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Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1

Final Report
For
Burlington Air National Guard Base,
Vermont

Air National Guard
Andrews Air Force Base, Maryland

Prepared For:
United States Air Force
Occupational and Environmental Health Laboratory (USAF OEHL)
Brooks Air Force Base, Texas 78235-5501

March 1986

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INSTALLATION RESTORATION PROGRAM
PHASE II - CONFIRMATION/QUANTIFICATION
STAGE 1

FINAL REPORT

FOR

VERMONT AIR NATIONAL GUARD
BURLINGTON AIR NATIONAL GUARD BASE
BURLINGTON, VERMONT 05415

AIR NATIONAL GUARD
ANDREWS AFB, MARYLAND 20331-6008

MARCH 1986

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A Problem Confirmation Study was conducted at Burlington Air National Guard Base in Vermont. The study included two sites: Site 1, a former Fire Department training area/old landfill, and Site 2, a construction rubble landfill. Five new monitor wells were installed at Site 1. Groundwater samples were collected from the new monitor wells and from three existing monitor wells at Site 1, and surface water samples were collected from both sites. On the basis of water quality data collected in this investigation, both sites have been confirmed as potential sources of contamination. Recommendations have been made for monitoring at Site No. 2, and a site characterization study to assess the magnitude and extent of contamination at Site No. 1.

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PREFACE

The Phase II, Stage 1 Problem Confirmation Study was completed in accordance with the Department of Defense (DoD) Installation Restoration Program. The overall mission of the Phase II portion of the program is to identify whether, in fact, suspect hazardous waste disposal sites on USAF Installations have resulted in environmental degradation and to determine to what extent that degradation manifests itself. To this end, the Phase II, Stage 1 Study is confirmatory in substance; later stages address problem quantification if justified by the Stage 1 investigations.

The Phase II, Stage 1 investigation at the Burlington Air National Guard Base of the Vermont Air National Guard was performed under OEHL Contract Number F33615-80-D-4006/0031. The project was authorized in April 1984. Exploratory drilling was completed in May 1984. Field studies and follow-up sampling were completed between June and September 1984.

For WESTON, Peter J. Marks provided overall program management and quality assurance direction for the project. Dr. Frederick Bopp III provided technical input with the quality assurance aspect of the investigation. Richard L. Kraybill acted as project manager; Glenn R. Smart was the field team leader. 1LT Maria R. LaMagna OEHL/TS serves as the present technical monitor for the project.

WESTON is appreciative of the cooperative efforts of Mr. Thomas E. O'Donovan, Jr., Col. Ronald H. Morgan, and Major David Bombard for their guidance in assuring the project goals were responsive to the public and regulation concerns expressed in this matter. The cooperation of Mr. Harry Lindenhofen ANGS/DEV during the Phase II PreSurvey inspection was very much appreciated.

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EXECUTIVE SUMMARY

ES 1.0 INTRODUCTION

Roy F. Weston, Inc. (WESTON) was retained by the U. S. Air Force Occupational and Environmental Health Laboratory (USAF OEHL) under Contract No. F33615-80-D-4006 to provide general engineering, hydrogeological and analytical services. These services were applied to the Installation Restoration Program (IRP) Phase II Stage 1 effort at the Burlington Air National Guard Base in Burlington, Vermont under Task Order 0031 of this contract.

In 1976 the Department of Defense (DoD) devised a comprehensive Installation Restoration Program (IRP). The purpose of the IRP is to assess and control both potential and actual migration of environmental contamination that may have resulted from past operations and disposal practices on DoD facilities. In response to the Resource Conservation and Recovery Act of 1976 (RCRA) and in anticipation of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA or "Superfund"), the DoD issued a Defense Environmental Quality Program Policy Memorandum (DEQPPM) dated June, 1980 (DEQPPM 80-6), requiring identification of past hazardous waste disposal sites on DoD installations. The U.S. Air Force implemented DEQPPM 80-6 by message in December, 1980. The program was revised by DEQPPM 81-5 (11 December 1981) which reissued and amplified all previous directives and memoranda on the IRP. The Air Force implemented DEQPPM 81-5 by message on 21 January 1982. The Installation Restoration Program has been developed as a four-phase program as follows:

Phase I - Problem Identification/Records Search
Phase II - Problem Confirmation and Quantification
Phase III - Technology Base Development
Phase IV - Corrective Action

Only the Phase II Stage 1 portion of the IRP effort at Burlington Air National Guard Base was part of this Task Order.

ES 2.0 SCOPE OF WORK

The Burlington Air National Guard Base (Burlington ANGB), located at Burlington International Airport, is situated in the Champlain Lowland near Burlington, Vermont. Burlington

ANGB occupies land bordering on the north side of the Burlington International Airport. Field operations for the Phase II Stage 1 Study focused on two sites illustrated on Figure S-1. Site 1 consists of a former fire department training area (FDTA) and old landfill; Site 2 is a construction rubble dump.

As part of the Phase II Study, a total of five monitoring wells were constructed around the perimeter of Site 1. In situ permeability tests were performed in these wells to estimate flow through the various deposits underlying the site. Water samples were collected from the five newly constructed wells, three existing wells on the FDTA/Old Landfill and from six surface water stations located up and downgradient of both sites. Samples were analyzed for priority pollutant volatile organics, Methyl Ethyl Ketone (MEK), Methyl Isobutyl Ketone (MIBK), priority pollutant metals, phenols, and oils and greases. One round of samples was collected during the Phase II effort. Comparisons with previous existing well and stream data were made. All Phase II water quality analyses were accomplished in accordance with the USEPA Standard Methods under rigorous Quality Assurance procedures. All data were analyzed to produce as complete an assessment of ground and surface water quality as possible at the confirmation level of activity.

ES 3.0 MAJOR FINDINGS

Based on the analyses performed to date, the FDTA/Old Landfill is a source of contamination to ground water resources in the immediate vicinity of the site. Volatile organic contamination was detected in shallow sands at the FDTA/Old Landfill. Free-floating hydrocarbons having fuel oil odors were noted in Wells BP-7 and BP-12 during the sampling program. The principal organic constituents of concern and their highest concentrations were:

- benzene (120 ug/l)
- 1-2 trans-dichloroethylene (2,700 ug/l)
- trichloroethylene (7 ug/l)
- xylenes (690 ug/l)
- vinyl chloride (40 ug/l)
- chloroethane (8 ug/l).

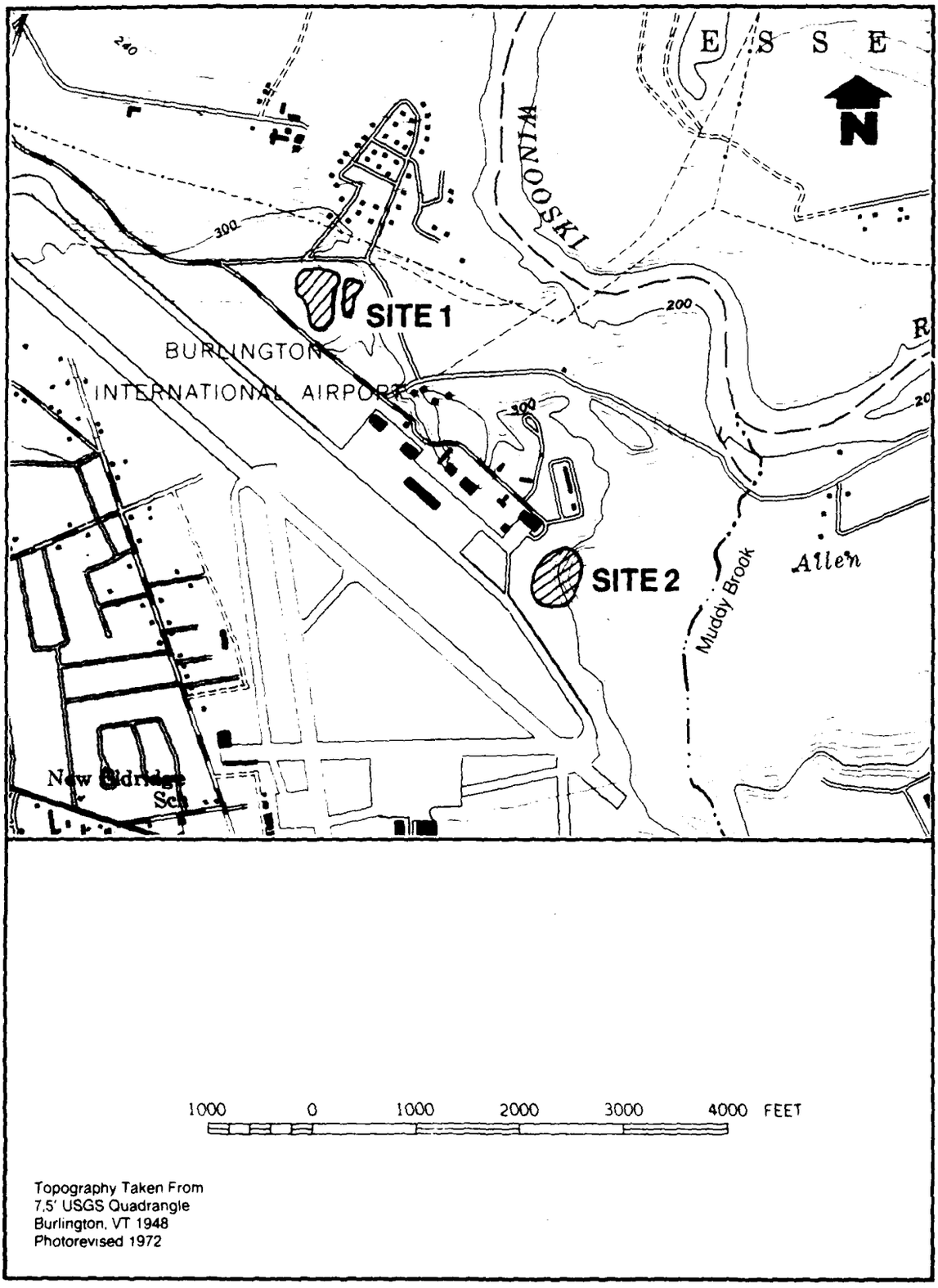


FIGURE S-1 POTENTIAL SOURCE SITE LOCATION MAP BURLINGTON AIR NATIONAL GUARD BASE

All of these results exceeded either the 10^{-6} cancer risk or SNARLS EPA Guidance Criteria. Further explanation of these guidance criteria can be found in Subsection 4.3 of this report.

The discharge of contaminants to the local surface waters around the FDTA/Old Landfill is not as large a potential problem as the discharge to ground water, although several volatile organic compounds (VOC) ranging up to 13 ug/l were detected in stream samples around the site. Perimeter downgradient monitoring wells RFW-2, RFW-3 and RFW-4, which penetrate the uppermost saturated deposits, exhibit levels of organic contamination ranging from trace (<10 ug/l) to low (<250 ug/l) levels. Well RFW-3 exhibited 170 ug/l of 1,2 trans-dichloroethylene which exceeds the 10^{-6} Cancer Risk but does not exceed the SNARLS 10-day exposure EPA Guidance Criteria of 270 ug/l (See Subsection 4.3).

The volatile organics detected in samples from Muddy Creek, as measured downgradient from the Construction Rubble Dump, may not be entirely attributable to that source. However, sample SW-5, collected at the toe of the dump, exhibited over 100 ug/l of total priority pollutant volatile organic compounds. Although this is a moderately low value, limited follow up evaluations are deemed warranted.

Based on the Phase II Stage 1 Confirmation Study, the following key conclusions have been drawn:

1. Ground water occurs under unconfined or water table conditions in deltaic sands which underlie the FDTA/Old Landfill (Site 1). Ground water flow within the shallow localized water table is generally to the north and northeast.

2. The deltaic sands become thinner in a northerly direction such that bedrock is exposed at the surface immediately north of the site. Lacustrine clays, which are as much as 15 feet thick in RFW-1, become thinner or absent on the northern perimeter of the FDTA/Old Landfill (Site 1). Similarly, the sandy glacial tills which occur beneath the clay stratum in RFW-1 are absent in RFW-2, RFW-3 and RFW-4.

3. A strong downward hydraulic gradient occurs between the shallow water table and the semi

confined to confined water within the underlying glacial tills and bedrock. Thus, recharge from the deltaic sands to the bedrock formation is inferred. Where clays are thin or absent, essentially no confining unit occurs to separate the shallow from the deeper flow system. This is the case on the lower, downgradient portions of the site. Infiltration to a deeper flow system may explain why the stream below the FDTA/Old Landfill (Site 1) is intermittent in this area.

4. Deeper wells intersecting representative depths of the bedrock Bascom Formation would be required to assess hydraulic conditions and water quality in the regional bedrock flow system. Wells RFW-2, RFW-3 and RFW-4 which penetrate the surface of the bedrock are not constructed in such a way as to be able to provide this bedrock hydrogeologic data.

5. Levels of total volatile priority pollutant organics were detected at the FDTA/Old Landfill Site ranging from 7 ug/l in BP-2 to 3580 ug/l in BP-7. These ranges do not include trace levels (<10 ug/l) of various compounds for which quantification could not be precisely made. Free floating hydrocarbons with a fuel oil odor were noted in Wells BP-7 and BP-12 during sampling. It is unclear whether the old landfill is contributing substantially to these water quality results. Further, the limits of the former FDTA and the Old Landfill have not yet been defined.

6. Surface water sampling in and around the FDTA/Old Landfill (Site 1) and the Construction Rubble Landfill (Site 2) has revealed limited impacts based upon the presence of USEPA Priority Pollutant List volatile organic compounds. Individual analytes potentially attributable to former site operations are present at concentrations ranging from trace levels (<10 ug/l)

to 51 ug/l (Trichloroethylene). The total volatile organic compounds in surface waters have not been observed to exceed 500 ug/l. These concentrations are one to two orders of magnitude below the levels detected in wells BP-7 and BP-12 on the FDTA site.

7. Based on the EPA Guidance Criteria (SNARLS and Water Quality Criteria Documents, 1980) for various organic parameters, wells BP-7 and BP-12 exceed the SNARLS or 10^{-6} Cancer Risk for seven priority pollutant organics. Well RFW-2, which exhibited levels of contamination an order of magnitude lower than BP-7 and BP-12, exceeded the 10^{-6} Cancer Risk for 1,2 trans-dichloroethylene (see subsection 4.3 for further explanation of these guidance criteria).

8. USEPA Priority Pollutant List metals analyzed in surface or ground water samples collected for the Phase II Study, all lie within standards.

ES 4.0 RECOMMENDATIONS

WESTON has classified both the FDTA/Old Landfill Site and the Construction Rubble Dump Site as Category II sites. That is, each site requires additional monitoring and evaluation to assess the magnitude and extent of existing ground water contamination. WESTON has made specific recommendations for activities to be undertaken during Phase II, Stage 2 at Burlington ANGB, and these recommendations are summarized in Table S-1.

TABLE S - 1

RECOMMENDED QUANTIFICATION STAGE ACTIONS

BURLINGTON AIR NATIONAL GUARD BASE

SITES	RECOMMENDED ACTIONS	RATIONALE
Collective Actions .FDTA/Old Landfill .Construction Rubble Landfill	Develop an interim quarterly monitoring and assessment plan for both sites and initiate a conceptual model of site.	Interim monitoring to substantiate water quality findings, observe seasonal trends & note conditions in perimeter composite shallow wells RFW-2, RFW-3, & RFW-4; prepare conceptual model to validate further monitoring and off-site impact projections.
	Obtain aerial survey and prepare large scale contour map.	Required to identify appropriate future sampling locations, relate data collection points to field conditions, accuracy control & interpret field findings, & present results in intelligible manner; required for possible future closure design.
	Seismic Refraction/Fracture Trace Analysis	Non-destructive tests & evaluation of potential anomalies in subsurface stratigraphy required to optimize well site locations and provide stratigraphic correlation between monitoring points - Need based on observed variability of subsurface stratigraphy.
	Implement an expanded ground & surface water monitoring program with additional well nests to include representative bedrock monitoring; convert RFW-2, 3 and 4 to top of rock monitoring piezometers; drill and construct shallow piezometers RFW-2A, RFW-3A, and RFW-4A in deltaic sands.	Determine regional flow and water quality in overlying unconsolidated deposits & bedrock at & beyond site perimeter; identify source(s) of volatile compounds in surface waters; quantify the hydrogeologic relationship between shallow & deep water bearing zones. These efforts are aimed at determining the nature & extent of contamination. Conversion of RFW-2,3, & 4 to top of rock wells to eliminate concerns of potential short circuiting.
	Interim Assessment Report	Document interim monitoring results after two rounds of sampling from the expanded monitoring network and provide specific recommendations, if any, for further engineering evaluation or field study at either site.
Site characterization .FDTA/Old Landfill	Determine boundary limits of sites and distinguish sites initially with geophysical techniques	Required as basis for understanding the location of specific sources of contamination, the magnitude of those sources & position in the hydrogeologic setting, screening tool for safety concerns & optimization of test pit/auger study.
	Conduct test pit/power auger investigation; measure & analyze free hydrocarbon layer on water table	Collect soils/wastes in vadose zone for quantifying source (s) of contamination; identify location & quality of free hydrocarbon layer for recovery/containment assessments.
	Perform boring & construct recovery/test well in contaminated zone of shallow water table; collect lacustrine clay sample during drilling of bedrock well at RFW-1 location	Recovery/Test well needed to assess aquifer characteristics - will also measure viability of hydrocarbon recovery clay sample for triaxial permeability test for flow net analysis.
	Conduct field studies including well survey, oil thickness measurements, water level measurements, & pump tests	Data needed for quantifying & predicting the nature & extent of contamination specifically from the FDTA/Old Landfill; assessing advantages & limitations of various remedial or closure strategies.
	Report preparation	Document supplemental investigation with specific recommendations for further engineering evaluation or field study.
.Construction Rubble Landfill	No site characterization studies	None required pending development of interim assessment report.

SECTION 1

INTRODUCTION

1.1 INSTALLATION RESTORATION PROGRAM

In 1976 the Department of Defense (DoD) devised a comprehensive Installation Restoration Program (IRP). The purpose of the IRP is to assess and control migration of environmental contamination that may have resulted from past operations and disposal practices on DoD facilities. In response to the Resource Conservation and Recovery Act of 1976 (RCRA) and in anticipation of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA or "Superfund"), the DoD issued a Defense Environmental Quality Program Policy Memorandum (DEQPPM) dated June, 1980 (DEQPPM 80-6), requiring identification of past hazardous waste disposal sites on DoD agency installations. The U.S. Air Force implemented DEQPPM 80-6 by message in December, 1980. The program was revised by DEQPPM 81-5 (11 December 1981) which reissued and amplified all previous directives and memoranda on the IRP. The Air Force implemented DEQPPM 81-5 by message on 21 January 1982. The Installation Restoration Program has been developed as a four-phase program as follows:

Phase I - Problem Identification/Records Search
Phase II - Problem Confirmation and Quantification
Phase III - Technology Base Development
Phase IV - Corrective Action

Appendix A contains a listing of definitions, acronyms and nomenclature used in this report.

1.2 PROGRAM HISTORY AT BURLINGTON AIR NATIONAL GUARD BASE

Roy F. Weston, Inc. (WESTON) has been retained by the United States Air Force Occupational and Environmental Health Laboratory (USAF OEHL) under Contract Number F33615-80-D-4006 to provide general engineering, hydrogeological and analytical services. The Phase I Problem Identification/Records Search for the Burlington Air National Guard Base at Burlington, Vermont (Burlington ANGB) was accomplished by CH2M Hill in September 1983. In response to the findings contained in

the CH2M Hill Phase I Final Report, the USAF OEHL issued Task Order 0029 to WESTON, directing that a Phase II pre-survey site inspection be conducted at Burlington ANGB. The purpose of this pre-survey was to obtain sufficient information to develop a work scope and cost estimate for the conduct of a Phase II, Stage I Problem Confirmation Study at Burlington ANGB.

The Pre-Survey Report was submitted in October 1983. Following modifications in the Scope of Work, Task Order 0031, dated 9 April 1984, was issued directing that work be undertaken at two sites, the former Fire Department Training Area and Old Landfill (FDTA/Old Landfill) and a "Construction Rubble" Landfill. A copy of the formal task order is included as Appendix B.

On 18 April 1984 WESTON met with Mr. Thomas E. O'Donovan, Jr., Deputy Adjutant General; Col. Ronald H. Morgan, Chief of Staff; and Major David Bombard, Chief of Supply, to discuss field protocols, supply and communication needs, and exploratory drilling locations and access. Also on that date, the well site locations were inspected by Green Mountain Boring Company, Inc. in preparation for drilling. Major Bombard arranged for a water supply source for the driller as well as site access clearing. Exploratory boring and monitoring well construction commenced on 7 May 1984 and was completed 23 May 1984. Sampling of wells and other monitoring points, as well as all survey work was completed on 25 and 26 June 1984. Selected analytes were re-sampled on 1 and 2 September 1984. This report documents the procedures and findings of the work accomplished during the Phase II Stage 1 study.

1.3 BASE PROFILE

Burlington Air National Guard Base encompasses an area of approximately 240 acres at the Burlington International Airport, Chittenden County, Vermont. The installation is located about four miles east of downtown Burlington in a rural, residential area. Figure 1-1 is a regional index map showing the location of Burlington ANGB.

The principal mission of the base is to maintain operationally ready F-4D Phantom aircraft, crews and support personnel through the 158th Tactical Fighter Group. This unit is available for immediate deployment to Europe under Presidential order. Previous missions included providing readiness-alert aircraft for a number of interceptor overseas support missions.

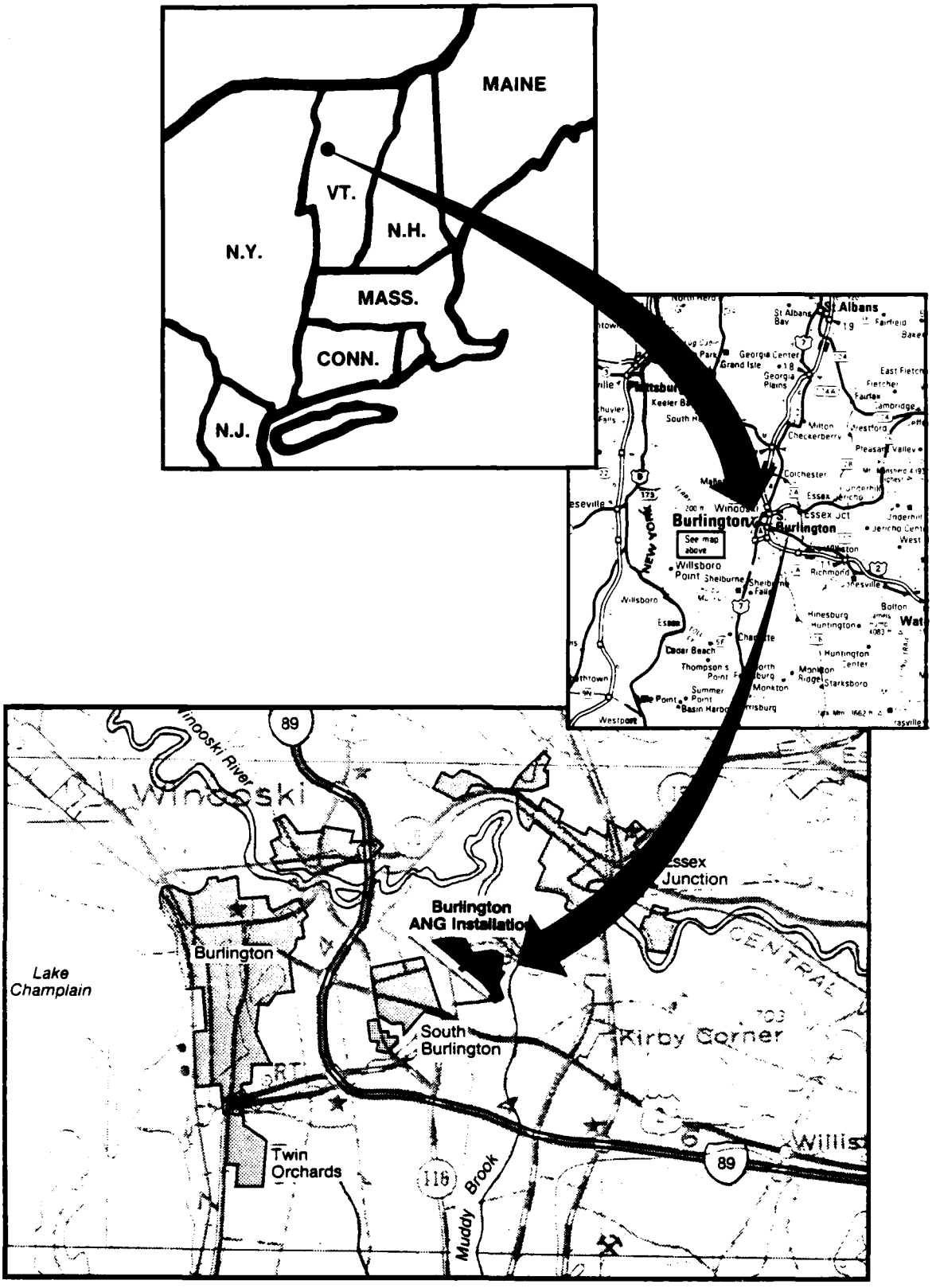


FIGURE 1-1 REGIONAL LOCATION MAP OF BURLINGTON AIR NATIONAL GUARD BASE

Past Air National Guard activities at Burlington ANGB in support of operational missions have resulted in the occurrence at the facility of two waste disposal sites of potential concern. These sites are illustrated on Figure 1-2. Each of these sites was rated by CH2M Hill during the Phase I activities in accordance with the IRP Hazard Assessment Rating Methodology (HARM). The results of these ratings are summarized in Table 1-1 (from the CH2M Hill report):

Table 1-1

Priority Listing of Disposal Sites

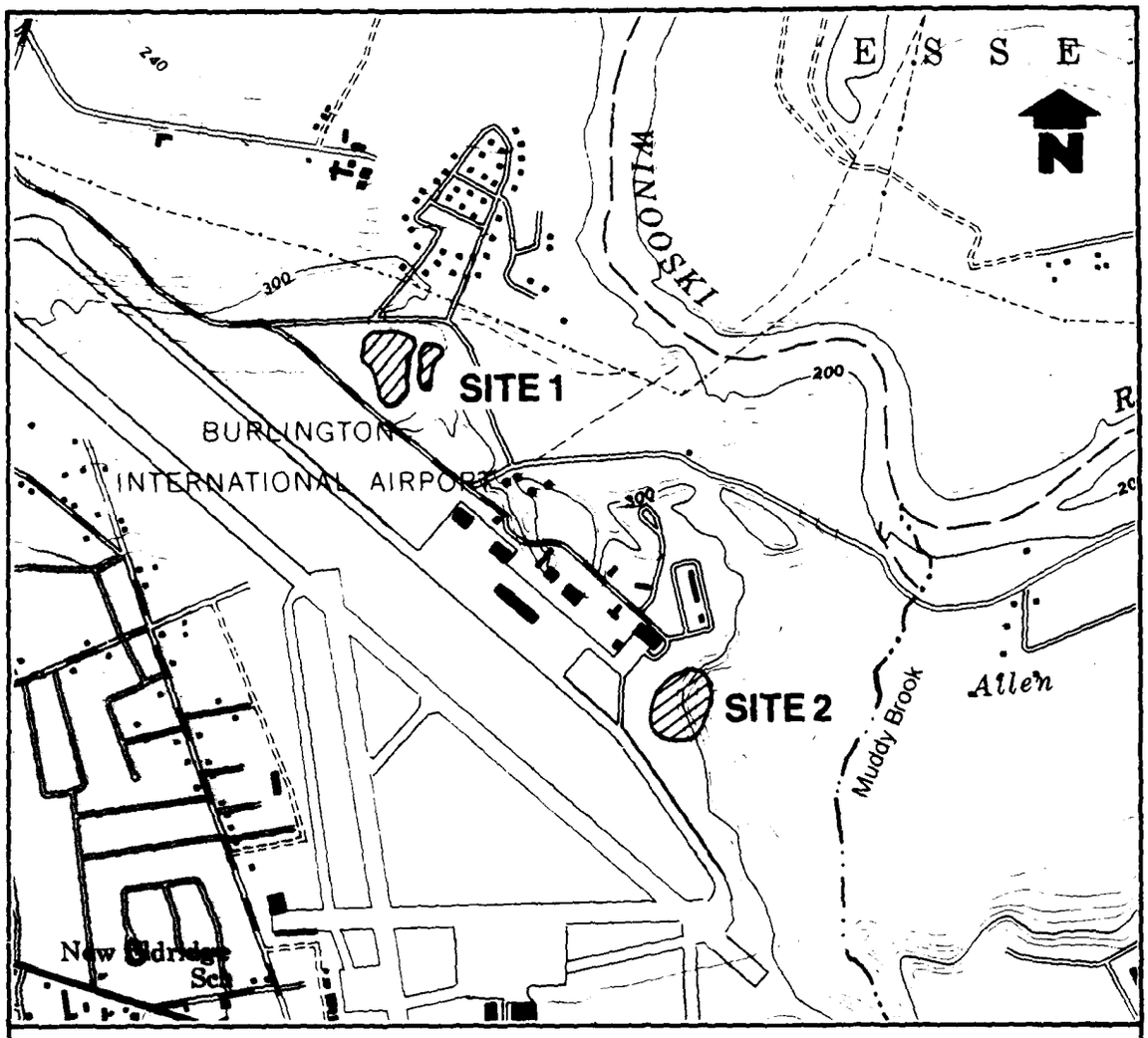
Site No.	Site Description	HARM Score
1	Fire Department Training Area and Old Landfill	82
2	"Construction Rubble" Landfill	48

Based upon these ratings and all other pertinent data, Phase II activities were recommended at both of these sites. A modification of Task Order 0031 addresses both of these sites in terms of an environmental monitoring and assessment program.

1.3.1 History and Description of Site No. 1, Former Fire Department Training Area (FDTA) and Old Landfill

The FDTA and Old Landfill (Figure 1-3) encompass approximately 10 acres of land, bordered by Poor Farm Road, the new base exit road. Due to the close proximity of the sites to each other, they are here considered as one site.

From 1960 to 1973, the Fire Department Training Area (FDTA) was used to conduct fire training exercises. Training exercises were scheduled an average of 26 times per year. Approximately 2000 gallons of clean and recovered JP-4 fuel was discharged to an unlined sandy area of the site and ignited for each burn. The approximate burn area is depicted on Figure 1-3. Between 1973 and 1980, the exercises were conducted 12 times per year using approximately 30 gallons of fuel per burn. Reportedly, waste oils and solvents were also burned in the area. Since 1980, all Fire Department Training has taken place at Plattsburgh Air Force Base.



Topography Taken From
7.5' USGS Quadrangle
Burlington, VT 1948
Photorevised 1972

FIGURE 1-2 POTENTIAL SOURCE SITE LOCATION MAP BURLINGTON AIR NATIONAL GUARD BASE

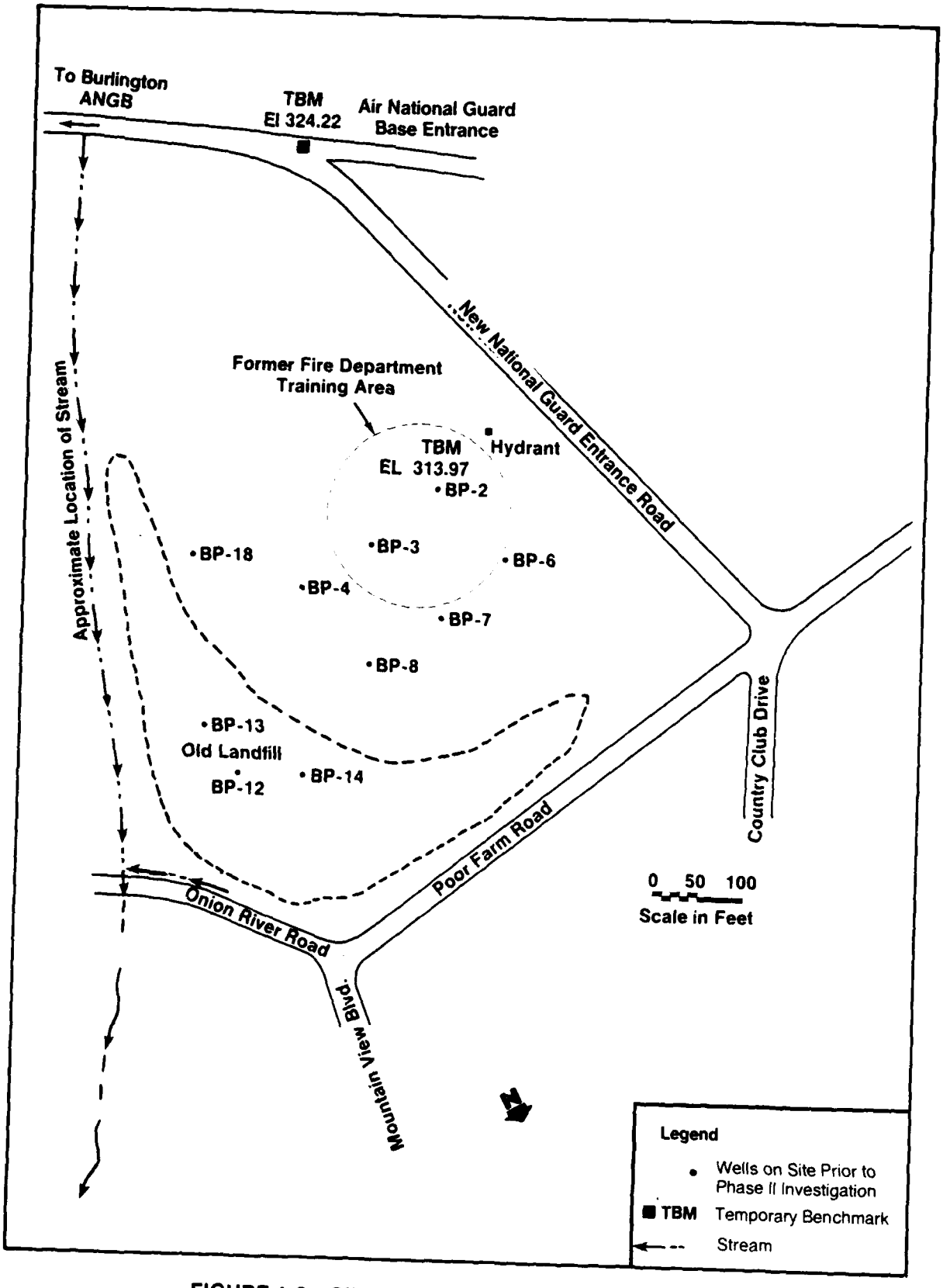


FIGURE 1-3 GENERAL SITE MAP OF SITE 1, FDTA/OLD LANDFILL

According to file records, the closure of the site included the removal of contaminated soil. The upper three feet of soil was removed from the burn area and disposed of in 1980 (CH2M HIll, 1983).

The approximate boundary of the landfill at the FDTA area is also illustrated on Figure 1-3. The landfill portion of the site was used from 1960 to 1980 and received construction debris, scrap metal, and an unknown quantity of waste oils, spent solvents, and cleaners. This area is on the base boundary adjacent to an intermittent tributary of the Winooski River.

In February 1982, ten shallow ground-water monitoring wells were installed in the area to provide ground-water quality sampling points and hydraulic input to determine the direction of ground-water flow. The locations of the wells are shown on Figure 1-3. On February 26, 1982 one round of samples was collected and analyzed for the priority pollutant volatile organic compounds (VOC). The results, shown in Table 1-2, indicated moderate to high contamination by a number of VOC compounds in seven of the wells located in the immediate vicinity of the FDTA.

In January, 1984, personnel from Burlington ANGB collected surface water and soil samples from the locations shown on Figure 1-4. Surface water samples from the top portion of the stream (surface water sample) and from just above the stream bed (stream bed water sample) were collected at seven locations upstream and downstream from the Fire Department Training Area (FDTA) and the Construction Rubble Landfill. Water samples were anlayzed for oils and greases, volatile organic compounds (VOC), and phenols and zinc at three locations. At three locations, soil samples were obtained from the stream bed material and analyzed for the EP Toxicity metals only. All samples were sent to the USAF OEHL laboratory at Brooks AFB for analysis. The analytical results are listed in Table 1-3. These results show the presence of VOC compounds at relatively low levels in most locations except at the upstream location for the FTDA, at which concentrations of MEK up to 87.0 mg/l were reported. The unnamed tributary in the vicinity of the FDTA also showed low levels of VOC compounds for the January, 1984 sampling period.

1.3.2 History and Description of Site No. 2, Construction Rubble Landfill

The Construction Rubble Landfill is located on a steep escarpment behind Hangar 5. The approximately two acre site has been in use since 1960 for the disposal of construction rubble and demolition debris from the installation. Reportedly, small quantities of waste oils and spent solvents were also disposed of at this location. The site continues in use today for small quantities of demolition debris.

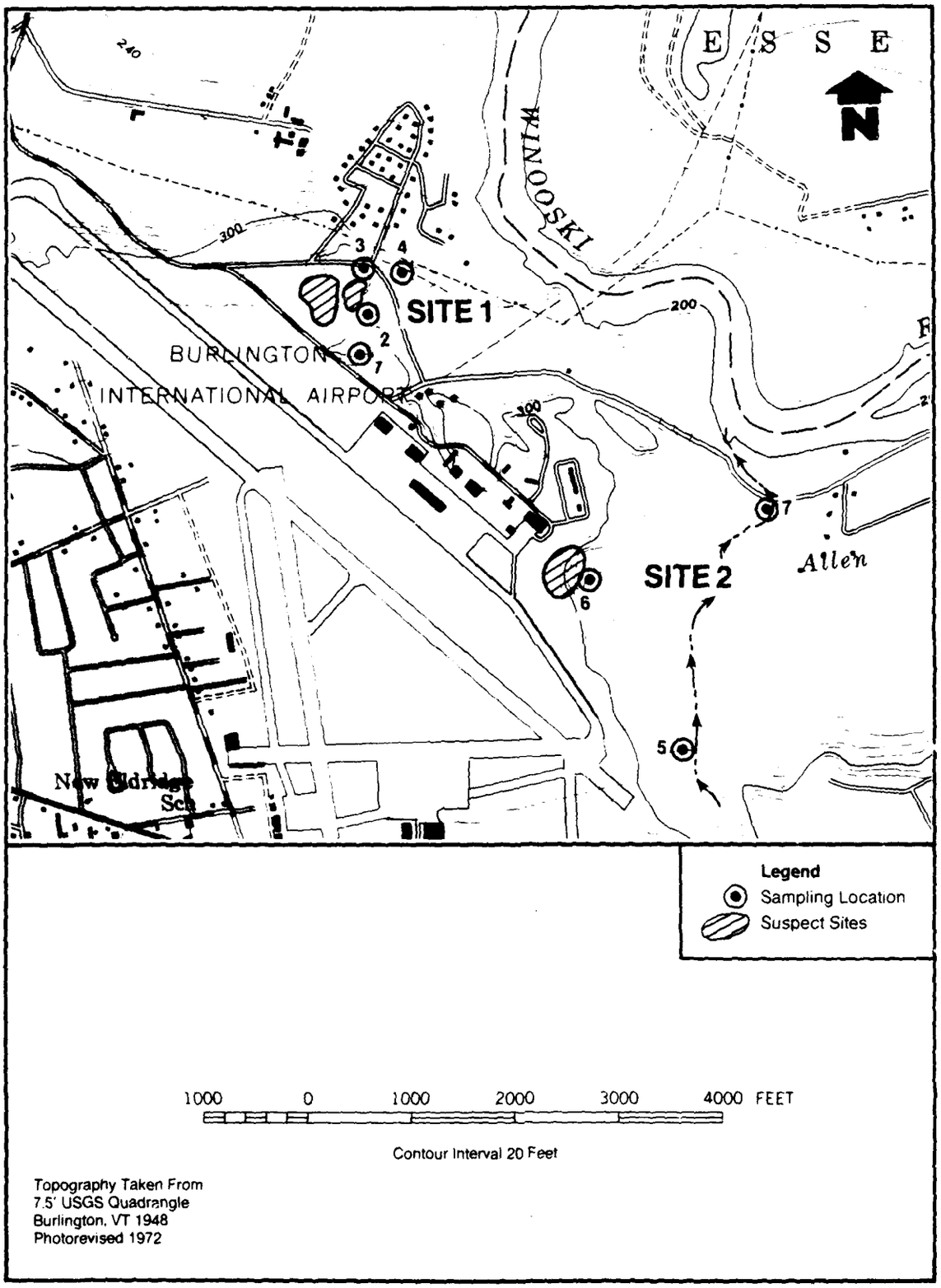


FIGURE 1-4 SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS JANUARY, 1984 BURLINGTON AIR NATIONAL GUARD BASE

TABLE 1-2

SUMMARY OF MONITORING WELL DATA[a]

February, 1982

Compound	Well Number and Concentration (ppb)									
	BP-2	BP-3	BP-4	BP-6	BP-7	BP-8	BP-12	BP-13	BP-14	BP-18
Methylene Chloride	ND[b]	1.0	1.2	ND	ND	ND	2.4	ND	2.6	ND
1,1,1-Trichloroethane	ND	44.4	ND	ND	ND	ND	584	58	ND	ND
Trichloroethylene	18.7	2.2	1.2	ND	ND	430	54	5.3	1,166	ND
1,2-Dichloroethylene	0.9	ND	735	4.4	2,265	ND	1,790	1,277	1,925	ND
Benzene	ND	173	104	ND	61	18.1	129	ND	20.6	ND
Ethylbenzene	ND	85	100	ND	10.6	51	142	ND	ND	ND
Toluene	ND	500	661	30	230	271	1,029	15.1	25.1	ND
O-xylene	ND	271	587	ND	61	1,005	523	ND	26.3	ND
m-xylene	ND	334	642	ND	54	1,067	660	ND	ND	ND
p-xylene	ND	110	236	ND	25	407	185	ND	ND	ND
Methyl Ethyl Ketone	ND	3,700	1,122	ND	2,030	93?	3,152	358	1,494	ND
2,2-Tetrachlorethylene	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL VOC's	200	5,221	4,189	34	4,737	4,331	8,250	1,713	4,660	ND

[a]Samples collected on February 26, 1982 and analyzed by USAF OEHL/SA, Brooks AFB, Texas Data was submitted to the Burlington ANG Installation in a report dated June 30, 1982.

[b]ND = None detected

DATA FROM CH_2M Hill Phase I Report (1983)

TABLE 1-3 SURFACE WATER AND SEDIMENT SAMPLING RESULTS, DECEMBER 1983

BURLINGTON AIR NATIONAL GUARD BASE

1-3.1 FIRE DEPARTMENT TRAINING AREA

Parameter	Detection Limit and Reporting Unit	Site 1 - Remote Upstream Surface Water	Site 1 - Remote Upstream Streambed Water	Site 2 - Upstream of 24" Pipe Surface Water	Site 2 - Upstream of 24" Pipe Streambed Water	Site 3 - at 24" Pipe Surface Water	Site 3 - at 24" Pipe Streambed Water	Site 4 - Downstream Surface Water	Site 4 - Downstream Streambed Water
Oils and Greases	0.3 mg/l	ND	*	ND	*	Broken	*	ND	*
Volatile Organic Halocarbons[1]									
Chloroform	0.1 ug/l	ND	ND	ND	ND	0.4	0.5	0.4	0.4
Trans-1,2-dichloroethene	0.1 ug/l	ND	ND	ND	ND	6.9	7.0	3.3	4.7
1,1,1-trichloroethane	0.1 ug/l	ND	ND	Trace	ND	0.8	0.7	0.4	ND
Trichloroethylene	0.1 ug/l	ND	ND	ND	ND	ND	0.3	ND	ND
Volatile Organic Aromatics[1]									
Ethylbenzene	1.0 ug/l	ND	ND	ND	ND	Trace	Trace	Trace	Trace
Methyl Ethyl Ketone	2.0 ug/l	87.0	6.9	4.1	3.0	4.8	3.0	Trace	Trace
M-xylene	1.0 ug/l	ND	ND	ND	ND	Trace	Trace	Trace	Trace
O-xylene	1.0 ug/l	ND	ND	ND	ND	Trace	Trace	Trace	Trace
P-xylene	1.0 ug/l	ND	ND	ND	ND	Trace	Trace	ND	ND

1-3.2 CONSTRUCTION RUBBLE LANDFILL

Parameter	Detection Limit and Reporting Unit	Site 5 - Remote Upstream Surface Water	Site 5 - Remote Upstream Streambed Water	Site 5 - Remote Upstream Soil	Site 6 - Seepage Pit Surface Water	Site 6 - Seepage Pit Streambed Water	Site 6 - Seepage Pit Soil	Site 7 - Downstream Surface Water	Site 7 - Downstream Streambed Water	Site 7 - Downstream Soil
CP Toxicity Metals[1]	0.001-0.02 mg/l	*	*		*	*		*	*	
Arsenic				ND			0.12			ND
Zinc (dissolved)	50 ug/l	ND	*	*	ND	*	*	ND	*	*
Oils and Greases	0.3 mg/l	0.5	*	*	ND	*	*	ND	*	*
Phenol	10.0 ug/l	ND	*	*	ND	*	*	ND	*	*
Volatile Organic Halocarbons[1]										
Trichloroethylene	0.1 ug/l	1.0	0.4	*	ND	ND	*	ND	ND	*
Volatile Organic Aromatics[1]	1.0-2.0 ug/l	ND	ND	*	ND	ND	*	ND	ND	*

ND = below detection limit
* = analysis not requested
(1) = compounds not listed were below detection limits in all samples

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Due to the topographic position of the site on a steep hill, dumped materials have, historically, not been covered. The demolition deposits and construction rubble extend to the toe of the escarpment where several intermittent spring-fed runs discharge towards Muddy Brook (Figure 1-2). This site was also preliminarily investigated in January, 1984 by Vermont ANGB personnel. The sampling locations around Site 2 are illustrated on Figure 1-4. The results revealed very low levels of contamination from the Construction Rubble Landfill.

1.4 CONTAMINATION PROFILE

Burlington ANGB has not been a major generator of hazardous material, and those wastes currently generated are either recycled or properly disposed of through the Defense Property Disposal Office (DPDO). Historically, the types of hazardous wastes generated included: recovered JP-4, spent solvents, cleaners, and waste oils. In the past, much of the combustible material was burned during Fire Department Training exercises, but unknown and possibly large quantities of hazardous substances may have seeped into the ground water beneath the FDTA. This concern is based upon reports of historical site use which indicate that over 300,000 gallons of combustibles were discharged and ignited on sandy permeable soils during the course of twenty years of site use. That significant quantities of residual petroleum products might have entered the ground-water flow system is concluded based on some of the initial sampling results performed prior to the initiation of the Phase II investigation.

Based upon the Phase I Records Search Report and available analytical data, the key chemical parameters of potential concern at Burlington ANGB were: oils and greases, priority pollutant heavy metals and volatile organics, Methyl Ethyl Ketone, Methyl Isobutyl Ketone, and phenols. To develop an initial determination of whether or not past disposal practices have adversely impacted the ground and surface waters in and around the FDTA/Old Landfill and the Construction Rubble Landfill, a Phase II, Stage 1 Problem Confirmation Study was authorized under the IRP Program. Both ground and surface waters were sampled and analyzed for the parameters listed in Table 1-4. The details of the field work are described in Section 3 of this report.

TABLE 1-4

ANALYTICAL PROTOCOL

PARAMETER	DETECTION LEVEL
Volatile Organic Compounds (Priority Pollutants)	*
Methyl Isobutyl Ketone (MIBK)	*
Methyl Ethyl Ketone (MEK)	*
Xylene	*
Antimony	10 ug/l
Arsenic	10 ug/l
Beryllium	10 ug/l
Cadmium	10 ug/l
Chromium	50 ug/l
Copper	50 ug/l
Lead	20 ug/l
Mercury	1 ug/l
Nickel	100 ug/l
Selenium	10 ug/l
Silver	10 ug/l
Thallium	10 ug/l
Zinc	50 ug/l
Oil and Grease	100 ug/l
Phenols	1 ug/l

*Detection levels are as specified for compounds listed in EPA Methods 624 and 625

1.5 FIELD TEAM

The Phase II Confirmation Study at Burlington ANGB was conducted by staff personnel of Roy F. Weston, Inc., and was managed through WESTON's Regional Office in Concord, New Hampshire. The following personnel served lead functions in this project:

MR. PETER J. MARKS, PROGRAM MANAGER: Corporate Vice President and Manager of Laboratory Services, M.S. in Environmental Science, 18 years of experience in laboratory analysis and applied environmental sciences.

MR. RICHARD L. KRAYBILL, P.G., PROJECT MANAGER: Regional Geologist for New England, M.S. in Geological Sciences, with over 14 years of experience of applied geology and hydrogeology.

MR. GLENN R. SMART, PROJECT GEOLOGIST: Hydrogeologist with over 7 years of experience in hydrologic, geologic, and engineering sciences.

MR. WALTER M. LEIS, P.G., GEOTECHNICAL QUALITY ASSURANCE OFFICER: Corporate Vice President and Manager of the Geosciences Department, M.S. in Geological Sciences, Registered Professional Geologist, over 10 years of experience in hydrogeology and applied geological sciences.

MR. JAMES S. SMITH, PH.D., LABORATORY QUALITY ASSURANCE OFFICER: Ph.D. in Chemistry, over 16 years of experience in laboratory analysis.

Professional profiles of these key personnel, as well as other project personnel are contained in Appendix C.

1.6 FACTORS OF CONCERN

While the Phase I study noted no evidence of environmental stress resulting from past waste disposal practices at Burlington ANGB, two concerns should be addressed.

First, the FDTA/Old Landfill received hazardous material on a regular basis for twenty years. These wastes were discharged to an area of moderately permeable silty sands which may recharge a fractured bedrock aquifer that crops out within 200 feet of the site. Although the bedrock aquifer has not, historically, been extensively utilized as a local

source of potable water, it is, however, a potential future drinking water source. Also, private wells utilize this aquifer southeast and remote from the sites of concern.

Second, analytical results of surface water testing of the stream flowing off-site near the FDTA have shown some contamination by volatile organic contaminants. The implications of the off-site impacts, if any, are a concern in terms of existing and potential surface water use.

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SECTION 2

ENVIRONMENTAL SETTING

2.1 REGIONAL GEOLOGY

The Burlington Air National Guard Base is situated in the Champlain Lowland, a 12 to 15 mile wide area of low relief with isolated hills (SCS, 1974). Bounded on the west by Lake Champlain and on the east by the Green Mountains, the lowland lies between the Champlain and Hinesburg Thrust Faults and is part of the Hinesburg Synclinorium. Figure 2-1 (CH2M Hill, 1983) illustrates the bedrock geology of the synclinorium. The bedrock seen in outcrops near the site, along the Winooski River, in Winooski Gorge and at numerous quarries in the area belongs to the Bascom Formation, a series of interbedded limestones, dolomites, and shales of Ordovician age. In some areas the sedimentary rock has been metamorphosed to quartzites, marbles, and slates (SCS, 1974).

The entire area was subjected to severe erosion by Pre-Wisconsin stages of glaciation and again in the Late Wisconsin Stage. The earlier ice invasion covered the area with glacial till and later with lacustrine silts and clays, deposited by a glacial lake which formed as the ice sheet retreated. A subsequent re-advance of the ice moving south through the valley scoured away much of the previously deposited material.

Ice and sedimentary material deposited during the retreat of this last glacier, blocked the Champlain Valley and formed a large lake, Lake Vermont. A thick layer of lacustrine silts and clays was subsequently deposited throughout the Champlain valley lowlands. As the continental glaciers melted, the waters of Lake Vermont were drained through the St. Lawrence Valley but were later replaced by the Champlain Sea, which was caused by a short-lived worldwide rise in sea level. In the absence of the heavy mantle of glacial ice, post-glacial isostatic uplift produced the present elevations (SCS, 1974).

Post-glacial erosion by the Winooski River and its tributaries has produced escarpments on the north and east of the installation and has reworked the glacial deposits of the broad floodplain. Figure 2-2 shows a generalized stratigraphic column for the area. This figure was

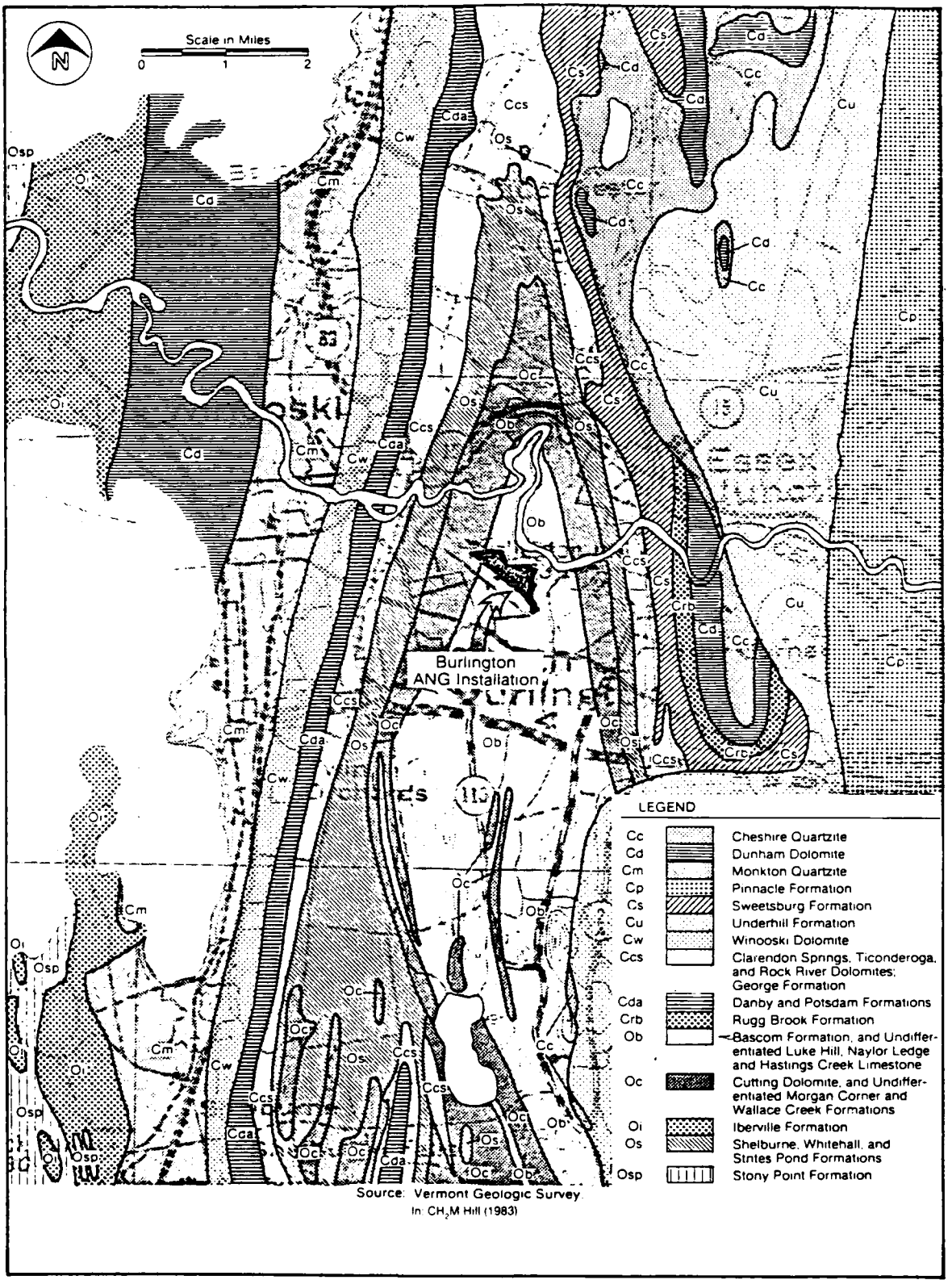


FIGURE 2-1 REGIONAL BEDROCK GEOLOGIC MAP

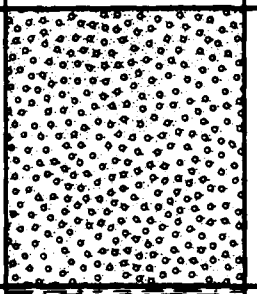
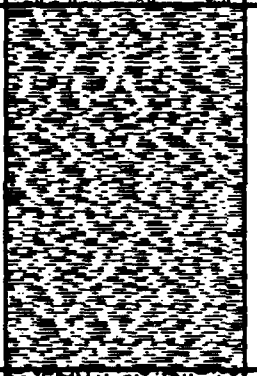
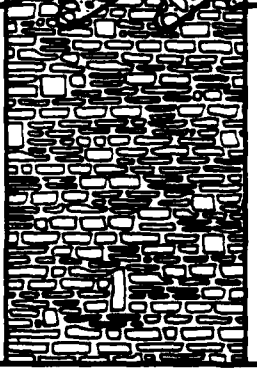
ERA	Period	EPOCH	Unit	Columnar Section	Thickness In Feet	Typical Lithologic Characteristics
Cenozoic	Quarternary	Recent	Fill/Landfill		0-7'	
		Pleistocene	Deltaic Deposits		9-50'	Fine to Coarse Brown to Gray Sand to Sandy Silt
			Lacustrine/ Marine Deposits		4"-16'	Gray to Blue Gray Clay, and Silty Clay, Trace Gravel
			Gravelly Glacial Till and Boulders Large		0-22+'	Gray Nonstatified Boulders, Gravel, Sand Silt, and Clay Admistures Angular to Subangular Cobbles
Paleozoic	Ordovician		Unconformity Beekmantown Group Bascom Formation			White Crystalline Limestone

FIGURE 2-2 GENERALIZED STRATIGRAPHIC COLUMN

generated from existing data and from the results of the exploratory boring program for the Phase II effort. Depths to bedrock vary greatly throughout the Champlain Valley, and range from 0 to 475 feet (Heindel 1980). Heindel (1980) cited several areas where depths to bedrock exceed 100 feet calling them bedrock depressions and noted that several of these areas are within a few hundred yards of bedrock outcrops. Well data in the vicinity of these depressions are sparse and their extent and configurations are ill-defined. Possible explanations of their origin are thrust slice escarpments, sink holes, or caves.

2.2 SOILS

The Soil Conservation Service Chittenden County soil survey classifies the soils underlying the site as chiefly belonging to the Adams and Windsor loamy sands. These soils developed on sandy beach, delta, and terrace deposits, and typically are excessively drained. The hazard of water erosion is slight, even in unvegetated areas; however, unvegetated areas are susceptible to wind erosion. Much of the area beneath and adjacent to the site has been altered by the addition of fill material deposited during the construction of the airport and by landfilling operations associated with base activities.

2.3 TOPOGRAPHY

The topography of Western Chittenden County is dominated by delta lowlands to the west and the Green Mountains to the east. Elevations range from about 95 feet National Geodetic Vertical Datum (NGVD) at Lake Champlain to 4290 feet atop Mount Mansfield several miles northeast of Burlington ANGB. The intervening Lake Plain is dissected by deeply incised streambeds formed by gully erosion of the native sandy soils. Burlington ANGB is situated on a broad terrace above the Winooski River Valley. The elevations over most of the installation range from 300-310 (NGVD), but slope sharply downward to the north and east toward the Winooski River some 50-60 feet below.

2.4 SURFACE DRAINAGE

Drainage from the base flows through the Muddy Brook to Allen Brook and into the Winooski River, and from several intermittent streams which flow directly to the Winooski River. The river ultimately flows into Lake Champlain. Drainage from the runways and buildings flows through culverts to the installation boundary. One such culvert

discharges to a gully southeast of the former Fire Department Training Area (FDTA) and contributes flow to an intermittent stream which probably also receives recharge from the areas of suspected contamination (see Figure 1-3).

According to the Phase I Study, the Winooski River, from Lake Champlain to a point approximately two miles upstream of the site, and Allen Brook, have been given a Class "C" rating while Muddy brook has been rated as a Class "B" waterway (Vermont DWR, 1980). Table 2-1 lists the State of Vermont's criteria for stream classifications.

2.5 CLIMATE

The Champlain Valley has a cool, humid, continental climate with a mean annual air temperature of 42°F and a range of from a minimum average daily temperature of 7.6°F in January to a maximum average daily temperature of 81.0°F in July. Normal annual precipitation is 32.54 inches which is fairly evenly distributed throughout the year, ranging from a low of 1.68 inches in February to a high of 3.72 inches in August (SCS, 1974). The severity of precipitation events is moderated by the presence of the Adirondack Mountains to the west and the Green Mountains to the east. The annual precipitation recorded at Burlington ANGB averages 32 inches per year (SCS, 1974).

2.6 HYDROGEOLOGY

Ground water in the vicinity of Burlington ANGB occurs under unconfined (water table) conditions in the deltaic, glacio-fluvial, and recent deposits, and under semi-confined or artesian conditions in the fractured bedrock beneath the lacustrine clays. The deltaic deposits underlying Burlington ANGB are classified as having low ground-water potential and little use is made of the unconsolidated aquifer for potable water purposes (CH2M-Hill, 1983). The Phase I Study found records of only four wells having been constructed in these deltaic deposits since 1966. In reviewing records of yields of wells constructed in the Bascom Formation, Heindel (1980) found a median yield of 19.9 gallons per minute for the 23 wells on record. An area having excellent potential for ground water resource development is located approximately one mile north of Burlington ANGB. A similar area is located west of the base; however, due to their remote locations neither area should be adversely impacted by former operations at the base. A potential does exist for contamination of the bedrock aquifer beneath Burlington ANGB especially in areas where the lacustrine clay confining layer thins out.

TABLE 2-1

CRITERIA FOR STREAM CLASSIFICATION
IN THE STATE OF VERMONT

Classification	Criteria
A	These waters are suitable for a public water supply with disinfection when necessary. The character is uniformly excellent.
B	These waters are suitable for bathing and recreation, irrigation, and agricultural uses. They are good fish habitats and are acceptable for public water supply with filtration and disinfection.
C	These waters are suitable for recreation, boating and irrigation of crops. They are not used for consumption without boiling. They are good habitat for wildlife and common food and game fishes indigenous to the region. Industrial uses which are consistent with other class uses are acceptable.

Maps prepared by Heindel (1980) show a regional bedrock ground-water flow direction trending north/northwest toward Burlington ANGB. The regional piezometric surface generally mimics the ground surface at a depth of approximately 20 feet, although depths to ground water of up to 200 feet have been measured in wells (Heindel, 1980). Water table elevations and consequently flow directions in surficial deposits vary greatly due to the complex nature of the deposits.

SECTION 3

FIELD PROGRAM

3.1 PROGRAM DEVELOPMENT

Based upon the conclusions of the Phase I Records Search and the overall relative HARM score ratings it was determined that two sites, the former Fire Department Training Area (FDTA) and Old Landfill (considered together as site No. 1), and the Construction Rubble Landfill (site No. 2), warranted additional study.

On 6 and 7 October 1983 WESTON conducted a pre-survey site inspection of the two listed sites. A Pre-Survey Report was issued in October 1983 which presented recommendations for a preliminary hydrogeologic investigation and sampling program at the FDTA and Old Landfill, and a limited sampling program at the Construction Rubble Landfill. The locations of the sites investigated are illustrated on Figure 1-2.

3.1.1 Site No. 1 - Fire Department Training Area and Old Landfill

The WESTON Pre-Survey Report suggested certain modifications to the Phase I recommendations. At an upgradient well location, WESTON recommended the installation of a two well couplet if it were found that a multi-aquifer condition existed. WESTON further recommended that three downgradient wells be installed to aid in delineating the extent of any off-site migration of contaminants. The Phase II Pre-Survey Report also selected four surface water sampling locations to assess impacts the site might have on surface water adjacent to and downgradient from the site.

3.1.2 Site No. 2 - Construction Rubble Landfill

WESTON recommended that three additional surface water samples be collected from points representative of surface water quality data upstream and downstream from the Construction Rubble Landfill, as well as from a seep below this site. WESTON did not recommend sediment sampling at this stage of the investigation.

3.1.3 Analytical Protocol

Based upon past sample analyses, manifests, and other background data, an analytical protocol was selected for the two recommended sites to provide indicators of specific and non-specific contamination. The parameters chosen are listed in Table 1-4.

3.1.4 Formal Scope of Work

Task Order 0031 is included in Appendix B. This modified Task Order was the basis for the implementation of the field program described subsequently.

3.2 HYDROGEOLOGIC FIELD INVESTIGATION

A preliminary investigation has been conducted to define the hydrogeologic and geologic setting at Burlington ANGB. This investigation also assessed the potential adverse environmental impacts from contaminants resulting from past waste handling and disposal practices at the former Fire Department Training Area (FDTA)/Old Landfill and the Construction Rubble Landfill. To evaluate potential problems, data were obtained from ten existing monitoring wells, five newly installed wells, and six surface water sampling locations. The new monitoring wells were installed to provide ground water flow direction and gradient information, to serve as ground water sampling locations, and to determine depths to bedrock underlying the site. The planned surface water and well locations for Site 1 are shown in Figure 3-1. As an adjunct to the drilling program at Site 1, a series of surface water sampling and staff gage locations were selected to establish and assess surface water and ground water relationships and to determine if contaminated ground water is adversely impacting local surface waters. The surface water sampling locations which address Sites 1 and 2 are illustrated on Figure 3-2.

3.2.1 Drilling Program

As recommended in the Phase II Pre-Survey Report, the drilling program was confined to Site No. 1 (the FDTA/Old Landfill) at Burlington ANGB. A total of five wells were installed as specified in the work order. Two were installed as an upgradient well couplet; and three were installed as downgradient wells.

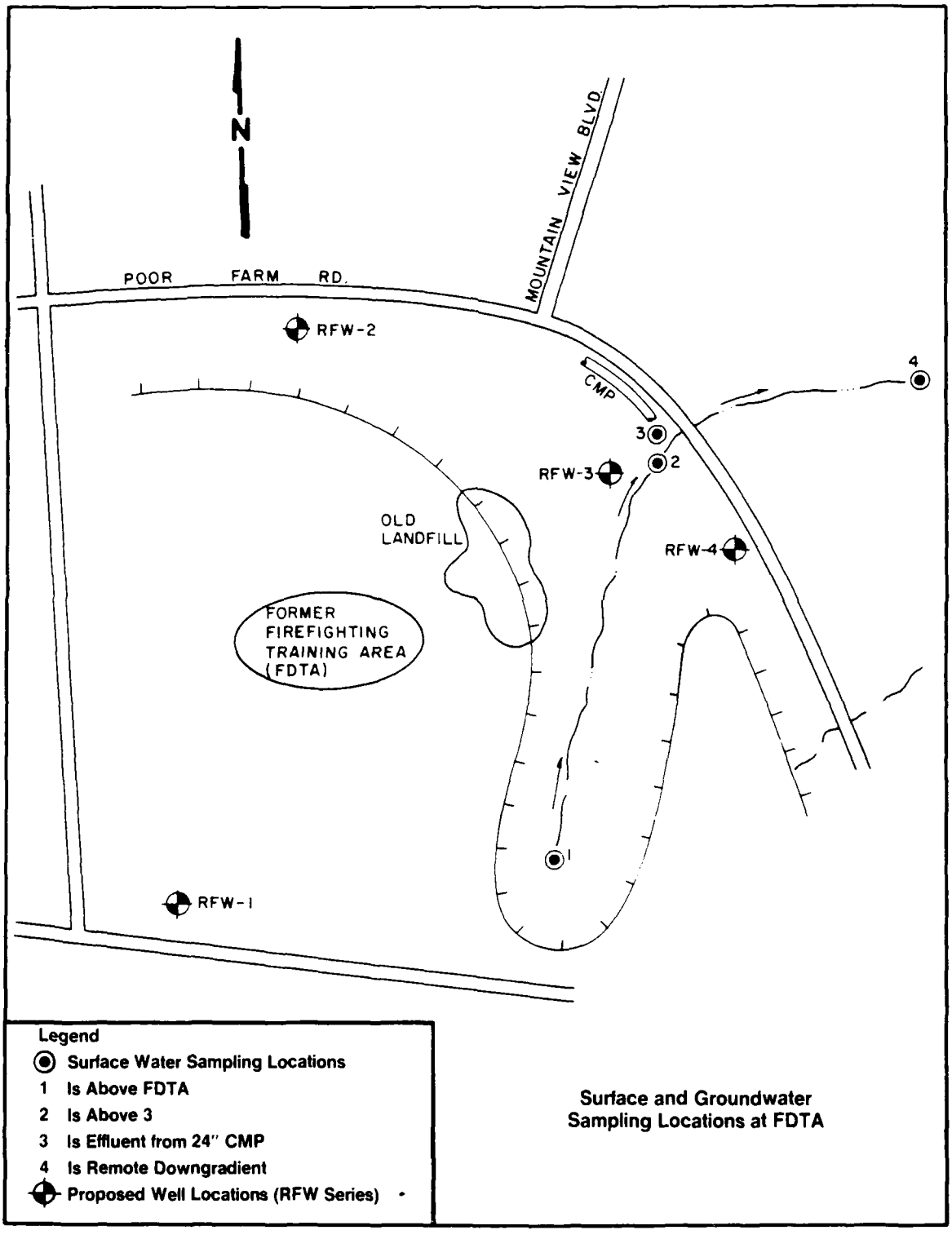


FIGURE 3-1 PROPOSED PHASE II SURFACE AND GROUNDWATER SAMPLING LOCATIONS AT FDTA/OLD LANDFILL

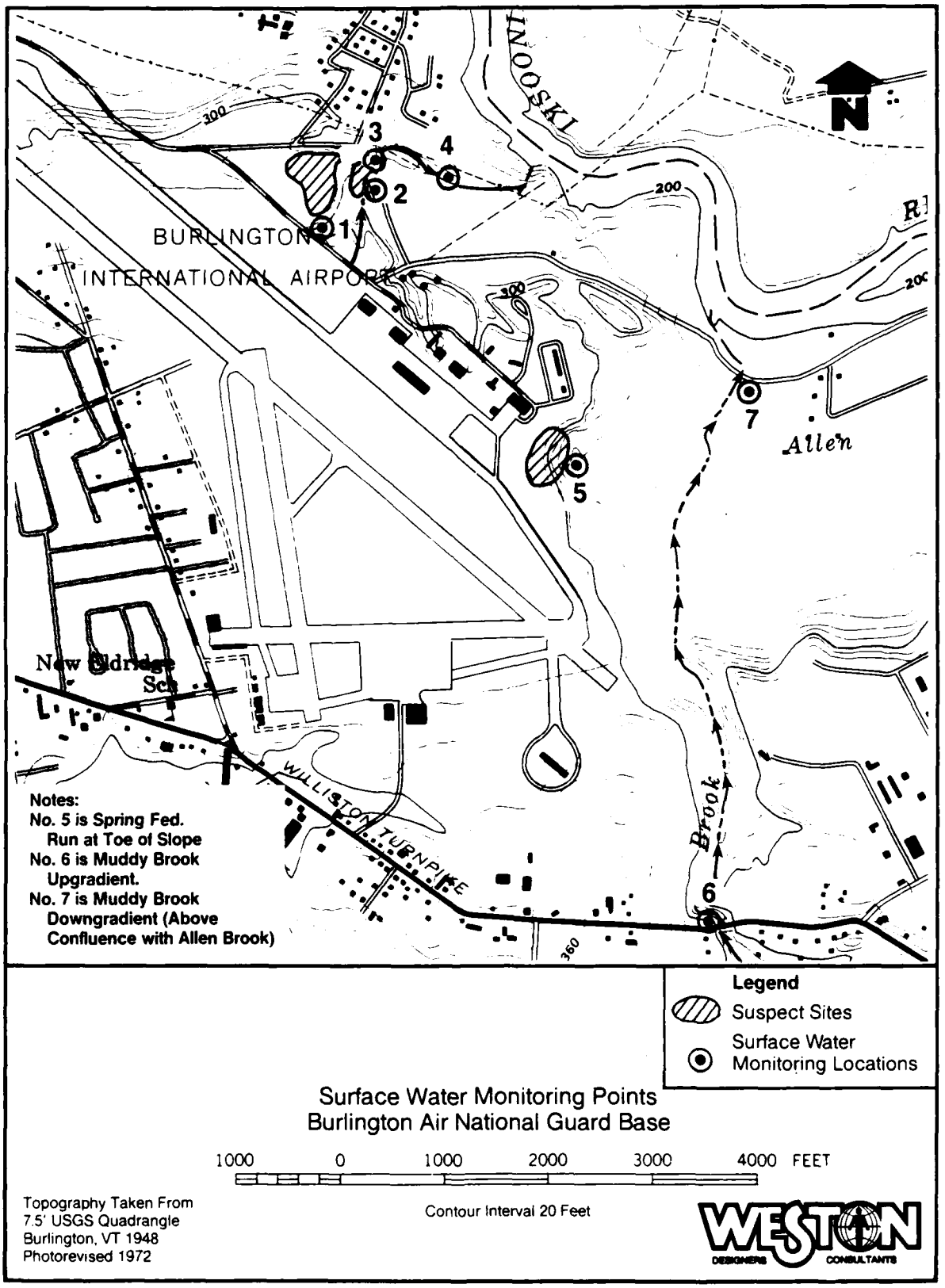


FIGURE 3-2 PHASE II SURFACE WATER SAMPLING LOCATIONS BURLINGTON AIR NATIONAL GUARD BASE

Background data contained in the Phase I Report prepared by CH2M Hill indicated that the site was underlain by successive layers of sand, clay, and possibly glacial till, deposited upon sedimentary bedrock of the Bascom Formation. To better understand the local geologic conditions it was decided to attempt to install an upgradient boring to confirm bedrock occurrence. Confirmation would be made by drilling or coring five feet into bedrock. In the event that a multi-aquifer condition was encountered, a second shallow well was to be installed to monitor water quality, to detect vertical hydraulic gradients, and to measure piezometric surface elevations in the upper aquifer, while the deep well would be screened in the deeper aquifer for the same purposes.

Three downgradient wells were installed around the perimeter of the site to determine the nature of the stratigraphy, to measure depths to the water table, and to evaluate local water quality. The actual well locations are illustrated on Figure 3-3.

3.2.2 Monitoring Well Installation Summary

All monitoring wells were drilled with either a truck-mounted Mobile Drill B40-L Rig or a trailer-mounted Mobile Drill B-47 Rig using hollow-stem augers or wash-and-case techniques with four inch I.D. casing. Soils in all borings except RFW-1A were sampled at five-foot intervals with a two-inch diameter, two foot long split-spoon sampler using Standard Penetration Test (SPT) techniques (ASTM Standard Method No. D-1586). Split-spoon sampling of RFW-1A was not necessary due to its proximity to RFW-1. Rock coring was performed using either an NX or a BX core barrel. All soil samples and rock cores were retained in archives at the WESTON office in Concord, New Hampshire. During the installation of all borings, an HNu Model PI-101 Photo Ionization Detector was used to screen split-spoon samples for evidence of volatile organic contaminants and to monitor air quality at the well head.

Within each boring, a monitoring well was constructed using two-inch diameter, Schedule 80 polyvinylchloride (PVC) pipe and well screens with No. 10 (0.010 inch) machine slots and factory threaded couplings. The annular space of the well was backfilled with a suitable washed sand to a point one to five feet above the top of the well screen. Above the sand pack, a bentonite slurry, tremied into place, or bentonite

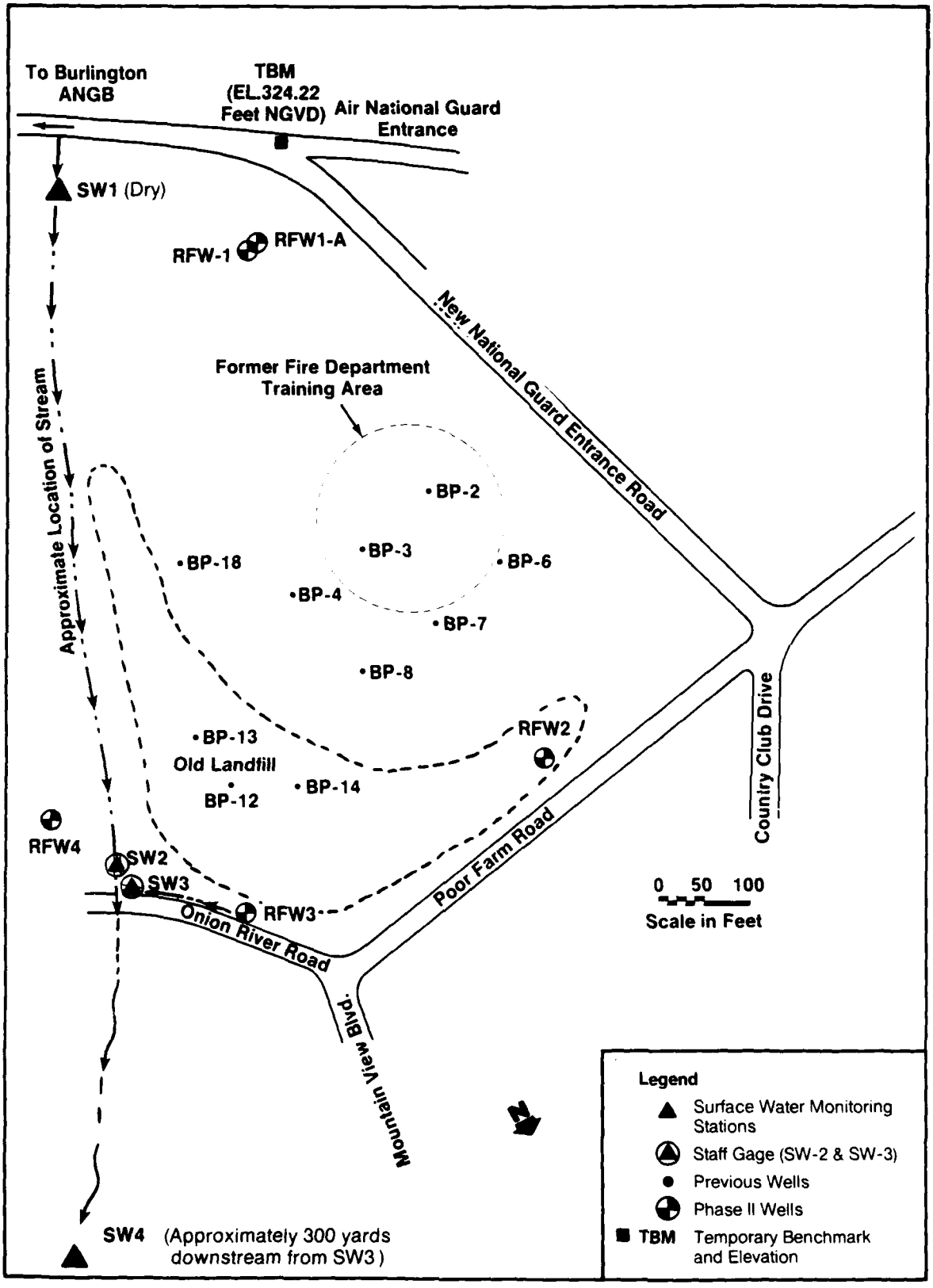


FIGURE 3-3 SITE MAP OF THE FDTA/OLD LANDFILL AREA SHOWING LOCATION OF PHASE II MONITOR WELLS

pellets were used to seal the annulus to a point two to three feet below ground surface. The wells were finished by installing a locking, hardened steel, protective casing around the PVC pipe set in a concrete plug.

Each well was developed by surging and bailing until the discharge was clear of particulate matter. The stratigraphy at each well location is discussed in Section 4.1 of this report and well logs are included in Appendix D. The construction details of the individual wells are reviewed below and summarized in Table 3-1 and Figure 3-4.

3.2.2.1 Upgradient Wells

A well couplet, RFW-1 and RFW-1A, was installed adjacent to the main entrance road (Figure 3-3) to provide upgradient water quality data and to better define the local stratigraphy. Boring RFW-1 was constructed by case and wash techniques using four inch I.D. steel casing. The casing was advanced to refusal at approximately 67 feet below ground surface. Using a combination of NX and BX core barrels and a tri-cone roller bit, the hole was advanced through coarse gravel, sand and boulders to a total depth of 88 feet. Since a multi-aquifer condition existed, RFW-1 was screened from 65 feet below ground surface to approximately 80 feet where the bore hole collapsed. The annular space above 65 feet was grouted with a bentonite slurry to within three feet of land surface to isolate the well screen in the deep aquifer.

Boring RFW-1A was then drilled adjacent to RFW-1 by hollow-stem auger technique to a depth of approximately 49.5 feet below ground surface. The well was completed in deltaic sands by installing 35 feet of screen and 17 feet of riser pipe.

3.2.2.2 Downgradient Wells

As specified in the Task Order, three downgradient wells were installed at the perimeter of the FDTA/Old Landfill (Figure 3-3). RFW-2 was drilled using 3 1/2-inch I.D. hollow stem augers to bedrock refusal at a depth of approximately 18 feet. Refusal was confirmed by advancing an NX core barrel approximately 4.5 feet into bedrock. RFW-3 and 4 were both drilled with a 3 1/2-inch I.D. hollow stem auger through approximately nine feet of overburden to bedrock and subsequently five feet into bedrock with an NX

TABLE 3-1

SUMMARY OF WELL CONSTRUCTION DETAILS

Well	Approximate Land Surface Elevation (ft)	TOC (ft)	Below Ground Surface Screened Interval(ft)	Sandpacked Interval(ft)	Geology of Screened Zone
RFW-1	322.82	325.27	65-80	60-80	Bouldery Sandy Till
RFW-1A	323.01	325.84	14-49	7.5-49	Deltaic Sands
RFW-2	304.94	307.84	12-22	10.22	Deltaic Sands/Rock Surface
RFW-3	281.37	284.05	4.5-14.5	3.5-14.5	Deltaic Sands/Rock Surface
RFW-4	277.25	279.74	4.5-14.5	3.5-14.5	Deltaic Sands/Rock Surface

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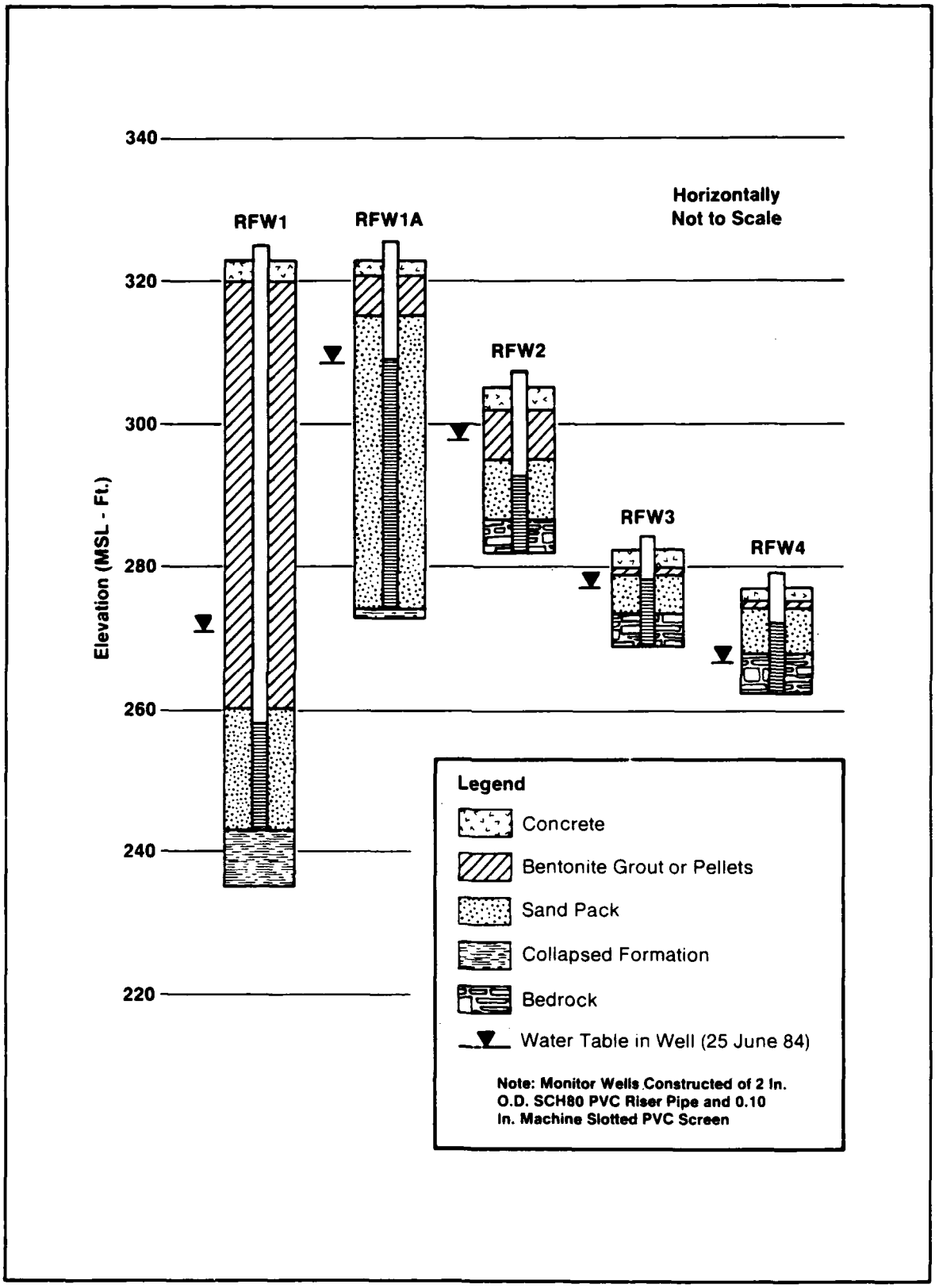

FIGURE 3-4 WELL COMPLETION DIAGRAM FOR ALL PHASE II MONITOR WELLS AT BURLINGTON AIR NATIONAL GUARD BASE

core barrel. All downgradient wells were completed by screening the full saturated thickness of the overburden as well as the five foot core hole. The wells were completed and developed by methods described in 3.2.2.

3.2.3 Surface Water Program

On 25 and 26 June 1984, six surface water locations were sampled and two staff gauges were installed at surface water sampling points SW-2 and SW-3 (Figure 3-3). The planned upgradient surface water monitoring point for the FDTA/Old Landfill (Figure 3-1) was dry during the periods scheduled for sampling. Consequently, no sample could be obtained upgradient of Site 1. However, seepage was entering the water course lateral to the FDTA/Old Landfill enabling a sample to be collected at point SW-2 (Figure 3-3). Sample point SW-3 is located immediately downstream from a 24-inch corrugated metal drain pipe which parallels Poor Farm Road. Sampling point SW-4 is a remote downgradient sampling location approximately 300 yards downstream from SW-2 and SW-3.

Sampling locations for the Construction Rubble Landfill (Site 2) are illustrated on Figure 3-2. Sampling point SW-5 is at the toe of the Construction Rubble Landfill from which emerges an intermittent spring fed run. At the time of sampling, the water sample consisted of standing water.

Sampling point SW-6 represents a background water quality sampling point and was taken from Muddy Brook upstream of the site where it passes beneath Route 2-A. Sampling point SW-7 is at the downstream end of a culvert where Muddy Brook flows under River Cove Road.

Staff gages SG-1, SG-2 and SG-3 were installed at surface sampling locations SW-1, SW-2 and SW-3 respectively. The purpose of the staff gages was to assess the relationship between the surface water elevations and the ground water flow patterns.

3.2.4 Field Testing

In order to maximize the data collected from each of the installed monitoring wells, various field tests and testing techniques were used. Field testing involved: surveying of the top-of-casing, bedrock outcrop, and staff gage elevations to provide hydrogeologic and hydraulic gradient

data, permeability tests to provide data for determination of aquifer characteristics in the vicinity of the well screens and field water quality testing to provide pH, temperature, and specific conductance data. Each of these field tests is described in the following paragraphs.

3.2.4.1 Surveying

A complete survey of all new wells and staff gages was performed on 25 and 26 June 1984. A Dietzgen Top-Site 6140 30-second transit was used for determination of horizontal locations to an accuracy of ±10 feet. A Kern GKO-A automatic level was used for all elevations to an accuracy of ±0.05 feet. Initially, all elevations were computed using assumed data from previous studies at the base. The two points used were a temporary benchmark on the center line of the base entrance road and the top of casing elevation for monitoring well BP-2. When all the newly installed wells had been surveyed, a level line was run to a point of known elevation, the finished floor elevation of Building 110 (327.00 feet), and the casing elevations were converted to National Geodetic Vertical Datum (NGVD). Table 3-1 documents the results of the surveying activities related to the new wells.

3.2.4.2 Water Level Measurements

On 25 June 1984 a complete round of water level measurements was taken prior sampling the wells. On that occasion a battery powered Soil Test Model DR-760A Water Level Probe was used. All readings were obtained with respect to the top of the PVC casing. Table 3-2 contains a listing of all readings and calculated water level elevations.

3.2.4.3 Permeability Testing

In situ permeability testing was conducted on the five newly installed wells. The test techniques used were developed by the
United States Department of the Navy, Naval Facilities Engineering Command and are described in Cedergren (1977). The essential procedures are as follows:

a. The static water level in the well to be tested was measured and recorded.

TABLE 3-2

SURVEY AND WATER LEVEL ELEVATION DATA - PHASE II

MONITORING POINT NUMBER	GROUND SURFACE ELEVATION (ft)	REFERENCE POINT TOP of CASING (ft)	7 July 1983		25 June 1984	
			Reading (ft.)	Elevation (ft.)	Reading (ft.)	Elevation (ft.)
RFW 1	322.82	325.27			54.83	270.44
RFW 1A	323.01	325.84			17.32	308.52
RFW 2	304.94	307.84			9.95	297.89
RFW 3	281.57	284.05			6.78	277.27
RFW 4	277.25	279.74			12.87	266.87
BP 2	310.97	313.97	9.16	304.81	9.07	304.90
BP 3	318.90	319.09	15.42	303.67	15.22	303.87
BP 4	317.34	320.78	18.63	302.15	18.41	302.37
BP 6	310.19	310.19	7.33	302.86	7.12	303.07
BP 7	310.20	310.20	8.10	302.1	7.68	302.52
BP 8	310.61	312.61	11.42	301.19	14.88	297.73
BP 12	308.88	311.38	20.33	291.05	19.85	291.53
BP 13	305.29	311.04	16.58	294.46	15.72	295.32
BP 14	309.07	310.92	17.37	293.55	16.91	294.01
BP 18	313.35	315.75	17.54	298.21	16.82	298.93
SG-1		316.92*			Dry	-----
SG-2		271.75*			1.83	269.92
SG-3		273.19*			1.65	271.54

* Top of Staff Gage

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b. Water was pumped into the well until the level was even with the top of the PVC casing.

c. As the water level returned to the static position, the elapsed time and level readings were recorded until the level returned to at least 90% of the static level.

Results obtained from in situ permeability testing are summarized in Table 3-3. Results are discussed in Section 4-2 of this report.

3.2.4.4 Field Water Quality Testing

Field water quality testing was conducted during the water quality sampling phase of the project. This was conducted the week of 25 June 1984. Specific conductance and temperature were measured in the field using a Yellow Springs Instrument Company Model 33 Meter. Field pH measurements were made using an Analytical Measurements Model 107 pH Meter. Sampling was conducted at all new monitoring wells, three existing wells, and six surface water sites. Table 3-4 contains a complete list of all field water quality testing data.

3.2.5 Water Quality Sampling

The purpose of the water quality sampling program was to identify, insofar as possible at the level of a confirmation survey, the location, concentration, and areal extent of any contamination present in the hydrogeologic environment. From the information gathered, it is possible to deduce the general direction in which these contaminants are migrating and their probable source. To achieve these goals efficiently, specific field procedures were developed for purging the wells, collecting the samples, and ensuring field quality control. These procedures have been used to obtain a single set of representative samples for chemical analysis from monitoring wells and surface water sampling locations. The sampling and quality assurance plans used to accomplish these goals are contained in Appendix E. Sample chain-of- custody documentation is contained in Appendix G. Sampling was conducted during the week of 25 June 1984. Due to missed holding times and incomplete analyses, selected analytes were re-sampled on 1 and 2 September 1984. These sample results are contained in Appendix H with the results of the June, 1984 sampling round. Sampling protocols were the same for both sampling episodes.

TABLE 3-3

RESULTS OF IN SITU PERMEABILITY TESTING

Monitor Point	Type Test	Hydraulic Conductivity cm/sec	Hydraulic Conductivity ft/d
RFW-1	Slug	5.2×10^{-5}	1.5×10^{-1}
RFW-1A	Slug	5.9×10^{-6}	1.7×10^{-2}
RFW-2	Slug	2.9×10^{-5}	8.2×10^{-2}
RFW-3	Slug	3.4×10^{-5}	9.6×10^{-2}
RFW-4	Slug	1.6×10^{-6}	4.5×10^{-3}

Note: cm/sec centimeters per second
ft/d feet per day

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TABLE 3-4

FIELD WATER QUALITY TEST RESULTS

25 June 1984

Location	Temperature (C^{o})	pH	Conductivity (umhos/cm)
RFW-1	9	8.0	180
RFW-1A	10	7.1	300
RFW-2	11	7.8	165
RFW-3	14	7.0	290
RFW-4	16	7.0	270
BP-2	11	6.1	295
BP-7	12	6.3	360
BP-12	12	6.6	280
SW-1*	--	--	--
SW-2	--	7.2	280
SW-3	--	7.5	370
SW-4	--	7.1	315
SW-5	--	7.2	150
SW-6	--	8.0	260
SW-7	--	7.2	160

*No sample taken

SECTION 4

RESULTS

4.1 SITE INTERPRETIVE GEOLOGY

Prior to the Phase II investigation, little direct information was available pertaining to the local geology at Burlington ANGB. A review of regional geologic data indicated that the site is underlain by glacio-fluvial, deltaic, and beach deposits overlying either lacustrine clays or glacial till. These, in turn, overlie Ordovician age sedimentary rocks of the Bascom formation. The Phase II Pre-Survey Report noted that bedrock might occur at or near the surface, based upon the presence of limestone quarries within 2000 feet of the site.

Split-spoon samples obtained during the drilling of Well RFW-1 indicate that the southern portions of the FDTA is underlain by approximately 50 feet of brown to gray, coarse to fine deltaic deposits and sand grading to fine sandy silt with depth. At 50 feet below ground surface, a plastic gray clay was encountered in RFW-1 which extended for the next 16 feet. This clay contained a trace of silt and pebbles which may have been deposited with the clays due to ice rafting as the retreating glaciers broke up. Below the clay, for approximately 22 feet, a bouldery till was encountered which required the use of a diamond tip core barrel and a tri-cone bit to advance the boring. Drilling was discontinued at a depth of 88 feet without having encountered bedrock, due to the inability of the driller to advance the casing with the available equipment.

At RFW-2, located approximately 650 feet north of RFW-1, five feet of medium-grained sands were encountered overlying silty fine sands, clay, and finely crystalline limestone bedrock. A four foot core of bedrock contained twelve fractures several of which showed evidence of iron staining (see Appendix D - Boring Logs).

At wells RFW-3 and RFW-4, approximately nine feet of silty sands were encountered overlying a veneer of clay on limestone bedrock. Five foot bedrock cores recovered at each of these wells contained eight and fourteen fractures, respectively, and as in the core from well RFW-2, several

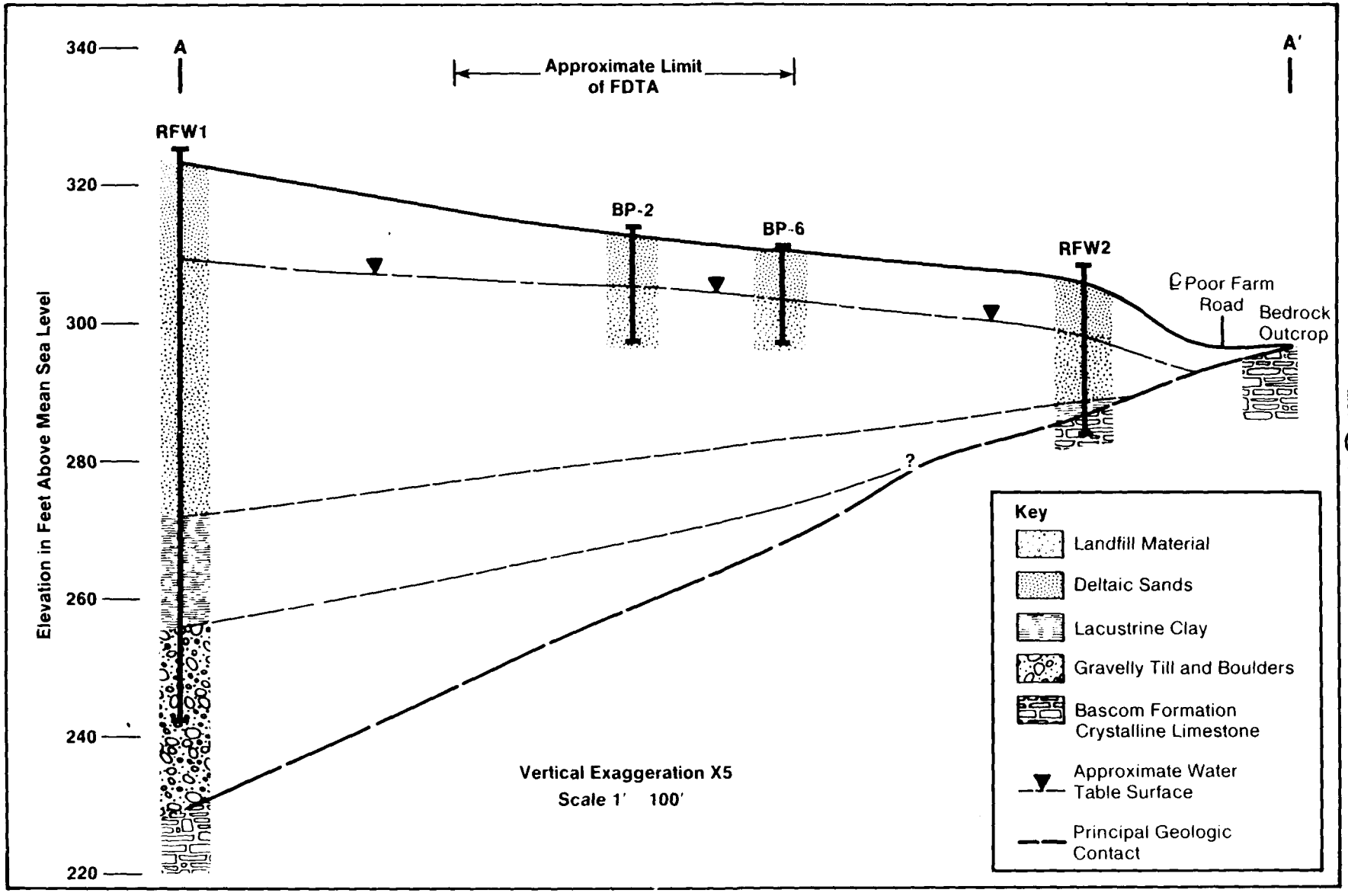

FIGURE 4-1 GEOLOGICAL CROSS-SECTION THROUGH FIRE DEPARTMENT TRAINING AREA

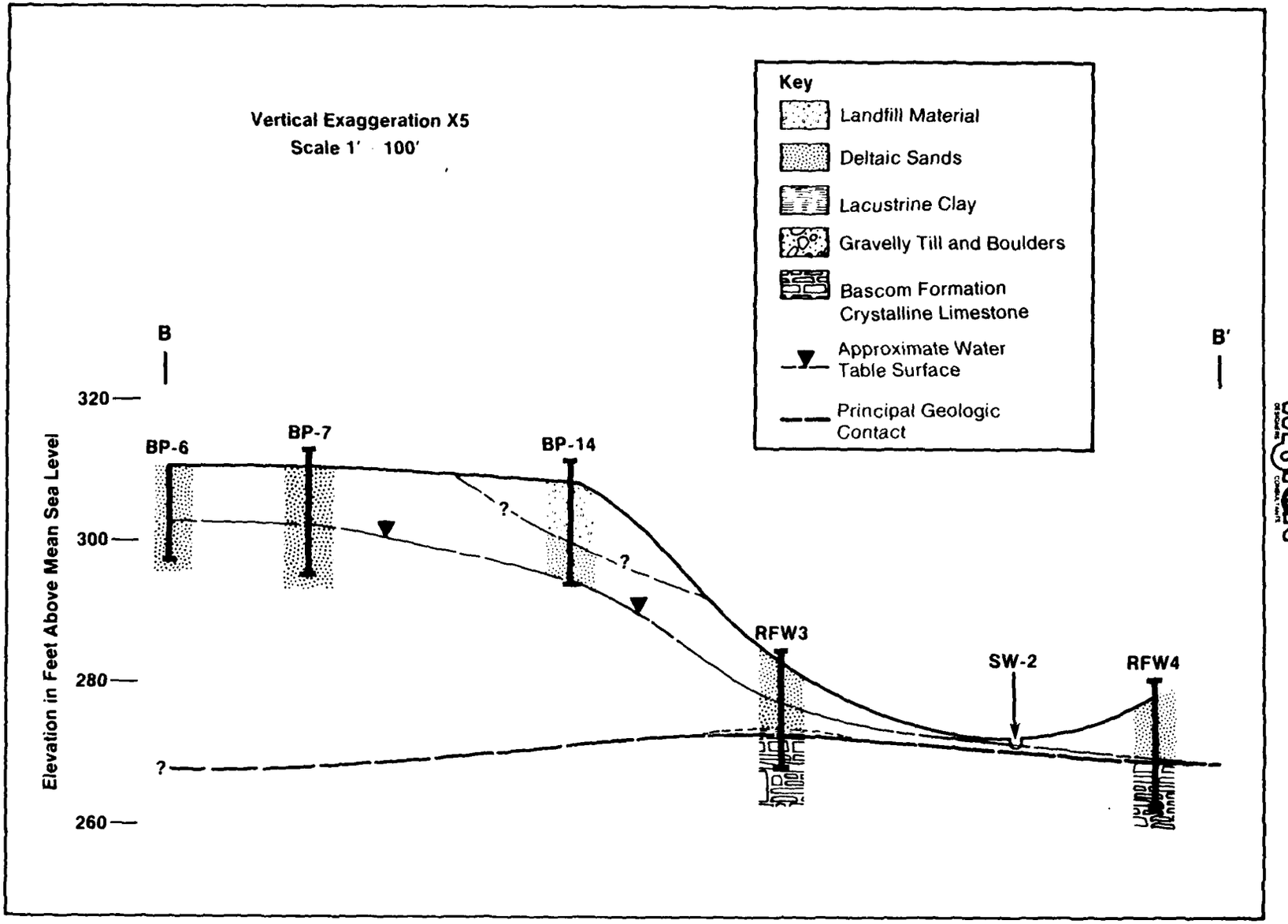

FIGURE 4-2 GEOLOGICAL CROSS-SECTION THROUGH FDTA/OLD LANDFILL

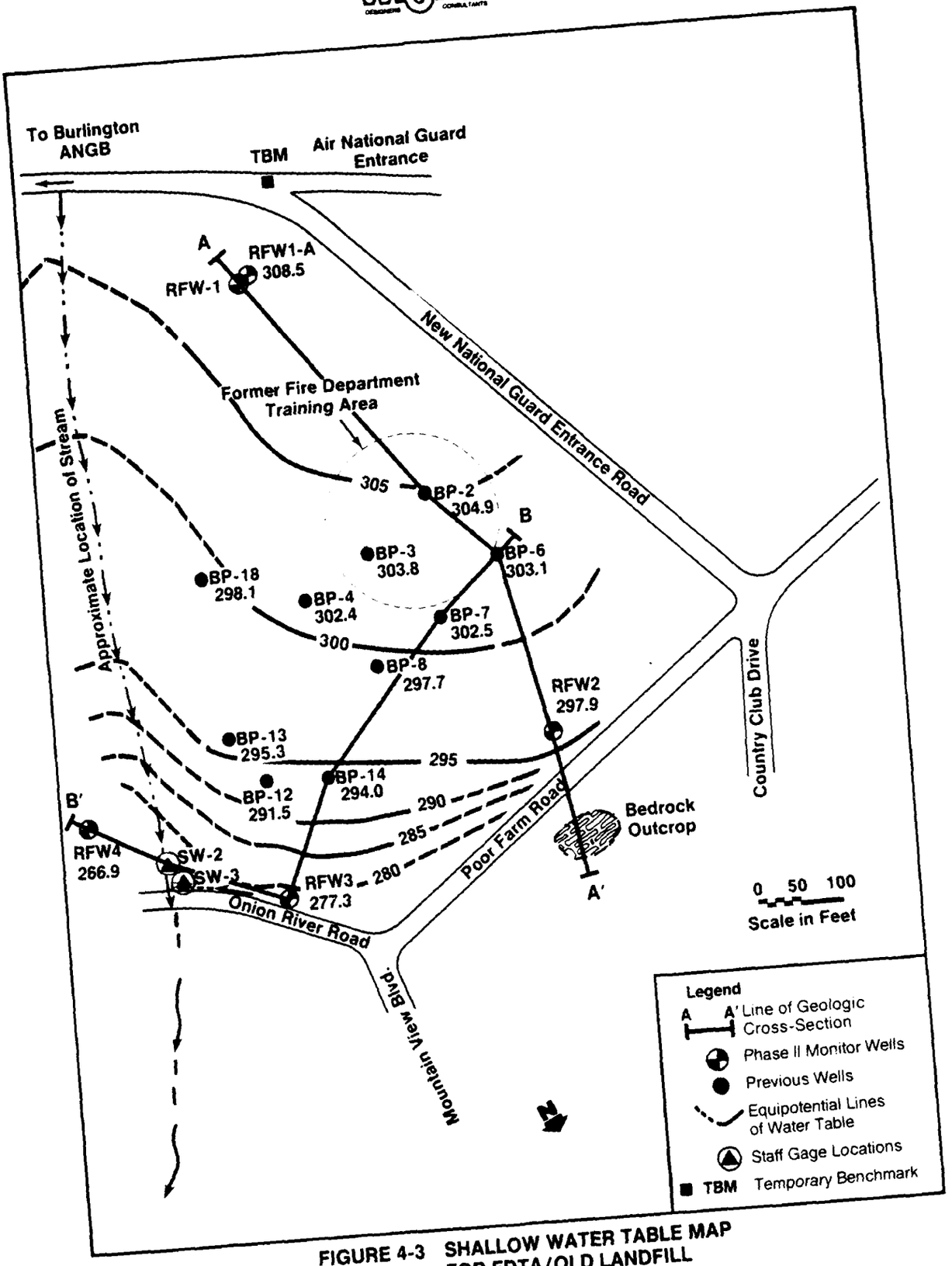

FIGURE 4-3 SHALLOW WATER TABLE MAP FOR FDTA/OLD LANDFILL JUNE, 1984

ground water from the FDTA/Old Landfill area. The water table gradient of the shallow flow system is approximately 0.03 across the site, but steepens sharply to approximately 0.11 from BP-14 on the deltaic deposits to RFW-3 which lies at the base of the deltaic escarpment that borders Site 1 to the north and east. From RFW-3 to the stream, the measured gradient flattens to approximately 0.03 and continues downward toward RFW-4.

The water level measurements in RFW-1 were significantly lower than in the adjacent shallow well RFW-1A. A head difference of 38.1 feet was measured in June 1984. This compared to a vertical hydraulic gradient of approximately 1.2 (h/L). Water table elevations in wells RFW-3 and RFW-4 are probably more closely associated with the shallow water table rather than the regional bedrock flow regime. Bedrock wells would be needed to obtain better definition of the regional flow regime in the Bascom Formation. Wells RFW-2, RFW-3 and RFW-4 do not constitute representative bedrock monitoring wells.

4.2.1 Ground Water Flow Rate Calculations

The results of in situ slug tests were used to compute the approximate hydraulic conductivity (K, a measure of permeability) of the deltaic sands, the sandy glacial till, and the composite bedrock/overburden deposits (Table 3-3). The results ranged from $1x10^{-6}$ centimeters per second (cm/sec) in RFW-4 to $5.2x10^{-5}$ cm/sec in RFW-1. Slug test data are contained in Appendix F.

Well RFW-1 which is screened entirely in the sandy glacial till exhibited the highest hydraulic conductivity value ($5.2x10^{-5}$ cm/sec). Well RFW-1A is screened entirely within the deltaic sands. Wells RFW-2, RFW-3 and RFW-4 are shallow wells screened across the deltaic sands and the top surface of the bedrock. The calculated hydraulic conductivities in these wells reflect the composite conditions within the shallow, unconfined saturated zones. The average hydraulic conductivity of those wells intersecting delataic sands is $1.8x10^{-5}$ cm/sec or 0.05 feet per day (ft/d). This value is concluded to be the most representative for the shallow flow system and was used in further assessments of the ground water flow regime.

The average ground water velocity through a saturated material is given by the equation:

$$Vs = Ki/N_e$$

where:

Vs = Seepage or actual flow velocity (L/T)
K = Average hydraulic conductivity (L/T)
i = Hydraulic gradient (dimensionless)
N_e Effective porosity (dimensionless)

Assuming a conservative value for N_e of 0.30 and using the measured gradient of 0.03 and a value of K of 0.05 ft/d, the estimated flow velocity of ground water through the deltaic sands beneath the site is about 1.8 feet per year. This very low horizontal migration rate is principally influenced by the low hydraulic conductivity values derived from the slug tests in the deltaic sands. The exploratory borings revealed that the deltaic sands were predominately mixtures of fine sands and silts. In some of the split-spoon samples, silt and fine sand were found in equal proportions. Thus, the lithology of the deltaic deposits supports the low hydraulic conductivity values obtained by in situ well tests.

It should be noted, however, that the slug test procedures provide order of magnitude results and sometimes yield low estimates of hydraulic conductivity. Thus, flow velocities a factor of ten higher than those computed would still be within realistic estimates.

An approximate determination of the quantity of ground water flow through the deltaic sands beneath the site has been computed by employing the Darcy equation:

$$Q = KiA$$

where:

Q = Potential ground water flow (L^3/T)
K = Hydraulic conductivity (L/T)
i = Hydraulic gradient (dimensionless)
A = Cross-Sectional area (L^2)

For the purpose of this approximation, the average K value of 0.05 ft/d and the measured hydraulic gradient of 0.03 were used. An approximate cross-sectional area of 7200 square feet was computed by assuming a wetted thickness of 24 feet of aquifer material above the clay confining stratum extending 300 feet across the upgradient portions of the site. Substituting these values into the above equation results in an estimated quantity of 80 gallons per day (GPD) of ground water flow through the deltaic sands towards the installation boundary. This is an order of magnitude estimate dependant primarily to the estimate of hydraulic conductivity.

Because the deltaic sands beneath the site become thinner towards the installation boundary to the north (Figures 4-1 and 4-2), the fate of ground water in the deltaic sands beneath the site is of particular interest. The substantial difference in hydraulic head measurements in the well couplet RFW-1 and RFW-1A suggests the potential for a significant downward or deep recharge flow component. This head loss translates to a vertical hydraulic gradient between the deltaic sands and deeper aquifer zones of approximately 2.4 according tot he relationship:

$$I = \frac{\Delta h}{L}$$

where:

i = Hydraulic gradient
Δh = Differnece in hydraulic head (38.1 feet)
L = Distance across which head loss occurs (16 feet, thickness of the intervening clay stratum)

Although a substantial downward gradient occurs in the vicinity of the RFW-1 and RFW-1A couplet, the presence of a plastic clay stratum between the unconfined aquifer and the bedrock limits the potential quantity of recharge to the bedrock aquifer at this point. The potential amount of recharge through the clay into the bedrock is of particular interest since this represents a possible pathway for off-site migration of contaminants. Permeability tests of the lacustrine clay were not conducted. From a visual classification of the clay, an hydraulic conductivity of the clay of 2.8×10^{-5} ft/d (1×10^{-8} cm/sec) is estimated for computing potential flow quantities through the clay stratum.

Using the Darcy equation (Q=KiA) and an estimated recharge area of seven acres, over 150 gallons per day of recharge can potentially occur through the clay into the underlying bedrock through the relatively permeable sandy till (where it occurs). Since only 80 gallons per day of shallow ground water flow was calculated to occur in the deltaic sands beneath the site. Virtually all of the shallow flow can migrate vertically downward into the bedrock aquifer. Both the stratigraphy of the deltaic sands and the computations of vertical recharge indicate this is probably the case.

The potential flow pathways in the the regional bedrock system underlying the site can be mult-directional based upon natural lithologioc and stratigraphic variations as well as manmade structures. The composition of the bedrock suggests that it may represent a relatively permeable regional aquifer. The key to refining the definition of the shallow deep flow regime around the FDTA/Old Landfill is through a more detailed correlation of the hydraulic conditions and the water quality data. The following discussion presents the preliminary results of the water quality sampling conducted for the Phase II Study.

4.3 WATER QUALITY RESULTS - GENERAL

The principal objective of the Phase II Confirmation Study was to determine if past hazardous waste operations or disposal practices have resulted in environmental degradation. The analytical results of the Phase II Study represent a full round of sampling (February, 1982) by Vermont ANG personnel at the shallow monitoring wells installed in 1982, a second round of ground-water sampling (June and September, 1984) by WESTON personnel from the five new Phase II wells and selected existing wells, one round of surface water samples conducted by Vermont ANG personnel (January, 1984) and one by WESTON personnel (September, 1984). Certain elements of the sampling protocol were inadvertently omitted during the analyses of the WESTON (June, 1984) sampling period. Accordingly, WESTON personnel collected additionalsamples at selected monitor wells and surface water locations so that the missing parameters could be analyzed. Volatile organic analyses of the ground-water and

surface water samples collected in June, 1984 did not meet recommended EPA holding times. Consequently, resampling of the ground and surface waters for volatile analyses was performed in September, 1984. Also, four of the ground-water samples for mercury were lost from the June 1984 sampling round. Thus, repeat sampling and analysis for mercury was conducted at all ground water monitoring points in September 1984. In June 1984, five of the 13 Priority Pollutant metal analyses were performed on the surface water samples. In September 1984, resampling of surface waters was performed for all thirteen Priority Pollutant metals. In September 1984, samples were collected for oil and grease and phenols analyses since these samples had not been collected in June 1984. All results are included in Appendix H of this report.

Ground-water quality results are listed in Table 4-1; surface water quality results are presented in Table 4-2. A complete list of analytical results from the Phase II sampling and analytical program is included in Appendix H of this report.

On November 28, 1980, the US Environmental Protection Agency issued criteria for 64 toxic pollutants or pollutant categories which could be found in surface waters. The criteria established recommended maximum concentrations for acute and chronic exposure to these pollutants for both human and aquatic life. The derivation of these exposure values was based upon cancer risk, toxic properties, and organoleptic properties.

The limits set for cancer risk are not based upon a "safe" level for carcinogens in water. The criteria state, that for maximum protection of human health, the concentration should be zero. However, where this cannot be achieved, a range of concentrations corresponding to incremental cancer risks of one in ten million to one in one hundred thousand was presented (10^{-7} to 10^{-5}).

Toxic limits were established at levels for which no adverse effects would be produced.

These are the health related limits which have been used in this report to evaluate potential impacts. It should be noted that the cancer risk column is based upon one cancer case

TABLE 4-1

COMPOSITE GROUNDWATER QUALITY DATA - BURLINGTON AIR NATIONAL GUARD BASE

PHASE II INVESTIGATION

Analyte	Unit	RFW 1	RFW 1A	RFW 2	RFW 3	RFW 4	BP 2	BP7	BP12	RFW1B(2)	BP-1(3)	LAB Blank (4)
Oil & grease	Mg/l	(1)	ND	0.15	0.66	0.27	1.56	3.45	2.22	ND	ND	ND
Phenol	Mg/l	ND	0.043	ND	ND	ND	ND	0.035	0.23	ND	ND	ND
Sb	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ug/l	ND	ND	ND	ND	ND	12.7	22.7	11.8	ND	ND	ND
Be	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cu	ug/l	ND	ND	17.7	16.0	18.1	10.1	ND	ND	ND	ND	ND
Pb	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ug/l	11.0	11.1	14.1	34.2	16.3	41.6	73.2	60.3	ND	ND	ND
Se	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ag	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tl	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ug/l	56.0	22	83	78	98	164	22	21.5	ND	ND	ND
Hg	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ug/l	Trace	ND	ND	ND	ND	7	ND	ND	ND	ND	ND
Methylene Chloride	ug/l	ND	ND	10	Trace	ND	ND	ND	ND	ND	ND	ND
1,2 trans-Dichloroethylene	ug/l	ND	ND	5	170	Trace	ND	2700	ND	ND	ND	ND
1,1,1-Trichloroethane	ug/l	ND	ND	Trace	50	ND	ND	ND	ND	ND	ND	ND
Benzene	ug/l	ND	ND	Trace	Trace		Trace	100	130	ND	ND	ND
1,1 -Dichloroethane	ug/l	ND	ND	ND	Trace	ND	ND	ND	1200	ND	ND	ND
Ethylbenzene	ug/l	ND	ND	ND	ND	ND	Trace	80	50	ND	ND	ND
Xylenes	ug/l	ND	ND	ND	ND	ND	Trace	400	690	ND	ND	ND
Toluene	ug/l	ND	ND	ND	ND	ND	ND	300	450	ND	ND	ND
Vinyl Chloride	ug/l	ND	ND	ND	ND	ND	ND	ND	40	ND	ND	ND
Chloroethane	ug/l	ND	ND	ND	ND	ND	ND	ND	5	ND	ND	ND
1,1-Dichloroethylene	ug/l	ND	ND	ND	ND	ND	ND	ND	ND 5	ND	ND	ND
MEK	ug/l	ND	ND	ND	ND	ND	ND	ND	3	ND	ND	ND
MIBK	ug/l	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	ND

(1) Oil & Grease sample contaminated in lab

(2) RFW-1B Field Blank - metals, oils & grease, phenols

(3) BP-1 Field Blank - Volatiles

(4) Laboratory Blanks - See Appendix H

(5) Oil & Grease, Phenol & Metals Samples collected week of 11 June, 1984;
Hg & Volatiles Collected in September 1984. See Appendix I for full data files.

ND - None Detected.

TABLE 4-2

COMPOSITE SURFACE WATER QUALITY DATA - PHASE II INVESTIGATION

BURLINGTON AIR NATIONAL GUARD BASE

Analyte	Unit	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8 (1)	LAB Blank	SW-1 (1)
Oil & Grease	mg/l	0.1	ND	ND	ND	0.2	0.1	ND	ND	ND
Phenol	ug/l	ND	ND	30	ND	ND	36	ND	ND	ND
Chromium (Total) (3)	ug/l	ND	ND	10	ND	ND	ND	ND	ND	ND
Zinc (3)	ug/l	16	32	27	26	16	22	33	5	ND
Chloroform	ug/l	ND	ND	Trace	ND	ND	ND	ND	ND	ND
1,2 Dichloroethane	ug/l	Trace	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	ug/l	Trace	Trace	13	11	Trace	15	ND	ND	Trace
Tetrachloroethylene	ug/l	Trace	Trace	ND	51	20	65	ND	ND	23
Toluene	ug/l	Trace	Trace	Trace	Trace	ND	Trace	ND	ND	Trace
1,2 Trans-Dichloroethylene	ug/l	ND	Trace	ND	33	ND	ND	ND	ND	ND
Trichloroethylene	ug/l	ND	Trace	Trace	51	ND	Trace	ND	ND	ND
Dichlorodifluoromethane	ug/l	ND	ND	Trace	Trace	ND	Trace	ND	ND	ND
1,1,2,2 Tetrachloroethane	ug/l	ND	ND	Trace	ND	ND	Trace	ND	ND	ND
1,1 ,1,Trichloroethane	ug/l	ND	ND	Trace	Trace	ND	Trace	ND	ND	ND
Trichlorofluoromethane	ug/l	ND	ND	Trace	Trace	ND	Trace	ND	ND	ND

(1) SW-1 and SW-8 are Field Blanks (Location SW-1 was dry)

(2) All stream samples were resampled for volatile organic compounds - September, 1984 Results indicated no detectable levels in any samples.

(3) Thirteen Priority Pollutant Metals Analyses Performed - all other results were "none detected"

ND None Detected.

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in one million, (10^{-6}). EPA's evaluation criteria under CERCLA (Annex XIII) for selecting contaminant levels to protect public health call for the remedial action to "attain levels of contamination which represent an incremental risk of contracting cancer between 10^{-5} and 10^{-6}." The 10^{-6} value was used to achieve the maximum protection to the public.

In addition to the cancer risk assessment criteria, the US EPA Office of Drinking Water provides advice on health effects upon request, concerning unregulated contaminants found in drinking water at which adverse health effects would not be anticipated with a margin of safety; it is called a SNARL (Suggested No Adverse Response Level). Normally values are provided for one-day, 10-day and longer-term exposure periods where available data exists. A SNARL does not condone the presence of a contaminant in drinking water, but rather provides useful information to assist in the setting of control priorities in cases when they have been found.

SNARLS are not legally enforceable standards; they are not issued as an official regulation, and they may or may not lead ultimately to the issuance of a national standard or Maximum Contamination Level (MCL). The latter must take into account occurrence and relative source contribution factors, in addition to health effects. It is quite conceivable that the concentration set for SNARL purposes might differ from an eventual MCL. The SNARLS may also change as additional information becomes available. In short SNARLS are offered as advice to assist those that are dealing with specific contamination situations to protect public health.

The above information concerning SNARLS was taken directly from guidance documentation authored by the EPA and made available to WESTON. The SNARLS levels for various compounds were also used in evaluating the results of ground and surface water sampling.

4.3.1 Water Quality Findings - FDTA/Old Landfill

Three existing and five newly installed wells were monitored on an initial basis for the Phase II investigation. The water quality results in Table 4-1 all reflect water quality conditions in and around the FDTA. Overall results indicate impacts from former operations and disposal practices at the site. The principal wells affected are the on-site BP

series wells, installed in early 1982, and downgradient perimeter wells RFW-2, RFW-3 and RFW-4.

Background wells RFW 1 and RFW-1A (Figure 3-3) exhibited the least evidence of contamination. Of these two wells, the sample from RFW-1A contained 0.043 mg/l phenol which is in excess of Federal and Vermont Safe Drinking Water Standards of 0.001 mg/l (API, 1983). The source of the presence of phenols in upgradient well RFW-1A is conjectural at this point. The presence of phenols might be a cross contamination problem although this well was sampled before others where phenols were not detected. An upgradient source not associated with the historical activities of Site 1 might also be the cause. The precise boundaries of Site 1 have not been defined. Therefore, prior activities at this site may also be the source of the phenols in RFW-1A. It should be noted that other organic analytes which are associated with the FDTA/Old Landfill (Tables 1-2 and 4-1) were absent in wells RFW-1 and RFW-1A. Deep well RFW-1 did not reveal substantive evidence of contamination.

On site well BP-12 is the most severely impacted with chlorinated organics, BTX compounds (benzene, toluene and xylene), MEK, and MIBK, which were present at concentrations up to 2,500 ug/l. Because BP-12 is near the Old Landfill, impacts from the fill are inferred. During sampling and water level measurements floating hydrocarbons with fuel oil odors were observed in BP-7 and BP-12. Floating hydrocarbons were also noted in BP-3 during water level monitoring.

A comparison of Table 1-2 with 4-1 indicates that the chemical compounds in BP-7 and BP-12 are similar for the two rounds of samples; however, the total concentration of volatile organic compounds are about 50% lower in the June 1984 ground-water results. This may be a result of variations between sampling techniques as well as natural conditions over time such as dilution due to infiltration of seasonal precipitation.

The analytical protocol for ground-water samples included analysis for the 13 Priority Pollutant Metals. Detectable levels of arsenic, copper, nickel, and zinc were monitored in low concentrations (<100 ug/l). All other metal results were below the detection limits for the compounds of concern. All groundwater metal analyses were within Federal and Vermont Drinking Water Standards (API, 1983).

Newly installed downgradient perimeter wells RFW-2, RFW-3, and RFW-4 all revealed volatile organic compounds. Wells RFW-2 and RFW-4 revealed traces of several volatile organic compounds; 10 ug/l of methylene chloride was detected in RFW-2 (Table 4-1). RFW-3 exhibited 170 ug/l 1,2 of 1,2 trans-dichloroethylene and 50 ug/l of 1,1,1-trichloroethane. These were the most elevated volatile analytes detected in the perimeter wells.

Surface water samples SW-2, SW-3, and SW-4 were collected from the unnamed tributary stream below the FDTA/Old Landfill. The volatile results for the June, 1984, sampling event showed traces of a number of organic compounds (Table 4-2). The remote downgradient sample, SW-4, contained traces of seven organic analytes,which was more than the perimeter locations SW-2 and SW-3. The September, 1984 resampling of these same points indicated no detectable levels of organics in the surface waters (Appendix H). However, the January 1984 results obtained by Burlington ANGB (Table 1-3) exhibited higher VOC concentrations than WESTON's June and September, 1984 volatile analyses. Thus, some seasonal trends are inferred from the surface water data collected to date in the vicinity of the FDTA/Old Landfill.

The unnamed tributary stream below SW-2, SW-3 and SW-4 (Figure 3-3) becomes ephemeral below the FDTA/Old Landfill site. As determined at this point, no direct discharge into Muddy Brook (sampling point SW-7, Figure 3-2) occurs from the surface flow emerging from the FDTA. The wet weather surface flow pattern needs to be defined to the Winooski River (Figure 3-2) from this site.

In summary, the on-site wells (BP-7 and BP-12) exhibit volatile organic concentrations two to three orders of magnitude higher than the downgradient perimeter wells and surface water samples collected in the vicinity of the FDTA. Because the perimeter wells exhibit organic constituents and a downward recharge component of flow occurs to the bedrock flow regime, a potential exists for off-site migration of volatile compounds to occur. The concentrations of these constituents in the bedrock unit cannot be assessed at this point since monitoring wells penetrating representative portions of the bedrock aquifer were not constructed.

4.3.2 Water Quality Findings - Construction Rubble Landfill

Surface water samples were collected to monitor the environmental impacts of the Construction Rubble Landfill. Sampl-

ing locations were selected at the toe of the fill (SW-5, Figure 3-2), upstream on Muddy Brook (SW-6) and downstream at its confluence with the Winooski River. These results are presented on Table 4-2.

As seen on Table 4-2, selected metals, phenols, and oil and grease are present in concentrations under 200 ug/l (0.2 mg/l) in all samples including upstream sample SW-6. Upgradient sampling point SW-6 exhibited the highest oil and grease concentration (0.2 mg/l). Zinc concentrations (33 ug/l) are also present in the field blank (SW-8) within the same range of concentration (16-32 ug/l) as the other field samples.

Samples SW-5 and SW-7 at the Construction Rubble Landfill and in Muddy Creek at the Winooski River both exhibited the presence of priority pollutants in total concentrations below 500 ug/l. Individual analytes were all below 100 ug/l. From this initial sampling, and from the January 1984 USAF sampling results (Table 1-3), the presence of small concentrations of priority pollutants originating from the Construction Rubble Landfill is concluded to be discharging to the tributary streams. The concentrations may likely be a function of seasonal or temporal variations in seepage from the Dump. Whether, in fact, the water quality findings from station SW-7 results solely from the seepage from the Construction Rubble Landfill cannot be ascertained; nor can conclusions be drawn regarding the presence of priority pollutants in ground water in the vicinity of the landfill. No explanation of the presence of MEK and MIBK in remote upstream sample 1 (Figure 1-4 and Table 1-3) can be made without further information.

4.4 SIGNIFICANCE OF FINDINGS

Based on the Phase II Confirmation Study the following key conclusions have been drawn:

1. Ground water occurs under unconfined or water table conditions in the deltaic sands underlying the FDTA/Old Landfill site. Ground water flow within this shallow localized water table zone is generally to the north and northeast. Ground water also occurs under semi-confined or confined conditions within the underlying sandy glacial till or fractured bedrock of the Bascom Formation. Although the horizontal gradients in the shallow water table may

be on the order of 0.03, a strong vertically downward gradient or recharge component was measured in well couplet RFW-1 and RFW-1A.

2. Stratigraphically, the deltaic sands under the FDTA/Old Landfill become thinner to the north and east so that bedrock is exposed at or near the surface near wells RFW-3 and RFW-4. The potentially confining lacustrine clays observed in RFW-1 are essentially absent in these downgradient monitoring wells. Clays were encountered as a thin veneer in RFW-3 and RFW-4. Therefore, a continuous confining unit, separating the shallow water table from the regional bedrock flow system may not exist.

3. Based on preliminary calculations of hydraulic conductivity and estimates of clay permeability, a significant portion of the shallow water table at the site is capable of recharging the regional bedrock flow system. Because the shallow water table is limited or absent in areas downgradient of the site, recharge to the bedrock system is concluded to be occurring. The water quality effects on the underlying bedrock flow system are inferred.

4. Surface water sampling has shown limited impacts oy the presence of volatile organic compounds. Individual analytes are typically present at less than 100 ug/l. Total volatile organic compounds in surface waters have not been observed to exceed 500 ug/l. These levels are at least one to two orders of magnitude below the levels detected in Wells BP-7 and BP-12 on the FDTA site.

5. The perimeter wells, RFW-2, RFW-3 and RFW-4, around the FDTA exhibit evidence of contamination by volatile organic compounds. These wells monitor shallow flow conditions between the deltaic sands and the uppermost surface of bedrock. The regional flow and water quality conditions in the deeper bedrock aquifer are important to an overall assessment of the nature and extent of water quality impacts from former site use. Until this is monitored, projections of off-site impacts can only be inferred.

6. Table 4-3 illustrates known criteria for priority pollutant organic analytes and the corresponding

TABLE 4-3

COMPARISON OF HAZARDOUS WASTE ANALYTES WITH WATER QUALITY GUIDANCE CRITERIA

Analyte(ug/l)	Water Quality Criteria Document 10-6 Cancer Risk ug/l	SNARLS Lifeline Exposure ug/l	Monitoring Points Exceeding Criteria C=Cancer/S=SNARLS
Benzene	0.66	350 (1)	BP-7(C),BP-12(C)
Ethylbenzene	1400	--	None
Chloroform	0.19	--	SW-4 (t)
1,2 trans-Dichloroethylene	0.033	270 (2)	RFW-2(C),RFW-3(C), BP-7(C&S), SW-3 (t), SW-5(C)
1,1 Dichloroethylene	0.033	70	BP-12 (C),
Methylene Chloride (3)	0.19	150	RFW-2(C), RFW-3(C), SW-2(t), SW-4(C),SW3(t) SW-5(C), SW-6(t),SW7(t)
1,1,1,-Trichloroethane	--	1000	None
Trichloroethylene	2.7	75	BP-12(C), SW-5(C)
Tetrachloroethylene (4)	0.80	40	SW-5(C&S), SW-7(C&S)
MEK	--	1000 (2)	None
Xylenes	--	620	BP-12(S)
Vinyl Chloride	2	--	BP-12(C)
Toluene (5)	14,300	1000 (2)	None
Chloroethane	0.94	--	BP-12 (C)

(1) 7 Day Exposure

(2) 10 Day Exposure

(3) Trace showed in Field Blank SW-1 (Location SW-1 was dry)
(4) 23 ug/l Showed in Field Blank SW-1 (Location SW-1 was dry)
(5) Trace showed in Field Blank SW-1 (Location SW-1 was dry)

NOTE: Dashes (--) Indicate there is no specified standard or criterion for the compound

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wells and surface waters exceeding the guidance criteria from various source references. Vermont and Federally adopted Drinking Water Standards do not exist for the parameters shown on Table 4-3 although the excursions from the guidance criteria may be grounds for further recommended actions by the Vermont Agency of Environmental Conservation. Based on the guidance criteria, wells BP-7, BP-12 and RFW-2 exhibit the most elevated volatile organic concentrations. Downgradient surface water samples SW-4, SW-5 and SW-7 also exhibited evidence of impacts above guidance criteria.

7. Actual on-site investigations to define and quantify the source areas of volatile organic contamination have not yet been conducted. In particular, in situ investigations at the FDTA/Old Landfill are critical to an understanding of the relationship of the monitored conditions to projections of off-site impacts as well as evaluation of on-site remedies.

8. Volatile organic contamination of ground water has often been associated with valley trends in the paleosurface stratigraphy. That is, elevated organic constituents in ground water are often associated with zones where the underlying bedrock or confining layer is comparatively deep. Pockets of concentrated organics are postulated to reside in saturated permeable overburden within these valleys or depressed zones in the paleosurface.

   RFW-1 did not penetrate to bedrock nor has there been a clear concept developed of the continuity of subsurface stratigraphy beyond the areas already drilled. The variability in the continuity of the local subsurface stratigraphy complicates any projections of off-site migration of volatile organic compounds. Lateral variations in stratigraphy also increase the difficulty of obtaining representative site monitoring.

9. Priority pollutant metals were not present in significant concentrations. To date, no problems associated with metals in ground or surface waters around these sites have been detected.

The following sections of this report discuss the alternative methods and recommendations for the FDTA/Old Landfill and Construction Rubble Landfill based upon the data collected and evaluated to date.

SECTION 5

ALTERNATIVE MEASURES

5.1 GENERAL

The principal goal of this Phase II Confirmation Study was to determine whether or not environmental degradation was occurring as a result of past practices of waste disposal at Burlington ANGB. The recommended work scope directed that an initial round of samples be collected. The basis for many of the foregoing conclusions is, therefore, predicated on this single set of analyses and preliminary USAF/ Burlington ANGB well and stream sampling conducted in early 1982 and in 1984.

The presence of priority pollutant compounds in the area streams and perimeter monitoring wells requires further evaluation. It is apparent that additional emphasis needs to be placed on the problem definition aspects of the environmental contamination detected at Burlington ANGB. The alternative actions to be considered can be categorized as follows:

1. Quantification Stage interim water quality monitoring at existing monitoring wells and stream points.

2. Expanding the ground and surface water monitoring network for Quantification Stage efforts.

3. Preparation of Interim Assessment Reports

4. Further on-site investigations at the FDTA/Old Landfill, including expansion of the monitoring network.

5. Preliminary Concept Engineering Assessment - FDTA/Old Landfill and Construction Rubble Dump.

6. Off-site resource analyses/monitoring.

5.2 FDTA/OLD LANDFILL

Repetitive water quality analyses from the BP series wells indicate a significant on-site ground-water problem in the shallow flow system under the site proper. The source(s),

areal extent of fill, and relationship to the hydrogeologic setting need to be defined before assessing remedial actions.

In conjunction with any on-site characterization studies, the ground and surface water monitoring network should be expanded as interim monitoring of the existing facilities proceeds. An interim monitoring plan needs to be developed prior to further site analyses.

5.2.1 Off-Site Investigation

As part of the plan to expand the ground-water monitoring network, decisions must be made for the optimal placement of additional wells. Supplemental well site locations would be enhanced by undertaking non-destructive, selected geophysical studies on the site and surrounding areas. In particular, a seismic refraction survey could assist in determining bedrock or other stratigraphic conditions which might anistropically affect ground-water flow. Preliminary site modelling and a fracture trace analysis would also improve optimum off-site remote well locations.

From the data gathered to date, monitoring wells penetrating representative portions of the bedrock aquifer are required for the Quantification Study at this site. It is important to establish the relationship of water quality and flow in bedrock to the overlying deposits. Therefore, depending on the conditions encountered, multi-level couplets such as installed at the RFW-1 location should be considered with the recommended bedrock wells.

The entire area should be flown for aerial surveying and a topographic map prepared as the basis for further site work.

5.2.2 On-Site Investigation - FDTA/Old Landfill

The BP series wells installed by the USAF partially penetrate the deltaic sands in the vicinity of the FDTA/Old Landfill. The analytical results from these wells indicate contaminated conditions in the immediate vicinity of the suspect disposal areas. Free floating petroleum products with a fuel oil odor were noted in Wells BP-3, BP-7, and BP-12. The environmental impacts of former site use need to be explored further.

First is the definition of the lateral and vertical extent of these former disposal sites. The approximate locations of the FDTA and Old Landfill, as illustrated on Figure 3-3, have not been confirmed by direct evidence. The definition of the former disposal sites needs to be refined as part of the Quantification Stage effort. The second aspect pertains to determining whether the FDTA or the Old Landfill are still contributing sources to the degradation of ground water beneath the site. To this end, non-destructive geophysical techniques including seismic refraction, Ground Penetrating Radar (GPR) and magnetometer are warranted as an initial screening step prior to on-site drilling or test pit excavation. The follow-on test pit and exploratory boring work would focus on quantifying the source(s) and their relationship to the local hydrogeologic conditions.

As part of the Quantification Stage effort at least one fully penetrating well in the deltaic sands should be positioned on-site for pump testing and shallow aquifer characteristics analyses. Wells RFW-2, RFW-3, and RFW-4 need to be converted to top of rock monitoring piezometers and three adjacent shallow couplets isolated in the deltaic sands need to be constructed to monitor conditions with each individual stratum.

5.3 CONSTRUCTION RUBBLE LANDFILL

The Construction Rubble Landfill, which was suspected of having received small quantities of waste oils and spent solvents, periodically exhibits volatile organic contamination at levels, to date, up to 150 ug/l of total quantifiable volatile priority pollutant organics (SW-5, June 1984 sampling round). The January 1984 and September 1984 sampling of surface waters at the toe of the Construction Rubble Landfill did not detect priority pollutant organic compounds. These results indicate periodic flushing of volatile organics from the Construction Rubble Landfill.

Periodic sampling upstream from the Construction Rubble Landfill has revealed the presence of volatile organic compounds hydraulically above the Construction Rubble Landfill. In January 1984, an upstream sample exhibited 87 ug/l Methyl Ethyl Ketone; in June 1984, an upstream sample revealed 20 ug/l of Tetrachloroethylene. Unidentified upstream sources are concluded to be responsible for these results.

The surface water monitoring program needs to be expanded at this site and made a part of the overall interim monitoring plan. Also, a limited ground-water monitoring program should be performed in conjunction with the Quantification Stage studies at the FDTA/Old Landfill. The recommended program is discussed in Section 6.1.1. This work should be undertaken to confirm or negate adverse impacts to ground-water quality from the Construction Rubble Landfill. The Construction Rubble Landfill should be included in any aerial topographic mapping program.

5.4 SUMMARY

Documentation of ground-water degradation at the FDTA/Old Landfill has been confirmed by the Phase II Study. The presence of priority pollutant volatile organic compounds is sufficiently elevated as to warrant further on-site monitoring, including water quality and ground-water flow analyses of the bedrock aquifer.

Although the Construction Rubble Landfill was found to leach volatile organics at trace or moderately low levels, it appears, initially, that trace organics persist in the spring-fed run discharging to Muddy Brook through its course to the Winooski River. Whether or not the downstream samples in Muddy Brook represent more than one source is unknown at this time. In summary, additional stream monitoring and limited ground-water monitoring at the Construction Rubble Landfill are warranted in conjunction with the Quantification Stage efforts at the FDTA/Old Landfill.

SECTION 6

RECOMMENDATIONS

6.1 GENERAL

The findings of the Phase II Study at two sites at Burlington ANGB indicate the need for follow on work. This work includes:

1. Development of an interim monitoring and assessment plan.

2. Implementation of an expanded surface and ground-water monitoring program for the collective sites with an emphasis on quantifying the extent of volatile organic compounds in the ground-water flow regime in the Bascom Formation.

3. Preparation of full coverage topographic survey of both sites.

4. Characterization of environmental conditions and source contamination at the FDTA/Old Landfill site in conjunction with conceptual remedial strategies.

The recommended actions discussed below are intended to establish the data base for evaluation of what, if any, remedial actions might be necessary for each site. It is anticipated that additional monitoring at the construction Rubble Landfill (site No. 2) will confirm the findings summarized herin, and that additional action will not be required. However, the level of contamination noted in the deltaic sands at the FDTA/Old Landfill dictates the need for a more detailed site characterization study.

6.2 COLLECTIVE SITE RECOMMENDATIONS

The following supplemental work is recommended for the collective analyses of the FDTA/Old Landfill and Construction Rubble Landfill.

1. An interim monitoring and assessment plan should be developed for sites No. 1 and 2. The interim plan would include quarterly monitoring of

selected existing wells and the expanded surface water monitoring stations around each site. It is proposed that the interim monitoring network be made up of the existing wells and surface water locations and three additional surface water sampling locations (Figure 6-1). The analytical protocol in the interim monitoring period should include priority pollutant volatile analyses, MEK, MIBK, xylenes, phenols, pH and conductance.

A preliminary model of the ground-water flow system should be developed as part of the interim monitoring and assessment plan. The model will assist in identifying data needs as well as optimizing the selection of sites for an expanded monitoring program. Quarterly monitoring/status reports would be prepared as an output of the interim monitoring and assessment plan.

2. The entire area should be aerial surveyed and a topographic map prepared of the sites in question. The map should be prepared at a two foot contour interval and cover approximately a 400 acre area between Burlington ANGB and the Winooski River. The sites in question should be gridded. No detailed topographic mapping of Burlington ANGB was obtained in the Phase I and II studies to date. Topographic controls are needed for future study.

3. A seismic refraction survey and air photo fracture trace analysis should be performed to assist in the location of supplemental wells. Up to 10,000 feet of seismic refraction survey is recommended to provide stratigraphic control, identify potential flow anomalies affected by stratigraphic variations and provide correlation between monitoring sites.

4 Upon completion of the above recommended actions, additional monitoring wells should be installed to provide expanded ground-water monitoring of both sites 1 and 2. Tentatively, ten additional well sites are proposed as illustrated in Figure 6-1.

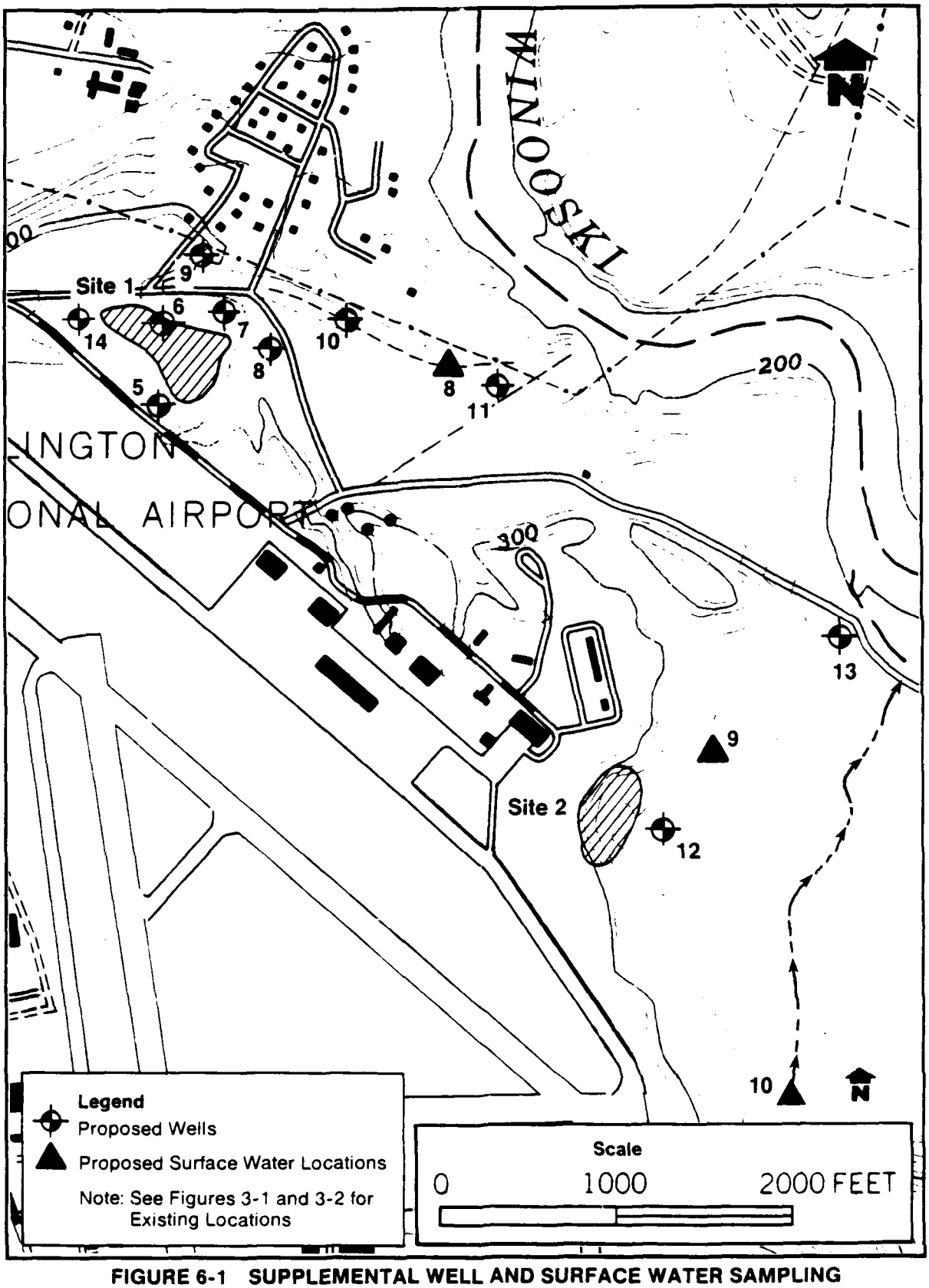

FIGURE 6-1 SUPPLEMENTAL WELL AND SURFACE WATER SAMPLING LOCATIONS - BURLINGTON AIR NATIONAL GUARD BASE

A bedrock well would be constructed at the RFW-1 location to substantiate water quality conditions in bedrock at that point. Bedrock wells would be constructed at RFW-2, RFW-3 and RFW-4 to representative depths. The other six proposed well locations (locations 9 through 14 in Figure 6-1) will probably shift as preliminary modeling, seismic survey, and fracture trace analyses dictate.

Proposed wells 9 through 14 (Figure 6-1) would be drilled and bedrock wells installed to representative depths in the underlying limestone/dolomites. Saturated overburden would be monitored with piezometer nests as required. Two rounds of water quality analyses would be performed according to the Interim Monitoring Protocol (paragraph 1 above). A comprehensive assessment report would prepared for all work completed to date. The need for additional site characterization study at site No. 2 (the Construction Rubble Landfill) would be evaluated at that time.

6.3. ON SITE CHARACTERIZATION STUDY-FDTA/OLD LANDFILL

Determining the nature and extent of environmental effects from past disposal practices will also require on site characterization studies at site No. 1. As discussed in Section 5, there is a need to define the position of any present sources of contamination, their magnitude, and relative contribution to the environment. This, as well as their relationship to the hydrogeologic setting, must be defined in order to implement an effective closure strategy. To that end, the following actions are recommended:

1. The limits of the former FDTA and the Old Landfill need to be defined and mapped. Initially, seismic refraction should be run on the site to refine our understanding of the subsurface stratigraphy. Ground Penetrating Radar (GPR) with complementary magnetometer equipment should be employed to map fill deposits. Electromagnetic terrain conductivity (EM) will also be utilized in the landfill

areas to pinpoint fill boundaries. These geophysical techniques will provide pre-screening for on site excavations and borings.

2. Test pits and power auger borings will be advanced at selected locations. Soils/wastes from each hole will be field screened with an HNu with a portable gas chromatograph (GC) as back-up verification. A representative portion of all collected soil samples will be analyzed in the laboratory for volatile organic analyses and specific identification of suspect hydrocarbons (fuel oil, AVGAS, JP-4). Up to 50 test pit/power auger probes are estimated with a minimum of three samples from each point. Approximately 20 samples would undergo confirmatory laboratory analyses. These results will be contoured three-dimensionally with the field test results to provide an overall quantification of contamination above the water table.

3. One boring would be performed to the top of the lacustrine clay in the area of highest suspect contamination. Continuous split spoon samples would be obtained from this boring. A fully screened four-inch multi-purpose test/recovery well would be installed in this hole for later pump tests. During the drilling of the bedrock well at the RFW-1 location, a Shelby tube of the lacustrine clay would be collected for triaxial permeability tests.

4. Field studies including well survey, water level measurements, and pump tests will be performed to characterize site conditions and gather data for reporting the probable nature and extent of contamination from the FDTA/Old Landfill.

5. A report will be prepared identifying site conditions and examining the advantages and limitations of various remedial options. The need, if any, for remedial actions would be documented in that report.

The above recommendations are based on the findings of the Phase II study in accordance with the goals of the IRP program.

Since the FDTA/Old Landfill had been preliminarily investigated prior to the Phase II, Stage 1 study, the latest investigation has corroborated the earlier findings. In addition, the Phase II, Stage 1 study has also projected off-site migration of organic constituents in the bedrock flow system. More representative sampling of the regional bedrock aquifer is in order before determining a remedial or closure strategy. As additional water quality data and modeling results become available, the supplemental work scope as described above will probably require some revisions. The field program must be flexible enough to respond to the field findings, especially where subsurface conditions are as variable as encountered during the Phase II work performed to date.

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APPENDICES

APPENDIX A

ACRONYMS, DEFINITIONS, NOMENCLATURE AND UNITS OF MEASURE

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APPENDIX A

AFB	Air Force Base
ANG	Air National Guard
ANGB	Air National Guard Base
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
Bldg.	Building
CERCLA	Comprehensive Environmental Response Compensation and Liability Act of 1980
cm/sec	Centimeters per second
CSG	Combat Support Group
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DoD	Department of Defense
^{o}C	Degrees Centigrade
^{o}F	Degrees Fahrenheit
FDTA	Fire Department Training Area
ft/min	Feet per minute
gpm	Gallons per minute
gpd	Gallons per day
HARM	Hazard Assessment Rating Method
hr	Hour
in	Inches
IRP	Installation Restoration Program

Appendix A (cont.)

K	Hydraulic conductivity in L/T or $L^3/L^2/T$
MS	Master of Science Degree
MEK	Methyl Ethyl Ketone
MIBK	Methyl Isobutyl Ketone
ug/l	Micrograms per liter (equivalent to parts per billion in water)
umho/cm	Micromhos per centimeter (units of specific conductance)
mg/l	Milligrams per liter (equivalent to parts per million in water)
mgd	Million gallons per day
MSL	Mean sea level datum
N	North
NDI	Non-destructive inspection
NGVD	National Geodetic Vertical Datum
No.	Number
O & G	Oil and Grease
OEHL	Occupational and Environmental Health Laboratory
%	Percent
P.G.	Registered Professional Geologist
Ph.D.	Doctor of Philosophy Degree
ppb	Parts per billion (equivalent to ug/l in water)
ppm	Parts per million (equivalent to mg/l in water)

Appendix A (cont.)

PVC	Polyvinyl chloride
QA/QC	Quality assurance/quality control
RCRA	Resource Conservation and Recovery Act of 1976
SAC	Strategic Air Command
SNARL	Suggested No Action Response Level
TAW	Tactical Airlift Wing
TCE	Trichloroethylene
TOC	Top of casing
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds

Chemical Elements:

Sb - Antimony
As - Arsenic
Be - Beryllium
Cd - Cadmium
Cr - Chromium
Cu - Copper
Pb - Lead
Ni - Nickel
Ng - Mercury
Se - Selenium
Ag - Silver
Th - Thallium
Zn - Zinc

APPENDIX B

SCOPE OF WORK

84 Jun 25

Installation Restoration Program*
Phase II Field Evaluation
Burlington Air National Guard (ANG)

I. DESCRIPTION OF WORK

The purpose of this task is to determine if environmental contamination has resulted from waste disposal practices at Burlington ANG VT and to provide estimates of the magnitude and extent of contamination, should contamination be found.

The presurvey report (mailed under separate cover) and Phase I IRP report (mailed under separate cover) incorporate all background and description of the site for this task. To accomplish this investigation, the contractor shall take the following actions:

A. General:

1. Determine the areal extent of the site by reviewing available aerial photos of the base, both historical and the most recent panchromatic and infrared.

2. Unless otherwise specified in site specific action, groundwater samples shall be analyzed for 31 Priority Pollutant Volatile Organics (VOA) and methylisobutylketone (MIBK), methylethylketone (MEK) and xylene (using EPA Methods 624 and 625), 13 Priority Pollutant Metals (using Atomic Absorption Spectroscopy), oils and greases using IR Method and Phenols. The required limits of detection for the above analyses is given in Attachment 1. All water samples shall be analyzed on site by the contractor for pH, temperature and specific conductance. Sampling, maximum holding time and preservation of samples shall strictly comply with the following references: Examination of Water and Wastewater, 15th Ed. (1980), pp. 35-42, ASTM, Part 31, pp. 72-82, (1976), Method D-3370, and Methods for Chemical Analysis of Waters and Wastes, EPA Manual 600/4-79-020, pp. xiii to xix (1979).

3. Sample bottles shall be prepared in the laboratory prior to sampling in accordance with EPA 624 and 625 protocol methods for Priority Pollutant Volatile Organics. Chain-of-custody records for all samples, field blanks and quality control duplicates will be maintained.

4. Groundwater monitoring wells installed during this effort shall be drilled using hollow stem augers. Case and wash techniques shall be used when necessary to advance the hole. All final well construction shall satisfy all requirements of the U.S. EPA and State of Vermont.

5. Each well shall be constructed of two-inch diameter, Schedule 40 PVC pipe using threaded, non-glued fittings. The screened zone in each well shall consist of No. 10 or 20 slot commercial PVC screen (0.010 or 0.020 inch) depending upon the geologic findings during drilling. The annulus of the screened zone shall be sand-packed with Ottawa Sand or equivalent. All wells shall be tremie grouted from the top of the sand pack to within three feet of

*Highlights of modification are underscored

the ground surface with a bentonite grout mixture. The remaining annulus shall be sealed in a Portland neat cement mixed with native sands for strength. Each well shall be completed with the installation of black iron protective casing and a locking cap. Each well shall be clearly numbered with an exterior paint.

6. After construction, the wells shall be purged by pumping or bailing until the well bore is purged of suspended solids to the satisfaction of the supervising geologist who shall oversee all well drilling and construction.

7. During the well development process in situ slug or recovery testing shall be performed at each new well. The testing methods used shall be standard slug and recovery techniques in common professional use, and essentially involve the following procedures:

- o The static water level in the well to be tested will be measured and recorded.
- o Either pre-pumped groundwater will be added to the level of the top of casing, or water will be pumped out to induce drawdown.
- o As the water level returns to the static position, the elapsed time and level readings will be recorded until the water level returns to 90 percent of the original static level.

The rate of flow at the piezometers is proportional to the hydraulic conductivity (K), expressed in centimeters per second (cm/sec), of the geologic stratum tested, and the unrecovered head difference, or Head Ratio, versus the time (t) indicates an exponential decline in the recovery rate with time. From this data hydraulic conductivities can be computed.

8. Following well construction, the top of the new and existing well casing elevations shall be level surveyed to an accuracy of ±0.05 feet and horizontally located to an accuracy of ±10 feet. After development, survey and an additional time for water level stabilization, synoptic groundwater level measurements shall be recorded. A complete round of water level measurements shall be taken prior to any water quality sampling. A single round of water quality samples shall be taken from each newly constructed monitoring well protocols. A minimum of three volumes of standing water from each well shall be removed using a bottom-fill stainless steel and teflon bailer or an all stainless steel submersible sampling pump or equivalent method. Chemical sampling will be performed with a stainless steel and teflon bailer only.

B. In addition to items delineated in A above, conduct the following specific actions at the site identified on Burlington ANG.

Site 1 - Fire Department Training Area (FDTA) and Old Landfill

a. An exploratory boring shall be drilled at a position upgradient of the FDTA. (RFW in Figure 1.) The location shall be adjacent to the main entrance road to the former burn and fill site. This boring shall be carried through to confirmed refusal or bedrock, with standard five-foot interval

split spoon samples being taken and screened for organic vapors with a photo-ionization meter or equivalent organic vapor detection devise. Bedrock should be confirmed by coring or drilling a minimum of five feet into rock.

Based upon the exploratory boring field findings, a single or cluster monitoring well shall be constructed. If a cluster well is indicated by evidence of multi-aquifer conditions in the unconsolidated deposits, a deep monitoring well shall be placed beneath the aquitard. A second, shallow monitoring well shall be set in a separate hole drilled adjacent to the deep exploratory boring. The depth of the shallow cluster well shall be determined from the deep exploratory boring. Each well shall be fully screened in the saturated permeable deposits in the zones of interest. For estimating purposes, the deep well is projected to a depth of 100 feet, the shall well to a depth of 60 feet. The deep well is estimated to have 20 feet of screen and the shallow well is estimated to have 40 feet of screen.

b. In addition to the background exploratory drilling and well development, three downgradient shallow monitoring wells in the uppermost saturated sandy deposits shall be installed as shown in Figure 1 (FRW-2, RFW-3, and RFW-4). The estimated depth of each monitoring well shall average 30 feet with 20 feet of screen. The wells shall all be located at the perimeter of the burn and fill site (FDTA). These shallow monitoring wells shall be drilled 10 feet into low permeability clayey deposits or refusal or bedrock, whichever comes first. Refusal or bedrock shall be confirmed by coring or drilling a minimum of five feet.

c. One groundwater sample shall be collected and analyzed (as specified in I.A.2 above) from each of the five newly developed monitoring wells described in a and b above.

d. One groundwater sample shall be collected and analyzed (as specified in I.A.2 above) from the following existing monitoring wells: BP-2, BP-7 and BP-12 which are identified in Figure 1.

e. Collect one surface water sample from each of the four sampling locations indicated in Figure 2 in the tributary stream near the Fire Department Training Area and Old Landfill.

f. Collect one surface water sample from each of the three sampling locations indicated on Figure 2 in Muddy Brook.

g. Each surface water sample shall be analyzed as specified in I.A.2 above. A maximum of ten samples shall be analyzed.

C. Field data collected at the sites shall be plotted and mapped. The nature of contamination and magnitude and potential of contaminant flow to receiving groundwaters shall be determined or estimated. Upon completion of analysis, the data shall be tabulated and incorporated into the next R&D status report as specified in Item VI below.

D. Well Installation and Cleanup

The well and boring area shall be cleaned following the completion of each well and boring. Drill cutting shall be removed and the general area clean. If hazardous waste is generated in the process of well installation the contractor shall be responsible for proper containerization (according to

local Civil Engineering office requirements) for eventual government disposal. Disposal of drill cuttings is not the responsibility of the contractor.

E. Data Review

All results of sampling and analysis shall be tabulated and incorporated into an informal technical report prior to submission of draft report and forwarded to USAF OEHL for review (Atch 1, Sequence 3, as specified in Item VI below).

F. Reporting

1. A draft report delineating all findings of this field investigations shall be prepared and forwarded to the USAF OEHL as specified in Item VI below for Air Force review and comment. This report shall include a discussion of the regional hydrogeology, well logs or projects wells, data from water level surveys, groundwater surface and gradient maps, vertical and horizontal flow vectors and laboratory quality assurance information. The report shall follow the USAF OEHL supplied format (mailed under separate cover).

2. Estimates shall be made of the magnitude, extent and discussion of movement of contaminants discovered. Potential environmental consequences of discovered contaminations shall be identified and estimated.

3. Specific requirements, if any, for future groundwater and surface water monitoring must be identified.

II. SITE LOATION AND DATES:

Burlington Air National Guard Base VT
Date to be established

III. BASE SUPPORT: None

IV. GOVERNMENT FURNISHED PROPERTY: None

V. GOVERNMENT POINTS OF CONTACT:

1. 1Lt Maria R. LaMagna
USAF OEHL/TS
Brooks AFB TX 78235
(512) 536-2158
AV 240-2158

2. Maj David Bombard
158th RMS/LGS
Burlington IAP VT 05415-895
(802) 658-0770
AV 689-4352

3. Lt Col Thomas Webb
ANGSC/SGB
Andrews AFB MD 20331
(301) 981-5926
AV 858-5926

4. Mr Harry Lindenhoffen
ANGSC/DEV
Andrews AFB MD 20331
(301) 981-6693
AV 858-6693

VI. In addition to sequence numbers 1, 5 and 11 listed in Atch 1 to the contract, which are applicable to all orders, the sequence number listed below are applicable to this order. Also shown are data applicable to this order.

Seq Nr	Block 10	Block 11	Block 12	Block 13	Block 14
3	One/T	**	**		
4	One/R	84 Aug 24	84 Sep 07	85 Jan 07	*

*A minimum of two draft reports will be required. After incorporating Air Force comments concerning the first draft report, the contractor shall supply the USAF OEHL with a second draft report. The report will be forwarded to the applicable regulatory agencies for their comments. The contractor shall supply the USAF OEHL with 20 copies of each draft report and 50 copies plus the original camera ready copy of the final report.

**Upon completion of analysis.

Required Sample Analytical Detection Levels

Chemical Analysis	Detection Limit
Volatile Organic Compound (VOC-31 Priority Pollutants)	*
Methyl Isobutyl Ketone (MIBK)	*
Methyl Ethyl Ketone (MEK)	*
Xylene	*

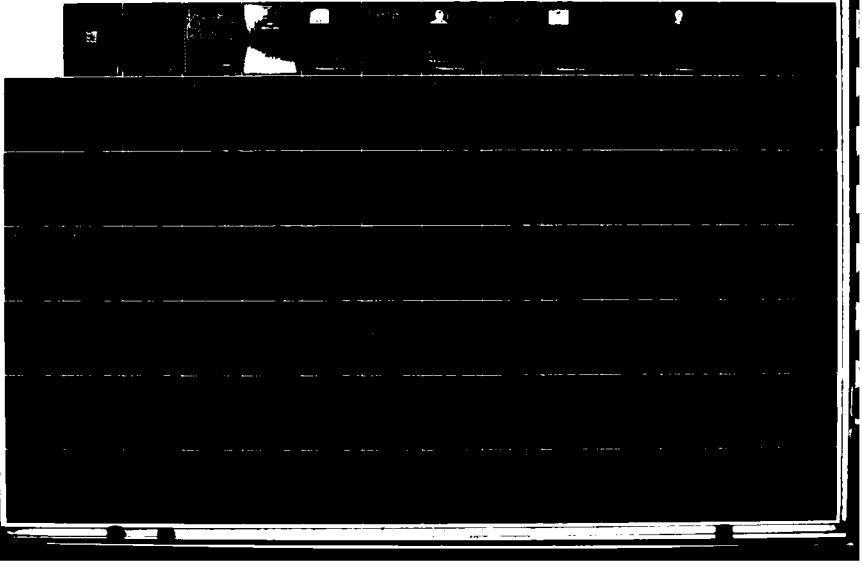
13 Priority Pollutant Metals (using Atomic Absorption):

Antimony - 10 µg/L
Arsenic -10 µg/L
Beryllium - 10 µg/L
Cadmium - 10 µg/L
Chromium - 50 µg/L
Copper - 50 µg/L
Lead - 20 µg/L
Mercury - 1 µg/L
Nickel - 100 µg/L
Selenium - 10 µg/L
Silver - 10 µg/L
Thallium - 10 µg/L
Zinc - 50 µg/L

Oil and grease (using IR) - 100 µg/L
Phenols - 1 µg/L

*Detection level are as specified for compound listed in EPA Methods 624 and 625.

AD-A197 435 INSTALLATION RESTORATION PROGRAM PHASE 2 2/3
CONFIRMATION/QUANTIFICATION STAGE 1(U) WESTON (ROY F)
INC WEST CHESTER PA 28 MAR 86 F33615-80-D-4006
UNCLASSIFIED F/G 24/4 NL



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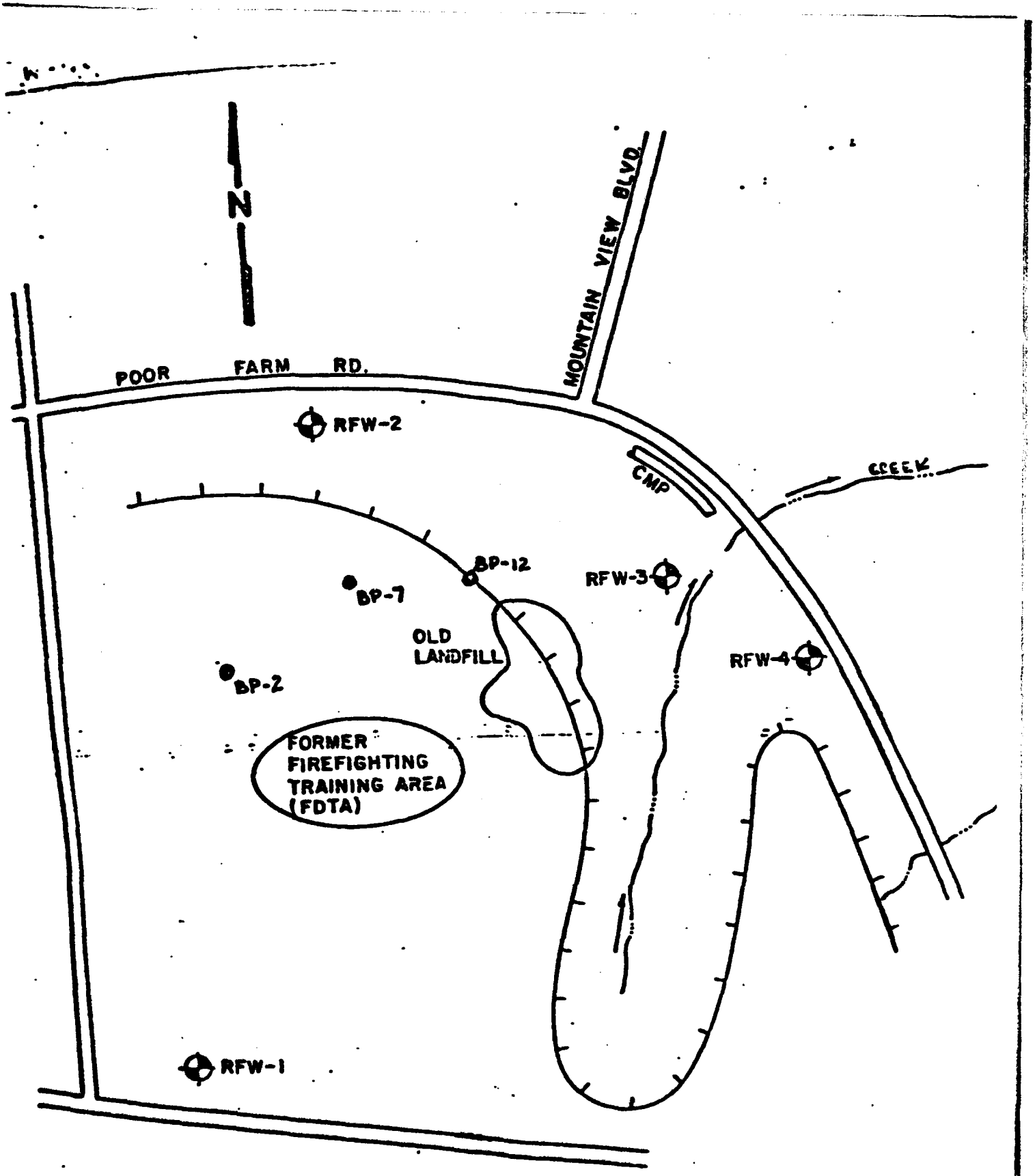


FIGURE 1

● EXISTING MONITORING WELLS TO BE SAMPLED

- BP-2

- BP-7

GROUNDWATER SAMPLING LOCATIONS AT FD

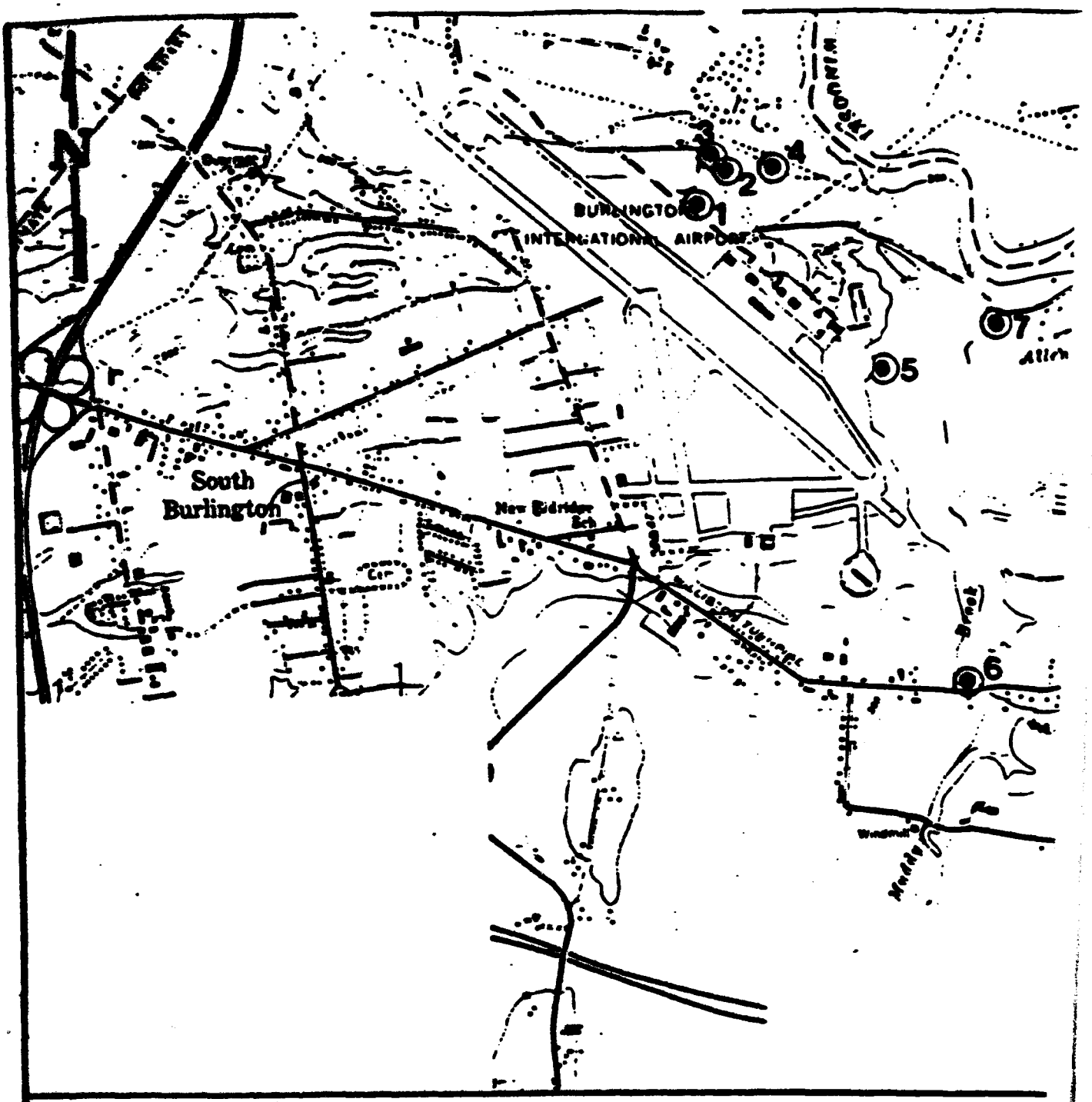
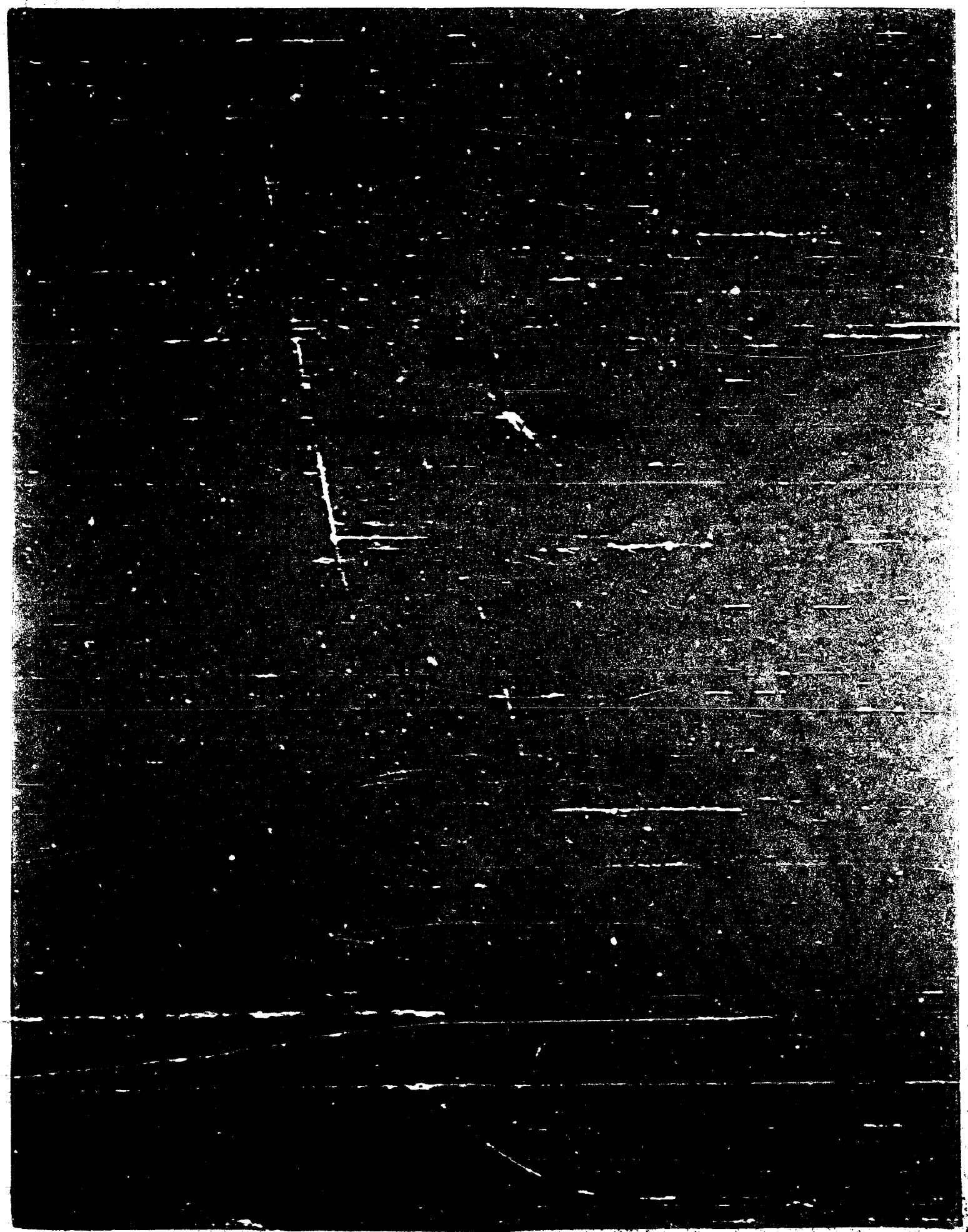


FIGURE 2

SURFACE WATER MONITORING LOCATIONS



Peter J. Marks

Fields of Competence

Project management; environmental analytical laboratory analysis; hazardous waste, groundwater and soil contamination; source emissions/ambient air sampling; wastewater treatment; biological monitoring methods; and environmental engineering.

Experience Summary

Eighteen years in Environmental Laboratory and Environmental Engineering as Project Scientist, Project Engineer, Process Development Supervisor, and Manager of Environmental Laboratory with WESTON. Experience in analytical laboratory, wastewater surveys, hazardous waste, groundwater and soil contamination, DoD-specific wastes, stream surveys, process development studies, and source emission and ambient air testing. In-depth experience in pulp and paper, steel, organic chemicals, pharmaceutical, glass, petroleum, petrochemical, metal plating, food industries and DoD.

Applied research on a number of advanced wastewater treatment projects funded by Federal EPA.

Credentials

B.S., Biology—Franklin and Marshall College (1963)

M.S., Environmental Engineering and Science—Drexel University (1965)

American Society for Testing and Materials

Water Pollution Control Federation

Water Pollution Control Association of Pennsylvania

Employment History

1965-Present	WESTON
1963-1964	Lancaster County General Hospital Research Laboratory for Analytical Methods Development

Key Projects

USAF/OEHL Brooks AFB. Program Manager for this three-year BOA contract provides technical support in environmental engineering surveys, wastewater characterization programs, geological investigations, hydrogeological studies, landfill leachate monitoring and landfill siting investigations, bioassay studies, wastewater and hazardous waste treatability studies, and laboratory testing and/or field investigations of environmental instrumentation/equipment. Collection, analysis, and reporting of contaminants present in water and wastewater samples in support of Air Force Environmental Health Programs.

United States Army Toxic and Hazardous Materials Agency (USATHAMA), Aberdeen *Proving* Ground, Maryland. Program Manager for three-year basic ordering agreement contract to provide research and development for technology in support of the DOD Installation Restoration Program. The objective of the Program is to identify and develop treatment methods/technology for containment and/or remedial action. Technology development for remedial action is to include groundwater, soils, sediments, and sludges.

Confidential Client, Ohio. Project Manager of an on-going contract to conduct corporate environmental testing and special projects at client's U.S. and overseas plants. WESTON must be able to assign up to four professionals to a project within a two week notice.

Confidential Client (Inorganic and Organic Chemicals). Product Manager of a current contract to conduct wastewater sampling and analysis of plant effluent for priority pollutants. The project also includes a wastewater treatability study to evaluate a number of process alternatives for removal of priority pollutants from the present effluent.

Confidential Client, Utah. Technical Project Manager for in-depth wastewater survey, in-plant study, treatability study, and concept engineering study in support of the client's objectives to meet 1983 effluent limitations. WESTON had two project engineers, two chemists, five technicians and an operating laboratory in the field. Field effort is six months duration.

Professional Profile

In conjunction with University of Delaware College, WESTON analyzed more than 500 biological and marine sediment samples for eleven constituent trace metals as part of a program to identify and trace the migration of metals from ocean dumping of sludges on the continental shelf off the coast of the State of Delaware, acted as Technical Project Manager.

Project Manager in charge of a wastewater analysis and biological treatability project for industrial client for the identification and degradation of six pesticide-containing wastewaters.

U.S. EPA Environmental Monitoring and Support Laboratory. Multi-year contract to provide reference laboratory analysis on QA/QC samples produced from the EPA Analytical Laboratory QA/QC program.

Publications

"Microbiological Inhibition Testing Procedure," Biological Methods for the Assessment of Water Quality, A.S.T.M. Publication STP 528.

"Heat Treatment of Waste Activated Sludge" (with V.T. Stack).

"Biological Monitoring in Activated Sludge Treatment Process," a joint paper with Stover/Woldman.

Richard L. Kraybill

Fields of Competence

Hydrogeologic and geotechnical investigations of hazardous waste sites and landfills; evaluations of potential site use for solid and liquid waste disposal and secure land burial facilities; hydrogeologi : analyses of remedial alternatives for groundwater contamination problems. Management of hydrogeologic projects involving groundwater resource evaluation, monitoring, development, and protection; analyses of groundwater quality trends as compared to land use.

Experience Summary

Fifteen years of professional experience in the field of groundwater pollution control. Expertise in providing technical guidance and advice to industry and public and governmental agencies on hydrogeologically related problems of groundwater management, protection, and development.

Prepared hydrogeologic reports assessing groundwater availability and suitability for supply; conducted investigations of groundwater pollution incidents and developed reports with specific recommendations relating to serious pollution problems and large scale water resource issues.

Coordinated and supervised subsurface exploratory work for hydrogeologic investigations relating to landfills, hazardous waste sites, groundwater injection systems, and other projects affecting groundwater; organized and performed studies utilizing advanced hydrogeologic methods such as ionic tracers, earth resistivity, and remote sensing; utilized mathematical principles of groundwater flow in hydrogeologic investigations.

Participated in planning, coordination and development of groundwater recovery and treatment projects where groundwater has been polluted.

Provided consultation and expert testimony on hydrogeologic aspects of disposal of hazardous and non-hazardous wastes. Managed group of geologists involved in hydrogeologic-geotechnical investigations.

Credentials

B.A., Geology—Lafayette College (1967)

M.S., Geology—Rutgers University (1977)

Affiliations

National Water Well Association, Technical Division

Water Pollution Control Federation

Pennsylvania Water Pollution Control Association, Eastern Section

Geological Society of America, Hydrogeologic and Engineering Divisions

Employment History

1981-Present	WESTON
1979-1981	Wehran Engineering Earth Sciences Group
1967-1979	Commonwealth of Pennsylvania

Key Projects

Senior Project Hydrogeologist on study involving the containment of PCB migration from five sites known to have received large quantities of materials containing PCB's.

Senior Project Hydrogeologist on the closure and cut-off wall certification of a large hazardous waste disposal site in a wetlands area in Michigan.

Project Manager for the hydrogeologic study and remediation analysis of a hazardous waste disposal site in Chester, PA, under contract with the PA Department of Environmental Resources and the EPA.

Developed and managed a site feasibility assessment and major detailed hydrogeologic-geotechnical investigation for the design of a secure landfill in Model City, NY.

Managed the investigation, design remediation and closure of an uncontrolled hazardous waste disposal site.

Professional Profile

Senior Hydrogeologist and Project Manager for an in-situ closure of a plating waste impoundment.

Senior Hydrogeologist for investigation and design of a secure sewage sludge disposal facility involving groundwater cutoff by slurry trench methods.

Senior Hydrogeologist for five U.S. Air Force projects developing work scopes for investigating impacts at suspect hazardous waste disposal sites under the USAF-IRP program.

At one USAF Base, performed a detailed preliminary investigation of an existing groundwater pollution problem with the objective of assessing potential impacts on a nearly public water supply resource.

Project Manager and Senior Hydrogeologist pertaining to the environmental assessment and disposal of hazardous wastes at the largest metal finishing industry in Maine. Portions of project involved evaluation, risk assessment and concept closure of a hazardous waste impoundment; EPA sludge delisting; and hazardous waste Part B applications.

Project Manager and Hydrogeologist for landfill development, closure and site permitting.

Publications

"Groundwater Quality, Variation, and Trends as Compared to Land Use in a Critical Carbonate Recharge Area." Presented at the NWWA Exposition—Technical Division Annual Meeting, Boston, Massachusetts, 1977.

"Regulatory—Technical Aspects of Sewage Sludge Disposal on the Land Surface." Presented at the Pennsylvania Water Pollution Control Association Annual Convention, 1977.

"Hydrogeologic Considerations and Remedial Alternatives Assessment at Uncontrolled Hazardous Waste Disposal Sites." Vanderbilt University-sponsored Technical Program for Environmental Protection Agency, Region V, Cincinnati, Ohio, 1981.

"In-situ Remediation and Closure of a Plating Waste Impoundment", *Toxic and Hazardous Waste*. Proceedings of the Fifteenth Mid-Atlantic Industrial Waste Conference, June 1983.

Walter M. Leis, P.G.

Registration

Registered Professional Geologist in the States of Georgia (No. 440) and Indiana.

Fields of Competence

Detection and abatement of groundwater contamination; design of artificial recharge wells; deep well disposal; simulation of groundwater systems; hydrogeologic evaluation of hazardous waste sites and landfills; practical applications of geophysical surveys to hydrologic systems, site investigations, and borehole geophysical surveys. Geochemical studies of acid mine drainage and hazardous wastes.

Experience Summary

Sixteen years experience as field hydrogeologist, field supervisor, project director, research director. Six years research involving two consecutive projects: 1) application of geophysical techniques in evaluating groundwater supplies in fractured rock terrain in Delaware and Pennsylvania; 2) project director for an artificial recharge and deep well disposal study. Provided consultation for waste disposal and aquifer quality problems for coastal communities.

Developed geochemical sampling techniques for deep mine sampling. Evaluated synthetic and field hydrologic data for deep formulational analysis in coal field projects.

Earlier research experience involved developing techniques for mapping subsurface regional structures having interstate hydrologic significance, and defining ore bodies by geochemical prospecting.

Credentials

B.S., Biochemistry—Albright College (1966)

M.S., Hydrogeology—University of Delaware (1975)

Cooperative Program Environmental Engineering—University of Pennsylvania

Additional special course work in Geology and Hydrology, Franklin and Marshall College and Pennsylvania State University

Remote Sensing Data Processing Training, Goddard Space Center (1978)

OWRR Research Fellow, 1973

National Water Well Association, Technical Division.

Geological Society of America, Engineering Geological Division.

Society of Economic Paleontologists and Mineralogists

Employment History

1974-Present	WESTON
1973-1974	University of Delaware Water Resources Center
1971-1973	University of Delaware
1967-1971	Pennsylvania Department of Environmental Resources

Key Projects

Definition of groundwater contamination from sanitary landfill leachate and recovery of contaminants to protect heavily used aquifer in Delaware.

Field design studies for artificial recharge and waste disposal wells.

Design and construction of hydrologic isolation systems for various class hazardous wastes.

Design and supervision of chemical and physical rehabilitation of groundwater collection systems in fractured rock and coastal plain areas.

Principal investigator for six projects involving subsurface migration of PCB's in New York, New Jersey, Pennsylvania, and Oklahoma.

Design and construction supervision of hydrocarbon recovery wells in Pennsylvania.

Professional Profile

Geochemical evaluation of coal mine pools in West Virginia.

Geochemistry of subsurface migration of toxic substances.

Principal investigator for eight projects involving migration of volatile chlorinated hydrocarbons in groundwater.

Mineable reserve evaluations for coal, sand and gravel, limestone, clay deposits, mine reclamation, and monitoring.

Design geophysical and remote sensing assessments of hazardous waste disposal areas.

Publications

Leis, W., and R.R. Jordan, 1974, "Geologic Control of Groundwater Movement in a Portion of the Delaware Piedmont", OWRR—DEL 20.

Leis, W., 1976, "Artificial Recharge for Coastal Sussex County, Delaware", University of Delaware Press, Water Resources Center.

Leis, W., D.R. Clark, and A. Thomas, 1976, "Control Program for Leachate Affecting a Multiple Aquifer System, Army Creek Landfill, New Castle County, Delaware", National Conference on Management and Disposal of Residue on Land.

Leis, W., W.F. Beers, J.M. Davidson, and G.D. Knowles, 1978, "Migration of PCB's by Groundwater Transport—A Case Study of Twelve Landfills & Dredge Disposal Sites on the Upper Hudson Valley, New York", Proceedings of the 1st Annual Conference of Applied Research & Practice on Municipal and Industrial Waste.

Leis, W., R.D. Moose, and W.F. Beers, "Critical Area Maps, a Regional Assessment for Karst Topography", Association of Engineering Geologists 1978 Annual Meeting.

Leis, W., and W.F. Beers, "Soil Isotherm Studies to Predict PCB Migration Within Groundwater", (Abstract) ASTM 1979 Annual Meeting, Philadelphia, Pennsylvania.

Thomas, A., and W. Leis, "Physical & Chemical Rehabilitation of Contaminant Recovery Wells", Association of Engineering Geologists 1978 Annual Meeting.

Leis, W., W.F. Beers, and F. Benenati, "Migration of PCB's from Landfills and Dredge Disposal Sites in the Upper Hudson River Valley", New York Academy of Science Symposium on PCB's in the Hudson River.

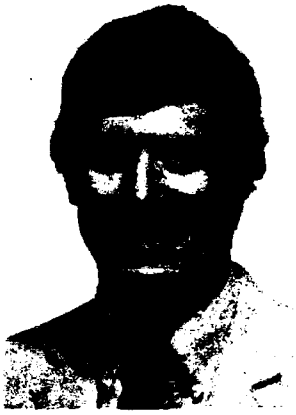
Leis, W., "Subsurface Reclamation by Counter Pumping Systems: Geologic and Geotechnical Aspects of Land Reclamation", ASCE/AEG 1979 Symposium.

Leis, W., and A. Metry, "Field Characterization of Leachate Quality", Water Pollution Control Federation 1979 Annual Meeting.

Leis, W., and A. Metry, "Multimedia Pathways of Contaminant Migration", Water Pollution Control Federation 1980 Annual Meeting.

Leis, W., and K. Sheedy, "Geophysical Location of Abandoned Waste Disposal Sites", 1980 National Conference on Management of Uncontrolled Hazardous Waste Sites.

Sheedy, K., and W. Leis, 1982, "Hydrogeological Assessment in Karst Environments (chapter)."



Glenn R. Smart

Fields of Competence

Hydrogeologic investigations of potential hazardous waste sites and landfills; design and supervision of installation of groundwater monitoring programs; collection of field data and evaluation of potential environmental impact; management of hydrogeologic projects at hazardous waste sites.

Experience Summary

Seven years of experience in various aspects of the water resource industry. Involvement in over 100 hazardous waste projects in sixteen states. Development of hazardous waste site preliminary assessments and full field investigations. Development of site safety plans for use during hazardous waste site evaluations. Fully trained in the use of respiratory protective equipment, emergency first aid procedures, site sampling protocols and chain-of-custody procedures, and general site safety programs. Frequent interaction with government and industrial clients. Provided expert testimony for superfund litigation.

Employed remote sensing techniques and on-site investigations to locate favorable sites for the development of groundwater supplies. Collected field data, compiled hydrologic and hydraulic input, prepared reports for flood insurance studies. Presented study results to federal, state and local authorities.

Credentials

B.S., Hydrology—University of New Hampshire (1977)

National Water Well Association, Technical Division

American Water Resource Association

Employment History

1984-Present	WESTON
1979-1984	Ecology and Environment, Inc.
1977-1979	Sverdrup & Parcel and Associates, Inc.

Key Projects

Project Manager for Superfund site hydrogeologic investigation to determine potential impact on local well water supplies.

Project Manager for complete hydrogeologic investigation of Superfund site involving alleged contamination of municipal field.

Project Manager for confidential industrial client. Project included hydrogeologic study to determine the groundwater quality beneath site slated for industrial development.

Supervised a team of six field geologists and participated in collection of geologic data for nationwide mineral survey. Responsible for all planning, logistics, quality assurance and financial control of the team.

Designed shallow water table study to assess impact of past waste disposal practices of confidential client.

Designed and supervised installation of numerous groundwater monitoring programs at hazardous waste sites.

Publications

Hagger, C.L.D., and G.R. Smart, "Drilling and Installation of Groundwater Monitoring Wells on Hazardous Waste Sites: Construction Specifications and Preparations for Non-ideal Field Conditions." Paper presented to Northeast Conference on the Impact of Waste Storage and Disposal on Groundwater Resources, Ithaca, New York, July, 1982.

Smart, G.R., "A Cost-Effective Approach to Monitoring Well Installation." Paper presented to Triangle Conference on Environmental Technology, University of North Carolina at Chapel Hill, North Carolina, April, 1983.

Smart, G.R., "Installation of Monitoring Wells at Hazardous Waste Sites." Paper presented to 1983 Spill Control and Hazardous Materials Conference, New Haven, Connecticut, 1983.

Smart, G.R., "Design of Monitoring Well Systems to Meet RCRA Requirements." Presented at the HMCRI Waste Site Conference, Houston, Texas, March, 1984.

Professional Profile

APPENDIX D

WELL COMPLETION LOGS

APPENDIX A

ACRONYMS, DEFINITIONS, NOMENCLATURE AND UNITS OF MEASURE

WELL NUMBERING SYSTEM

BURLINGTON AIR NATIONAL GUARD BASE

"RFW" SERIES (APPENDIX D-1)

Test borings completed with monitor wells installed by Green Mountain Boring for Roy F. Weston, Inc.

8-21 May 1984

"BP" SERIES (APPENDIX D-2)

Test borings completed with monitor wells installed by Soil Exploration Corporation for Miller Engineering and Testing, Inc.

23-25 February 1982

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permit fully legible reproduction

APPENDIX D-1

"RFW" WELLS

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WESTON DESIGNERS CONSULTANTS

TEST BORING LOG

BORING NO.

PROJECT :

CLIENT :

BORING CONTRACTOR :

GROUND WATER :

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE				
DIA.				
WT.				
FALL				

SHEET NO. OF

JOB NO.

ELEVATION

DATE STARTED

DATE FINISHED

DRILLER

INSPECTOR

WELL CONSTRUCTION	DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0					
	5					
	10					
	15					
	20					
	25					
	30					
	35					
	40					
	45					

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permit fully legible reproduction

WESTON DESIGNERS CONSULTANTS

TEST BORING LOG
BORING NO.

PROJECT :
SHEET NO. OF
CLIENT :
JOB NO.

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	45					
	50					
	55					
	60					
	65					
	70					
	75					
	80					
	85					
	90					
	95					

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TEST BORING LOG

BORING NO.

PROJECT :

CLIENT :

BORING CONTRACTOR :

SHEET NO. 1 OF 2

JOB NO.

ELEVATION

DATE STARTED

DATE FINISHED

DRILLER

INSPECTOR

GROUND WATER :

DATE	TIME	WATER EL.	SCREEN
	0930		

	CAS.	SAMP.	CORE	TUBE
TYPE				
DIA.				
WT.				
FALL				

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0					
	5					
	10					
	15					
	20					
	25					
	30					
	35					
	40					
	45					

WESTON DESIGNERS CONSULTANTS

TEST BORING LOG

BORING NO.

PROJECT :

SHEET NO. 2 OF 2

CLIENT :

JOB NO.

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	45					
	50					
	55					
	60					
	65					
	70					
	75					
	80					
	85					
	90					
	95					

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TEST BORING LOG

BORING NO. [illegible]

PROJECT : [illegible]	SHEET NO. [illegible] OF [illegible]
CLIENT : [illegible]	JOB NO. [illegible]
BORING CONTRACTOR :	ELEVATION [illegible]
GROUND WATER :	DATE STARTED [illegible]
	DATE FINISHED [illegible]
	DRILLER [illegible]
	INSPECTOR [illegible]

DATE	TIME	WATER EL.	SCREEN		CAS.	SAMP.	CORE	TUBE
[illegible]	[illegible]	[illegible]	[illegible]	TYPE				
				DIA.				
				WT.				
				FALL				

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
[illegible]	0	S-1	SS	1-2-3-3	[illegible]	
					[illegible]	
					[illegible]	
	5	S-2	SS	21-7-7-7		[illegible] 7'
					7	[illegible]
	10	S-3	SS	[illegible]	[illegible]	
	15	S-4	SS	[illegible]	[illegible]	
				[illegible]	[illegible]	
	20	S5	[illegible]		[illegible]	
	25					
	30					
	35					
	40					
	45					

WESTON DESIGNERS CONSULTANTS

TEST BORING LOG

BORING NO.

PROJECT :	SHEET NO. OF
CLIENT :	JOB NO.
BORING CONTRACTOR :	ELEVATION
GROUND WATER :	DATE STARTED
DATE / TIME / WATER EL. / SCREEN	DATE FINISHED
	DRILLER
	INSPECTOR

	CAS.	SAMP.	CORE	TUBE
TYPE				
DIA.				
WT.				
FALL				

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0	S1	SS	2-1-1-2		
	5	S2	SS	5-7-		Dry @ 7'
	10		NX		9.0	
	15					
	20					
	25					
	30					
	35					
	40					
	45					

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WESTON DESIGNERS CONSULTANTS

TEST BORING LOG

BORING NO.

PROJECT :	SHEET NO. OF
CLIENT :	JOB NO.
BORING CONTRACTOR :	ELEVATION
GROUND WATER :	DATE STARTED
DATE / TIME / WATER EL. / SCREEN	DATE FINISHED
	DRILLER
	INSPECTOR

	CAS.	SAMP.	CORE	TUBE
TYPE				
DIA.				
WT.				
FALL				

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
SAND PACK	0, 5, 10, 15, 20, 25, 30, 35, 40, 45					

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APPENDIX D-2

"BP" WELLS

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(617) 897-8737

SOIL EXPLORATION CORPORATION
TEST BORINGS • GEOLOGICAL CONSULTING

OAK HILL PROFESSIONAL PARK
LONDONDERRY, N.H. 03053
(603) 627-3051

To Miller Engineering & Testing, Inc. Date 3/1/82 Job No. 82-042

Location Burlington International Airport, Burlington, Vt. Scale 1" 4 ft.

Test Boring No. 2
2/23/82
Ground Surface

0'0"
Ground frost.
2'0"
Firm to hard, damp to wet, fine to medium sand, trace to little, inorganic silt. Trace of odor.
2'0" 8-10-12
3'6"
8'6" 8-9-10
10'0"
Hard to very compact, wet, very fine sand and inorganic clay like silt. Trace of odor.
10'0" 10-14-21
11'6"
14'0" 21-33-42
15'6"

End of boring 15'6"
Water Level 10'0"
upon completion.

Installed well point at 12'0"

MATERIALS USED:
Sch 40 Machine slotted PVC
Sch 40 Machined ends PVC
Sch 40 End Plug PVC
Sch 40 End Cap PVC

Test Boring No. 3
2/23/82
Ground Surface

0'0"
Ground Frost.
2'0"
Firm, damp, fine to medium sand, trace of inorganic silt.
2'0" 5-7-9
3'6"
7-8-9
10'0"
12'6"
Firm, damp to wet, very fine sand and inorganic silt. Some fuel odor
16'0"

End of boring 16'0"
Water Level 10'0"
upon completion

Installed well point at 16'0"

MATERIALS USED:

5'	3"	Sch 40 Machine slotted PVC
15'	3"	Sch 40 Machined ends PVC
1	3"	Sch 40 End Plug PVC
1	3"	Sch 40 End Cap PVC

Figures in Right Hand Column indicate the Number of Blows Necessary to Drive 30 [illegible]

Casing Data
HOLLOW STEM AUGER
Casing O.D. ____ I.D. ____
Hammer Fall ____

Sampler Data
Sampler O.D. 2" [illegible]
Inside Length of Sampler [illegible]
Hammer Fall [illegible]

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LONDONDERRY, N.H. 03053
(603) 627 3051

To Miller Engineering & Testing, Inc. Date 3/1/82 Job No. 82-042

Location Burlington International Airport, Burlington, Vt. Scale 1" = 4 ft.

Test Boring No. 4
2/23-24/82
Ground Surface

0'0" Ground frost.

2'0" Firm to compact, damp, fine to medium sand, trace to little inorganic silt. Trace of odor.

2'0" 4-5-6
3'6"
8'6" 12-15-17
10'0"
13'6" 16-17-21
15'0"
17'6"

continued

Test Boring No. 4
continued

17'6" Stiff to hard, damp to wet, inorganic claylike silt and very fine sand. Trace of odor.

18'6" 10-12-
20'0"
23'6" 15-12-
25'0"
28'6" 21-54-
30'0"

End of boring 30'0"
Water Level 29'0"
upon completion.

Installed well point at 30'0"

MATERIALS USED:
10' 3" Sch 40 Machine slotted PVC
12'6" 3" Sch 40 Machined ends PVC
1 3" Sch 40 End Plug PVC
1 3" Sch 40 End Cap PVC

Figures in Right Hand Column indicate the Number of Blows Necessary to Drive Spoon ___ Using 140 lb. weight

Casing Data
HOLLOW STEM AUGER
Casing O.D. D-2-2 I.D. ___
Hammer Fall ___

Sampler Data
Sampler O.D. 2" I.D. 1 3/8"
Inside Length of Sampler ___
Hammer Fall 30"

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LONDONDERRY, N.H. 03053
(603) 627-3051

To Miller Engineering & Testing, Inc. Date 3/1/82 Job No. 82-042

Location Burlington International Airport, Burlington, Vt Scale 1" = 4'-0"

Test Boring No. 6
2/24/82
Ground Surface

0'0" Ground frost.

2'0" Firm, dry, fine to medium sand, trace of inorganic silt.

2'0" 4-6-7
3'6"

7'6" Firm to compact, damp to wet, very fine sand and inorganic claylike silt.

8'0" 7-8-9
9'6"

13'6" 11-14-19
15'0"

18'6" 16-19-21
20'0"

20'0"

End of boring 20'0"
Water Level 14'0"
upon completion.

Installed well point at 15'0"

MATERIALS USED:
10' 3" Sch 40 Machine slotted PVC
5' 3" Sch 40 Machined ends PVC
1 3" Sch 40 End Plug PVC
1 3" Sch 40 End Cap PVC

Test Boring No. 7
2/24/82
Ground Surface

0'0" Ground frost.

2'0" Firm, dry, fine sand, trace of inorganic silt and fine gravel.

2'0" 5-4-7
3'6"

7'6" Firm to hard, damp, very fine sand and inorganic silt.

8'0" 8-10-11
9'6"

12'0" Very stiff to hard, damp to wet, inorganic claylike silt and very fine sand. Trace of odor.

13'0" 16-19-3[illegible]
14'6"

15'0"

End of boring 15'0"
Water Level 14'0"
upon completion.

Installed well point at 15'0"

MATERIALS USED:
10' 3" Sch 40 Machine slotted PVC
5' 3" Sch 40 Machined ends PVC
1 3" Sch 40 End Plug PVC
1 3" Sch 40 End Cap

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Figures in Right Hand Column Indicate the Number of Blows Necessary to Drive Spoon

Casing Data
HOLLOW STEM AUGER
Casing O.D. ~~D-22-3~~

Sampler Data
Sampler O.D. 2" D [illegible]-3/8"
Inside Length of Sampler [illegible]

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LONDONDERRY, N.H. 03053
(603) 627-3051

To Miller Engineering & Testing, Inc Date 3/1/82 Job No. 82-042

Location Burlington International Airport, Burlington, Vt. Scale 1" = 4 ft.

Test Boring No. 8
2/25/82
Ground Surface

0'0"	Ground frost.	2'0"	
2'0"	Loose, damp, very fine to fine sand, some inorganic silt.	3'6"	3-4-4
8'0"	Medium to hard, wet, inorganic silt and very fine sand, trace of clay. Little odor.	8'6"	5-4-7
		10'0"	
		15'0"	16-18-23
16'6"		16'6"	

End of boring 16'6"
Water Level 15'0"
upon completion.

Installed well point at 16'0"

MATERIALS USED:
10' 3" Sch 40 Machine slotted PVC
6' 3" Sch 40 Machined ends PVC
1 3" Sch 40 End Plug PVC
1 3" Sch 40 End Cap PVC
1 3" Female adapter

Test Boring No. 12
2/24/82
Ground Surface

0'0"	Ground frost.	2'0"	
2'0"	Loose, damp, fine sand, some inorganic silt, plastic, (fill).	3'6"	3-4-5
		8'6"	5-6-6
		10'0"	
		13'6"	4-5-5
		15'0"	
17'0"	Firm, damp, fine to medium sand and inorganic silt. Trace of odor.	18'0"	5-6-6
		19'6"	
22'0"	Firm, wet, very fine sand and inorganic silt. Trace of odor.	23'0"	8-10-
24'6"		24'6"	

End of boring 24'6"
Water Level 23'0"
upon completion.
Installed well at 24'6"

MATERIALS USED:
20' 3" Sch 40 Machine slotted PVC
6' 3" Sch 40 Machined ends PVC
1 3" Sch 40 End Plug PVC
1 3" Sch 40 End Cap PVC
1 3" Female adapter

Figures in Right Hand Column indicate the Number of Blows Necessary to Drive spoon 1' using 140 lb. weight

Casing Data
HOLLOW STEM AUGER
Casing O.D. ____ I.D. ____
Hammer Fall D-2-4

Sampler Data
Sampler O.D. 2" I.D. 1-3/8"
Inside Length of Sampler 24"
Hammer Fall 30"

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OAK HILL PROFESSIONAL PARK
LONDONDERRY, N.H. 03053
603 [illegible] 3051

To Miller Engineering and Testing, Inc. Date 3/1/82 Job No. 82-042

Location Burlington International Airport, Burlington, Vt. Scale 1" 4 ft.

Test Boring No. 13

2/25/82
Ground Surface

0'0"	Ground frost.	2'0"	
2'0"	Loose, damp, fine to medium sand, little organic silt, trace of plastic, (fill).	2'0"	4-4-5
		3'6"	
		8'6"	3-5-4
		10'0"	
11'0"	Loose, damp, fine sand, little to some inorganic silt.	12'0"	2-2-3
		13'6"	
18'0"	Stiff, damp to wet, inorganic silt and very fine sand. Little odor.	18'6"	8-9-10
20'0"		20'0"	

End of boring 20'0"
Water Level 19'0"
upon completion.

Installed well point at 20'0"

MATERIALS USED:
- 10' 3" Sch 40 Machine slotted PVC
- 12' 3" Sch 40 Machined Ends PVC
- 3" Sch 40 End Plug PVC
- 3" Sch 40 End Cap PVC
- 40 lb. bag of sand.

Test Boring No. 14

2/25/82
Ground Surface

0'0"	Ground frost.	2'0"	
2'0"	Loose to firm, damp, fine to medium sand, trace of inorganic silt and fine gravel.	2'0"	3-4-5
		3'6"	
7'6"	Loose to firm, damp, fine to medium sand, little inorganic silt.	8'6"	4-5-6
		10'0"	
12'0"	Compact to very compact, damp to wet, very fine sand and inorganic silt. Little odor.	13'0"	14-19-23
		14'6	
		20'0"	
21'6"		21'6"	

End of boring 21'6"
Water Level 19'0"
upon completion.

Installed well point at 19'0"

MATERIALS USED:
- 10' 3" Sch 40 Machine slotted PVC
- 12'6-3" Sch 40 Machined Ends PVC
- 3" Sch 40 End Plug PVC
- 3" Sch 40 End Cap PVC
- 40 lb. bag of sand.

Figures in Right Hand Column Indicate the Number of Blows Necessary to Drive spoon
[illegible] 140 lb. weight

Casing Data
HOLLOW STEM AUGER
Casing O.D. [illegible] I.D. [illegible]
Hammer Fall D-2-5

Sampler Data
Sampler O.D. 2" I.D. 1-3/8"
Inside Length of Sampler 18"
Hammer Fall 30"

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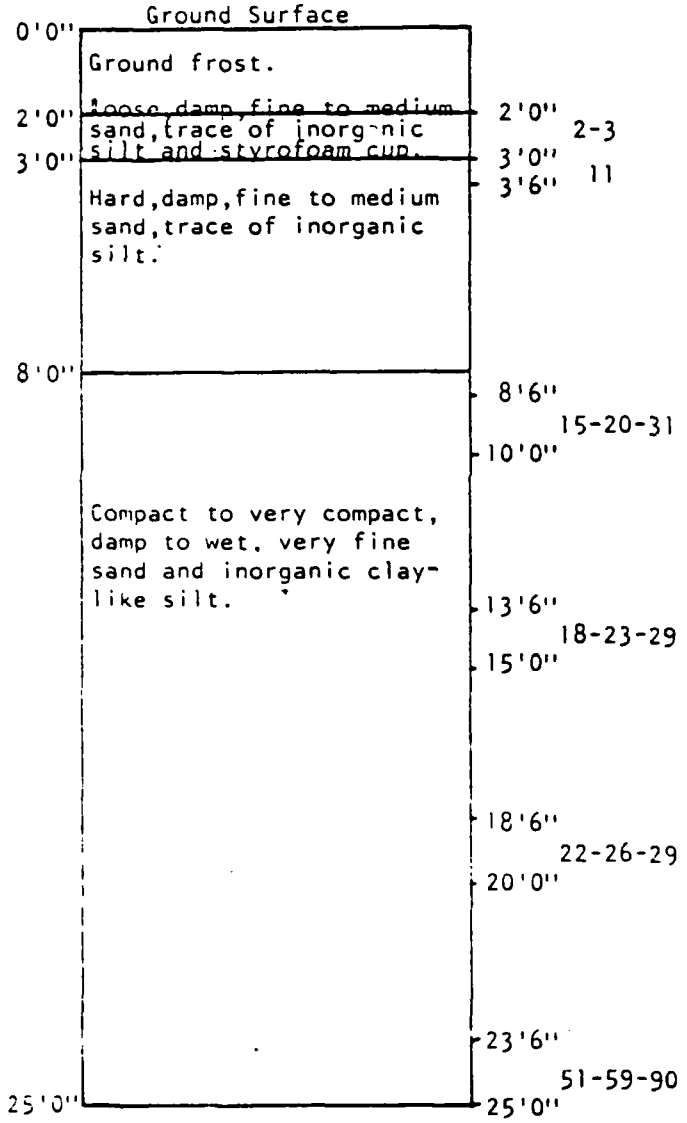
(603) 627-3051

To Miller Engineering & Testing, Inc. Date 3/1/82 Job No. 82-042

Location Burlington International Airport, Burlington, Vt. Scale 1" = 4 ft.

Test Boring No. 18
2/23/82
Ground Surface



End of boring 25'0"
Water Level 21'0"
upon completion.

Installed well point at 22'6"

MATERIALS USED:

5'	3" Sch 40 Machine slotted PVC
10'	3" Sch 40 Machined Ends PVC
1	3" Sch 40 End Plug
1	3" Sch 40 End Cap

Figures in Right Hand Column indicate the Number of Blows Necessary to Drive spoon 6" using 140 lb. weight	Casing Data HOLLOW STEM AUGER Casing O.D. ____ I.D. ____ Hammer Fall D-2-6	Sampler Data Sampler O.D 2" I.D 1-3/8" Inside Length of Sampler 18" Hammer Fall 30"

APPENDIX E

SAMPLING AND ANALYTICAL PLANS

WESTON

APPENDIX E

SAMPLING AND QA/QC PLANS

E-1.1 MONITOR WELL PURGING

All groundwater sampling is accomplished after the installed monitoring wells are properly developed and have stabilized for a period of at least two weeks. Prior to collecting samples, each well is purged by pumping a minimum of three volumes of standing water in the well using a Johnson-Keck submersible pump. This ensures that a representative sample of the aquifer is collected during the sampling process. The field procedures used for monitoring well purging include the following guidelines:

1. Prior to placing any equipment into the well, the equipment is scrubbed with Alconox (detergent) solution and rinsed with distilled water.

2. Before purging, the depth to water from the referenced measuring point on the top of the well casing is measured and recorded.

3. The volume of water to be purged is calculated based on the amount of standing water in the well casing.

4. The well is purged by pumping, removing at least three times the calculated volume of standing water in the well casing.

5. The pump is disconnected and removed from the well. The equipment is decontaminated by scrubbing with Alconox and flushed with deionized water.

6. The protective caps are secured.

E-1.2 MONITOR WELL SAMPLE COLLECTION

Groundwater sampling will be directed towards the detection of:

1. Phenols
2. Metals
3. Volatile Organics.
4. Oil and grease.

All required sample containers and preservatives will be prepared and supplied by WESTON Laboratories in accordance with standard U.S. EPA procedures and protocols.

After well purging, sampling activities consist of the following procedures:

1. A 3/4 inch diameter, 4-foot long stainless steel and teflon bailer is decontaminated with Alconox and copious amounts of distilled water. The field filtering equipment consisting of a 0.45 micron filter, filtration apparatus and vacuum lines are similarly decontaminated.

2. The cleaned bailer is slowly lowered into the well using a new, clean nylon rope and is allowed to fill with well water. The bailer is retrieved and emptied. This procedure is repeated three times. After the fourth bailer full, the well water sample is filtered in the field for only the metals through a 0.45 micron filter. Samples for all organic and anion analyses are recovered in similar fashion, but are not filtered. At surface water locations a plastic bucket is substituted for the bailer and is lowered into the stream. It is subjected to the same decontamination and rinsing procedures.

3. Each sample bottle is filled with an appropriate sample. The sample containers used will be:

   - Volatile Organics - two 40 ml septum seal glass vials (analyzed by EPA method 624).

   - Oil and Grease - one, 1-liter amber glass bottle.

   - Phenolics - one, 250 ml amber glass bottle preserved with $CuSO_4$ (copper sulfate) and H_3PO_4 (phosphoric acid).

   - Metals (Priority Pollutant) - one, 1-liter plastic bottle preserved with nitric acid.

4. A grab sample is taken for immediate field measurement of temperature, pH, and conductivity.

5. The sample containers will be wrapped in packaging material and placed in a thermal chest packed with enough ice to insure cooling to 4°C.

E-2.0 QUALITY ASSURANCE PLAN

WESTON Analytical Services enforces a rigid QA/QC program toward maintenance of validity and reliability of all analytical data. The Laboratory QA/QC Manual (Table of Contents thereof is Attachment No. 1 to this appendix) outlines the specifics of the QA/QC plan. This plan is patterned after the EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories (EPA-600/4-79-019, March 1979), augmented by general applicable experience and interaction with the QA/QC plan of the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). All methods and procedures followed by WESTOn are either USEPA or ASTM-approved. Any variations from such procedures, regardless of cause, are documented by the responsible analyst(s) and are documentable, and, literature-traceable. A general review of this QA/QC plan is in the following paragraphs.

Although specific QA/QC measures for each method are designated in WESTON's Laboratory Quality Assurance Manual, the general QA/QC program normally includes:

- EPA-acceptable sample preparation and analytical methods.
- Instrument calibration via use of Standard Analytical Reference Materials (SARMS).
- Regular equipment maintenance and servicing.
- Use of SARMS and QA/QC samples (spikes, laboratory blanks, replicates, and splits) to ascertain overall precision.
- Statistical evaluation of data to delineate acceptable limits.
- Documentation of system/operator performance.
- Suitable chain-of-custody procedures.
- Maintenance and archiving of all records, charts, and logs generated in the above.
- Proper reporting.

Acceptable analyses at WESTON's Analytical Laboratory Services include, but are not limited to, the above.

In general, WESTON's QA/QC sequence follows the following diagram (Figure E-1). Documentation (as available from instrument recordings and technicians' notebooks) is sufficient to validate each step in the sequence.

E-2.1 CONTAINER PREPARATION

Another consideration in this project was that of sample container preparation. Accordingly, all appropriate sample bottles were cleaned in a manner mandated by the U.S. EPA to insure maximal cleanliness (and minimal contamination) before the containers went to the field. Sufficient bottles to accommodate both laboratory and field blank requirements were prepared in a single batch mode for each sampling event. Attachment 2 (page ES-11 through ES-13) provide the specific procedures which were followed for the bottles prepared to meet the contract analytical protocol (Table 4-1).

ES-2.2 VERIFICATION/VALIDATION

The following verification/Validation were followed for this undertaking. Laboratory blanks were prepared to insure that no background level of specific analytes was introduced by laboratory procedures. Laboratory duplicates were performed to provide a measure of the precision of the analytical procedure. Standard Analtyical Reference Materials (SARMS) were employed to determine the accuracy and precision of the procedures. Spikes were performed to further assess the precision and accuracy of the analytical method. Field blanks were collected to assure that field sampling protocols resulted in representative samples. Field blanks also provide an indication of the "practical" detection limits of the analytes of concern. Field duplicates were collected to demonstrate the natural variability resulting from field sample collection or the degreeof homogeneity of the sample matrix.

All data archieved for future reference, retrieval, or processing. Appendix H contains data resulting from the above verification.

- Field Blanks - To provide a check on contamination of containers and/or preservatives and to establish "practical" detection limits.

WESTON has used all of the above in this project. All data resulting from these verification media have been archived for future reference, retrieval, or processing.

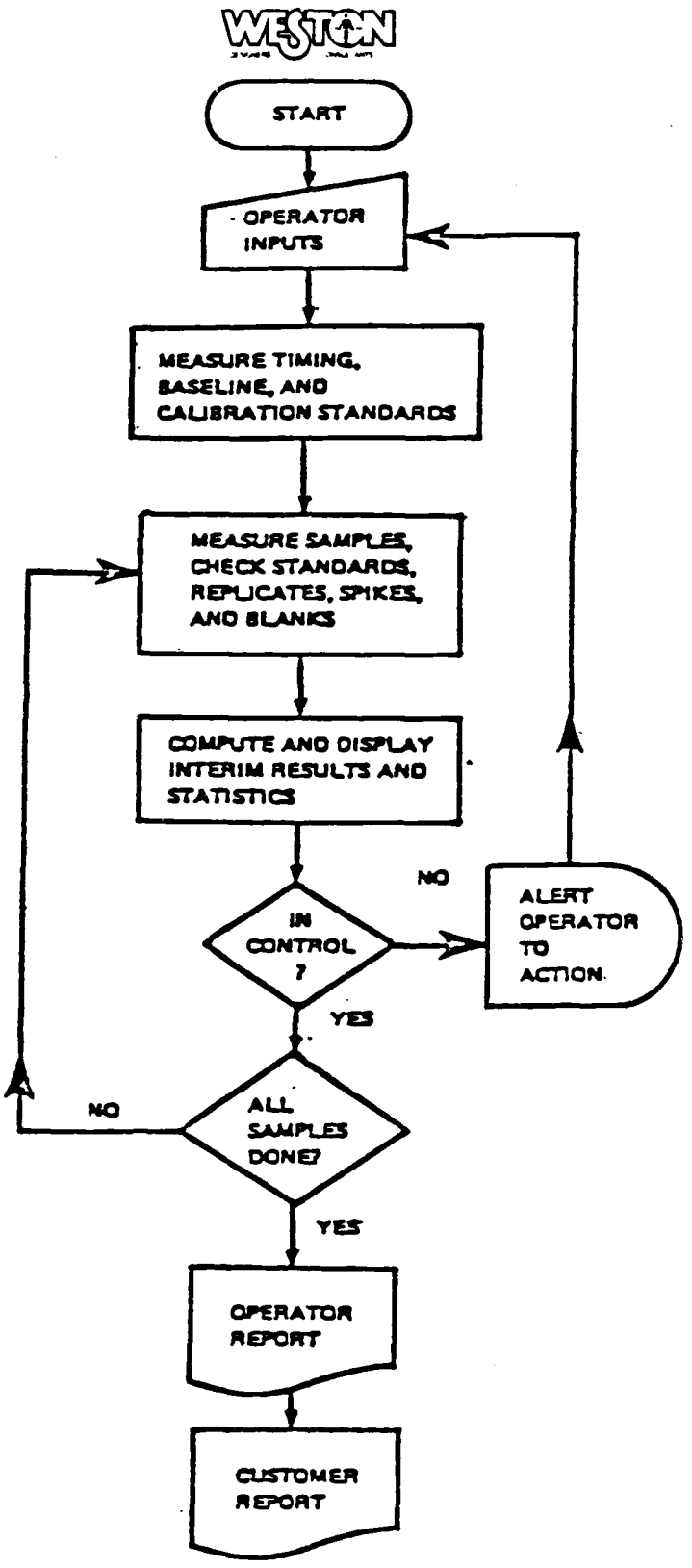


Figure E-1: Flow Chart of the Sequence of Events during a Controlled Series of Laboratory Measurements.

E-2.3 DATA HANDLING - LABORATORY

Use of any analytical data should be preceded by an assessment of its quality. The assessment should be based on accuracy, precision, completeness, representativeness, and comparability. These criteria are, in turn, assessed as follows:

- Accuracy - Is it acceptable for the planned use? QA/QC shall measure the accuracy of all data.
- Precision - Is it acceptable for the planned use? QA/QC shall reflect the reproducibility of the measurements.
- Completeness - Are the data sufficient for the planned use? QA/QC shall identify the quantity of data needed to match the goals.
- Representativeness -Do the data accurately reflect actual site conditions, sampling procedures, and analytical method? QA/QC shall ensure this.
- Comparability - Is the report self-consistent in format, units, and standardization of methods used to generate it? QA/QC shall ensure this.

Additionally, statistical methods outlined in the QA/QC program have been applicable to data evaluation.

The Laboratory Supervisor and the Laboratory QA/QC Officer have been responsible for the evaluation of the above criteria and for enforcement of analytical protocols that will necessarily lead to acceptable data quality. The signature of the Supervisor and QA/QC Officer accompany each laboratory analytical report and serve to ensure the overall validity of the reported data.

E-2.4 SAMPLE PLAN/LOG

Normal protocol demands client-and /or site-specific logging of all sample batches delivered to WESTON. Basic information -- such as client name, address, etc.; client phone number; reporting/invoicing instructions; site descriptions; and parameter-specifications and total requirements -- is initiated here. Additionally, sample storage/disposal instructions as well as turnaround requirements and sample collection requirements are addressed at this point.

The appropriate number of method blanks is also logged at this point, and in-house chain-of-custody documentation is initiated here.

E-2.5 SAMPLE RESULTS

WESTON's analytical protocols generally require five-point calibration curve plus a reagent blank s the basis for quantification analytes from a linear calibration curve. (A three-point plus blank curve vs. the original five point one is acceptable if it falls within the QA/QC requirements of $\pm$ 3 standard deviation of the original curve.) Linear regression analysis is then performed. Method- and detection limit-specific data are accessed for quantitation and report-writing from each such data set. For reporting accuracy, the algorithm

$$\frac{\text{Linear-Regressed Raw Concentration from Calibration Curve} \times \text{Solid Sample Extract Volume If Solid}}{\text{Solid Sample Mass If Solid} \times \text{Fraction Solids If Solid}} \times \text{Concentration or Dilution Factor} = \text{Final Concentration}$$

is used for all quantitations. (All such algorithm input data are archived for long-term storage.) Detection limits for solids are generated on a per-sample basis and calculated by replacing "LINEAR-REGRESSED RAW CONCENTRATION FROM CALIBRATION CURVE" with "DETECTION LIMIT OF ANALYTE IN LIQUID MATRIX" in the above equation.

E-2.6 CHAIN-OF-CUSTODY

Since they document the history of samples, chain-of-custody procedures are a crucial part of a sampling/analysis program. Chain-of-custody documentation enables identification and tracking of a sample from collection to analysis to reporting.

WESTON's chain-of-custody program necessitates the use of EPA-approved sample labels, secure custody, and attendant recordkeeping. Depending on the client's requirements, WESTON also offers container sealing during unattended transportation of samples.

In essence, WESTON considers a sample in custody if it: is in a WESTON employee's physical possession; it is in view of that WESTON employee; is secured by that WESTON employee to prevent tampering; or is secured by that WESTON employee in an area that is restricted to authorized personnel.

Each time a sample is relinquished from one analyst to another or from one major location to another, WESTON's analytical personnel are required to make appropriate entries. Personnel-specific initials are used as identifiers of analysts, as are location codes for various locations (refrigerators, extraction areas, analytical areas, etc.) within the laboratory. Each transaction for each sample is accompanied by a specific reason for transfer. Chain-of-custody documentation is given in Appendix F.

E.2.7 QA/QC OFFICER

Toward maintenance of a rigid, credible QA/QC regimen, WESTON Analytical Services maintains a full-time, in-house QA/QC officer who retains independent authority to declare out-of-control situations, thereby precluding reporting of unacceptable data. The QA/QC officer has been available, as needed, on the project.

APPENDIX E ATTACHMENT NO. 1

WESTON ANALYTICAL LABORATORY QUALITY ASSURANCE PLAN
11/30/84

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STANDARD SAMPLING PLANS

CONTAINER PREPARATION

1.0 PURPOSE

The bottle preparation procedures for various analytical requirements are given below. The summaries in Figures 1 through 5 give preservation requirements and bottle types for both organic and inorganic analytes.

2.0 PROCEDURE

2.1 B/N/A, Pesticides, TCDD, Nitroaromatics, Oil and Grease

2.1.1 Wash glassware with a low phosphate detergent (i.e., Alconox). Rinse with tap water three (3) times and deionized water two (2) times.

2.1.2 Rinse with acetone (once).

2.1.3 Rinse with hexane (once).

2.1.4 Rinse with deionized water two (2) times.

2.1.5 Kiln dry at 450°C for ten (10) hours.

2.1.6 Allow to cool.

2.1.7 Cap with clean caps with teflon liners.

2.2 Volatile Organics (VOA), TOX, TOC

2.2.1 Order precleaned vials, if possible. If vials need to be cleaned, the procedure in item 2.2.2 should be used for vials and septa.

2.2.2 Wash septa and vials with a low phosphate detergent (i.e., Alconox), rinse with tap water five (5) times and deionized water ten (10) times.

Do not use any organic solvents (i.e., acetone, hexane, methylene chloride, etc.) when cleaning VOA vials, TOX or TOC bottles.

2.2.2.1 Air dry septa.

2.2.2.2 Kiln dry vials at 450°C for ten (10) hours. Allow to

cool.

2.2.3 Cap vials with clean, teflon-lined septa with the teflon side (shiny side) toward the vial.

2.3 Metals

2.3.1 Wash with soap, rinse with tap water five (5) times and deionized water five (5) times.

2.3.2 Rinse with nitric acid (Ultrex grade).

2.3.3 Rinse with deionized water five (5) times.

2.4 Inorganic Analytes

2.4.1 Use new bottles, rinse with deionized water five (5) times.

2.5 Organic Analytes Classified as Inorganic Analytes: BOD, COD, MBAS, NTA, Oil and Grease, Phenolics

2.5.1 Oil and grease: See Section 2.1.

2.5.2 TOC: See Section 2.2.

2.5.3 BOD, COD, MBAS, NTA, phenolics: Use new bottles, rinse with deionized water five (5) times.

2.6 Microbiology: Total Coliform, Fecal Coliform, Fecal Streptococcus, Total Plate Count, etc.

2.6.1 Use autoclavable bottles (polypropylene), wide mouth, 250 mL minimum.

2.6.2 Wash with soap, rinse with tap water five (5) times, and deionized water five (5) times.

2.6.3 To each 250 mL bottle, add 0.2 mL of ten (10) percent $Na_2S_2O_3$ (sodium thiosulfate). Cap loosely.

2.6.4 Apply a strip of heat-sensitive tape or other sterilization indicator to each bottle.

2.6.5 Autoclave for thirty (30) minutes at 151°C. Allow to cool, then tighten caps.

NOTE: If caps are on too tight during the autoclave step, bottles will implode as they cool.

2.7 Charcoal, Silica Gel, Florisil Tubes for NIOSH Methods

2.7.1 For Industrial Hygiene, Source Testing, Ambient Air Testing purchase precleaned, sealed tubes from an appropriate vendor, e.g., SKC, Inc. or DuPont.

2.8 Tenax, Tenax/Charcoal Tubes for VOST

2.8.1 Preparation of tubes, reagents, hardware and miscellaneous materials required for assembly and storage of VOST tubes is described in OP 16-11-001. Protocol for the Collection and Analysis of Volatile POHCs Using VOST from the Technical Support Office, Industrial Environmental Research Laboratory, US EPA, Research Triangle Park, NC 27711. February 1984.

APPENDIX E
ATTACHMENT NO. 3
QUALITY ASSURANCE STATEMENT
Revised July 3, 1985

Resource Analysts, Inc.
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RESOURCE ANALYSTS, INCORPORATED
QUALITY ASSURANCE MANUAL

I. INTRODUCTION

1.1 Description of Services

Resource Analysts Incorporated provides clients with environmental sampling and chemical analysis services together with technical support in the application of the chemical data produced.

1.2 Corporate Commitment to Quality

RAI stands committed to providing chemical measurements of quality consistent with client needs and requirements in a reasonable time while maintaining cost control. This committment recognizes the need for data to be representative of the environmental conditions under consideration, and for data to be valid and reliable, suitable for making decisions that invlove public health and safety, property rights and legal liabilities. To this end RAI has developed a company-wide Quality Assurance (QA) Plan and maintains an ongoing QA Program. A QA Officer is appointed by and reports to the President of the Company, independent of other operational and budgetary concerns.

RAI is committed to employing proper analytical methods, to aquiring equipment appropriate to the methods and maintaining such equipemnt in good condition, to securing qualified staff and to co-ordinating all aspects of operation to insure that reports of known and acceptable quality are produced.

The QA Program seeks to document all of these activities.

1.3 Objectives of the QA Program

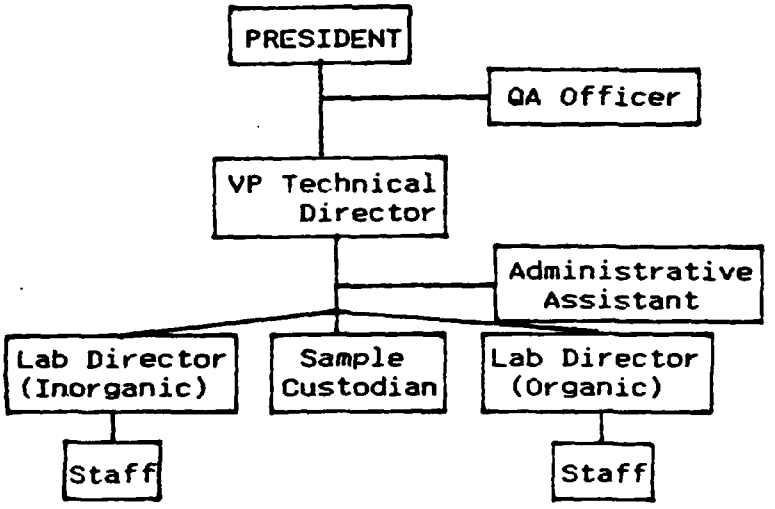
The primary objective of the QA Program is to create general conditions within the company that provide chemical measurements that are valid and reliable and reflect the actual conditions at the time and place that a sample was taken. To assure these conditions, it is imperative that data are of known quality and comparibility. This document details the Quality Control (QC) and QA procedures required to establish such conditions and provide for improving quality and representativeness when indicated.

1.4 Periodic Review

This document has been reviewed and approved by the company QA management structure for relevance, inclusiveness and consistency with current state of the art. It shall be updated when any phase of the program can be changed in such a way as to better achieve the overall objectives of the program or to improve the procedures it covers or when deficiencies are discovered. Such modifications are subject to the same review and approval as original components of the program.. A history of modifications is maintained by the QA Office.

II. CORPORATE AND LABORATORY STRUCTURE

The following chart lays out the structure of the company with respect to Quality Assurance/Control:



The responsibilities for each QA management element are detailed in those sections of this manual which apply to that QA element. Generally they are described as follows:

2.1 QA Officer:
Reporting directly to the president, and outside the day to day operations in the laboratory, the QA Officer is responsible for updating the QA Program. He assesses and coordinates the implementation, and assures documentation. He conducts routine checks on operations and data management. He performs internal audits and reviews performance evaluation results. He initiates and coordinates corrective actions, reporting to the president on progress and performance.

2.2 Technical Director
The Technical Director is responsible for work plans tailored to the needs of the project. He is the primary contact within the laboratory with all overseeing government agencies. He is responsible for the selection of methods, application of quality control and quality assurance, and for overseeing corrective actions as may be required.

2.3 Laboratory Director
Reporting to the Technical Director, the individual laboratory directors organize the personnel, equipment and materials that are needed to meet the QA objectives for the analyses to be performed. With the guidance of the Technical Director, they select procedures and detection limits required for the samples and the client's needs. They review the data generated and resolve day to day discrepancies. They implement corrective measures as required when deficiencies are detected through internal audits and routine checks by the QA Officer or when quality control indicates problems.

III. SAMPLE MANAGEMENT AND DOCUMENT CONTROL

3.1 Sample Receipt
Samples are first received by an appointed technical administrative assistant who removes the samples from shipping containers together with all accompanying documentation such as chain of custody forms, sample inventory, analysis request forms, etc. The samples are inspected for general condition and discrepancies between package contents and sample inventory sheets/analysis request sheets. Exception reports are prepared at this time for samples whose integrity is suspect or unacceptable. Samples are then entered into the Master Log. A project number is assigned to the sample group and unique individual sample numbers are assigned to each sample container. The Master Log serves to document for the following:

Chain of Custody Requirements
Date and Time of Receipt
Priority Status to be Assigned to the Sample Group
Project Number
Client and Responsible Individual, Together with Client Project Reference
Client Sample Identification/Sample Description
Preservation during Shippment
Preservation/Special handling upon Receipt
Container Type and Volume
Analysis Requested
Date Due
Project Manager if Appropriate

The laboratory sample custodian then inspects the condition of the samples. If discrepancies, omissions or inappropriate samples are noted, an exception report is prepared and transmitted to the client immediately and any resolvable problems are solved. If the client cannot be reached, samples in question are assigned to cold storage (4.C) and no further action is taken until the problem is resolved. The sample custodian prepares a project control sheet (Figure 1)for the sample group and laboratory control sheets for the samples (Figures 2,3,4). The project sheet initiates the project file into which all documentation accompanying the sample group is placed. The custodian delivers the samples to the individuals responsible for immediate sample workup, and the to the individual laboratory sample storage locations.

3.2 Sample Storage

Samples are logged into each storage location. When samples are removed for analysis or workup they are logged out of storage by the analyst and logged in upon return, together with notations on any alterations which may compromise sample integrity. (Figure 5)

All samples are stored so as to minimize physical or chemical alteration of the sample prior to analysis. The type of storage and preservation applied to a sample is determined from the analytical method reference when applicable. In the absence of these specific storage/preservation requirements the requirements of Table 3.1 are followed.

TABLE 3.1

SUMMARY OF SPECIAL HANDLING OR SAMPLING REQUIREMENTS

DETERMINATION	CONTAINER	MIN. SIZE (mL)	PRESERVATION	MAX. STORAGE (days)
Acidity	P,G	100	4 C	14
Alkalinity	P,G	100	4 C	14
BOD	P,G	1000	4 C	2
Boron	P	100		28
Bromide	P,G			28
Carbon, Organic, total	G	100	H2SO4 pH<2	28
Carbon dioxide	P,G	100	Analyze immediately	
COD	P,G	100	H2SO4 pH<2	28
Chloride	P,G	50		28
Chlorine residual	P,G	200	analyze immediately	
Chlorophyll	P,G	500	Freeze;in dark	30
Color	P,G	50	4 C	2
Conductivity	P,G	100	4 C	28
Cyanide, total	P,G	500	NaOH pH>12	14
Cyanide, amenable to chlorination	P,G	500	100 mg Na2S203/L	
Fluoride	P	300		28
Grease & Oil	G	1000	H2SO4 pH<2, 4 C	28
Hardness	P,G	100	HNO3 pH<2	6 months
Iodine	P,G	500	analyze immediately	
Metals, total	P,G	100	HNO3 pH<2	6 months
dissolved	P,G	100	Filter immediately HNO3 pH<2	6 months
Chromium VI	P,G	200	4 C	1
Mercury	P,G	500	HNO3 ph<2, 4 C	28
Ammonia	P,G	400	H2SO4 pH<2, 4 C	28
Nitrate	P,G	100	H2SO4 pH<2, 4 C	2
Nitrite	P,G	50	4 C	2
Nitrate+Nitrite	P,G	200	4 C	28
Kjeldhal Nitrogen	P,G	500	H2SO4 pH<2, 4 C	28
Odor	G	200	analyze immediately	
Pesticides	G	1000	4 C	7
Phenols	G	500	H2SO4 pH<2	28
Purgeables	G/T	2x40	4 C, 10ppm HgCl if septic	14
Oxygen, dissolved	G (BOD)	300	analyze immediately	
pH	P,G	25	analyze immediately	
Phosphate	G	100	4 C	2
Residue	P,G	100	4 C	7
Salinity	G/Wax	240	Wax Seal	6 months
Silica	P	50	4 C	28
Sulfate	P,G	50	4 C	28
Sulfide	P,G	500	4 C, 2ml zinc acetate, NaOH pH>9	7
Temperature	P,G	1000	analyze immediately	
Turbidity	P,G	100	4 C	2

Designated laboratory sample storage locations are designed to limit access to authorized personnel only, and provisions for lock and key access are provided in some cases.

Samples are kept for 15 days from date of final report when practical, after which they are discarded or disposed of and logged into a laboratory disposal record which contains the date and method of disposal.

3.3 Scheduling of Analyses

The individual laboratory directors are responsible for scheduling analyses so that holding times listed in Table 3.1 are not exceeded. Dates of analysis are recorded in the laboratory notebooks.

IV. GENERAL LABORATORY PROCEDURES

4.1 Instrument Maintenance

Preventive maintenance is provided for all instruments and equipment as specified by the manufacturer, or as established by the appropriate Laboratory Director, whichever is more frequent. Preventive maintenance is conducted in order to assure timely, accurate and reproducible analytical processes in a safe and healthful laboratory environment.

Pumps, Compressors, Exhaust Systems

Routine checks are made and logged for oil, filters, dessicants and leakage as appropriate.

Electronic Instruments (AA,GC,GC/MS,Spectrophotometers,etc)

Routine general checks and cleaning are performed and logged.

Glassware

Specialized glassware is appropriately cleaned and stored. Broken glassware is repaired or disposed of and logged for replacement. For certain analyses, glassware may be segregated, labelled and taken out of general service.

Balances

Semi annual preventive maintenance and cleaning is provided by analytical balance professionals.

Corrective maintenance is provided as required for all instruments and equipment. Factory replacement parts, trained service technicians and first quality materials are used if available and necessary. It is the policy of RAI to conduct repairs at the lowest level of complexity necessary and to obtain parts directly from primary manufacturers whenever possible. This policy is aimed at maintaining speed, economy and reliability of optimum quality maintenance.

4.2 Calibration Procedures and Frequency

The following describes generally the calibration procedures for instruments used for analysis. More detailed descriptions are provided under analytical procedures specific to the individual parameters as presented in Standard Operating Procedures.

Analytical Balance

Every six months calibration of the entire analytical range is checked by a qualified service technician. Each day that balance is used the calibration is checked for gross malfunction or trends using a Class S weights dedicated to this function. Readings obtained are recorded in a separate notebook.

pH/Electrometer

Before use each day, and once after each four (4) hours of use, the meter is calibrated using pH 4 and pH 10 buffer solutions. The calibration is checked using a pH 7 buffer. If agreement between the three buffer solutions cannot be made to .0.05 units, the entire analytical unit is checked for the source of problems (probe, buffer solutions, etc.). Results of the calibration, together with the date, time and analyst's initials are recorded in a separate notebook. All buffer solutions used are purchased from reputable laboratory suppliers as "certified".

Spectrophotometer

Each day that measurements are to be made the instrument is checked with three standard color cuvettes and the results, along with the date, time and analyst's initials are recorded in a separate notebook.

Atomic Absorption Spectrometer

Initial calibration is made using at least three (3) points. The calibration is checked every ten (10) determinations using at least one (1) standard. If the calibration check shows a change of >10%, the calibration is rejected and a new curve is established.

Calibration is checked at all three (3) points at least once during each hour of use. Results of calibrations and checks are kept in a laboratory notebook together with the results of analysis of samples. Calibrations are performed using solutions prepared from reference standards purchased from reputable laboratory suppliers as "certified", or are prepared from ultra high purity metals or salts purchased from suppliers specializing in high purity chemicals.

Gas Chromatograph

Each GC system is initally calibrated at two (2) points bracketing the expected sample concentrations. A third sample point is used if deviation from linearity is >5%. The system is checked for calibration drift or variability with two check standards each day, or one check sample with each six (6), whichever is more frequent. Deviations or variability of >15% requires that the source of the problem be investigated and the system recalibrated.

Solutions used for calibration are purchased from reputable laboratory suppliers specializing in organic reference materials or prepared from EPA reference materials, or other reference materials of predetermined composition purchased from specialty suppliers.

Gas Chromatograph/Mass Spectrometer

Each GC/MS system is initially calibrated at three (3) points bracketing the working range of the system. Calibration is checked daily with a mid-range standard. If the instrument is to be used for two (2) or more working shifts, the calibration is checked once each shift. Calibration is checked during each sample run with the use of surogate standard spikes which include MS calibration check compounds. If calibration check standards or suogate standards vary by >15%, or if the spectra obtained for each MS calibration check compound does not meet criteria for that compound, the cause of the problem is investigated and the system is recalibrated, or retuned and recalibrated.

Pensky Martens Closed Cup Flash Point Apparatus

Once each month the thermometer is checked against an NBS traceable certified thermometer. System performance is checked by analyzing reference materials at least once with each set of samples.

4.3 Preparation of Reagents and Standards used in Instrument Calibrations

All solvents used for the preparation of calibrations are of Pesticide Grade Quality. Distilled water is checked for background levels. Only Class A volumetric glassware is used in preparation of standards. All reagents are obtained from reputable laboratory suppliers, or are of determined quality. Prepared reagents and standards are dated and initialled by the preparer and stored under conditions that prevent degradation or alteration. Any signs of degradation or alteration of a reference material requires its removal from use.

4.4 Glassware

Sample containers and analytical glassware is prepared prior to use and cleaned after use in accordance with pertinent EPA protocols and/or SOP in use. All analytical glassware is cleaned promptly following analysis prior to storage.

4.5 Training

The Technical Director is responsible for a staff training program, which is administered by the Laboratory Directors. Training is conducted for each technician on each method they are to perform. No individual may conduct any analysis without continuous direct supervision until training in that analytical method has been completed and ability to produce quality results

documented.

Training effort is minimized by a policy of hiring candidates for technical staff positions who satisify criteria of experience, education and communication skills which favor acceptance of individuals likely to readily meet training criteria.

A policy of support for continuing professional development is followed, encouraging staff to acquire, maintain and broaden technical competence by academic and other courses and seminars.

4.6 Safety

Safety policies and measures are detailed in the RAI Safety Manual. In summary, handling of samples, equipment, materials and wastes is conducted with safety and health of staff as a primary concern. Unsafe operations inherently threaten the quality, completeness and timeliness of analytical services and are not tolerated.

4.7 Analytical procedures

Analytical work is conducted by strict adherance to Standard Operation Procedures (SOP) designed for each project. Routinely used SOP documents include:

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

EPA SW 846 Test Methods for Evalutaing Solid Wastes

Standard Methods for the Examination of Water and Wastewater, 15th Edition

SOP documents may be adapted from other sources or generated in-house as client needs may require. Procedural references are a part of recordkeeping and reporting.

V. ANALYTICAL QUALITY CONTROL

Analytical quality control measures are taken to maintain reliability in analytical determinations required to control accuracy and precision.

Primary QC measures consist of analyzing check standards, duplicates and spiked samples (at 10% samples analyzed). Results from such samples are used to prepare control charts defining accuracy and precision of methods.

QC tests to validate accuracy and precision include:

- Blanks
- Duplicates
- Surrogate Standards
- Matrix Spikes
- Internal Standards
- Performance Standards

These are used regularly to determine if an analytical method is performing within specifications, and if not, why.

5.1 Accuracy

Accuracy is determined by check standards and spiked samples.

5.1.1 Internal Standards

Calibrated internal standards check system performance with each sample, and are used when appropriate. Results are transcribed to accuracy control charts and compared to the mean. (Figures 5.1,5.2)

Any deviations beyond a predetermined value determine that the method is not performing within specifications. Corrective action is required and may include reanalysis, method recalibration and corrective maintenance.

5.1.2 Surrogate Standards

For certain analyses a surrogate standard is added to each sample/blank prior to preparation. Percent recovery is determined on the surrogate standard and is evaluated with respect to predetermined upper and lower performance limits. The need for correction is evaluated and executed as in 5.1.1

5.1.3 Matrix Spikes

For each sample lot, or at least 1 out of every 10 samples, a matrix spike is prepared. Percent matrix recovery is calculated and evaluated. Poor recovery may or may not mean that the analytical method is performing within specifications. Comparitive evaluation of the matrix spike with the surrogate standard will resolve whether poor recovery is a matrix problem or a laboratory problem. Corrective action is executed as needed.

5.1.4 Performance Standards

It is RAI plolicy to apply for and analyze standards for State and Federal government, which are split with others.

In-house performance standards in the form of blind samples, prepared by the Laboratory Directors, are also analyzed by the technicians and evaluated.

5.1.2 Method Blanks

Method blanks are analyzed at a ratio of 1 blank per lot of samples. Data is used as follows:

If blank value $>$ 2x method detection limit $<$ 0.5 sample value ;
blank value is subtracted from sample value.

If blank value >0.5 sample value, do not correct ; report as "Not detected above blank" or reanalyze.

5.2 Precision

Precision is determined by replicate analyses. Duplicate samples are analyzed at a ratio of 1 duplicate analysis to every 10 samples.

Replicates are used in two ways depending upon project requirements.

1. Data is reported with other sample results along with appropriate measures of standard detection for each replicate.

2. In larger programs (10 duplicate pairs) upper confidence limit would be 3.2 R at 99% confidence level where R is the mean relative range of the duplicate assemblage. Individual duplicates would be evaluated for precision relative to this upper confidence limit.

5.3 Corrective measures

QC decisions and corrective measures vary with the type of analysis and checks being done. In addition to specifics, RAI maintains a general systematic resolution procedure for any laboratory deficiency as follows:

- Reports are examined for sample age, analysis selection
- Data are examined for mathematical and/or typographical errors
- Instruments are checked for faults and calibration
- Entire procedure is reviewed by Laboratory Director or Technical Director for procedural errors

If this is not adequate government or private specialists are employed to provide increased expertise.

VI. DATA REDUCTION, VALIDATION AND REPORTING

6.1 Data Reduction and Validation

The analyst who completes the analysis assembles all relevant raw data and results together with strip chart recordings, instrument settings and other information essential to data interpretation. Data to be reduced to a final result is entered onto a standardized data reduction form in many cases. In other cases data reduction is performed in the laboratory notebook. The final results are recorded on the Laboratory Control Data Sheet (Figure 6.1) for that sample and submitted to the Laboratory Director together with all supporting data for validation.

The Laboratory Director reviews and checks calculations in at least 10% of the analyses. If any errors are discovered the entire packet is returned to the analyst for full rework. QC requirements are checked for acceptability and any corrective measures are initiated.

If accepted the Laboratory Director assembles the data with other data from the sample set, drafts a final report and forwards the report, together with the data packet, to the Technical Director.

The Technical Director reviews the calculations, but focuses primarily upon the appropriateness of the methods employed, detection limits and wether QC criteria were satisified. Any deviations from the referenced methods are checked for documentation and validity, and QC corrective actions are reviewed for successful resolution.

If the Technical Director suspects improper QC or inappropriate method selection or alteration, one of two actions are taken ; the analyst may be interviewed for a more detailed explanation, or the sample group may be reanalyzed with proper QC measures and methodology employed. When the packet is accepted it is then forwarded to the Program Manager.

The Program Manager reviews the report in a manner similar to the Technical Director, questioning aspects of the work relative to appropriateness and responsiveness to client needs. He reviews completeness and assures that any special handling requirements were met, including method selection or precision. Upon the Program Manager's approval a final report is produced.

6.2 Reports

Reports are drafted by the personnel and their supervisors and finally formatted by the Technical Director. Standardized report forms are used when possible. The final report is checked by the Technical Director, checked by the Program Manager and signed by the Technical Director. Reports are mailed or shipped via special courier service to the client in a timely manner. Reports may be given over the telephone only under special circustances; only the written report is valid.

6.3 Laboratory Audits

The Quality Assurance Director ensures the President that all Quality Control measures herin are in place. The QA Director and the President meet weekly to review lab workload, personnel performance and training, instrument requirements and maintenance, Analytical methods, non-routine analyses, safety and QA/QC procedural improvement. Any items pertinent to QC are assigned to indviduals for resolution. The QA Director performs a monthly lab audit inspecting:

Sample Storage
Chain of Custody Documentation
QC Precision Activities
QC Accuracy Activities
Instrument Maintenance
Documentation

Any infractions are listed by the QA Director and discussed with each Laboratory Director. Oversights are discussed with the analyst and his/her Laboratory Director while the Laboratory Director decides how to correct systematic errors or misunderstandings. Modifications too cumbersome to be handled by the Laboratory Director alone are handled by the Laboratory Director, QA Director and President.

Quarterly or more frequently as required, the QA Officer reviews program and audit performance at his discretion. Audit reports and program reviews are provided to the President for submittal, with his comments, to the Board of Directors.

APPENDIX F

SLUG TEST ANALYSES

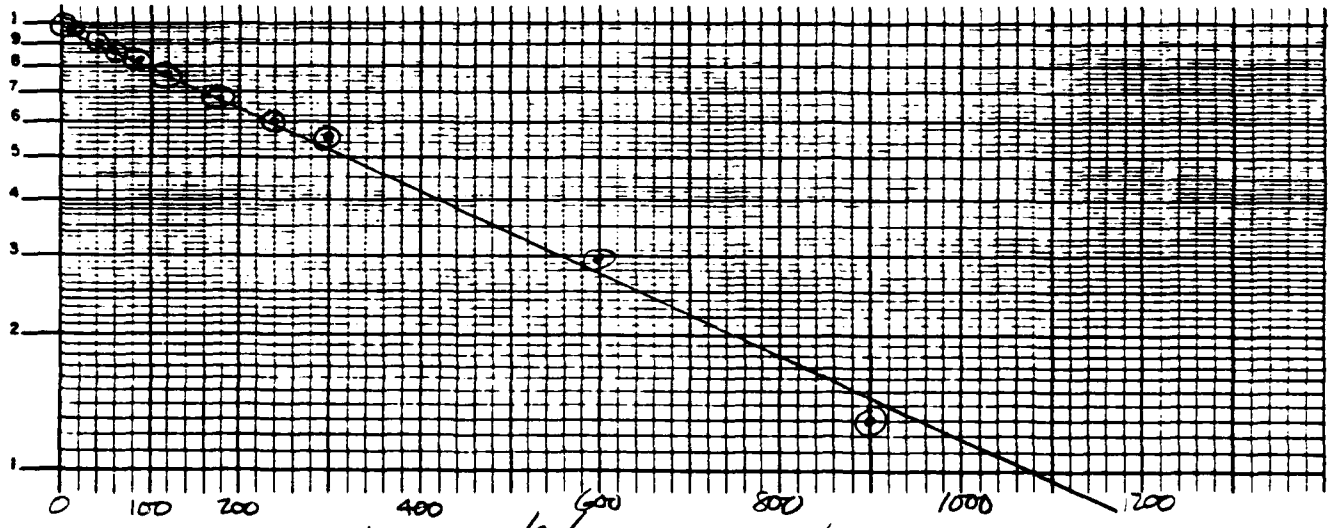
RFW-1

$$K = \frac{r^2 \ln\left[\frac{L}{R}\right] \ln\left[\frac{h_1}{h_2}\right]}{2L(t_2 - t_1)}$$

$r = 2.54$ cm
$R = 5.08$ cm
$L = 609.6$ cm
$t_1 = 15$ sec
$t_2 = 600$ sec
$h_1 = 0.97$
$h_2 = 0.29$

$$K = \frac{(2.54)^2 (4.79)(1.21)}{2(609.6)(600-15)}$$

$$K = \frac{37.38}{7.13 \times 10^5} = 5.2 \times 10^{-5} \text{ cm/sec}$$



$h_0 = 52.5$

t	h	h/h_0
15	50.67	.97
30	48.83	.93
45	47.50	.90
60	46.00	.88
90	42.42	.81
120	40.58	.77
180	36.08	.69
240	31.58	.60
300	28.42	.54
600	15.33	.29
900	6.17	.12
1200	4.00	.08

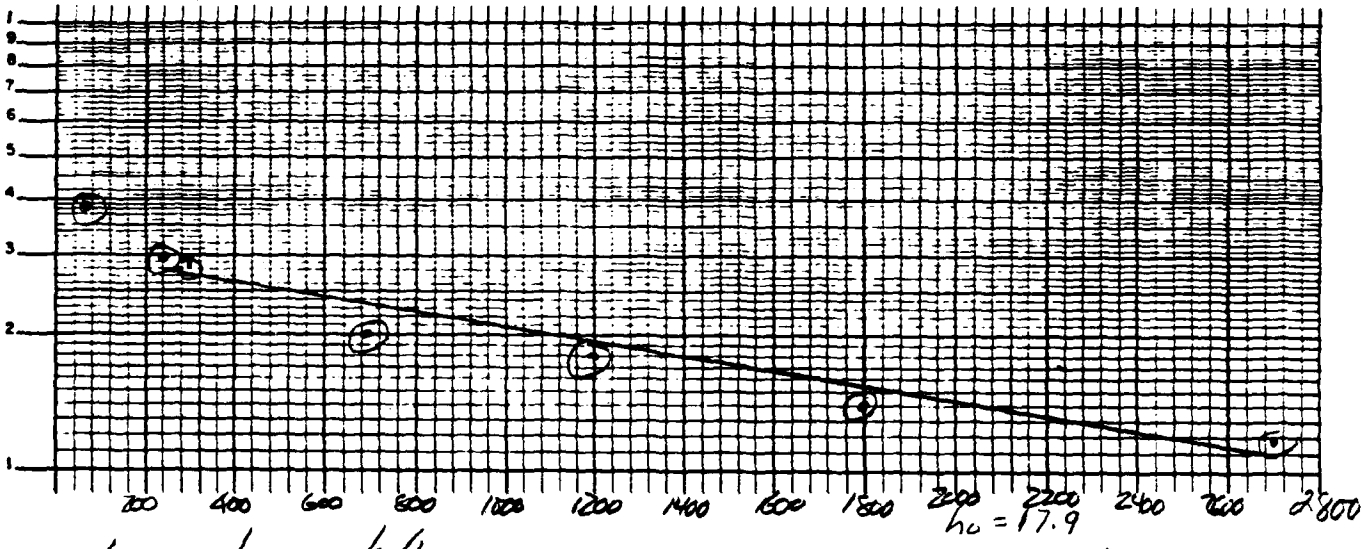
RFW-1A

$$K = \frac{r^2 \ln\left[\frac{L}{R}\right] \ln\left[\frac{h_1}{h_2}\right]}{2L(t_2 - t_1)}$$

$r = 2.54$ cm
$R = 8.89$ cm
$L = 975.36$ cm (SAT)
$t_1 = 180$ sec
$t_2 = 2700$ sec
$h_1 = .31$
$h_2 = .12$

$$K = \frac{(2.54)^2 (4.70)(.95)}{2(975.36)(2700-180)}$$

$$K = \frac{28.81}{4.9 \times 10^6} = 5.9 \times 10^{-6} \text{ cm/sec}$$



t	h	h/h₀
0	17.9	1.0
5	15.48	.86
15	12.57	.70
30	10.07	.56
60	7.23	.40
120	5.9	.32
150	5.73	.32
180	5.48	.31
240	5.4	.30

t	h	h/h₀
500	5.23	.29
600	4.23	.24
900	3.57	.20
1200	3.15	.18
1800	2.57	.14
2700	2.23	.12
3600	1.9	.11

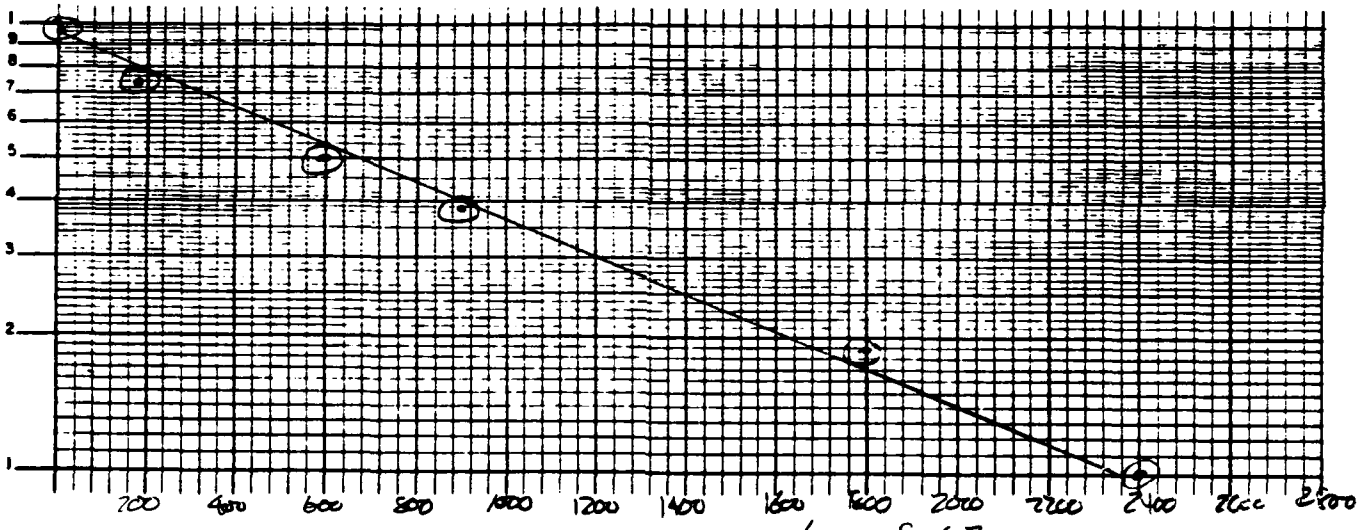
RFW-2

$$K = \frac{r^2 \ln\left[\frac{L}{R}\right] \ln\left(\frac{h_1}{h_2}\right)}{2L(t_2 - t_1)}$$

$r = 2.54$ cm
$R = 8.89$ cm
$L = 381$ cm
$t_1 = 60$ sec
$t_2 = 2400$ sec
$h_1 = 0.87$
$h_2 = 0.10$

$$K = \frac{(2.54)^2 (3.76)}{2(381)(2400-60)} \quad (2.10)$$

$$K = \frac{52.40}{1.78 \times 10^6} = 2.9 \times 10^{-5} \text{ cm/sec}$$



$h_0 = 8.67$

t	h	h/h_0
15	.33	.96
30	.42	.95
60	1.12	.87
120	1.75	.80
180	2.25	.74
240	2.67	.69
300	2.92	.66
600	4.33	.50
900	5.33	.39
1800	7.00	.19
2400	7.33	.10

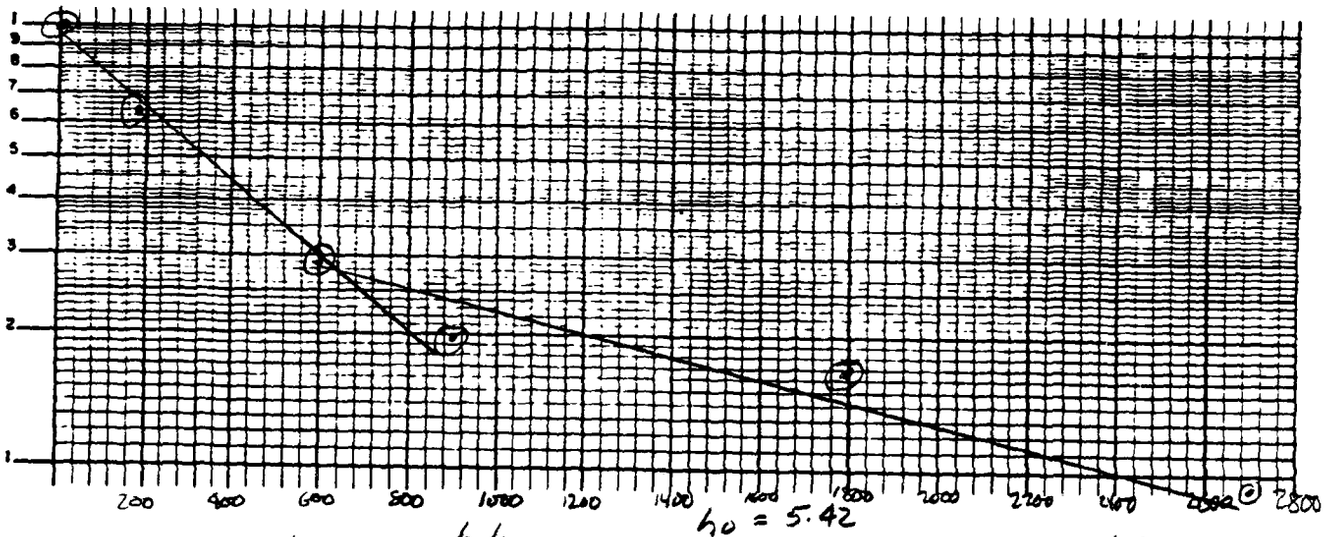
RFW-3

$$K = \frac{r^2 \ln\left[\frac{L}{R}\right] \ln\left[\frac{h_1}{h_2}\right]}{2L(t_2 - t_1)}$$

$$K = \frac{(2.54)^2 (3.77)\ (1.29)}{2(219.45)(2700-600)}$$

$$K = \frac{31.34}{921,690} = 3.4 \times 10^{-5}\ cm/sec$$

$r = 2.54$ cm
$R = 5.08$ cm
$L = 219.45$ cm (SAT.)
$t_2 = 2700$ sec
$t_1 = 600$ sec.
$h_1 = 0.29$
$h_2 = 0.08$



$h_0 = 5.42$

t	h	h/h₀
15	.17	.97
30	.33	.94
45	.67	.88
60	.83	.85
90	1.17	.78
120	1.50	.72
180	2.08	.62
240	2.25	.58
300	2.92	.46

t	h	h/h₀
600	3.83	.29
900	4.25	.22
1800	4.50	.17
2700	5.00	.08

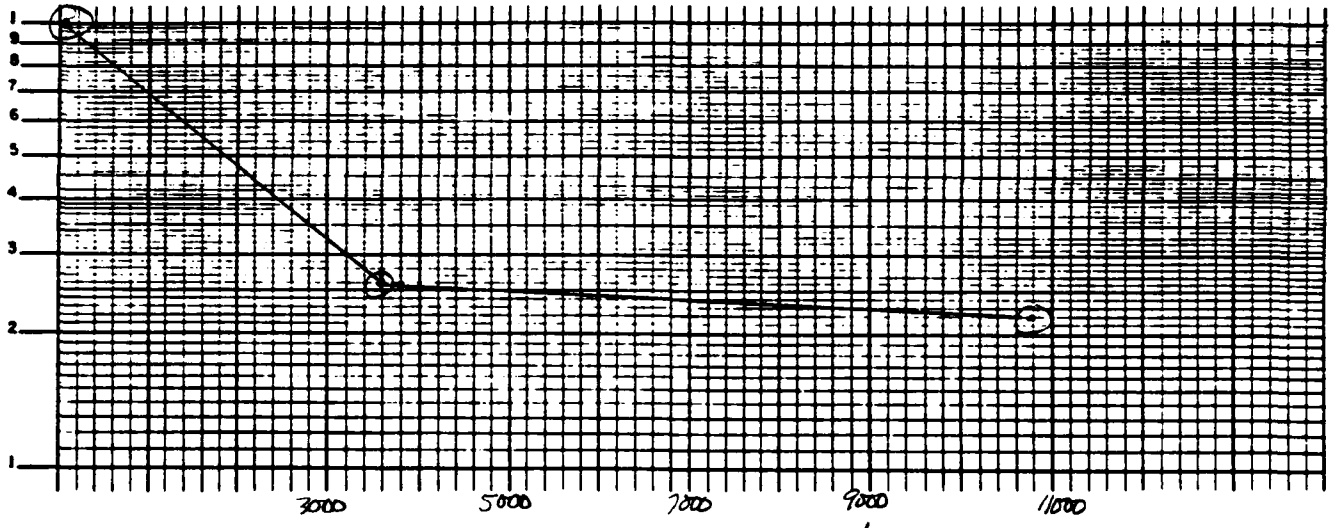
RFW-4

$$K = \frac{r^2 \ln\left[\frac{L}{R}\right] \ln\left[\frac{h_1}{h_2}\right]}{2L(t_2 - t_1)}$$

$r = 2.54$ cm
$R = 5.08$ cm
$L = 152.4$ [sat.]
$t_1 = 3600$ sec.
$t_2 = 10{,}800$ sec.
$h_1 = 0.26$
$h_2 = 0.22$

$$\frac{(2.54)^2 (3.4)}{2(152.4)(7200)} \quad (.16)$$

$$\frac{3.51}{2.2 \times 10^6} = 1.6 \times 10^{-6} \text{ cm/sec}$$



$h_0 = 12.25$

t	h	h/h₀
30	12.21	.996
60	12.00	.98
90	11.87	.97
120	11.67	.95
180	11.37	.93
240	11.08	.90
300	10.75	.88
600	9.33	.76
900	8.25	.67
3600	3.17	.26
7200	3.00	.24
10,800	2.75	.22

APPENDIX G

CHAIN OF CUSTODY

CHAIN OF CUSTODY RECORD

SHEET 1 OF 1

PROJECT NO.

PROJECT NAME: BANG AFB

SAMPLERS' SIGNATURES: Glenn R Grant

STA NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	VOA	METALS	OIL & GREASE	PHENOL			REMARKS
1	6/25	0920			WELL RFW 1	6	3	1	1	1			
1A	6/25	1010			WELL RFW 1-A	6	3	1	1	1			
1B	6/25	1020			WELL RFW 1-B	6	3	1	1	1			
2	6/25	1045			WELL RFW-2	6	3	1	1	1			
2	6/25	1215			WELL BP-2	6	3	1	1	1			
4	6/26	0950			WELL RFW-4	6	3	1	1	1			
3	6/25	1525			WELL RFW-3	6	3	1	1	1			
SW 2	6/25	1429			SW-2	4	3	1					
SW 3	6/25	1450			SW-3	4	3	1					
SW 4	6/25	1501			SW-4	4	3	1					
SW 7	6/25	1545			SW-7	4	3	1					
SW 5	6/25	1600			SW-5	4	3	1					
SW 1	6/25	1620			SW-1	4	3	1					
SW 6	6/25	1350			SW-6	4	3	1					
BP-12	6/26	1:00			BP-12	4	3	1	1	1			
BP-7	6/26	1:30			BP-7	4	3	1	1	1			

RECEIVED
JUL 2 1984
ROY F. WESTON, INC.
CONCORD OFFICE

RELINQUISHED BY	DATE	TIME	RECEIVED BY	RELINQUISHED BY	DATE	TIME	RECEIVED BY
[signature]	6/27/1	10:00	[signature] 10:00				
RELINQUISHED BY	DATE	TIME	RECEIVED BY	RELINQUISHED BY	DATE	TIME	RECEIVED BY
[signature]							
RELINQUISHED BY	DATE	TIME	RECEIVED FOR LABORATORY BY	DATE	TIME	REMARKS	

G-1

CHAIN OF CUSTODY RECORD

SHEET ___ OF ___

PROJECT NO.

PROJECT NAME

SAMPLERS SIGNATURES

STA NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	VOA	METAL'S	OIL & GREASE	PHENOL			REMARKS
1	6/25	0920			WELL # 1	6	3	1	1	1			88' DEEP 54.10" TO WATER PUMPED WELL 50 MIN REMOVED 50 gal
1A	6/25	10:10			WELL # 1A	6	3	1	1	1			44' DEEP 17.32 TO WATER PUMPED WELL 30 MIN REMOVED 30 gal
1B	6/25	10:20			1-B	6	3	1	1	1			BLANK OUT OF BAILER 6/25/84
2	6/25	10:45			RFW - 2	6	3	1	1	1			4 MIN DRY, 1 MIN DRY, 1 MIN DRY, 1 MIN DRY PUMPED WELL TOTAL OF 7 MIN REMOVED 7 gal
BP 2	6/25	12:15			BP - 2	6	3	1	1	1			PUMPED WELL 30 MIN 30 gal removed
4	6/26	0950			RFW - 4	6	3	1	1	1			PUMPED WELL DRY 4/25/ SAMPLED 6/26/84
3	6/25	1545			RFW - 3	6	3	1	1	1			PUMPED DRY 4 TIMES & SAMPLED
SW 2	6/25	14:20			SW - 2	4	3	1					GRAB
SW 3	6/25	1450			SW - 3	4	3	1					GRAB
SW 4	6/25	1501			SW - 4	4	3	1					GRAB
SW 7	6/25	1545			SW - 7	4	3	1					GRAB
SW 5	6/25	1600			SW - 5	4	3	1					GRAB SPCD 150 x 15 cm PH 7.2
SW	6/25	1620			SW - 1	4	3	1					BLANK OUT OF BOTTLE TRIP BLANK
SW 6	6/25	1650			SW - 6	4	3	1					GRAB
BP-12	6/26	1100			BP - 12	6	3	1	1	1			PUMPED WELL DRY 2 MIN, 4 MIN DRY 3 MIN DRY TOTAL
BP-7	6/26				BP - 7	6							PUMPED WELL

RELINQUISHED BY	DATE	TIME	RECEIVED BY	RELINQUISHED BY	DATE	TIME	RECEIVED BY

RELINQUISHED BY	DATE	TIME	RECEIVED BY	RELINQUISHED BY	DATE	TIME	RECEIVED BY

RELINQUISHED BY	DATE	TIME	RECEIVED FOR LABORATORY BY	DATE	TIME	REMARKS

CLIENT B.A.N.G. AFB UT. PRIORITY/HAZARD _____

WO#/PO# _____ SUBMITTED BY Ron Matthews

DATE RECEIVED _____ MISC. _____

RFW#	SAMPLE DESCRIPTION	DATE COLLECTED	PA	PA	PA	PA	PA	PA	PA
1.	BP-12	9/1/84	Hg	VOA + MEK, MIBK & XYLENES					
2.	BP-1	9/1/84	Hg	VOA					
3.	BP-7	9/1/84	Hg	VOA					
4.	BP-2	9/1/84	Hg	VOA					
5.	RFW-1	9/1/84	Hg	VOA					
6.	RFW-1A	9/1/84	Hg	VOA					
7.	RFW-3	9/1/84	Hg	VOA					
8.	RFW-4	9/1/84	Hg	VOA					
9.	RFW-2	9/1/84	Hg	VOA +					
10.	SW-5	9/1/84	METALS	VOA Hg	PHENOLS				C
11.	SW-1 NO SAMPLE	9/1/84	Hg	NO	SAMPLE SW-1				
12.	SW-4	9/2/84	ARSENIC						
13.	SW-7	9/2/84							
14.	SW-2	9/2/84							
15.	SW-3	9/2/84							
16.	SW-6	9/2/84	PULLUTANTS						
17.	SW-2A	9/2/84							
18.	SW-8	9/2/84							V
19.			↓	↓					
20.					↓	↓			
21.									
22.									
23.									
24.									
25.									

CHAIN OF CUSTODY

1. RFW # 06280531

2. No. of bottles on this sheet:

40 ml	
100 ml	
250 ml	
500 ml	
1000 ml	
Total	

3. Sampled by: [illegible]

4. Samples preserved and prepared according to S.O.P.: _____ Initials

Relinquished	Received by	Time	Date	Reason for Change of Custody
[illegible]	R.L. [illegible]	3 PM	9/3/84	DELIVER TO LAB
R.L. [illegible]	W. [illegible]	7:15 PM	5 Sept 84	Deliver
[illegible]		[illegible]	4 Sept 84	Laboratory

COMMENTS: _____

BY RLK DATE 8/30/84 DIV ____ SHEET 2 OF 3
CHKD BY ____ DATE ____ DEPT ____ W.O. NO. ____
PROJECT ____
SUBJECT ____

	Volatiles (1)	Priority Pollutant Metals (2)	Mercury (Hg) Only	Oil & Grease (3)	Phenols (4)
RFW-1	x		x	x	
RFW-1A	x		x		
RFW-2	x		x		
RFW-3	x		x		
RFW-4	x		x		
BP-2	x		x		
BP-7	x		x		
BP-12	x		x		
SW-1 —	NO SAMPLE	x		~~x~~	~~x~~
SW-2	x	x		x	x
SW-3	x	x		x	x
SW-4	x	x		x	x
SW-5	x	x		x	x
SW-6	x	x		x	x
SW-7	x	x		x	x
LAB BLANK	x	x		x	x
FIELD Blank	x (BP-1)	x (SW-8)	(BP-1)	x (SW-8)	x (SW-8)
Duplicate	x (SW-2A)	x (SW-2A)		x (SW-2A)	x (SW-2A)
TOTAL	~~18~~ 17	~~10~~ 9	~~9~~ 9	~~11~~ 10	~~10~~ 9

(1) 31 Priority Pollutants + MEK, MIBK, XYLENES

(2) 13 Priority Pollutants See Attached sheet w/ detection limits

(3) Attached sheet with detection limits

(4) " " " " "

APPENDIX H

ANALYTICAL DATA

AND

QA/QC REPORTS

WESTON

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE RECEIVED: 27 June 1984

RFW SAMPLE NO:	8406-398-0010	0020	0030	0040
SAMPLE DESCRIPTION:	RFW 1	RFW 1A	RFW 1B	RFW 2
ANALYSIS:				
Sb, ug/L	NF	NF	NF	NF
As, ug/L	NF	NF	NF	NF
Be, ug/L	NF	NF	NF	NF
Cd, ug/L	NF	NF	NF	NF
Cr, ug/L	NF	NF	NF	NF
Cu, ug/L	NF	NF	NF	17.7
Pb, ug/L	NF	NF	NF	NF
Ni, ug/L	11.0	11.1	NF	14.1
Se, ug/L	NF	NF	NF	NF
Ag, ug/L	NF	NF	NF	NF
Tl, ug/L	NF	NF	NF	NF
Zn, ug/L	56	22	NF	83

RFW SAMPLE NO:	0050	0060	0070	0150
SAMPLE DESCRIPTION:	BP-2	RFW 4	RFW 3	BP-12
ANALYSIS:				
Sb, ug/L	NF	NF	NF	NF
As, ug/L	12.7	NF	NF	11.8
Be, ug/L	NF	NF	NF	NF
Cd, ug/L	NF	NF	NF	NF
Cr, ug/L	NF	NF	NF	NF
Cu, ug/L	10.1	18.1	16.0	NF
Pb, ug/L	NF	NF	NF	NF
Ni, ug/L	41.6	16.3	34.2	60.3
Se, ug/L	NF	NF	NF	NF
Ag, ug/L	NF	NF	NF	NF
Tl, ug/L	NF	NF	NF	NF
Zn, ug/L	164	98	78	20

NB: The mercury (Hg) samples will be completed by 8/21/84. The answers will be called to Glen Smart that day.

WESTON

DATA SUMMARY FOR:	BURLINGTON AIR NATIONAL GUARD		
RFW SAMPLE NO:	S406-398-0160	0170	0180
SAMPLE DESCRIPTION:	BP-7	Lab Blank	RFW 1B
ANALYSIS:			
Sb, ug/L	NF	NF	NF
As, ug/L	22.7	NF	NF
Be, ug/L	NF	NF	NF
Cd, ug/L	NF	NF	NF
Cr, ug/L	NF	NF	NF
Cu, ug/L	NF	NF	NF
Pb, ug/L	NF	NF	NF
Ni, ug/L	73.2	NF	NF
Se, ug/L	NF	NF	NF
Ag, ug/L	NF	NF	NF
Tl, ug/L	NF	NF	NF
Zn, ug/L	22	20.5	21.5

NF = Not Found Detection Limit of all metals = 10 ug/L

WESTON

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO:	8406-398-0090	0100	0110	0120	0130
SAMPLE DESCRIPTION:	SW-2	SW-3	SW-4	SW-7	SW-5
ANALYSIS:					
Cd, ug/L	NF	NF	NF	NF	NF
Pb, ug/L	NF	NF	NF	NF	NF
Zn, ug/L	33	20	22	20.5	21.5
Cr, ug/L	NF	NF	NF	NF	NF
Cu, ug/L	NF	NF	NF	NF	NF

RFW SAMPLE NO:	0140	0150
SAMPLE DESCRIPTION:	SW-1	Blk SW-6
ANALYSIS:		
Cd, ug/L	NF	NF
Pb, ug/L	NF	NF
Zn, ug/L	19.5	24.5
Cr, ug/L	NF	NF
Cu, ug/L	NF	NF

NF = Not Found Limit of Detection for all metals = 10 ug/L

WESTON

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

RFW SAMPLE NO.	SAMPLE DESCRIPTION	PHENOL, mg/L
8406-398-0460	RFW 1	NF
8406-398-0470	RFW 1A	0.043
8406-398-0480	RFW 1B	NF
8406-398-0490	RFW 2	NF
8406-398-0500	BP-2	NF
8406-398-0510	RFW 4	NF
8406-398-0520	RFW 3	NF
8406-398-0530	BP-12	0.23
8406-398-0540	BP-7	0.035
8406-398-0550	Lab blank	NF
8406-398-0630	RFW 3 Duplicate	NF

NF = Not Found Limit of Detection for Phenol = 0.005 mg/L

WESTON

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

RFW SAMPLE NO	SAMPLE DESCRIPTION	OIL/GREASE, mg/L
8406-398-0360	RFW 1	*
8406-398-0370	RFW 1A	NF
8406-398-0380	RFW 1B	NF
8406-398-0390	RFW 2	0.15
8406-398-0400	BP-2	1.56
8406-398-0410	RFW 4	0.27
8406-398-0420	RFW 3	0.66
8406-398-0430	BP-12	2.22
8406-398-0440	BP-7	3.45
8406-398-0450	Lab Blank	NF
8406-398-0610	RFW 3 Duplicate	**

NF = Not Found

Limit of Detection for Oil/Grease = 0.01 mg/L

* Sample Not Found

** Not enough sample

WESTON

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO.	SAMPLE DESCRIPTION	Hg, ug/L
8406-398-0010	RFW 1	*
8406-398-0020	RFW 1A	NF
8406-398-0030	RFW 1B	0.56
8406-398-0040	RFW 2	2.86
8406-398-0050	BP-2	NF
8406-398-0060	RFW-4	1.68
8406-398-0070	RFW-3	NF
8406-398-0150	BP-12	*
8406-398-0160	BP-7	*
8406-398-0180	RFW 1B	*

NF = Not Found Limit of Detection for Hg = 0.5 ug/L

* Sample Lost

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0310

SAMPLE DESCRIPTION: SW-1

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration ug/L X
mg/L
Other

Acrolein	NF	Methylene Chloride	1 < x < 10
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	23
Bis (chloromethyl) Ether	NF	Toluene	1 < x < 10
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0260

SAMPLE DESCRIPTION: SW-2

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X
mg/L
Other

Acrolein	NF	Methylene Chloride	$1 < x < 10$
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	$1 < x < 10$
Bis (chloromethyl) Ether	NF	Toluene	$1 < x < 10$
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	$1 < x < 10$		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0270

SAMPLE DESCRIPTION: SW-3

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X

mg/L

Other

Acrolein	NF	Methylene Chloride	1 < x < 10
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	1 < x < 10
Bis (chloromethyl) Ether	NF	Toluene	1 < x < 10
Bromoform	NF	1,2 Trans Dichloroethylene	1 < x < 10
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	1 < x < 10
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0280

SAMPLE DESCRIPTION: SW-4

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X
mg/L
Other

Acrolein	NF	Methylene Chloride	13
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	1 < x < 10
Benzene	NF	Tetrachloroethylene	110
Bis (chloromethyl) Ether	NF	Toluene	1 < x < 10
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	1 < x < 10
Chlorodibromomethane	NF	Trichloroethylene	1 < x < 10
Chloroethane	NF	Trichlorofluoromethane	1 < x < 10
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	1 < x < 10	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	1 < x < 10		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0300

SAMPLE DESCRIPTION: SW-5

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration ug/L X
mg/L
Other

Acrolein	NF	Methylene Chloride	11
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	51
Bis (chloromethyl) Ether	NF	Toluene	1 < x < 10
Bromoform	NF	1,2 Trans Dichloroethylene	33
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	59
Chloroethane	NF	Trichlorofluoromethane	1 < x < 10
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	1 < x < 10		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0320

SAMPLE DESCRIPTION: SW-6

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X

mg/L

Other

Acrolein	NF	Methylene Chloride	1 < x < 10
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	20
Bis (chloromethyl) Ether	NF	Toluene	NF
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0290

SAMPLE DESCRIPTION: SW-7

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X

mg/L

Other

Acrolein	NF	Methylene Chloride	15
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	1 < x < 10
Benzene	NF	Tetrachloroethylene	65
Bis (chloromethyl) Ether	NF	Toluene	1 < x < 10
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	1 < x < 10
Chlorodibromomethane	NF	Trichloroethylene	1 < x < 10
Chloroethane	NF	Trichlorofluoromethane	1 < x < 10
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	1 < x < 10		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropene	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE RECEIVED: 27 June 1984

RFW SAMPLE NO: 8406-398-0190

SAMPLE DESCRIPTION: RFW 1

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X

mg/L

Other

Acrolein	NF	Methylene Chloride	11
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	NF
Bis (chloromethyl) Ether	NF	Toluene	NF
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	11	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE RECEIVED: 27 June 1984

RFW SAMPLE NO: 8406-398-0200

SAMPLE DESCRIPTION: RFW 1A

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X

mg/L

Other

Acrolein	NF	Methylene Chloride	1 < x < 10
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	NF
Bis (chloromethyl) Ether	NF	Toluene	NF
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	1 < x < 10	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE RECEIVED: 27 June 1984

RFW SAMPLE NO: 8406-398-0220

SAMPLE DESCRIPTION: RFW 1B

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X

mg/L

Other

Acrolein	NF	Methylene Chloride	1 < x < 10
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	NF
Bis (chloromethyl) Ether	NF	Toluene	1 < x < 10
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0220

SAMPLE DESCRIPTION: RFW 2

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X

mg/L

Other

Acrolein	NF	Methylene Chloride	12
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	NF
Bis (chloromethyl) Ether	NF	Toluene	NF
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	1 < x < 10
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	1 < x < 10	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0250

SAMPLE DESCRIPTION: RFW 3

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X
mg/L
Other

Acrolein	NF	Methylene Chloride	$1 < x < 10$
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	$1 < x < 10$
Bis (chloromethyl) Ether	NF	Toluene	$1 < x < 10$
Bromoform	NF	1,2 Trans Dichloroethylene	66
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	15
Chlorodibromomethane	NF	Trichloroethylene	$1 < x < 10$
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	$1 < x < 10$		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0240

SAMPLE DESCRIPTION: RFW 4

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X
mg/L
Other

Acrolein	NF	Methylene Chloride	1< x <10
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	NF
Bis (chloromethyl) Ether	NF	Toluene	1< x <10
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	1< x <10	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	1< x <10		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0230

SAMPLE DESCRIPTION: BP-2

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X

mg/L

Other

Acrolein	NF	Methylene Chloride	15
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	NF	Tetrachloroethylene	NF
Bis (chloromethyl) Ether	NF	Toluene	NF
Bromoform	NF	1,2 Trans Dichloroethylene	NF
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	1 < x < 10
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	NF	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	NF		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	NF		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0340

SAMPLE DESCRIPTION: BP-7

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X
mg/L
Other

Acrolein	NF	Methylene Chloride	98
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	250	Tetrachloroethylene	42
Bis (chloromethyl) Ether	NF	Toluene	620
Bromoform	NF	1,2 Trans Dichloroethylene	3700
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	12
Chloroethane	$1 < x < 10$	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	$1 < x < 10$
Chloroform	$1 < x < 10$	Other	
Dichlorobromomethane	NF	Limit of Detection = 10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	$1 < x < 10$		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	$1 < x < 10$		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	210		
Methyl Bromide	NF		
Methyl Chloride	NF		

DATA SUMMARY FOR: BURLINGTON AIR NATIONAL GUARD

DATE: 27 June 1984

RFW SAMPLE NO: 8406-398-0330

SAMPLE DESCRIPTION: BP-12

GC/MS FRACTION

VOLATILE COMPOUNDS

Units of Concentration µg/L X
mg/L
Other

Acrolein	NF	Methylene Chloride	1 < x < 10
Acrylonitrile	NF	1,1,2,2 Tetrachloroethane	NF
Benzene	150	Tetrachloroethylene	1 < x < 10
Bis (chloromethyl) Ether	NF	Toluene	280
Bromoform	NF	1,2 Trans Dichloroethylene	440
Carbon Tetrachloride	NF	1,1,2 Trichloroethane	NF
Chlorobenzene	NF	1,1,1 Trichloroethane	NF
Chlorodibromomethane	NF	Trichloroethylene	NF
Chloroethane	1 < x < 10	Trichlorofluoromethane	NF
2-Chloroethylvinyl Ether	NF	Vinyl Chloride	NF
Chloroform	NF	Other	
Dichlorobromomethane	NF	Limit of Detection =10 ug/L	
Dichlorodifluoromethane	NF		
1,1 Dichloroethane	1 < x < 10		
1,2 Dichloroethane	NF		
1,1 Dichloroethylene	NF		
1,2 Dichloropropane	NF		
1,2 Dichloropropylene	NF		
Ethylbenzene	96		
Methyl Bromide	NF		
Methyl Chloride	NF		

WESTON

QA/QC REPORT
FOR LABORATORY ANALYSES
PERFORMED ON SAMPLES FROM
BURLINGTON AIR NATIONAL GUARD BASE

SAMPLES RECEIVED 27 JUNE 1984

WESTON

METALS ANALYSES

RFW NUMBER	ANALYSES
8406-398-0090	Cd,Pb,Zn,Cr,Cu
-0100	"
-0110	"
-0120	"
-0130	"
-0140	"
-0150	"
-0160	Cd,Pb,Zn,Cr,Cu,Sb,As,Be,Ni,Se,Ag,Tl
-0170 (LAB BLANK)	"
-0180	"
-0010	"
-0020	Cd,Pb,Zn,Cr,Cu,Sb,As,Be,Ni,Se,Ag,Tl,Hg
-0030	"
-0040	"
-0050	"
-0060	"
-0070	"

DATE RECEIVED: 27 June 1984

DATE ANALYZED: See Attached Sheet

METHOD OF ANALYSIS: See Attached Sheet (except Hg : 245.1)

DETECTION LIMIT: 10 µg/L except Hg 0.5 µg/L

LAB BLANK, LAB DUPLICATE, SPIKE ANALYSES: See Attached Sheet

QUALITY CONTROL DATE
BURLINGTON AIR NATIONAL GUARD BASE

R.F.W. NO.	PARAMETERS	REPLICATE 1st	REPLICATE 2nd	METHOD OF ANALYSIS	DATE OF ANALYSIS
8406-398/ Lab Blank	Zn	0 µg/L	-	M289.2	26 July 1984
8406-398-0040	Zn	83 µg/L	76 µg/L	M289.2	25 July 1984
8406-398/ Lab Blank	Tl	0 µg/L	-	M279.2	25 July 1984
8406-398/ Lab Blank	Ni	0 µg/L	-	M249.2	26 July 1984
-	Be	-	-	M210.2	25 July 1984
8406-398/ Lab Blank	Sb	0 µg/L	-	M204.2	25 July 1984
8406-398/ Lab Blank	Pb	0 µg/L	-	M239.2	23 July 1984
8406-398/ Lab Blank	Cd	0 µg/L	-	M213.2	23 July 1984
8406-398/ Lab Blank	Cu	0 µg/L	-	M220.2	23 July 1984
-	Ag	-	-	M272.2	20 July 1984
-	Cr	-	-	M218.2	20 July 1984
8406-398/ Lab Blank	Se	0 µg/L	-	M270.2	10 July 1984
8406-398/Spike Blank Spike	Se	127% Recovery	-	M270.2	10 July 1984
8406-398/ Lab Blank	As	0 µg/L	-	M206.2	10 July 1984
8406-398/Spike Blank Spike	As	99% Recovery	-	M206.2	10 July 1984
8406-398-0010 Dup	Hg	1.20 µg/L	1.32 µg/L	245.1	-

WESTON

PHENOL ANALYSIS

RFW NUMBER: 8406-398-0460 through 8406-398-0550 and 8406-398-0630

DATE RECEIVED: 27 June 1984
DATE ANALYZED: 3 July 1984
METHOD OF ANALYSIS: 420.1
DETECTION LIMIT: 0.005 mg/L

LAB BLANK, DUPLICATE ANALYSIS
LAB BLANK: N.F.
8406-398-0520 DUPLICATE: N.F.

AD-A197 435 INSTALLATION RESTORATION PROGRAM PHASE 2 CONFIRMATION/QUANTIFICATION STAGE 1(U) WESTON (ROY F) INC WEST CHESTER PA 28 MAR 86 F33615-80-D-4006 3/3

UNCLASSIFIED F/G 24/4 NL

[redacted]

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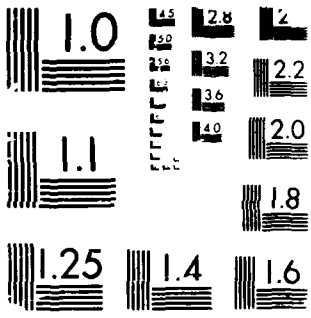


MICROCOPY RESOLUTION TEST CHAR

WESTON

OIL AND GREASE ANALYSIS

RFW NUMBER: 8406-398-0360 through 8406-398-0450 and 8406-398-0610

DATE RECEIVED: 27 June 1984

DATE ANALYZED: 5 July 1984

METHOD OF ANALYSIS: Modification of EPA Method 413.2

DETECTION LIMIT: 0.01 mg/L

LAB BLANK, DUPLICATE ANALYSIS

LAB BLANK: N.F.

WESTON

VOA ANALYSIS

RFW NUMBER: 8406-398-0190 through 8406-398-0340

DATE RECEIVED: 27 June 1984

DATE ANALYZED: 23 July 1984 through 28 July 1984

METHOD OF ANALYSIS: EPA Method 624

DETECTION LIMIT: 10 µg/L for all compounds

LAB BLANK, DUPLICATE/SPIKE/MATRIX SPIKE ANALYSIS

INSTRUMENT BLANK: <10 µg/L

RAI

Resource Analysts, Incorporated
Box 4778 Hampton, NH 03842
(603) 926-7777

September 25, 1984

Mr. Richard Kraybill
Roy F. Weston, Inc.
Weston Way
West Chester, PA 19380

Dear Mr. Kraybill:

Please accept this letter in explanation of the incompleteness of data reported under our laboratory number 3725.

Sample RFW-1 was logged into the laboratory for analysis of petroleum hydrocarbons as per EPA 600/4-79-020 Method 413.1. During analysis glassware failure resulted in the contamination of the fluorocarbon extract of this sample. As a result no final datum could be produced. Samples from the same field point were evaluated and rejected as unsuitable for use in this determination.

We regret this accident, and are keenly aware of the inconvenience of both a lost data point and field effort. Please be assured of our efforts to minimize the likelihood of incidents of this kind in the future.

Sincerely,
RESOURCE ANALYSTS, INC.

Russell D. Foster, Jr.
Technical Director

David N. Pease
President

RDF:aeh

RAI

Resource Analysts, Incorporated
Box 4778 Hampton, NH 03842
(603) 926-7777

TO:

Mr. Glen Smart
Roy F. Weston, Inc.
2 Chennell Drive
Concord, NH 03301

PO # Burlington Air National Guard
Date Received: 9-4-84

Lab Number: 3724/3725

Date Reported: 9-18-84

IDENTIFICATION

Water samples from Burlington, VT Air National Guard Station

PARAMETER	SAMPLE DESIGNATION

please see attachments

Switalski/Van Kouwenberg/Clarke/Moore
ANALYST

DIRECTOR

Lab Number: 3724-1
Sample Designation: RFW-1
Date: 9-5-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	Trace	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-2
Sample Designation: RFW-2
Date: 9-6-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	10	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	5	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	Trace	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	Trace	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-3
Sample Designation: RFW-3
Date: 9-6-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	25
2V.	VINYL CHLORIDE	BDL	25
3V.	CHLOROETHANE	BDL	25
4V.	BROMOMETHANE	BDL	25
5V.	ACROLEIN	BDL	250
6V.	ACRYLONITRILE	BDL	250
7V.	METHYLENE CHLORIDE	Trace	25
8V.	TRICHLOROFLUOROMETHANE	BDL	25
9V.	1,1-DICHLOROETHYLENE	BDL	25
10V.	1,1-DICHLOROETHANE	Trace	25
11V.	1,2-trans-DICHLOROETHYLENE	170	25
12V.	CHLOROFORM	BDL	25
13V.	1,2-DICHLOROETHANE	BDL	25
14V.	1,1,1-TRICHLOROETHANE	50	25
15V.	CARBON TETRACHLORIDE	BDL	25
16V.	BROMODICHLOROMETHANE	BDL	25
17V.	1,2-DICHLOROPROPANE	BDL	25
18V.	1,3-trans-DICHLOROPROPENE	BDL	25
19V.	TRICHLOROETHYLENE	BDL	25
20V.	BENZENE	Trace	25
21V.	1,3-cis-DICHLOROPROPENE	BDL	25
22V.	1,1,2-TRICHLOROETHANE	BDL	25
23V.	DIBROMOCHLOROMETHANE	BDL	25
24V.	BROMOFORM	BDL	25
25V.	TETRACHLOROETHYLENE	BDL	25
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	25
27V.	TOLUENE	BDL	25
28V.	CHLOROBENZENE	BDL	25
29V.	ETHYLBENZENE	BDL	25
30V.	2-CHLOROETHYL VINYL ETHER	BDL	25
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-4
Sample Designation: RFW-4
Date: 9-6-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	Trace	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-5
Sample Designation: BP-1
Date: 9-6-74

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-6
Sample Designation: BP-2
Date: 9-11-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	7	5
20V.	BENZENE	Trace	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	Trace	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	Trace	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-7
Sample Designation: BP-7
Date: 9-11-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	50
2V.	VINYL CHLORIDE	BDL	50
3V.	CHLOROETHANE	BDL	50
4V.	BROMOMETHANE	BDL	50
5V.	ACROLEIN	BDL	500
6V.	ACRYLONITRILE	BDL	500
7V.	METHYLENE CHLORIDE	BDL	50
8V.	TRICHLOROFLUOROMETHANE	BDL	50
9V.	1,1-DICHLOROETHYLENE	BDL	50
10V.	1,1-DICHLOROETHANE	BDL	50
11V.	1,2-trans-DICHLOROETHYLENE	2700	50
12V.	CHLOROFORM	BDL	50
13V.	1,2-DICHLOROETHANE	BDL	50
14V.	1,1,1-TRICHLOROETHANE	BDL	50
15V.	CARBON TETRACHLORIDE	BDL	50
16V.	BROMODICHLOROMETHANE	BDL	50
17V.	1,2-DICHLOROPROPANE	BDL	50
18V.	1,3-trans-DICHLOROPROPENE	BDL	50
19V.	TRICHLOROETHYLENE	BDL	50
20V.	BENZENE	100	50
21V.	1,3-cis-DICHLOROPROPENE	BDL	50
22V.	1,1,2-TRICHLOROETHANE	BDL	50
23V.	DIBROMOCHLOROMETHANE	BDL	50
24V.	BROMOFORM	BDL	50
25V.	TETRACHLOROETHYLENE	BDL	50
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	50
27V.	TOLUENE	300	50
28V.	CHLOROBENZENE	BDL	50
29V.	ETHYLBENZENE	80	50
30V.	2-CHLOROETHYL VINYL ETHER	BDL	50
	MEK	BDL	500
	MIBK	BDL	500
	XYLENES	400	50

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-8
Sample Designation: BP-12
Date: 9-11-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	40	5
3V.	CHLOROETHANE	8	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	8	5
10V.	1,1-DICHLOROETHANE	1200	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	130	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	450	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	50	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	50	50
	MIBK	20	50
	XYLENES	690	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-9
Sample Designation: SW-2
Date: 9-13-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-10
Sample Designation: SW-2A
Date: 9-13-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-11
Sample Designation: SW-3
Date: 9-13-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-12
Sample Designation: SW-4
Date: 9-13-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-13
Sample Designation: SW-5
Date: 9-13-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-14
Sample Designation: SW-6
Date: 9-13-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-15
Sample Designation: SW-7
Date: 9-13-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-16
Sample Designation: DI Water Balnk
Date: 9-13-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3724-17
Sample Designation: RFW-1A
Date: 9-13-84

	VOLATILE ORGANICS	CONCENTRATION (UG/L)	DETECTION LIMIT (UG/L)
1V.	CHLOROMETHANE	BDL	5
2V.	VINYL CHLORIDE	BDL	5
3V.	CHLOROETHANE	BDL	5
4V.	BROMOMETHANE	BDL	5
5V.	ACROLEIN	BDL	50
6V.	ACRYLONITRILE	BDL	50
7V.	METHYLENE CHLORIDE	BDL	5
8V.	TRICHLOROFLUOROMETHANE	BDL	5
9V.	1,1-DICHLOROETHYLENE	BDL	5
10V.	1,1-DICHLOROETHANE	BDL	5
11V.	1,2-trans-DICHLOROETHYLENE	BDL	5
12V.	CHLOROFORM	BDL	5
13V.	1,2-DICHLOROETHANE	BDL	5
14V.	1,1,1-TRICHLOROETHANE	BDL	5
15V.	CARBON TETRACHLORIDE	BDL	5
16V.	BROMODICHLOROMETHANE	BDL	5
17V.	1,2-DICHLOROPROPANE	BDL	5
18V.	1,3-trans-DICHLOROPROPENE	BDL	5
19V.	TRICHLOROETHYLENE	BDL	5
20V.	BENZENE	BDL	5
21V.	1,3-cis-DICHLOROPROPENE	BDL	5
22V.	1,1,2-TRICHLOROETHANE	BDL	5
23V.	DIBROMOCHLOROMETHANE	BDL	5
24V.	BROMOFORM	BDL	5
25V.	TETRACHLOROETHYLENE	BDL	5
26V.	1,1,2,2-TETRACHLOROETHANE	BDL	5
27V.	TOLUENE	BDL	5
28V.	CHLOROBENZENE	BDL	5
29V.	ETHYLBENZENE	BDL	5
30V.	2-CHLOROETHYL VINYL ETHER	BDL	5
	MEK	BDL	50
	MIBK	BDL	50
	XYLENES	BDL	5

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: EPA 600/4-79-020 METHOD 624

Resource Analysts, Incorporated

Lab Number: 3725
Roy F. Weston
Burlington Air National Guard

PARAMETER	METHOD	REF	SW-2	SW-2A	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	Blank
Silver, total (mg/L)	7760	1.	<0.008	<0.008	<0.008	<0.004	<0.008	<0.008	<0.008	<0.008	<0.008
Arsenic, total (mg/L)	7060	1.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Beryllium, total (mg/L)	210.1	2.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Cadmium, total (mg/L)	7130	1.	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Chromium, total (mg/L)	7190	1.	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper, total (mg/L)	220.1	2.	<0.02	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury, total (mg/L)	7470	1.	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Nickel, total (mg/L)	7520	1.	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Lead, total (mg/L)	7420	1.	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Antimony, total (mg/L)	7040	1.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium, total (mg/L)	7740	1.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium, total (mg/L)	279.1	2.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc, total (mg/L)	289.1	2.	0.016	0.026	0.032	0.027	0.026	0.016	0.022	0.033	0.005

1. SW 846, 2nd Edition
2. EPA 600/4-79-020

Lab Number: 3725
Roy F. Weston
Burlington Air National Guard
18 September 1984

Sample Designation	Mercury, total (mg/L)
RFW-1	<0.0004
RFW-1A	<0.0004
RFW-2	<0.0004
RFW-3	<0.0004
RFW-4	<0.0004
BP-1	<0.0004
BP-2	<0.0004
BP-7	<0.0004
BP-12	<0.0004

The above analyses were performed as per SW 846, 2nd Edition Method 7470

Lab Number: 3725
Roy F. Weston, Inc.
Burlington Air National Guard

SAMPLE DESIGNATION	OIL AND GREASE (mg/L)	PHENOLS, TOTAL (ug/L)
SW2	0.1	<10
SW2A	<0.1	<10
SW3	<0.1	<10
SW4	<0.1	30
SW5	<0.1	<10
SW6	0.2	<10
SW7	0.1	36
SW8	<0.1	<10
DI Water Balnk	<0.1	<10
RFW 1	sample lost	

RAI

Resource Analysts, Incorporated
Box 4778 Hampton, NH 03842
(603) 926-7777

31 October 1985

Ms. Alison Dunn
Geosciences Department
Roy F. Weston, Inc.
1 Weston Way
West Chester, PA 19380

Dear Alison:

Enclosed please find a Quality Control/Quality Assurance retrospective review of our job numbers 3724 and 3725. Method QC documentation for oil and grease, total phenols, and volatile organics have been compiled for your review. Additional data are available on request.

If you should have any questions, please do not hesitate to give me a call.

Sincerely,
RESOURCE ANALYSTS, INC.

Russell D. Foster, Jr.
Technical Director

Oil and Grease Quality Control Summary
Laboratory Number: 3725

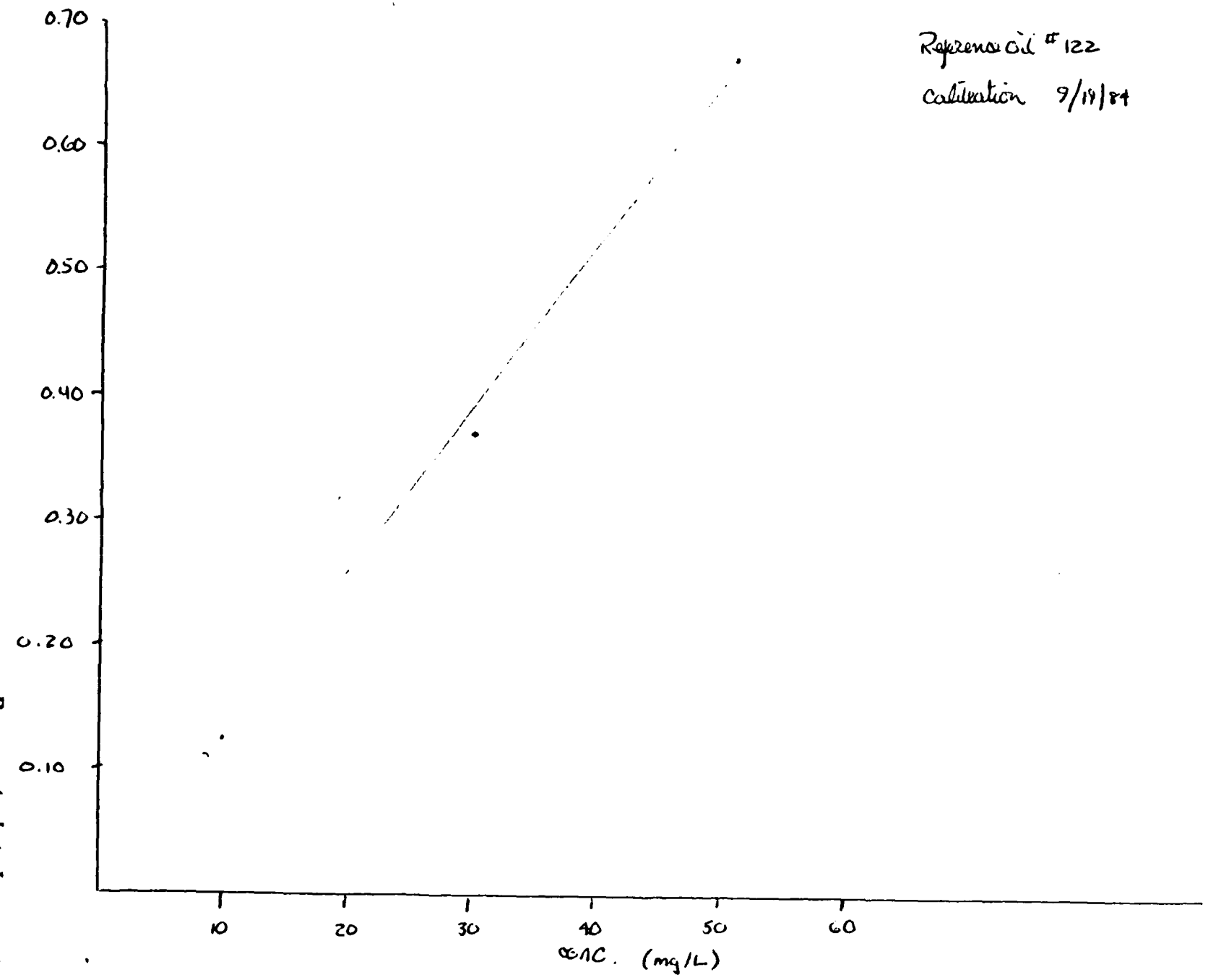
1) Precision

Sample	Rep 1	Rep 2	Range
SW-8 (3725-26)	<0.1mg/L		
SW-8 (3725-35)		<0.1mg/L	0

2) Accuracy

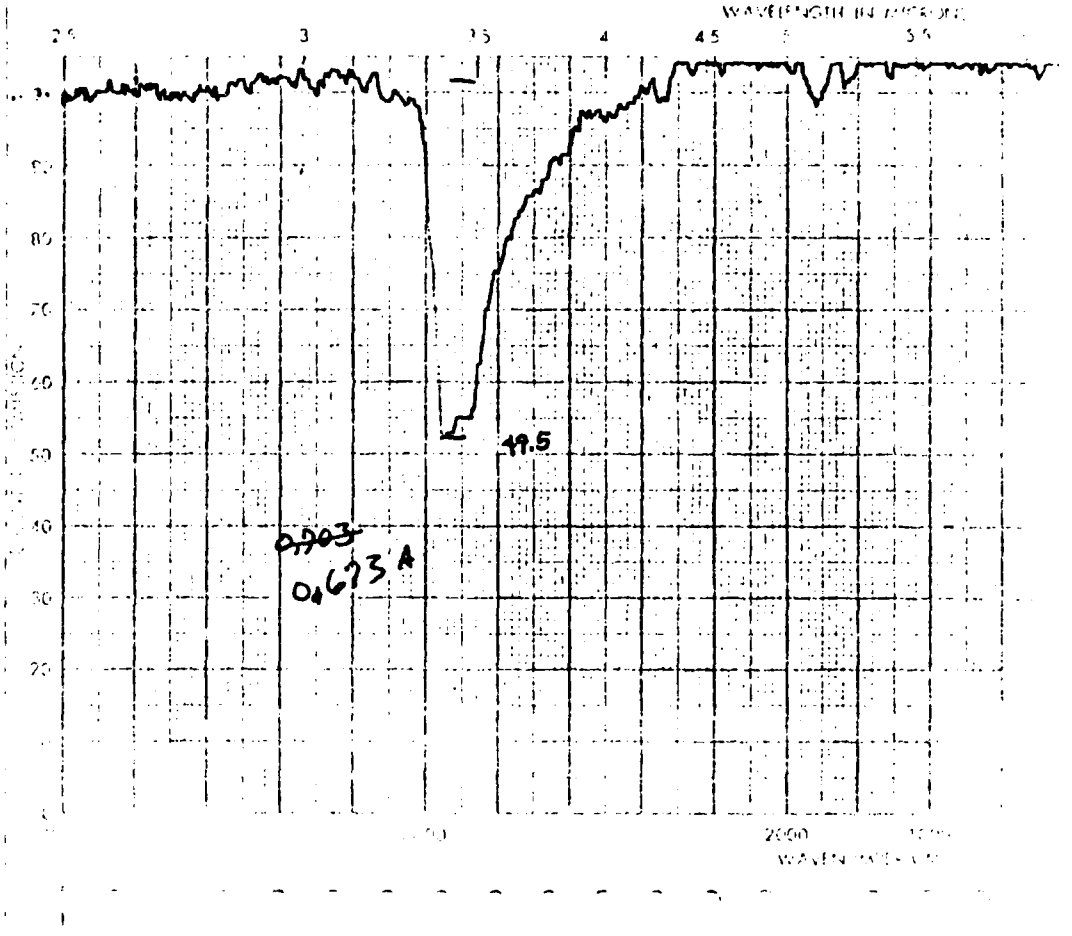
Sample	Original Conc. (mg/L)	Spike Level (mg/L)	Conc. Found (mg/L)	% Recovery (%)
DI Water	<0.1	50.0	44.7	89.4

Resource Analysts, Incorporated


Reference oil # 122
Calibration 9/19/84
0.70
0.60
0.50
0.40
0.30
0.20
0.10
ABS
10
20
30
40
50
60
CONC. (mg/L)

SPECTRUM NO. 3
DATE 9/17/84
50.93 mg/L
Oil & Grease Reference
from # 122
ANALYST
SIGNATURE

FILE 500
SAMPLE
CONCENTRATION
PHASE
COMMENTS



SPECTRUM NO. R-4

DATE 9/19/84

REFERENCE OIL

#122

SAMPLE TYPE

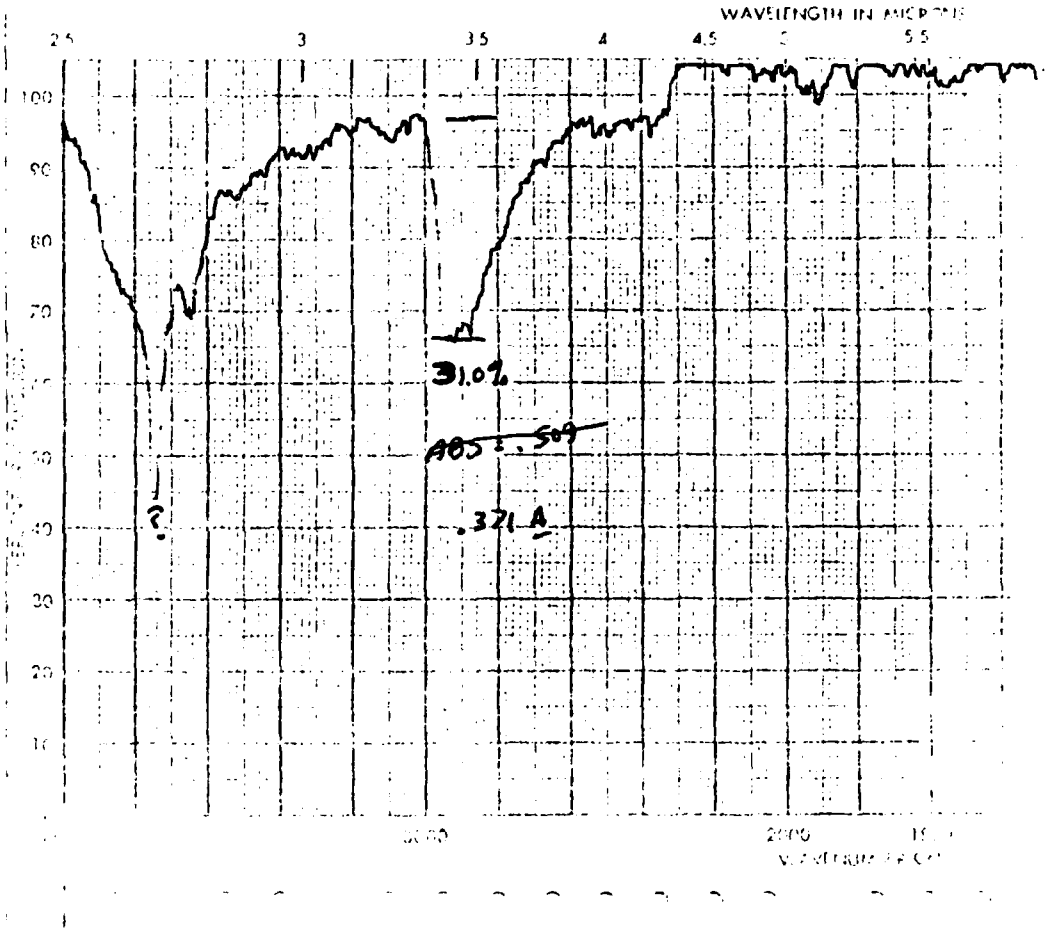
CELL 50 Quartz

SOLVENT Freon

CONCENTRATION 30.3 mg/L

DATE

COMMENTS



Resource Analysis, Incorporated

SPECTRUM NO. 2

9/17/84

10.19 mg/L

OIL & GREASE REFERENCE

OIL FROM #122

SOURCE

STRUCTURE

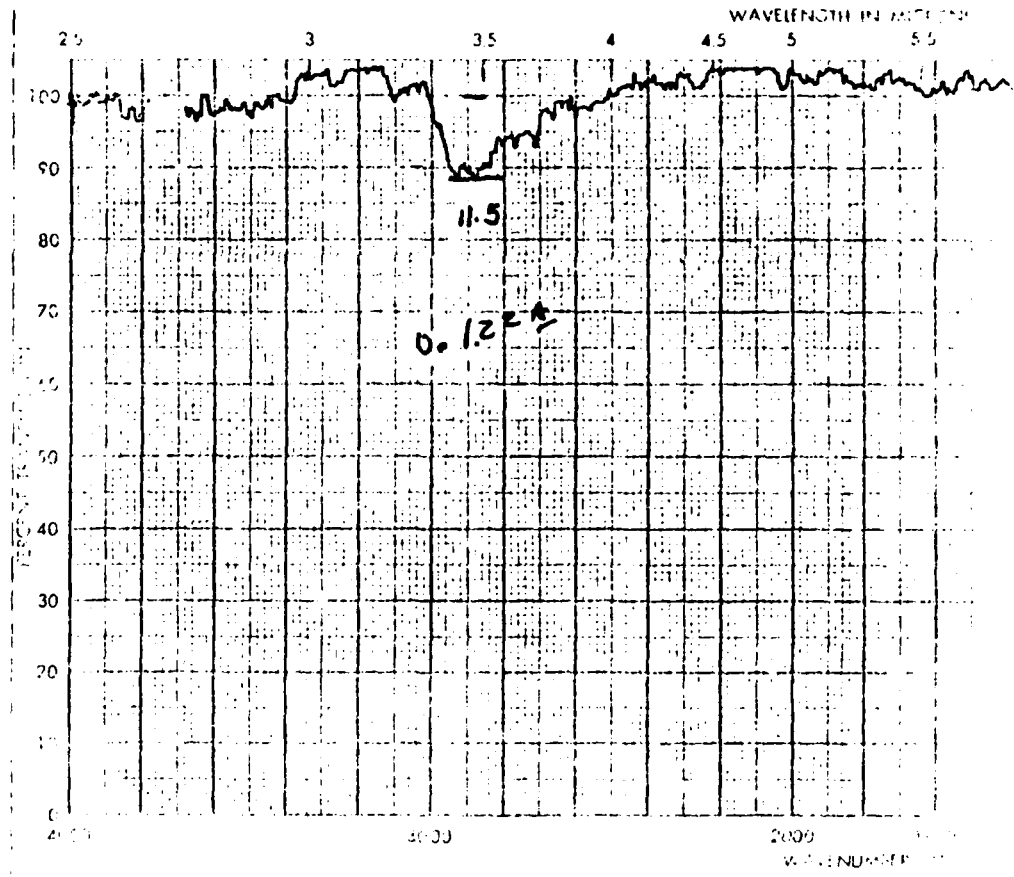
DATE

SOLVENT

CONCENTRATION

PHASE

COMMENTS



Resource Analysts, Incorporated

SPECTRUM NO. 5

DATE 7/17/84

Reference OD

SAMPLE #122

STRUCTURE

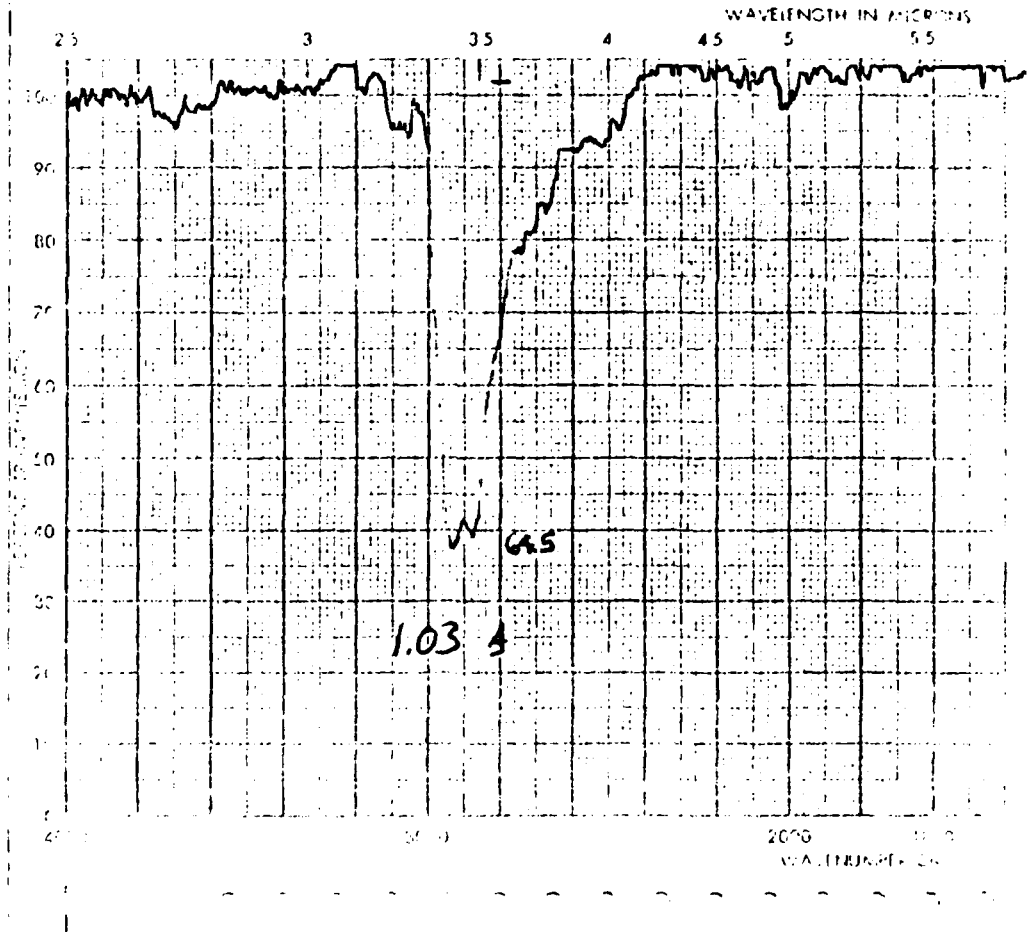
50 Quartz

SOLVENT Freon

CONCENTRATION 101 mg/L

FILM

COMMENTS



Resource Analysts, Incorporated

O & G QUANTITATION FORM - IR DETERMINATION

EPA METHOD 413.2 (liquids)

	LAB #	R	Cv	D	total mg	Sw	mg/L O&G	Blank Corrected (✓)
	3725-19	4	0.025	1	0.1	0.750	0.1	0.1 mg/L
	3725-20	<4	0.025	1	<0.1	0.660	<.1	<0.1 mg/L
	3725-21	<4	0.025	1	<0.1	0.670	<.1	<0.1 mg/L
	3725-22	<4	0.025	1	<0.1	0.770	<.1	<0.1 mg/L
	3725-23	<4	0.025	1	<0.1	0.72	<.1	<0.1 mg/L
	3725-24	6	0.025	1	0.15	0.765	0.2	0.2 mg/L
	3725-25	4	0.025	1	0.1	0.685	0.1	0.1 mg/L
*	3725-26	<4	0.025	1	<0.1	0.715	<0.1	<0.1 mg/L
	3725-27	<4	0.025	1	<0.1	0.610	<0.1	<0.1 mg/L
*	3725-35	<4	0.025	1	<0.1	0.935	<0.1	<0.1 mg/L
	3725-36	sample lost						
	3725-37	<4	0.025	1	<0.1	0.876	<0.1	<0.1 mg/L
	BLANK	<4	0.025	1	<0.1	1.00	<0.1	<0.1 mg/L
	SPIKE	71.5	.025	25	44.7	1.00	44.7	44.7 mg/L

$$mg/L = \frac{R \times D \times Cv}{Sv}$$

R = Oil & Grease mg/L from daily calibration plot

Cv = Volume of concentrated sample (in liters)

D = Dilution factor

Sw = Original sample weight (in grams)

Resource Analysts, Incorporated

Oil and Grease

Lab # 3725
Client Weston
Sample #'s _____

Method 413.2 with conc. of extract
QC: BLANK — included SPIKE 50 mg/L Reference Oil Solution #122

Sample #	Sample vol.	Final vol. Oil+Grease (Cv) ↓	Final vol.	Prepped by:	Date	Sample type	Comments
3725-35	0.935		0.025		9/18	L	
3725-36	0.940		0.025	LAD	9/18	L	
3725-37	0.87		lost	LAD	9/13	L	glassware broke
Blank	1.00		"	LAD	9/19	L	
SPIKE	1.00		"	LAD	9/19	L	
3725-19	0.75		"	LAD	9/19	L	
3725-20	0.660		"	LAD	9/19	L	
3725-21	0.670		"	LAD	9/19	L	
3725-22	0.770		"	LAD	9/19	L	
3725-23	0.720		"	LAD	9/19	L	
3725-24	0.765		"	LAD	9/19	L	
3725-25	0.685		"	LAD	9/19	L	
3725-26	0.715		"	LAD	9/19	L	
3725-27	0.610		"	LAD	9/19	L	

notes:

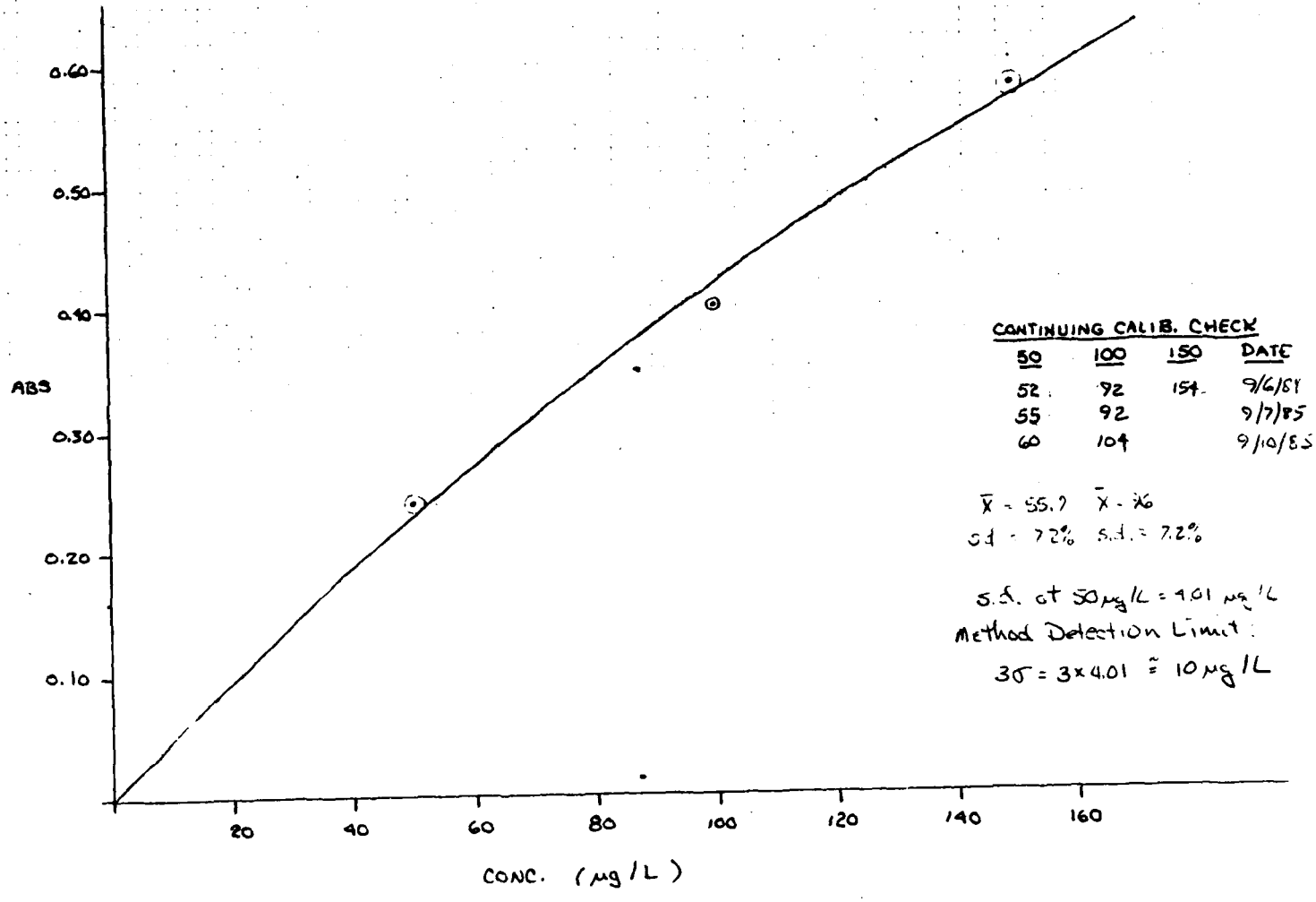
Resource Analysts, Incorporated

transf cred to: RDF date 9/19/94 / _____

Total Phenols Quality Control Summary
Laboratory Number: 3725

.) Precision & Accuracy	Rep 1	Rep 2	Rep 3	Average	Relative Stad.Dev.	Average (%) Recovery
Sample						
50ug/L check sample	52	55	60	55.7	7.2%	114%
100ug/L check sample	92	92	104	96	7.2%	114%

INITIAL CALIBRATION
TOTAL PHENOLS, 200mL extraction.
9/6/84



CONTINUING CALIB. CHECK

50	100	150	DATE
52	92	154	9/6/85
55	92		9/7/85
60	104		9/10/85

$\bar{X}$ = 55.7 $\bar{X}$ = 86
σ = 7.2% S.D. = 7.2%

S.D. at 50µg/L = 4.01 µg/L
Method Detection Limit:
3σ = 3×4.01 ≈ 10µg/L

9/6/84

(74)

Total Phenols

SAMPLE	VOL.	VOL. DISTILLATE	VOL. DIST. EXTRACTED	BLANK CORRECTED ABSORBANCE	CONCENTRATION
3725-20	200	202	170	<0.05	< 10 µg/L
3725-26	200	202	170	<0.05	< 10 µg/L
Blank	200	—	200	0.00	
50 µg/L SPIKE	200	—	200	0.24	52 µg/L
100 µg/L Spike	200	—	200	0.40	92 µg/L
150 µg/L Spike	200	—	200	0.58	154 µg/L

By: REM (EDF)

Total Phenols 9/6/84 (75)

Sample	sample volume	distillate volume	vol. distillate extracted	Blank corrected Absorbance	concentration
3725-19	200mL	198	170	<0.05	<10 µg/L
3725-23	"	192	170	<0.05	<10 µg/L
3725-24	"	215	170	<0.05	<10 µg/L
3725-27	"	205	170	<0.05	<10 µg/L
Blank	"	200	200	0.00	0.00
100µg/L SPIKE	"	200	200	0.46	108µg/L

Laboratory pure water used for spikes and blank. By: RE/ (ROF)

TOTAL Phenols (cont'd) 9/7/84

3725-25	200mL	200	170	0.16	36µg/L
3725-21	200mL	204	170	<0.05	<10 µg/L
Blank	200 mL	—	200	0.00	
50µg/L SPIKE	200mL	—	200	0.26	55 µg/L
100µg/L SPIKE	200mL	—	200	0.40	92µg/L

Laboratory pure water used for spikes.
- Blank and spikes analyzed directly without distillation.

Example calculation: 3725-25

0.16 from calibration = 31 µg/L

$$31\ \mu g/L \times \frac{200}{170} \times \frac{200}{200} = 36\ \mu g/L$$

Resource Analysts, Incorporated

By: RE/ (ROF)

(81)

9/10/84 Total Phenols

Sample	Sample Volume	Distillate Volume	vol. Distillate extracted	Blank corrected Absorbance	concentration
3725-22 ~~3728-2~~	200mL	203	170	0.215	63µg/L
3728-2	200mL	230	170	0.13	30 µg/L
Blank	200mL	—	200	0.00	
50µg/L	200	—	200	0.27	60µg/L
100µg/L	200	—	200	0.43	104µg/L

By: REM

ROF

VOLATILE ORGANICS QUALITY CONTROL
SUMMARY

SURROGATE STANDARD RECOVERY DATA

9/6/84

SAMPLE	BCE	BCP	DCB	BFB
3724-1	119	102	92	
3724-2	98	100	103	99
3724-3	112	112	105	118
3724-4	91	94	91	96
3724-5	78	90	107	86

BCE	BROMOCHLOROETHANE
BCP	BROMOCHLOROPROPANE
DCB	DICHLOROBUTANE
BFB	BROMOFLUOROBENZENE

GC/MS TUNING AND MASS CALIBRATION

Bromofluorobenzene (BFB)

Case No. 3724 Contractor _____ Contract No. _____

Instrument ID _____ Date 9/6 Time AM

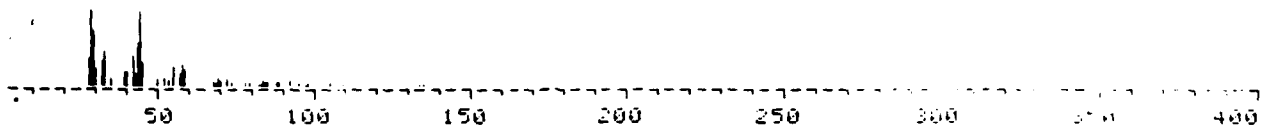
Lab ID _____ Data Release Authorized By: RE

m/e	ION ABUNDANCE CRITERIA	%RELATIVE ABUNDANCE
50	15.0 - 40.0% of the base peak	42.7
75	30.0 - 60.0% of the base peak	55.6
95	Base peak, 100% relative abundance	100
96	5.0 - 9.0% of the base peak	6.3
173	Less than 1.0% of the base peak	<1
174	Greater than 50.0% of the base peak	71.5
175	5.0 - 9.0% of mass 174	5.0 (6.7)[1]
176	Greater than 95.0%, but less than 101.0% of mass 174	70.7 (98.9)[1]
177	5.0 - 9.0% of mass 176	5.0 (7.1)[2]

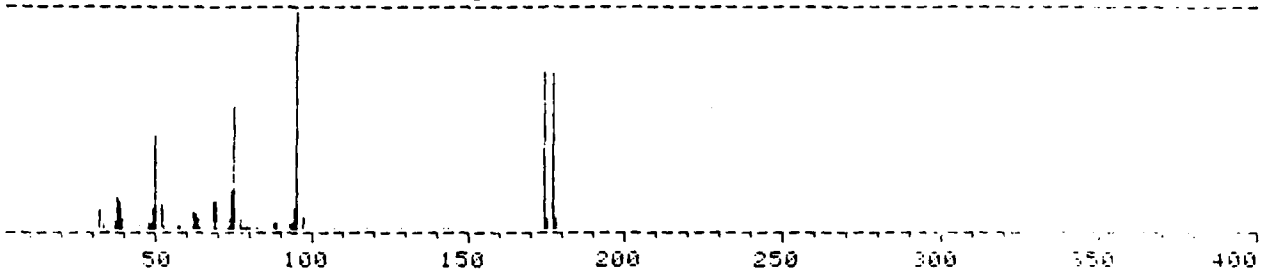
[1] Value in parenthesis is % mass 174.
[2] Value in parenthesis is % mass 176.

THIS PERFORMANCE TUNE APPLIES TO THE FOLLOWING SAMPLES, BLANKS AND STANDARDS.

SAMPLE ID	LAB ID	DATE OF ANALYSIS	TIME OF ANALYSIS
3724-1		9/6	
3724-2		"	
3724-3		"	
3724-4		"	
3724-5		"	



STRIPPED SPECTRUM 523.047 - 503.047 stored in 1.047
Sample 3729 Ret.Time= 29.26 Number of Peaks 67 File type = processed
Base Peak= 95.10 Base Peak Abundance= 239 Total Abundance= 1366



SPECTRA PLOT/TAB PROGRAM, (Rev 3/80)

** Spectrum # 1.047 ** Sample # 3729 Retention Time= 29.3 minutes
Scanned from 26 to 260 amu Number of Peaks Detected = 67
File type = linear
Base Peak = 95.10 Base Peak Abundance = 239 Total Abundance = 1366
Lower Abundance Cutoff Level = 0.0%

MASS	ABUNDANCE (%)	MASS	ABUNDANCE (%)	MASS	ABUNDANCE (%)
27.20	1.3	69.10	12.6	106.10	0.8
31.10	9.2	70.10	0.8	107.10	0.4
33.10	2.5	72.10	1.3	115.10	0.4
36.10	3.8	73.10	5.0	117.00	0.8
37.10	15.5	74.10	18.4	120.00	0.8
38.10	13.0	75.10	55.6	129.00	0.4
39.10	5.0	76.10	5.4	130.00	0.4
45.10	2.5	77.10	0.8	137.10	0.4
47.10	4.2	78.10	1.3	141.00	0.8
48.10	2.5	79.00	2.1	143.00	0.8
49.10	9.6	80.10	1.3	148.00	0.4
50.10	42.7	81.00	2.5	149.10	0.4
51.10	12.1	82.10	0.8	150.10	0.4
52.00	1.7	86.10	0.4	152.10	0.4
55.10	0.8	87.10	4.2	153.00	0.4
56.10	2.5	88.10	3.3	157.00	0.4
57.10	4.2	92.10	2.9	159.00	0.4
60.10	2.5	93.10	4.2	174.00	71.5
61.10	7.9	94.10	10.0	175.00	5.0
62.10	6.7	95.10	100.0	176.00	70.7
63.10	4.6	96.10	6.3	177.00	5.0
64.10	1.3	104.10	0.8	195.10	0.4
68.10	13.4				

Initial Calibration Data
Volatile HSL Compounds

Case No: _____ Instrument I D: 5972

Contractor: _____ Calibration Date: 9/4/85

Contract No: _____

Minimum $\overline{RF}$ for SPCC is 0.300 Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{100}	RF_{150}	RF_{200}	$\overline{RF}$	% RSD	CCC* SPCC**
Chloromethane						710		**
Bromomethane						814		
Vinyl Chloride						690		*
Chloroethane						1815		
Methylene Chloride						2308		
Acetone						1831		
Carbon Disulfide								
1, 1-Dichloroethene						4170		*
1, 1-Dichloroethane						8961		**
Trans-1, 2-Dichloroethene						3076		
Chloroform						2863		*
1, 2-Dichloroethane						791		
2-Butanone						1809		
1, 1, 1-Trichloroethane						5967		
Carbon Tetrachloride						4166		
Vinyl Acetate								
Bromodichloromethane						1697		
1, 2-Dichloropropane						363		*
Trans-1, 3-Dichloropropene						311		
Trichloroethene						4949		
Dibromochloromethane						951		
1, 1, 2-Trichloroethane						612		
Benzene						12942		
cis-1, 3-Dichloropropene						526		
2-Chloroethylvinylether						309		
Bromoform						131		**
2-Hexanone								
4-Methyl-2-Pentanone						1956		
Tetrachloroethene						4155		
1, 1, 2, 2-Tetrachloroethane						567		**
Toluene						14512		*
Chlorobenzene						10191		**
Ethylbenzene						16250		*
Styrene								
Total Xylenes						17182		

RF -Response Factor (subscript is the amount of ug/L)
$\overline{RF}$ -Average Response Factor
%RSD -Percent Relative Standard Deviation

CCC -Calibration Check Compounds (*)
SPCC -System Performance Check Compounds (**)

Form VI

Resource Analysts, Incorporated

SURROGATE STANDARD RECOVERY DATA

9/11/84

SAMPLE	BCE	BCP	DCB	BFB
3724-6	84	71	80	88
3724-7	113	133	144	129
3724-8	102	95	75	83

BCE	BROMOCHLOROETHANE
BCP	BROMOCHLOROPROPANE
DCB	DICHLOROBUTANE
BFB	BROMOFLUOROBENZENE

GC/MS TUNING AND MASS CALIBRATION

Bromofluorobenzene (BFB)

Case No. 3724 Contractor _____ Contract No. _____

Instrument ID 5992 Date 9/11/84 Time _____

Lab ID _____ Data Release Authorized By: EDS

m/e	ION ABUNDANCE CRITERIA	%RELATIVE ABUNDANCE	
50	15.0 - 40.0% of the base peak	26.4	
75	30.0 - 60.0% of the base peak	52.6	
95	Base peak, 100% relative abundance	100	
96	5.0 - 9.0% of the base peak	8.0	
173	Less than 1.0% of the base peak	< 1	
174	Greater than 50.0% of the base peak	76.3	
175	5.0 - 9.0% of mass 174	6.5	(8.5)[1]
176	Greater than 95.0%, but less than 101.0% of mass 174	74.2	(97.2)[1]
177	5.0 - 9.0% of mass 176	5.7	(7.7)[2]

[1]Value in parenthesis is % mass 174.
[2]Value in parenthesis is % mass 176.

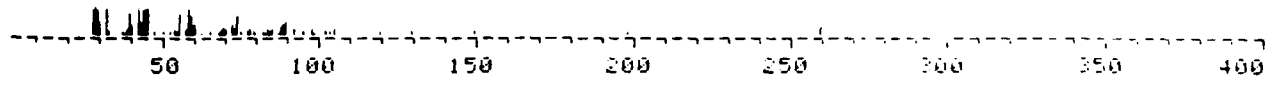
THIS PERFORMANCE TUNE APPLIES TO THE FOLLOWING SAMPLES, BLANKS AND STANDARDS.

SAMPLE ID	LAB ID	DATE OF ANALYSIS	TIME OF ANALYSIS
3724-6		9/11/84	
3724-7		"	
3724-8		"	
		"	
		"	

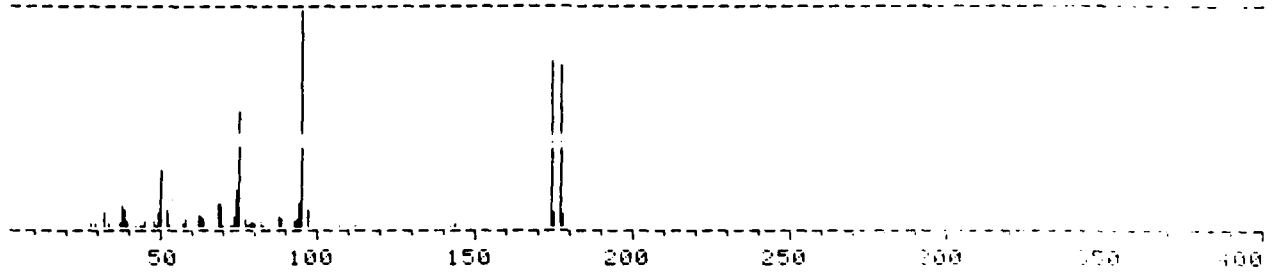
4/84

FORM V

Resource Analysts, Incorporated



STRIPPED SPECTRUM 515.020 - 495.020 stored in 1.020
Sample 3 Ret.Time= 28.88 Number of Peaks 76 File type = processed
Base Peak= 95.10 Base Peak Abundance= 489 Total Abundance= 2644



SPECTRA PLOT/TAB PROGRAM, [Rev 3/80]

** Spectrum # 1.020 ** Sample # 3 Retention Time = 28.9 minutes
Scanned from 26 to 260 amu Number of Peaks Detected = 76
File type = linear
Base Peak = 95.10 Base Peak Abundance = 489 Total Abundance = 2644
Lower Abundance Cutoff Level = 0.0%

MASS	ABUNDANCE (%)	MASS	ABUNDANCE (%)	MASS	ABUNDANCE (%)
27.05	2.5	61.05	5.5	89.10	0.2
29.05	1.6	62.05	5.1	92.10	3.1
30.05	0.4	63.05	4.3	93.10	4.5
31.05	7.2	67.05	0.4	94.10	11.2
32.05	0.4	68.05	11.2	95.10	100.0
33.05	1.6	69.05	10.8	96.10	8.0
36.05	1.6	70.05	0.6	97.10	0.2
37.05	9.6	71.05	0.6	98.10	0.4
38.05	8.2	72.05	0.8	101.00	0.2
39.05	3.3	73.05	4.9	104.00	1.2
41.05	1.0	74.10	16.6	104.90	0.4
42.05	0.4	75.10	52.6	106.00	1.2
43.05	1.0	76.10	4.1	111.20	1.4
44.05	1.0	77.10	0.6	115.10	1.2
45.05	3.5	78.00	1.6	117.10	1.4
47.05	3.3	79.00	3.3	119.00	0.6
48.05	1.2	80.00	1.8	128.00	1.2
49.05	6.5	81.00	3.1	129.10	0.2
50.05	26.4	82.10	0.8	141.00	1.4
51.05	7.8	83.10	0.2	143.00	1.6
52.15	1.4	84.10	0.4	174.05	76.3
55.05	0.4	85.10	0.4	175.05	6.5
56.05	2.0	86.10	0.2	176.05	74.2
57.05	4.1	87.00	5.3	177.05	5.7
59.05	0.2	88.10	4.5	259.20	0.2
60.05	1.2				

Initial Calibration Data
Volatile HSL Compounds

Case No: _____ Instrument I D: _____

Contractor: _____ Calibration Date: 9/11/84

Contract No: _____

Minimum $\overline{RF}$ for SPCC is 0.300 Maximum % RSD for CCC is 30%

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{100}	RF_{150}	RF_{200}	$\overline{RF}$	% RSD	CCC* SPCC**
Chloromethane								**
Bromomethane								
Vinyl Chloride						1979		*
Chloroethane						5333		
Methylene Chloride						5837		
Acetone								
Carbon Disulfide								
1, 1-Dichloroethene								*
1, 1-Dichloroethane								**
Trans-1, 2-Dichloroethene						11227		
Chloroform								*
1, 2-Dichloroethane								
2-Butanone						3257		
1, 1, 1-Trichloroethane								
Carbon Tetrachloride								
Vinyl Acetate								
Bromodichloromethane								
1, 2-Dichloropropane								*
Trans-1, 3-Dichloropropene								
Trichloroethene						1199.3		
Dibromochloromethane								
1, 1, 2-Trichloroethane								
Benzene						38629		
cis-1, 3-Dichloropropene								
2-Chloroethylvinylether								
Bromoform								**
2-Hexanone								
4-Methyl-2-Pentanone								
Tetrachloroethene								
1, 1, 2, 2-Tetrachloroethane								**
Toluene						4270		*
Chlorobenzene								**
Ethylbenzene						4962		*
Styrene								
Total Xylenes						63349		

RF -Response Factor (subscript is the amount of ug/L)
$\overline{RF}$ -Average Response Factor
%RSD -Percent Relative Standard Deviation

CCC -Calibration Check Compounds (*)
SPCC -System Performance Check Compounds (**)

Form VI

Resource Analysts, Incorporated

SURROGATE STANDARD RECOVERY

9/13/84

SAMPLE	BCE	BCP	DCB
3724-9	121	109	100
3724-10	124	116	107
3724-11	109	97	102
3724-12	126	110	116
3724-13	88	84	103
3724-14	59	84	98
3724-15	87	78	92
3724-17	78	80	93

BCE	BROMOCHLOROETHANE
BCP	BROMOCHLOROPROPANE
DCB	DICHLOROBUTANE
BFB	BROMOFLUOROBENZENE

GC/MS TUNING AND MASS CALIBRATION

Bromofluorobenzene (BFB)

Case No. 3724 Contractor _____ Contract No. _____

Instrument ID _____ Date 9/13/84 Time Am

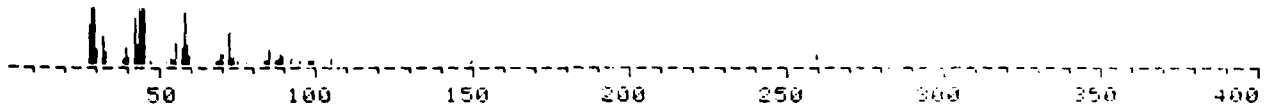
Lab ID _____ Data Release Authorized By: RDF

m/e	ION ABUNDANCE CRITERIA	%RELATIVE ABUNDANCE	
50	15.0 - 40.0% of the base peak	26.8	
75	30.0 - 60.0% of the base peak	50.8	
95	Base peak, 100% relative abundance	100	
96	5.0 - 9.0% of the base peak	8.1	
173	Less than 1.0% of the base peak	-	
174	Greater than 50.0% of the base peak	82.9	
175	5.0 - 9.0% of mass 174	6.6	(8.0)[1]
176	Greater than 95.0%, but less than 101.0% of mass 174	78.8	(95)[1]
177	5.0 - 9.0% of mass 176	5.4	(6.8)[2]

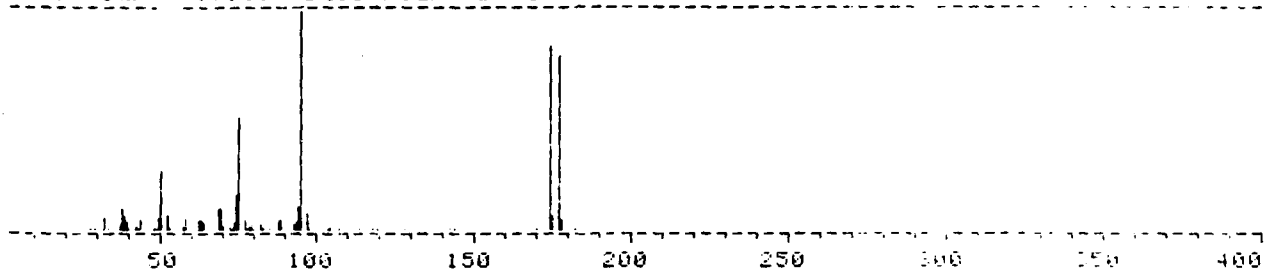
[1]Value in parenthesis is % mass 174.
[2]Value in parenthesis is % mass 176.

THIS PERFORMANCE TUNE APPLIES TO THE FOLLOWING SAMPLES, BLANKS AND STANDARDS.

SAMPLE ID	LAB ID	DATE OF ANALYSIS	TIME OF ANALYSIS
3724-9		9/13/84	
3724-10		"	
3724-11		"	
3724-12		"	
3724-13		"	
3724-14		"	
3724-15		"	
3724-16		"	
3724-17		"	
		"	



STRIPPED SPECTRUM 468.040 - 448.040 stored in 1.040
Sample 3780 Ret.Time= 26.06 Number of Peaks 75 File type = processed
Base Peak= 95.10 Base Peak Abundance= 608 Total Abundance= [illegible]



[illegible]

** Spectrum # 1.040 ** Sample # 3780 Retention Time = 26.1 minutes
Scanned from 26 to 260 amu Number of Peaks Detected = 75
File type = linear
Base Peak = 95.10 Base Peak Abundance = 608 Total Abundance = 3384
Lower Abundance Cutoff Level = 0.0%

MASS	ABUNDANCE (%)	MASS	ABUNDANCE (%)	MASS	ABUNDANCE (%)
27.05	1.3	60.05	1.8	92.10	[illegible]
29.05	1.3	61.05	5.4	93.10	4.4
31.05	6.1	62.05	5.1	94.10	11.3
33.05	1.5	63.05	3.9	95.10	100.0
36.05	2.8	68.05	10.2	96.10	8.1
37.05	10.0	69.05	10.7	97.10	0.7
38.05	7.4	70.05	1.8	98.20	0.3
39.05	3.9	71.15	1.6	99.20	0.3
40.05	0.7	72.05	0.8	103.10	1.2
41.05	2.5	73.05	4.3	104.10	1.6
42.05	1.0	74.10	15.8	105.10	0.2
43.05	5.4	75.10	50.8	106.00	1.0
45.05	0.7	76.10	5.1	112.20	0.2
46.05	0.2	77.10	0.8	113.10	1.0
47.05	2.5	78.10	1.6	117.00	1.3
48.05	1.2	79.00	3.8	119.00	1.2
49.05	6.1	80.10	1.5	127.20	0.8
50.05	26.8	81.00	3.1	141.10	1.5
51.05	7.2	82.00	1.3	143.00	1.0
52.05	1.0	83.20	0.3	170.25	1.0
53.05	0.2	84.20	0.5	174.05	82.9
55.05	1.5	85.20	1.3	175.05	6.6
56.05	2.5	86.10	0.2	176.05	78.8
57.15	6.4	87.10	5.1	177.05	5.4
58.05	0.3	88.10	4.8	181.05	0.8

Initial Calibration Data
Volatile HSL Compounds

Case No: _____ Instrument I D: 5992

Contractor: _____ Calibration Date: 9/13/85

Contract No: _____

Laboratory ID								
Compound	RF_{20}	RF_{50}	RF_{100}	RF_{150}	RF_{200}	RF	% RSD	CCC· SPCC··
Chloromethane		1540		1510	1450	1500	2.1	··
Bromomethane		1600		1500	1400	1500	6.6	
Vinyl Chloride		1840		1850	1710	1800	4.3	·
Chloroethane		5345		5365	4650	5120	7.2	
Methylene Chloride		6701		6509	6130	6450	4.3	
Acetone		905		1341	1055	1100	20	
Carbon Disulfide								
1, 1-Dichloroethene		12100		9810	9690	10500	12.7	·
1, 1-Dichloroethane		23150		27380	28370	25300	10.5	··
Trans-1, 2-Dichloroethene		13170		12590	11990	12590	4.8	
Chloroform		12710		13090	13500	13100	1.7	·
1, 2-Dichloroethane		9610		4815	3505	4310	16.3	
2-Butanone		2130		1710	1590	1910	11.0	
1, 1, 1-Trichloroethane		20180		19210	19110	19500	3.0	
Carbon Tetrachloride		13610		13130	18560	15100	12.7	
Vinyl Acetate								
Bromodichloromethane		3650		3521	3261	3610	1.3	
1, 2-Dichloropropane		422		742	801	662	32.7	·
Trans-1, 3-Dichloropropene		3650		2916	2884	3150	16.8	
Trichloroethene		12493		19312	15810	19200	18.6	
Dibromochloromethane						1501		
1, 1, 2-Trichloroethane						2510		
Benzene		48162		43160	33578	42300	14.9	
cis-1, 3-Dichloropropene		2815		3879	4136	3610	17.4	
2-Chloroethylvinylether		1155		599	1006	1620	12.6	
Bromoform		249		269	232	250	7.4	··
2-Hexanone								
4-Methyl-2-Pentanone		1948		2066	2136	2050	4.6	
Tetrachloroethene		14040		14340	11060	13200	13.7	
1, 1, 2, 2-Tetrachloroethane						9510		··
Toluene		50460		48480	38760	45800	13.6	·
Chlorobenzene		36250		34910	30060	33500	9.6	··
Ethylbenzene		56430		58830	44250	53200	14.7	·
Styrene								
Total Xylenes				68830	45370	52100	18.2	

RF -Response Factor (subscript is the amount of ug/L)
RF -Average Response Factor
%RSD -Percent Relative Standard Deviation

CCC -Calibration Check Compounds (·)
SPCC -System Performance Check Compounds (··)

Form VI

APPENDIX I

SAFETY PLAN

WESTON

SAFETY PLAN

Date: _____

Region: _____

TDD#: _____

PCS#: _____

A. Incident Description

1. Location: BURLINGTON ANG BURLINGTON, VT 2. Date: 6/19/04

3. Type: Spill ( ) Fire ( ) HW Site ( ) Other LANDFILL

4. Status CLOSED

5. Response Objectives SAMPLE WELLS & SURFACE WATER

6. Background Review: Complete (✓) Partial ( )

   If partial, why? _____

7. Hazard Level: High ( ) Moderate (✓) Low ( ) Unknown ( )

   Inhalation (✓) Ingestion (✓) Contact ( ) Radiation ( )

8. Site Plan/Sketch attached Yes (✓) No ( )

9. Background Material attached Yes ( ) No (✓)

B. Material Description

1. Type: Liquid (✓) Solid ( ) Sludge (✓) Vapor/Gas (✓)

2. Chemical Name/Class VOLATILE ORGANICS

3. Characteristics: Corrosive ( ) Ignitable (✓)

WESTON

B. Material Description (cont'd)

3. Characteristics(cont'd)- Biological Agent ( )

Volatile (✓) Toxic ( ) Reactive ( )

4. Toxicity: TLVs _____ IDLHs _____

_____ _____

_____ _____

5. Special Hazards _____

6. Acute Exposure Symptoms _____

C. Site Description

1. Size < 10 ACRES

2. Surrounding Population HOUSING DEVELOPEMENT NEARBY

3. Buildings/Homes _____

4. Topography ROLLING TO HILLY

5. Receiving Waters STREAM TO WILLAMETTE RIVER

6. Weather _____

7. Unusual Features AIRPORT

_____

_____

8. Site History ALG FIRE TRAINING AREA AND LANDFILL

VOLATILES DETECTED UP TO ~10 PPM IN SOME

ONSITE WELLS

D. Personnel Protection

1. Entry Level of Protective clothing: A ( ) B ( )

C ( ) D (✓)

2. If not B, why? PAST ACTIVITIES INDICATE NOT

APPROPRIATE

WESTON

E. Decontamination Procedures

1. Attach sketch showing Exclusion Zone, Contamination Reduction Zone, Support Zone and numerically labelled Decontamination Stations.
2. For each decontamination station note procedure and materials need on an attachment page.

F. General Information

1. Team members

GLENN SMART _____

STEVE MICHELSEN _____

REN ALTHOUSE _____

2. Site Safety Coordinator _____

G. Emergency Information

1. Have nearby people been evacuated: Yes ( ) No (X)

If yes over how large and area? _____

Who initiated the evacuation? _____

2. First Aid Instructions LEAVE SITE IF DIZZY, LIGHT HEADED OR NAUSEOUS, WASH AREA OF DIRECT CONTACT.

3. Sources of help:

	NAME	TOWN	PHONE	NOTIFIED Yes	NOTIFIED No
Fire	SEE ATTACHMENT			( )	( )
Police				( )	( )
Ambulance				( )	( )

WESTON

D. Personnel Protection (cont'd)

3. Site Instrument Readings:

% 02 _____ % LEL _____

Radioactivity _____ HNU NONE DETECTED

OVA _____ Other _____

4. If no site readings, why? _____

_____

5. Was protective level up or downgraded: Yes ( ) No (✓)

Up or downgraded to: A ( ) B ( ) C ( ) D ( )

Why _____

_____

_____

Actual Change: _____

_____

6. Respirator Protective Equipment:

SCBA _____ Canister Type _____

Gas Mask _____ Cartridge Type _____

Ultra Twin IF NECESSARY

Dust Mask _____

7. Protective Clothing:

GLOVES ULTRA TWIN (if necessary) _____

BOOTS _____ _____

TYVEKS (IF NECESSARY) _____ _____

8. Field Monitoring Equipment and Materials:

HNu _____ _____

CONDUCTIVITY _____ _____

pH _____ _____

WESTON

Prepared by GLENN SMART

Date 6/14/84

Approved by _____

Date _____

FOR HSO USE ONLY

Reviewed and Comments _____

Action Required? Yes ( ) No ( ) If yes, what action _____

Followup carried out? Date _____

_____ _____

S.O. Signature Date

WESTON

3. Sources of help (cont'd)

	NAME	TOWN	PHONE	NOTIFIED Yes	No
Hospital	SEE			( )	( )
Poison Info				( )	( )
Airport	ATTACHMENT			( )	( )
Heliport				( )	( )
Site Tel				( )	( )
Nearest Tel				( )	( )

4. Emergency Telephone Numbers

WESTON Hot Line	215-524-1925 or 1926	
WESTON NPO	215-431-0797 or 0798 or 215-692-3030	
P. B. Lederman - NPM	201-665-0359	(Home)
S. M. Gertz - HSO	215-667-5461	(Home)
Medical Emergency	513-421-3063	(Nat'l Service)
EPA - ERT Emergency	201-321-6660	
Chemtrec	800-424-9300	
Centers For Disease Control	404-329-3311 404-329-3644	(day) (night)
National Pesticide Medical Emergency	800-845-7633	(Regional Services)

WESTON

MODIFIED LEVEL "D" WITH HNu MONITORING.

GLOVES

BOOTS

SAFETY GLASSES

IF HNu READING OF GREATER THAN 5 PPM ABOVE BACKGROUND IN BREATHING ZONE, DON RESPIRATORS WITH GMC/H CARTRIDGES AND COATED TYVEKS.

DAT
FILM