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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 8

999 18TH STREET - SUITE 500

Public Record

(enf. conf. portion redacted)

APR 25 2000

Ref: 8EPR-ER

SECOND ACTION MEMORANDUM AMENDMENT

SUBJECT: Request for an Amendment to the Classic Emergency Removal Action at the Lockwood Solvent Site in Billings, Yellowstone County, Montana. **ACTION MEMORANDUM AMENDMENT**

FROM: Pete Stevenson, On-Scene Coordinator
Emergency Response Team

THROUGH: Steve D. Hawthorn, Supervisor
Emergency Response Unit
for Steve Hawthorn

Douglas M. Skie, Director
Preparedness, Assessment & Emergency Response Programs

Max H. Dodson, Assistant Regional Administrator
Office of Ecosystems Protection & Remediation

Site ID#: AK

Category of Removal: Classic Emergency Removal
Fund Lead

I. PURPOSE

The purpose of this Action Memorandum Amendment is to document and request approval of a Ceiling Increase for the Removal Action described herein for the Lockwood Solvent site (Site) located in Lomond Lane Area, Billings, Yellowstone County, Montana. The original response/removal action was initiated under the On-Scene Coordinator's (OSC) $250,000 funding authority and addressed the need to mitigate the threat of hazardous substances including tetrachloroethylene (PCE), trichloroethylene (TCE), 1,2-dichloroethylene (DCE), and vinyl chloride (VC) which have been found in residential wells which are being used for drinking water.

This Second Removal Action Amendment at the Site continues to address the necessity for providing a permanent solution to contaminated drinking water by extending the water main and connecting 14 of the homes to the municipal water system. The Original Action Memorandum was requested to provide bottled-water to designated residences; this was amended due to the high cost of providing bottled water and because contaminant exposure was still taking place to the residents when they showered, washed clothes, and engaged in other water-related activities (See attached Action Memorandum dated 1/27/00 - Attachment 1a). The ceiling increase requested on 1/27/00 was to $761,000; however, upon initial interaction with the State, Lockwood Water User's Association, and the subcontractor, it has been determined that as a result of unforeseen complexities of interconnection, additional distance to several of the homes, and additional labor costs, the ceiling estimate for this Removal Action needs to be revised to $1,266,000. In addition to minor cost revisions at the individual residences, new costs resulted from: 1) A requirement by the Lockwood Water User's Association that the water main be looped to the Site (rather than "dead-end") in order to allow for better circulation. This has doubled the cost for installation of the water main. 2) The use of "viton", rather than standard, gaskets is being required, due to potential permeation by the contaminants.

II. SITE CONDITIONS AND BACKGROUND

The Lockwood Solvent site (LSS) includes several residences which have domestic wells for drinking water and other domestic uses. The initial Removal Action (See Attached Action Memorandum dated July 14, 1999 - Attachment 1) allowed temporary provision of bottled water to several residences that have wells with Perchloroethene (PCE) contamination above the Removal Action Level (RAL) of 70 parts per billion (ppb). An Amendment (approved on January 27, 2000 - Attachment 1a) proposed a permanent solution by extending the water main and connecting 14 of the homes to the municipal water system.

A. SITE DESCRIPTION

1. Removal Site Evaluation

On May 21, 1999, MDEQ submitted a letter to the Region VIII Emergency Response Unit (EPA) requesting assistance at the Site and provided the analytical results from the Integrated Assessment (IA) at the Site which indicated that immediate help was needed in providing bottled water at residences with contaminated domestic wells (See Action Memorandum dated July 14, 1999 - Attachment 1). MDEQ reported PCE at levels of 1,900 ppb, trichloroethene (TCE) to 150 ppb, cis-dichloroethene (DCE) to 590 ppb, trans-dichloroethene to 19 ppb, and vinylchloride to 190 ppb.

EPA mobilized its Superfund Technical Assessment and Response Team (START) to the site to collect domestic well groundwater samples, direct-push (Geoprobe) groundwater samples, and collect residential air samples. Concurrent monitoring-well installation and soil sampling were conducted by the Response Engineering and Analytical Contract (REAC). Domestic well, direct-push Geoprobe, monitoring well, and soil results have been summarized in REAC's Final Report - VOC Groundwater Plume Delineation and Potential Source Area Assessment, Lockwood Solvent Site, 11/29/99 (Attachment 2). The summary of results indicated:

a. A Lockwood Lomond Lane area has a VOC plume, comprised mainly of PCE. Breakdown products - TCE, cis-1,2-DCE, and vinyl chloride are also present.

b. Groundwater within the identified VOC plume has been impacted by the primary VOCs at concentrations in excess of Federal and State drinking water standards. (The Federal drinking water standards for PCE, TCE, cis-1,2-DCE, and vinyl chloride are 5 ppb, 5 ppb, 70 ppb, and 2 ppb, respectively.) Much of the plume is above Federal removal action levels, and the plume has an imminent and substantial impact on several residential wells.

c. The release of VOCs to groundwater is estimated to have occurred a minimum of 10-15 years ago, and the volume of the release is estimated to have been approximately 200 gallons. Further investigation is necessary to determine the source of VOCs affecting the area groundwater quality.

d. One residential well is impacted by carbon tetrachloride (CCl^4) at 5 milligrams per liter ($\mu g/L$)

2. Physical Location and Site Characteristics

The Site consists of a groundwater plume/contaminants and its soil sources located in the Lomond Lane Area in the West ½ of Section 26, Township 1 North, Range 26 East of Yellowstone County - a section of Lockwood that exists north of Cerise Road, west of Klenck Lane, south of the Yellowstone River, and east of Sandy Lane (See

Figure 1 of attached Action Memorandum for Location Map). Most of the homes/businesses in the Site area use groundwater as their primary source of drinking water.

3. **Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant, or Contaminant**

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

4. **NPL Status**

This Site is not on the National Priorities List.

B. **OTHER ACTIONS TO DATE**

1. **Previous Actions**

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

2. **Current Actions**

EPA initiated a Removal Action at the Site under the OSC's emergency funding authority - refer to Attached Action Memorandum dated 7/14/99 (Attachment 1). An Alternatives Analysis was prepared in October of 1999, and an Amended Action Memorandum was approved on January 27, 2000. After approval of the Action Memorandum Amendment the Alternatives Analysis was revisited and cost bids were received for extension of the water main and connections to the municipal water system; increased projected costs required the submission of this Second Action Memorandum Amendment. EPA is developing a Work Plan and preparing for initiating/subcontracting of the connection of 14 residences to the municipal water system.

C. **STATE AND LOCAL AUTHORITIES' ROLE**

1. **State and Local Actions to Date**

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

2. **Potential for Continued State/Local Response**

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

The conditions at the Site presented a threat to public health and the environment and met the criteria for initiating a Removal Action under 40 CFR §300.415(b)(2) of the NCP.

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

IV. ENDANGERMENT DETERMINATION

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the Removal Action described in this Action Memorandum, would have presented and, until a permanent water source is attained, continues to present an endangerment to the public health/ welfare.

V. PROPOSED ACTIONS AND ESTIMATED COSTS

A. PROPOSED ACTIONS

1. Proposed Action Description

EPA's Contractor (START) coordinated an Alternatives Analysis (URS Operating Services, Inc., START, October 11, 1999, - Contract No. 68-W5-0031) [See Attachment 3]. The action selected and approved in the January 27, 2000, Action Memorandum Amendment consisted of extending the water main and connecting 14 of the homes to the municipal water system. The Alternatives Analysis (Attachment 3) provides an explanation of the costs for the various alternatives; however, several changes in cost needed to be added to the alternatives because of unforeseen complexities and local/State requirements when EPA began developing a Work Plan and preparing for initiating the connection of the residences to the municipal water system. Cost additions for re-evaluation included:

a. Connecting to the water main

Costs for "looping" the water main, using "viton" [rather than standard] gaskets, and other additional miscellaneous costs which have been reviewed in this Action Memorandum were added to the total estimated cost of this alternative.

b. Installing an air stripping system

Quarterly sampling/monitoring (State requirement) must be added to this alternative at a cost of approximately $60,000 per year.

Upon re-evaluation of the Alternatives Analysis, with consideration for long-term maintenance/monitoring, including the new costs listed above, it was determined that the most feasible and cost efficient action would still be to connect the 14 homes to the municipal water system.

2. Contribution to Remedial Performance

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

3. Description of Alternate Technologies

URS Operating Services, Inc., START, conducted an Alternatives Analysis for the remediation of household water at the Lockwood Solvents Site and submitted it to EPA on October 11, 1999 (Contract No. 68-W5-0031) [See Attachment 3].

4. Engineering Evaluation/Cost Analysis (EE/CA)

A cost analysis was prepared with the Alternatives Analysis (See Attachment 3).

5. Applicable or Relevant and Appropriate Requirements (ARARs)

Refer to Attached Action Memorandum dated January 27, 2000 (Attachment 2).

6. Project Schedule

The Removal Action to furnish bottled water to affected residences was initiated on July 13, 1999. An Alternatives Analysis was prepared in October of 1999, and an Amended Action Memorandum was approved on January 27, 2000. After approval of the Action Memorandum Amendment the Alternatives Analysis was revisited and cost bids were received for extension of the water main and connections to the municipal water system; increased projected costs are included in this Second Action Memorandum Amendment. The analyses and Work Plan have been initiated; and, if this Amendment is approved, it is anticipated that the removal actions will be completed by Summer of 2000.

7. Estimated Costs

The January 14, 1999, Action Memorandum authorized a Project Ceiling of $41,000 for the Removal Action. The requested Ceiling Increase for the first Action Memorandum Amendment is $720,000, bringing the total estimated Project Ceiling to $761,000. This requested Ceiling Increase for this Action Memorandum Amendment is $505,000, bringing the total estimated Project Ceiling to $1,266,000.

	Previous Action	Proposed Action	Proposed New Project Ceiling
Extramural Costs:			
Cost-bottled water	$ 10,000	-	$ 10,000
ERRS Costs	$ 20,000	-	$ 20,000
REAC Costs	$ 30,000		$ 30,000
START Costs	$ 50,000		$ 50,000
Water Main/Municipal	$ 470,000	**$391.000**	**$ 861,000**
20% Contingency	$ 116,000	**$ 84,000**	**$ 290,000**
TOTAL EXTRAMURAL	$ 696,000	**$475,000**	**$1,171,000**
Intramural Costs:			
Direct Costs	$ 33,000		$ 33,000
Indirect Costs	$ 32,000	**$ 30,000**	**$ 62,000**
TOTAL, INTRAMURAL	$ 65,000	**$ 30,000**	**$ 95,000**
PROJECT CEILING	$ 761,000	**$505,000**	**$1,266,000**

VII. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

If action is delayed or not taken at the Site, the health risks will continue to be present for the residents at the Site who are using the contaminated water for cooking, bathing, washing, etc.

VIII. OUTSTANDING POLICY ISSUES

None

X. RECOMMENDATIONS

This decision document represents an Amendment to the selected Removal Action for the Lockwood Solvent Site in Billings, Yellowstone County, Montana. The selected Removal Action Amendment was developed in accordance with CERCLA, as amended, and is consistent with NCP. This decision is based on the administrative record for the Site.

Conditions at the Site meet the NCP §300.415(b)(2) criteria for a Removal, and I recommend your approval of the proposed Removal Action. The total project ceiling is estimated to be $1,266,000 and of this, an estimated $1,171,000 comes from the Regional removal allowance.

Approve: Dale Vodehnal Acting ARA. Date: 4/25/2000

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

Disapprove: ______________________ Date: __________

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

ATTACHMENTS:

#1 - Action Memorandum dated 7/14/99
#1a - Amended Action Memorandum dated 1/27/00
#2 - REAC Final Report -Source area Assessment - 11/29/99
#3 - START - Alternatives Analysis - 10/11/99
#4 - Benson Memorandum
#5 - Bussey Memorandum

Attachment 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 8

999 18TH STREET - SUITE 500

Ref: 8EPR-ER

ACTION MEMORANDUM JUL 14 1999

SUBJECT: Documentation of a Removal Action at the Lockwood Solvent Site in Billings, Yellowstone County, Montana.

TO: Site File

FROM: Pete Stevenson, On-Scene Coordinator
Emergency Response Team

THROUGH: Steve D. Hawthorn, Supervisor
Emergency Response Unit

Douglas M. Skie, Director
Preparedness, Assessment & Emergency Response Programs

Max H. Dodson, Assistant Regional Administrator
Office of Ecosystems Protection & Remediation

Site ID#: AK

Category of Removal: Classic Emergency Removal
Fund Lead

I. PURPOSE

The purpose of this Action Memorandum is to document the Removal Action described herein for the Lockwood Solvent site (Site) located in Lomond Lane Area, Billings, Yellowstone County, Montana. The response was initiated under the On-Scene Coordinator's (OSC) $250,000 funding authority and addressed the need to mitigate the threat of tetrachloroethylene (PCE), trichloroethylene (TCE), dichloroethylene (DCE), and vinyl chloride (VC) which were found in residential/business wells which are being used for drinking water.

Conditions existing at the Site presented an endangerment to human health and the environment and met the criteria for initiating a Removal Action under 40 CFR, Section 300.415(b)(2) of the National Contingency Plan (NCP). The actions discussed in this memorandum are anticipated to require less than 12 months and two million dollars to complete.

MAW S.H.
for 7/14/99

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Based on the nature of the Site conditions and response, there are no nationally significant or precedent-setting issues associated with this Removal Action.

II. SITE CONDITIONS AND BACKGROUND

The Lockwood Solvent site (LSS) consists of several residences/businesses which have domestic wells for drinking water and other domestic uses. The contamination was reported to EPA by the Montana Department of Environmental Quality (MDEQ), and it requested emergency removal assistance to provide alternate water, control of the sources of groundwater contamination, and groundwater monitoring at the Site.

A. *SITE DESCRIPTION*

1. Removal Site Evaluation

On May 21, 1999, MDEQ submitted a letter to to the Region VIII Emergency Response Unit (EPA) requesting assistance at the Site and provided the analytical results from the Integrated Assessment (IA) at the Site which indicated that immediate help was needed in providing bottled water at ten locations with contaminated domestic wells (See Laboratory Analytic Data from DEQ Contract #460007-Attachment 1). The laboratory results indicated that the wells were contaminated with 1 or more volatile organic compounds (VOC) above the maximum concentration level (MCL) as determined by the Montana water quality standards commonly known as WQB-7 standards .

2. Physical Location and Site Characteristics

The Site is a residential/business section located in the Lomond Lane Area in the West ½ of Section 26, Township 1 North, Range 26 East of Yellowstone County - a section of Lockwood that exists north of Cerise Road, west of Klenck Lane, south of the Yellowstone River, and east of Sandy Lane (See Figure 1 - Location Map). Most of the homes/businesses in the LSS area use groundwater as their primary source of drinking water.

3. Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant, or Contaminant

Tetrachloroethylene (also referred to as perchloroethylene) [PCE] has been found to produce liver cancer in laboratory animals when administered orally, as well as renal toxicity and hepatotoxicity following chronic inhalation exposures. PCE is a CERCLA hazardous substance and often results in breakdown products of trichlorothylene (TCE), dichlotoethylene (DCE), and vinyl chloride (VC). For example, in environments deprived of oxygen, PCE will breakdown to TCE, which will then become DCE. DCE will then breakdown further and become VC. The data collected by the IA indicated elevated levels of TCE and its breakdown products existed throughout the Site.

PCE is commonly used in dry cleaning, with minor use in industrial metal cleaning and degreasing. TCE is commonly used for degreasing metal parts. DCE is an intermediate chemical and is utilized in the production of solvents. Vinyl chloride is used to make polyvinyl chloride products, including pipes, wire, and automobile upholstery. PCE and TCE are non-flammable, while DCE and VC are flammable. They all evaporate easily and are heavier then water. Short-term exposure to high levels of any or all of these chemicals can cause dizziness, vomiting, stomach pain, headaches, sleepiness, and nausea. PCE, TCE, and DCE are possible human carcinogens, and vinyl chloride is a known human carcinogen.

The State of Montana has adopted numeric water quality standards for surface water and groundwater, commonly known as WQB-7 standards. Standards are listed in units of micrograms per liter or parts per billion (ppb). The following table shows the WQB-7 groundwater, highest groundwater concentration at the LSS, the highest recorded concentration in a private well at the LSS for each main contaminant of concern, and the Removal Action Levels:

Chemical	WQB-7 Standard (ppb)	Highest Recorded LSS Groundwater Concentration (ppb)	Highest Recorded LSS Well Water Concentration (ppb)	Removal Action Level (ppb)*
PCE	5.0	4,279	1,900	70
TCE	5.0	3,770	150	300
DCE (cis/trans)	70.0	15,200	590	400/600
Vinyl Chloride	0.15	415	190	2
Carbon tetrachloride	5.0	12	12	30

*9/22/94 - Removal Action Level Update from Deborah Y. Dietrich, Director - EPA Emergency Response Division.

4. NPL Status

This Site is not on the National Priorities List.

B. OTHER ACTIONS TO DATE

1. Previous Actions

No previous actions have been performed at this Site.

2. Current Actions

EPA has initiated a Removal Action at the Site under the OSC's emergency funding authority. The OSC reviewed the sample results, consulted the site situation with EPA toxicologists and discussed the seriousness of the situation with MDEQ; bottled water has been temporarily supplied by MDEQ to 10 of the residences which were using domestic water which was over the WQB-7 standards.

The immediate actions taken were effective in limiting exposure to the hazardous substances at the Site.

C. STATE AND LOCAL AUTHORITIES' ROLE

1. State and Local Actions to Date

MDEQ requested EPA assistance and sent bills for bottled water to EPA for payment by 7/18/99. County/State officials are aware of and involved in the Removal Action.

2. Potential for Continued State/Local Response

An investigation is currently underway by MDEQ and EPA to verify the plume location and source of contamination.

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

The conditions at the Site presented a threat to public health and the environment and met the criteria for initiating a Removal Action under 40 CFR §300.415(b)(2) of the NCP.

A. Threats to Public Health or Welfare

The following factors from §300.415(b)(2) of the NCP form the basis for EPA's determination of the threat present and the appropriate action to be taken:

(i) Actual or potential exposure to hazardous substances by nearby populations.

(ii) Actual or potential contamination of drinking water supplies or sensitive ecosystems; and

(viii) Other situations or factors that may pose threats to public health or welfare or the environment (high concentrations of PCE, TCE, DCE, and VC.

B. Threats to the Environment

Specific threats to wildlife and plants have not been evaluated at this time. It is uncertain whether wildlife in the surrounding habitats is currently being adversely affected by the contaminants present on or off-site.

IV. ENDANGERMENT DETERMINATION

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the Removal Action described in this Action Memorandum, would have presented an endangerment to the public health/ welfare.

V. PROPOSED ACTIONS AND ESTIMATED COSTS

A. PROPOSED ACTIONS

1. Proposed Action Description

The Removal Action at the Site has been conducted to respond to the contamination of drinking water from domestic wells. Presently the Removal Action levels for PCE have been exceeded in 8 residential wells. Since Removal Action levels have not been exceeded at four of the 10 residences where MDEQ is providing bottled water, these four residences will not be provided water under this Removal Action. In addition, two homes, where PCE is greater than the Removal Action Level, have cisterns and are currently supplied with adequate clean water. Thus, in this particular Removal Action, EPA will provide bottled water to 6 residences. EPA toxicologists are also reviewing the information for the Site. This expedited action was necessary to protect the residents from ingestion exposure. Therefore, bottled water is temporarily being provided, until such time that an alternative water supply can be provided or the source of contamination can be identified. In the future it will be necessary to further sample, evaluate, and respond to a potential plume of contamination in the wells/water at the Site. Additional samples will be evaluated to determine the location of the plume, and to see if recovery of contaminants is possible. An Amended Action Memorandum may be necessary in order to remove the source of contamination and/or provide a permanent solution for whole-house water use.

2. **Contribution to Remedial Performance**

The Removal Action will not affect any future Remedial Action on the Site.

3. **Description of Alternate Technologies**

N/A at this time.

4. **Engineering Evaluation/Cost Analysis (EE/CA)**

This Removal Action is classic emergency and required immediate action; therefore, an EE/CA is not required.

5. **Applicable or Relevant and Appropriate Requirements (ARARs)**

Because this action is classic emergency all Federal and State ARARs have not been identified at this time.

6. **Project Schedule**

This Removal Action was initiated on July 13, 1999. It is anticipated that the removal actions will be completed during FY99.

B. **ESTIMATED COSTS**

Extramural Regional Allowance Costs:

Cost for bottled water	$10,000
ERRS	$20,000
20% Contingency	$ 6,000
TOTAL EXTRAMURAL COSTS	$36,000

Intramural Costs:

Intramural Direct Costs	$ 3,000
Intramural Indirect Costs	$ 2,000
TOTAL INTRAMURAL COSTS	$ 5,000

TOTAL: REMOVAL PROJECT CEILING: $41,000

VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

If action had been delayed or not taken at the Site, the health risks would have increased to the residents/businesses at the Site who were drinking the contaminated water and/or using it for cooking, bathing, washing, etc.

VII. OUTSTANDING POLICY ISSUES

None

VIII. ENFORCEMENT

Potential enforcement actions will be reviewed to determine if there is a responsible party for the contamination and/or plume.

X. RECOMMENDATIONS

This decision document represents the selected Removal Action for the Lockwood Solvent Site in Billings, Yellowstone County, Montana. The selected Removal Action was developed in accordance with CERCLA, as amended, and is consistent with NCP. This decision is based on the administrative record for the Site.

Conditions at the Site meet the NCP §300.415(b)(2) criteria for a Removal, and I utilized the $250,000 Emergency Removal Action funding authority delegated to Region VIII OSCs to authorize funding for this Removal Action. The total project ceiling is estimated to be $41,000 and of this, an estimated $36,000 comes from the Regional removal allowance.

[signature] 7/14/99

On-Scene Coordinator Date

Attachments:

Attachment 1 - Laboratory Analysis Data
Figure 1 - Site Location Map

Attachment 1

Lockwood Solvent Site

Laboratory Analytical Data for groundwater wells - does not include on-site Geoprobe investigations

Sample Location	Use	Sample date	Contaminants of Concern (ppb)						well depth	# of		
	Type		PCE	TCE	cDCE	tDCE	VC	CT	(ft bgs)	people	water use	notes
366 Bonnie Lane	r/c	September-98	3.3	2.1	0.77	ND	ND	ND		1	well whole house	property has storage units, junk yard and residence
366 Bonnie Lane		January-99	3.3	2	0.71	ND	ND	ND				
366 Bonnie Lane		April-99	3.5	2	0.72	ND	ND	ND				
139 Cerise Road	r	June-98	1U	4	7	1U	1U	ND	20	5	bottled for drinking, well for rest	two residences on this property
139 Cerise Road		September-98	ND	4	5.3	.25J	ND	ND				
139 Cerise Road		January-99	ND	4.4	6.1	ND	ND	ND				
139 Cerise Road		April-99	ND	3.9	4.9	ND	ND	ND				
140 Cerise Road	r	June-98	1U	4	7	1U	1U	ND	20	1	bottled for drinking, well for rest	
140 Cerise Road		January-99	ND	4.5	6.1	ND	ND	ND				
140 Cerise Road		April-99	ND	4.3	5.1	ND	ND	ND				
179 Cerise Road	c	January-99	ND	4.8	7.5	ND	ND	ND		unk	well for commercial use	
1112 Doon Ave	r	June-98	11	2	2	1U	1UJ	ND	60-70	1	bottled for drinking, well for rest	
1112 Doon Ave		January-99	80D	9.4	12	ND	ND	ND				
1117 Doon Ave	c	January-99	40D	2.8	2.4	ND	ND	ND		2	bottled for drinking, well for rest	
1135 Doon Ave	r	none								unk		house has been vacant since June 98, no information available
1443 Gordon	r	June-98	1U	.8J	1	1U	1UJ	ND	65	unk	well whole house	
1443 Gordon		April-99	ND	ND	ND	ND	ND	ND				
211 Island Park Road	r	June-98	1U	2	2	1U	1UJ	ND		vac	well whole house	vacant since last fall
1007 Island Park Road	r	none								vac		house has been vacant since June 98, no information available
1107 Island Park Road	r	June-98	1U	1U	1	1U	1U	ND	20	2	cistern whole house	well for yard
1107 Island Park Road		April-99	ND	.45J	.43J	ND	ND	ND				
1115 Island Park Road	r	none								vac	cistern whole house	house has been vacant, well for yard
510 Klenck Lane	c	January-99	ND	ND	ND	ND	ND	ND		6	bottled for drinking, well for rest	
532 Klenck Lane	c	January-99	ND	ND	ND	ND	ND	ND		15	bottled for drinking, well for rest	
542 Klenck Lane	r	September-98	ND	ND	ND	ND	ND	ND		4	well whole house	
139 Lomond Lane	r	June-98	1U	1	1U	1U	1UJ	ND	12		public water supply	well for yard, resident connected to public water supply prior to investigations
139 Lomond Lane		April-99	ND	2.2	.45J	ND	ND	ND				
221 Lomond Lane	c	January-99	ND	ND	ND	ND	ND	ND		10	cistern whole facility	
221 Lomond Lane		April-99	ND	ND	ND	ND	ND	ND				
232 Lomond Lane	rx7	June-98	1U	2	1	1U	1UJ	ND	24	21	well whole house	trailer park with 7 residential mobile homes served from one well
232 Lomond Lane		September-98	ND	2.4	0.73	ND	ND	ND				
232 Lomond Lane		January-99	ND	2.2	0.57	ND	ND	ND				
232 Lomond Lane		April-99	ND	1.5	.26J	ND	ND	ND				
236 Lomond Lane	r	June-98	1U	2	1	1U	1U	ND	20	3	well whole house	
236 Lomond Lane		April-99	ND	1.4	0.5	ND	ND	ND				
345 Lomond Lane	irr	September-98	15	4.8	18	0.52	1.9	0.5				this well serves for irrigation and well is located at Mt. Terrazzo office
349 Lomond Lane	r/c	September-98	2.8	1.2	5.1	ND	ND	12		4/5	bottled for drinking, well for rest	this well serves both Mt Terrazzo and Kuck - residential in office of Mt. Terrazzo, well located at Kuck shop
349 Lomond Lane		April-99	2.1	0.82	4.8	ND	ND	6.2				
403 Lomond Lane	r	June-98	1900D	150D	590D	5	190D	ND	29	2	cistern whole house	they put in cistern in September, well for yard
418 Lomond Lane	r	June-98	670D	130D	470D	5	160D	ND	15.8	2	cistern house	well for yard and toilets
504 Lomond Lane	r	none								vac		house has been vacant since June 98, possible limited cistern use
505 Lomond Lane	c	September-98	661	110	306D	5.2	39	ND	n/a		n/a	sample taken from gravel pond surface water
505 Lomond Lane	r/c	September-98	507	109D	405D	19	38D	ND		3/3	bottled for drinking, well for rest	also serves as office for gravel pit, same employees as residents
522 Lomond Lane	r	June-98	83D	45E	72D	1	22J	ND	26	2	bottled for drinking, well for rest	
528 Lomond Lane	r	June-98	340D	83D	320D	3	33JD	ND	22	1	bottled for drinking, well for rest	
534 Lomond Lane	r	September-98	319D	81D	217D	3.2	9	ND		3	bottled for drinking, well for rest	
546 Lomond Lane	r	June-98	440D	90D	280D	3	17	ND		2	bottled for drinking, well for rest	
546 Lomond Lane		January-99	395D	82D	184D	2.2	11	ND				
327 Sandy Lane	c	January-99	ND	ND	ND	ND	ND	ND		1	bottled for drinking, well for rest	
327 Sandy Lane		April-99	ND	ND	ND	ND	ND	ND				
516 Sandy Lane	r	none							42	2	cistern whole house	well for yard and commercial on 517 Sandy
517 Sandy Lane	c	January-99	27D	5.1	70	ND	ND	ND		4	bottled for drinking, well for rest	
1305 Taylor Place	c	January-99	ND	3.7	ND	ND	ND	ND			bottled for drinking, well for rest	public water supply is available on Taylor Place
1307 Taylor Place	c	January-99	ND	9.1	ND	ND	ND	ND			bottled for drinking, well for rest	public water supply is available on Taylor Place
1323 Taylor Place	c	January-99	ND	3.1	ND	ND	ND	ND			bottled for drinking, well for rest	well same for 1311 Taylor Place (office), public water supply is available on Taylor Place

Note: Commercial trucking populations do not include periodic drivers.

r/c = residential or commercial

irr = irrigation use only

CT = carbon tetrachloride

vac = currently vacant residence

unk = unknown

Attachment 1a

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 8

999 18TH STREET - SUITE 500

JAN 27 2000

Ref: 8EPR-ER

ACTION MEMORANDUM AMENDMENT

SUBJECT: Request for an Amendment to the Classic Emergency Removal Action at the Lockwood Solvent Site in Billings, Yellowstone County, Montana. **ACTION MEMORANDUM AMENDMENT**

FROM: Pete Stevenson, On-Scene Coordinator
Emergency Response Team

THROUGH: Steve D. Hawthorn, Supervisor
Emergency Response Unit

Douglas M. Skie, Director
Preparedness, Assessment & Emergency Response Programs

Max H. Dodson, Assistant Regional Administrator
Office of Ecosystems Protection & Remediation

Site ID#: AK

Category of Removal: Classic Emergency Removal
Fund Lead

I. PURPOSE

The purpose of this Action Memorandum Amendment is to document and request approval of a 12-month Exemption, Ceiling Increase, and Modification of the Proposed Action for the Removal Action described herein for the Lockwood Solvent site (Site) located in Lomond Lane Area, Billings, Yellowstone County, Montana. The original response/removal action was initiated under the On-Scene Coordinator's (OSC) $250,000 funding authority and addressed the need to mitigate the threat of hazardous substances including tetrachloroethylene (PCE), trichloroethylene (TCE), 1,2-dichloroethylene (DCE), and vinyl chloride (VC) which have been found in residential wells which are being used for drinking water.

The Removal Action Amendment at the Site, including the 12-month exemption, ceiling increase, and modification described herein, continues to satisfy the criteria for Removal Actions under Section 300.415 (b)(2) of the National Contingency Plan (NCP). This request meets the emergency criteria for exemption from the statutory limits on Removal Actions and is necessary because continuing the current procedure of providing bottled-water to designated residences is unacceptable due to its high cost, and because contaminant exposure is still taking place to the residents when they shower, wash clothes, and engage in other water-related activities.

Based on the nature of the Site conditions and response, there are no nationally significant or precedent-setting issues associated with this Removal Action.

II. SITE CONDITIONS AND BACKGROUND

The Lockwood Solvent site (LSS) includes several residences which have domestic wells for drinking water and other domestic uses. The initial Removal Action (See Attached Action Memorandum dated July 14, 1999 - Attachment 1) allowed temporary provision of bottled water to several residences that have wells with Perchloroethene (PCE) contamination above the Removal Action Level (RAL) of 70 parts per billion (ppb).

A. SITE DESCRIPTION

1. Removal Site Evaluation

On May 21, 1999, MDEQ submitted a letter to to the Region VIII Emergency Response Unit (EPA) requesting assistance at the Site and provided the analytical results from the Integrated Assessment (IA) at the Site which indicated that immediate help was needed in providing bottled water at residences with contaminated domestic wells (See Action Memorandum dated July 14, 1999 - Attachment 1). MDEQ reported PCE at levels of 1,900 ppb, trichloroethene (TCE) to 150 ppb, cis-dichloroethene (DCE) to 590 ppb, trans-dichloroethene to 19 ppb, and vinylchloride to 190 ppb.

EPA mobilized its Superfund Technical Assessment and Response Team (START) to the site to collect domestic well groundwater samples, direct-push (Geoprobe) groundwater samples, and collect residential air samples. Concurrent monitoring-well installation and soil sampling were conducted by the Response Engineering and Analytical Contract (REAC).

Domestic well, direct-push Geoprobe, monitoring well, and soil results have been summarized in REAC's Final Report - VOC Groundwater Plume Delineation and Potential Source Area Assessment, Lockwood Solvent Site, 11/29/99 (Attachment 2). The summary of results indicates:

a. A Lockwood Lomond Lane area has a VOC plume, comprised mainly of PCE. Breakdown products - TCE, cis-1,2-DCE, and vinyl chloride are also present.

b. Groundwater within the identified VOC plume has been impacted by the primary VOCs at concentrations in excess of Federal and State drinking water standards. (The Federal drinking water standards for PCE, TCE, cis-1,2-DCE, and vinyl chloride are 5 ppb, 5 ppb, 70 ppb, and 2 ppb, respectively.) Much of the plume is above Federal removal action levels, and the plume has an imminent and substantial impact on several residential wells.

c. The release of VOCs to groundwater is estimated to have occurred a minimum of 10-15 years ago, and the volume of the release is estimated to have been approximately 200 gallons. Further investigation is necessary to determine the source of VOCs affecting the area groundwater quality.

d. One residential well is impacted by carbon tetrachloride (CCl^4) at 5 milligrams per liter ($\mu g/L$)

2. **Physical Location and Site Characteristics**

The Site consists of a groundwater plume/contaminants and its soil sources located in the Lomond Lane Area in the West ½ of Section 26, Township 1 North, Range 26 East of Yellowstone County - a section of Lockwood that exists north of Cerise Road, west of Klenck Lane, south of the Yellowstone River, and east of Sandy Lane (See Figure 1 of attached Action Memorandum for Location Map). Most of the homes/businesses in the Site area use groundwater as their primary source of drinking water.

3. **Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant, or Contaminant**

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

4. **NPL Status**

This Site is not on the National Priorities List.

B. OTHER ACTIONS TO DATE

1. **Previous Actions**

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

2. **Current Actions**

EPA has initiated a Removal Action at the Site under the OSC's emergency funding authority - refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

C. STATE AND LOCAL AUTHORITIES' ROLE

1. **State and Local Actions to Date**

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

2. **Potential for Continued State/Local Response**

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

The conditions at the Site presented a threat to public health and the environment and met the criteria for initiating a Removal Action under 40 CFR §300.415(b)(2) of the NCP.

A. **Threats to Public Health or Welfare**

The following factors from §300.415(b)(2) of the NCP form the basis for EPA's determination of the threat present and the appropriate action to be taken:

(i) Actual or potential exposure to hazardous substances by nearby populations;

(ii) Actual or potential contamination of drinking water supplies or sensitive ecosystems; and

(iii) Other situations or factors that may pose threats to public health or welfare or the environment (high concentrations of PCE, TCE, DCE, and VC.

B. Threats to the Environment

Refer to Attached Action Memorandum dated 7/14/99 (Attachment 1).

IV. ENDANGERMENT DETERMINATION

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the Removal Action described in this Action Memorandum, would have presented and, until a permanent water source is attained, continues to present an endangerment to the public health/ welfare.

V. EXEMPTION FROM STATUTORY LIMITS

A. Emergency and Consistency Exemption:

1. Site conditions meet the criteria set forth in CERCLA §104(c)(1)(A). There is an immediate risk to public health or welfare and the environment as a result of the threat of tetrachloroethylene, trichloroethylene, dichloroethylene, carbon tetrachloride, and vinyl chloride which have been found in residential wells which are being used for drinking water. The threats to public health or welfare and the environment that are prevalent on this Site are explained in more detail in the attached Action Memoranda dated July 14, 1999, and Attachment 4 - Benson Memorandum.

2. Continued response actions are required to prevent, limit, or mitigate an emergency; therefore, it is necessary to request a ceiling increase, modification of scope, and 12-month exemption. Continuing the current procedure of providing bottled-water to designated residences is unacceptable due to its high cost, and bottled water does not address all avenues of exposure - most notably, exposure through inhalation/ingestion as a result of showering, washing clothes, cooking, and other water-related activities. This Action Memorandum Amendment proposes a permanent solution by extending the water main and connecting 14 of the homes to the municipal water system:

If this request for a modification of action, ceiling increase, and 12-month exemption is not granted, children, as well as adults living at the Site, will continue to be exposed to potentially dangerous levels of tetrachloroethylene, trichloroethylene, dichloroethylene, carbon tetrachloride, and vinyl chloride which have been found in residential wells which are being used for drinking water.

3. Assistance from other government agencies is not anticipated on a timely basis because neither the State nor the County have the funds/capability to take any actions at the Site. Consequently, the timely completion of this Removal Action can only be accomplished if this Action Memorandum Exemption is approved.

VI. PROPOSED ACTIONS AND ESTIMATED COSTS

A. PROPOSED ACTIONS

1. Proposed Action Description

EPA's Contractor (START) has coordinated an Alternatives Analysis and the action which has been selected by EPA for this amendment proposal consists of extending the water main and connecting 14 of the homes to the municipal water system:

- 11 homes > 70 ppb of PCE
- 1 home > 5 ppb of Carbon Tetrachloride
- 2 homes with imminent endangerment due to being near the downgradient plume. (A slight shift in the direction of the plume will send PCE volumes in these wells to >70 mg/L. See Attachment 5 - Bussey Memorandum.)

2. Contribution to Remedial Performance

The proposed actions will not adversely impact any future Remedial Actions and for the 14 residences it may constitute most of the Remedial Action. There has been an effort toward coordination between the Pre- Remedial, Remedial, and Removal Programs to fully address public health concerns in a timely and cost effective manner. The Site will be submitted for potential Remedial listing, but this Removal Action will be conducted as per NCP §300.415(d).

3. Description of Alternate Technologies

URS Operating Services, Inc., START, conducted an Alternatives Analysis for the remediation of household water at the Lockwood Solvents Site and submitted it to EPA on October 11, 1999 (Contract No. 68-W5-0031) [See Attachment 3]. Cost analyses and ratings were prepared for 4 alternatives:

- No action (continue with bottled water);
- Whole house air stripping;
- Whole house carbon filtering; and
- Connecting the affected homes to the municipal water supply.

4. **Engineering Evaluation/Cost Analysis (EE/CA)**

A cost analysis was prepared with the Alternatives Analysis (See Attachment 3). A full EE/CA has not been performed, however b/c as provided in Section 300.415 (b)(4), a planning period of at least 6 months does not exist due to the exigencies at the site.

5. **Applicable or Relevant and Appropriate Requirements (ARARs)**

Because this action is a classic emergency not all Federal and State ARARs have been identified at this time. EPA has requested a list of ARARS from the State and initial Federal ARARs are:

a. Clean Water Act (33 USC Sections 1341 and 1344).Clean Water Act (40 CFR Part 230).
b. Safe Drinking Water Act (42 USC Section 300[g]; 40 CFR Part 141 Subpart B).

6. **Project Schedule**

The Removal Action to furnish bottled water to affected residences was initiated on July 13, 1999. In preparation for submission of this Amendment, several companies were contacted for information leading to an Alternatives Analysis. After approval of this Action Memorandum Amendment it will be necessary to revisit the Alternatives Analysis and receive cost bids for extension of the water main and connections to the municipal water system. It is anticipated that analyses and Work Plan can be completed in early 2000, and the removal actions will be completed during Spring of 2000.

7. Estimated Costs

The January 14, 1999, Action Memorandum authorized a Project Ceiling of $41,000 for the Removal Action. The requested Ceiling Increase for this Action Memorandum is $720,000, bringing the total estimated Project Ceiling to $761,000.

	Previous Action	Proposed Action	Proposed New Project Ceiling
Extramural Costs:			
Cost-bottled water	$ 10,000	-	$ 10,000
ERRS Costs	$ 20,000	$ -	$ 20,000
REAC Costs		**$ 30,000**	**$ 30,000**
START Costs		**$ 50,000**	**$ 50,000**
Water Main/Municipal	**$ 0**	**$470,000**	**$470,000**
20% Contingency	$ 6,000	**$110,000**	**$116,000**
TOTAL EXTRAMURAL	$ 36,000	**$660,000**	**$696,000**
Intramural Costs:			
Direct Costs	$ 3,000	$ 30,000	$ 33,000
Indirect Costs	$ 2,000	**$ 30,000**	**$ 32,000**
TOTAL, INTRAMURAL	$ 5,000	**$ 60,000**	**$ 65,000**
PROJECT CEILING	$ 41,000	**$720,000**	**$761,000**

VII. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

If action is delayed or not taken at the Site, the health risks will continue to be present for the residents at the Site who are using the contaminated water for cooking, bathing, washing, etc.

VIII. OUTSTANDING POLICY ISSUES

None

X. RECOMMENDATIONS

This decision document represents and Amendment to the selected Removal Action for the Lockwood Solvent Site in Billings, Yellowstone County, Montana. The selected Removal Action Amendment was developed in accordance with CERCLA, as amended, and is consistent with NCP. This decision is based on the administrative record for the Site.

Conditions at the Site meet the NCP §300.415(b)(2) criteria for a Removal, and I recommend your approval of the proposed Removal Action. The total project ceiling is estimated to be $761,000 and of this, an estimated $696,000 comes from the Regional removal allowance.

Approve: Max H Dodson **Date:** 1/27/00

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

Disapprove:__________ **Date:**__________

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

ATTACHMENTS:

#1 - Action Memorandum dated 7/14/99
#2 - REAC Final Report -Source area Assessment - 11/29/99
#3 - START - Alternatives Analysis - 10/11/99
#4 - Benson Memorandum
#5 - Bussey Memorandum

Attachment 2

Lockheed Martin Technology Services Group
Environmental Services REAC
2890 Woodbridge Avenue, Building 209 Annex Edison, NJ 08837-3679
Telephone 732-321-4200 Facsimile 732-494-4021

LOCKHEED MARTIN

DATE: 29 November 1999

TO: Alan Humphrey, U.S. EPA/ERTC Work Assignment Manager

THROUGH: Gary Newhart, REAC Section Leader

FROM: for Donald T. Bussey, REAC Task Leader

SUBJECT: DOCUMENT TRANSMITTAL UNDER WORK ASSIGNMENT 0-077

Attached please find the following document prepared under this work assignment:

FINAL REPORT
VOC GROUNDWATER PLUME DELINEATION AND POTENTIAL SOURCE AREA ASSESSMENT
LOCKWOOD SOLVENT SITE - LOMOND LANE AREA
LOCKWOOD, MONTANA

cc: Central File - WA 0-077 (w/attachment)
REAC Program Manager (w/o attachment)
Peter Stevenson, U.S. EPA Region 8 On-Scene Coordinator, Denver, Colorado
David Williams, U.S. EPA Region 8, Denver, Colorado
Rosemary Rowe, U.S. EPA Region 8, Helena, Montana
Catherine LeCours, Montana Department of Health and Environmental Sciences, Helena, Montana
Anne Hellie, URS Operating Services, Inc., Denver, Colorado

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FINAL REPORT
VOC GROUNDWATER PLUME DELINEATION AND
POTENTIAL SOURCE AREA ASSESSMENT
LOCKWOOD SOLVENT SITE - LOMOND LANE AREA
LOCKWOOD, MONTANA
NOVEMBER 1999

U.S. EPA Work Assignment No.: 0-077
Lockheed Martin Work Order No.: R1A00077
U.S. EPA Contract No.: 68-C99-223

Prepared by:		Prepared for:
Lockheed Martin/REAC		U.S. EPA/ERTC
Donald T. Bussey REAC Task Leader	12/2/99 Date	Alan Humphrey Work Assignment Manager
Steven A. Clapp REAC Program Manager	12/3/99 Date	

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1.0 INTRODUCTION

1.1 Background

The Lockwood Solvent Site is located in the Town of Lockwood, Montana in Yellowstone County, east of the City of Billings and southeast of the Yellowstone River. Previous investigations conducted by Pioneer Technical Services, Inc. (Pioneer) focused on the Lomond Lane area (January 1999 and April 1999). Pioneer identified volatile organic compounds (VOCs) impacting the local groundwater through a local residential well sampling and a limited direct-push technology groundwater sampling program. The primary VOCs identified included tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride. Groundwater samples obtained during the Pioneer investigations were collected from unconsolidated fluvial deposits (silt, sand, gravel, and cobbles) at or near the water table at depths of approximately 20-25 feet below ground surface (bgs). The Lomond Lane area is a mixed residential, commercial, and light industrial area. The potable water supply for this area is from wells installed within the fluvial sediments, several of which have been impacted by VOCs in excess of Federal and State drinking water standards.

At the direction of the United States Environmental Protection Agency (U.S. EPA) Environmental Response Team Center (ERTC) Work Assignment Manager (WAM), Alan Humphrey, personnel of the Response Engineering and Analytical Contract (REAC) assisted in a site evaluation as defined in REAC's *Final Sampling Plan, PCE Groundwater Plume and Source Area Delineation Evaluation, Lockwood Solvent Site, Lockwood, Montana (October 13, 1999).* All data specific to the assessment are included in this summary report of findings.

1.2 Project Objectives

Based upon the results of the Pioneer studies, this investigation evaluated the shallow unconsolidated water table aquifer in the Lomond Lane area to better define the horizontal and vertical extent of the VOC groundwater contamination. Additionally, a permanent network of groundwater monitor wells was installed for future plume monitoring. A potential source area assessment was planned to define the horizontal and vertical extent of impacted soils (above the water table within the potential source area) as defined by the Pioneer studies at the Kuck Trucking property. Indoor residential air quality was also evaluated to assess whether residences above the center of the VOC plume were being affected by vapors possibly emanating from the VOC plume.

1.3 Project Scope

Groundwater VOC plume delineation involved collection of groundwater samples utilizing direct-push techniques and collection of groundwater samples in residential wells. The data were used to select permanent groundwater monitor wells locations, subsequently installed and sampled. Potential source area VOC delineation began with a soil gas survey near the potential source area as defined by the Pioneer studies. Based upon the results of the soil gas survey, a limited soil sampling program was to be conducted to identify and delineate the VOC potential source area. Soil sampling locations were modified in the field as discussed later. To assess whether VOC vapors are entering residences within the center of the VOC plume, indoor air samples were also collected for analysis.

2.0 METHODOLOGY

Field methods employed during this study generally follow the Standard Operating Procedures (SOPs) and protocols presented in the Sampling Plan. A summary of the field efforts employed during this evaluation are discussed below, including changes to the Sampling Plan based on field conditions and/or findings.

2.1 Groundwater VOC Plume Delineation

2.1.1 Residential Well Groundwater Sampling

Between 13 and 20 September 1999, 27 private wells (local residences and businesses) were sampled for VOC analyses. An off-site lab, Paragon Analytics, Inc. (Paragon), used SW-846 Method 524.2 to analyze these samples. For comparison purposes, 12 of these samples were also analyzed on site by the REAC Viking gas chromatography/mass spectrometry (GC/MS) instrument. Viking GC/MS data (from residential wells and direct-push points) were also used on site to assist in selection of monitor well placement (discussed below). The locations of the residential wells are illustrated on Plate 1.

2.1.2 Direct-Push Groundwater Sampling

Direct-push groundwater sampling provided near real-time data by use of the portable on site Viking GC/MS. Samples from direct-push points analyzed by the Viking GC/MS, combined with Viking data from the residential well sampling portion of the project, provided data subsequently used to select the location of groundwater monitor wells. For comparison purposes eight of these samples were also analyzed off site by Paragon. From 15 through 20 September 1999, 37 points were installed to approximately 20 feet. In addition, seven point locations had shallow (approximate depth - 10 feet) and/or deep (approximate depth - 30 feet) samples collected to allow for evaluation of the vertical component of the VOC plume.

The direct-push points were installed along six lines as specified in the Sampling Plan. Line six was added after completion of the Sampling Plan. Four lines consisted of six points (Lines 1 through 4), and one line (Line 6) consisted of three points. Lines 1 and 6 were completed to evaluate the groundwater quality upgradient of the assumed potential source area in an attempt to eliminate possible upgradient VOC sources south of Coulson's Ditch. Lines 2 through 4 were completed to assess the VOC plume's cross-gradient margins. Additionally, one line of three hole locations (Line 5) was installed within the center of the VOC plume, along the plume's axis. All Line 5 locations were sampled at approximate depths of 10, 20, and 30 feet to evaluate the vertical groundwater chemistry within the center of the VOC plume. Additional vertical data was collected at locations DP-13, DP-14, DP-61, and DP-63 (Plate 1). Additional point locations were added at DP-17 and DP-64, and points DP-71 through DP-75 were completed to better define the background groundwater chemistry. The locations of all direct-push points are illustrated on Plate 1.

2.1.3 Groundwater Monitor Well Installation

After on site review of groundwater VOC concentration data, locations of eleven groundwater monitor wells were selected. The wells were subsequently installed between 23 September and 1 October 1999. The Sampling Plan had called for the installation of eight monitor wells, but based on preliminary data, the planned upgradient well was relocated. An additional center-of-plume and two cross gradient wells were also added to the installation program.

The newly installed groundwater monitor wells (EPA-1 through EPA-11) are the primary components of the Lomond Lane area permanent groundwater quality monitoring network. The network can continually provide information on the geochemistry of the plume, as well as information on groundwater flow direction, gradient, and velocity.

The locations of the eleven monitor wells are illustrated on Plate 1. Four wells (EPA-7, EPA-8, EPA-9, and EPA-11) were located within the center of the VOC plume along its axis. Six wells were installed along the cross-gradient margins (three on each side, EPA-2, EPA-3, and EPA-4 west of the plume, and EPA- 5, EPA-6, and EPA-10 east of the plume). One well (EPA-1) was installed upgradient of the VOC plume.

The groundwater monitor wells were installed by conventional hollow stem auger (HSA) drilling methods. Lithologic samples were collected using split spoon sampling techniques (as provided in the Sampling Plan). The wells were constructed of flush-joint, threaded 2-inch inner-diameter well casings with a 10 foot 0.010-inch slot well screen set at the bottom of each well string. The three wells installed within the center of the VOC plume (EPA-7, EPA-9, and EPA-11) were constructed of stainless steel (with the above-ground portion of the well constructed of PVC), while the remainder of the wells were constructed entirely of PVC. All wells were completed above grade, and protected by locking steel casings.

During monitor well completions "flowing" sand was a problem which resulted in some modifications of well screen positions. Flowing sand is a phenomena where saturated formation material flows into and up through the HSA string during periods of drilling inactivity. This also hindered insertion of the artificial sand pack, resulting in the wells being mainly naturally sand packed with aquifer material. The natural formation contains varying amounts of silt and clay (finer than the well screen openings) which entered the wells during purging. Over time this should diminish. Following completion, the wells were developed, clearing much of the fine-grained material from each well and ensuring transmission of groundwater into the wells.

Appendix A includes the well log reports submitted (as required) to the State of Montana. These logs include a description of subsurface geologic materials encountered during the completion of the well bores, as well as data on groundwater depth and well construction.

2.1.4 Groundwater Monitor Well Sampling and Elevation Gauging

Subsequent to the installation of the groundwater monitor wells, each was monitored for water levels and sampled. Each well was gauged for depth to groundwater on 19 October 1999 (Table 1). All wells were sampled for off site groundwater quality assessment by Paragon for VOC analyses by SW-846 Method 524.2. The monitor wells were sampled employing standard U.S. EPA procedures.

2.1.5 Horizontal Location and Vertical Elevation Surveys

Accurately located field data points are depicted on an enlarged 1997 air photograph on Plates 1 through 6. The horizontal positions of the direct-push point, residential well, and surface water quality sampling locations were acquired using the global positioning system (GPS) equipment and software. The horizontal positions of the monitor wells, Coulson's Ditch surface water elevation measurements, and two soil boring locations were determined by a licensed land surveyor. The Surveyor also determined the vertical ground level and top of PVC elevation for the monitor wells and position elevation for the Coulson's Ditch monitoring points. The horizontal positions of major road intersections were also determined. These positions allowed the data to be brought into the computer assisted drafting environment and positioned on the digitized air photograph. Appendix B contains the data and notes from the professional land survey specific to horizontal locations of the groundwater monitor wells, and the vertical data for the wells and ditch monitoring points (vertical data also summarized in Table 1).

2.2 Potential Source Area VOC Assessment

The Sampling Plan for this investigation called for an assessment of what appeared to be the VOC potential source area near Kuck Trucking based on the Pioneer studies. Elements of the assessment are discussed in sections 2.2.1, 2.2.2, and 2.2.3 below.

2.2.1 Potential Source Area Soil Gas Survey

Prior to evaluation of early groundwater data, several soil gas samples were collected for on site analysis. These samples were collected from the approximate area outlined in Plate 1.

2.2.2 Potential Source Area EM-31 Geophysical Survey

An EM-31 Survey was conducted to evaluate the reports of buried drums/tanks received by local residents and surmised by the Pioneer reports in the approximate area outlined in Plate 1. The EM-31 survey was conducted in the in-phase mode, essentially functioning as a metal detector.

2.2.3 Potential Source Area Soil Sampling

Originally the Sampling Plan called for collection of subsurface soil samples from an area defined by the soil gas survey. However, based upon preliminary data, several subsurface soil samples were collected above the water table south of Coulson's Ditch to document soil quality at three locations: SB-1 (3.0-4.5 feet), SB-2 (1.5-3.0feet), and EPA-11 (1.5-3.0 feet and 4.5-6.0feet) (Plate 1). Collected soil samples were submitted to Paragon for VOC analysis by SW-846 Method 8260B.

2.3 Indoor Residential Air Quality Evaluation

Indoor residential air quality sampling was conducted at 403 and 418 Lomond Lane in order to assess whether VOCs were emanating from the VOC groundwater plume through the overburden and entering residences. This sampling was conducted in the residence's living space and crawl space. Collected samples were submitted to Air Toxics LTD. for analysis. These samples, including results and interpretations, are summarized in *URS Operating Services, Inc. (1999), Sampling Activities Report, Lockwood Solvent Site, Lockwood, Montana.*

2.4 Coulson's Ditch Surface Water Quality Assessment

Preliminary groundwater results indicated the potential VOC source to be southeast (upgradient) of Coulson's Ditch. A modification to the field program, as defined in the Sampling Plan, was made in the field to include collection of three surface water samples from Coulson's Ditch. The purpose of this sampling was to evaluate if detectable concentrations of VOCs were in the surface water flowing through the VOC plume in hydraulic communication with the water table aquifer. Three samples were collected (SW-1, SW-2, and SW-3 - Plate 1) and were analyzed on site by the Viking GC/MS.

3.0 RESULTS

3.1 Groundwater VOC Plume Delineation

3.1.1 Hydrogeology

Based upon observations made during direct-push operations and soil boring completions, the water table aquifer in the Lomond Lane area is comprised of unconsolidated fluvial sediments. These deposits are coarse-grained river channel sediment such as sand and gravel deposited within the paleo-Yellowstone River, interfingered with finer grained deposits which accumulated in slower moving water along the ancient river channel margins. The river channel deposits can be well sorted, but can also be poorly sorted containing some silt. The fine-grained deposits are clay and silt, with lesser amounts of sand and gravel, sometimes very loosely compacted, but not horizontally extensive. Appendix A contains the Montana Well Log Reports for the eleven newly installed monitor wells, which include geologic and hydrogeologic observations in addition to well construction and completion details.

The thickness of the unconsolidated deposits was determined to be 23 feet, 25 feet, 23.5 feet, and 31.5 feet (for an average of 25.75 feet), at EPA-2, EPA-5, EPA-6, and EPA-7, respectively. Bedrock was a grey sandstone at EPA-2 and EPA-7, and was a dark brown shale at EPA-5 and EPA-6. Geologic data below top of bedrock was not acquired as part of this investigation.

The depth to groundwater at the eleven monitor well locations varied from 4.2 feet to 12.8 feet, and averaged 6.9 feet. The saturated aquifer thickness from the water table to bedrock (at the four borings locations which were advanced to bedrock) averaged 19.5 feet in thickness.

Plate 2 illustrates groundwater elevation data (summarized in Table 1) and contours for the eleven new wells as gauged on 19 October 1999. The groundwater flow direction based upon these data is also presented. In general, groundwater flow south of Coulson's Ditch from EPA-1 to the ditch is towards the northwest. North of the ditch the flow direction widens with components of flow towards both the north-northwest and to the north. Also presented on Plate 2 are the surface water elevation data at points C-1 and C-2 (also summarized in Table 1). This data was not used in preparation of the groundwater elevation contours (or flow direction determination). However at the time of the 19 October 1999 gauging, water levels in the monitor wells were consistent with levels at ditch points C-1 and C-2.

The calculated groundwater gradient (i) corresponding to the groundwater flow direction as depicted on Plate 2 is approximately 0.004 feet per foot. Assuming a horizontal hydraulic conductivity (K) of 1,000 gallons per day per square foot, and a porosity (n) of 30 percent (both standard for these types of sediments), and converting from gallons to cubic feet, the groundwater velocity (V), in feet per day, has been calculated using the following equation:

$$V = K\, i / n\, (7.48)$$

3.1.4 Vertical Distribution of PCE and Associated Compounds Within The Horizontal Extent of The Lomond Lane Area VOC Plume

During the direct-push portion of the groundwater investigation, several direct-push sampling locations were sampled at multiple vertical positions to allow evaluation of the vertical distribution of primary VOCs in the water table aquifer. Figure 2 presents the vertical data at select direct-push locations along the VOC plume axis (vertical profile), the location of which is depicted on Plate 1.

The majority of vertical VOC profile data presented in Figure 2 are consistent with what is expected along the axis of an older chlorinated hydrocarbon plume. The highest concentrations of PCE measured in the plume are not indicative of a pure phase product. PCE and related breakdown products (Figure 1) are distributed throughout the water column in ratios expected after a period of considerable residence time. This is consistant with PCE behavior at these concentrations. Vertical data at DP-51 and DP-52 (Figure 2) indicate elevated concentrations of PCE and breakdown compounds throughout the water column. Further down gradient (DP-53), detected concentrations increased downward through the water column, indicating the downward vertical migration of VOCs along the plume axis. This is likely the result of the active pumping of local residential wells and/or recharge from precipitation.

Vertical data at DP-63 further up gradient indicated that 2,700 ppb of PCE is located just above bedrock at 27-30 feet below land surface. However, at this point the 9 to 12 foot sample contained 1,800 ppb of cis-1,2-DCE and 610 ppb of vinyl chloride. DP-63 and EPA-11 are located in the same position. Monitor well EPA-11, screened at the interval 15 to 25 feet, contained only 95 ppb of PCE, but 1,700 ppb of cis-1,2-DCE and 770 ppb of vinyl chloride. These data indicate that the well was completed in a different zone than the zone containing the highest concentration of PCE just above the bedrock at DP-63.

3.2 Potential Source Area VOC Assessment

Several soil gas samples were collected in the area illustrated on Plate 1. Data generated for these samples were reported in a separate REAC analytical report not included herein. Although VOC compounds were detected in the samples, concentrations were not elevated to levels indicative of a potential source area. The concentrations are consistent with off-gassing of the VOC groundwater plume.

The EM-31 electromagnetic geophysical survey revealed no evidence of buried metallic debris in the area delineated on Plate 1.

Based on a review of preliminary results of the soil gas data, the EM-31 survey, and the direct-push groundwater data, the scope of the potential source area VOC assessment at Kuck Trucking was reduced, and only four soil samples were collected from a low lying area immediately south of Coulson's Ditch (Plate 1) that may have received runoff from the upgradient facility. Soil samples at DP-51 were not collected because preliminary soil gas and vertical groundwater samples were not present at levels indicative of a potential source area. Results of the analyses of the four soil are presented in Appendix F. Although low levels of PCE, TCE, and cis-1,2-DCE were measured in several of the samples, the detected concentrations are not elevated to levels indicative of a potential source area but are at concentrations consistent with off-gassing of the VOC groundwater plume.

3.3 Assessment of Age and Volume of Release(s) Responsible For The Identified VOC Groundwater Plume

This section attempts to calculate the approximate volume of the release of PCE and estimates the approximate age of the groundwater VOC plume. Assumptions have been made and therefore care should be exercised when using these calculations for anything more than discussion purposes.

The VOC analyses indicate the presence of PCE and related breakdown compounds (such as TCE, cis-1,2-DCE, and vinyl chloride) in the groundwater (Figure 1, Table 2). The relative proportion of PCE to the various breakdown compounds indicates that the PCE has been dissolved in the site groundwater for a significant period of time. This is further supported as the breakdown products are present at significant concentrations relative to PCE at both the upgradient and downgradient areas of the plume. Because the plume is approximately 3,000 feet in length, and the calculated groundwater flow velocity is approximately 650 feet per year, the minimum age of the plume is estimated to be approximately 5 years. The concentration of the parent compound (PCE) near the potential source appears to be decreasing, as the highest VOC concentrations are present downgradient (Plate 3). This indicates the plume age is likely to be an additional 5 to 10 years, for an approximate speculated minimum age of 10 to 15 years.

The dimensions of the identified VOC plume are approximately 3,000 feet in length (l), 1,000 feet in width (w), and 20 feet in thickness (t). Assuming a porosity of thirty percent, and converting from cubic feet to gallons, the volume of groundwater within the plume (V), in gallons, is:

$$V = l\ w\ t\ (0.3)\ (7.48)$$

Therefore, $V = (3{,}000)\ (1{,}000)\ (20)\ (0.3)\ (7.48) = 1.35 \times 10^{8}$ gallons

Assuming an average PCE concentration within the plume of 500 ppb, the percentage of PCE in groundwater is 5.0×10^{-7}. The volume of PCE (V_{PCE}) within the plume is therefore estimated as:

$$V_{PCE} = (1.35 \times 10^{8} \text{ gallons})\ (5.0 \times 10^{-7}) = 67.5 \text{ gallons}$$

Assuming one half of the original PCE has broken down to other compounds, the estimate for V_{PCE} can be doubled to approximately 135 gallons. As it is likely that additional PCE is present in the source area, and that some has biodegraded or entered the Yellowstone River, it is estimated that the release of PCE to the groundwater at the Lomond Lane area was approximately 200 gallons. It is unknown if the release was catastrophic, or slow but continuous over time.

3.4 Indoor Residential Air Quality Evaluation

Results of the indoor residential air quality evaluation are presented in a separate report, not contained herein, entitled *URS Operating Services, Inc. (1999), Sampling Activities Report, Lockwood Solvent Site, Lockwood, Montana.* This report also presents a discussion of results for the air quality analytical data.

3.5 Coulson's Ditch Surface Water Quality Assessment

Three surface water samples (SW-1, SW-2, and SW-3) were collected during the field program to assess the potential affect of the VOC plume on Coulson's Ditch (Plate 1). These samples were analyzed on site by the REAC Viking GC/MS and are presented within Appendix E. No detectable concentration of any VOC compound was evident in these three surface water samples. Therefore there is no apparent affect of the VOC plume on water quality in Coulson's Ditch.

4.0 SUMMARY OF RESULTS

The potable groundwater zone in use at the Lomond Lane area is the shallow water table aquifer comprised of an approximately 25-foot thick (20-foot saturated thickness) section of river channel and river margin sediment above sedimentary rock. A well defined VOC plume, comprised mainly of PCE, TCE, cis-1,2-DCE, and vinyl chloride, has been characterized by a groundwater sampling program utilizing residential wells, direct-push grab groundwater samples, and newly installed groundwater monitor wells.

The distribution pattern of the PCE isoconcentration contours indicates that the highest concentrations are downgradient of a yet to be identified specific source, although elevated levels were detected to the southeast as far as monitor well EPA-11 (Plate 3). This indicates that the source of the PCE is decreasing, and that the release is relatively old. Figure 1 indicates that PCE breakdown products (TCE, cis-1,2-DCE, and vinyl chloride) are most elevated near the source (Plates 4 through 6). Downgradient of the source the PCE, TCE, and cis-1,2-DCE plumes (Plates 3-5) are depicted by contours opening towards the Yellowstone River, while the vinyl chloride plume (Plate 6) is closed. This is consistent with PCE breakdown as vinyl chloride is the final breakdown compound (Figure 1). Small depression contours are illustrated on Plates 3 and 6, centered at 403 Lomond Lane. These are probably due to the usage of RW-10 (the first residential well downgradient of the source along the plume axis) which likely induces local groundwater movement of cleaner water towards the well.

Groundwater within the identified VOC plume has been impacted by the primary VOCs at concentrations in excess of Federal and State drinking water standards. The Federal drinking water standards for PCE, TCE, cis-1,2-DCE, and vinyl chloride are 5 ppb, 5 ppb, 70 ppb, and 2 ppb, respectively. Much of the plume is above Federal removal action levels. The plume has an imminent and substantial impact on many residential wells.

The release of VOCs to groundwater is estimated to have occurred a minimum of 10-15 years ago, and the volume of the release of PCE is estimated to have been approximately 200 gallons. The surface water quality in the ditch does not seem to be affected by the VOC plume passing through and/or beneath it, but the seasonal relationship between the ditch and the identified VOC plume should be monitored. The installed groundwater monitor well network is well positioned for future groundwater plume monitoring supplemented by select residential wells.

The majority of vertical VOC profile data presented in Figure 2 are consistent with what is expected along a plume axis of an older chlorinated hydrocarbon plume. PCE and related breakdown products (Figure 1) are distributed throughout the water column in ratios expected after a period of considerable time. Vertical data at DP-51 and DP-52 (Figure 2) indicate elevated concentrations of PCE and breakdown compounds throughout the water column. Further downgradient (DP-53), concentrations increase donwards through the water column, indicating the downward vertical migration of VOCs along the plume axis. This is likely the result of local residential wells being utilized.

Data from the potential source area VOC assessment at Kuck Trucking indicate there are no buried drums or underground storage tanks in the area identified on Plate 1. The results of a limited soil gas survey did not reveal a zone of elevated soil contamination in the area identified on Plate 1.

Based upon the groundwater flow pattern and the VOC plume position the potential source of VOCs affecting the area groundwater quality is likely on the HCI Dyce Chemical, Inc. (HCI Dyce) property. Isoconcentration contours open towards the southeast at the operating area fenceline. Analytical data upgradient and surrounding the HCI Dyce property indicate that there is no potential source upgradient of HCI Dyce. Further investigation is necessary to determine the actual extent and magnitude of PCE soil and groundwater contamination on the HCI Dyce facility.

5.0 REFERENCES

Lockheed Martin/REAC. October 13, 1999. Final Sampling Plan, PCE Groundwater Plume and Potential source area Delineation Evaluation, Lockwood Solvent Site, Lockwood, Montana.

Pioneer Technical Services, Inc. January 1999. Sampling and Analytical Results Report for the Lockwood Solvent Site, Lockwood, Montana.

Pioneer Technical Services, Inc. April 1999. Final Sampling and Analytical Results Report for the Lockwood Solvent Site - Lomond Lane Area, Billings, Montana.

URS Operating Services, Inc. November 1999. Sampling Activities Report, Lockwood Solvent Site, Lockwood, Montana.

TABLE 1

GROUNDWATER AND SURFACE WATER ELEVATION DATA
LOCKWOOD SOLVENT SITE - LOMOND LANE AREA
LOCKWOOD, MONTANA

Monitoring Well Identification	Elevation Ground Level (Feet MSL)	Elevation Top PVC (Feet MSL)	Depth to Groundwater From Top of PVC 19-Oct-1999 (Feet)	Groundwater Elevation (Feet MSL) 19-Oct-1999
EPA-1	3,107.75	3,110.80	15.64	3,095.16
EPA-2	3,095.03	3,097.57	7.99	3,089.58
EPA-3	3,089.61	3,092.73	8.61	3,084.12
EPA-4	3,091.46	3,094.16	11.47	3,082.69
EPA-5	3,088.49	3,091.27	9.88	3,081.39
EPA-6	3,090.28	3,093.06	9.07	3,083.99
EPA-7	3,092.38	3,095.23	8.78	3,086.45
EPA-8	3,089.54	3,091.96	9.51	3,082.45
EPA-9	3,089.30	3,091.79	7.83	3,083.96
EPA-10	3,095.40	3,098.00	6.75	3,091.25
EPA-11	3,094.75	3,097.39	7.22	3,090.17

Coulson's Ditch Monitoring Point	Elevation Top of Culvert (Feet MSL)	Depth to Surface Water From Top of Culvert 19-Oct-1999 (Feet)	Surface Water Elevation (Feet MSL) 19-Oct-1999
C-1 (East Side at Lomond Lane)	3,092.35	3.03	3,089.32
C-2 (West Site at Klenck Lane)	3,092.68	3.52	3,089.16

NOTE: MSL - Mean Sea Level.

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VOC CONCENTRATIONS IN GROUNDWATER
LOCKWOOD SOLVENT SITE - LOMOND LANE AREA
LOCKWOOD, MONTANA

RESIDENTIAL WELL SAMPLES

Sample I.D.	Date Sampled	Data Source	PCE	TCE	c-1,2-DCE	VC
RW-1	20-Sep-99	Paragon	0.5 U	2.8	0.86	0.5 U
RW-2	20-Sep-99	Paragon	1.0 U	1.3	0.54 J	1.0 U
RW-3	20-Sep-99	Paragon	0.5 U	2.3	0.43 J	0.5 U
RW-4	20-Sep-99	Paragon	340	64	140	5.0 U
RW-4	13-Sep-99	Viking	370	66	140	20 U
RW-5	20-Sep-99	Paragon	240	52	130	5.0 U
RW-5	13-Sep-99	Viking	210	43	100	20 U
RW-6	20-Sep-99	Paragon	0.5 U	8.2	0.72	0.5 U
RW-7 (RW-6 Dup)	20-Sep-99	Paragon	0.5 U	8.0	0.72	0.5 U
RW-8	14-Sep-99	Paragon	2.4	1.0	4.4	0.5 U
RW-8	14-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
RW-9	14-Sep-99	Paragon	990	130	330	49
RW-9	14-Sep-99	Viking	950	120	300	32 J
RW-10	14-Sep-99	Paragon	1,500	100	240	47
RW-10	14-Sep-99	Viking	1,600	100 U	210	100 U
RW-11	14-Sep-99	Paragon	990	140	390	87
RW-11	14-Sep-99	Viking	910	120	340	53
RW-12	14-Sep-99	Paragon	37	5.0	8.4	0.5 U
RW-12	14-Sep-99	Viking	24	5.0 U	5.8 J	5.0 U
RW-13	14-Sep-99	Paragon	18	2.7	1.5	0.5 U
RW-13	14-Sep-99	Viking	19	5.0 U	5.0 U	5.0 U
RW-14	14-Sep-99	Paragon	3.4	2.5	0.81	0.5 U
RW-14	14-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
RW-15	20-Sep-99	Paragon	0.5 U	0.78	0.58	0.5 U
RW-16	20-Sep-99	Paragon	0.5 U	0.69	0.26 J	0.5 U
RW-17	20-Sep-99	Paragon	0.5 U	4.4	5.6	0.5 U
RW-18	20-Sep-99	Paragon	0.5 U	3.4	3.9	0.5 U
RW-19	15-Sep-99	Paragon	43	5.9	4.4	1.0 U
RW-19	15-Sep-99	Viking	42	5.5 J	5.0 U	5.0 U

TABLE 2

VOC CONCENTRATIONS IN GROUNDWATER
LOCKWOOD SOLVENT SITE - LOMOND LANE AREA
LOCKWOOD, MONTANA

RESIDENTIAL WELL SAMPLES

Sample I.D.	Date Sampled	Data Source	PCE	TCE	c-1,2-DCE	VC
RW-20	15-Sep-99	Paragon	250	50	160	25
RW-21 (RW-20 Dup)	15-Sep-99	Paragon	240	48	160	24
RW-20	15-Sep-99	Viking	250	47	140	17
RW-20 (Dup)	15-Sep-99	Viking	260	46	140	17
RW-22	15-Sep-99	Paragon	0.5 U	0.42 J	0.66	0.5 U
RW-23	15-Sep-99	Paragon	0.5 U	0.21 J	0.5 U	0.5 U
RW-24	15-Sep-99	Paragon	0.5 U	0.96	0.6	0.5 U
RW-25	15-Sep-99	Paragon	0.5 U	4.7	5.3	0.5 U
RW-26	15-Sep-99	Paragon	49	5.7	1.9	1.0 U
RW-27	15-Sep-99	Paragon	36	4.4	3.4	0.5 U
RW-28	15-Sep-99	Paragon	220	49	140	5.0 U
RW-28	15-Sep-99	Viking	250	48	120	20 U
RW-29	21-Oct-99	Paragon	100	18	53	5

VOC CONCENTRATIONS IN GROUNDWATER
LOCKWOOD SOLVENT SITE - LOMOND LANE AREA
LOCKWOOD, MONTANA

DIRECT-PUSH GROUNDWATER SAMPLES

Sample I.D.	Date Sampled	Data Source	PCE	TCE	c-1,2-DCE	VC
DP-11 (18'-21')	16-Sep-99	Viking	5.0 U	7.4 J	5.0 U	5.0 U
DP-12 (18'-21')	16-Sep-99	Viking	5.0 U	13	13	5.0 U
DP-13 (9'-12')	16-Sep-99	Viking	5.0 U	5.0 U	13	5.0 U
DP-13 (18'-21')	16-Sep-99	Viking	5.0 U	5.7 J	37	5.0 U
DP-13 (18'-21') Dup	16-Sep-99	Viking	5.0 U	6.2 J	39	5.0 U
DP-14 (10'-11')	16-Sep-99	Viking	680	62	210	25 U
DP-14 (18'-21')	16-Sep-99	Paragon	1,500	350	1,300	330
DP-14 (18'-21')	16-Sep-99	Viking	1,500	350	1,300	250
DP-15 (18'-21')	15-Sep-99	Paragon	5.9	1.7	19	0.5 U
DP-15 (18'-21')	15-Sep-99	Viking	6.6 J	5.0 U	19	5.0 U
DP-16 (16'-17')	15-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-17 (18'-21')	16-Sep-99	Paragon	1,600	110	360	120
DP-17 (18'-21')	16-Sep-99	Viking	1,800	110 J	350	100 U
DP-21 (21'-24')	17-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-22 (20'-23')	17-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-23 (18'-21')	17-Sep-99	Viking	280	76	360	53
DP-24 (21'-24')	18-Sep-99	Viking	76	5.0 U	6.1	5.0 U
DP-25 (21'-24')	18-Sep-99	Paragon	0.19 J	0.14 J	0.21 J	0.5 U
DP-25 (21'-24')	18-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-26 (16'-19')	18-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-31 (21'-24')	17-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-32 (21'-24')	17-Sep-99	Viking	140	27	85	11
DP-33 (21'-24')	17-Sep-99	Viking	310	54	200	27 J
DP-34 (21'-24')	18-Sep-99	Viking	1,200	110	270	39
DP-35 (18'-21')	18-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-36 (21'-24')	18-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-41 (21'-24')	16-Sep-99	Viking	150	5.0 U	5.0 U	5.0 U

TABLE 2

VOC CONCENTRATIONS IN GROUNDWATER
LOCKWOOD SOLVENT SITE - LOMOND LANE AREA
LOCKWOOD, MONTANA

DIRECT-PUSH GROUNDWATER SAMPLES

Sample I.D.	Date Sampled	Data Source	PCE	TCE	c-1,2-DCE	VC
DP-42 (18'-21')	17-Sep-99	Viking	250	47	74	5.0 U
DP-43 (21'-24')	17-Sep-99	Viking	270	53	110	10 U
DP-44 (21'-24')	18-Sep-99	Viking	870	110	290	40
DP-45 (21'-24')	18-Sep-99	Viking	78	6.4 J	10	5.0 U
DP-46 (21'-24')	18-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-51 (9'-12')	15-Sep-99	Paragon	4,200	160	420	100 U
DP-51 (9'-12')	15-Sep-99	Viking	3,900	130 J	370	100 U
DP-51 (18'-21')	15-Sep-99	Viking	3,300	200 U	270 J	200 U
DP-51 (27'-30')	15-Sep-99	Viking	4,000	100 U	310	100 U
DP-52 (9'-12')	15-Sep-99	Viking	980	140 J	380	100 U
DP-52 (18'-21')	15-Sep-99	Viking	2,100	110	290	53 J
DP-52 (18'-21') Dup	15-Sep-99	Viking	2,000	110	300	53 J
DP-52 (27'-30')	15-Sep-99	Viking	1,900	100 U	190 J	100 U
DP-53 (9'-12')	15-Sep-99	Viking	450	93 J	360	50 U
DP-53 (18'-21')	15-Sep-99	Viking	850	130	430	71
DP-53 (27'-30')	15-Sep-99	Viking	1,400	170	460	82
DP-61 (9'-12')	16-Sep-99	Viking	5.0 U	5.8 J	5.0 U	5.0 U
DP-61 (18'-21')	16-Sep-99	Viking	5.0 U	8.0 J	5.0 U	5.0 U
DP-62 (18'-21')	16-Sep-99	Viking	17	26	570	18
DP-63 (10'-11')	15-Sep-99	Viking	240	130	1,800	610
DP-63 (18'-21')	15-Sep-99	Paragon	340	50	560	330
DP-63 (18'-21')	15-Sep-99	Viking	360	50 U	460	210
DP-63 (27'-30')	15-Sep-99	Paragon	2,200	210	520	220
DP-63 (27'-30')	15-Sep-99	Viking	2,700	240	510	260
DP-64 (18'-21')	17-Sep-99	Viking	5.0 U	5.0 U	11	5.0 U

TABLE 2

VOC CONCENTRATIONS IN GROUNDWATER
LOCKWOOD SOLVENT SITE - LOMOND LANE AREA
LOCKWOOD, MONTANA

DIRECT-PUSH GROUNDWATER SAMPLES

Sample I.D.	Date Sampled	Data Source	PCE	TCE	c-1,2-DCE	VC
DP-71 (18'-21')	20-Sep-99	Paragon	0.5 U	**1.0**	0.5 U	0.5 U
DP-71 (18'-21')	20-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-72 (18'-21')	20-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-73 (21'-24')	20-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-74 (21'-24')	20-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U
DP-75 (21'-24')	20-Sep-99	Viking	5.0 U	5.0 U	5.0 U	5.0 U

VOC CONCENTRATIONS IN GROUNDWATER
LOCKWOOD SOLVENT SITE - LOMOND LANE AREA
LOCKWOOD, MONTANA

GROUNDWATER MONITOR WELL SAMPLES

Sample I.D.	Date Sampled	Data Source	PCE	TCE	c-1,2-DCE	VC
EPA-1	21-Oct-99	Paragon	0.5 U	0.5 U	0.5 U	0.5 U
EPA-2	21-Oct-99	Paragon	0.5 U	4.9	0.52	0.5 U
EPA-3	21-Oct-99	Paragon	2.8	2.1	2.3	0.5 U
EPA-4	21-Oct-99	Paragon	55	7.9	9.9	2.5 U
EPA-5	21-Oct-99	Paragon	0.48 J	0.29 J	0.93	0.5 U
EPA-6	21-Oct-99	Paragon	0.5 U	0.5 U	0.39 J	0.5 U
EPA-7	21-Oct-99	Paragon	1,700	41 J	180	32 J
EPA-8	21-Oct-99	Paragon	570	99	340	55
EPA-9	21-Oct-99	Paragon	570	250	870	93
EPA-10	21-Oct-99	Paragon	0.5 U	0.18 J	0.26 J	0.5 U
EPA-11	21-Oct-99	Paragon	95	34	1,700	770
EPA-12 (EPA-11 Dup)	21-Oct-99	Paragon	88	33	1,700	770

NOTES:

Data Reported in ug/L (ppb).
Paragon - Paragon Analytics, Inc.
Viking - REAC's On-Site GC/MS.
PCE - Tetrachloroethene.
TCE - Trichloroethene.
c-1,2-DCE - Dichloroethene.
VC - Vinyl Chloride.
U - Compound Not Detected Above Listed Detection Limit.
J - Estimated Value Below Detection Limit.

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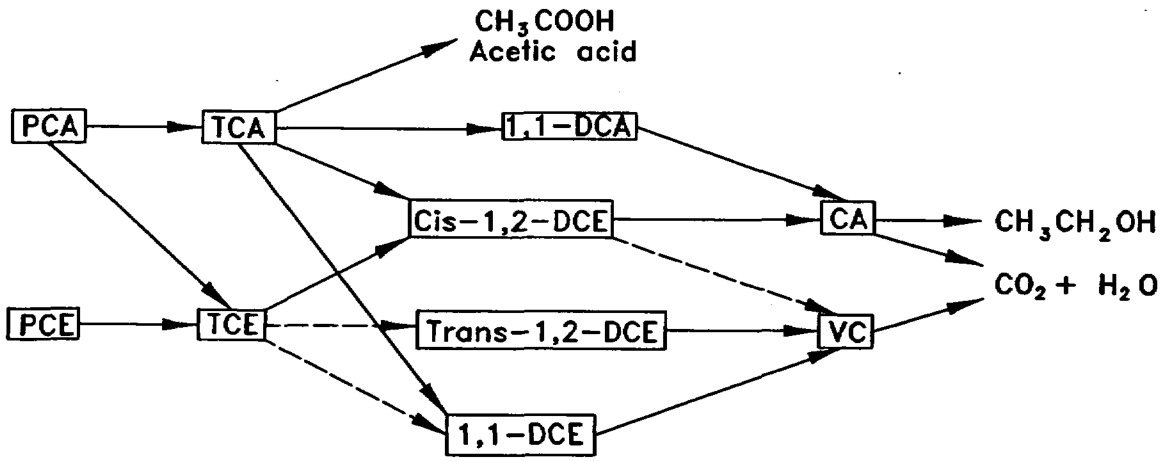
TABLE 3

RESIDENTIAL WELL AND AIR SAMPLE IDENTIFICATIONS REFERENCED TO STREET ADDRESSES LOCKWOOD SOLVENT SITE - LOMOND LANE AREA LOCKWOOD, MONTANA

Street Address	Residential Well Identifications	Residential Air Sample Locations
366 Boonie	RW-14	
139 Cerise	RW-18	
140 Cerise	RW-25	
179 Cerise	RW-17	
1112 Doon	RW-19	
1117 Doon	RW-13	
1135 Doon	RW-29	
1107 Island Park	RW-15	
1115 Island Park	RW-24	
510 Klenck	RW-22	
542 Klenck	RW-23	
139 Lomond	RW-3	
232 Lomond	RW-2	
236 Lomond	RW-1	
345 Lomond	RW-12	
349 Lomond	RW-8	
403 Lomond	RW-10	RA-1 & RA-2 (crawl space), RA-3 (dining room)
418 Lomond	RW-11	RA-4 (crawl space), RA-5 (living room)
505 Lomond	RW-9	
522 Lomond	RW-20 & RW-21	
528 Lomond	RW-28	
534 Lomond	RW-5	
546 Lomond	RW-4	
327 Sandy	RW-16	
516 Sandy	RW-26	
517 Sandy	RW-27	
1307 Taylor	RW-6 & RW-7	

filename: lockdata5.wb3



Major Mechanism

Biodegradation

↓

Abiotic elimination
Biodegradation

↓

Footnotes

– – – – Minor pathway
Cis-1,2-DCE generates at approximately 30 times the concentration of trans-1,2-DCE(3) and by a factor of 25:1 (8).

PCA	=	Tetrachloroethane
1,1,1-TCA	=	1,1,1-Trichloroethane
1,1-DCA	=	1,1-Dichloroethane
Cis-1,2-DCE	=	Cis-1,2-Dichloroethene
CA	=	Chloroethane
PCE	=	Tetrachloroethene
TCE	=	Trichloroethene
Trans-1,2-DCE	=	Trans-1,1-Dichloroethene
VC	=	Vinyl chloride
1,1-DCE	=	1,1-Dichloroethene

Source: Predicting the fate and Transport of Organic Compounds in Groundwater, Hazardous Materials Control, Roger L. Olsen, Andy Davis, July/August, 1990.

U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
68-C99-223
W.O.# R1A00077

FIGURE 1
TRANSFORMATION OF CHLORINATED ALIPHATIC HYDROCARBONS
LOCKWOOD SOLVENT SITE-
LOMOND LANE AREA
LOCKWOOD, MONTANA
NOVEMBER 1999

077_FIG1.DWG 11/5/99

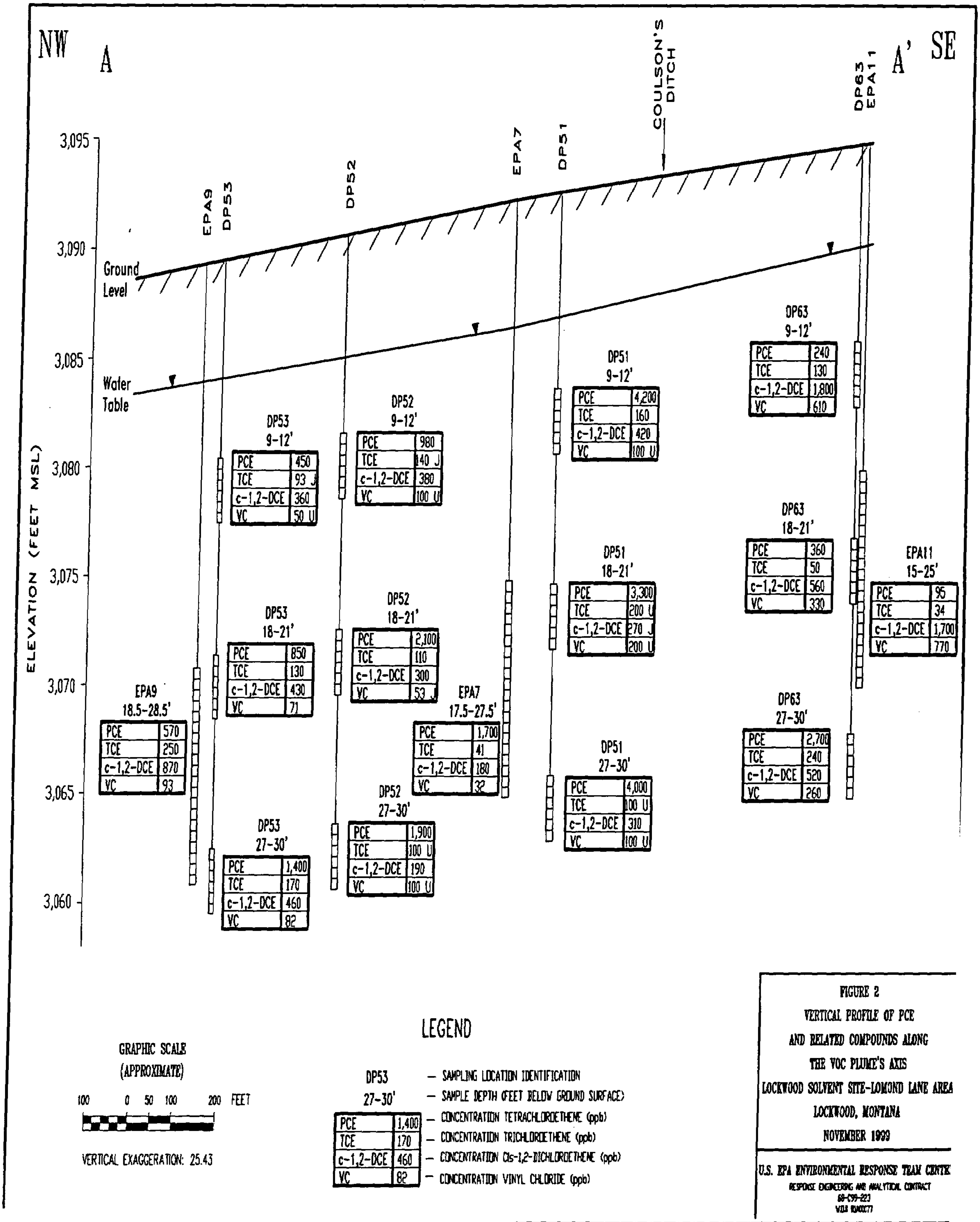


FIGURE 2
VERTICAL PROFILE OF PCE AND RELATED COMPOUNDS ALONG THE VOC PLUME'S AXIS
LOCKWOOD SOLVENT SITE-LOMOND LANE AREA
LOCKWOOD, MONTANA
NOVEMBER 1999

Attachment 3

ALTERNATIVES ANALYSIS

LOCKWOOD SOLVENTS
Lockwood, Yellowstone County, Montana

EPA Contract No. 68-W5-0031
TDD No. 9907-0016

Prepared By:
Aaron Burns
Environmental Scientist

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Approved: [signature] Date: 10/24/99
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Approved: C.W. B[signature] FOR Date: 10/11/99
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DISTRIBUTION LIST

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ALTERNATIVES ANALYSIS

LOCKWOOD SOLVENTS
Lockwood, Yellowstone County, Montana

TABLE OF CONTENTS

1.0 INTRODUCTION

URS Operating Services Inc. (UOS) has been tasked by the U.S. Environmental Protection Agency (EPA), Region VIII, under TDD# 9907-0016 to conduct an Alternatives Analysis for the remediation of household water at the Lockwood Solvents site in Lockwood, Yellowstone County, Montana. Many of the wells in the town of Lockwood, Montana, are contaminated with chlorinated solvents. Currently the EPA and the Montana Department of Environmental Quality (MDEQ) are providing bottled water to eight residences that have wells with Perchloroethene (PCE) contamination above the Removal Action Level (RAL) of 70 ppb. Continuing the current bottled water system is unacceptable due to the high cost and contaminant exposure to the residents from showering and engaging in other water-related activities.

Four alternatives have been identified for evaluation to determine the most feasible and cost effective remedial measure. The following alternatives will be evaluated as part of this analysis:

1) No action;
2) Whole house air stripping;
3) Whole house carbon filtering; and
4) Connecting the affected homes to the municipal water supply.

Alternative 1, no action, has been evaluated and would result in continued cost for bottled water and contaminant exposure to residents via water use for purposes other than drinking. Alternatives 2 and 3 consist of removing the contaminants from the well water to concentrations below the EPA Maximum Contaminant Level (MCL) of less than 5 parts per billion (ppb). In these alternatives, all the water used by the household will be treated by a residential filtering or stripping system located next to or inside the home. Alternative 4 consists of extending the water main and connecting the homes to the municipal water system.

2.0 BACKGROUND

The Lockwood Solvents site consists of a contaminated groundwater plume located in the town of Lockwood, Yellowstone County, Montana, east of the city of Billings, southeast of the Yellowstone River. The source of the contamination is currently unidentified. The site is occupied by mixed residential, commercial, and light industrial properties in the Lomond Lane area. Pioneer Technical Services, Inc. (Pioneer) investigated the site in January and April 1999 for the MDEQ and reported analytical results, sample locations, and maps of contaminant plumes (Pioneer Technical Services, Inc. (Pioneer) 1999a; Pioneer 1999b). The Pioneer reports identified volatile organic compounds (VOCs) impacting the local groundwater through a local residential well sampling and a limited direct-push technology groundwater sampling program. The primary VOCs identified were Tetrachloroethene or Perchloroethene (PCE), Trichloroethene (TCE), and cis-1,2-Dichloroethene (DCE). The highest levels of PCE and TCE found during the Pioneer investigation were 1,900 ppb and 150 ppb, respectively. Groundwater samples obtained during the Pioneer investigation were collected from unconsolidated fluvial deposits (silt, sand, gravel, and cobbles) at or near the water table at depths of approximately 20 to 25 feet. The potable water supply for this area is from wells installed within the fluvial sediments, several of which have been impacted by VOCs in excess of federal and state drinking water standards (Pioneer 1999a; Pioneer 1999b). A sampling event was conducted at the Lockwood Solvents site by UOS in September 1999. The preliminary data indicate that the September 1999 UOS sampling will show contamination similar to that in results from the 1999 Pioneer study.

3.0 OBJECTIVES

The PCE/TCE contaminate plume located in the community of Lockwood is adversely affecting water quality in many of the water wells. Drinking water quality is of primary concern. Exposure to the contaminants from water usage other than drinking (i.e., showering) is of secondary concern. Currently eight residences with PCE contaminated water at levels greater than the RAL are being supplied with bottled water for drinking. The objective of this alternatives analysis is to determine the best long term solution that will improve the household water quality to within the EPA MCL standards.

4.0 DESCRIPTION OF ALTERNATIVES

Four alternatives considered in this section include no action, air stripping of well water, carbon filtration of well water, and hooking up the homes to the municipal water supply.

4.1 NO ACTION

Under the "No Action" alternative, residents will continue to be provided with bottled drinking water. Residents will continue to use contaminated water for all uses except for drinking.

<u>No Action Alternative Rating</u>

Effectiveness: Not effective at reducing residents' exposure to VOCs during showering and other water-related activities.

Implementability: No additional action required. Bottled water delivery will continue.

Cost: No additional cost; continued cost for bottled water.

Acceptability: Impact to residents will continue, limited only by the bottled water.

4.2 AIR STRIPPING SYSTEM

4.2.1 Description of Air Stripping Systems

Air stripping systems mix VOC-contaminated water with air. The VOCs volatilize into the air, and are removed from the water. The air strippers must be housed in a heated structure. Due to the size of the strippers, a 5-foot by 10-foot freestanding shed will be built for each home. The shed will be lighted, insulated, and heated. The electric system must be upgraded to 100-amp service at the home. An electric meter will be installed on the shed. The shed must be connected to the house plumbing and also connected to the well six feet below grade. The proposed air stripper design for the Lockwood Solvents site is as follows. Well water is prefiltered by a Big Blue® prefilter. The water volume is measured by a water meter. The contaminated water is pressurized. The high pressure water enters the air stripper and is sprayed into a tray. Air is blown up through small (commonly less than five millimeters (mm)) holes in the bottom of the tray. The air forms a froth of bubbles commonly more than five inches thick. The froth creates a large mass transfer surface area where the contaminants volatilize. The contaminated exhaust is vented from the shed. The cleaned water percolates through the small holes in the bottom of the tray and falls into a holding tank. The water then passes through a 18-inch by 45-inch Granular Activated Carbon (GAC) polishing tank. Upon exiting the polishing tank the water is ready for household use.

4.2.2 Performance of Air Stripping Systems

Three main factors determine the performance of any given air stripper:

(1) Size of the aeration tank (i.e., volume of water that can be aerated at a given time);

(2) Contamination level of the influent; and

(3) The time the water remains in the aeration tank.

Air strippers can reduce any concentration of VOCs to levels below the MCL. However, as the concentration of VOCs increases, the time the water spends in the aeration tank must also increase if the effluent contamination level is to remain constant. As the time in the aeration tank increases, the flow rate of the effluent decreases. Therefore, it is important to determine an adequate size for the aeration tank based on the contamination level of the influent and the desired effluent flow rate. When the household water flow rate exceeds the flow rate the air stripper was designed for, the effluent contamination levels may exceed the MCL. One way to ensure this will not happen is to design the stripper to handle a larger flow rate than is expected. The cost of air strippers increases rapidly as the size of the systems increases. Therefore, a compromise between performance and economic concerns must be reached and a Maximum Household Flow Rate (MHF) must be set. To ensure the effluent flow rate remains below the MHF a flow controller may be installed. This will cause a decrease in water pressure if the household attempts to draw a flow rate larger than the MHF. While low water pressure may be an inconvenience, the water quality will be preserved.

4.2.3 Cost of Air Stripping Systems

Initial costs for small air stripping systems are approximately $20,000 per unit (see Table 1A). This cost is low to moderate compared to the other alternatives evaluated in this report (see Table 4). The stripping system requires routine maintenance that consists of a technician cleaning the buildup of deposits that accumulate inside the system. A bleach solution is also run through the system to reduce microbes. The frequency of the maintenance is determined by the water quality of the influent. Water with high concentrations of dissolved metals and salts will cause the system to require more frequent maintenance than water depleted of these substances. A typical maintenance schedule can range from monthly to annual maintenance. This report assumes quarterly maintenance will be necessary. The cost of electricity to operate the system is very small, approximately $70 per year (see Table 1B). The total maintenance, sampling, and operational costs are low (approximately $3,000 per year per stripper) compared with carbon filtration, but much higher than connecting to municipal water (see Table 1B). The system can be installed and operational within a few weeks.

TABLE 1A
Initial Cost of Air Stripping System

Description	Quantity	Cost per Residence	Total Cost
Air stripping unit	8	$2,801	$22,408
Shipping	8	$400	$3,200
Installation	8	$400	$3,200
Prefilters and GAC water polishing	8	$1,100	$8,800
Shed and shed setup materials	8	$8,000	$64,000
Personnel time for shed setup	8	$1,200	$9,600
START, EPA time (1st year sampling)*	8	$1,250	$10,000
START, EPA time (setup)**	8	$1,200	$9,600
SUBTOTAL		**$16,351**	**$130,808**
Contingency (20%)		$3,270	$26,162
TOTAL		**$19,621**	**$156,970**

* Cost of additional sampling required during the first year of operation
** Cost of START and EPA time during the setup of the air strippers

TABLE 1B
Yearly Cost of Maintenance and Operation of Air Strippers

Description	Units per Year	Cost per Unit	Total Cost per Year
Electricity to run the air stripper	8	$70	$560
Testing of household water	48	$150	$7,200
Cleaning and maintenance of stripper	32	$100	$3,200
START, EPA cost for sampling event	4	$2,500	$10,000
SUBTOTAL			**$20,960**
Contingency (20%)			$4,192
TOTAL			**$25,152**

Note: Maintenance Cost per air stripper is Total Cost divided by the number of stripper ($3,144).

The costs of the air strippers, installation, shipping, and maintenance in Tables 1A and 1B are based on the estimate given by North East Environmental Products (NEEP). These numbers are believed to represent accurately the approximate cost of purchase, installation, and operation of an air stripping system adequate for the Lockwood site.

Air Stripping Alternative Rating

Effectiveness: Effective at reducing exposure to VOCs from water to levels below the MCL providing the system is maintained and monitored.

Implementability: Small units allow for easy shipping and setup. The systems can be shipped in under two weeks from time of ordering.

Cost: Low to moderate initial cost and moderate operational costs. Quarterly maintenance would be required.

Acceptability: Health risks posed by contaminants to residents will be reduced to acceptable levels.

4.3 CARBON FILTRATION SYSTEM

4.3.1 Description of Carbon Filtration Systems

The carbon filtration system operates by pumping contaminated water through a bed of activated carbon. The contaminants are trapped on the porous surface of the activated carbon, and removed from the water. The filtering system must be housed in a heated structure. Due to the size of the system, a 4-foot by 8-foot freestanding shed will be built for each home. The shed will be lighted, insulated, and heated. The electric system must be upgraded to 100-amp service at the home. An electric meter will be installed on the shed. The shed must be connected to the house plumbing and also connected to the well six feet below grade. The proposed carbon filtration design for the Lockwood Solvents site is as follows. Well water is prefiltered by a Big Blue® prefilter. The water volume is measured by a water meter. The contaminated water is pressurized and pushed through a series of two

18-inch by 45-inch GAC tanks. A second series of two 18-inch by 45-inch GAC tanks are connected in parallel with the previous two tanks to act as backups. After filtration the water is fed back into the household plumbing.

4.3.2 Performance of Carbon Filtration Systems

Three main factors determine the performance of any given carbon filtration system:

(1) Thickness of the activated carbon bed;
(2) Contamination level of the influent; and
(3) Time the water remains in contact with the activated carbon.

Carbon filtration can not remediate nonaqueous phase chlorinated solvents, and they can not effectively remediate high concentrations of these contaminants. Carbon filters can reduce low concentrations of dissolved VOCs to levels below the MCL. However, as the concentration of VOCs increases, the time the contaminated water needs to be in contact with the carbon must increase if the effluent contamination level is to remain constant. As the time in the filtration system increases, the flow rate of the effluent decreases. Therefore, it is important to determine the adequate size of the filter based on the contamination level of the influent and the desired effluent flow rate. When the household flow rate exceeds the flow rate for which the filtration system was designed, the effluent contamination levels may exceed the MCL. Similar to air stripping, a maximum household flow rate must be set to ensure treatment to below the MCL. The carbon filters must be changed periodically. Periodic water sampling is required to determine when a new filter is needed. The time between filter changes can only be determined once the system is operating. Water with metals and organics needs more frequent filter changing than metal and organic depleted water. Filters commonly are changed from monthly to annually. The spent carbon is tested and most likely is disposed of in a nonhazardous landfill. While this report assumes filter changing annually, a new filter will most likely be needed more often than once per year. Carbon filtration was used by the EPA Region VIII at the Twins Inn site in Arvada, Colorado. The Twins Inn site, which had similar contaminants and concentrations, required filter change-out twice per year.

4.3.3 Cost of Carbon Filtration Systems

Initial costs of a carbon filtration system are approximately $25,000 per unit, which is moderate compared to the other alternatives evaluated in this report (see Table 4). Note the discrepancy between *Culligan of Billings* and the other three carbon filtration companies. *Culligan of Billings* provided a detailed estimate of the carbon filtration system based on the Lockwood site. The other companies based their estimates on past experience rather than the Lockwood site specifics. Therefore, it is likely that the *Culligan of Billings* is a closer estimate of the true cost of a carbon filtration system at the Lockwood site and the Culligan costs are used in Tables 2A and 2B. The maintenance, sampling, and operational costs are high (approximately $5,500 per year) compared with the other alternatives (see Table 2B). The system can be installed and operational within a few weeks.

TABLE 2A
Initial Cost of Carbon Filtration System

Description	Quantity	Cost per Residence	Total Cost
Cost of Units	8	$6,625	$53,000
Factory Set-up fee	8	$1,495	$11,960
Set-up and Delivery	8	$125	$1,000
Cost of carbon	8	$1,000	$8,000
Shed and setup materials	8	$8,000	$64,000
Personnel time for shed setup	8	$1,200	$9,600
Installation of filters	8	$400	$3,200
START, EPA time (1st year sampling)*	8	$1,250	$10,000
START, EPA time (setup)**	8	$1,200	$9,600
SUBTOTAL		**$21,295**	**$170,360**
Contingency (20%)		$4,259	$34,072
TOTAL		**$25,554**	**$204,432**

* Cost of additional sampling required during the first year of operation
** Cost of START and EPA time during the setup of the carbon filters

TABLE 2B
Yearly Cost of Maintenance and Operation of Carbon Filtration System

Description	Units per Year	Cost per Unit	Total Cost per Year
Testing of household water	48	$150	$7,200
Rebed of Carbon	8	$1,000	$8,000
Freight of spent filter to and from factory	8	$977	$7,816
Testing and disposal of spent filter*	8	$400	$3,200
Pick-up and Shipment	8	$160	$1,280
START, EPA cost for sampling event	8	$2,500	$10,000
SUBTOTAL			**$37,496**
Contingency (20%)			$7,499
TOTAL			**$44,995**

* Assumes nonhazardous disposal

Note: Maintenance Cost per filtration system is Total Cost divided by the number of systems ($5,624).

Carbon Filtration Alternative Rating

Effectiveness: At lower concentration levels, effective at reducing exposure to VOCs from water to levels below the MCL providing the system is maintained, monitored.

Implementability: The systems would have to be designed by an engineer and tested on site, with a moderate chance of additional modifications needed.

Cost: Moderate initial and relatively high operational costs. Frequent maintenance, testing, and disposal costs would be required.

Acceptability: Health risks posed by contaminants to residents will be reduced to acceptable levels, except for homes with high contamination levels.

4.4 MUNICIPAL WATER SUPPLY

4.4.1 Description of Connecting Residences to Municipal Water Supply

Connecting residents to the Lockwood municipal water supply will involve trenching and extending the water main from the intersection of Taylor Place and Lomond Lane down the length of Lomond Lane. An additional water main will 'T' from the Lomond Lane main and run the extent of Doon Avenue. Lateral pipes will be laid from the main line to each home that is to be connected. If necessary, additional water main pipe may be installed along Sandy Lane, and Taylor Place to include all homes that may be affected by the PCE/TCE plume. Advantages to this alternative are that homes connected to the municipal water supply will meet all water quality standards, long term water quality testing will not be needed, and connection of additional homes to the water main at a later time can be accomplished inexpensively.

4.4.2 Performance of Municipal Water Supply

Water treated via air stripping and carbon filtration may still have VOC concentrations below the MCL (< 5 ppb). The municipal water supply will provide clean water with no VOC concentrations. The system is reliant on the quality of the municipal water supply that undergoes routine testing and is not at risk. This alternative requires no additional residential testing and no set maximum household flow rate as air stripping and carbon filtration both do.

4.4.3 Cost of Connecting the Residences to the Municipal Water Supply

The drawbacks to this alternative are the large initial cost of construction (approximately $328,320 total; this breaks down to $41,040 per home for 8 homes) and the long time needed to complete the work (weeks to months). There are no operational or maintenance costs. This cost estimate is based on the belief that the municipal water main currently ends at the intersection of Taylor Place and Lomond Lane.

TABLE 3
Cost of Municipal Water

Description	Quantity	Cost	Total Cost
12" water main installed	3,400 feet	$30 per foot	$102,000
1.5" lateral pipes	2,400 feet	$18 per foot	$43,200
Dewatering	5,800 feet	$10 per foot	$58,000
System Development Fee (City charge)	8	$1,500 per home	$12,000
Membership to Association fee	8	$50 per home	$400
Accessories	5,800 feet	$10 per foot	$58,000
SUBTOTAL			$273,600
Contingency (20%)			$54,720
TOTAL			$328,320

Table 3 is based on phone conversation with *Empire Sand and Gravel*. This estimate agrees closely with the *Castlerock Excavation* estimate (Table 4) and is believed to be relatively accurate assuming no unforseen complications arise.

<u>Municipal Water Alternative Rating</u>

Effectiveness: Most effective alternative at reducing exposure to VOCs.

Implementability: Large scale trenching and pipe laying would be required. Closeness to the river may cause dewatering problems (the water table is at less than 25 feet below ground surface). Fluvial sediment should be easy to excavate. Construction may take weeks or months to be completed.

Cost: Extremely high initial cost. No additional maintenance or testing would be required. The two-year warranty required by the local government is provided for in the estimate above.

Acceptability: Health risks posed by contaminants to residents via household water will be eliminated.

5.0 SELECTION OF ALTERNATIVES

Four alternatives were evaluated in the sections above to determine the most feasible and cost effective remedial measure for removing VOCs from the water supply of homes in the Lockwood Solvents site. A qualitative rating has been assigned for each criteria for the four alternatives evaluated (see Table 5). Based on the cost and exposure considerations, connection to the municipal water supply is the most attractive alternative.

TABLE 4
Summary of Alternative Costs

Subcontractor	Cost Per Home	Maintenance Cost Per Year	Eight Homes, One Year	Eight Homes, Four Years	Eight Homes, Seven Years
North East Environmental Products* (AS)	$19,621	$3,144	$182,120	$257,576	$333,032
ORS Environmental Systems * (AS)	$19,888	$3,144	$184,256	$259,712	$335.168
Aeronx (AS)	$20,021	$3,144	$185,320	$260,776	$336,232
WES Inc. (AS)	$27,421	$3,144	$244,520	$319,976	$395,432
Culligan of Billings * (CF)	$25,554	$5,624	$249,424	$384,400	$519,376
Water Specialities (CF)	$23,364	$5,624	$231,904	$366,880	$501,856
Monsanto/Enviro-Chem (CF)	$22,644	$5,624	$226,144	$361,120	$496,096
Pure Water Solution (CF)	$21,204	$5,624	$214,624	$349,600	$484,576
Castlerock Excavating (MW)	NA	$0	$319,800	$319,800	$319,800
Empire Sand and Gravel (MW)	NA	$0	$328,320	$328,320	$328,320

* Indicates that companies submitted detailed estimates.
CF Carbon Filtration
AS Air Stripping
MW Municipal Water

The costs in Table 4 reflect the price for the alternative quoted by the respective subcontractor plus the cost the EPA would have to pay for the housing, sampling, maintenance, and operation of the system (Tables 1A, 1B, 2A, 2B, and 3 itemize these expenses).

TABLE 5
Summary of Alternative Ratings

Alternative	Effectiveness*	Implementability	Capital Cost / House**	Acceptability
No Action / Bottled Water	2	Easy	$5,250	Low
Air Stripping***	4	Moderate	$41,896	High
Carbon Filtration	3	Moderate	$64,922	Moderate
Municipal Water	5	Moderate	$41,040	High

* Rating scale:
0 = not effective 1 = marginally effective 2 = somewhat effective 3 = effective 4 = highly effective 5 = completely effective
** Capital cost per home for a seven year period.
*** Based on 1999 Pioneer data.

The findings from the scheduled September 1999 sampling are needed to confirm the Pioneer 1999 sampling results. Preliminary data indicate that the September 1999 sampling will show similar contamination as the 1999 Pioneer study.

Connecting the homes to the municipal water supply will eliminate the VOC exposure threat from household water. This is the only alternative that eliminates exposure. While this alternative offers better performance, the large initial cost is offset by the absence of long term maintenance or sampling. The break-even point for air stripping and carbon filtration are seven and four years, respectively (see Table 4). The break-even point is the time at which the cost of connecting the homes to the municipal water supply equals the cost of the air stripping/carbon filtration. Connection to municipal water is an attractive alternative because it is a permanent solution, has the best performance of all the alternatives, does not require periodic maintenance and sampling, and has a break-even point of seven years or less. This suggests that connecting the homes to the municipal water supply is the best alternative.

The most attractive option is to connect each home to the municipal water supply. Support for this conclusion may be confirmed by direct comparison of each alternative with connection to municipal water.

The No Action alternative would not satisfactorily address VOC exposure from household water, and the cost for bottled drinking water would continue. Therefore, this is an unacceptable alternative.

Air Stripping can adequately reduce VOCs to levels below the MCL. While this alternative offers a low to moderate initial cost, the maintenance and sampling costs make this alternative less cost effective over seven years than connection to the municipal water supply (see Tables 1 and 5). Therefore, this is an unacceptable alternative.

Whereas, **Carbon Filtration** can adequately reduce low concentrations of VOCs to levels below the MCL, at the higher contaminant concentrations this alternative is not viable. While this alternative offers a moderate initial cost, the maintenance and disposal costs make this alternative much less cost effective over four years than connection to the municipal water supply (see Tables 1 and 5). Therefore, this is an unacceptable alternative.

6.0 SUMMARY

This Alternatives Analysis report evaluated four alternatives intended to reduce the amount of VOCs in the household water of homes in the town of Lockwood. The following alternatives were evaluated as part of this analysis:

1. No Action;
2. Air Stripping of well water;
3. Carbon Filtering of well water; and
4. Connecting the homes to the municipal water supply.

Each alternative was evaluated according to effectiveness, implementation, total cost, and acceptability. Based on these criteria, the connection to the municipal water supply is selected as the most feasible and cost-effective alternative based on the 1999 Pioneer sampling and the preliminary data from the 1999 START sampling.

7.0 LIST OF REFERENCES

Pioneer Technical Services, Inc. (Pioneer) 1999a. "Final Sampling and Analytical Results Report for the Lockwood Solvents Site." January 1999.

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URS Operating Services, Inc. (UOS). 1995a. "Generic Quality Assurance Project Plan for the Superfund Technical Assessment and Response Team, EPA Region VIII." December 1995.

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URS Operating Services, Inc. (UOS). 1999. Lockwood Solvents. Site-Specific Health and Safety Plan. August 1999.

Attachment 4

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

490964

Ref: 8WM-DW

MEMORANDUM

SUBJECT: Aspen Park - Removal Action Level for Carbon Tetrachloride

FROM: Robert Benson, Ph.D., Toxicologist RB 11/3/94
Christopher Weis, Ph.D., D.A.B.T., Toxicologist CW 11/3/94

TO: Peter Stevenson, 8HWM-ER
OSC

The purpose of this memorandum is to establish a site specific removal action level (RAL) of 5 μg/l for carbon tetrachloride in the drinking water wells in Aspen Park. The RAL in OSWER Directive 9360.1-02 is 30 μg/l. For the reasons discussed below, we believe that this lower level is required to protect adequately the health of the residents of Aspen Park.

OSWER Directive 9360.1-02, Final Guidance on Numeric Removal Action Levels for Contaminated Drinking Water, October 25, 1993, with attached table dated May 1993, establishes a RAL for carbon tetrachloride of 30 μg/l. This value does not account for exposures from sources other than ingestion of the water. Page 7 of the Directive allows for the establishment of RALs below that level based on site specific conditions. We believe site specific conditions in Aspen Park require a level of 5 μg/l. The primary reason is that because carbon tetrachloride is a volatile chemical and will also penetrate the skin, there will be significant exposure to residents from breathing air in the home contaminated with carbon tetrachloride and from using the contaminated water for bathing.

Because carbon tetrachloride is volatile, providing alternative drinking water alone is not adequate to protect the residents from exposure to carbon tetrachloride. The residents need an alternative source of water for their total domestic needs, either from point-of-entry treatment, a new well into an uncontaminated aquifer, or a central water supply that is free of volatile organic chemicals.

Carbon tetrachloride is a volatile chemical.

Because carbon tetrachloride is a volatile chemical, the air in the homes will be contaminated with carbon tetrachloride from other uses of water in the home. Showering/bathing, using an automatic dishwasher, using a home humidifier or vaporizer,

There are wells in the vicinity that greatly exceed the RAL of 30 μg/l.

There are a substantial number of wells in the area that have a concentration of carbon tetrachloride in excess of 30 μg/l. The highest concentration found to date is 26,000 μg/l.

The carbon tetrachloride plume is likely to move rapidly.

Some information suggests that the ground water flow in the area is complex and is determined by fractures in the bed rock. There are domestic wells that have contamination greatly exceeding the existing RAL. Therefore, the concentration of carbon tetrachloride in wells at the edge of the plume is likely to increase dramatically.

Attachment 5

Lockheed Martin Technology Services Group
Environmental Services REAC
2890 Woodbridge Avenue, Building 209 Annex Edison, NJ 08837-3679
Telephone 732-321-4200 Facsimile 732-494-4021

LOCKHEED MARTIN

December 27, 1999

Mr. Peter Stevenson, OSC
U.S. EPA Region 8
999 18th Street
Suite 500
Denver, Colorado 80202-2405

Dear Pete,

Subsequent to our last discussion, this letter has been prepared to document the likely reason why the VOC plume at the Lockwood Solvent Site - Lomond Lane Area, may broaden north of Coulson's Ditch, and the potential impact to the downgradient plume geometry and position if the likely reason for this broadening becomes more or less a factor in the future.

As discussed in the Final Report, the VOC plume broadens north of Coulson's ditch, with components of groundwater flow direction both to the north and to the north-northwest. The likely reason for the plume's broadening is the reported large scale dewatering activities which are known to occur at the sand and gravel pit. As large scale dewatering is performed, the plume's tendency would be to shift to the north. Without dewatering, the plume axis would shift to the northwest. As a result, the plume margin, and the position of the higher concentrations of VOCs downgradient of Coulson's ditch, may shift from time to time as a result in changing pumping conditions at the gravel pit. This would indicate that a conservative approach in estimating the plume's downgradient extent should be exercised in considering residential water supply options.

Please let me know if we may be of additional assistance in this matter.

Donald T. Bussey, CPG
Hydrogeologist