.0	5.	UGL		ETHYL HEXANOL
105:000506A506	2-PROPANOL	F9.0	5.	UGL		2-PROPANOL
106:000601P601	ACENAPHTHENE	F9.0	10.	UGL		ACENAPHTHENE
107:000602P602	ACROLEIN	F9.0	.	UGLU		ACROLEIN
108:000603P603	ACRYLONITR	F9.0	.	UGLU		ACRYLONITRILE
109:000604P604	BENZENE	F9.0	3.	UGLU		BENZENE

110:000605P605	BENZIDINE	F9.0	10.	UGL	BENZIDINE
111:000606P606	CCL4	F9.0	3.	UGLU	CARBON TETRACHLORIDE
112:000607P607	C6H5CL	F9.0	3.	UGLU	CHLOROBENZENE
113:000608P608	124CLBENZENE	F9.0	10.	UGLU	1,2,4-TRICHLOROBENZENE
114:000609P609	C6CL6	F9.0	10.	UGL	HEXACHLOROBENZENE
115:000610P610	CH2CLCH2CL	F9.0	3.	UGLU	1,2-DICHLOROETHANE
116:000611P611	CH3CCL3	F9.0	3.	UGLU	1,1,1-TRICHLOROETHANE
117:000612P612	CL6ETHANE	F9.0	10.	UGLU	HEXACHLOROETHANE
118:000613P613	CH3CHCL2	F9.0	3.	UGLU	1,1-DICHLOROETHANE
119:000614P614	CH2CLCHCL2	F9.0	3.	UGLU	1,1,2-TRICHLOROETHANE
120:000615P615	CHCL2CHCL2	F9.0	3.	UGLU	1,1,2,2-TETRACHLOROETHANE
121:000616P616	CHLOROETHANE	F9.0	3.	UGLU	CHLOROETHANE
122:000617P617	BCLMETHER	F9.0	10.	UGL	BIS(CHLOROMETHYL)ETHER
123:000618P618	B2CLETHETHER	F9.0	10.	UGL	BIS(2-CHLOROETHYL)ETHER
124:000619P619	2CLETHVINETH	F9.0	3.	UGLU	2-CHLOROETHYLVINYL ETHER
125:000620P620	2CLNAPHTH	F9.0	10.	UGL	2-CHLORONAPHTHALENE
126:000621P621	246CLPHENOL	F9.0	25.	UGL	2,4,6-TRICHLOROPHENOL
127:000622P622	4CL3MPHENOL	F9.0	25.	UGL	4-CHLORO-3-METHYLPHENOL
128:000623P623	CHLOROFORM	F9.0	3.	UGLU	CHLOROFORM
129:000624P624	2CLPHENOL	F9.0	25.	UGL	2-CHLOROPHENOL
130:000625P625	12C6H4CL2	F9.0	10.	UGL	1,2-DICHLOROBENZENE
131:000626P626	13C6H4CL2	F9.0	10.	UGL	1,3-DICHLOROBENZENE
132:000627P627	14C6H4CL2	F9.0	10.	UGL	1,4-DICHLOROBENZENE
133:000628P628	33CLBENZI	F9.0	10.	UGL	3,3'-DICHLOROBENZIDINE
134:000629P629	CH2CCL2	F9.0	3.	UGLU	1,1-DICHLOROETHYLENE
135:000630P630	CHCLCHCL	F9.0	3.	UGLU	TRANS 1,2-DICHLOROETHYLENE
136:000631P631	24CLPHENOL	F9.0	25.	UGL	2,4-DICHLOROPHENOL
137:000632P632	CH3CHCLCH2CL	F9.0	3.	UGLU	1,2-DICHLOROPROPANE
138:000633P633	CHCLCHCH2CL	F9.0	3.	UGLU	TRANS 1,3-DICHLOROPROPENE
139:000634P634	24MPHENOL	F9.0	25.	UGL	2,4-DIMETHYLPHENOL
140:000637P637	12PHHYDRAZ	F9.0	10.	UGL	1,2-DIPHENYLHYDRAZINE
141:000638P638	ETHYLBENZENE	F9.0	3.	UGLU	ETHYLBENZENE
142:000639P639	FLUORANTHENE	F9.0	10.	UGL	FLUORANTHENE
143:000640P640	4CLPHPHETHER	F9.0	10.	UGL	4-CHLOROPHENYL PHENYL ETHER
144:000641P641	4BRPHPHETHER	F9.0	10.	UGL	4-BROMOPHENYL PHENYL ETHER
145:000642P642	B2CLISPETHER	F9.0	10.	UGL	BIS(2-CHLOROISOPROPYL)ETHER
146:000643P643	B2CLETHXMETH	F9.0	10.	UGL	BIS(2-CHLOROETHOXY)METHANE
147:000644P644	CH2CL2	F9.0	3.	UGLU	METHYLENE CHLORIDE
148:000645P645	CH3CL	F9.0	3.	UGLU	CHLOROMETHANE
149:000646P646	BROMOMETHANE	F9.0	3.	UGLU	BROMOMETHANE
150:000647P647	BROMOFORM	F9.0	3.	UGLU	BROMOFORM
151:000648P648	CHBRCL2	F9.0	3.	UGLU	BROMODICHLOROMETHANE
152:000649P649	CFCL3	F9.0	3.	UGLU	TRICHLOROFLUOROMETHANE
153:000650P650	CF2CL2	F9.0	3.	UGLU	DICHLORODIFLUOROMETHANE
154:000651P651	CHBR2CL	F9.0	3.	UGLU	CHLORODIBROMOMETHANE
155:000652P652	HEXCLBUTDIEN	F9.0	10.	UGL	HEXACHLOROBUTADIENE
156:000653P653	HXCLCYCPENDI	F9.0	10.	UGL	HEXACHLOROCYCLOPENTADIENE
157:000654P654	ISOPHORONE	F9.0	10.	UGL	ISOPHORONE
158:000655P655	NAPHTHALENE	F9.0	10.	UGL	NAPHTHALENE
159:000656P656	NITROBENZENE	F9.0	10.	UGL	NITROBENZENE
160:000657P657	2NPHENOL	F9.0	25.	UGL	2-NITROPHENOL
161:000658P658	4NPHENOL	F9.0	25.	UGL	4-NITROPHENOL
162:000659P659	24NPHENOL	F9.0	250.	UGL	2,4-DINITROPHENOL
163:000660P660	46N2MPHENOL	F9.0	250.	UGL	4,6-DINITRO-2-METHYLPHENOL
164:000661P661	NNDMAMINE	F9.0	10.	UGL	N-NITROSODIMETHYLAMINE
165:000662P662	NNDPHAMINE	F9.0	10.	UGL	N-NITROSODIPHENYLAMINE
166:000663P663	NNDNPAMINE	F9.0	10.	UGL	N-NITROSODI-N-PROPYLAMINE

167:000664P664	PENTCLPHENOLF	9.0	25.	UGL	PENTACHLOROPHENOL
168:000665P665	PHENOL(AE) F	9.0	25.	UGL	PHENOL
169:000666P666	B2ETHHEXPHTHF	9.0	10.	UGL	BIS(2-ETHYLHEXYL)PHTHALATE
170:000667P667	BUTBENPHTH F	9.0	10.	UGL	BUTYL BENZYL PHTHALATE
171:000668P668	DNBUTPHTH F	9.0	10.	UGL	DI-N-BUTYL PHTHALATE
172:000669P669	DNOCTPHTH F	9.0	10.	UGL	DI-N-OCTYL PHTHALATE
173:000670P670	DIETHPHTH F	9.0	10.	UGL	DIETHYL PHTHALATE
174:000671P671	DIMETHPHTH F	9.0	10.	UGL	DIMETHYL PHTHALATE
175:000672P672	BEN(A)ANTH F	9.0	10.	UGL	BENZO(A)ANTHRACENE
176:000673P673	BEN(A)PYR F	9.0	10.	UGL	BENZO(A)PYRENE
177:000674P674	BEN(B)FLUOR F	9.0	10.	UGL	BENZO(B)FLUORANTHENE
178:000675P675	BEN(K)FLUOR F	9.0	10.	UGL	BENZO(K)FLUORANTHENE
179:000676P676	CHRYSENE F	9.0	10.	UGL	CHRYSENE
180:000677P677	ACENAPHTHYLEF	9.0	10.	UGL	ACENAPHTHYLENE
181:000678P678	ANTHRACENE F	9.0	10.	UGL	ANTHRACENE
182:000679P679	BEN(GHI)PERYF	9.0	25.	UGL	BENZO(GHI)PERYLENE
183:000680P680	FLUORENE F	9.0	10.	UGL	FLUORENE
184:000681P681	PHENANTHRENEF	9.0	10.	UGL	PHENANTHRENE
185:000682P682	DBEN(AH)ANTHF	9.0	25.	UGL	DIBENZO(A,H)ANTHRACENE
186:000683P683	IND123CDPYR F	9.0	25.	UGL	INDENO(1,2,3-CD)PYRENE
187:000684P684	PYRENE F	9.0	10.	UGL	PYRENE
188:000685P685	CCL2CCL2 F	9.0	3.	UGLU	TETRACHLOROETHYLENE
189:000686P686	TOLUENE F	9.0	3.	UGLU	TOLUENE
190:000687P687	CHCLCCL2 F	9.0	3.	UGLU	TRICHLOROETHYLENE
191:000688P688	CH2CHCL F	9.0	3.	UGLU	VINYL CHLORIDE
192:000689P689	ALDRIN F	9.2	.16	UGL	ALDRIN
193:000690P690	DIELDRIN F	9.2	.24	UGL	DIELDRIN
194:000691P691	CHLORDANE F	9.1	1.	UGL	CHLORDANE
195:000692P692	4,4'-DDT F	9.1	0.60	UGL	4,4'-DDT
196:000693P693	4,4'-DDE F	9.1	0.40	UGL	4,4'-DDE
197:000694P694	4,4'-DDD F	9.1	0.40	UGL	4,4'-DDD
198:000695P695	ENDOSULFAN IF	9.1	50.	UGL	ENDOSULFAN I
199:000696P696	ENDOSULFANIIF	9.1	50.	UGL	ENDOSULFAN II
200:000697P697	ENDOS SULF F	9.1	50.	UGL	ENDOSULFAN SULFATE
201:000699P699	ENDRIN ALD F	9.1	50.	UGL	ENDRIN ALDEHYDE
202:000700P700	HEPTACHLOR F	9.2	.06	UGL	HEPTACHLOR
203:000701P701	HEPTACHLEPOXF	9.2	.16	UGL	HEPTACHLOR EPOXIDE
204:000702P702	ALPHA-BHC F	9.1	20.	UGL	ALPHA-BHC
205:000703P703	BETA-BHC F	9.1	20.	UGL	BETA-BHC
206:000704P704	DELTA-BHC F	9.1	20.	UGL	DELTA-BHC
207:000706P706	PCB-1242 F	9.1	50.	UGL	PCB-1242
208:000707P707	PCB-1254 F	9.1	50.	UGL	PCB-1254
209:000708P708	PCB-1221 F	9.1	50.	UGL	PCB-1221
210:000709P709	PCB-1232 F	9.1	50.	UGL	PCB-1232
211:000710P710	PCB-1248 F	9.1	50.	UGL	PCB-1248
212:000711P711	PCB-1260 F	9.1	50.	UGL	PCB-1260
213:000712P712	PCB-1016 F	9.1	50.	UGL	PCB-1016
214:000713P713	WHATTHEHELL F	9.1	3.	UGL	CIS 1,3-DICHLOROPROPENE
215:000714P714	1,2-DCLETHY F	9.1	3.	UGL	CIS 1,2-DICHLOROETHYLENE
216:000715A715	MALATHION F	9.1	1.6	UGL	MALATHION
217:000716A716	PARATHION F	9.1	0.4	UGL	PARATHION
218:000717A717	METHYL PARA F	9.1	0.6	UGL	METHYL PARATHION
219:000718A718	DIAZINON F	9.1	1.0	UGL	DIAZINON
220:000719A719	CHLORDANE(T)F	9.1	1.2	UGL	CHLORDANE (TECH)
221:000720A720	CIS-CHLOR F	9.2	.16	UGL	CIS-CHLORDANE
222:000721A721	TRANS-CHLOR F	9.2	.16	UGL	TRANS-CHLORDANE
223:000722A722	OXYCHLORDANEF	9.2	.16	UGL	OXYCHLORDANE

224:000723A723	2,4,5-T	F9.1	.5	UGL	2,4,5-T
225:000724A724	CHLORPYRIFOS	F9.2	.24	UGL	CHLORPYRIFOS
226:000725A725	RONNEL	F9.1	.2	UGL	RONNEL
227:000726A726	DDT	F9.1	.6	UGL	DDT
228:000727A727	DDD	F9.1	.4	UGL	DDD
229:000728A728	DDE	F9.1	.4	UGL	DDE
230:000729A729	BHC	F9.1	.2	UGL	BHC
231:000730A730	PCB(54 & 60)	F9.1	.8	UGL	PCB (AROCLOR 1254 & 1260)
232:000731A731	TEP	F9.0	10.	UGL	TRIETHYL PHOSPHATE
233:000732A732	QUINOLINE	F9.0	10.	UGL	QUINOLINE
234:000733A733	ISOQUINOLINE	F9.0	10.	UGL	ISOQUINOLINE
235:000734A734	CRESOL	F9.0	25.	UGL	CRESOL
236:000735A735	4,6-DN-O-CRE	F9.0	25.	UGL	4,6-DINITRO-O-CRESOL
237:000736A736	3,4-BENZOFL	F9.0	25.	UGL	3,4-BENZOFLUORANTHENE
238:000737A737	P-CHL-M-CRE	F9.0	25.	UGL	P-CHLORO-M-CRESOL
239:000738A738	PHTHALATES	F9.0	10.	UGL	PHTHALATES
240:000739A739	HYDROCARBONS	F9.0	10.	UGL	HYDROCARBONS
241:000740A740	FREON 112	F9.0	3.	UGL	TETRACHLORODIFLUOROETHANE
242:000741A741	CS2	F9.0	3.	UGL	CARBON DISULFIDE
243:000800A800	2,4' DDE	F9.0	0.40	UGL	2,4'-DDE
244:000801MIREX	MIREX	F9.2	.04	UGL	MIREX
245:000802A802	2,4'-DDT	F9.1	0.60	UGL	2,4'-DDT
246:000803A803	2,4'-DDD	F9.1	0.40	UGL	2,4'-DDD
247:000804A804	TETRAHYDROF	F9.1	3.	UGL	TETRAHYDROFURAN
248:000805A805	MEK	F9.1	3.	UGL	METHYL ETHYL KETONE
249:000806A806	MIBK	F9.1	3.	UGL	METHYL ISOBUTYL KETONE
250:000807A807	DE ETHER	F9.1	3.	UGL	DIETHYL ETHER
251:000808A808	TOTAL THM	F9.1	1.	UGL	TRIHALOMETHANES
252:000809A809	HDA DE	F9.0	5.	UGL	HEXADECANOIC ACID, DIOCTYL ESTER
253:000810SULFUR	SULFUR	F9.0	5.	UGL	SULFUR
254:000811A811	ISOPR ETHER	F9.0	3.	UGL	ISOPROPYL ETHER
255:000812A812	MIPK	F9.0	3.	UGL	METHYL ISOPROPYL KETONE
256:000813A813	2-HEPTANONE	F9.0	3.	UGL	METHYL-N-AMYL KETONE
257:000814A814	4-M,2-P	F9.0	3.	UGL	4-METHYL-2-PROPANONE
258:000815A815	CRYOFLEX	F9.0	.	UGL	CRYOFLEX
259:000816A816	TBP	F9.0	.	UGL	TRIBUTYL PHOSPHATE
260:000817A817	A817	F9.0	.	UGL	N,N,4-TRIMETHYL BENZENESULFONAMIDE
261:000818A818	A818	F9.0	.	UGL	2-PROPANOL,1-[2-(2-METHOXY-1-METHYLETHOXY)-1-METHYLETHOXY]
262:000819A819	A819	F9.0	10.	UGL	HEPTANOIC ACID
263:000820A820	A820	F9.0	10.	UGL	BENZOIC ACID
264:000821A821	A821	F9.0	10.	UGL	METHYL HEXANOIC ACID
265:000822A822	A822	F9.0	10.	UGL	METHYL PENTANOIC ACID
266:000823A823	A823	F9.0	10.	UGL	METHYL BUTANOIC ACID
267:000824A824	A824	F9.0	10.	UGL	HEXANOIC ACID
268:000825A825	A825	F9.0	10.	UGL	BENZENEDICARBOXYLIC ACID
269:000826A826	A826	F9.0	10.	UGL	DIMETHYL CYCLOPENTANE
270:000827A827	A827	F9.0	10.	UGL	XYLENE
271:000828A828	A828	F9.0	10.	UGL	META XYLENE
272:000829A829	A829	F9.0	10.	UGL	PARA XYLENE
273:000830A830	A830	F9.0	10.	UGL	2,2-OXYBIS PROPANE
274:000831A831	A831	F9.0	10.	UGL	CYCLOHEXANONE
275:000832A832	A832	F9.0	3.	UGL	DICHLOROFLUOROMETHANE
276:000833A833	A833	F9.0	3.	UGL	2-METHYL BUTANE
277:000834A834	A834	F9.0	3.	UGL	2-METHYL-1-PENTANE
278:000835A835	A835	F9.0	3.	UGL	METHYL CYCLOHEXANE
279:000836A836	A836	F9.0	3.	UGL	2,5-DIETHYL TETRAHYDROFURAN
280:000837A837	A837	F9.0	3.	UGL	2,2-DIMETHYL PROPANOL

281:000838A838	A838	F9.0	3.	UGL		TRIETHYL ESTER PHOSPHONATE
282:000839A839	A839	F9.0	3.	UGL		1,1'-OXYBIS (2-ETHOXY) ETHANE
283:000840A840	A840	F9.0	3.	UGL		1,1-OXYBIS ETHANE
284:000841A841	A841	F9.0	10.	UGL		NONYL PHENOL
285:000842A842	A842	F9.0	10.	UGL		TETRAMETHYL BUTYL PHENOL
286:000843A843	A843	F9.0	10.	UGL		METHYL ETHYL PHENOL
287:000844A844	A844	F9.0	10.	UGL		ETHYL PHENOL
288:000845A845	A845	F9.0	10.	UGL		DIMETHYL PHENOL
289:000846A846	A846	F9.0	10.	UGL		BROMACIL
290:000847A847	A847	F9.0	10.	UGL		TRIETHYL ESTER OF PHOSPHORIC ACID
291:000848A848	A848	F9.0	3.	UGL		ETHYL CYCLOHEXANE
292:000849A849	A849	F9.0	10.	UGL		2-METHOXY-2-METHYL PROPANE
293:000850A850	A850	F9.0	10.	UGL		2-VINYL CROTONALDEHYDE
294:000851A851	A851	F9.0	10.	UGL		DIOCTYL HEXANDIOATE
295:000852A852	A852	F9.0	5	UGL		BENZOTHIAZOLE
296:000853A853	A853	F9.0	10	UGL		SUBSTITUTED PHENOL
297:000854A854	A854	F9.0	10	UGL		AZIDO METHYL BENZENES
298:000855A855	HEXANEDIOIC	F9.0	10	UGL		HEXANEDIOIC ACID, DIOCTYL ESTER
299:000856A856	A856	F9.0	10	UGL		2 ETHYL HEXANOIC ACID
300:000857A857	A857	F9.0	10	UGL		OCTYL PHENOL
301:000858A858	A858	F9.0	10	UGL		PROMETON
302:000859A859	A859	F9.0	3	UGL		2,2-DIMETHYL OXIRANE
303:000860A860	A860	F9.0	10	UGL		METHYL BENZENAMINE
304:000861A861	A861	F9.0	10	UGL		NITRO METHYL BENZENAMINE
305:000862A862	A862	F9.0	10	UGL		2-NITROTOLUENE
306:000863A863	A863	F9.0	10.	UGL		4-NITROTOLUENE
307:000864A864	A864	F9.0	10.	UGL		THIOBISMETHANE
308:000865A865	A865	F9.0	3.	UGL		1-ETHYL,4-METHYL BENZENE
309:000866A866	A866	F9.0	3.	UGL		TRIMETHYL BENZENES
310:000867A867	A867	F9.0	3.	UGL		DIMETHYL DISULFIDE
311:000888X888	X888	F9.0	10.	UGL		UNIDENTIFIED SUBSTITUTED BENZENES
312:000889X889	UNID COMPS	F9.0	.	UGL		UNIDENTIFIED COMPOUNDS
313:000890X890	UNID COMP 1	F9.1	.	UGL		UNIDENTIFIED COMPOUND 1
314:000891X891	UNID COMP 2	F9.1	.	UGL		UNIDENTIFIED COMPOUND 2
315:000892X892	UNID COMP 3	F9.1	.	UGL		UNIDENTIFIED COMPOUND 3
316:000893X893	UNID TOX	F9.1	.	UGL		UNIDENTIFIED CHLORINATED COMPOUND
317:000894X894	H B UNK	F9.1	.	UGL		HIGH BOILING UNKNOWN
318:000895X895	H B HC	F9.1	.	UGL		HIGH BOILING HYDROCARBONS
319:000896X896	X896	F9.0	5.	UGL		ORGANIC ACID METHYL ESTER
320:000897X897	X897	F9.0	5.	UGL		ORGANIC ACID ESTER
321:000898X898	X898	F9.0	25.	UGL		SERIES OF SILICONES
322:000899X899	X899	F9.0	10.	UGL		UNKNOWN TRIAZINE COMPOUND
323:000900X900	X900	F9.0	10.	UGL		PROPENYL BENZENE
324:000904GC-PHC	PURGHALOCARB				31	14D PURGEABLE HALOCARBONS (METHOD 601)
325:000905GC-PA	PURGAROMATIC				31	14D PURGEABLE AROMATICS (METHOD 602)
326:000906GCMS-V	GCMS-PURG				31	14D PURGEABLES (METHOD 624)
327:000907M603-P	M603 PURG				31	3D ACROLEIN & ACRYLONITRILE (METHOD 603)
328:000908GC-A	M604 PHENOLS				32	7D PHENOLS (METHOD 604)
329:000909M605	BENZIDINES				34	7D BENZIDINES (METHOD 605)
330:000910M606	PHTHALATES				34	7D PHTHALATE ESTERS (METHOD 606)
331:000911M607	NITROSAMINES				34	7D NITROSAMINES (METHOD 607)
332:000912M608	OCLPEST/PCB				33	7D ORGANOCHLORINE PESTICIDES & PCBS (METHOD 608)
333:000913M609	NIT AROM				34	7D NITROAROMATICS & ISOPHORONE (METHOD 609)
334:000914M610	PAH				34	7D POLYNUCLEAR AROMATIC HYDROCARBONS (METHOD 610)
335:000915M611	HALOETHERS				34	7D HALOETHERS (METHOD 611)
336:000916M612	M612 HC				34	7D CHLORINATED HYDROCARBONS (METHOD 612)
337:000917M613	DIOXIN					7D (METHOD 613)

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338:000918GCMS-BGCMS-BNE
339:000919GCMS-AGCMS-AE
340:000920GCMS-OGCMS-PEST
341:000921GCPESTGC-PEST SCAN
342:000922HERB  HERBICIDES
343:999999      DUMMY
```

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34  7D BASE-NEUTRAL EXTRACTABLES (METHOD 625 BASE NEUTRALS)
32  7D ACID EXTRACTABLES (METHOD 625 ACIDS)
33  7D PESTICIDE EXTRACTABLES (METHOD 625 PESTICIDES)
35  7D GC PESTICIDE SCAN
35  7D 3 HERBICIDES(SM509B)-2,4,5-T;SILVEX; & 2,4-D
 0
```

Card Columns	Field Width	Type Spec	Just	Entry
1-6	6	I6		Parameter number.
7-12	6	A6	L	Parameter code.
13-24	12	2A6	L	Parameter name; may be abbreviated if the actual name is longer than 12 characters.
25-28	4	A4		"F9.?"; where ? is either 1, 2, or 3. The number is the number of digits that will be printed to the right of the decimal on data tables.
29-37	9	F9.3		Typical detection limit for the parameter.
38-40	3	A3	L	Units code; options are: MGL - milligrams per liter UGL - micrograms per liter PCL - picocuries per liter UMC - micromhos per centimeter PH - pH units NTU - nephelometric turbidity units TON - threshold odor number TDN - taste dilution index number CU - color units PHM - per 100 milliliters
41	1	A1		Filtering code; options: F - samples must be filtered U - samples must be unfiltered B - filtered or unfiltered
42-43	2	I2	R	Parameter group number; (1-40).
44	1	A1		Parameter group change code; a "." entry indicates that the group number cannot be changed without modifying computer programs; B otherwise.
45-47	3	I2,A1	R	Parameter holding time code; first 2 columns to have an integer time entry; last column to identify units of time (H - hours, D - days, M - months). Holding time is not total holding time for parameter, but time until first action by lab is necessary (such as extraction).
48	1			B
49-132	84	14A6	L	Parameter name.

TECHNICAL STATEMENT OF WORK FOR

GROUND-WATER SAMPLE ANALYSES

Developed by:

The U.S. Army Environmental Hygiene Agency
Aberdeen Proving Ground, MD 21010-5422

June 1986

Encl 2

CONTENTS

ATTACHMENT 1

Attachment 1 details analytical methodologies which should be used by contract laboratory for analyses of RCRA ground-water samples for inorganic, organic, and radiochemical contaminants. Attachment 1 also lists detection limits obtained by USAEHA in-house laboratories for respective analytical methodologies.

TABLE 1-1. REQUIRED CHEMICAL MEASUREMENTS, METHODOLOGY, AND DETECTION LIMITS FOR INORGANIC NONMETALS

Parameter	Required Methodology	Required Method Reference	Detection Limit[1]
Acidity	Titrametric	EPA 305.1[2]	1.0 mg/L as $CaCO_3$
Alkalinity	Titrametric	EPA 310.1[2]	1.0 mg/L as $CaCO_3$
Chloride	Titrametric	EPA 325.2[2]	1.0 mg/L
Hardness	Titrametric, EDTA	EPA 130.2[2]	1.0 mg/L as $CaCO_3$
pH	Electrochemical	EPA 150.1[2]	0.1 pH units
Total Dissolved Solids (TDS)	Gravimetric, 180 °C	EPA 160.1[2]	1.0 mg/L
Total Solids (TS)	Gravimetric, 105 °C	EPA 160.3[2]	1.0 mg/L
Total Suspended Solids (TSS)	Gravimetric, 105 °C	EPA 160.2[2]	1.0 mg/L
Total Volatile Dissolved Solids (TVDS)	Gravimetric, 550 °C	EPA 160.4[2]	1.0 mg/L
Total Volatile Solids (TVS)	Gravimetric, 550 °C	EPA 160.4[2]	1.0 mg/L
Total Volatile Suspended Solids (TVSS)	Gravimetric, 550 °C	EPA 160.4[2]	1.0 mg/L
Turbidity	Nephelometric	EPA 180.1[2]	0.2 NTU
Settleable Solids	Gravimetric	EPA 160.5[2]	1.0 mg/L
Nitrite Nitrogen	Spectrophotometric	EPA 300.0[2]	0.01 mg/L
Orthophosphate Phosphorus	Colorimetric	EPA 365.2[2]	0.02 mg/L
BOD	Bioassay	EPA 405.1[2]	1.0 mg/L
MBAS	Colorimetric	EPA 425.1[2]	0.05 mg/L

See footnotes, page 4.

Parameter	Required Methodology	Required Method Reference	Detection Limit[1]
Color	Spectrophotometric	EPA 110.3[2]	5 Color units
Sulfide	Colorimetric	EPA 376.2[2]	0.05 mg/L
Hexavalent Chromium	Atomic Absorption Chelation/Extraction	EPA 218.4[2]	0.025 mg/L
Silica	Colorimetric	EPA 370.1[2]	0.02 mg/L
2,4,6-TNT	Gas Chromatography	AEHA In-House Procedure	0.001 mg/L
2,4-DNT	Gas Chromatography	AEHA In-House Procedure	0.001 mg/L
2,6-DNT	Gas Chromatography	AEHA In-House Procedure	0.001 mg/L
RDX	Liquid Chromatography	AEHA In-House Procedure	0.03 mg/L
HMX	Liquid Chromatography	AEHA In-House Procedure	0.1 mg/L
Tetryl	Gas Chromatography	AEHA In-House Procedure	0.005 mg/L
Ammonium Picrate (Picric Acid)	Liquid Chromatography	AEHA In-House Procedure	0.5 mg/L
Urea	Ion Chromatography	AEHA In-House Procedure	0.1 mg/L
Melamine	Liquid Chromatography	AEHA In-House Procedure	0.5 mg/L
Nitroguanidine	Liquid Chromatography	AEHA In-House Procedure	0.1 mg/L
Specific Conductance	Wheatstone Bridge at 25 °C	USEPA Method Manual[2] Method #120.1	0.1 micromhos/cm

See footnotes, page 4.

Parameter	Required Methodology	Required Method Reference	Detection Limit[1]
Total Organic Carbon	Ultra-Violet Promoted Persulfate Oxidation	USEPA Method Manual[2] Method #415.2	50 micrograms/liter
	- OR -		
	Catalytic Combustion	EPA 415.1[2]	0.1 mg/L
Total Organic Halogen	Carbon Adsorption, Pyrolysis and Microcoulemetric Titration	USEPA Method #450.1[7]	10 micrograms/liter
Ammonia	Manual distillation followed by Nesslerization or Automated Phenate Color Development.	EPA 350.1[2] SM 417A & B[3]	0.10 mg/L as N
Chemical Oxygen Demand	Dichromate reflex followed by Titration or Sealed Tube Digestion.	EPA 410.4[2] SM 508[3]	15.0 mg/L
Cyanide	Distillation followed by Pyridine/Barbituric Acid Color Development	EPA 335.2[2]	0.01 mg/L
Fluoride	Distillation followed measurement by specific ion electrode	EPA 340.2[2] SM 413A & B[3]	0.10 mg/L
Grease & Oil	Liquid/Liquid Extraction with Freon	EPA 413.1[2] SM 503 A[3]	1.0 mg/L
Nitrate-Nitrite	Automated Cadmium Reduction	EPA 353.2[2]	0.01 mgL as N
Total Kjeldahl Nitrogen	Manual Kjeldahl Digestion followed by Manual Distillation and Nesslerization	EPA 351.3[2]	0.1 mg/L as N
Phenol	Manual Distillation followed by Chloroform Extraction/4AAP Color Development	EPA 420.1[2] SM 510 A & B[3]	0.01 mg/L

See footnotes, page 4.

Parameter	Required Methodology	Required Method Reference	Detection Limit[1]
Phosphate	Manual Perchloric Acid Digestion followed by Asorbic Acid Color Development	SM 424C(III) & F[3]	0.02 mg/L as P
Sulfate	Automated, Methyl Thymol Blue or Turbimetric	EPA 378.2[2]	2.0 mg/L

[1] Detection limit is defined as the lowest concentration for which results are obtainable within the accuracy and precision requirements detailed in Attachment 2.

[2] "Methods for Chemical Analysis of Water and Wastes," March 1979, US Environmental Protection Agency, Cincinnati, Ohio 45265.

[3] "Standard Methods for the Examination of Water and Wastewater," 15th Edition, 1980, American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington, DC 20005.

[4] "Methods of Soil Analysis," 1965, American Society of Agronomy, Madison, Wisconsin.

[5] "Test Methods for Evaluating Solid Wastes," July 1982, US Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC 20460.

[6] "Chemistry of the Soil," 1964, Firman Bear, Van Nostrand Reinhold Co., New York, New York.

[7] Unpublished procedure copies of which are available from US Environmental Protection Agency, Cincinnati, Ohio upon telephonic or written request.

TABLE 1-2. REQUIRED CHEMICAL MEASUREMENTS, METHODOLOGY AND DETECTION LIMITS FOR METALS

Parameter	Required Methodology	Required Method Reference EPA Method Manual[1]	Required Detection Limit[2]
Aluminum	Digestion, Direct Aspiration or Furnace Technique Atomic Absorption, ICPES[3]	200.0 200.7 202.1 202.2	1.000 mg/L
Antimony	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 204.1 204.2	0.500 mg/L
Arsenic	Oxadative Digestion, Gaseous Hydride, or Furnace Technique Atomic Absorption, ICPES[3]	200.0 200.7 206.2 206.3	0.010 mg/L
Barium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 208.1 208.2	0.300 mg/L
Beryllium	Digestion, Direct Aspiration or Furnace Technique Atomic Absorption, ICPES[3]	200.0 200.7 210.1 210.2	0.050 mg/L
Boron	Digestion, ICPES[3] Colorimetric, Curcumin	200.0 200.7 212.3	10.00 mg/L
Cadmium	Digestion, Direct Aspiration or Furnace Technique Atomic Absorption, ICPES[3]	200.0 200.7 213.1 213.2	0.001 mg/L
Calcium	Digestion, Direct Aspiration Atomic Absorption, ICPES[3] Titrimetric, EDTA	200.0 200.7 215.1 215.2	1.000 mg/L
Chromium	Digestion, Direct Aspiration or Furnace Technique Chelation extraction Coprecipitation Atomic Absorption, ICPES[3]	200.0 200.7 218.1 218.2 218.3 218.4 218.5	0.001 mg/L

See footnotes, page 3.

Parameter	Required Methodology	Required Method Reference EPA Method Manual[1]	Required Detection Limit[2]
Cobalt	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 219.1 219.2	0.200 mg/L
Copper	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 220.1 220.2	0.025 mg/L
Iron	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 236.1 236.2	0.100 mg/L
Lead	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 239.1 239.2	0.005 mg/L
Magnesium	Digestion, Direct Aspiration Atomic Absorption, ICPES[3]	200.0 200.7 242.1	0.500 mg/L
Manganese	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 243.1 243.2	0.030 mg/L
Mercury	Digestion, Manual or Automated Cold Vapor Technique, ICPES[3]	200.0 245.1 245.2 245.5	0.0002 mg/L
Molybdenum	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 246.1 246.2	0.500 mg/L
Nickel	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 249.1 249.2	0.100 mg/L
Potassium	Digestion, Direct Aspiration Atomic Absorption, ICPES[3]	200.0 200.7 258.1	0.500 mg/L

See footnotes, page 3.

Parameter	Required Methodology	Required Method Reference EPA Method Manual[1]	Required Detection Limit[2]
Selenium	Oxidative Digestion, Gaseous Hydride or Furnace Technique Atomic Absorption ICPES[3]	200.0 200.7 270.2 270.3	0.005 mg/L
Silver	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 272.1 272.2	0.025 mg/L
Sodium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 273.1 273.2	1.000 mg/L
Thallium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 279.1 279.2	1.000 mg/L
Tin	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 282.1 282.2	1.000 mg/L
Titanium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 283.1 283.2	1.000 mg/L
Vanadium	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 286.1 286.2	2.000 mg/L
Zinc	Digestion, Direct Aspiration or Furnace Technique, Atomic Absorption, ICPES[3]	200.0 200.7 289.1 289.2	0.015 mg/L

[1] "Methods for Chemical Analysis of Water and Wastes," March 1979, US Environmental Protection Agency, Cincinnati, Ohio 45265.

[2] Detection limit is defined as the lowest concentration for which results are obtained within accuracy and precision requirements detailed in Attachment 2. Lower limits may be requested for some samples, which will be submitted in the request for analysis.

[3] Inductively Coupled Plasma Emission spectroscopy.

TABLE 1-3. REQUIRED CHEMICAL MEASUREMENTS, METHODOLOGY AND DETECTION LIMITS FOR ORGANICS

Parameter	Methodology Description	Required Method Reference[1]	Required Detection Limit (micrograms/liter)
Volatile Organic Compounds	Gas Chromatography Mass Spectrometry	624	3
benzene	"	624	3
carbon tetrachloride	"	624	3
chlorobenzene	"	624	3
1,2-dichloroethane	"	624	3
1,1,1-trichloroethane	"	624	3
1,1-dichloroethane	"	624	3
1,1,2-trichloroethane	"	624	3
1,1,2,2-tetrachloroethane	"	624	3
chloroethane	"	624	3
2-chloroethyl vinyl ether	"	624	3
chloroform	"	624	3
1,1-dichloroethene	"	624	3
trans-1,2-dichloroethene	"	624	3
1,2-dichloropropane	"	624	3
trans-1,3-dichloropropene	"	624	3
cis-1,3-dichloropropene	"	624	3
ethylbenzene	"	624	3
methylene chloride	"	624	3
chloromethane	"	624	3
bromomethane	"	624	3
bromoform	"	624	3
bromodichloromethane	"	624	3
chlorodibromomethane	"	624	3
tetrachloroethane	"	624	3
toluene	"	624	3
trichloroethane	"	624	3
vinyl chloride	"	624	3
fluorotrichloromethane	"	624	3
Base/Neutral and Acid Extractable Organic Compounds	Gas Chromatography Mass Spectrometry		
acenaphthene	"	625	10
1,2,4-trichlorobenzene	"	625	10
hexachlorobenzene	"	625	10
hexachloroethane	"	625	10
bis (2-chloroethyl) ether	"	625	10
2-chloronaphthalene	"	625	10
2,4,6-trichlorophenol	"	625	25
4-chloro-3-methylphenol	"	625	25
2-chlorophenol	"	625	25
1,2-dichlorobenzene	"	625	25

See footnotes, page 3.

Parameter	Methodology Description	Required Method Reference[1]	Required Detection Limit (micrograms/liter)
	Gas Chromatography		
1,3-dichlorobenzene	Mass Spectrometry	625	10
1,4-dichlorobenzene	"	625	10
2,4-dichlorophenol	"	625	25
2,4-dimethylphenol	"	625	25
2,4-dinitrotoluene	"	625	10
2,6-dinitrotoluene	"	625	10
fluoranthene	"	625	10
4-chlorophenyl phenyl ether	"	625	10
4-bromophenyl phenyl ether	"	625	10
bis (2-chloroisopropyl) ether	"	625	10
bis (2-chlorothoxy) methane	"	625	10
hexachlorobutadiene	"	625	10
isophorone	"	625	10
naphthalene	"	625	10
nitrobenzene	"	625	10
2-nitrophenol	"	625	25
4-nitrophenol	"	625	25
2,4-dinitrophenol	"	625	250
4,6-dinitro-2-methylphenol	"	625	250
N-nitrosodipropylamine	"	625	10
pentachlorophenol	"	625	25
phenol	"	625	25
bis (2-ethylhexyl) phthalate	"	625	10
benzyl butyl phthalate	"	625	10
di-n-butyl phthalate	"	625	10
di-n-octyl phthalate	"	625	10
diethyl phthalate	"	625	10
dimethyl phthalate	"	625	10
benzo(a)anthracene	"	625	10
benzo(a)pyrene	"	625	10
benzo(b)fluoranthene	"	625	10
benzo(k)fluoranthene	"	625	10
chrysene	"	625	10
acenaphthylene	"	625	10
anthracene	"	625	10
benzo(ghi)perylene	"	625	25
fluorene	"	625	10
phenanthrene	"	625	10
dibenzo(ah)anthracene	"	625	25
indeno(1,2,3-cd)pyrene	"	625	25
pyrene	"	625	10
PCB 1016	"	625	50
PCB 1221	"	625	50
PCB 1232	"	625	50
PCB 1242	"	625	50
PCB 1248	"	625	50

See footnotes, page 3.

Parameter	Methodology Description	Required Method[1] Reference	Required Detection Limit (micrograms/liter)
PCB 1254	"	625	50
PCB 1260	"	625	50
	Gas Chromatography		
Benzidine[2]	Mass Spectrometry	625	10
3,3'-dichlorobenzidine[2]	"	625	10
hexachlorocyclopentadiene[2]	"	625	10
N-nitrosodimethylamine[2]	"	625	10
N-nitrosodiphenylamine[2]	"	625	10
Pesticide Organic Compounds	Gas Chromatography/ Electron Capture Detection	608	
aldrin	"	608	0.16
dieldrin	"	608	0.24
chlordane	"	608	1.20
4,4'-DDT	"	608	0.60
4,4'-DDE	"	608	0.40
4,4'-DDD	"	608	0.40
endosulfan I	"	608	0.14
endosulfan II	"	608	0.14
endosulfan sulfate	"	608	0.066
endrin	"	608	0.04
endrin aldehyde	"	608	0.23
heptachlor	"	608	0.06
heptachlor epoxide	"	608	0.16
a-BHC	"	608	0.20
b-BHC	"	608	0.20
d-BHC	"	608	0.20
g-BHC	"	608	0.08
toxaphene	"	608	1.60
PCB 1016	"	608	1.00
PCB 1221	"	608	1.00
PCB 1232	"	608	1.00
PCB 1242	"	608	1.00
PCB 1248	"	608	1.00
PCB 1254	"	608	1.00
PCB 1260	"	608	1.00
Methoxychlor	"	608	1.60
2,4-D	"	SM 509B[2]	3.80
Silvex	"	SM 509B[2]	0.50

[1] "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," July 1982, US Environmental Protection Agency, Cincinnati, Ohio 45268.

[2] These compounds have been identified by USEPA as being labile with respect to Method 625. Accuracy and precision requirements as identified in Table in Attachment 2 will not pertain to these compounds.

[3] "Standard Methods for the Examination of Water and Wastewater", 16th Edition, 1985, American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington DC 20005.

TABLE 1-4. REQUIRED CHEMICAL MEASUREMENTS, METHODOLOGY AND DETECTION LIMITS FOR RADIOCHEMICALS

No.	Parameter	Methodology	Method Reference	Detection Limit
1	Screening Procedure/Aliq. Size	Gravimetric Analysis	1(Enclosure 2)	NA
2	Gross Alpha (<500 mg/L Dissolved Solids)	Proportional	EPA 900.0[1]	1.0 pCi/L
3	Gross Beta (<500 mg/L Dissolved Solids)	Proportional Counting	EPA 900.0[1]	4.0 pCi/L
4	Gross Alpha (>500 mg/L Dissolved Solids)	Proportional Counting	EPA Method A (Enclosure 1)	1.0 pCi/L
5	Gross Beta (>500 mg/L Dissolved Solids)	Proportional Counting	EPA Method 900.0[2]	[3]
6	Gross Alpha	Proportional Counting	2(Enclosure 3)	1.0 pCi/L
7	Gross Beta	Proportional Counting	2(Enclosure 3)	4.0 pCi/L

[1] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water" August, 1980, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268.

[2] Due to the presence of high dissolved solids content, a smaller aliquot size will be taken for analysis.

[3] Detection limit dependent on aliquot size taken for analysis.

EPA METHOD A

DETERMINATION OF GROSS ALPHA ACTIVITY
IN DRINKING WATER BY COPRECIPITATION

1. Scope and Application

1.1 Many drinking water supplies contain dissolved solids at such high concentrations (>500 mg/liter) that measurement of gross alpha activity, by evaporating an aliquot of a sample and counting for alpha activity, seriously lacks sensitivity and reproducibility. The nitrated salts (formed by evaporation of sample aliquot containing nitric acid) of some water samples are hygroscopic and must be converted to the oxides by heating to get a stable sample residue.

1.2 This method provides for the separation of all actinide alpha emitting radionuclides by coprecipitation with barium sulfate and iron hydroxide from liter samples of drinking water. Dissolved solids problems are eliminated. Sensitivity can be increased by using larger sample aliquots. Reproducibility is improved by the use of constant amounts of carrier (barium and iron).

1.3 This method provides for a screening measurement to indicate whether specific radium-226 and/or uranium analysis is required for a drinking water supply.

2. Summary of Method

2.1 An aliquot of a drinking water sample is acidified with sulfuric acid and boiled vigorously for 10 minutes to outgas carbon dioxide and radon-222 from the sample. Barium carrier is added and the aliquot is stirred for about 30 minutes to coprecipitate radium with barium sulfate.

2.2 Iron carrier is added to the aliquot, is then neutralized with ammonium hydroxide, and is continued to be heated and stirred for another 30 minutes to coprecipitate other alpha emitters with iron hydroxide carrier.

2.3 The coprecipitate is filtered, dried, and counted for alpha activity.

3. Sampling Handling and Preservation

3.1 A representative sample must be collected from a monitoring well and should be large enough so that meaningful aliquots can be taken.

3.2 To minimize adsorption losses to the walls of the sample container, it is recommended that samples be preserved at the time of collection by the addition of 5 ml of 70 percent HNO_3 (concentrated) per liter of sample, making the samples 0.35% HNO_3 solutions. Samples can be acid-preserved when they arrive at the laboratory. They should then be stored (after acid addition) for at least 16 hours (overnight) before aliquots are taken for analysis.

4. Interferences

4.1 Since gross alpha screening of ground water samples is primarily addressing radium concentrations (especially radium-226), and since the radium isotopes decay to short-lived progeny, standards and samples should be counted at as nearly the same elapsed time as possible after alpha activity precipitation. If there are wide differences in the elapsed times for standards and samples in the elapsed time range of 0-20 days, there will be significant errors in the counting efficiencies used. It is recommended that a short time be allowed between the alpha activity precipitation and the mid-point of the alpha count. However, three hours should be allowed for the decay of the radon-222 progeny before starting the alpha count.

4.2 Samples that contain sulfate and/or hydroxide insoluble precipitates will have greater total precipitates than from the added barium and iron carriers, and therefore will have counting efficiencies that are biased low.

4.3 Iron hydroxide precipitate collected on membrane filters without a holding agent will flake when dried and easily separate from the filter. Five (5) mg of paper pulp fiber added to the sample will greatly help to secure the iron hydroxide to the filter. Glass fiber filters are recommended over membrane filters because the surface glass fibers also help to secure the precipitate to the filter.

5. Apparatus

5.1 Hotplate/magnetic stirrer and stirring bars.

5.2 Glassware.

5.3 Filter membranes, 47 mm diameter, 0.45 micrometer pore size or glass fiber filters, such as Gelman type A/E or Millipore Type AP.

5 4 Drying lamp.

5.5 Planchets, stainless steel, 2 inch diameter.

5.6 Alpha scintillation counter or low background proportional alpha counter.

6. Reagents

6.1 Ammonium hydroxide, 6M. Dilute 400 ml reagent grade HN_4OH to 1 liter with distilled water.

6.2 Barium carrier, 5 mg Ba^{+2}/ml. Dissolve 4.4 g $BaCL_2 \cdot 9H_2O$ in 500 ml distilled water.

6.3 Bromocresol purple, 0.1 percent. Dissolve 100 mg of the water soluble reagent in 100 ml distilled water.

6 4 Iron carrier, 5 mg Fe^{+3}/ml. Dissolve 17.5 g $Fe(NO_3)_3, \cdot 9H_2O$ in 200 ml distilled water containing 2 ml 16M HNO_3. Dilute to 500 ml.

6.5 Sulfuric acid, 1M. Dilute 55 ml of the 96 percent reagent grade H_2SO_4 to 1 liter with distilled water.

6.6 Paper pulp/water mixture - add a 0.5 g paper pulp pellet to 500 ml of distilled water plus 5 drops of a (1+4) detergent plus water solution in a plastic bottle. Cap the bottle and stir vigorously for three hours before using. This mixture should be stirring when an aliquot is taken.

6.7 Five drops of a (1+4) detergent plus water solution added to the sample will prevent the precipitate from collecting on the beaker wall and will assist in filtering the precipitate. (Examples of wetting agents: Rohm and Haas Triton N101 or Triton X100.)

7. Calibration

7.1 Thorium-230 is a recommended pure alpha emitter for gross alpha efficiency calibration especially if the alpha contribution to the beta channel is to be determined. If only gross alpha measurements are to be made on samples, natural uranium is an adequate standard for gross alpha counting efficiency calibration.

7.2 Spike 500 ml portions of tap water in separate beakers (at least 100 pCi) of standard alpha emitter activity. Add 2.5 ml of HNO_3 (Conc.) to each spiked sample. With these spiked samples, determine a counting efficiency (cpm/pCi) for the alpha emitter by taking the samples through the procedure (parts 8.1 - 8.10).

7.3 Unspiked tap water portions (500 ml) should be taken through the procedure for blank corrections of alpha activity in the tap water plus the reagents used.

7.4 Calculations

$$\text{Efficiency, cpm/pCi} = \frac{C_s - C_b}{pCi}$$

C_s = mean spiked sample counts per minute
C_b = mean blank counts per minute
pCi = spike activity

8. Procedure (the following method was presented by Robert Lieberman of the Eastern Environmental Radiation Facility, Montgomery, Alabama, at the Health Physics Society meeting in Las Vegas, Nevada, August, 1982. Some minor changes were made as a result of a single laboratory test of the method by the EMSL-Las Vegas, Quality Assurance Division).

8.1 Use a measured aliquot of water sample. If the sample is less than 500 ml, dilute to 500 ml with distilled water. Samples of 500 ml to 1 liter use as is.

8.2 Add 5 drops of the (1+4) detergent plus water reagent.

8.3 Place the sample on a magnetic stirrer/hot plate and, while stirring, gently add 20 ml of 1M H_2SO_4 and boil for 10 minutes to flush carbon dioxide (from carbonates and bicarbonates) from the sample. Radon will also be flushed from the sample.

8.4 Lower the hot plate temperature to below sample boiling, continue stirring and add 1 ml of barium carrier solution (5 mg Ba/ml). Continue stirring for 30 minutes.

8.5 Add 1 ml of bromocresol purple indicator solution, 1 ml of iron carrier solution, and 5 ml of paper pulp/water reagent (aliquot taken while the paper pulp/water mixture is stirring).

8.6 Continue stirring and add 6M HN_4OH dropwise to the sample until there is a distinct color change (yellow to purple). Continue warming and stirring for 30 minuest.

8.7 Filter the sample through a glass fiber filter (or membrane filter if further analysis is to be done), rinsing all precipitate from the beaker to the filter. Wash the precipitate with 25 ml of distilled water.

8.8 Allow 3 hours for the collected radon progeny to decay and dry the filter at 105°C or under a mild heat lamp.

8.9 Count the filters for gross alpha activity. An early count of the gross alpha activity, after the three hour decay period, is recommended to minimize additional radon ingrowth which is not easily corrected for when there are other alpha emitters in the sample.

8.10 Store samples in a desiccator if they are to be recounted at a later date.

8.11 Prepare a reagent blank precipitate to determine the reagent alpha activity background.

9. Calculations

9.1 Gross alpha activity, pCi/liter $= \dfrac{C_1 - C_B}{EV}$

E = counter efficiency, cpm/pCi
V = volume analyzed, liters
C_1 = sample, counts per minute
C_B = reagent blank, counts per minute

9.2 Lower Limit of Detection, LLD

$$\text{LLD, Gross alpha, pCi/liter} = \frac{4.66\ C_B}{E\ V\ T}$$

C_B = reagent background, counts per minute
T = counting time
E = counter efficiency cpm/pCi
V = reagent blank, counts per minute

This LLD calculation is valid if the sample counting time is equal to the background counting time.

10. Precision and Accuracy

(To be added from single laboratory and multilab tests of the method.)

APPENDIX A

Total alpha factors for radium-226 with change in elapsed time between alpha activity precipitation and the midpoint of the alpha count (from Kirby's tables, "Decay and Growth Tables for the Naturally Occurring Radioactive Series, AEC Research and Development Report MLM-2042)."

Elapsed Time #t = hrs, (days)	Total Alpha Factor Ra-226 Parent Only* Alpha Factor	% Increase	Ra-226 plus Po-210 Fraction** Alpha Factor	% Increase
0	1.0000	0.0	1.5100	0.0
4	1.0800	8.0	1.5900	5.3
8	1.1668	16.7	1.6768	11.0
12	1.2511	25.1	1.7611	16.6
16	1.3329	33.3	1.8429	22.0
20	1.4123	41.2	1.9223	27.3
24 (1)	1.4893	48.9	1.9993	32.4
36	1.7068	70.7	2.2168	46.8
48 (2)	1.9055	90.5	2.4155	60.0
60	2.0870	109	2.5970	72.0
72 (3)	2.2528	125	2.7628	83.0
84	2.4042	140	2.9142	93.0
96 (4)	2.5424	154	3.0524	102
(5)	2.7841	178	3.2941	118
(6)	2.9856	198	3.4956	131
(7)	3.1538	215	3.6638	143
(8)	3.2941	229	3.8041	152
(10)	3.5087	251	4.0187	166
(15)	3.8015	280	4.3115	185
(20)	3.9198	292	4.4298	193
(25)	3.9675	297	4.4775	196
(30)	3.9869	299	4.4969	198

---

* This data, from Kirby's tables, assumes a pure parent at #t=0.

* This data is (*) plus a 0.51 fraction of Po-210 which is also an alpha emitter. The ratio of Po-210 to Ra-226 in the EMSL-LV Ra-226 standard (March 23, 1984) is 0.51.

APPENDIX B

Elapsed Time #t hours	Total Alpha	Ingrowth Factor	Estimated Ra-226 % bias (-)
0	1.000	0 000	
1	1.016	0.016	
2	1.036	0.036	
3	1.058	0.058	
4	1.080	0.080	3
5	1.102	0.102	4
6	1.124	0.124	5
7	1.145	0.145	6
8	1.166	0.166	7
9	1.188	0.188	8.5
10	1.209	0.209	10
11	1.230	0.230	11
12	1.251	0.251	12
13	1.271	0.271	13
14	1.292	0.292	14
15	1.313	0.313	14.4
16	1.333	0.333	15
17	1.353	0.353	16
18	1.373	0.373	17
19	1.392	0.392	18
20	1.412	0.412	19
21	1.432	0.432	20
22	1.451	0.451	21
23	1.470	0.470	22
24	1.489	0.489	23

APPENDIX C

Estimation of the Ra-226 alpha contribution to the gross alpha count

The Ra-226 concentration (pCi/l) at #t = D is estimated by the following equation:

Estimated Ra-226 = Alpha count at #t = 7 days - Alpha Count at #t = 0, or early time after separation ÷ counting efficiency (cpm/pCi) x 7 day ingrowth factor* (see Appendices A and B).

* While the total Alpha factor for Ra-226 at 7 days ingrowth time is 3.1538, the alpha ingrowth factor is 3.1538 - 1.000 or 2.1538.

Example:

Assume a sample contains

Ra-226	=	10.0 pCi/l
Po-210	=	5.1 pCi/l
Natural Uranium	=	20.0 pCi/l
Total Alpha		35.1 pCi/l at #t = 0

Assume counting efficiency = 0.20 cpm/dpm or 0.444 cpm/pCi.

The alpha count at #t = 0 would be 0.444 cpm/pCi x 35.1 pCi/l = 15.6 cpm/l.

At 7 days of ingrowth the 10.0 pCi/l Ra-226 alpha component would increase to a total of 10.0 pCi/l x 3.1538 = 31.58 pCi/l.

At #t = 7 days the total gross alpha would be

Ra=226 plus progency	=	31.58 pCi/l
Po-210	=	5.1 pCi/l
Natural Uranium	=	20.0 pCi/l
		56.6 pCi/l

The #t = 7 days, alpha count rate would be 0.444 cpm/pCi x 56.5 pCi/l = 25.1 cpm/l

then:

$$\text{Estimated Ra-226} = \frac{25.1 \text{ cpm/l} - 15.6 \text{ cpm/l}}{0.44 \text{ cpm/pCi} \times 2.1538}$$

= 9.93 pCi/l, compared to the 10.0 pCi/l given above.

Since the early alpha count is taken at some time after 3 hours from coprecipitation of the alpha emitters, the estimated Ra-226 component of the sample will be biased low. The percent of bias for early alpha counts of #t = 4 to 24 hours is shown in Appendix B. Estimated Ra-226 results can be normalized to #t = 0, using the percent bias values in Appendix B.

In the example above, if the early alpha count had been as late as #t = 24 hours, the calculations would be as follows:

At #t = 24 hours the total gross alpha would be:

Ra-226 plus progeny	=	10.0 pCi/l x 1.489	=	14.9 pCi/l
		Po-210	=	5.1 pCi/l
		Natural Uranium	=	20.0 pCi/l
				40.0 pCi/l

and the alpha count would be

$$0.444 \text{ cpm/pCi} \times 40.0 \text{ pCi/l} = 17.8 \text{ cpm/l}$$

then the estimated Ra-226 $= \dfrac{25.1 - 17.8}{0.444 \times 2.1538} = 7.63$ pCi/l, which

is biased low by 23 percent.

Normalized to #t = 0, $\dfrac{7.63}{1.0 - 0.23} = 9.92$ pCi/l compared to 10.0 pCi/l.

9. Calculations.

9.1 When counting for only alpha calculate the alpha radioactivity by the following equation:

$$\text{Alpha activity } (\mu\text{Ci/g}) = \frac{\text{ACPM}_{NET}}{(2.2 \times 10^6)(CE)(A)}$$

Where: $ACPM_{NET}$ = net alpha count rate (gross alpha count rate minus the alpha background rate) on the alpha voltage plateau

CE = alpha efficiency factor, read from graph of efficiency versus mg of water solids per cm^2 of planchet area, (cpm/dpm)

A = sample aliquot in grams

2.2×10^6 = conversion factor from dpm to µCi

9.2 When counting beta radioactivity in the presence of alpha radioactivity by gas flow proportional counting systems (on the beta plateau) alpha particles are also counted. Since alpha particles are more readily absorbed by increasing sample thickness than beta particles, the alpha/beta count ratios vary with increasing sample thickness. Therefore, it is necessary to prepare a calibration curve by counting standards containing americium-241 with increasing thickness of solids on the alpha plateau and then on the beta plateau, plotting the ratios of the two counts vs sample thickness. The alpha into beta cross talk from that curve is used to correct the amplified alpha count on the beta plateau. (See Appendix A.) When significant alpha activity is indicated by the sample, count at the alpha voltage plateau, the beta activity of the sample can be determined by counting the sample at the beta voltage plateau and calculating the activity from the following equation:

$$\text{Beta activity } (\mu Ci/g) = \frac{[BCPM_{NET} - (ACPM_{NET} \times \text{X-TALK})]}{(2.22 \times 10^6)(CE)(A)}$$

Where:

$BCPM_{NET}$ = net beta count rate (gross beta count rate minus the beta background count rate) at the beta voltage plateau

CE = beta efficiency factor, read from graph of efficiency versus mg of water solids per cm^2 of planchet, area (cpm/dpm)

$ACPM_{NET}$ = net alpha count rate

X-TALK = alpha into beta cross-talk, read from the graph of the ratio of alpha counted at the beta voltage/alpha counted at the alpha voltage vs sample density thickness

A = sample aliquot in grams

2.22×10^6 = conversion factor from dpm to µCi

9.3 Results are reported in microcurie per gram (µCi/g) of soil and in one of the following ways:

a. If the activity is greater than the LLD, it is reported with a 1.96 sigma error (i.e., 1.7 +- 0.1 µCi/g)

b. If the calculated activity is less than the LLD, the results are reported as less than the LLD.

For more detailed information on reporting results see the section entitled "Reporting of Results" in the RAB Standing Operating Procedure Manual.

$$\text{LLD } (\mu Ci/g) = \frac{4.65 \sqrt{\frac{CPM_B}{T}}}{\frac{6}{(2.22 \times 10)\ (CE)\ (A)}}$$

$$\text{STANDARD DEVIATION} = \pm \frac{\sqrt{\frac{CPM_{S+B}}{T} + \frac{CPM_B}{T}}}{\frac{6}{(2.2 \times 10)\ (CE)\ (A)}}$$

Where :

LLD	=	lower limit of detection
CPM_{S+B}	=	count rate of sample plus background
CPM_B	=	count rate of background
CE	=	counting efficiency
A	=	aliquot in grams
T	=	counting time in minutes
µCi/g	=	microcurie per gram

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2. Radioassay Procedures for Environmental Samples, Jan 1967, National Center for Radiological Health, Publication No. 999-RH-27, pages 7-3 to 7-4.

3. Simultaneous Determination of Alpha-Emitting Nuclides of Radium Through Californium in Large Environmental and Biological Samples, Claude W. Sill, Forest D. Hindman, and Jesse I. Anderson, USAEC, Idaho Falls, Idaho, (prepublication copy).

4. Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980, Method 900.0, paragraph 4.3.

Screening Procedure to Determine Aliquot Size for Analyses of Water Samples for Gross Alpha and Gross Beta.

1. Introduction.

Water samples contain low concentrations of radioactivity. It is therefore essential to analyze as large a sample aliquot as is needed to meet required detection limits specified in Table 1-4 in Attachment 1. Therefore, this screening procedure must be performed before analyses of samples for Gross Alpha and Gross Beta.

2. Procedure.

To screen water samples for determination of aliquot size weigh a 5/16" stainless steel planchet. Place a 3 ml aliquot of sample on the planchet and place the planchet on a hot plate. Heat the sample to dryness for approximately 30 minutes. Remove from the hot plate and place in a desiccator until cool. Reweigh the sample to obtain amount of solids in the sample and use the following formula to determine an aliquot size for the sample:

$$\frac{M \times SA \times A}{\text{mg solids found}} = \text{aliquot size in ml}$$

where: $M = 5.00\ mg/cm^2$, the maximum solids density thickness required.
$SA = 19.3\ cm^2$, the area of the planchet
$A = 3$ ml, the volume of the aliquot

Result obtained will give the maximum amount of aliquot needed to produce 5 mg/cm^2 solids on a planchet. The maximum volume of aliquot calculated in this procedure is 300 ml. If calculated volumes are less than 300 ml, the volume closest to the next lowest 50 ml increment will be used (i.e. for 222 ml use 200 ml, for 185 ml use 150 ml).

Upon completion of screening procedure, analyze water samples for Gross Alpha and Gross Beta using required methodology specified in Table 1-4 in Attachment 1.

METHOD 2

Analysis of Ground Water, Surface Water and Wastewater Samples for Gross Alpha and Gross Beta Radiation

1. For determination of Gross Alpha and Gross Beta activity of samples containing dissolved and suspended solids (< 500 mg/L dissolved solids) use EPA Method 900.0.

2. For determination of Gross Alpha activity of samples containing dissolved and suspended solids (>500 mg/L dissolved solids) use EPA Method A.

3. For determination of Gross Beta activity of samples containing dissolved and suspended solids (>500 mg/L dissolved solids) use EPA Method 900.0. Note: Due to the presence of high dissolved solids content, a smaller aliquot size (five or tens mls) will be taken for analysis.

4. For determination of Gross Alpha and Gross Beta activity of filtered samples (less than 500 mg/L dissolved solids), first filter sample through a 0.45 micron filter and then analyze filtrate by EPA Methode 900.0.

5. For determination of Gross Alpha activity of filtered samples (greater than 500 mg/L dissolved solids), first filter sample through a 0.45 micron filter and analyze filtrate by EPA Method A.

6. For determination of Gross Beta activity of filtered samples (greater than 500 mg/L dissolved solids), first filter sample through a 0.45 micron filter and analyze filtrate by EPA Method 900.0. Note: Due to the presence of high dissolved solids content, a smaller aliquot size (five or ten mls) will taken for analysis.

ATTACHMENT 2

Attachment 2 details quality assurance/quality control guidelines which are to be strictly followed by contract laboratory to assure generation of good quality data during administration of contract.

I. GENERAL QUALITY CONTROL REQUIREMENTS

The purpose of this document is to provide a uniform set of procedures for the performance of chemical analyses of samples, and verification of the sample data generated. The program will also assist laboratory personnel in recalling and defending their actions under cross examination if required to present court testimony in litigation. The contract laboratory must adhere to the quality control/quality assurance requirements of the contract. For a discussion and a description of analytical quality control, the following references are offered:

1. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", US Environmental Protection Agency, Environmental Monitoring and Support Laboratory EPA-600/4-79-019, March 1979, Cincinnati, OH 45268.

2. "Manual of Analytical Quality Control for Pesticides in Human and Environmental Media", US Environmental Protection Agency, Health Effects Research Laboratory, EPA-600/1-76-017, January 1979, Research Triangle Park, NC 27711.

3. "Industrial Hygiene Laboratory Quality Control Manual", Technical Report No. 78, revised Dec 31, 1976 and July 31, 1979, Division of Physical Sciences and Engineering, National Institute for Occupational Safety and Health, Cincinnati, OH 45226.

The laboratory must adhere to good laboratory practices for laboratory cleanliness as applied to glassware, apparatus and facilities in general; and for reagent preparation and solvent and/or gas usage. Additional guidelines are found in reference 1 listed above. The cost of performing all quality control procedures specified in this attachment is to be included in the price of performing the requested chemical analyses.

II. QUALITY CONTROL REQUIREMENTS

The contract laboratory is encouraged to follow all quality control guidelines and procedures listed in above references. Specific analytical quality control, as well as accuracy and precision requirements are provided as Enclosure 1. Strict adherence to these requirements must be maintained. Nonadherance to the requirements may be grounds for termination of the contract. When additional quality control procedures are specified in the analytical methods, the contractor must also follow these procedures.

Examples of quality control requirements which will be included in contracts follow. Examples of forms for required documentation of QC data are also included as Enclosures 2-4.

A. Inorganics.

The following quality control operations for inorganic analytes must be performed during each daily analytical run:

1. Initial Calibration Verification.

2. Blank Analysis.

3. Duplicate Sample Analysis.

4. Spiked Sample Analysis.

1. Initial Calibration Verification.

Guidelines for instrumental calibration are given in EPA 600/4-79-020. After the systems have been calibrated, the accuracy of the initial calibrating solutions shall be documented for every analyte by the analysis of EPA Reference Standard Solutions [available from EPA, telephone (513) 684-7325], or trace element standard reference material available from National Bureau of Standards, telephone (301) 921-2045).

When measurements for the certified components differ statistically from the accepted value (i.e., exceed the combined accuracy and precision limits in Enclosure 1) and the discrepancy cannot be resolved by using prepared, properly diluted and preserved calibrating standards, the concentration for the calibrating standard stock solution shall be adjusted in acceptable measurements for the certified solution components.

The values for the initial calibration verification shall be recorded on the QC Report form provided as Enclosure 2.

Fresh stock calibrating solutions for each analyte shall be prepared monthly and before each set of existing stock calibration standards is consumed. In order to maintain traceability to the reference standards, old and new sets of calibration standards for each analyte must agree (based on conventional t-test analysis) using data from five(5) alternating measurements on the old and new diluted standards before a new set of calibrating standards is accepted for use.

2. A calibration blank must be analyzed each time an instrument is calibrated.

3. Duplicate Sample Analysis.

At least one duplicate sample analysis shall be performed with each group of samples. If possible, the duplicate analysis should be performed on a sample for which the original result is above the detection limit. The relative percent differences (RPD) for each component are calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

Where RPD = Relative Percent Difference
D_1 = First Sample Value
D_2 = Second Sample Value (duplicate)

The results of the duplicate analysis must be reported on the QC Report Form (Enclosure 2).

If duplicate sample results fail to meet precision criteria, the contractor must implement a previously written contingency plan and resolve the discrepancy. The plan must include the following:

1. Checking of data for calculation and/or transcription errors.

2. Preparation of new standards.

3. Recalibration of instruments.

4. Reanalysis of duplicate samples. If upon reanalysis, results do not meet precision specifications, the contractor is required to contact the COR immediately by telephone for further guidance. If reanalysis of duplicate samples falls within precision specifications, the suspicion exists that the precision specification is not met for the other samples in that group. The contractor is then required to run duplicate analyses of 10 percent of samples or all (whichever is smaller) samples of the group in question. If these duplicate results fall within the precision specification, no further action is needed except to report results. (Note that Contractor is required to report all results, including those that did not fall within the precision specification). If the duplicate results from reanalysis do not fall within the precision specification (taking into consideration the original sample results) then all the samples in the group in question must be reanalyzed.

4. Spiked Sample Analysis.

The spiked sample analysis is designed to provide information about the effect of the sample matrix on the measurement methodology. The spike is added after the digestion. Spiking prior to digestion can be complicated by absorption characteristics of the sample that can confound interpretation of the recovery data; thus, it is added as stated above. At least one spiked sample analysis shall be performed on each group of samples of a similar matrix for each batch of samples received. The analyte spike should be added to obtain one-half to twice the endogenous level. If the sample to be spiked is found to be below the detection limit for analyte of interest, then the sample should be spiked to obtain a minimum of ten times the detection limit. Individual component percent recoveries are calculated as follows:

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

Where: SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

The results of the spiked sample analysis must be reported on the QC Report Form (Enclosure 2). If spiked sample results fail to meet accuracy criteria, the contractor must employ a previously written contingency plan and resolve the discrepancy. The plan must include the following:

1. Checking of data for calculation and/or transcription errors.

2. Preparation of new standards.

3. Recalibration of instruments.

4. Reanalysis of spiked sample.

If upon reanalysis, the spike recovery does not meet accuracy specification, the contractor is required to contact the COR immediately by telephone for further guidance. If upon reanalysis, the spike recovery falls within the accuracy specifications (Enclosure 1), the suspicion exists that the accuracy specification is not met for the other samples of the respective matrix. The contractor is then required to reanalyze 10 percent of the samples or all (whichever is smaller) samples of the matrix in question. If agreement of these results of reanalyses with the original results is within the precision specification (Enclosure 1), no further action is needed except to report results. (Note that contractor is required to report all results including those that did not fall within the accuracy and/or precision specifications). If agreement is not within the precision specification, then all the samples of the matrix in question must be reanalyzed.

NOTE: Cost for all reanalyses brought about by breakdown in internal quality control will be borne by the contractor.

B. ORGANICS.

The following quality control operations for organic analytes must be performed during each daily analytical run:

1. Instrument calibration.

2. GC/MS Performance Tests (Method 624 and 625 only).

3. Reagent Blank Analysis.

4. Surrogate Recovery Analysis (Method 624 and 625 only).

5. Matrix Spiked Duplicate Analysis.

1. Guidelines for instrument calibration are given in Section 7 of EPA Methods 608, 624 and 625.

2. Guidelines for GC/MS Performance Tests are given in Section 10 of EPA Method 624 and Section 12 of EPA Method 625.

3. A reagent blank is a volume of distilled water carried through the entire analytical scheme. The reagent blank volume should be approximately equal to the sample volumes being processed. Reagent blank analysis must be performed with every batch of samples analyzed. The reagent blank is used in all analyses to verify that the determined concentrations do not reflect contamination.

If an organic analyte is detected in the blank, the blank value is utilized in the calculation of the sample according to the following options:

a. If the concentration in the blank is equal to the method detection limit specified in Task Order, the blank value is ignored.

b. If the concentration in the blank is less than or equal to one-half the concentration detected in a sample, the sample value shall be corrected accordingly, for the blank value, and the reported value noted with a "C" in the "Measured Value" column of the reporting form.

c. If the concentration in the blank is greater than one-half the concentration detected in a sample, the compound should be reported as "ND" but with a "B" in the "Measured Value" column of the reporting form. The cause of this high blank should be determined and corrected. After the problem is corrected, the batch of samples which was analyzed with the blank shall be reanalyzed at the contractor's expense.

4. Surrogate standard determinations must be performed on all samples and blanks. All samples and blanks must be fortified before purging or extraction with only those spiking compounds listed in Enclosure 3 to monitor preparation and analysis of sample. Surrogate recovery results will be reported on form (Enclosure 3) and will be evaluated for acceptance by determining whether the measured concentrations fall inside the quality control limits given on form. The surrogate recovery for each component is calculated as follows:

$$\text{Surrogate Recovery} = \frac{Q_d}{Q_a} \times 100\%$$

where: Q_d = quantity determined by analysis

Q_a = quantity added to the sample

Treatment of surrogate recovery information is as follows:

a. If surrogate recovery for a reagent blank is outside the quality control limits, the reagent blank should be reinjected or repurged. If this fails to correct the problem, the analytical system is out of control and must be corrected before continuing.

b. If the sample surrogate recovery is outside the quality control limits listed in Enclosure 3, this must be so noted by an asterisk in the appropriate portion of the form.

c. When the recovery of <u>any one</u> surrogate spiking compound exceeds the quality control limits listed on form, the contractor must employ a previously written contingency plan to identify and resolve the discrepancy. This plan must include the following:

(1) Checking calculation of final results.

(2) Preparation of new internal and surrogate standards.

(3) Recalibration of instrumentation.

(4) Reanalysis of samples. Duplicate samples will be collected by this installation and submitted for this purpose. Cost of reanalysis will be borne by the contract laboratory.

5. Matrix spiked duplicate analysis must be performed on at least one sample from each batch or 5 percent of all samples, whichever is larger. To accomplish this, three additional duplicate samples (one to be held in reserve should reanalysis of the matrix spiked duplicate be necessary) will be collected, submitted, and designated for matrix spiked duplicate analysis. The matrix spike will consist of a standard mix of specific organic compounds. The recoveries of compounds in the spiking mix will provide information about the matrix effect of the sample on the analytical methodology. The results of the matrix spiked duplicate analysis should be reported on a form such as the example given in Enclosure 4. Recoveries for individual components of the matrix spike are calculated as follows:

$$\% \text{ Recovery} = \frac{A - B}{C} \times 100$$

where: A = Spiked Sample Result (ppb)
B = Sample Result (ppb)
C = Spike Added (ppb) from spiking solution

The relative percent differences (RPD) for each component are calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100\%$$

where: RPD = Relative Percent Difference
D_1 = First Spiked Sample Value
D_2 = Second Spiked Sample Value (duplicate)

Treatment of matrix spiked duplicate information is as follows:

a. If matrix spiked recoveries and/or RPD's are outside the quality control limits listed on form (Enclosure 4), this must be so noted by an asterisk in the appropriate portion (% Rec or RPD) of this form.

b. When the recovery and/or RPD of any one compound of the matrix spiking solution exceeds the quality control limits listed on Enclosure 4, the contractor must employ a previously written contingency plan to identify and resolve the discrepancy. This plan must include the following:

(1) Checking calculation of final results.

(2) Preparation of new internal and surrogate standards.

(3) Recalibration of instrumentation.

(4) Reanalysis of matrix spike duplicate.

(5) Reanalysis of all samples analyzed with matrix spike duplicate.

Preparation of Matrix Spike Standard Mix.

Specific volatile, acid, base/neutral and pesticide organic compounds should be weighed out and dissolved in methanol and acetone. The concentration of each compound in the base/neutral, acid and volatile standard mixes should be 5 mg/ml in methanol. The concentration of each compound in the pesticide standard mix should be .5 mg/ml in acetone. The compounds listed below should be used to prepare the standard mixes:

Base/Neutrals Standard Mix

1,2,3-Trichlorobenzene
Acenaphthene
2,6-Dinitrotoluene
Di-n-butyl phthalate
Pyrene
N-Nitroso-di-n-propylamine
1,2-Dichlorobenzene

Acids Standard Mix

Pentachlorophenol
2,Methyl-4,6-Dinitrophenol
2-Chlorophenol
4-Chloro-3-Methylphenol
2-Nitrophenol

Pesticides Standard Mix

Heptachlor	Lindane
Aldrin	Endrin
Dieldrin	PP'DDT

Volatile Standard Mix

Chlorobenzene
1-1-Dichloroethylene
Trichloroethylene
Toluene
Benzene

Preparation of Matrix Spiking Solutions

Base Neutrals

To prepare the matrix spiking solution for the base/neutrals, first prepare a stock solution, then the spiking solution as follows:

Stock Solution: Transfer 1.0 mL of each of the base/neutral compounds listed to the same 10-mL volumetric flask. When the transfer is complete, bring up to volume with methanol and mix well.

Spiking Solution: Transfer 1.0 mL of the stock solution to a 10-mL volumetric flask and bring up to volume with methanol. This will provide a matrix spiking solution of 50 µg/mL. Add 1.0 mL of this solution to each sample replicate that has been designated as a base/neutral matrix spike.

Acids

To prepare the matrix spiking solution for the acid compounds, follow the same protocol as that for the base/neutrals. This will provide a matrix

spiking solution of 50 µg/ml. Add 1.0 mL of this solution to each sample replicate that has been designated as an acid matrix spike.

Volatiles:

To prepare the matrix spiking solution for the volatiles, first prepare a stock solution, then the spiking solution as follows:

Stock Solution: Transfer 0.5 mL of each of the volatiles listed to a 10-mL volumetric flask and bring up to volume with methanol and mix well.

Spiking Solution: Transfer 1.0 mL of the stock solution to a 10 ml volumetric flask and bring up to volume with methanol and mix well. This solution will provide a matrix spiking solution of 25 µg/mL. Spike each sample replicate designated as a volatile matrix spike with 50 µl of this solution.

Pesticides

To prepare the matrix spiking solution for the pesticides, first prepare a stock solution, then the spiking solution as follows:

Stock Solution: Transfer 1.0 mL of each of the pesticides listed to a 10-mL volumetric flask and bring up to volume with methanol and mix well.

Spiking solution: Transfer 1.0 mL of the stock solution to a 10 mL volumetric flask and bring up to volume and mix well. This will provide a matrix spiking solution of 5 µg/mL. Add 1.0 mL of this solution to each sample replicate that has been designated as a pesticide matrix spike.

1. Contractor must be certified by the US Environmental Protection Agency or at least one State Government to conduct radiochemical analyses of drinking water in accordance with the Safe Drinking Water Act (Public Law 93-523). Contractor shall abide by all critical elements and recommended practices for radiochemistry which are identified in Manual for the Certification of Laboratory Analyzing Drinking Water, Criteria and Procedures, Quality Assurance, US Environmental Protection Agency Office of Drinking Water (WH-550), Washington, D.C. 20460, October 1982, EPA-570/9-82-D02. Contractor must participate in the USEPA proficiency testing program conducted by the USEPA Environmental Monitoring and Support Laboratory, Las Vegas, Nevada for those radiochemical procedures included in this contract. Exceptions will be made for those procedures not available in the USEPA program. The proficiency testing program must consist of analyses of both the intercomparison samples and blind performance samples. Contractor must successfully meet USEPA criteria for proficiency testing. Contractor's identification code for the USEPA Proficiency Testing Program must be revealed to COR for monitoring of performance.

2. For analytical quality control procedures the contractor is referred to Handbook For Analytical Quality Control In Radioanalytical Laboratories, US Environmental Protection Agency, Office of Research and Development, Washington, D.C. 20460, August 1977, EPA-600/7-77-088. It is recommended that the contractor follow all the procedures described in this handbook in order to form the basis of an effective quality control system.

3. Accomplishment of the following quality control procedures is mandatory:

a. To minimize cross contamination of samples the contract laboratory must be arranged so that radioactive materials are confined to one area clearly designated as a "Hot" area, to which access is restricted to authorized users of radioactive materials.

b. All dilution of radioactive materials to working concentrations must be performed in an isolated area.

c. Counting instruments must be located in a room isolated from all other laboratory activities. To reduce fluctuations and stabilize background radiation contributions, shielding of all counting instruments is necessary. Thick shields of selected lead or steel with graded liners must be used to reduce measurably the background radiation arising from environmental radioactivity. Background must be reduced further by using anti-coincidence counting techniques. The temperature of the counting room must be kept below 30°C and must not vary by no more than $\pm$3°C. Humidity must be kept between 35 and 70 percent.

d. The contract laboratory must be able to generate, in its own facility, reagent water that meets the requirements to qualify as American Society of Testing and Materials (ASIM), Type II water as described in 1983 Annual Book of ASIM Standards, Part 31, Designation D1193-77, "Standard Specification for Reagent Water." Water of this quality must be used for

all radiochemical procedures included in this contract. Contractor must analyze the reagent water at least weekly and document results to reflect adherence to ASIM requirements. Documentation must be made available to COR during site visits. COR may elect to perform analyses on-site to verify quality of reagent water.

e. Instrument logbooks containing records of usage and servicing must be maintained and kept up-to-date for counting and other laboratory instruments.

f. Standards must be considered invalid and disposed of after passing through 4 half lives from date of certification.

g. A specific check source should be used with each counting system. A source chosen as a check will contain a nuclide or nuclides whose energy of radiation corresponds to the type of analysis for which the counting system is to be used. This source will be counted for a predetermined time before each use of the counting system to determine general performance of the system and to ensure that the efficiency of the system has not changed. The check source must be sealed or encapsulated to prevent loss of the source and contamination of the counting system. The check source-to-detector geometry must be known and held constant. The count rate must be entered in the instrument's logbook and plotted on a statistical quality control chart established for the specific system. This value is compared with the ± 2 sigma (warning) limits and the ± 3 sigma (out-of-control) limits, and the procedure is repeated if the ± 3 sigma boundary is exceeded. Sustained values above the warning levels require appropriate action. A contingency plan must be in place and documented, for all analysts to follow in the event plotted points fall outside ± 2 sigma and/or ± 3 sigma limits.

h. Before each use of a counting system, background for the system must be counted for the same counting time for which samples normally are counted. This value must be entered in the logbook and plotted on a statistical quality control chart established for the specific system. The value is to be compared with established ± 2 and ± 3 sigma limits. A contingency plan must be in place and documented, for all analysts to follow in the event plotted points fall outside the ± 2 sigma and/or ± 3 sigma limits.

i. For alpha and beta counting systems, on a quarterly basis or after electronic repair or modification, the detector plateau for gas-discharge devices must be determined and plotted. All pertinent instrument settings, the source used, and the rate of gas flow must be recorded on the plateau graph which must be attached permanently to the logbook. From this plateau, the operating voltage is selected or verified and the plateau slope at the operating point is calculated. The slope must not exceed 2 percent per 100 volts for a Strontium-90 source. The operating potential is selected as the midpoint of the plateau. Thereafter, the high voltage setting must be checked for drift once every two months.

j. For multichannel gamma spectrometers, the instrument must have a proper energy calibration before instrument efficiency or background counting rates are determined. A multiline reference source must be counted

for a time sufficient to provide acceptable statistics (<1% counting error at 1 sigma). After energy calibration, the check source must be counted for a predetermined time before each use by using a selected energy window.

k. For gamma spectrometry, an energy efficiency curve must be determined annually for each germanium detector system for each geometry with a multiline reference source calibrated by the National Bureau of Standards. The curve for the most frequently used geometry must be checked before each use during the year.

l. All calibration standard solutions must be obtained from the US Environmental Protection Agency or the National Bureau of Standards. Standards must not be used beyond four half-lives of the radionuclides. All reagents must be at least ACS grade or better.

m. At least one duplicate sample analysis must be performed with each group of radiological samples of a specific matrix which are submitted to the contract laboratory for analyses. If possible the duplicate sample analysis should be performed on a sample for which the original result is above the detection limit. The relative percent difference (RPD) is then calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

where RPD = Relative Percent Difference
D_1 = First Sample Value
D_2 = Second Sample Value

The results for the duplicate analysis must be reported on QC form (Enclosure 2). If results for duplicate analyses exceed precision criteria specified in Table (Enclosure 1), the contract laboratory must implement a previously written contingency plan and resolve the discrepancy. The plan must include the following:

a. Check of data for calculation and/or transcription errors.

b. Preparation of new standards.

c. Recalibration of instrumentation.

d. Reanalysis of duplicate samples.

If upon reanalysis results exceed precision criteria, the contractor is required to contact the COR immediately by telephone for further guidance. If reanalysis of duplicate samples generates results which are within precision criteria, the suspicion exists that the precision criteria is not met for the other samples of the respective matrix. The contract laboratory is then required to perform duplicate analyses of 10 percent of

radiological samples or all (whichever is smaller) radiological samples of the sample matrix in question. If these duplicate results are within precision criteria, no further action is required except to report the results. If the duplicate results from reanalysis are not within the precision criteria, then all radiological samples of the matrix in question must be reanalyzed.

n. Internal quality control (QC) samples must be prepared by the Quality Control Coordinator and submitted concurrently with radiological samples of each matrix for analyses. The contract laboratory is required to analyze one QC sample per 10 radiological samples submitted or one QC sample per batch of radiological samples submitted (whichever is smaller) to the contract laboratory. The recoveries for the QC samples must be reported on QC form (Enclosure 2). Results for these recoveries must also be plotted on control charts to visually monitor trends and to visually identify out of control situations. The COR reserves the right to inspect control charts during on site visits. For information on the construction of control charts consult the following reference: "Handbook for Analytical Quality Control in Radioanalytical Laboratories". EPA-600/7-77-088, August, 1977, US Environmental Protection Agency, Washington, D.C. 20460. When recoveries of QC samples exceed accuracy criteria stated in the Table, provided as Enclosure 1, the contract laboratory must employ a previously written contingency plan to resolve the discrepancy. This plan includes the following:

a. Check of data for calculation and/or transcription errors.

b. Preparation of new standards.

c. Recalibration of instrumentation.

d. Reanalysis of QC samples.

If upon reanalysis of the QC sample the recovery exceeds the accuracy criteria, the contract laboratory is required to contact the COR immediately by telephone for further guidance. If upon reanalysis of the QC sample the recovery is within the accuracy criteria, the suspicion exists that the accuracy criteria is not met for the other radiological samples in the batch. The contract laboratory is then required to reanalyze 10 percent of the samples or all (whichever is smaller) radiological samples in question. If agreement of these results for reanalyses with the original results is within the precision criteria stated in Table, no further action is needed except to report results. If agreement is not within the precision criteria, then all radiological samples must be reanalyzed and results reported accordingly.

Cost for all reanalyses caused by breakdown in the internal quality control system will be borne by the contract laboratory.

TABLE. REQUIRED ACCURACY AND PRECISION FOR ANALYSIS

Chemical Analysis	Range of Concentration (mg/l)	Combined Accuracy and Precision Required (+ %)
Aluminum	1.00-100	30
Antimony	0.5-2.0	45
Arsenic	0.01-1.00	30
Barium	0.30-1.00	30
Beryllium	0.05-1.00	21
Boron	10.0-100	45
Cadmium	0.001-1.00	30
Calcium	1.00-100	24
Chromium	0.001-5.00	24
Cobalt	0.20-2.00	30
Copper	0.025-2.00	27
Iron	1.0-50	18
Lead	0.005-5.00	30
Magnesium	0.50-50.0	15
Manganese	0.03-2.00	21
Mercury	0.0002-0.0040	30
Molybdenum	0.50-10	45
Nickel	0.10-2.00	30
Potassium	0.50-5.00	15
Selenium	0.005-0.050	45
Silver	0.025-0.500	30
Sodium	1.00-250	21
Thallium	1.00-10.0	30
Tin	1.00-10.0	30
Titanium	1.00-10.0	30
Vanadium	2.00-10.0	30
Zinc	0.015-10.0	27
Ammonia	0.10 - 50.0	24
Chemical Oxygen Demand	15.0 - 1000	30
Cyanide, Total and Amenable to Chlorination	0.01 - 100	30
Fluoride	0.1 - 10	24
Grease & Oil	1.00 - 1000	18
Moisture	0.1% - 100%	15
Nitrate-Nitrite	0.01 - 100	15
Total Kjeldahl Nitrogen	0.10 - 100	36
Phenol	0.01 - 100	24
Phosphate	0.02 - 1000	24
Sulfate	2.0 - 1000	30
Total Organic Carbon	0.10 - 100	27
Volatile Acids	5 - 100	30

* The accuracy and precision values are given for water samples only at this time, except for moisture, because they do not exist for soil and sludge at present. USAEHA reserves the right to hold contract laboratory to accuracy and precision requirements for soil and sludge as they become available.

Chemical Analysis	Range of Concentration	Combined Accuracy and Precision Required (+%)
Specific Conductance	0.1 - 100,000 µmhos/cm	10
T. Organic Carbon	50 - 100,000 µg/l	18
T. Organic Halogen	10 - 1000 µg/l	20
Acidity	1.0 - 1000	15
Alkalinity	1.0 - 5000	24
Chloride	1.0 - 5000	15
Hardness	1.0 - 500	15
pH	1 - 14 pH units	.2 units
TDS	1 - 100,000	30
TS	1 - 100,000	30
TSS	1 - 100,000	30
TVDS	1 - 100,000	30
TVS	1 - 100,000	30
TVSS	1 - 100,000	30
Turbidity	0.2-200 NTU	30
Settleable Solids	1.0-1000 mg/L	30
Nitrite Nitrogen	0.01-10 mg/L	15
Orthophosphate Phosphorus	0.02-20 mg/L	30
BOD	1.0-1000 mg/L	45
MBAS	0.05-50 mg/L	45
Color	5-500 Color Units	45
Sulfide	0.05-50 mg/L	30
Hexavalent Chromium	0.025-25 mg/L	30
Silica	0.2-200 mg/L	21
2,4,6-TNT	0.001-1.0 mg/L	30
2,4-DNT	0.001-1.0 mg/L	30
2,6-DNT	0.001-1.0 mg/L	30
RDX	0.03-30 mg/L	30
HMX	0.1-100 mg/L	30
Tetryl	0.005-5.0 mg/L	30
Ammonium Picrate (Picric Acid)	0.5-500 mg/L	30
Urea	0.1-100 mg/L	30
Melamine	0.5-500 mg/L	30
Nitroguanidine	0.1-100 mg/L	30

TABLE. REQUIRED ACCURACY AND PRECISION FOR ANALYSIS

Analysis	Range of Concentration (mg/l)	Accuracy Required (%)	Precision Required (%)
Volatile Organic Compounds	0.01 - 100	± 36	± 24
Acid/Base/Neutral Extractable Organic Compounds	0.01 - 100	± 60	± 40
Pesticide Organic Compounds	0.0001 - 100	± 30	± 20

TABLE. REQUIRED ACCURACY AND PRECISION FOR ANALYSIS

Chemical Parameter	Precision*	Accuracy**
Gross Alpha	24	30
Gross Beta	10	20
Tritium	10	20
Strontium 89 & 90	20	30
Radium 226 & 228	20	30
Iodine 131	10	20
Gamma Emitters	10	30
Uranium	24	30
Other Actinides	30	45

* Precision is expressed as two times the Relative Standard Deviation.
** Accuracy is expressed as three times the method Bias.

Lab Name: _____ QC Report No. _____

Sample No's: _____ To _____

Number of Samples: _____

QC REPORT FORM I

Analyte: _____

Method: _____

Units

Initial Calibration Verification	Reference Standard Source _____	Found: _____ True Value: _____ % Recovery: _____
Duplicate Sample Results	Sample No.: _____	Sample Result: _____ Duplicate Result: _____ RPD% _____
Spiked Sample Results	Sample No: _____	Sample Result: _____ Spike Result: _____ Spike Added: _____ % Recovery: _____

Comments:

Analyst Signature: _____

Date: _____

Data Reviewed and Validated by: _____

Date: _____

QC FORM II

WATER/WASTEWATER SURROGATE RECOVERY +

LAB NAME _____ DATA REVIEWED AND VALIDATED BY _____

ANALYST SIGNATURE _____ DATE _____

	Volatile	Acid/Base/Neutral				
USAEHA SAMPLE NO.	D_8 TOLUENE (84-114)	D_5 NITROBENZENE (42-131)	2-FLUORO BIPHENYL (50-154)	D_5 PHENOL (15-90)	2-FLUORO PHENOL (25-115)	REMARKS

+ Control limits are listed in parentheses for each surrogate compound and are listed in units of percent recovery. These limits are established by the Environmental Protection Agency and are to be used only for monitoring surrogate recovery.

OC FORM III

MATRIX SPIKED DUPLICATE ANALYSIS

LAB NAME _____ DATA REVIEWED AND VALIDATED BY _____

ANALYST SIGNATURE _____ DATE _____

Instrument Group	Compound	Matrix Spike #1 C Concentration Spike Added(ppb)	Matrix Spike #1 A Spiked Sample Result (ppb)	Matrix Spike #1 B Sample Result (ppb)	Matrix Spike #1 A-B Spike Result (ppb)	Matrix Spike #1 % Rec	Matrix Spike #2 C Concentration Spike Added(ppb)	Matrix Spike #2 A Spiked Sample Result (ppb)	Matrix Spike #2 B Sample Result (ppb)	Matrix Spike #2 A-B Spike Result (ppb)	Matrix Spike #2 % Rec	Ave % Rec	QC Limit Ave % Rec
Volatile Organic Compounds	1, 1 Dichloroethylene												+ 36
	Trichloroethylene												+ 36
	Chlorobenzene												+ 36
	Toluene												+ 36
	Benzene												+ 36
Base/Neutral Extractable Organic Compounds	1,2,4-Trichlorobenzene												+ 59
	Acenaphthene												+ 59
	2,6 Dinitrotoluene												+ 59
	Di-n-Butylphthalate												+ 59
	Pyrene												+ 59
	N-Nitrosodipropylamine												+ 59
	1,2 Dichlorobenzene												+ 59
Acid Extractable Compounds	Pentachlorophenol												+ 60
	2, Methyl-4,6 Dinitrophenol												+ 60
	2, Chlorophenol												+ 60
	4,Chloro-3-Methylphenol												+ 60
	2, Nitrophenol												+ 60
Pesticide Compounds	Lindane												+ 30
	Heptachlor												+ 30
	Aldrin												+ 30
	Dieldrin												+ 30
	Endrin												+ 30
	p,p' - DDT												+ 30

NOTE: Tabulated values which are outside of QC limit should be indicated by an asterisk.

PART 1

QC FORM III

MATRIX SPIKED DUPLICATE ANALYSIS

LAB NAME _____ DATA REVIEWED AND VALIDATED BY _____

ANALYST SIGNATURE _____ DATE _____

Contaminant Group	Compound	D1 Matrix Spike # 1 Spiked Sample Result	D2 Matrix Spike # 2 Spiked Sample Result	RPD	QC Limit RPD
Volatile	1,1 Dichloroethylene				± 24
	Trichloroethylene				± 24
Organic	Chlorobenzene				± 24
	Toluene				± 24
Compounds	Benzene				± 24
Base/Neutral	1,2,4-Trichlorobenzene				± 40
	Acenaphthene				± 40
Extractable	2,6 Dinitrotoluene				± 40
	Di-N-Butylphthalate				± 40
Organic	Pyrene				± 40
	N-Nitrosodi-N-Propylamine				± 40
Compounds	1,2 Dichlorobenzene				± 40
Acid	Pentachlorophenol				± 40
	2, Methyl-4,6 Dinitrophenol				± 40
Extractable	2, Chlorophenol				± 40
	4, Chloro-3-Methylphenol				± 40
Organic Compounds	2, Nitrophenol				± 40
Pesticide	Lindane				± 20
	Heptachlor				± 20
Organic	Aldrin				± 20
Compounds	Dieldrin				± 20
	Endrin				± 20
	p,p' - DDT				± 20
	[illegible]				[illegible]

NOTE: Tabulated values which are outside of QC limit should be indicated by an asterisk.

ATTACHMENT 3

Attachment 3 details chain-of-custody procedures which contract laboratory must adhere to during administration of contract.

Specifications for Chain-of-Custody and Document Control Procedures

The Contractor must have written standing operating procedures (SOP) for receipt of samples, maintenance of custody, tracking the analysis of samples and assembly of completed data. These procedures are necessary to ensure that analytical data collected under this contract are acceptable for use in litigation. The Contractor's SOP shall provide mechanisms and documentation to meet each of the following specifications and shall be used by the COR for the basis for laboratory evidence audits.

1. The Contractor shall have a designated sample custodian responsible for receipt of the samples.

2. The Contractor shall have written SOP's for receiving and logging in of the samples. The procedures shall include documentation of the sample condition, maintenance of custody and sample security and documentation of verification of sample tag information against custody records.

3. The Contractor shall have written SOP's for maintenance of the security of the samples after log in and shall demonstrate security of the sample storage and laboratory areas.

4. The Contractor shall have written SOP's for tracking the work performed on any particular sample. The tracking system shall include standard logging formats, logbook entry procedures and a means of controlling logbook pages, computer printouts, and other written or printed documents relevant to the samples. Logbooks, printed forms or other written documentation must be available to describe the work performed in each of the following stages of analysis:

   a. Sample Receipt
   b. Sample Analysis
   c. Data Reduction
   d. Data Reporting

5. The Contractor shall have written SOP's for organization and assembly of all documents relating to analyses of samples for this contract. Documents shall be filed according to sample label numbers. The procedures must ensure that all documents including logbook pages, sample tracking records, measurement readout records, computer printouts, raw data summaries, correspondence and any other written documents having reference to the samples are compiled in one location for submission to the installation. The system must include a document numbering and inventory procedure.

6. Document control and chain-of-custody records include but are not limited to: sample tags, custody records, sample tracking records, analysts logbook pages, bench sheets, measurement readout records, analysis chronicles, computer printouts, raw data summaries, instrument logbook pages, correspondence, and the document inventory.

Chain-of-Custody and Document Control Procedures
for Designated Samples Requiring Such

Sample Control

A sample is physical evidence collected from a facility or from the environment. An essential part of this investigations effort is the control of the evidence gathered. To accomplish this, the following chain-of-custody and document control procedure have been established.

Sample Identification

Each sample bottle shall be labeled with a tag containing the sample number and sample description to identify the contents of the bottle. Additionally, the sample number shall be marked on the outside of any special packaging container to facilitate identification.

Chain-of-Custody Procedures

Because of the nature of the data being collected, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. To maintain and document sample custody, the chain-of-custody procedures described herein are followed.

A sample is under custody if:

1. It is your actual possession, or

2. It is in your view, after being in your physical possession, or

3. It was in your possession and they you locked or sealed it up to prevent tampering, or

4. It is in a secure area.

To assure custody of samples during transport and shipping, each sample within a packaging container is recorded on a chain-of-custody records shown in enclosure 1. Each sample number is recorded, and the number of containers shipped is recorded on the sheets. Also, record the other information regarding the project, samples (or shipper if returning empty bottles), method of shipment and remember to sign and date the sheet. The original custody sheet is then placed inside the package (protected from damage) and the package sealed.

Sample containers, shipping boxes, coolers or other packages will be sealed. The seal must be placed so the container cannot be opened without breaking the seal.

Upon receipt of samples in custody, inspect the package and note any damage to the sealing tape or custody seals. Note on the custody record or other logbook that the seals or locks were intact upon receipt if no tampering or damage appears to have occurred. Open the packages and verify that each

item listed on the sheet is present and correctly identified. If all data and samples are correct, sign and date the "received by Laboratory by" box. In the event errors are noted, record the discrepancies in the remarks column (initial and date each comment) then sign the chain-of-custody record.

Laboratory Document Control

The goal of the Document Control Program is to assure that all documents for a specified group of samples will be accounted for when the group is completed. The program includes a document numbering and inventory procedure for preparation of the specified documentation packages for each case.

Logbooks

All observations and results recorded by the Laboratory but not on pre-printed data sheets are entered into permanent laboratory logbooks. Data recorded are referenced with the sample numbers, date and analyst's signature at the top of the page. Data from only one group or batch of samples are recorded per page. When all the data from a batch is compiled, copies of all logbook entries must be included in the documentation package.

Instrument logs are also limited to one sample group per page with the group sample numbers recorded at the top of each page. Copies of these logs must also be included in the final documentation package.

Corrections to Documentation

All documentation in logbooks and other documents shall be in ink. If an error is made in a logbook assigned to one individual, that person should make corrections simply by crossing a line through the error and entering the correct information. Changes made subsequently are dated and initialed. Corrections made to other data records or nonpersonal logbooks are made by crossing a single line through the error, entering the correct information and initialing and dating the correction.

Consistency of Documentation

Before releasing analytical results, the laboratory assembles and cross checks the information on sample tags, custody records, lab bench sheets, personal and instrument logs and other relevant data to ensure that data pertaining to each particular sample or group of samples is consistent throughout the record.

Document Numbering and Inventory Procedure

In order to provide document accountability of the completed analysis records, each item is inventoried and assigned an identifier associating it to sample label numbers.

All documents relevant to each sample group including: logbook pages, bench sheets, custody records, etc., are inventoried. Each data generator (analyst) is responsible for ensuring that all documents generated are placed in the file for inventory and returned to the installation. Enclosure 2 is an example of a document inventory.

CHAIN OF CUSTODY RECORD

INSTALLATION			COLLECTION DATE/TIME			TYPE OF SAMPLE
SITE IDENTIFICATION			ANALYTICAL QUALITY ASSURANCE OFFICE NUMBER			LABORATORY NUMBER
RELINQUISHED BY SIGNATURE	DATE	TIME	RECEIVED BY SIGNATURE	DATE	TIME	ANALYSES PERFORMED BY RECEIVER

AEHA Form 235, 1 Dec 83 (USAPPC OTL)

ATTACHMENT 4

Attachment 4 delineates data reporting procedures to be used by the contract laboratory(s).

The contract laboratory(s) shall report data to the installation and to USAEHA. Data reports shall include both hard copy and soft copy as described below. Note that some installations may not wish to receive soft copy data.

1. HARD COPY DATA PACKAGE. Data report package for analyses of each sample (including all required QC-Attachment 2) shall include:

a. Tabulated results in appropriate units of the analytes specified in the contract, validated and signed in original signature by the Laboratory Manager. *Data are to be identified by sample numbers.

b. Analytical results for quality control samples.

c. Tabulation of current calculated instrument detection limits as determined by the laboratory.

d. Legible photocopy of raw data (measurement readout record) with sufficient information to unequivocally identify:

(1) calibration standards (including prep date)

(2) laboratory reagent blanks

(3) samples and any atypical dilution

(4) quality control samples

(5) any instrument adjustments or apparent anomalies on the measurement record. Information shall include a key to abbreviations, with response units stated.

2. SOFT COPY DATA PACKAGE.

a. Hardware. All results for field samples shall be reported to the installation (where requested) and USAEHA on 5 1/4-inch floppy disks. The laboratory shall maintain the original disk and at least one backup disk, in addition to the disks used for reporting. Disks shall be mailed in packaging that will protect them from bending or scratching. If a disk is damaged in transport, another copy of that disk shall be provided by the laboratory. All disks submitted to USAEHA will be returned to the laboratory for reuse.

* In the event the Laboratory Manager cannot validate all data reported for each sample, he/she will provide a detailed description of the problems associated with the sample.

b. Software. The data shall be entered into ASCII files only. Each result shall comprise one data record. The format to be used for chemical data records is as follows:

Chemical Data Records

Card Columns	Field Width	Type Spec	Just	Entry
1-6	6	I6	L	Installation number (see enclosure 1 for installation codes).
7-12	6	I6	L	Parameter code (see enclosure 2 for parameter codes and numbers).
		or		
		I6	R	Parameter number The parameter code and number are as defined in file RG2GN$D.PARAM (enclosure 2).
13-20	8	A6,A2	L	Entry to identify method of analysis.
21-22	2	A2	L	Code to identify performing laboratory: XX - lab codes to be designated by COR For example, EH - Army Environmental Hygiene Agency
23-25	3	A3	L	Units code as defined in file RG2GN$D.PARAM.
26-27	2	A2	L	Filtering coded (0.45 micron filter size): U - unfiltered F - filtered FP - filtered with pressure apparatus FV - filtered with vacuum apparatus
28-29	2	A2	L	Sample type: GW - ground water SW - surface water
30-31	2	A2	L	Sampling method code (to be added by installation if desired).
32-36	5	I5		Sampling date (Julian)
37-41	5	A5	L	Well ID (Sampling site ID)
42	1	A1		Detection code; b if parameter detected, otherwise "<".
43-51	9	F9.3		Value detected or detection limit if none detected.
52-80	29	4A6,A5	L	Comments as appropriate.

FILE RG2GNSD.NAME
FILE FORMAT SPECIFICATIONS ARE PROVIDED AS PAGE 3 OF THIS ENCLOSURE

```
 1:109804CTSTRATFORD AEP, CT
 2:121478KYFT KNOX, KY
 3:121506KYLEXINGTON-BLUE GRASS AD, KY
 4:124004MDABERDEEN PROVING GROUND, MD
 5:125176MAFT DEVENS, MA
 6:134201NJFT DIX, NJ
 7:134693NJPICATINNY ARSENAL, NJ
 8:136216NYFT DRUM, NY
 9:136794NYSENECA AD, NY
10:136939NYWATERVLIET ARSENAL, NY
11:136953NYWEST POINT MILITARY ACADEMY, NY
12:139729OHRAVENNA AAP, OH
13:142394PAFT INDIANTOWN GAP, PA
14:142461PALETTERKENNY AD, PA
15:151389VAFT AP HILL, VA
16:151693VAFT PICKETT, VA
17:151724VARADFORD AAP, VA
18:301035ALANNISTON AD, AL
19:301750ALREDSTONE ARSENAL, AL
20:301767ALFT RUCKER, AL
21:313048GAFT GILLEM, GA
22:313355GAFT GORDON, GA
23:313834GAFT STEWART, GA
24:321128KYFT CAMPBELL, KY
25:347408TNHOLSTON AAP, TN
26:347580TNMILAN AAP, TN
27:347927TNVOLUNTEER AAP, TN
28:417432ILJOLIET AAP, IL
29:417800ILSAVANNA ADA, IL
30:418173INCRANE NWSC, IN
31:418351INFT BENJAMIN HARRISON, IN
32:418393ININDIANA AAP, IN
33:418403INJEFFERSON PROVING GROUND, IN
34:418611INNEWPORT AAP, IN
35:419422IAIDWA AAP, IA
36:420736KSFT RILEY, KS
37:420785KSSUNFLOWER AAP, KS
38:427887MNTWIN CITIES AAP, MN
39:429494MOLAKE CITY AAP, MO
40:455057WIBADGER AAP, WI
41:455533WIFT MCCOY, WI
42:505698ARPINE BLUFF ARSENAL, AR
43:522543LALOUISIANA AAP, LA
44:522722LAFT POLK, LA
45:540548OKMCALESTER AAP, OK
46:540801OKFT SILL, OK
47:548513TXLONE STAR AAP, TX
48:548515TXLONGHORN AAP, TX
49:548733TXRED RIVER AD, TX
50:602736AKFT RICHARDSON, AK
51:602955AKFT WAINWRIGHT, AK
52:606742CARIVERBANK AAP, CA
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53:606886CADEFENSE DEPOT TRACY, CA
54:608135COFT CARSON, CO
55:608728COPUEBLO AD, CO
56:60876CCOROCKY MOUNTAIN ARSENAL, CO
57:63235CNVHAWTHORNE AAP, NV
58:641899ORUMATILLA ADA, OR
59:64915CUTDEFENSE DEPOT OGDEN, UT
60:649878UTTOOELE AD, UT
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ALL

RG2GN$D.NAME

Card Columns	Field Width	Type Spec	Just	Entry
1-6	6	I6		Installation number (region code + ARLOC).
7-8	2	A2		State abbreviation.
9-80	72	12A6	L	Installation name.

FILE RG2GN$D.PARAM
FILE FORMAT SPECIFICATIONS ARE PROVIDED AS PAGE 8 OF THIS ENCLOSURE.

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 1:000101AS     ARSENIC      F9.3      .01 MGLF  1. 6M ARSENIC
 2:000102BA     BARIUM       F9.2      .05 MGLF  1. 6M BARIUM
 3:000103CD     CADMIUM      F9.3      .001MGLF  1. 6M CADMIUM
 4:000104CR     CHROMIUM     F9.3      .001MGLF  1. 6M CHROMIUM
 5:000105F      FLUORIDE     F9.1      .1  MGL  28.28D FLUORIDE
 6:000106PB     LEAD         F9.3      .005MGLF  1. 6M LEAD
 7:000107HG     MERCURY      F9.1      .2  UGLF  5.28D MERCURY
 8:000108N02N03N02+N03 AS NF9.2      .01 MGL  20.28D NITRATE + NITRITE AS NITROGEN
 9:000109SE     SELENIUM     F9.3      .005MGLF  1. 6M SELENIUM
10:000110AG     SILVER       F9.3      .001MGLF  1. 6M SILVER
11:000111ENDRINENDRIN       F9.2      .04 UGLF  2. 7D ENDRIN
12:000112LINDANLINDANE      F9.2      .08 UGLF  2. 7D LINDANE
13:000113TOXAPHTOXAPHENE    F9.1     1.6  UGLF  2. 7D TOXAPHENE
14:000114METHOXMETHOXYCHLORF9.1     1.6  UGLF  2. 7D METHOXYCHLOR
15:00011524D    2,4-D        F9.1     3.8  UGLF  2. 7D 2,4-D
16:000116SILVEXSILVEX        F9.1      .5  UGLF  2. 7D SILVEX
17:000117GALPHAGROSS ALPHA   F9.2     0.4  PCLF  4. 6M GROSS ALPHA
18:000118RAD226RADIUM-226    F9.2      .05 PCLF  4  6M RADIUM-226
19:000119RAD228RADIUM-228    F9.2      .70 PCLF  4  6M RADIUM-228
20:000120GBETA GROSS BETA    F9.2     1.1  PCLF  4. 6M GROSS BETA
21:000121STRN90STRONTIUM-90F9.1     0.7  PCLF  4     STRONTIUM-90
22:000122TRITIUTRITIUM       F9.0   550.   PCLF  4     TRITIUM
23:000123URAN  URANIUM       F9.2     0.3  PCLF  4  6M URANIUM
24:000124TH-234THORIUM 234   F9.2     0.3  PCLF       THORIUM-234
25:000126TURB  TURBIDITY     F9.0     1.0  NTUU25 48H TURBIDITY
26:000127TCBACTTOTCOLBACT    F9.0     1.   PHMU   6H TOTAL COLOFORM BACTERIA
27:000128FCBACTFECCOLBACT    F9.0     1.   PHMU   6H FECAL COLOFORM BACTERIA
28:000151CL     CHLORIDE     F9.1     1.0  MGL  14.28D CHLORIDE
29:000152FE     IRON         F9.2      .02 MGLF  1. 6M IRON
30:000153MN     MANGANESE    F9.3      .001MGLF  1. 6M MANGANESE
31:000154PHENOLPHENOL        F9.2      .01 MGLF19.28D TOTAL RECOVERABLE PHENOLICS
32:000155NA     SODIUM       F9.0     1.   MGLF  1. 6M SODIUM
33:000156S04    SULFATE      F9.1     2.0  MGL  14.28D SULFATE
34:000169CONDFDCOND(FIELD)   F9.0     1.0  UMCU    2H SPECIFIC CONDUCTIVITY(FIELD)
35:000170PH     PH(FIELD)    F9.1          PH U    2H PH(FIELD)
36:000171PH-LABPH(LAB)       F9.1          PH U22     PH(LAB)
37:000172COND   SPEC COND    F9.0     1.0  UMCU22.28D SPECIFIC CONDUCTIVITY
38:000173TOC    TOC          F9.1      .1  MGLF17.28D TOTAL ORGANIC CARBON
39:000174TOX    TOX          F9.3     0.01 MGLU 3.  7D TOTAL ORGANIC HALIDE
40:000175POX    POX          F9.3     0.01 MGLU 3   7D PURGEABLE ORGANIC HALIDE
41:000176NPOX   NPOX         F9.3     0.01 MGLU 3   7D NON-PURGEABLE ORGANIC HALIDE
42:000177TOC-UFTOC(UNFILT)   F9.1     1.   MGLU18 28D TOTAL ORGANIC CARBON(UNFILTERED SAMPLE)
43:000181COD    COD          F9.0    13.   MGL  20 28D CHEMICAL OXYGEN DEMAND
44:000182TEMP   TEMPERATURE  F9.0          C  U    OH TEMPERATURE
45:000183TDS    TDS          F9.0     1.   MGLU24 14D TOTAL DISSOLVED SOLIDS
46:000184TSS    SUSP SOLIDS  F9.0     1.   MGLU23  7D TOTAL SUSPENDED SOLIDS
47:000185TS     TOT SOLIDS   F9.0     1.   MGLU24 14D TOTAL SOLIDS
48:000186ACID   ACIDITY                      U26 14D ACIDITY
49:000187T-ALK  TOTAL ALK    F9.0     2.   MGLU26 14D TOTAL ALKALINITY
50:000188HARD   HARDNESS     F9.0     2.   MGLF27  6M HARDNESS
51:000189RCL    CHLORINE     F9.1      .05          2H TOTAL RESIDUAL CHLORINE
52:000190HARD-CHARD(CALCUL)F9.1     0.3  MGLF  1   6M CALCULATED HARDNESS
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53:	000191	SETSOL	SET SOLIDS	F9.0	1.		MGLU	25	7D SETTLEABLE SOLIDS
54:	000192	P-ALK	PHENTHLN ALK	F9.0	1.		MGLU		14D PHENOLPHTHALEIN ALKALINITY
55:	000201	NO3-N	NITRATE-N	F9.2	.01	MGL	15	48H	NITRATE AS NITROGEN
56:	000202	NO2-N	NITRITE-N	F9.2	.01	MGL	15	48H	NITRITE AS NITROGEN
57:	000203	NH3-N	AMMONIA-N	F9.2	.05	MGL	20	28D	AMMONIA AS NITROGEN
58:	000204	TKN	TOT KJEL N	F9.2	.1	MGL	20	28D	TOTAL KJELDAHL NITROGEN
59:	000211	PO4-P	PHOSPHATE-P	F9.2	.02	MGL	20	28D	TOTAL PHOSPHATE AS PHOSPHORUS
60:	000212	DPO4-P	ORTHO PHOS-P	F9.2	.02	MGL	15	48H	ORTHOPHOSPHATE AS PHOSPHORUS
61:	000221	BOD-5	BOD-5 DAY	F9.0	1.	MGLF	10	48H	5-DAY BIOCHEMICAL OXYGEN DEMAND
62:	000225	OG	GREASE + OIL	F9.1	.2	MGLU	9	28D	OIL AND GREASE
63:	000226	MBAS	SURFACTANTS	F9.2	.05	MGLF	16	48H	SURFACTANTS
64:	000231	COLOR	COLOR	F9.0	5.	CU	F16	48H	COLOR
65:	000232	ODOR	ODOR	F9.0	1.	TONU			ODOR
66:	000233	TASTE	TASTE			U			TASTE
67:	000251	CN	CYANIDE	F9.2	.01	MGL	7	14D	TOTAL CYANIDE
68:	000261	S	SULFIDE	F9.2	.05	MGL	8	28D	SULFIDE
69:	000281	CU	COPPER	F9.3	.025	MGLF	1	6M	COPPER
70:	000282	ZN	ZINC	F9.2	.015	MGLF	1	6M	ZINC
71:	000283	HEXCR	HEX CHROMIUM	F9.2	.05	MGLF	6	48H	HEXAVALENT CHROMIUM
72:	000284	K	POTASSIUM	F9.2	.1	MGLF	1	6M	POTASSIUM
73:	000285	MG	MAGNESIUM	F9.2	.02	MGLF	1	6M	MAGNESIUM
74:	000286	CA	CALCIUM	F9.1	.1	MGLF	1	6M	CALCIUM
75:	000287	NI	NICKEL	F9.2	.01	MGLF	1	6M	NICKEL
76:	000288	V	VANADIUM	F9.1	.025	MGLF	1	6M	VANADIUM
77:	000289	SB	ANTIMONY	F9.3	.003	MGLF	1	6M	ANTIMONY
78:	000290	BE	BERYLLIUM	F9.2	.001	MGLF	1	6M	BERYLLIUM
79:	000291	TL	THALLIUM	F9.2	.001	MGLF	1	6M	THALLIUM
80:	000292	B	BORON	F9.2	0.05	MGLF	1	6M	BORON
81:	000293	CO	COBALT	F9.1	.1	MGLF	1	6M	COBALT
82:	000294	AL	ALUMINUM	F9.1	.01	MGLF	1	6M	ALUMINUM
83:	000295	SIO2	SILICA	F9.2	.20	MGLF	11	28D	SILICA
84:	000296	SN	TIN	F9.2	.50	MGLF	1	6M	TIN
85:	000297	MO	MOLYBDENUM	F9.2	.50	MGLF	1	6M	MOLYBDENUM
86:	000401	246TNT	2,4,6-TNT	F9.3	.001	MGLF	12		2,4,6-TRINITROTOLUENE
87:	000402	24DNT	2,4-DNT	F9.3	.001	MGLF	12		2,4-DINITROTOLUENE
88:	000403	26DNT	2,6-DNT	F9.3	.001	MGLF	12		2,6-DINITROTOLUENE
89:	000404	RDX	RDX	F9.3	.03	MGLF	12		ROX
90:	000405	HMX	HMX	F9.3	.10	MGLF	12		HMX
91:	000406	TETRYL	TETRYL	F9.3	.01	MGLF	12		TETRYL
92:	000407	TNR	TNR	F9.0	.	MGLF	12		TRINITRORESORCINOL
93:	000408	NH4PIC	AMMONPICRATE	F9.0	10.	UGLF	12		AMMONIUM PICRATE
94:	000409	NQ	NQ	F9.1	0.5	MGL	37		NITROGUANIDINE
95:	000410	GUANN	GUAN NITRATE	F9.1	1.0	MGL	37		GUANIDINE NITRATE
96:	000420	THIODG	THIODIGLYCOL	F9.1	15.0	MGL	13		THIODIGLYCOL
97:	000430	UREA	UREA	F9.2		MGL	36		UREA
98:	000431	MELAMN	MELAMINE	F9.2		MGL	37		MELAMINE
99:	000432	FORM	FORMALDEHYDE	F9.2		MGL	38		FORMALDEHYDE
100:	000501	METHAN	METHANOL	F9.0	40.	UGLU			METHANOL
101:	000502	ETHAN	ETHANOL	F9.0	200.	UGLU			ETHANOL
102:	000503	ETHER	ETHER	F9.0	1.	UGLU			ETHER
103:	000504	ACETO	ACETONE	F9.0	5.	UGLU			ACETONE
104:	000505	A505	ETHYL HEXAN	F9.0	5.	UGL			ETHYL HEXANOL
105:	000506	A506	2-PROPANOL	F9.0	5.	UGL			2-PROPANOL
106:	000601	P601	ACENAPHTHENE	F9.0	10.	UGL			ACENAPHTHENE
107:	000602	P602	ACROLEIN	F9.0	.	UGLU			ACROLEIN
108:	000603	P603	ACRYLDNITR	F9.0	.	UGLU			ACRYLONITRILE
109:	000604	P604	BENZENE	F9.0	3.	UGLU			BENZENE

110:000605P605	BENZIDINE	F9.0	10.	UGL	BENZIDINE
111:000606P606	CCL4	F9.0	3.	UGLU	CARBON TETRACHLORIDE
112:000607P607	C6H5CL	F9.0	3.	UGLU	CHLOROBENZENE
113:000608P608	124CLBENZENE	F9.0	10.	UGLU	1,2,4-TRICHLOROBENZENE
114:000609P609	C6CL6	F9.0	10.	UGL	HEXACHLOROBENZENE
115:000610P610	CH2CLCH2CL	F9.0	3.	UGLU	1,2-DICHLOROETHANE
116:000611P611	CH3CCL3	F9.0	3.	UGLU	1,1,1-TRICHLOROETHANE
117:000612P612	CL6ETHANE	F9.0	10.	UGLU	HEXACHLOROETHANE
118:000613P613	CH3CHCL2	F9.0	3.	UGLU	1,1-DICHLOROETHANE
119:000614P614	CH2CLCHCL2	F9.0	3.	UGLU	1,1,2-TRICHLOROETHANE
120:000615P615	CHCL2CHCL2	F9.0	3.	UGLU	1,1,2,2-TETRACHLOROETHANE
121:000616P616	CHLOROETHANE	F9.0	3.	UGLU	CHLOROETHANE
122:000617P617	BCLMETHER	F9.0	10.	UGL	BIS(CHLOROMETHYL)ETHER
123:000618P618	B2CLETHETHER	F9.0	10.	UGL	BIS(2-CHLOROETHYL)ETHER
124:000619P619	2CLETHVINETH	F9.0	3.	UGLU	2-CHLOROETHYLVINYL ETHER
125:000620P620	2CLNAPHTH	F9.0	10.	UGL	2-CHLORONAPHTHALENE
126:000621P621	246CLPHENOL	F9.0	25.	UGL	2,4,6-TRICHLOROPHENOL
127:000622P622	4CL3MPHENOL	F9.0	25.	UGL	4-CHLORO-3-METHYLPHENOL
128:000623P623	CHLOROFORM	F9.0	3.	UGLU	CHLOROFORM
129:000624P624	2CLPHENOL	F9.0	25.	UGL	2-CHLOROPHENOL
130:000625P625	12C6H4CL2	F9.0	10.	UGL	1,2-DICHLOROBENZENE
131:000626P626	13C6H4CL2	F9.0	10.	UGL	1,3-DICHLOROBENZENE
132:000627P627	14C6H4CL2	F9.0	10.	UGL	1,4-DICHLOROBENZENE
133:000628P628	33CLBENZI	F9.0	10.	UGL	3,3'-DICHLOROBENZIDINE
134:000629P629	CH2CCL2	F9.0	3.	UGLU	1,1-DICHLOROETHYLENE
135:000630P630	CHCLCHCL	F9.0	3.	UGLU	TRANS 1,2-DICHLOROETHYLENE
136:000631P631	24CLPHENOL	F9.0	25.	UGL	2,4-DICHLOROPHENOL
137:000632P632	CH3CHCLCH2CL	F9.0	3.	UGLU	1,2-DICHLOROPROPANE
138:000633P633	CHCLCHCH2CL	F9.0	3.	UGLU	TRANS 1,3-DICHLOROPROPENE
139:000634P634	24MPHENOL	F9.0	25.	UGL	2,4-DIMETHYLPHENOL
140:000637P637	12PHHYDRAZ	F9.0	10.	UGL	1,2-DIPHENYLHYORAZINE
141:000638P638	ETHYLBENZENE	F9.0	3.	UGLU	ETHYLBENZENE
142:000639P639	FLUORANTHENE	F9.0	10.	UGL	FLUORANTHENE
143:000640P640	4CLPHPHETHER	F9.0	10.	UGL	4-CHLOROPHENYL PHENYL ETHER
144:000641P641	4BRPHPHETHER	F9.0	10.	UGL	4-BROMOPHENYL PHENYL ETHER
145:000642P642	B2CLISPETHER	F9.0	10.	UGL	BIS(2-CHLOROISOPROPYL)ETHER
146:000643P643	B2CLETHXMETH	F9.0	10.	UGL	BIS(2-CHLOROETHOXY)METHANE
147:000644P644	CH2CL2	F9.0	3.	UGLU	METHYLENE CHLORIDE
148:000645P645	CH3CL	F9.0	3.	UGLU	CHLOROMETHANE
149:000646P646	BROMOMETHANE	F9.0	3.	UGLU	BROMOMETHANE
150:000647P647	BROMOFORM	F9.0	3.	UGLU	BROMOFORM
151:000648P648	CHBRCL2	F9.0	3.	UGLU	BROMODICHLOROMETHANE
152:000649P649	CFCL3	F9.0	3.	UGLU	TRICHLOROFLUOROMETHANE
153:000650P650	CF2CL2	F9.0	3.	UGLU	DICHLORODIFLUOROMETHANE
154:000651P651	CHBR2CL	F9.0	3.	UGLU	CHLORODIBROMOMETHANE
155:000652P652	HEXCLBUTDIEN	F9.0	10.	UGL	HEXACHLOROBUTADIENE
156:000653P653	HXCLCYCPENDI	F9.0	10.	UGL	HEXACHLOROCYCLOPENTADIENE
157:000654P654	ISOPHORONE	F9.0	10.	UGL	ISOPHORONE
158:000655P655	NAPHTHALENE	F9.0	10.	UGL	NAPHTHALENE
159:000656P656	NITROBENZENE	F9.0	10.	UGL	NITROBENZENE
160:000657P657	2NPHENOL	F9.0	25.	UGL	2-NITROPHENOL
161:000658P658	4NPHENOL	F9.0	25.	UGL	4-NITROPHENOL
162:000659P659	24NPHENOL	F9.0	250.	UGL	2,4-DINITROPHENOL
163:000660P660	46N2MPHENOL	F9.0	250.	UGL	4,6-DINITRO-2-METHYLPHENOL
164:000661P661	NNDMAMINE	F9.0	10.	UGL	N-NITROSODIMETHYLAMINE
165:000662P662	NNDPHAMINE	F9.0	10.	UGL	N-NITROSODIPHENYLAMINE
166:000663P663	NNDNPAMINE	F9.0	10.	UGL	N-NITROSODI-N-PROPYLAMINE

167:C00664P664	PENTCLPHENOLF	9.0	25.	UGL	PENTACHLOROPHENOL
168:C00665P665	PHENOL(AE)	F9.0	25.	UGL	PHENOL
169:000666P666	B2ETHHEXPHTHF	9.0	10.	UGL	BIS(2-ETHYLHEXYL)PHTHALATE
170:000667P667	BUTBENPHTH	F9.0	10.	UGL	BUTYL BENZYL PHTHALATE
171:000668P668	DNBUTPHTH	F9.0	10.	UGL	DI-N-BUTYL PHTHALATE
172:000669P669	DNOCTPHTH	F9.0	10.	UGL	DI-N-OCTYL PHTHALATE
173:000670P670	DIETHPHTH	F9.0	10.	UGL	DIETHYL PHTHALATE
174:000671P671	DIMETHPHTH	F9.0	10.	UGL	DIMETHYL PHTHALATE
175:000672P672	BEN(A)ANTH	F9.0	10.	UGL	BENZO(A)ANTHRACENE
176:000673P673	BEN(A)PYR	F9.0	10.	UGL	BENZO(A)PYRENE
177:000674P674	BEN(B)FLUOR	F9.0	10.	UGL	BENZO(B)FLUORANTHENE
178:000675P675	BEN(K)FLUOR	F9.0	10.	UGL	BENZO(K)FLUORANTHENE
179:000676P676	CHRYSENE	F9.0	10.	UGL	CHRYSENE
180:000677P677	ACENAPHTHYLEF	9.0	10.	UGL	ACENAPHTHYLENE
181:000678P678	ANTHRACENE	F9.0	10.	UGL	ANTHRACENE
182:000679P679	BEN(GHI)PERYF	9.0	25.	UGL	BENZO(GHI)PERYLENE
183:000680P680	FLUORENE	F9.0	10.	UGL	FLUORENE
184:000681P681	PHENANTHRENEF	9.0	10.	UGL	PHENANTHRENE
185:000682P682	DBEN(AH)ANTHF	9.0	25.	UGL	DIBENZO(A,H)ANTHRACENE
186:000683P683	IND123CDPYR	F9.0	25.	UGL	INDENO(1,2,3-CD)PYRENE
187:000684P684	PYRENE	F9.0	10.	UGL	PYRENE
188:000685P685	CCL2CCL2	F9.0	3.	UGLU	TETRACHLOROETHYLENE
189:000686P686	TOLUENE	F9.0	3.	UGLU	TOLUENE
190:000687P687	CHCLCCL2	F9.0	3.	UGLU	TRICHLOROETHYLENE
191:000688P688	CH2CHCL	F9.0	3.	UGLU	VINYL CHLORIDE
192:000689P689	ALDRIN	F9.2	.16	UGL	ALDRIN
193:000690P690	DIELDRIN	F9.2	.24	UGL	DIELDRIN
194:000691P691	CHLORDANE	F9.1	1.	UGL	CHLORDANE
195:000692P692	4,4'-DDT	F9.1	0.60	UGL	4,4'-DDT
196:000693P693	4,4'-DDE	F9.1	0.40	UGL	4,4'-DDE
197:000694P694	4,4'-DDD	F9.1	0.40	UGL	4,4'-DDD
198:000695P695	ENDOSULFAN IF	9.1	50.	UGL	ENDOSULFAN I
199:000696P696	ENDOSULFANIIF	9.1	50.	UGL	ENDOSULFAN II
200:000697P697	ENDOS SULF	F9.1	50.	UGL	ENDOSULFAN SULFATE
201:000699P699	ENDRIN ALD	F9.1	50.	UGL	ENDRIN ALDEHYDE
202:000700P700	HEPTACHLOR	F9.2	.06	UGL	HEPTACHLOR
203:000701P701	HEPTACHLEPOXF	9.2	.16	UGL	HEPTACHLOR EPOXIDE
204:000702P702	ALPHA-BHC	F9.1	20.	UGL	ALPHA-BHC
205:000703P703	BETA-BHC	F9.1	20.	UGL	BETA-BHC
206:000704P704	DELTA-BHC	F9.1	20.	UGL	DELTA-BHC
207:000706P706	PCB-1242	F9.1	50.	UGL	PCB-1242
208:000707P707	PCB-1254	F9.1	50.	UGL	PCB-1254
209:000708P708	PCB-1221	F9.1	50.	UGL	PCB-1221
210:000709P709	PCB-1232	F9.1	50.	UGL	PCB-1232
211:000710P710	PCB-1248	F9.1	50.	UGL	PCB-1248
212:000711P711	PCB-1260	F9.1	50.	UGL	PCB-1260
213:000712P712	PCB-1016	F9.1	50.	UGL	PCB-1016
214:000713P713	WHATTHEHELL	F9.1	3.	UGL	CIS 1,3-DICHLOROPROPENE
215:000714P714	1,2-DCLETHY	F9.1	3.	UGL	CIS 1,2-DICHLOROETHYLENE
216:000715A715	MALATHION	F9.1	1.6	UGL	MALATHION
217:000716A716	PARATHION	F9.1	0.4	UGL	PARATHION
218:000717A717	METHYL PARA	F9.1	0.6	UGL	METHYL PARATHION
219:000718A718	DIAZINON	F9.1	1.0	UGL	DIAZINON
220:000719A719	CHLORDANE(T)	F9.1	1.2	UGL	CHLORDANE (TECH)
221:000720A720	CIS-CHLOR	F9.2	.16	UGL	CIS-CHLORDANE
222:000721A721	TRANS-CHLOR	F9.2	.16	UGL	TRANS-CHLORDANE
223:000722A722	OXYCHLORDANEF	9.2	.16	UGL	OXYCHLORDANE

224:000723A723	2,4,5-T	F9.1	.5	UGL	2,4,5-T
225:000724A724	CHLORPYRIFOS	F9.2	.24	UGL	CHLORPYRIFOS
226:000725A725	RONNEL	F9.1	.2	UGL	RONNEL
227:000726A726	DDT	F9.1	.6	UGL	DDT
228:000727A727	DDD	F9.1	.4	UGL	DDD
229:000728A728	DDE	F9.1	.4	UGL	DDE
230:000729A729	BHC	F9.1	.2	UGL	BHC
231:000730A730	PCB(54 & 60)	F9.1	.8	UGL	PCB (AROCLOR 1254 & 1260)
232:000731A731	TEP	F9.0	10.	UGL	TRIETHYL PHOSPHATE
233:000732A732	QUINOLINE	F9.0	10.	UGL	QUINOLINE
234:000733A733	ISOQUINOLINE	F9.0	10.	UGL	ISOQUINOLINE
235:000734A734	CRESOL	F9.0	25.	UGL	CRESOL
236:000735A735	4,6-DN-O-CRE	F9.0	25.	UGL	4,6-DINITRO-O-CRESOL
237:000736A736	3,4-BENZOFL	F9.0	25.	UGL	3,4-BENZOFLUORANTHENE
238:000737A737	P-CHL-M-CRE	F9.0	25.	UGL	P-CHLORO-M-CRESOL
239:000738A738	PHTHALATES	F9.0	10.	UGL	PHTHALATES
240:000739A739	HYDROCARBONS	F9.0	10.	UGL	HYDROCARBONS
241:000740A740	FREON 112	F9.0	3.	UGL	TETRACHLORODIFLUOROETHANE
242:000741A741	CS2	F9.0	3.	UGL	CARBON DISULFIDE
243:000800A800	2,4'-DDE	F9.0	0.40	UGL	2,4'-DDE
244:000801MIREX	MIREX	F9.2	.04	UGL	MIREX
245:000802A802	2,4'-DDT	F9.1	0.60	UGL	2,4'-DDT
246:000803A803	2,4'-DDD	F9.1	0.40	UGL	2,4'-DDD
247:000804A804	TETRAHYDROF	F9.1	3.	UGL	TETRAHYDROFURAN
248:000805A805	MEK	F9.1	3.	UGL	METHYL ETHYL KETONE
249:000806A806	MIBK	F9.1	3.	UGL	METHYL ISOBUTYL KETONE
250:000807A807	DE ETHER	F9.1	3.	UGL	DIETHYL ETHER
251:000808A808	TOTAL THM	F9.1	1.	UGL	TRIHALOMETHANES
252:000809A809	HDA DE	F9.0	5.	UGL	HEXADECANOIC ACID, DIOCTYL ESTER
253:000810SULFUR	SULFUR	F9.0	5.	UGL	SULFUR
254:000811A811	ISOPR ETHER	F9.0	3.	UGL	ISOPROPYL ETHER
255:000812A812	MIPK	F9.0	3.	UGL	METHYL ISOPROPYL KETONE
256:000813A813	2-HEPTANONE	F9.0	3.	UGL	METHYL-N-AMYL KETONE
257:000814A814	4-M,2-P	F9.0	3.	UGL	4-METHYL-2-PROPANONE
258:000815A815	CRYOFLEX	F9.0	.	UGL	CRYOFLEX
259:000816A816	TBP	F9.0	.	UGL	TRIBUTYL PHOSPHATE
260:000817A817	A817	F9.0	.	UGL	N,N,4-TRIMETHYL BENZENESULFONAMIDE
261:000818A818	A818	F9.0	.	UGL	2-PROPANOL,1-[2-(2-METHOXY-1-METHYLETHOXY)-1-METHYLETHOXY]
262:000819A819	A819	F9.0	10.	UGL	HEPTANOIC ACID
263:000820A820	A820	F9.0	10.	UGL	BENZOIC ACID
264:000821A821	A821	F9.0	10.	UGL	METHYL HEXANOIC ACID
265:000822A822	A822	F9.0	10.	UGL	METHYL PENTANOIC ACID
266:000823A823	A823	F9.0	10.	UGL	METHYL BUTANOIC ACID
267:000824A824	A824	F9.0	10.	UGL	HEXANOIC ACID
268:000825A825	A825	F9.0	10.	UGL	BENZENEDICARBOXYLIC ACID
269:000826A826	A826	F9.0	10.	UGL	DIMETHYL CYCLOPENTANE
270:000827A827	A827	F9.0	10.	UGL	XYLENE
271:000828A828	A828	F9.0	10.	UGL	META XYLENE
272:000829A829	A829	F9.0	10.	UGL	PARA XYLENE
273:000830A830	A830	F9.0	10.	UGL	2,2-OXYBIS PROPANE
274:000831A831	A831	F9.0	10.	UGL	CYCLOHEXANONE
275:000832A832	A832	F9.0	3.	UGL	DICHLOROFLUOROMETHANE
276:000833A833	A833	F9.0	3.	UGL	2-METHYL BUTANE
277:000834A834	A834	F9.0	3.	UGL	2-METHYL-1-PENTANE
278:000835A835	A835	F9.0	3.	UGL	METHYL CYCLOHEXANE
279:000836A836	A836	F9.0	3.	UGL	2,5-DIETHYL TETRAHYDROFURAN
280:000837A837	A837	F9.0	3.	UGL	2,2-DIMETHYL PROPANOL

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281:000838A838  A838          F9.0    3.   UGL        TRIETHYL ESTER PHOSPHONATE
282:000839A839  A839          F9.0    3.   UGL        1,1'-OXYBIS (2-ETHOXY) ETHANE
283:000840A840  A840          F9.0    3.   UGL        1,1-OXYBIS ETHANE
284:000841A841  A841          F9.0   10.   UGL        NONYL PHENOL
285:000842A842  A842          F9.0   10.   UGL        TETRAMETHYL BUTYL PHENOL
286:000843A843  A843          F9.0   10.   UGL        METHYL ETHYL PHENOL
287:000844A844  A844          F9.0   10.   UGL        ETHYL PHENOL
288:000845A845  A845          F9.0   10.   UGL        DIMETHYL PHENOL
289:000846A846  A846          F9.0   10.   UGL        BROMACIL
290:000847A847  A847          F9.0   10.   UGL        TRIETHYL ESTER OF PHOSPHORIC ACID
291:000848A848  A848          F9.0    3.   UGL        ETHYL CYCLOHEXANE
292:000849A849  A849          F9.0   10.   UGL        2-METHOXY-2-METHYL PROPANE
293:000850A850  A850          F9.0   10.   UGL        2-VINYL CROTONALDEHYDE
294:000851A851  A851          F9.0   10.   UGL        DIOCTYL HEXANDIOATE
295:000852A852  A852          F9.0    5.   UGL        BENZOTHIAZOLE
296:000853A853  A853          F9.0   10.   UGL        SUBSTITUTED PHENOL
297:000854A854  A854          F9.0   10.   UGL        AZIDO METHYL BENZENES
298:000855A855  HEXANEDIOIC   F9.0   10.   UGL        HEXANEDIOIC ACID, DIOCTYL ESTER
299:000856A856  A856          F9.0   10.   UGL        2-ETHYL HEXANOIC ACID
300:000857A857  A857          F9.0   10.   UGL        OCTYL PHENOL
301:000858A858  A858          F9.0   10.   UGL        PROMETON
302:000859A859  A859          F9.0    3.   UGL        2,2-DIMETHYL OXIRANE
303:000860A860  A860          F9.0   10.   UGL        METHYL BENZENAMINE
304:000861A861  A861          F9.0   10.   UGL        NITRO METHYL BENZENAMINE
305:000862A862  A862          F9.0   10.   UGL        2-NITROTOLUENE
306:000863A863  A863          F9.0   10.   UGL        4-NITROTOLUENE
307:000864A864  A864          F9.0   10.   UGL        THIOBISMETHANE
308:000865A865  A865          F9.0    3.   UGL        1-ETHYL,4-METHYL BENZENE
309:000866A866  A866          F9.0    3.   UGL        TRIMETHYL BENZENES
310:000867A867  A867          F9.0    3.   UGL        DIMETHYL DISULFIDE
311:000888X888  X888          F9.0   10.   UGL        UNIDENTIFIED SUBSTITUTED BENZENES
312:000889X889  UNID COMPS    F9.0     .   UGL        UNIDENTIFIED COMPOUNDS
313:000890X890  UNID COMP 1   F9.1     .   UGL        UNIDENTIFIED COMPOUND 1
314:000891X891  UNID COMP 2   F9.1     .   UGL        UNIDENTIFIED COMPOUND 2
315:000892X892  UNID COMP 3   F9.1     .   UGL        UNIDENTIFIED COMPOUND 3
316:000893X893  UNID TOX      F9.1     .   UGL        UNIDENTIFIED CHLORINATED COMPOUND
317:000894X894  H B UNK       F9.1     .   UGL        HIGH BOILING UNKNOWN
318:000895X895  H B HC        F9.1     .   UGL        HIGH BOILING HYDROCARBONS
319:000896X896  X896          F9.0    5.   UGL        ORGANIC ACID METHYL ESTER
320:000897X897  X897          F9.0    5.   UGL        ORGANIC ACID ESTER
321:000898X898  X898          F9.0   25.   UGL        SERIES OF SILICONES
322:000899X899  X899          F9.0   10.   UGL        UNKNOWN TRIAZINE COMPOUND
323:000900X900  X900          F9.0   10.   UGL        PROPENYL BENZENE
324:000904GC-PHCPURGHALOCARB                          31 14D PURGEABLE HALOCARBONS (METHOD 601)
325:000905GC-PA PURGAROMATIC                          31 14D PURGEABLE AROMATICS (METHOD 602)
326:000906GCMS-VGCMS-PURG                             31 14D PURGEABLES (METHOD 624)
327:000907M603-PM603 PURG                             31  3D ACROLEIN & ACRYLONITRILE (METHOD 603)
328:000908GC-A  M604 PHENOLS                          32  7D PHENOLS (METHOD 604)
329:000909M605  BENZIDINES                            34  7D BENZIDINES (METHOD 605)
330:000910M606  PHTHALATES                            34  7D PHTHALATE ESTERS (METHOD 606)
331:000911M607  NITROSAMINES                          34  7D NITROSAMINES (METHOD 607)
332:000912M608  OCLPEST/PCB                           33  7D ORGANOCHLORINE PESTICIDES & PCBS (METHOD 608)
333:000913M609  NIT AROM                              34  7D NITROAROMATICS & ISOPHORONE (METHOD 609)
334:000914M610  PAH                                   34  7D POLYNUCLEAR AROMATIC HYDROCARBONS (METHOD 610)
335:000915M611  HALOETHERS                            34  7D HALOETHERS (METHOD 611)
336:000916M612  M612 HC                               34  7D CHLORINATED HYDROCARBONS (METHOD 612)
337:000917M613  DIOXIN                                    7D (METHOD 613)
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338:000918GCMS-BGCMS-BNE                34  7D BASE-NEUTRAL EXTRACTABLES (METHOD 625 BASE NEUTRALS)
339:000919GCMS-AGCMS-AE                 32  7D ACID EXTRACTABLES (METHOD 625 ACIDS)
340:000920GCMS-OGCMS-PEST               33  7D PESTICIDE EXTRACTABLES (METHOD 625 PESTICIDES)
341:000921GCPESTGC-PEST SCAN            35  7D GC PESTICIDE SCAN
342:000922HERB   HERBICIDES             35  7D 3 HERBICIDES(SM509B)-2,4,5-T;SILVEX; & 2,4-D
343:999999       DUMMY                   0
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RG2GN$D.PARAM

Card Columns	Field Width	Type Spec	Just	Entry
1-6	6	I6		Parameter number.
7-12	6	A6	L	Parameter code.
13-24	12	2A6	L	Parameter name; may be abbreviated if the actual name is longer than 12 characters.
25-28	4	A4		"F9.?"; where ? is either 1, 2, or 3. The number is the number of digits that will be printed to the right of the decimal on data tables.
29-37	9	F9.3		Typical detection limit for the parameter.
38-40	3	A3	L	Units code; options are: MGL - milligrams per liter UGL - micrograms per liter PCL - picocuries per liter UMC - micromhos per centimeter PH - pH units NTU - nephelometric turbidity units TON - threshold odor number TDN - taste dilution index number CU - color units PHM - per 100 milliliters
41	1	A1		Filtering code; options: F - samples must be filtered U - samples must be unfiltered Ø - filtered or unfiltered
42-43	2	I2	R	Parameter group number; (1-40).
44	1	A1		Parameter group change code; a "." entry indicates that the group number cannot be changed without modifying computer programs; Ø otherwise.
45-47	3	I2,A1	R	Parameter holding time code; first 2 columns to have an integer time entry; last column to identify units of time (H - hours, D - days, M - months). Holding time is not total holding time for parameter, but time until first action by lab is necessary (such as extraction).
48	1			Ø
49-132	84	14A6	L	Parameter name.