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Agency

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Emergency and
Remedial Response

EPA/ROD/R03-90/101
September 1990

EPA

Superfund Record of Decision:

Keystone Sanitation Landfill, PA

50272-101

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SUPERFUND RECORD OF DECISION
Keystone Sanitation Landfill, PA
First Remedial Action

5. Report Date: 09/30/90

6.

7. Author(s)

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Washington, D.C. 20460

13. Type of Report & Period Covered: 800/000

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 40-acre Keystone Sanitation Landfill site, an inactive, privately owned landfill, is in Union Township, Adams County, Pennsylvania. Surrounding land use is primarily agricultural with scattered residences. From 1966 to 1990, the unlined landfill accepted household and municipal wastes as well as industrial and construction debris, including phosphorus-contaminated sand, potato sludge, resin sludge, incineration ash, and dried latex paint. The volume of non-homogeneous waste at the site currently is 1.7 million cubic yards. In 1982, State investigations revealed onsite ground water contamination and a contaminated onsite residential well attributable to leachate from the landfill contents. In 1984, EPA found low-level contamination in nearby residential wells. As a result of the ground water contamination, EPA ordered Keystone to install an onsite spray irrigation system and a leachate collection system to prevent migration of contaminants offsite. This Record of Decision (ROD) addresses Operable Unit 1 (OU1), the containment of onsite source area and remediation of onsite contaminated ground water. A subsequent ROD will address offsite ground water contamination in monitoring and residential wells (OU2). The primary contaminants of

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Keystone Sanitation Landfill, PA
First Remedial Action
Contaminated Media: soil, gw
Key Contaminants: VOCs (benzene, PCE, TCE, vinyl chloride), other organics (acids, phenols), metals (chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 143
	20. Security Class (This Page) None	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse*

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

Abstract (Continued)

concern affecting the soil and ground water are VOCs including benzene, PCE, TCE, and vinyl chloride; other organics including acids and phenols; and metals including chromium and lead.

The selected remedial action for this site includes excavating approximately 4,150 cubic yards of contaminated surface soil with consolidation of the soil in the landfill; placing a cap on the landfill and subsequent revegetation; installing an active gas extraction system to collect gases emitted from the landfill; pumping and treatment of ground water using equalization, flocculation/precipitation, filtration, ion exchange, air stripping, and filter press technologies, followed by offsite disposal of any sludge produced by these processes; discharging the treated water onsite to a surface stream; monitoring ground water, surface water, and sediment; installing an in-home water treatment system for the onsite resident; and implementing site access restrictions and institutional controls, including deed, land use, and ground water restrictions. The estimated present worth cost for this remedial action is $9,156,950, which includes an annual O&M cost of $217,000 for 30 years.

PERFORMANCE STANDARDS OR GOALS: No chemical-specific cleanup goals were stated in the ROD. For carcinogenic compounds, cleanup goals were established to reduce the excess lifetime cancer risk to 10^{-4} to 10^{-6}. For non-carcinogenic compounds, the goal is a hazard index (HI) equal to 1 or less. Individual ground water remediation standards are based on the more stringent of SDWA MCLs or non-zero MCLGs, or State background levels. If these levels cannot be met, the ROD will be amended.

RECORD OF DECISION

DECLARATION

Site Name and Location

Keystone Sanitation Landfill Site
Adams County, Union Township, Pennsylvania
Operable Unit One

Statement of Basis and Purpose

This decision document presents the selected remedial action for the Keystone Sanitation Landfill Site (Site) in Adams County, Union Township, Pennsylvania. It was developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended, 42 U.S.C. Section 9601 et seq. and is consistent, to the extent practicable, with the National Oil and Hazardous Substances Contingency Plan (NCP), 40 C.F.R. Part 300. 55 Fed. Reg. 8666 (March 8, 1990). This decision is based on the contents of the Administrative Record for the Site.

The Commonwealth of Pennsylvania concur with the Selected Remedy.

Assessment of the Site

Pursuant to duly delegated authority, I hereby determine, pursuant to Section 106 of CERCLA 42 U.S.C. § 9606 that actual or threatened releases of hazardous substances from this Site, as discussed in the Summary of Site Risks on pages 18 through 30, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare or the environment.

Description of the Remedy

The Selected Remedy addresses the principal threat posed by the Site from the ingestion of groundwater by reducing the risks to human health and environment through the use of groundwater extraction and treatment and the installation of an impermeable cap. It does not provide treatment of the waste as it has been found to be impracticable. This remedy will prevent continued infiltration from the wastes to the groundwater and reduce the

concentration and plume of groundwater contamination. A second Operable Unit will address offsite contamination.

Engineering and institutional controls are used to effect this remediation through the following components:

- Installation and maintenance of an impermeable cap and gas collection system over a 40-acre Site
- Installation and maintenance of groundwater extraction wells and treatment plant to reduce the concentrations of volatile organic compounds and metals in the groundwater
- Installation and maintenance of a fence around the site
- Monitoring of the groundwater in monitoring and residential wells
- Monitoring of the surface water and sediments
- Provision of a point-of-use treatment system to onsite residents
- Initiation of deed restrictions regarding present and future site activities including limitations on construction and aquifer use.

This Site will have a second Operable Unit to further study the groundwater contamination in the offsite monitoring and residential wells.

Declaration

The Selected Remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate for this remedial action and is cost-effective. This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility or volume as a principal element and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable for this Site. However, because treatment of the principal threats of the

found not to be practicable as a principal element of the remedy since the size of the landfill and the nonhomogeneity of the wastes preclude a remedy in which the contaminants could be treated in a cost-effective manner.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review shall be conducted as required by Section 121(c) of CERCLA 42 U.S.C. § 9621(c), within five years after commencement of the remedial action, and every five years thereafter as required, to ensure that the remedy continues to provide adequate protection of human health and the environment.

Edwin B. Erickson
Regional Administrator
Region III

9/30/90
Date

KEYSTONE SANITATION COMPANY SITE

RECORD OF DECISION

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KEYSTONE SANITATION COMPANY SITE

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KEYSTONE SANITATION COMPANY

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RECORD OF DECISION

KEYSTONE SANITATION LANDFILL SITE

Decision Summary

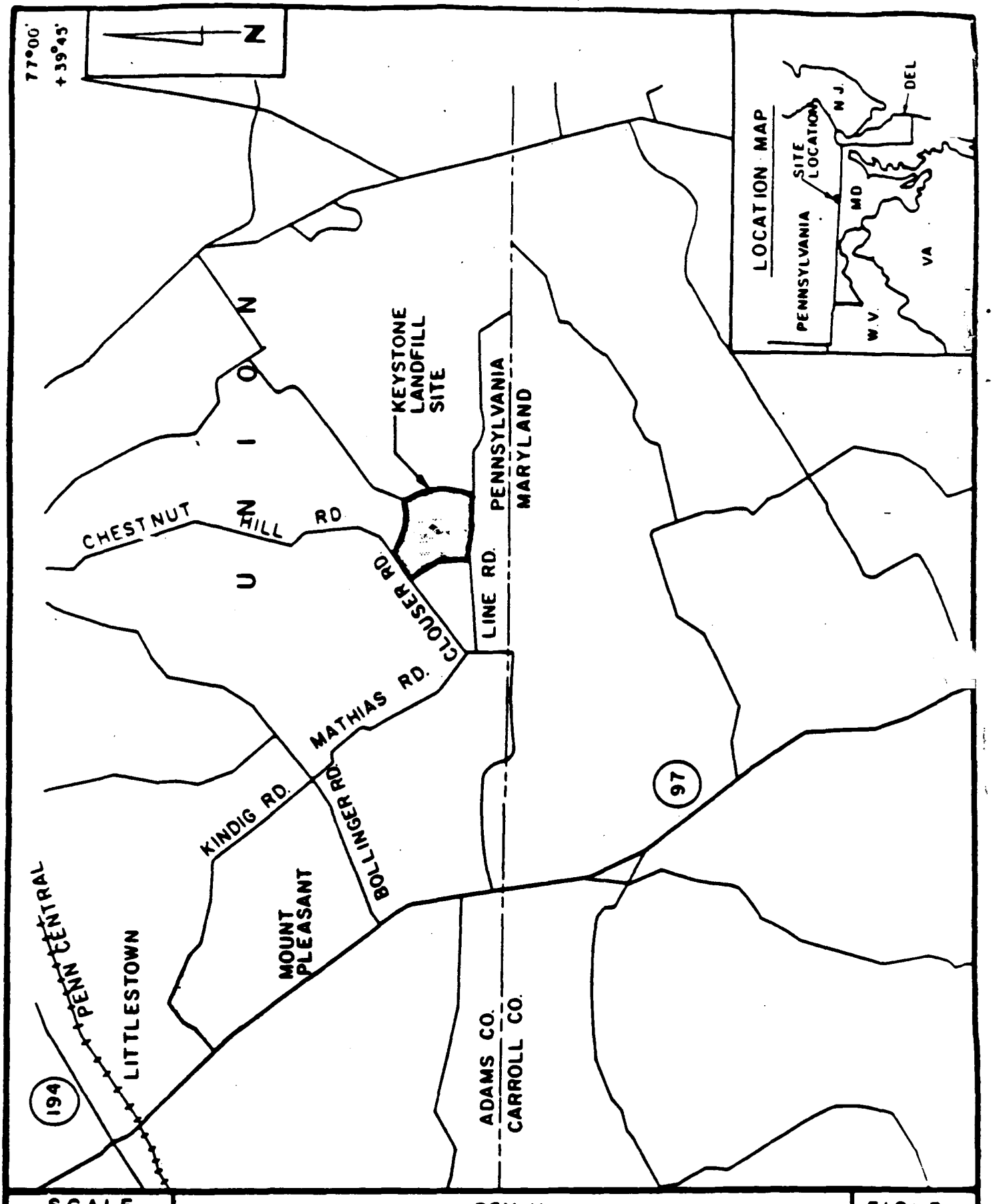
SITE NAME, LOCATION AND DESCRIPTION

The Keystone Sanitation Landfill Site (Keystone Site or Site) is an inactive privately owned facility (Keystone Sanitation Company or Keystone), permitted by Pennsylvania Department of Environmental Resources (PADER) to receive household and municipal wastes and certain types of industrial and construction debris. The landfill is located on a 40 acre tract of land in Union Township, Adams County, Pennsylvania, southwest of Hanover, Pennsylvania and is approximately 800 feet north of the Pennsylvania (PA)-Maryland (MD) border. (See Figure 1 for Site location). It is fenced on the eastern and western sides and bounded by Line Road to the south and Clouser Road to the northwest.

The landfill which operated from 1966 to April 1990 is situated on top of a ridge. It is built in a horse-shoe shape with the owner of the landfill residing in a home on the inside edge of the landfill property. There are approximately 36 residents within a 1-mile radius of the Keystone Site and approximately 700 residents within a 3-mile radius of the Site. Littlestown, Pennsylvania is the closest town to the Site. It has a population of approximately 3,000 and is located 3 miles north of the Site. Some residences are located near the landfill, but the predominant land use is agricultural, not residential. Residents in the area of the Site utilize domestic wells to obtain their water supply.

The topography of the area consists of gently rolling hills and valleys formed by the northeasterly tending elongated valleys and ridges. Most surface water flows northward to an unnamed perennial tributary of Conewago Creek located 100 feet north of the Keystone site. A smaller quantity of runoff flows southward into an unnamed tributary to Piney Creek, located about 2000 feet south of the Site in the State of Maryland.

The landfill was constructed as a renovating base landfill without a liner or leachate treatment or collection system. Depth of wastes average 30 feet. Fractured bedrock of the Marburg Schists underlies the Site overlain by varying thicknesses of silty clay soil which was used for constructing the base of each cell and for daily, intermediate and final cover. Its maximum elevation is approximately 700 feet with a vertical relief of approximately 100 feet within a 2000 foot radius of the Site. A perennial grass cap is growing over the Site with the exception of the two newly closed cells.



SCALE	REM V	FIGUR
1:37,820	**SITE LOCATION MAP**	1
DATE JULY 1990	KEYSTONE SANITATION LANDFILL SITE LITTLESTOWN, PENNSYLVANIA	

SITE HISTORY

Since 1966 (pre-dating the establishment of PADER in 1970), the Keystone Site has been used as a sanitary landfill. It is estimated that 300 to 376 tons per day of waste have been disposed at the site. In 1974, five monitoring wells (K1, K2, K3, K4, and K5) were installed by Keystone at the landfill perimeter to monitor groundwater quality.

In 1982, all facilities permitted by PADER were required to monitor groundwater for volatile organic compounds (VOCs). A sample taken by PADER in November 1982 from Keystone monitoring well K1 revealed VOC contamination in the groundwater. Subsequent testing of the onsite residential well and the nearby Mundorf Spring revealed that they also contained VOCs.

In April 1984, an EPA Field Investigation Team (FIT) performed a site investigation in response to citizen complaints of illegal dumping and groundwater contamination and to assess the Site's eligibility for inclusion on the EPA National Priorities List (NPL) established pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605. Sample results from the PADER and EPA FIT investigations confirmed that some residential wells contained low levels of VOC contamination.

In August 1984, as result of the VOC contamination, Keystone installed a spray irrigation system in the most contaminated area to prevent the migration of contaminants offsite and to remove VOCs from the groundwater. Water from Keystone monitoring well K1 was pumped to a series of sprayers located at the edge of the landfill, within the radius of influence of the well. In addition, a leachate collection system was installed on the south side of the landfill along Line Road. The leachate collection system consists of two perforated pipes and a storage tank. The storage tank is pumped periodically and the leachate disposed of offsite.

In the spring of 1985, the State of Maryland installed a series of monitoring wells at the Maryland border to monitor potential contaminant migration into Maryland. Low levels of VOC contamination have been consistently detected in Maryland well No.2 (MD2). However, no Maryland residential wells have been determined to be contaminated as a result of the landfill.

The Keystone Site was placed on the NPL in July 1987. In July 1987, the Potentially Responsible Parties (PRPs) were asked to perform the Remedial Investigation (RI) and Feasibility Study (FS) for the site. Negotiations failed to obtain cooperation from the PRPs to do the RI/FS and EPA assigned the RI/FS tasks to REM V, a federal government contractor.

Also in July 1987, Keystone signed a Consent Adjudication (CA) with PADER. The intent of the CA was to provide data for the development of an onsite groundwater remediation plan and to design and implement the plan. Keystone was required by the CA to analyze and summarize previously collected water quality data, determine the effectiveness of the existing spray irrigation system, install 3 additional monitor wells, abate groundwater contamination at the Site perimeter, prevent offsite groundwater contamination, and treat the contaminated offsite.

EPA and PADER recognized that two separate studies (the CA and the RI/FS) were being conducted on the Keystone Site. Therefore, it was agreed that the RI/FS would focus on obtaining offsite data while the CA study would focus on obtaining onsite data.

The RI/FS field activities began in the spring of 1989 and were completed in the winter of 1990. The objectives of the RI were: to determine the nature and extent of hazardous substances, pollutants or contaminants at the Site; to determine the impact of these hazardous substances on public health, welfare and the environment; to determine the extent to which sources of contaminants can be adequately identified and characterized; to gather sufficient information to determine the necessity for remedial action; and to provide data in order to evaluate and estimate costs for remedial alternatives during the FS.

The purpose of the FS was to develop a range of cost effective remedial alternatives which are protective of human health and the environment and comply with applicable or relevant and appropriate requirements (ARARs).

The RI/FS was finalized on July 20, 1990 and released to the public along with a Proposed Remedial Action Plan. A 60 day public comment period followed the release of these documents.

ENFORCEMENT ACTIVITIES

In November 1987, approximately 235 parties were sent 104(e) Information Request Letters and General Notice Letters to inform the PRPs of their potential liability with respect to remedial actions at the Keystone Site. In July 1988, 21 parties were issued Special Notice Letters pursuant to Section 122(e) of CERCLA, 42 U.S.C. § 9622(e), to request their participation in the RI/FS activities. A meeting was held in August of 1988 to negotiate with the PRPs. Negotiations failed to obtain cooperation from any of the PRPS and EPA funded the RI/FS activities. An additional PRP search is currently being finalized for this Site.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

Community involvement at this Site is very high with a mailing list of over 600 people. There are at least four organized citizen groups, two townships, two borough, and two State (MD and PA) and 1 County environmental agencies concerned about the public health and environmental effects of the landfill. These parties have rigorously interacted with the EPA and the State governments.

In accordance with Sections 113(k)(2)(B)(i-v) and 117(a)(2) of CERCLA, the public was kept informed and given an opportunity to participate in the Keystone Site activities. A public meeting was held on March 29, 1988 to discuss the workplan for the RI/FS. Numerous comments received on the RI/FS workplan were considered in the revisions to the Workplan. Several visits and numerous phone calls have been made to the community to keep them informed. In addition, two Fact Sheets on the RI/FS activities and the Proposed Plan have been distributed to the people on the mailing list.

On July 20, 1990, the Proposed Plan and the RI/FS were placed for public viewing in the four information repositories: The Adams County Public Library; the Hanover Public Library; the Carroll County Public Library and the St. Mary's United Church of Christ. The notice of availability was placed in the Gettysburg Times and the Hanover Evening Sun on July 20, 1990. A public comment period was originally to be held from July 20, 1990 to August 20, 1990. This comment period was extended to September 20, 1990 at the request of the public. The originally scheduled public meeting for August 15, 1990 was rescheduled and held on September 13, 1990. This rescheduling was requested by the public to allow them time to review the information and prepare comments for the meeting.

SCOPE AND ROLE OF RESPONSE ACTION

The scope and role of the response action is to prevent current and future exposure to the contaminated soils, to reduce contaminant migration into the groundwater and to prevent migration of the contaminated groundwater to uncontaminated areas. This response action addresses the principal threat at the Site from groundwater contamination through an impermeable cap and groundwater extraction and treatment. A second Operable Unit will address the offsite contamination concerns.

SUMMARY OF SITE CHARACTERISITICS

The Keystone Site located in the upland section of the western Piedmont Physiographic Province is bounded on the east by the Coastal Plain Province and on the west by the Blue Ridge Province.

Soil near the Keystone Site is typified by a variety of well-drained loams and silt loams containing rock fragments, and silt- and clay-size micas derived from the underlying saprolitic zone. The soil is described as a highly micaceous silty clay with some rock fragments, but containing no visible relict rock structures.

The Keystone Site is underlain by Precambrian Schist equivalent to the Babylon Phyllite of the Marburg formation (Marburg Schist) in Maryland. The Marburg is overlain by saprolith, a clayey soil with relict rock structures produced by in place weathering of the underlying schist. A generalized stratigraphic column of Keystone is presented in Figure 2, along with a cross section of the Site in Figure 3.

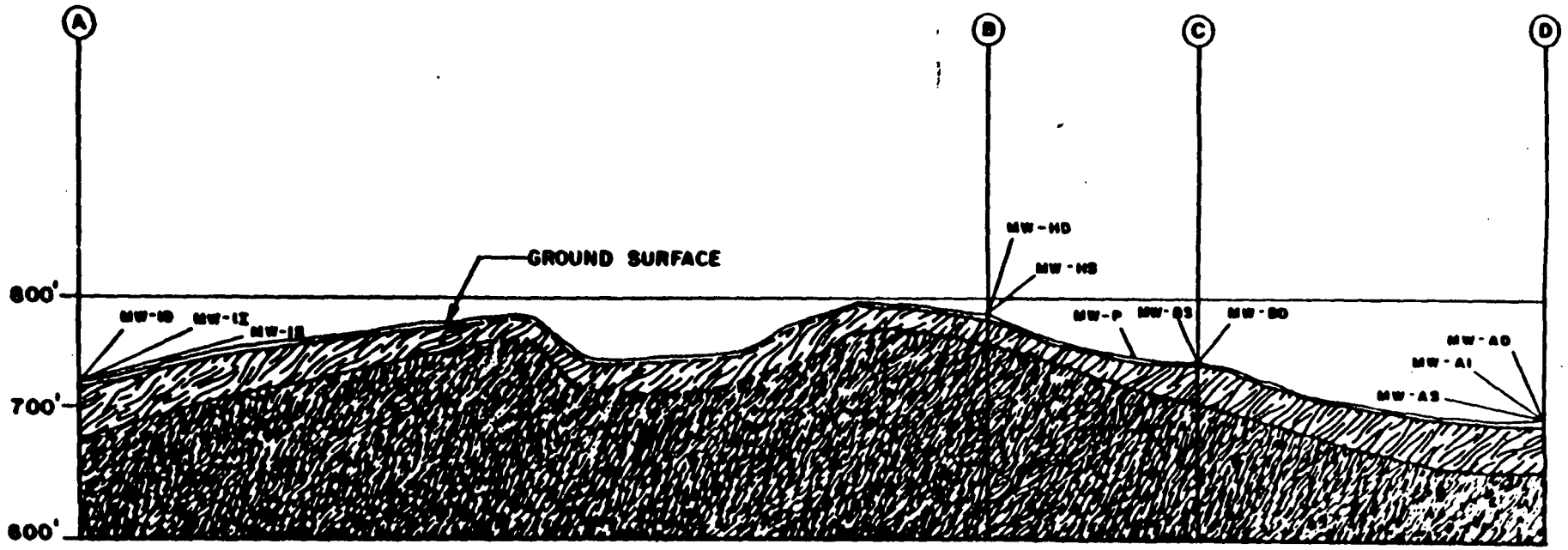
The steeply dipping Marburg Schist is a Precambrian Age metasediments consisting of a fine-grained, finely laminated grayish-green to grayish-blue schist which is predominantly composed of chloride, muscovite, quartz and albite. Considerable porosity is demonstrated in some quartz zones. Fractures were seen at the Site in some thick quartz zones encountered and mostly associated with loose, fractured vuggy quartz. Most fractures were annealed either with quartz or chlorite. Fracture zones ranged from a tenth of an inch to approximately one foot in thickness and usually contained crushed schist with small amounts of clayey gouge.

The saprolith overlying the Marburg Schist is produced from t h e in-placed weathering of the schist. The saprolith is of variable thickness and ranges from thin veneer on ridge tops to 30 feet in thickness in drainage areas and valley bottoms. Saprolith at the site consists of reddish-brown,brownish-gray and pale grayish-green clay and heavily weathered schist locally containing fresh quartz veinlets and fragments. Weathered schist which was significantly more competent than the overlying saprolith, was encountered in one of the boreholes from approximately 30 to 50 feet in depth. The weathered schist is a silvery grayish-green finely laminated rock that displays reddish brown to pale yellow-brown iron staining on foliation and fracture surfaces.

Geologic structures at the Keystone Site include faults, and fractures, and small-scale folding within the Marburg Schist. The dominant orientation of the foliation of the Marburg Schist parallels the regional NE-SW trend. (See Figure 4 for schistosity structure.) Fracture trace analysis at the Site confirmed two major structural trends: a regional schistosity striking between N 35 E and N 60 E, which is pervasive in the area of the landfill; and a local structural trend oriented almost due north and south which is apparent in the area immediately south of the landfill. These structural trends suggest that the groundwater flow may be locally deflected along preferential transport pathway parallel to the northeast-southwest schistosity in all directions from the Site. To the south of the landfill, flow may also be affected by

ERA	PERIOD	LITHOLOGY	DESCRIPTION
CENOZOIC	QUATERNARY	SOIL 0'	SOIL – PALE YELLOWISH BROWN, COHESIVE, FROM A FEW INCHES TO 6 FEET THICK.
		SAPROLITH	SAPROLITH – PALE YELLOWISH BROWN TO YELLOWISH GREY WEATHERED SCHIST, CONTAINING RESIDUUM OF LESS WEATHERED SCHIST AND QUARTZ FRAGMENTS. GRADUAL CONTACT WITH UNDERLYING SCHIST, RANGES FROM A FEW INCHES TO 50 FEET THICK.
		50'	
PRECAMBRIAN (?)		MARBURG SCHIST	SCHIST – GRAYISH GREEN TO GRAYISH BLUE SCHIST COMPOSED OF CHLORITE, MUSCOVITE, QUARTZ AND ALBITE, FINELY LAMINATED WITH CALCAREOUS AND QUARTZ-RICH ZONES; FINELY DISSEMINATED PYRITE IS COMMON.
		300'	

SCALE	REM V	FIGURE
AS SHOWN	GENERALIZED STRATIGRAPHIC COLUMN	2
DATE APRIL 1990	KEYSTONE SANITATION LANDFILL SITE UNION TOWNSHIP, PENNSYLVANIA	



SOIL

SAPROLITE

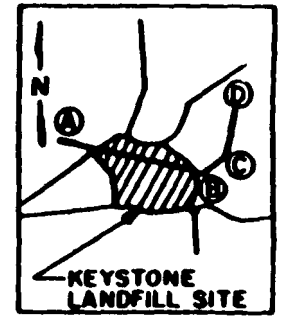
SCHIST

MW - MONITOR WELL

END POINT OF CROSS SECTION, OR CHANGE OF DIRECTION

CHANGE OF LITHOLOGY CONTACT

NO INFORMATION AVALIABLE

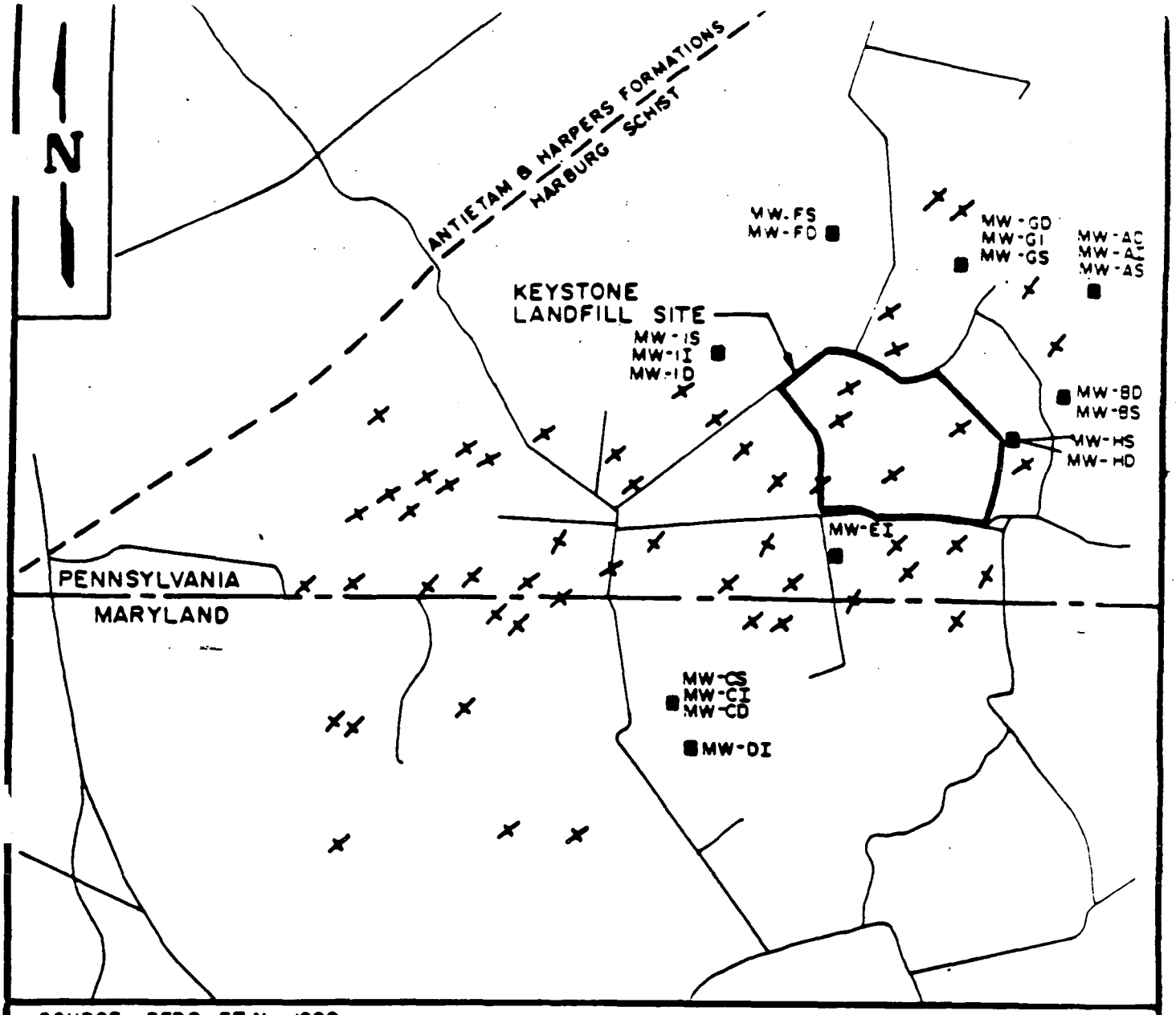


ONE VERTICAL INCH = 100'

ONE HORIZONTAL INCH = 400'

SCALE	REM V	FIGURE
AS SHOWN	KEYSTONE SITE GEOLOGIC CROSS SECTION	3
DATE	KEYSTONE SANITATION LANDFILL SITE UNION TOWNSHIP PENNSYLVANIA	

JOHNSON & MALHOTRA, P.C.



SOURCE: BERG ET AL, 1980.

LEGEND

- LITHOLOGIC CONTACT
- LINEATION ORIENTATION
- MONITOR WELL OR WELL CLUSTER

0 1000 2000 3000
FEET

SCALE	REM V	FIGURE
AS SHOWN	LINEATIONS DUE TO SCHISTOSITY, STRUCTURE OR COMPOSITIONAL LAYERING	4
DATE	KEYSTONE SANITATION LANDFILL SITE	
APRIL 1990	UNION TOWNSHIP, PENNSYLVANIA	

C.C.JOHNSON & MALHOTRA,P.C.

a local north-south secondary structural trend which is parallel to the slope of the land surface as a result of the northeast-tending bedrock ridge.

Groundwater at the Keystone Site occurs in both the shallow saturated saprolith (including the weathered schist) and in the underlying unweathered schist. However, shallow wells completed in saturated saprolith were found to produce significantly more water than deep wells in unweathered schist. This can be contributed to the weathering which has increased the secondary porosity of material, closer to the surface, allowing the saprolith to yield more water.

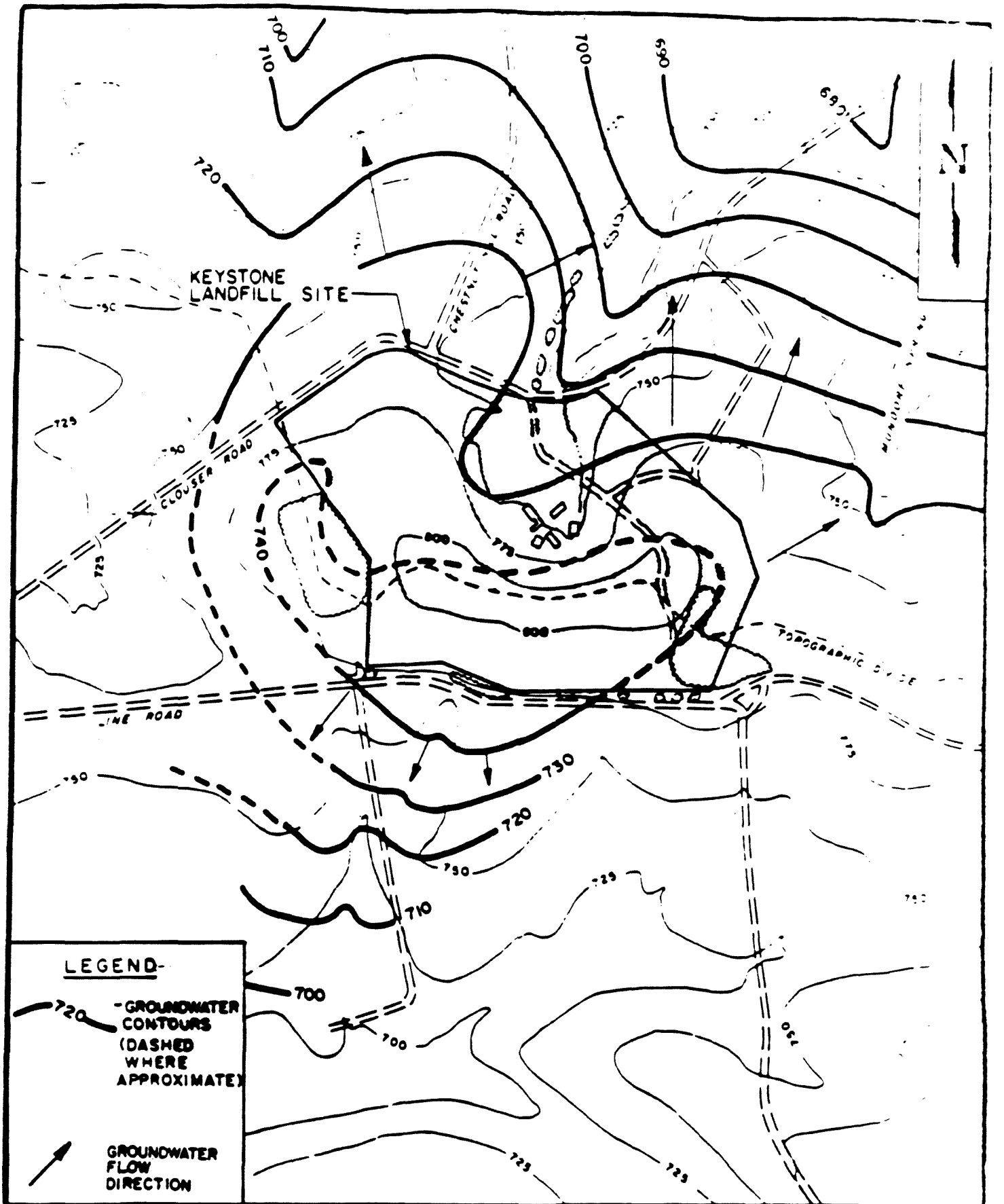
Two zones of low yield exist at the Keystone Site. One zone is deep, while the other is near the surface. In deep wells, low yields are the result of low secondary porosity associated with low permeability and poorly developed fracture networks in the schist below the weathered zone. In the upper zone from the surface to several feet below the surface, soil permeability is lower and secondary porosity is not a factor. The soils on the upper zone are silty clay with some fragmented rock, and restricts movement and contaminant migration in the shallow saturated saprolith.

Groundwater discharges to the surface waters were not documented in the RI investigation. However, given the topographic and potentiometric relation shown in Figure 5, a hydraulic connection can be expected.

The volume of wastes in the landfill have been estimated to be approximately 1.7 million cubic yards of non-homogeneous wastes. Very few records exist on the content of the cells in the landfill. The RI and CA investigations did not investigate the contents of the cells. It has been reported that in addition to the municipal waste accepted, various industrial solid wastes including phosphorus-contaminated sand, potatoe sludge, resin sludge, incineration ash from a wastewater treatment plant and dried latex paint were accepted. According to the Keystone owner and the manager, hazardous wastes have never knowingly been disposed at the Site.

NATURE AND EXTENT OF CONTAMINATION

The Keystone Site consists of an estimated 1.7 million cubic yards of nonhomogeneous waste. This is considered the source of contamination which has been detected in the soils, surface water, sediments and groundwater on and adjacent to the Site. The route of contaminant migration has been via the groundwater either through groundwater discharge or the spray irrigation system. Potentially exposed populations would include residents on or adjacent to the Site, workers at the Site and trespasser or visitors to the Site. In addition, environmental areas adjacent



SCALE
0' 500'

DATE
JUNE 1990

REM V

POTENTIOMETRIC SURFACE MAP

KEYSTONE SANITATION LANDFILL SITE
UNION TOWNSHIP, PENNSYLVANIA

FIGURE
5

to the Site would be potentially exposed to the contaminants. RI field activities included fracture trace analysis, surface geophysics, drilling and coring, borehole geophysics, packer tests, pump tests, monitor well installation and collection of Contract Laboratory Programs (CLP) samples which were analyzed by an EPA approved laboratory. CLP sampling included soil, surface water and sediments, groundwater and residential wells. An environmental survey was also conducted for impacts on local aquatic and land habitats.

There are currently eight monitoring wells onsite which have been installed by Keystone. In the RI, a total of 20 monitoring wells and one observation well were installed. This included four clusters consisting of a shallow, intermediate, and deep wells, three cluster wells consisting of shallow and deep wells and two single intermediate depth wells. The shallow wells were installed to monitor the water table in the unconsolidated saprolith and weathered bedrock at depths from 25 to 45 feet. The intermediate wells were installed in consolidated bedrock where significant water bearing zones were found at depth between 83 to 137 feet. In some locations, water was not available at the intermediate locations. The deep wells were screened at the deepest apparent water bearing zone at depths from 152 to 252 feet.

Soil sampling was conducted in six general areas and included 24 locations at two sample depths. Three soil samples (SL-19,SL-20, SL-21) were designated as background.

VOC contamination of the soil was confined to a few locations in the spray irrigation area. VOCs were not found in off-site soil samples. Several base neutral/acid extractables (BNAs) compounds and a few pesticides were found in the spray irrigation area. All TAL metals except cadmium, silver and cyanide were detected in onsite soil samples. Several metals (arsenic, chromium, copper, lead and zinc) detected onsite were also detected at similar concentration ranges offsite and in the core samples. The contaminants detected and their range of concentration can be seen in Table 1.

Eighteen surface water and ten sediment samples were taken during the RI/FS. Surface water and sediment samples taken at SW-1, SW-3, SD-1 and SD-3 were designated as background samples. Contaminants detected in the surface water include three VOCs found in samples from two surface water sampling locations that receive runoff and sediment from the landfill surface water. Also detected were five inorganics (mercury, cyanide, lead, chromium, copper and zinc) which exceeded the Ambient Water Quality Criteria (AWQC), 40 CFR Part 131. BNAs, pesticides, and PCBs were not detected in surface water samples. In the sediments, two BNAs and nine inorganics were detected. The contaminants detected in the surface water and sediments and their range of concentration can be seen in Table 2.

KEYSTONE SANITATION COMPANY SITE TABLE 1
Compounds/Analytes Detected in Soil Samples

Compounds/Analyte	Onsite Range of Concentration	Offsite Range of Concentration
Volatiles (VOCs)		
1,1 Dichloroethane	2J	
1,2 Dichloroethene(total)	6J	
1,1,1 Trichloroethane	2J-9	
Tetrachloroethene	43	
BNAs/Pesticides		
Naphthalate	19J	
Acenaphthene	33J	
Phenanthrene	19J-160J	17J-36J
Anthracene	14J-120J	
Fluoranthene	14J-200J	14J-63J
Benzo(a)anthracene	36J-190J	
Chrysene	20J-89J	19J-35J
Benzo(b)fluoranthene	23J-200J	22J-31J
Benzo(k)fluoranthene	13J-160J	
Benzo(a)pyrene	21J-180J	19J
Indeno(1,2,3-cd)pyrene	110J	
Dibenzo(a,h)anthracene	160J	
Benzo(g,h,i)perylene	100J	
Pentchlorphenol	73J	
Benzoic Acid	28J-240J	23J-130J
Dimethylphthalate	68J-88J	26J
Diethylphthalate	15J-160J	
Butylbenzylphthalate		35J
Di-n-octylphthalate	10J-140J	5J-28J
N-nitrosodiphenylamine	120J	
Heptachlor epoxide		2.3J-4.1J
Dieldrin	6.8J	2.2J-12J
4,4'DDE	12J-14J	
4,4'DDT		76
4-chloro-3-methyl phenol	96J	
Inorganics		
Antimony	(6.0)-(6.3)L	8.7L
Arsenic	(0.6)-4.8L	(1.4)J-86L
Beryllium	(0.5)-1.5	(0.54)-1.6
Chromium	13.4-22.6	10.7-32.2
Copper	11.2J-43.3	8.3J-38.2J
Lead	9.2-80	5.1J-102J
Mercury	0.11-1.2	0.10-0.13
Nickel	(6.2)-29.3	(6.1)-29.1
Selenium	(0.81)J	(0.47)J
Silver		4.2
Zinc	32.5-106	23.7-149

KEYSTONE SANITATION COMPANY TABLE 2

Range of concentrations detected in Surface Water and Sediments

Compounds/Analytes	Surface Water ug/l	Sediments ug/kg
Volatiles (VOCs)		
1,1,1 Trichloroethane	2J	-
Dichloroflouremethane	0.4	-
1,1 Dichloroethane	0.3	-
BNAs		
Benzoic Acid	-	110J
Bis(2-ethylhexyl)phthalate	-	52J-130J
Inorganics		
Arsenic	[2.1]-[5.0]	[2.1]-13.3
Beryllium	-	[0.46]-2.1
Cadmium	-	2.7J-11.1J
Chromium	13.4	12.7J-48.6J
Copper	[12.0]	9.5-31.7
Cyanide	10.0-18.0	-
Lead	[1.1]-18.9K	16.6J-200J
Mercury	0.30-7.8	-
Nickel	-	12.7J-53.6J
Selenium	[1.3]	[0.25]-[0.28]K
Zinc	[9.4]-67.7	62.7J-206J

KEYSTONE SANITATION COMPANY TABLE 3

Range of Concentration of

Compounds/Analytes Detected in the Monitor Wells

Compounds/Analyte	Onsite ug/l	Offsite ug/l
Volatiles(VOCs)		
Vinyl Chloride	4J-40	-
Chloroethane	3J-18J	-
1,1 Dichloroethene	5-16	-
1,1 Dichloroethane	4J-71	-
1,2 Dichloroethene(Total)	6-140	3J
1,1,1 Trichloroethane	3J-52	20J
Trichloroethene	3J-57	-
Carbon Disulfide	-	7-8
Benzene	7J-14	-
Tetrachloroethene	8-48	11-15J
Dichlorodifluoromethane	4J-48	-
BNAs/Pesticides		
Benzyl alcohol	-	3J
Benzoic Acid	3L	3J-4J
Diethylphthalate	2J	-
Bis(2ethylhexyl)phthalate	3J	3J-7J
N-nitrosodiphenylamine	-	4J
Indeno(1,2,3cd)pyrene	-	7J
Dibenzo(a,h)anthracene	-	4J
Aldrin	-	0.021J-0.16
4,4'DDT	-	0.04J-0.35
Gamma Chlordane	-	0.012J
Inorganics		
Arsenic	[1.2]-21.2L	[1.3]-[8.1]
Cadmium	-	[2.8]
Chromium	[6.4]-658	[4.0]-117
Copper	[23.4]-1300J	[24.3]-156
Lead	[2.0]-13.7	[3.0]-25.1J
Mercury	0.2J-0.4J	-
Nickel	[24.6]L-1040	[17.3]-89.7
Selenium	-	[1.0]L-[4.7]
Zinc	26.0J-98J	[26.6]-77.6J

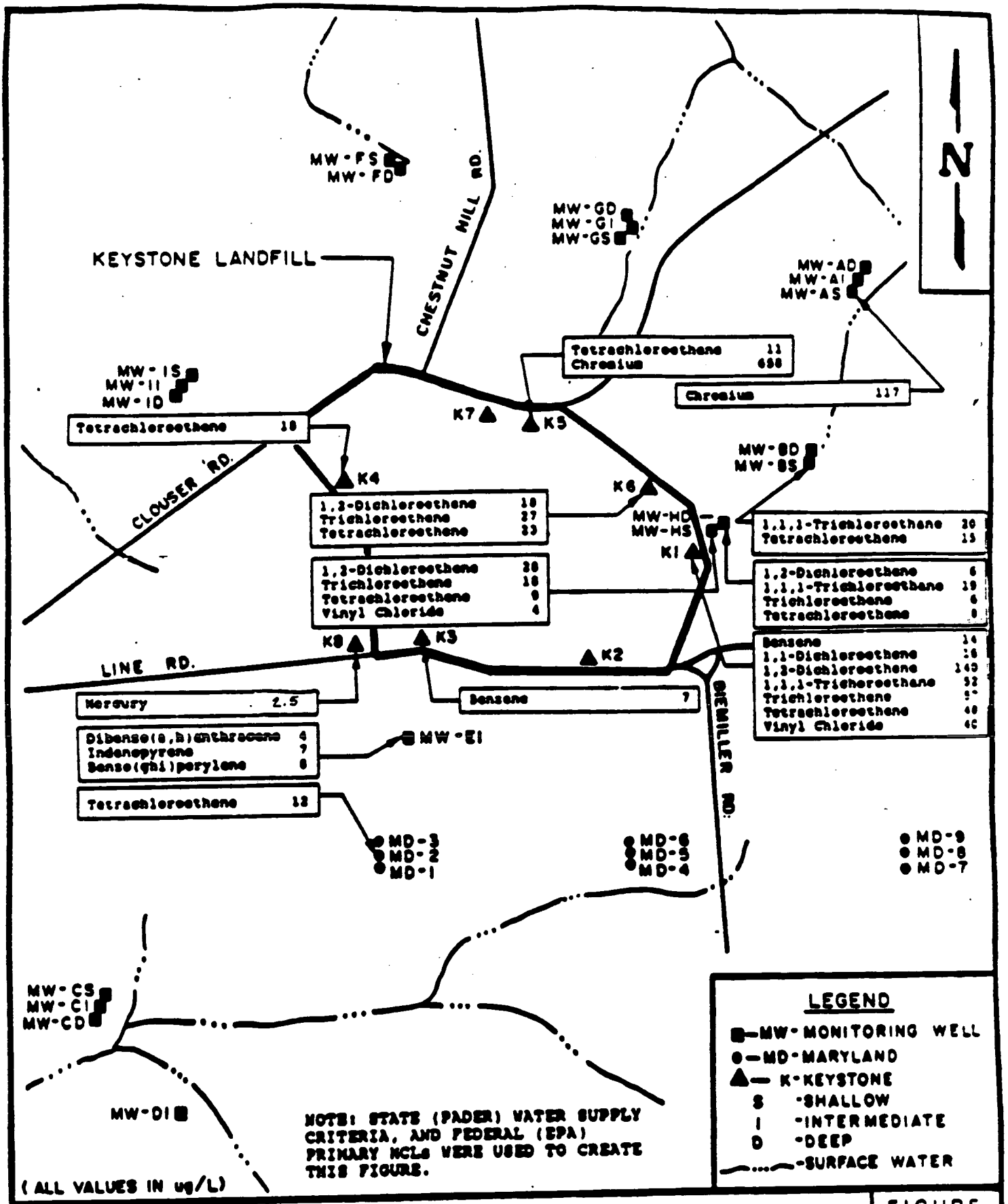
Groundwater samples were taken from both the onsite and offsite wells. The onsite wells included all Keystone wells (except K2) and RI wells MW-HS and MW-HD which are near K1. Background samples were obtained from wells MW-IS, MW-II, MW-ID, MW-FS and MW-FD which are located to the northeast of the Site.

Groundwater sampling revealed the detection of ten VOCs in onsite monitoring wells at concentrations up to 140 ug/1. Vinyl chloride, 1,1-dichloroethene, trichloroethene, and benzene were detected above the Federal Maximum Contaminant Levels (MCLs),40 CFR 141.11-141.16. Of these four contaminants, vinyl chloride and benzene are known human carcinogens. Low concentrations of four VOCs, carbon disulfide, 1,1,1-trichloroethane, tetrachloroethene and total 1,2-dichloroethene, were found in from offsite monitoring wells. No VOCs detected offsite exceeded Federal MCLs. VOC contaminated was detected at a maximum depth of 150 feet below the Keystone Site (MW-HD) and at shallow (25-35 feet) and at intermediate depths (65-85 feet) in offsite wells MW-BS and MD2, respectively.

Low concentrations (up to 3ug/1) of three BNAs, benzoic acid, diethylphthalate, and bis(2-ethylhexyl)phthalate, were found in onsite monitoring well K3. BNAs occurred in offsite wells in concentrations up to 20 ug/1 with a maximum frequency of detection of 6 out of 26 samples. No pesticides or PCBs were detected in the onsite wells but pesticides were detected in 6 out of 26 offsite wells.

Several metals were detected in the onsite monitoring wells at concentrations up to 1300 ug/1. Chromium was detected above Federal MCLs (50ug/1) at 658 ug/1 in onsite well K5. Metals detected in from offsite monitor wells were found randomly distributed around the site. Chromium and mercury exceeded Federal MCLs at MW-AS and K-8 respectively. Contaminants detected in the onsite and offsite wells and their range of concentration can be seen in Table 3. Also Figure 6 shows contaminants concentration exceeding applicable or relevant and appropriate regulations (ARARs).

Fifteen residential wells surrounding the Site including the one onsite residential well were sampled. Wells RW-13 and RW-15 which are located directly north of the Site were considered background wells. For the residential sampling, five VOCs, one BNA and three metals were detected in the one onsite residential well RW-1. No Federal MCLs were exceeded but the PA Water Supply Criteria was exceeded for tetrachloroethene and total 1,2 dichlororethene. No VOCs were detected in the offsite residential wells. Three BNAs, two pesticides and several metals were detected in offsite residential wells but none which exceeded Federal MCLs, 40 CFR 141.11-141.16 or PA Water Supply Criteria, 25 PA Code §§ 93.1 et. seq..



SCALE 0' 500'

DATE JULY 1990

REM V

GROUNDWATER CONTAMINANT CONCENTRATIONS EXCEEDING ARARs

KEYSTONE SANITATION LANDFILL SITE

LITTLESTOWN, PENNSYLVANIA

FIGURE 6

SUMMARY OF SITE RISKS

The purpose of the risk assessment performed for the Keystone Site was to assess if actual or threatened releases of hazardous substances pose potential risks to exposed individuals under current or possible future exposure circumstances. In order to accomplish this, the risk assessment focused on the following: (1) the contaminants detected during the RI; (2) the potential or actual potential exposure pathways; (3) the potential or actual human receptors; (4) the toxicity information on contaminants of concern; and (5) the risk characterization information. The following paragraphs will discuss these issues and provide a summarized rational for the Selected Remedy.

Contaminant Identification Information

At the Keystone Site, the groundwater, surface water, surface soil and sediments were considered media to which a human population may be exposed. Each of these media were analyzed for various organic and inorganic contaminants. Contaminants of concern were selected for each of the media sampled based on the frequency of occurrence of contaminants, concentrations found on-site relative to those found offsite, and concentrations relative to background (primarily for inorganic in soil, sediment, and groundwater).

The selected contaminants of concern for the surface soil medium are listed below:

- Inorganics: antimony, manganese, mercury ,selenium, and silver.
- Volatile Organic Compunds (VOCs): 2-hexanone, 1,1-dichloroethane,1,2-dichloroethene(total), 1,1,1-trichloroethane, trichloroethene, 4-methyl-2- pentanone, and tetrachloroethene.
- Semi-volatile Organic Compounds (SVOCs): Benzoic acid, dimethylphthalate, diethylphthalate, phenanthrene, anthracene, di-n-butylphthalate, fluoranthene, pyrene, butylbenzylphthalate, chrysene, di-n-octylphthalate, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,,h)anthracene, benzo(g,h,i)perylene and bis(2-ethylhexyl)phthalate.
- Pesticides: dieldrin.

The selected contaminants of concern for the surface water medi- are listed below:

- Inorganics: barium, chromium, copper, lead, manganese, mercury, selenium, vanadium, and zinc.

- VOCs: 1,1 dichloroethane, 1,1,1- trichloroethane, and tetrachloroethene.

The selected contaminants of concern for the sediments are listed below:

- Inorganics: barium, beryllium, lead, manganese, and silver.

- VOCs: methylene chloride, acetone, and 4-methyl-2-pentanone.

- SVOCs: bis(2ethylhexyl)phthalate.

The selected contaminants of concern for the groundwater medium are listed below:

- Inorganics: antimony, beryllium, barium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, selenium, and vanadium.

- VOCs: vinyl chloride, chloroethane, acetone, carbon disulfide, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene(total), 1,1,1-trichloroethane, trichloroethene, benzene, tetrachloroethene, and dichlorofluoromethane.

- SVOCs: benzoic acid, diethylphthalate, chrysene, bis(2-ethylhexyl)phthalate, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene.

- Pesticides: aldrin, and 4,4'-DDT.

The selected contaminants of concern for the groundwater/ residential well medium are listed below:

- Inorganics: antimony, beryllium, barium, cadmium, chromium, copper, cobalt, lead, manganese, mercury, nickel, selenium, vanadium, and zinc.

- VOCs: vinyl chloride, chloroethane, acetone, benzene, carbon disulfide, 1,1-dichloroethene, 1,2-dichloroethene(total), 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, 4-methyl-2-pentanone, and dichlorofuoromethane.

- SVOCs: benzoic acid, 2-chlorophenol, diethylphthalate, chrysene, bis(2-ethylhexyl)phthalate,indeno(1,2,3-cd)pyrene, di-n-butyphthalate, dimethylphthalate, benzo(g,h,i)perylene, and dibenz(a,h)anthracene

The contaminants of concern for each medium were evaluated for the following criteria: frequency of detection; range of sample quantitation levels for nondetected analytes; range of detected concentrations; background levels; 95% confidence mean concentrations for onsite and affected by the site sampling locations; maximum concentrations detected at onsite and affected by the site sampling locations; and calculated exposures.

Considering all these evaluation criteria, the following list of contaminants of concern were developed for the Keystone Site.

- Inorganics: antimony, beryllium, barium, cadmium, chromium, copper, cobalt, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc.

- VOCS: 2-hexanone, vinyl chloride, chloroethane, methylene chloride, acetone, benzene, carbon disulfide, 1,1-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethene(total), 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, 4-methyl-2-pentanone, and dichlorofluoromethane.

- SVOCs: benzoic acid, 2-chlorophenol,diethylphthalate, chrysene, bis(2-ethylhexyl)phthalate, phenanthrene, anthracene, di-n-butylphthalate, fluoranthene, dimethylphthalate, pyrene, butylbenzylphthalate, and di-n-octylphthalate.

Exposure Pathways

Exposure pathways identified at the Keystone Site have been considered for current and future use populations and include the following:

- Dermal contact and ingestion of surface soils and exposed wastes.

- Inhalation of suspended particles generated from soils and exposed wastes.

- Dermal contact and ingestion of sediments and surface water.

- Inhalation during showering, dermal contact with, and ingestion of.

The most likely potential exposed populations under current and future conditions are Keystone employees, trepassers, onsite remedial workers, and nearby residents. Since onsite residents and workers experience greater exposure at the site, the quantitative risk assessment was performed to evaluate onsite adults.

A reasonable maximum exposure (RME) was used to characterize the Site risks. It consists of conservative estimates of the following input parameters;

- o Exposure concentrations based on calculated 95% confidence mean.
- o Ingestion and inhalation rates on skin surface area exposed.
- o Exposure frequency (events/year or hours/year).
- o Exposure duration.
- o Exposure averaging time.
- o Meterological conditions conductive to generation of windborne dusts and volatile organic vapors.
- o Volatility of contaminants for the scenario of using contaminated for showering.

Using this RME approach, conservative estimates of the subchronic and chronic daily intakes (CDI) were developed. The CDI will assume a 70 year lifespan, a body weight of 70 kg., an exposure duration of 30 years, an exposure frequency depending on the media (250-365 days/year), the exposure concentration, and other factors depending on the model used specifically to assess the dose by that specific medium (e.g., ingestion of soils, dermal contact of soils). More information on the specific models can be found in the Risk Assessment in the RI.

Toxicity Assessment

Using the CDI, a quantitative assessment for cancer risks and quantitative measure of potential for adverse noncarcinogenic health effects resulting from contaminant exposure at the Site is derived. This is referred to as a toxicity assessment. In the toxicity assessment, cancer potency factors (CPFs) were identified for potential carcinogencic contaminants, and reference doses (RfDs) were identified for chemicals exhibiting noncarcinogencic effects.

CPFs have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogencic chemicals. CPFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$ are multiplied by the estimated intake of a potential carcinogencic chemicals, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risks associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risk calculated

from the CPF. Use of this approach makes an underestimation of the cancer risk highly unlikely. CPFs are derived from the results of human epidemiological studies for chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg/day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans.) These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

The CPFs and RfDs for the contaminants of concern are contained in Tables 4 & 5.

For the Keystone Site, excess lifetime cancer risks are determined by multiplying the daily intake level of chemical from environmental media with the CPF. These risks are probabilities that are generally expressed in scientific notation (e.g., 1x10-6 or 1E-06). An excess lifetime cancer risk of 1E-6 indicates that, as a plausible upper bound, an individual has a one in a million chance of developing cancer as result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site. The estimated lifetime excess cancer risks by exposure routes and environmental media are shown in Table 6.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may be reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposure within a single medium or across media. A HI less than one or equal to one indicates there is no significant risk of adverse health effects. The estimated HI or noncarcinogenic risk by exposure routes is shown on Table 7 and by environmental media on Table 8.

The results of the estimated excess lifetime cancer risks indicates that the total cancer risks for the Site is 5E-04. This value is considered outside the target range of 1E-04 to 1E-06 which is used by EPA for determining the need for a remedial action at the Site.

TABLE 4

CANCER POTENCY FACTORS

Chemical	Carcinogenic Slope Factor (q^*) (kg-d/mg)
Beryllium	4.3E+00
Cadmium	NA
Chromium	NA
Lead	4.0E-02
Nickel	NA
1,1-Dichloroethane	9.1E-02
1,1-Dichloroethene	6.0E-01
Benzene	2.9E-02
Methylene chloride	7.5E-03
Tetrachloroethene	5.1E-02
Trichloroethene	1.1E-02
Vinyl Chloride	2.3E+00
Benzo(a)Pyrene	NA
Benzo(b)Fluoranthene	NA
Benzo(g,h,i)Perylene	NA
Benzo(k)Fluoranthene	NA
bis(2-Ethylhexyl)Phthalate	1.4E-02
Chrysene	NA
Dibenz(a,h)Anthracene	NA
Indeno(1,2,3-cd)Pyrene	NA
Phenanthrene	NA
4,4'-DDT	3.4E-01
Aldrin	1.7E+01
Dieldrin	1.6E+01

TABLE 5

CHRONIC REFERENCE DOSES

Contaminant of Concern	Chronic Reference Dose (RfD) (mg/kg-day)
Antimony	NA
Barium	0.0001
Beryllium	NA
Cadmium	NA
Chromium	NA
Cobalt	NA
Copper	NA
Lead	NA
Manganese	0.0003
Mercury	NA
Nickel	NA
Selenium	NA
Silver	NA
Vanadium	NA
Zinc	NA
1,1,1-Trichloroethane	0.3
1,1-Dichloroethane	0.1
1,1-Dichloroethene	NA
1,2-Dichloroethene (total)	NA
2-Hexanone	NA
4-Methyl-2-pentanone	0.02
Acetone	NA
Benzene	NA
Carbon disulfide	NA
Chloroethane	NA
Dichlorodifluoromethane	0.05
Methylene chloride	0.857
Tetrachloroethene	NA
Trichloroethene	NA
Vinyl Chloride	NA
2-Chlorophenol	NA
Anthracene	NA
Benzoic Acid	NA
Benzo(a)pyrene	NA
Benzo(b)fluoranthene	NA
Benzo(g,h,i)perylene	NA
Benzo(k)fluoranthene	NA
bis(2-Ethylhexyl)phthalate	NA
Butylbenzylphthalate	NA
Chrysene	NA
Dibenz(a,h)anthracene	NA
Diethylphthalate	NA
Dimethylphthalate	NA
Di-n-Butylphthalate	NA
Di-n-octylphthalate	NA
Fluoranthene	NA
Indeno(1,2,3-cd)Pyrene	NA
Phenanthrene	NA
Pyrene	NA
4,4'-DDT	NA
Aldrin	NA
Dieldrin	NA

TOTAL CARCINOGENIC RISK BY EXPOSURE ROUTE (ADULTS) KEYSTONE SITE, PENNSYLVANIA

TABLE 6

Chemical	Lifetime Excess Cancer Rate (Dimensionless)				Percent Contribution to Lifetime Excess Cancer Rate			
	Oral	Dermal	Inhalation	Combined Total	Oral	Dermal	Inhalation	Combined Total
Beryllium	6E-05	9E-09	1E-08	6E-05	11.72%	0.00%	0.00%	11.73%
Cadmium	NA	NA	2E-08	2E-08	NA	NA	0.00%	0.00%
Chromium	NA	NA	4E-06	4E-06	NA	NA	0.71%	0.71%
Lead	3E-06	1E-09	NA	3E-06	0.64%	0.00%	NA	0.64%
Nickel	NA	NA	2E-07	2E-07	NA	NA	0.04%	0.04%
1,1-Dichloroethene	1E-05	3E-08	NA	1E-05	2.61%	0.01%	NA	2.61%
1,1-Dichloroethene	4E-05	8E-08	7E-05	1E-04	7.36%	0.01%	14.02%	21.39%
Benzene	2E-06	3E-09	2E-06	3E-06	0.32%	0.00%	0.30%	0.62%
Methylene chloride	0E+00	5E-10	0E+00	5E-10	NA	0.00%	NA	0.00%
Tetrachloroethene	6E-06	2E-08	4E-07	6E-06	1.08%	0.00%	0.07%	1.15%
Trichloroethene	1E-06	3E-09	2E-06	3E-06	0.22%	0.00%	0.33%	0.56%
Vinyl Chloride	3E-04	5E-07	3E-05	3E-04	52.25%	0.10%	6.27%	58.63%
Benzo(a)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)Perylene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)Phthalate	9E-07	5E-07	NA	1E-06	0.16%	0.10%	NA	0.26%
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)Anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	4E-07	5E-10	2E-08	4E-07	0.07%	0.00%	0.00%	0.08%
Aldrin	7E-06	9E-09	3E-07	8E-06	1.39%	0.00%	0.07%	1.46%
Dieldrin	7E-08	6E-07	6E-09	7E-07	0.01%	0.12%	0.00%	0.13%
TOTAL	4E-04	2E-06	1E-04	5E-04	77.84%	0.35%	21.81%	100.00%

TOTAL CHRONIC CARCINOGENIC RISK BY ENVIRONMENTAL MEDIA (ADULTS)

Chemical	Lifetime Excess Cancer Rates (Dimensionless)					Percent Contribution to Lifetime Excess Cancer Rates				
	Surface Soil	Sediment	Surface Water	Groundwater	Combined Total	Surface Soil	Sediment	Surface Water	Groundwater	Combined Total
Beryllium	NA	7E-10	NA	6E-05	6E-05	NA	0.00%	NA	11.41%	11.41%
Cadmium	NA	NA	NA	2E-08	2E-08	NA	NA	NA	0.00%	0.00%
Chromium	NA	NA	NA	4E-06	4E-06	NA	NA	NA	0.76%	0.76%
Lead	NA	5E-10	1E-08	3E-06	3E-06	NA	0.00%	0.00%	0.57%	0.57%
Nickel	5E-10	NA	NA	2E-07	2E-07	0.00%	NA	NA	0.04%	0.04%
1,1-Dichloroethene	3E-09	NA	5E-09	1E-05	1E-05	0.00%	NA	0.00%	2.62%	2.62%
1,1-Dichloroethene	NA	NA	NA	1E-04	1E-04	NA	NA	NA	21.48%	21.48%
Benzene	NA	NA	NA	3E-06	3E-06	NA	NA	NA	0.62%	0.62%
Methylene chloride	NA	5E-10	NA	NA	5E-10	NA	0.00%	NA	NA	0.00%
Tetrachloroethene	4E-09	NA	7E-09	6E-06	6E-06	0.00%	NA	0.00%	1.15%	1.15%
Trichloroethene	5E-10	NA	NA	3E-06	3E-06	0.00%	NA	NA	0.56%	0.56%
Vinyl Chloride	NA	NA	NA	3E-04	3E-04	NA	NA	NA	58.85%	58.85%
Benzo(a)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)Perylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)Phthalate	2E-08	1E-09	NA	1E-06	1E-06	0.00%	0.00%	NA	0.26%	0.26%
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)Anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	4E-07	4E-07	NA	NA	NA	0.08%	0.08%
Aldrin	NA	NA	NA	8E-06	8E-06	NA	NA	NA	1.46%	1.46%
Dieldrin	7E-07	NA	NA	NA	7E-07	0.13%	NA	NA	NA	0.13%

TOTAL CHRONIC NONCARCINOGENIC RISK BY EXPOSURE ROUTE (ADULTS)
KEYSTONE SITE, PENNSYLVANIA

TABLE 7

FILE: KEYSUM1.WK1
DATE: 09/02/90
CUMULATIVE RISK BY EXPOSURE ROUTES - ADULT CHRONIC HAZARD INDEX

Chemical	Hazard Index - Chronic Adult (Dimensionless)				Percent Contribution to Hazard Index - Chronic Adult			
	Oral	Dermal	Inhalation	Combined Total	Oral	Dermal	Inhalation	Combined Total
Antimony	2.900	0.000	NA	2.900	59.68%	0.01%	NA	59.69%
Barium	0.377	0.000	0.019	0.396	7.76%	0.00%	0.38%	8.14%
Beryllium	0.007	0.000	NA	0.007	0.14%	0.00%	NA	0.14%
Cadmium	0.145	0.000	NA	0.145	2.98%	0.00%	NA	2.98%
Chromium	0.464	0.000	NA	0.464	9.55%	0.00%	NA	9.55%
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Copper	0.131	0.000	NA	0.131	2.69%	0.00%	NA	2.69%
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	0.191	0.000	0.012	0.203	3.92%	0.00%	0.26%	4.18%
Mercury	0.029	0.000	NA	0.029	0.59%	0.00%	NA	0.59%
Nickel	0.281	0.000	NA	0.281	5.79%	0.00%	NA	5.79%
Selenium	0.025	0.000	NA	0.025	0.52%	0.00%	NA	0.52%
Silver	0.000	0.000	NA	0.000	0.00%	0.00%	NA	0.00%
Vanadium	0.083	0.000	NA	0.083	1.71%	0.00%	NA	1.71%
Zinc	0.040	0.000	NA	0.040	0.82%	0.00%	NA	0.82%
1,1,1-Trichloroethane	0.003	0.000	0.001	0.003	0.06%	0.00%	0.02%	0.07%
1,1-Dichloroethane	0.004	0.000	0.004	0.007	0.08%	0.00%	0.07%	0.15%
1,1-Dichloroethene	0.017	0.000	NA	0.017	0.36%	0.00%	NA	0.36%
1,2-Dichloroethene (Total)	0.020	0.000	NA	0.020	0.42%	0.00%	NA	0.42%
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-Pentanone	0.002	0.000	0.004	0.006	0.04%	0.00%	0.09%	0.12%
Acetone	0.005	0.000	NA	0.005	0.10%	0.00%	NA	0.10%
Benzene	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Disulfide	0.001	0.000	NA	0.001	0.03%	0.00%	NA	0.03%
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	0.001	0.000	0.004	0.006	0.02%	0.00%	0.09%	0.11%
Methylene Chloride	0.000	0.000	0.000	0.000	NA	0.00%	NA	0.00%
Tetrachloroethene	0.027	0.000	NA	0.027	0.56%	0.00%	NA	0.56%
Trichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	0.002	0.001	NA	0.004	0.05%	0.03%	NA	0.08%
Anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Benzoic Acid	0.000	0.000	NA	0.000	0.00%	0.00%	NA	0.00%
Benzo(a)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)Perylene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)Phthalate	0.007	0.004	NA	0.012	0.15%	0.09%	NA	0.24%
Butylbenzylphthalate	0.000	0.000	NA	0.000	0.00%	0.00%	NA	0.00%
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)Anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	0.000	0.000	NA	0.000	0.00%	0.00%	NA	0.00%
Dimethyl Phthalate	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	0.002	0.001	NA	0.003	0.04%	0.02%	NA	0.06%
Di-n-Octyl Phthalate	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	0.006	0.000	NA	0.006	0.11%	0.00%	NA	0.11%
Aldrin	0.035	0.000	NA	0.035	0.72%	0.00%	NA	0.72%
Dieldrin	0.000	0.002	NA	0.002	0.00%	0.04%	NA	0.04%
TOTAL	4.806	0.010	0.044	4.859	98.89%	0.20%	0.91%	100.00%

TOTAL CHRONIC NONCARCINOGENIC RISK BY ENVIRONMENTAL MEDIA (ADULTS) KEYSTONE SITE, PENNSYLVANIA

TABLE 8

FILE: KEYSUN2.WK1
DATE: 09/02/90
CUMULATIVE RISK BY ENVIRONMENTAL MEDIA - ADULT CHRONIC HAZARD INDEX

Chemical	Hazard Index - Adult Chronic (Dimensionless)					Percent Contribution to Hazard Index - Adult Chronic				
	Surface Soil	Sediment	Surface Water	Groundwater	Combined Total	Surface Soil	Sediment	Surface Water	Groundwater	Combined Total
Antimony	0.000	NA	NA	2.900	2.900	0.00%	NA	NA	59.65%	59.65%
Barium	NA	0.000	0.000	0.396	0.396	NA	0.00%	0.00%	8.15%	8.15%
Beryllium	NA	0.000	NA	0.007	0.007	NA	0.00%	NA	0.14%	0.14%
Cadmium	NA	NA	NA	0.145	0.145	NA	NA	NA	2.98%	2.98%
Chromium	NA	NA	0.000	0.464	0.464	NA	NA	0.00%	9.54%	9.55%
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	0.000	0.131	0.131	NA	NA	0.00%	2.69%	2.70%
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	0.000	0.000	0.001	0.204	0.205	0.01%	0.00%	0.01%	4.19%	4.21%
Mercury	0.000	NA	0.001	0.029	0.030	0.00%	NA	0.01%	0.60%	0.61%
Nickel	NA	NA	NA	0.281	0.281	NA	NA	NA	5.78%	5.78%
Selenium	0.000	NA	0.000	0.025	0.025	0.00%	NA	0.00%	0.51%	0.52%
Silver	0.000	0.000	NA	NA	0.000	0.00%	0.00%	NA	NA	0.00%
Vanadium	NA	NA	0.000	0.083	0.083	NA	NA	0.00%	1.71%	1.71%
Zinc	NA	NA	0.000	0.040	0.040	NA	NA	0.00%	0.82%	0.82%
1,1,1-Trichloroethane	0.000	NA	0.000	0.003	0.003	0.00%	NA	0.00%	0.07%	0.07%
1,1-Dichloroethane	0.000	NA	0.000	0.007	0.007	0.00%	NA	0.00%	0.15%	0.15%
1,1-Dichloroethene	NA	NA	NA	0.017	0.017	NA	NA	NA	0.36%	0.36%
1,2-Dichloroethene (Total)	0.000	NA	NA	0.020	0.020	0.00%	NA	NA	0.42%	0.42%
Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-2-Pentanone	0.000	0.000	NA	0.006	0.006	0.00%	0.00%	NA	0.12%	0.12%
Acetone	NA	0.000	NA	0.005	0.005	NA	0.00%	NA	0.10%	0.10%
Benzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Disulfide	NA	NA	NA	0.001	0.001	NA	NA	NA	0.03%	0.03%
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	0.006	0.006	NA	NA	NA	0.11%	0.11%
Methylene Chloride	NA	0.000	NA	NA	0.000	NA	0.00%	NA	NA	0.00%
Tetrachloroethene	0.000	NA	0.000	0.027	0.027	0.00%	NA	0.00%	0.56%	0.56%
Trichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	NA	NA	NA	0.004	0.004	NA	NA	NA	0.08%	0.08%
Anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzoic Acid	0.000	NA	NA	0.000	0.000	0.00%	NA	NA	0.00%	0.00%
Benzo(a)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)Perylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)Phthalate	0.000	0.000	NA	0.012	0.012	0.00%	0.00%	NA	0.24%	0.24%
Butylbenzylphthalate	0.000	NA	NA	NA	0.000	0.00%	NA	NA	NA	0.00%
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)Anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	0.000	NA	NA	0.000	0.000	0.00%	NA	NA	0.00%	0.00%
Dimethyl Phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	0.000	NA	NA	0.003	0.003	0.00%	NA	NA	0.06%	0.06%
Di-n-Octyl Phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	0.006	0.006	NA	NA	NA	0.11%	0.11%
Aldrin	NA	NA	NA	0.039	0.039	NA	NA	NA	0.72%	0.72%
Dieldrin	0.002	NA	NA	NA	0.002	0.04%	NA	NA	NA	0.04%
TOTAL	0.003	0.000	0.002	4.857	4.862	0.06%	0.00%	0.04%	99.90%	100.00%

The primary cancer risk comes from the ingestion of groundwater, and can be largely attributed to the presense of vinyl chloride detected at the value of 40 ug/l in well K-1 and a value of 4 ug/l at well HS. Both of these wells are onsite wells.

The results of the noncarcinogenic indices present a chronic Hazard Index for the Site of 4.862. This value exceeds the accepted value of one or less than one. The value of the HI is attributed to the presence of antimony, barium, manganese and chromium in the groundwater. These contaminants pose a threat to human health through either ingestion of the groundwater or inhalation of an aerosolized mist of groundwater.

In summary, both the Lifetime Excess Cancer Risks (5E-04) and the Hazard Index (4.862) exceeded EPA's accepted values of 1E-04 to 1E-06 and less than 1 respectively. As indicated by this, in its current condition, the Site presents an imminent and substantial endangerment to public health as set forth in Section 106 of CERCLA, 42 U.S.C. § 9606. Therefore, a remedial action is required to reduce the risks to human health.

Environmental Risks

An environmental risk assessment was conducted in the RI to assess the potential impacts to nonhuman receptors with the contaminants of concern at the Keystone Site. Potentially exposed populations (receptors) were identified and combined with information on exposure and toxicity on the contaminants of concern from the Site to derive the estimates of impact.

The potential receptors identified at the Site included terrestial plants, terrestial wildlife and aquatic life. For each of these receptors, exposure pathways were examined and are as follows:

Potential Recptors	Exposure Pathways
Terrestial Plants	Uptake from surface soils
Terrestial Wildlife	Ingestion of surface soils Ingestion of food
Aquatic Life	Direct contact with water Direct contact with sediments Ingestion of sediments Ingestion of food

For the terrestial plant and wildlife, it was determined that the exposures to the contaminants of concern at the Site would not have a significant impact.

For the fish and aquatic invertebraes at the Site, surface water toxicity values were available from the Ambient Water Quality

Criteria (AWQC) and the Lowest Observable Effect Concentration (LOEC). The AWQC establishes criteria for chromium, copper, lead, mercury, selenium and zinc. The LOEC is defined as the lowest concentration associated with a toxic effect and is used in the absence of AWQC for barium, manganese, 1,1,1 trichloroethane, and tetrachloroethene. For the Keystone Site, chromium, copper, cyanide,lead, zinc and mercury exceeded the AWQC. Of these contaminants, mercury was identified as a possible concern due to its ability to bioaccumulate in fathead minnow. However, this bioaccumulation is associated with methylmercury and not inorganic mercury. As we do not currently know the speciation of mercury at the Site, it is not possible to state whether these surface water concentrations are adversely impacting aquatic life at the Site.

For the amphibians at the Site, limited data was available on metal toxicity to amphibian species. Therefore, the assessment was restricted to VOCs and amphibians. From this assessment, it was determined that only concentrations of 1,1,1 trichloroethane exceeded the 1% mortality rate for frogs. The 1% mortality rate would be considered significant if frogs were an endangered species or have inherently low reproductive success. No endangered species of frogs have been identified at the Site nor has there been an indication of low reproductive success among frogs. Therefore, it can be concluded that adverse impacts to amphibian species at the Keystone Site are unlikely.

In summary, the environmental assessment determined the following:

- No adverse impact was determined to exist for the terrestial wildlife and terrestial plant populations at the Site from the contaminants of concern.

- AWQC was exceeded for chromium, copper, cyanide, lead, zinc and mercury. The presence of mercury in the form of methylmercury may adversely impact the aquatic life on the surface water.

- Additional sampling will be conducted to determine the speciation of mercury and monitor the levels of contaminants in the surface water and sediments.

DESCRIPTION OF ALTERNATIVES

The remedial objectives of the Keystone Site are to prevent current and future exposure to the contaminated soils, to reduce contaminate migration into the groundwater and to prevent migration of contaminated groundwater to uncontaminated area. To address these objectives, remedial alternatives were developed for contaminant source control and groundwater remediation.

Under the statutory requirements of CERCLA Section 121, 42 U.S.C. § 9621, the alternatives must be protective of human health

the environment, comply with applicable or relevant and appropriate requirements and be cost effective. It is also required that permanent solutions and alternative treatment technologies or resource recovery technologies be considered to the maximum extent practicable. This is to satisfy EPAs preference for treatment that reduces toxicity, mobility and volume of the Site related contaminants.

At the Keystone Site, certain technologies and process options were screened out due to the waste characteristics and Site conditions which made them technically and/or economically infeasible. The Keystone Site consists of approximately 1.7 million cubic yards of nonhomogeneous waste. Technologies such as biological treatment, solidification/stabilization, soil vapor extraction were not technically feasible for the nonhomogeneous waste content. Other technologies such as thermal treatment and offsite disposal were considered not economically feasible.
The Feasibilty Study should be referred to for further discussion on the technical impracticability of treatment technologies to this Site.

Five alternatives were given final consideration. With the exception of the No Action alternative required by the NCP and the Limited Action alternative, these alternatives all consider groundwater extraction and treatment. Two of the alternatives also consider containment of the waste. Pursuant to CERCLA 121(c) 42 U.S.C. § 9621(c), all alternatives will include a review every five years as wastes are being left onsite.

In the following discussion of the alternatives, the costs are presented as present worth costs for a period of thirty years with a five percent discount. The present worth costs consist of construction and operation and maintenance (O&M). Comparison of the costs is included in Table 9.

Alternative 1 - No Action

Under the National Oil and Hazardous Substances Contingency Plan, 40 CFR § 300.430(e)(6) 55 Fed. Reg. 8849 (March 8, 1990), the no action alternative must be considered as a baseline action against which all other alternatives are compared. It provides no remedial action and no reduction of risk posed by the surifical soils and grounswater at the Keystone site. Because wastes are being left onsite, a five year effectiveness review would be required. The only costs associated with this alternative is the present worth cost for the five year review which is $20,900. The no action alternative would not comply with the ARARs for the site.

Alternative 2 - Limited Action

The Limited Action alternative provides no remedial action and no reduction of the risks posed by surficial soil and groundwater at

the Keystone Site. Only one remedial action objective (to prevent direct contact with surface soils having contaminant concentrations in excess of accepted background levels, or which would pose an excess cancer risk) would be attained by this alternative.

This alternative would provide the minimum measures necessary to limit exposures of nearby residents to site contaminants. A fence would be installed at the perimeter of the property to physically restrict access and subsequently limit the potential for exposure to on-site contaminants. No measures limiting exposure to contaminants beyond the perimeter fence, or off-site, would be included. A galvanized steel, chain-link fence approximately 6,800 feet long would be constructed around the landfill.

The Limited Action alternative also includes monitoring (for an assumed period of 30 years, per OSWER Directive 9355.3-01) to determine variations in future contaminant migration. Also, restrictions on future property use, which would include aquifer use limitations and construction restrictions would be enacted. A point of use treatment unit would be provided to the onsite residents.

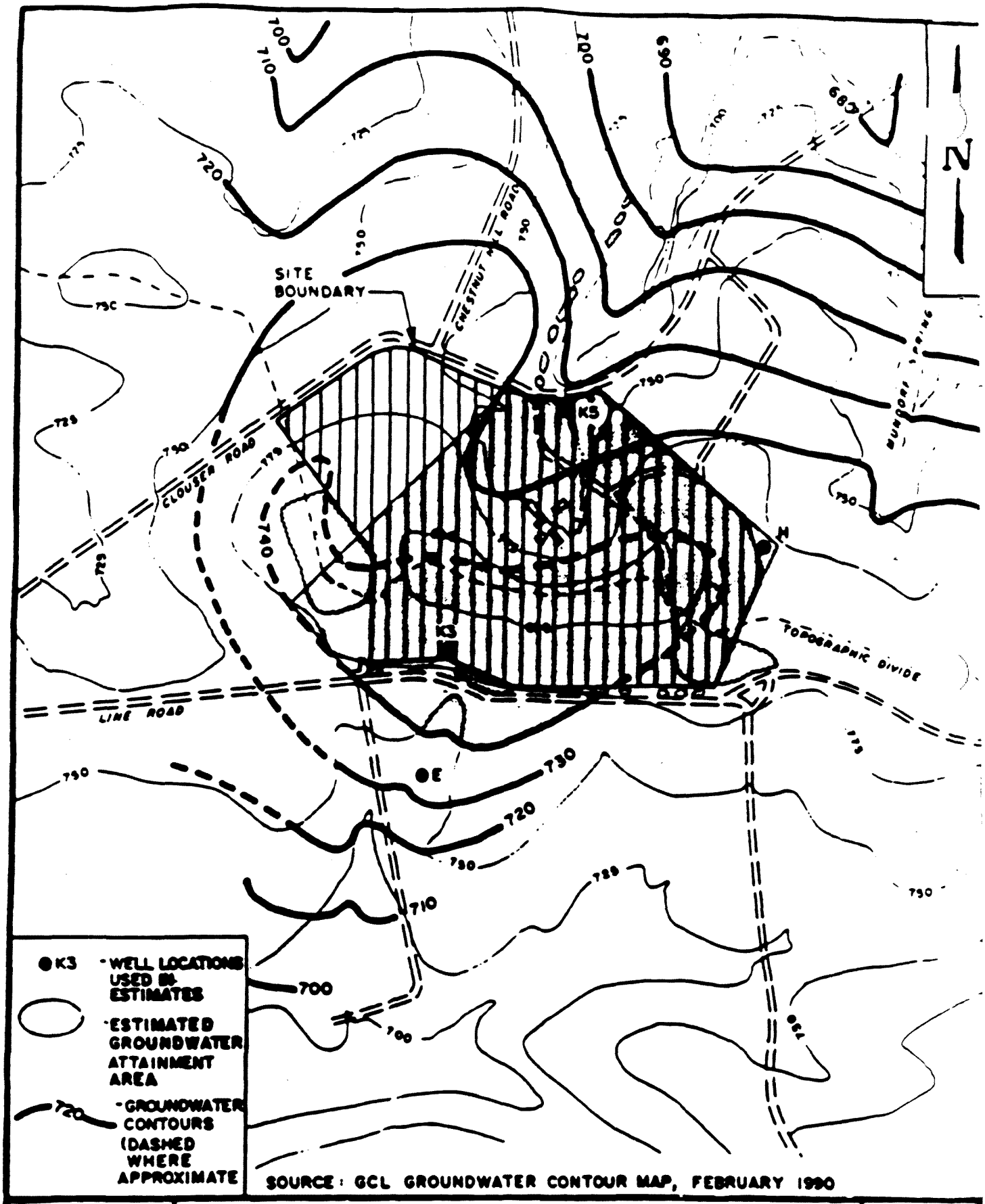
The present worth cost associated with this alternative is $720,000. This cost was incorrectly stated in the Proposed Plan as $719,000. These costs are for fencing, a sign, a water treatment unit, long term monitoring (30 years) and a five year review. The Limited Action alternative would not comply with applicable State and Federal ARARs pertaining to landfill closure and groundwater contaminant levels.

Alternative 3 - Groundwater Treatment

Alternative 3 provides for groundwater remediation in the form of groundwater collection, treatment and discharge. Groundwater treatment would meet the objectives of preventing contaminated groundwater from migrating offsite and to reduce contaminant levels contained in the migrating plume to an established cleanup goal.

This alternative includes extraction and treatment of groundwater from the unconsolidated soil and saprolith zone located above bedrock. Because of the lack of extractable water, no groundwater would be extracted from within the bedrock. The thickness of the groundwater aquifer above bedrock is estimated to vary from 5 to 15 feet. The point of compliance would be the area of attainment which would be slightly downgradient of the landfill itself (See Figure 7). The area of attainment may change during the Remedial Design phase.

A total of 20 extraction wells would be used to collect groundwater. The wells would be spaced about 200 feet apart along the south, east and north edges of the landfill and would capture contaminated groundwater originating under the landfill. The wells



SCALE 0' 500'	REM V AREA OF ATTAINMENT KEYSTONE SANITATION LANDFILL SITE LITTLESTOWN, PENNSYLVANIA	FIGURE
DATE JULY 1990		

C.C.JOHNSON & MALHOTRA,P.C.

would be spaced closer together in the low-lying areas (gullies) and further apart in the higher elevations of the Site. The exact number and placement of the wells will be determined in the Remedial Design phase. The perimeter of the landfill is the most efficient location for the wells, since the groundwater moves from the center to the edge of landfill, and the extraction wells would only enhance this radial flow.

Groundwater would be pumped and treated until adequate aquifer flushing has occurred to reduce groundwater contamination to meet the remediation goals for groundwater at the Site. These goals are the Federal MCls, or Non-zero Maximum Contaminant Levels Goals (MCLGs) as specified in the Safe Drinking Water Act 42 U.S.C. § 300f et. seq. (SDWA) and/or the Pennsylvania "background" ARAR specified in 25 PA Code §§ 264.90 - 264.100 in particular, by 25 PA Code §§ 264.97(i)(j) and 264.100(a)(9) which requires groundwater to be remediated to background, whichever are lower. The Commonwealth of Pennsylvania also maintains that the requirement to remediate to background is found in other legal authorities. See " The Selected Remedy" for further discussion. Actual treatment time required would be determined by monitoring contaminant reductions after the treatment begins. An estimated cleanup time to meet PA Water Supply Criteria is 46 years. No estimate of time has been made to reach background levels.

The treatment associated with the groundwater pumping would remove volatile organic compounds and metals. It may consist of equalization, flocculation/precipitation, filtration, ion exchange, air stripping and a filter press. Any sludge produced would be disposed in an appropriate offsite disposal facility in accordance with 40 CFR 268.1 - 268.50, 25 PA Code §§ 75.259-75.282 and 25 PA Code 75.21-75.38. Final selection of the process units would be determined during the Remedial Design phase.

The groundwater pump and treat alternative (#3) would be capable of producing an effluent which meets PA Water Quality Standards established in 25 PA Code §§ 93.1 et. seq., the Federal Water Quality Criteria established in 51 Fed. Reg. 43665 and the substantive requirements of a PA National Pollution Discharge Elimination System (NPDES) permit set forth in 25 PA Code §§ 92.1 et. seq. Emissions from the air stripper would meet the requirements of the Clean Air Act (Part D) (42 USC Sections 7401-7642) and OWSER Directive 9355.0-28. It would also be in accordance with Pennsylvania Air Pollution Control Act, 25 PA Code §§ 127.1 et.seq. that requires best available technology be implemented to minimize emissions. As this alternative does not provide the required closure for the municipal landfills, it would not comply with PA Municipal Waste Regulations, 25 PA Code §§ 273.234 for municipal landfill closure.

Other components of this Alternative 3 include: the installation of fence to limit access and prevent exposure of nearby residents;

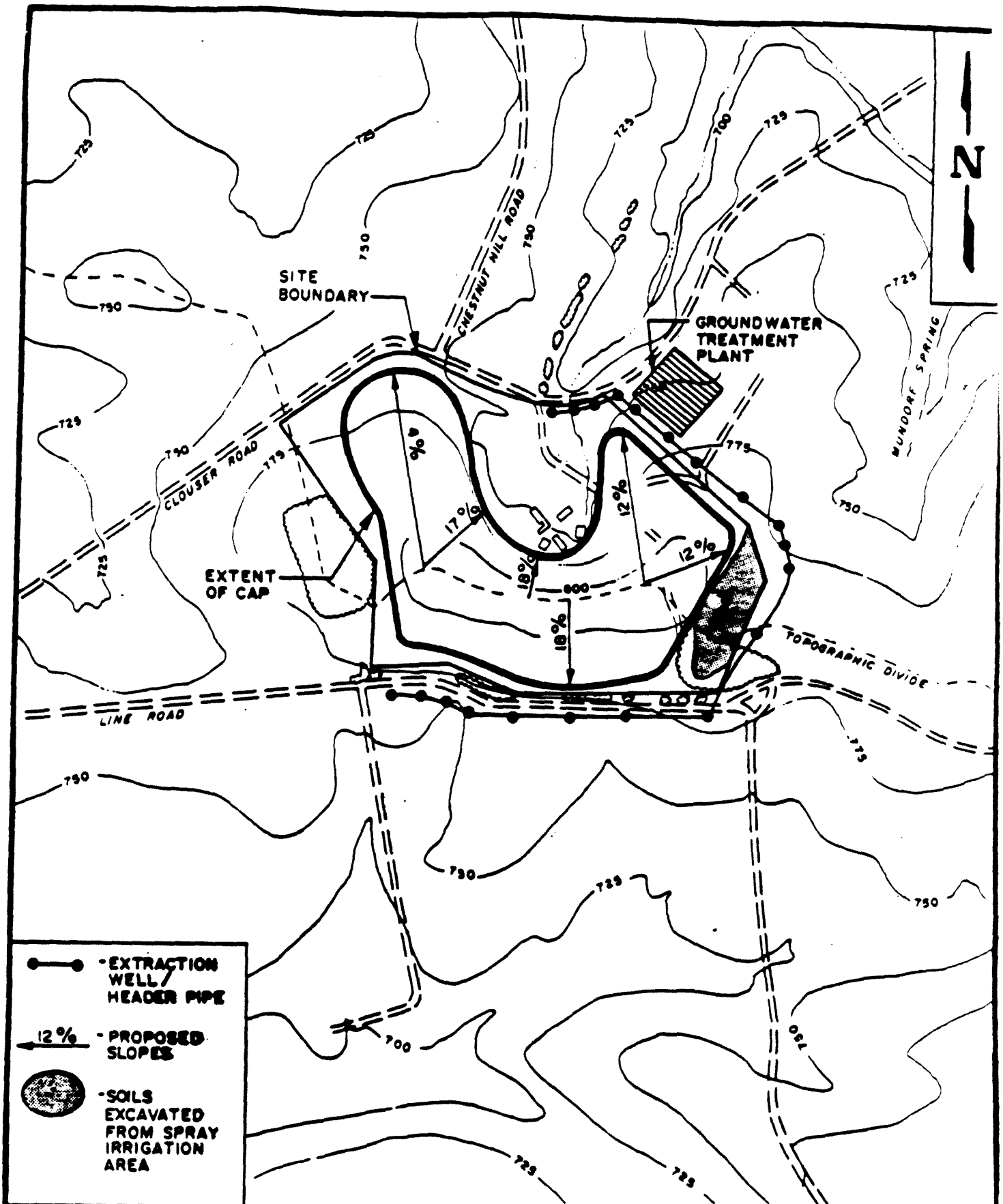
institutionals control to restrict placement of wells in the area to prevent ingestion by humans and interference with the efficiency of the groundwater extraction system; deed restrictions to prevent exposure by residents; long term groundwater monitoring and supply of treated water to onsite resident. The implementation time would be four months for the construction of the treatment plant and the installation of the extraction wells and collection system. A five year effectiveness review would also be conducted as wastes are being left onsite. The estimated present worth cost for the Alternative 3 for 30 years of groundwater extraction and treatment is $3,937,000. The Proposed Plan incorrectly stated the present worth cost as $4,234,000.

Alternative 4 - Groundwater Treatment and Impermeable Cap

Alternative 4 includes groundwater collection, treatment, and discharge as described for Alternative 3 in addition to an impermeable cap. It will also include fencing, groundwater monitoring, and the institutional/administrative control of Alternative 2. Groundwater would be pumped and treated until adequate aquifer flushing has occurred to reduce groundwater contamination to meet the remediation goals for groundwater at the Site. These goals are the Federal MCls or Non-zero MCLGs as specified in the Safe Drinking Water Act , U.S.C. 300f et. seq. (SDWA) and/or the Pennsylvania "background" ARAR specified in 25 PA Code §§ 264.90 - 264.100 in particular, by 25 PA Code §§ 264.97(i),(j) and 264.100(a)(9) which requires groundwater to be remediated to background, whichever are lower. The Commonwealth of Pennsylvania also maintains that the requirement to remediate to background is found in other legal authorities. See "The Selected Remedy" for further discussion. Actual treatment time required would be determined by monitoring contaminant reductions after the treatment begins. An estimated cleanup time to meet PA Water Supply Criteria is 46 years. No estimate of time has been made to reach background levels.

The point of compliance would be the area of attainment demonstrated in Figure 7. This area of attainment may change during the Remedial Design phase. An impermeable cap would provide containment of onsite waste and soils. The migration of contaminants from the wastes to groundwater would be reduced by controlling infiltration and reducing leachate generation. Potential exposures to contaminated surface soils through inhalation, ingestion, and dermal contact also would be reduced. A plan of Alternative 4 is shown in Figure 8.

As part of this alternative, surficial soils in the spray irrigation area containing VOCs would be excavated and deposited on top of the landfill where they would be covered by the impermeable cap. The area of these soils is approximately 2.6 acres and would be excavated to a depth of 1 foot, yielding a volume of approximately 4,150 cubic yards. Upon completion of the



SCALE 0' 500'

DATE JUNE 1990

REM V

ALTERNATIVE 4 - PLAN VIEW

KEYSTONE SANITATION LANDFILL SITE
LITTLESTOWN, PENNSYLVANIA

FIGURE 8

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cap, the exposure pathways for surface and subsurface soils, and buried wastes would be reduced.

The impermeable cap would be designed to conform to the cover requirements of 25 PA Code §§ 273.234 pertaining to Muncipal Landfill closure. The total area of the cap, including side slopes, would be approximately 40 acres and would cover a volume of 1.7 million cubic yards of wastes. The side slopes of the cap would range from 3 to 15 percent in order to conform with the existing contours and meet the requirements of 25 PA Code §§ 273.234. Depressions and erosion gullies on the landfill would be restored to grade with surrounding soil, as necessary. The top layer (and each layer beneath) of the cap would have a slope of at least 3 percent to enhance surface water runoff. The cap would require regrading to meet slope requirements and drainage ditches to collect and transfer runoff away from the landfill. Leachate generation will be reduced due to a reduction in precipitation infiltration. A vegetative cover would be placed on top.

An active gas extraction system designed to conform to the requirements of 25 PA Code §§ 273.292 would be installed between the existing landfill and the cap to prevent build up of methane gas. Gas collection wells installed to the depth of 20 feet and connected to a blower would collect the gas and send them to a gas burner. This will be further defined in the Remedial Design phase.

Any sludge produced from the unit processes would be disposed in an appropriate offsite disposal in compliance with 40 CFR 268.1-268.50.

A five year review would be conducted as wastes are being left onsite. The implementation time to install groundwater extraction wells and a treatment plant plus an impermeable cap would be 14 months.

Alternative 4 would comply with the Federal and State ARAR's for municipal landfill closure (25 PA Code §§273.234), air emissions (Clean Air Act (Part D)(42 USC §§7401-7642); OWSER Directive 9355.0-28; 25 PA Code §§127. et. seq.), surface water discharge (25 PA Code §§ 93.1 et. seq. ; 25 PA Code §§ 92.1 et. seq. ; 51 CFR 43665), residual sludges (40 CFR 2681.1-268.50; 25 PA Code §§ 75.259-75.282; 25 PA Code §§75.21-75.38), and the "background quality" requirement for groundwater in 25 PA Code §§ 264.90-264.100 or the MCLs or Non-zero MCLs, whichever is lower. See "The Selected Remedy" for further discussion. The estimated present worth cost for Alternative 4 consisting of 30 years of groundwater treatment and an impeameable cap is $9,156,950. The Proposed Plan incorrectly stated the present worth cost as $11,215,000.

Alternative 5 - Groundwater Treatment and Multimedia Cap

Alternative 5 provides the fencing, groundwater monitoring and administrative/institutional controls of Alternative 2. It also implements and satisfies the previously stated ARARs for the groundwater collection treatment and discharge of Alternative 3, plus adding a multimedia Cap. Groundwater extraction and treatment would reduce contaminant concentrations to "background quality" as required in 25 PA Code §§ 264.90 - 264.100 and in particular, by §§264.97(i),(j) and 264.100(a)(9) and/or the MCLs or NON-zero MCLGs as specified in the Safe Drinking Water Act, 42 U.S.C. 300f et. seq. (SDWA), whichever are lower. See "The Selected Remedy" for further STET discussion. The point of compliance would be the area of attainment demonstrated in Figure 7. This area of attainment may change during the Remedial Design phase. A multimedia cap would be used to provide containment of onsite wastes and soils. Contaminant migration would be prevented by eliminating infiltration and minimizing leachate generation. The synthetic membrane component of the multimedia cap is capable of reducing the infiltration by nearly 90 percent. This reduction in infiltration would have a direct effect on reducing leachate generation and the amount of extractable groundwater for treatment. Potential exposures to contaminated surface and subsurface soil and wastes through inhalation, ingestion, and dermal contact would be reduced.

The multimedia cap would have a total area of 40 acres and cover a volume of 1.7 million cubic yards. It would be designed in accordance with 25 PA Code §§ 273.234 for Muncipal Landfill closure. The side slopes of the cap would range from 3 to 5 percent and would require regrading. A gas collection system would be placed between the existing landfill and the multimedia cap. The cap would consist of a two foot layer of clay overlain by a 40-mil thick, low density, polyethylene synthetic membrane. Next would be a 1 foot thick granular drainage layer followed by a filter fabric. On top of the filter fabric, an 18 inch thick common borrow zone would be placed to protect the underlying layers and provide a shallow root zone. A 6 inch topsoil zone with vegetation would be the top layer. All layers of the cap would be sloped at a minimum of 3 percent to drain surface water.

All previously stated ARARs for Alternative 4 for municipal landfill closure, air emmisions, surface water discharge, residual sludges, and water quality would apply and be satisfied by Alternative 5. The treatment time is assumed to be 30 years in length. However, with the reduction of treatable volume, the treatment time may be reduced. Actual treatment time would be determined by monitoring the groundwater contaminant reduction after treatment begins. The implementation time to install groundwater extraction wells and a treatment plant plus an multimedia cap would be 14 months. A five year effectiveness review would be conducted to determine the effectiveness of the remedy and the need for continuing treatment.

The estimated present worth cost for 30 years of groundwater treatment and a multimedia cap contained in Alternative 5 is $10,695,000. The Proposed Plan incorrectly stated the present worth cost as $12,060,000.

COMPARATIVE ANALYSIS OF ALTERNATIVES

Pursuant to 40 C.F.R. Section 300.430 (e)(9)(iii), 55 Fed. Reg. 8849, an assessment of the individual alternatives against nine evaluation criteria specified in this regulation shall be made. These nine criteria have been categorized into three groups to weight their importance. The first group is threshold criteria of which each alterative must meet to be eligible for selection. The threshold criteria consists of overall protectiveness of human health and the environment and compliance with ARARs. The second group is the primary balancing criteria. This is used to evaluate the performance of each of the alternatives compared to the others. These criteria include long term effectiveness and permanence, reduction of toxicity, mobility and volume, short term effectiveness, implementability and cost. The third group is the modifying criteria which includes state and community acceptance that must be considered for the selection of the remedy.

The assessment of the five alternatives against the nine evaluation criteria and the description of each criterion are as follows:

Overall Protectiveness of Human Health and the Environment

The overall protectiveness criterion evaluates whether or not an alternative provides adequate protection to human health and the environment by eliminating, controlling or reducing the current and potential exposures to levels established as remediation goals.

Alternative 1 and 2 do not provide adequate protection to human health and the environment as they provide no remedial action or reduction of the risks.

Alternative 3 provides a degree of protection by using groundwater treatment. However, it does not provide a mitigative measure to prevent precipitation from infiltrating the wastes and causing continued groundwater contamination and generation of leachate.

Alteratives 4 and 5 have no discernable differences in overall protectiveness. The same degrees of protection of receptors would be provided by both alternatives. Alteratives 4 and 5 provide groundwater treatment that would be protective of the people utilizing it as drinking water. The treatment would also provide protection to the environment by lessening the groundwater discharge surface water. Alteratives 4 and 5 also include the placement of a cap over the landfill. This action will reduce

dermal exposure risk and groundwater contamination through containment of the wastes.

Compliance With Applicable or Relevant and Appropriate Requirements

The compliance with ARARs criterion evaluates whether the alternatives would meet all of the applicable or relevant and appropriate requirements of other environmental statues and/or provide grounds for involving a waiver.

Under Section 121(d) of CERCLA, 42 U.S.C. Section 9621(d), remedial actions must attain ARARs unless such ARARs may be waived under CERCLA Section 121(d)(4), 42.U.S.C. Section 9621(d)(4).

Alternatives 1 and 2 do not provide any measures which comply with ARARs.

Alternative 3 does provide groundwater treatment. It will comply with the ARARs for "background quality" established in 25 PA Code §§ 264.90-264.100 or the MCLs or Non-zero MCLs, whichever are lower. See "The Selected Remedy" for further discussion. It does not comply with Municipal Landfill Closure requirements in 25 PA Code §§ 273.234 as it does not provide closure of the landfill.

Alternatives 4 and 5 provide groundwater treatment that will comply with the ARAR for "background quality" established is 25 PA Code §§ 264.90-264.100 or the MCLs or Non-zero MCLs, whichever are lower. Alteratives 4 and 5 would also achieve compliance with the action specific and chemicals specific ARARs associated with these remedial actions as previously described in the paragraphs describing the specific alternatives.

Long term Effectiveness and Permanence

The long term effectiveness criterion evaluates the long term protection of human health and the environment over time, once the remedial action goals have been achieved. It focuses on the magnitude of residual risk and the adequacy and reliable of controls of the alternatives.

Alternatives 1 and 2 provide no long term effectiveness as they provide no remedial action or reduction of risks.

Alternative 3 would be considered minimally effective over the long term as it does not remediate the source and will require a longer treatment period than Alternatives 4 and 5.

Alternatives 4 and 5 provide the greatest degrees of long term effectiveness through source management with the use of the cap and groundwater extraction and treatment. It would reduce the

residual risks to the acceptable risk range of 1E-04 to 1E-06 excess cancer risk and less than 1 for the non-carcinogenic hazard index..

Reduction of Toxicity, Mobility and Volume through Treatment

This criterion evaluates the performance of the alternatives to reduce the toxicity, mobility and volume of the waste by assessing the degree of irreversibility and the types and quantity of residuals remaining.

Alternatives 1 and 2 do not provide any reduction in toxicity, mobility and volume.

Alternative 3 would reduce the levels of contaminants in the groundwater and retard their mobility. However, it would have no effect on the soils, the wastes and the landfill gases.

Alternatives 4 and 5 reduce the toxicity of the groundwater to remedial cleanup goal in a irreversible process. The mobility would be limited through the extraction process. The volume would be lessened by the installation of the cap and the groundwater extraction and treatment. The gas collection system would also irreversibility reduce the volume of methane released from the Site.

None of the alternatives addresses the CERCLA statutory preference for treatment of the waste as it has been determined to be impracticable.

Short-term Effectiveness

Short-term effectiveness evaluates the alternatives against the period of time needed to achieve protection of human health and the environment and any adverse impacts that may be posed during the construction and implementation period, until cleanup goals are achieved.

Alternatives 1 and 2 would impose the least short term impact to the community, remedial workers and the environment because no actions would be taken.

Alternative 3 would impose some minimal impact on the remedial workers and the environment through the installation of the extraction wells and treatment plant. Groundwater treatment would begin 3 to 4 months after plant construction begins.

Alternatives 4 and 5 would take the longest time to achieve protectiveness due to the estimated construction time for the cap of 8 months. In turn, it will also impose the largest amount of impact on the receptors through ground intrusive activities. It should be noted, however that the activities of Alternatives 4 and

5 should not cause greater releases than that which occurred during landfill operations. Active monitoring and contingencies bar cover will be used to minimize any emissions and short term impacts from the Site.

Implementability

The implementablibliy evaluation criterion consists of several subcomponents, including those which evaluate the compatibility of remedial measures with site conditions, availability of materials and services, ability to undertake further remedial actions if necessary, and regulatory considerations.

Alternatives 1 and 2 are easily implementable because no construction or monitoring would be involved. Alternatives 1 and 2 are generally not preferred by agencies when risks are high at a site, and its implementability, based solely on regulatory considerations is rated low.

Alternative 3 is fairly easy to implement. Undertaking additional remedial actions under this alternative is very easy as the waste is easily accessible. However, the ability to monitor grounderwater extraction may be difficult because flow patterns in the unconsolidated and bedrock zones are not fully known.

Alternative 4 would be more difficult to implement than Alternatives 1, 2, or 3 but not substantially more difficult. It would require more effort for the installation of the cap. It would also be difficult to monitor the effectiveness of the cap without disturbing the landfill.

Alterative 5 would be marginally more difficult than Alternative 4 due to the cap design and installation requirements.

Cost

The cost evaluation criterion considers the estimated cost for the capital and operation and maintenance (O&M) of the alternatives on a present worth basis. (See Table 9)

Alternative 1 has the lowest present worth cost at $20,900 to cover the five year effectiveness review.

Alternative 2 has a present worth cost of $720,000 to cover fencing, groundwater monitoring and administrative/ institutional controls.

Alternative 3 has a present worth cost of $3,937,000 to cover the groundwater treatment. Of these costs, $2,970,000 is present worth O & M costs.

Alternative 4 has a present worth cost of $9,157,000 to cover s

TABLE 9

ESTIMATED COSTS OF THE FIVE ALTERNATIVES

Alternative	Capital Cost	Annual	Present Worth
1. No Action	0	$ 7,000	$ 20,900
2. Limited Action	$110,000	$ 45,000	$720,000
3. Groundwater Extraction & Treatment	$967,000	$199,000	$3,937,000
4. Groundwater Treatment & Impermeable Cap	$5,906,950	$217,000	$ 9,156,950
5. Groundwater Treatment & Multimedia Cap	$7,525,000	$217,000	$10,695,000

treatment and an impermeable cap. Of these costs, approximately $4,000,000 is the cap and $3,250,000 is present worth O & M costs.

Alternative 5 has the highest present worth cost at $10,695,000 to cover treatment and a multimedia cap. Of these costs, approximalety $5,000,000 is the multimedia cap and $3,179,000 is present worth O & M costs.

State Acceptance

The Commonwealth of Pennsylvania has concurred with the selection of Alternative 4, groundwater treatment with the installation of an impermeable cap that meets PA Municipal Landfill Closure requirements.

Community Acceptance

The public meeting for presentation of the RI/FS and the Proposed Plan was held on September 13, 1990. Community interest was very high at this Site. Comments received during the public meeting and the comment period are discussed in the Responsiveness Summary attached to this Record of Decision.

THE SELECTED REMEDY

From the results of the RI/FS and the baseline risk assessment, it has been determined that a remedial response action is required at the Keystone Site to reduce the risk from the groundwater contamination. It has also been determined that due to the volume of the waste which is considered the source (1.7 million cubic yards) and the nonhomegeneity of the waste that is is impracticable to treat the source. Therefore, the remedial action response is to contain the waste (source) and treat the groundwater. Remedial action goals have been established to bring all risks to within the 10E-4 to 10E-6 risk range for carcinogenic risks and less than 1 for non-carcinogenic risks. It has also been established that the groundwater contamination will be reduced to meet the remediation goals of "background quality" as required in 25 PA Code §§ 264.90 - 264.100 and in particular, by §§ 264.97(i),(j) and 264.100(a)(9) and/or the MCLs or Non-zero MCLGs as specified in SDWA, whichever are lower. See the next paragraph for explanation. The Commonwealth of Pennsylvania also maintains that the requirement to remediate to background is found on other legal authorities.

Based on the considerations in CERCLA, detailed analysis of the five alternatives developed and comments from the Commonwealth of Pennsylvania, the State of Maryland and the public, EPA has selected a remedy. The remedy EPA has selected is Alternative 4- groundwater extraction, treatment and discharge and the installaton of an impermeable cap. The goal of this remedial

action is to restore groundwater to its beneficial use, which is, at this Site is as a drinking water source. In order to restore groundwater to its beneficial use, the groundwater treatment system would operate until Site-specific remediation goals are achieved. Thus the groundwater would be remediated until the contaminant levels reach MCLs, Non-zero Maximum Contaminant Levels Goals (MCLGs) or background, whichever are lower. If the implementation of the Selected Remedy demonstrates, in corroboration with hydrogeological and chemical evidence that it will be technically impracticable to achieve and maintain the remediation goals throughout the area of attainment, the EPA in consultation with the Commonwealth of Pennsylvania intends to amend the ROD or issue an Explanantion of Significant Differences to inform the public of alternative groundwater remediation goals.

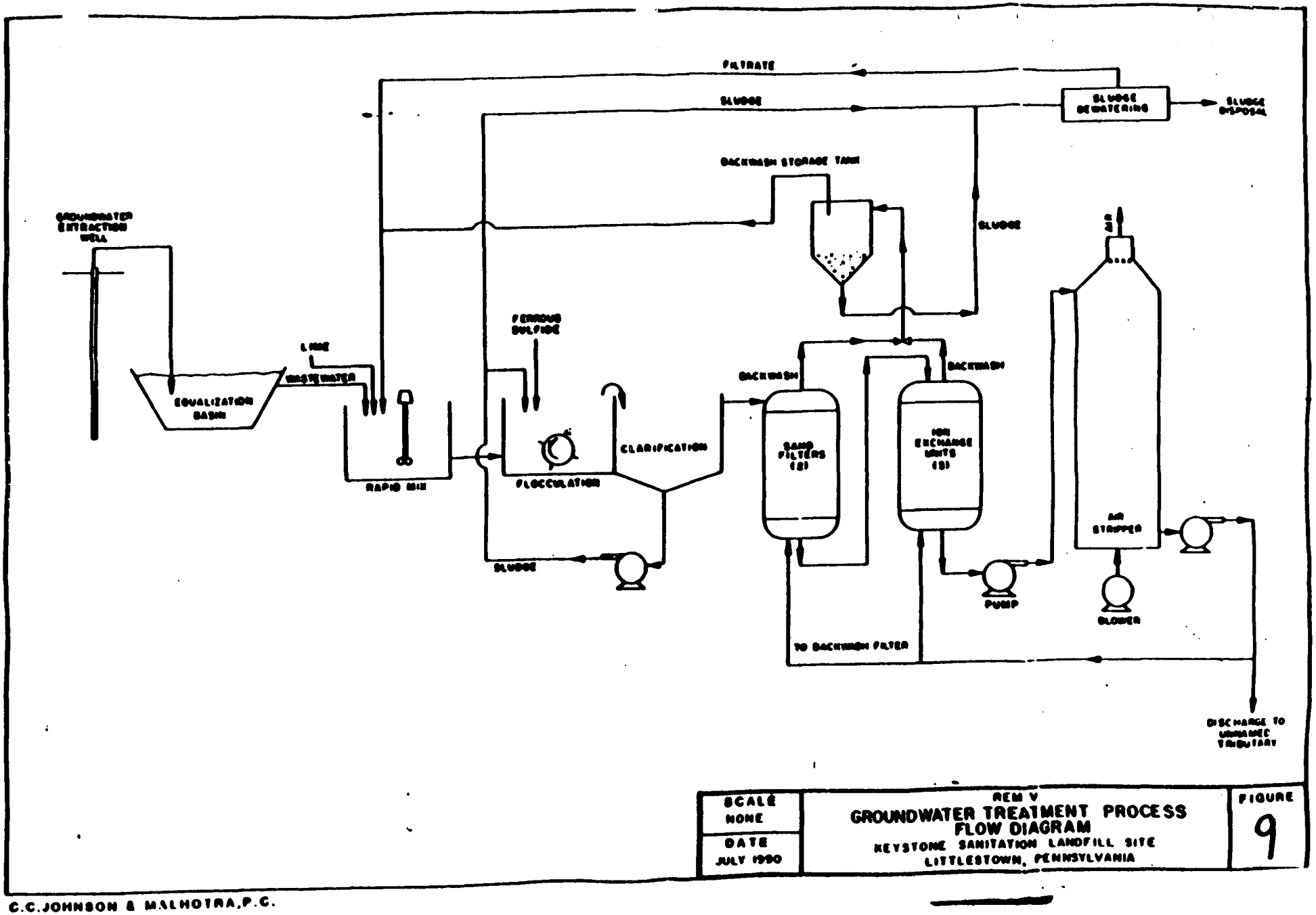
Groundwater extraction at the Keystone Site may consist of approximately 20 extraction wells pulling groundwater from the unconsiderated soil and saprolith zone above bedrock for treatment. The wells would be spaced about 200 feet apart along the south, east and north edge of the landfill and would capture the contaminated originating under the landfill. The Remedial Design will further define the location, number and spacing of these wells via a capture zone analysis. Placement of the wells close to the source will contain the plume and prevent future pulses of contamination from reaching the residential wells.

Maintenance of the collections system would include replacement of the pumps every five years and maintenance of the well screens every three years. The actual treatment time required would be determined by monitoring contaminant reductions after the treatment begins. A contaminant reduction curve could be plotted from actual results, after groundwater extraction and treatment begins, which could be used to predict the treatment time required. Based on the current knowledge of the Site and contaminants of concern, it has been estimated that treatment time would be approximately 46 years.

Groundwater treatment at the Keystone Site will be designed to treat a wide range of volatile organic contaminants, naturally occuring inorganic species and hazardous metals. In addition, the system must be easy to construct, operate, and maintain as well as discharge treated groundwater in an environmentally safe manner and location.

The following unit processes would be required for the groundwater treatment: Equalization; Flocculation/ Precipitation; Filtration; Ion Exchange; Air Stripping; and Filter Press. See Figure 9 for the flow diagram of the Selected Remedy.

Within this system, the equalization tank and flocculation/precipitation unit will be used to remove the



SCALE NONE	REM V GROUNDWATER TREATMENT PROCESS FLOW DIAGRAM KEYSTONE SANITATION LANDFILL SITE LITTLESTOWN, PENNSYLVANIA	FIGURE 9
DATE JULY 1990		

C.C.JOHNSON & MALHOTRA,P.C.

suspended solids and some dissolved metals. Sludges from these units will be dewatered in the filter press and disposed in an appropriate offsite facility as specified in 40 CFR 2681.1-268.50. The ion exchange unit would follow to remove the metals such as copper, chromium, nickel and mercury. Effluent from the ion exchange unit would be pumped to the air stripper where VOCs would be removed. The air stripper emmissions would meet the requirements of the Clean Air Act (Part D)(42 U.S.C. § 7401-7642), the OWSER Directive 9355.0 - 28 for an air stripper in ozone nonattainment areas and the PA Air Pollution Control Act, §§ 127.1 et. seq. requiring air emmisions to be controlled with best available technology. Effluent from the air stripper would be discharged from the treatment plant to the unnamed stream flowing north from the site. The volume of treated groundwater discharged would be equal to the volume entering the treatment plant with an expected discharge rate of 20 gpm. It would meet the substantive requirements of a PA NPDES permit required in 25 PA Code §§ 92.1 et. seq., the PA Water Quality Standard in 25 PA Code §§ 93.1 et. seq. and the Federal Water Quality Standards of 51 Fed. Reg. 43665. This discharge will not adversly impact the stream system.

The impermeable cap will be designed to comply with the 25 PA Code §§ 273.234 that pertains to landfill closure requirements. In these regulations, it states that the cap may be constructed of clay, a synthetic, or a composition of the two. The Commonwealth of Pennsylvania has indicated that several problems may occur with the use of a natural clay cap due to the permeability, maximum aggregate size requirements and others. The selection of the capping material will be determined in the Remedial Design phase of this remedial action. Therefore, it has been concluded that the cap will include, but not be limited to the following:

- a cap consisting of a 1 ft. clay layer or a 30 mil. synthetic liner
- a maximum cap permeability of 10^{-7} cm/sec
- a drainage layer over the cap
- a 2 ft. soil layer over the drainage layer
- a minumum surface slope of 3 percent
- a maximum slope of 15 percent
- minimization of soil erosion and sedimentation
- stormwater management based on a 24-hour, 25-year event

In addition to covering an area of 40 acres and a Volume of 1.7 million cubic yards, the cap will also cover contaminated

surficial soils from the spray irrigation area excavated to back ground levels and places on top of the landfill. An active gas extraction system would be installed in compliance with 25 PA Code §§ 273.292 between the existing landfill and the impermeable cap to prevent buildup of methane gas. Gas collection wells would be installed in the landfill to depths of approximately 20 feet. The gas would be collected through a piping network and sent to a gas burner. Leachate collection would not be considered necessary as the contaminated groundwater would be intercepted as it moves laterally from the Site. Since groundwater would be collected from the perimeter of the landfill, rather than beneath the landfill, groundwater levels beneath the landfill are not expected to drop appreciably. Settlement, due to extraction of groundwater, is not expected to pose a problem since the landfill is located on bedrock.

In addition to the groundwater treatment and cap, the remedy selected by EPA has several measures to ensure the protection of human health and the environment. The measures are as follows:

- New fencing will be installed at the perimeter of the property to restrict access and to limit exposure potential to onsite contaminants.

- Institutional and administrative controls through the use of deed restrictions on the sale and transfer of the property would be enacted to insure that future property owners would not misuse the Site. Restrictions on property use would include aquifer use limitations and limitations on construction.

- Groundwater would be monitored to determine the effectiveness of the remedy. Sampling will be conducted quarterly in the first year for TCL organic and TAL inorganic compounds. After the first year, sampling will be conducted semi-annually until the five year review occurs to evaluate the effectiveness of the remedy.

- Residential wells around the Site will be sampled quarterly in the first year for TCL organic and TAL inorganic compounds. After the first year, sampling will be conducted annually until the five year review occurs to evaluate the effectiveness of the remedy. If two sucessive samples detect MCLs being exceeded, an additional remedial action will be considered to provide the affected residents with potable water.

- Surface water and sediments will be sampled quarterly in the first year for TCL organics and TAL inorganic compounds plus methlymercury. After the first year, sampling will be conducted semi-annually until the five year review occurs to evaluate the effectiveness of the remedy. If an anomaly is

TABLE 10

THE SELECTED REMEDY COSTS

CAPITAL COSTS		PRESENT WORTH COSTS
Mobilization Site Preparation	161,450	
Gas Collection System	316,000	
Clay Cap	3,929,000	
Groundwater Extraction & Treatment	614,500	
Monitoring	11,000	
Miscellaneous	60,000	
	5,906,950	
Legal Fees (1% of Capital Costs)	51,000	
Engineering & Administrative Fee (5% of Capital)	255,000	
Subtotal	5,397,500	
Contingency (10% of subtotal)	509,000	
Total Capital Costs	**5,906,950**	**5,906,950**
OPERATION & MAINTENANCE		
Cap Inspection & Maintenance	17,000	
Groundwater Treatment	139,231	
Long Term Monitoring	35,000	
Public Health Assessment	6,300	
Subtotal	197,531	
Contingency (10%) of Subtotal	19,750	
Total ANNUAL O & M	**217,000**	**3,250,000**
TOTAL PRESENT WORTH COST		**9,156,950**

seen in two sucessive samples, additional studies will be conducted to determine the need for remedial action.

- The onsite residents would have an in home treatment system installed for their groundwater.

- A review would be conducted every five years as wastes are being left onsite. The assessment includes analyzing groundwater samples for TCL organic and TAL inorganic compounds. A report will be made to summarize the results and any related health effects.

The estimated net present worth of this remedy is $9,156,950. This was calculated using the cost associated with construction and the annual operation and maintenance plus contengenics. A 5% discount rate was used to convert the annual O & M costs to present worth costs and this was added to the total of the construction costs. See costs on Table 10 below. The total construction costs of $5,906,000 were combined with the present worth O & M costs of $3,250,00 to derive the total present worth costs of $9,157,000. The annual O & M costs are $217,000 with the first year O & M being somewhat larger due to the quarterly sampling requirements of the first year for the monitoring wells, residential wells, and surface water and sediments.

STATUTORY DETERMINATIONS

EPA's primary responsibility at Superfund remedial sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C. § 9621 establishes several other statutory requirements and preferences. These specify that when complete, selected remedial action for a site must comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental law unless a waiver is justified. The Selected Remedy also must be cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the EPA has a statutory preference for remedial actions that employ treatment that permanently and significantly reduces the volume, toxicity and mobility of hazardous substances as their principal element. The following sections discusses how the Selected Remedy meets the statutory requirements and preferences set forth by Section 121 of CERCLA, 42 U.S.C. § 9621.

Protection of Human Health and the Environment.

The baseline risk assessment identified inhalation and ingestion of groundwater as significant exposure pathways having an adverse effect on human health. The environmental survey in the RI indicated that although the Ambient Water Quality Criteria is being exceeded for several metals in the surface water, there is no

impact on the stream system. The Selected Remedy would protect human health and the environment by using groundwater extraction and treatment to halt the migration of the existing contamination plume and to reduce the level of contaminants being seen in the groundwater and surface water. This process is being used in conjunction with an impermeable cap to contain the wastes in the landfill which will lessen the volume and the concentration of contaminants to be removed.

The current risks associated with these exposure pathway is 1E-04 for inhalation and 4E-04 for ingestion to give a total lifetime excess cancer risk of 5E-04. By using the Selected Remedy, the risk level will be reduced to acceptable exposure range of 10-04 to 10-06 for carcinogenic risk and less than 1 for noncarcinogenic risks. There are no short term threats associated with the Selected Remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the remedy.

Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy of groundwater extraction and treatment and installation of an impermeable cap over the landfill will comply with all applicable or relevant and appropriate chemical, location, and action-specific requirements (ARARs). The ARARs are presented below:

Chemical Specific ARARs include these laws and requirements that regulate the release to the environment of specific substances having certain chemical or physical characteristics or materials containing specified chemical compounds. For the Keystone Site this includes:

- Safe Drinking Water Act (42 U.S.C.300f et. seq.)(MCLGs) Maximum Contaminant Levels (MCLs) (40 CFR 141.11-141.16)

- Pennsylvania "Background Quality" for remediation of groundwater as specified in 25 PA Code §§ 264.90 -264.100, and in particular by 25 PA Code §§ 264.97(i),(j) and 264.100(a)(9).

- Pennsylvania Water Quality Standards in 25 PA Code §§ 93.1 et seq. which establishes water quality criteria and designated water use protection for each stream.

- Pennsylvania NPDES Regulations in 25 PA Code §§ 92.1 et. seq.

- Federal Water Quality Standards, 51 CFR 43665

- Offsite Disposal requirements in 40 CFR 268.1-268.50 (Land Ban)

Action specific ARARs are usually technology or activity based requirements or limitations taken with respect to hazardous waste and tiggered by a remedial action. For the Keystone Site these are as follows:

- o Pennslyvania Air Quality Standard, 25 PA Code §§ 123.1(c) establishes requirements for fugitive dusts.
- o 25 PA Code §§ 127.12 (a)(5) requiring emissions be reduced to mimumum obtainable levels through the use of best available technology (BAT).
- o OWSER Directive 9355.0-28 for emmission from air stripper in ozone nonattainment areas.
- o National Emissions Standards for Hazardous Air Pollutants (NESHAPS) which contains emission standards for vinyl chloride plants. (61 C.F.R. § § 61.60 - 61.71)
- o Clean Air Act (Part D)(42 USC Section 7402-7642)
- o Pennslyvania Municipal Landfill Requirements, 25 PA Code § 75.1 et. seq. in particular 25 PA Code §§273.234. which sets forth municipal landfill cap requirements.
- o 25 PA Code §§ 102.1 et.seq. sets forth requirements for control of soil erosion and sedimentation resulting from earth moving activities.
- o 25 U.S.C. Parts 1910 and 1926 and 29 CFR Part 1910, Occupational Health and Safety Act states requirements for response actions at Superfund Sites.

Cost Effectiveness

The Selected Remedy is cost effective because it has been determined to provide overall effectiveness proportional to its costs in reducing the risk from groundwater contamination and landfilled waste. This remedy at $9,156,950 present net worth cost is the fourth highest costing remedy. While it is somewhat more costly than Alternative 1, 2, or 3, the additional costs for capping represents a degree of protection that is required by CERCLA for human health and the environment. This remedy provides a reasonable cost effective solution to a landfill volume of 3,177,000 cubic yards.

Utilization of Permanent Solution and Alternative Treatment Technologies to the Maximum Extent Practicable

The EPA has determined that the Selected Remedy represents the maximum extent to which permanent treatment technologies can be utilized in a cost effective manner for the Keystone Site. It has been recognized that the volume of nonhomogeneous wastes (3,177,000 cubic yards) represents a large obstacle in finding a cost-effective treatment technology. Of the alternatives that are protective of human health and the environment and comply with ARARs, the EPA, the Commonwealth of Pennsylvania and the State of Maryland have determined that the Selected Remedy provides the best balance among tradeoffs of the nine criteria in terms of long term effectiveness and permanence, reduction in toxicity, mobility and volume achieved through treatment, short term effectiveness, and implementability while being cost effective.

In addition, the selection of this remedy has received concurrence from the Commonwealth of Pennsylvania. The Selected Remedy is in compliance with the regulatory action that Pennsylvania may pursue under their Consent Adjudication with Keystone.

Preference for Treatment as a Principal Element

The statutory preference for a remedy that employs treatment as a principal element has been determined impracticable at the Keystone Site. Due to the large volume (3,177,000 cubic yards) of nonhomogeneous wastes, EPA has screened out treatment technologies and accepted containment and groundwater treatment as a remedy. This remedy addresses the principal threat at the site from groundwater contamination by preventing infiltration through the waste and provides control and treatment of the contaminant plume.

RESPONSIVENESS SUMMARY
KEYSTONE SANITATION LANDFILL SITE
UNION TOWNSHIP
ADAMS COUNTY, PENNSYLVANIA
SEPTEMBER 1990

This Community Relation Responsiveness Summary is divided into the following sections:

Section A: Overview- A discussion of EPA's preferred remedial alternative and the public reaction to this alternative.

Section B: Background of Community Involvement and Concerns- A brief history of community's interest in and involvement with Keystone Landfill Site, including a discussion of concerns raised by community members and officials during planning activities.

Section C: Summary of Public Comments Received During the Public Comment Period and Agency Responses- A summary of comments followed by EPA responses.

Section D: Remaining Concern- A description of remaining community concerns that should be considered as the EPA and Pennsylvania Department of Environmental Resources (PADER) conduct the Remedial Design and Remedial Action at the Keystone Sanitation Landfill Site.

In addition to Section A through D, a list of EPA Community Relations activities conducted at the Keystone Sanitation Landfill Site is included as Attachment A of this Responsiveness Summary.

A. OVERVIEW

EPA released the Remedial Investigation/Feasibility Study (RI/FS) and the Proposed Plan for Keystone Sanitation Landfill Site in Union Township, Adams County, Pennsylvania for review and comment on July 20, 1990. This began the 30 day Public Comment Period for the release of the Proposed Plan. In the Proposed Plan, the results of the RI/FS report and the alternatives evaluated in the FS, including EPA's preferred alternative for remediation of the Keystone Site were discussed. EPA's preferred remedial action alternative was the installation of an impermeable cap designed to meet Pennsylvania Municipal Landfill Closure requirements over the landfill and a ground water extraction and treatment system on the eastern and southern perimeters of the Site to treat the contaminated groundwater while preventing future migration of the contamination offsite. The groundwater extraction and treatment system would consist of unit processes to remove the volatile organic compounds (VOCs) and metals from the ground water and restore the groundwater to its most beneficial use.

The remediation goals for the groundwater would be the Pennsylvania "Background Quality" requirement specified in 25 PA Code §§ 264.90 - 264.200 and/or the Maximum Contaminant Levels (MCLs) or Maximum Contaminant Level Goals (MCLGs) specified in Safe Drinking Water Act 42 U.S.C. §§ 300f et.seq., whichever are lower. The treated groundwater would be discharged into surface waters to meet the substantive requirements of a PA NPDES permit required in 25 PA Code §§ 92.1 et. seq., and the PA Water Quality Standard in 25 PA Code §§ 93.1 et. seq. and the Federal Water Quality Standards of 51 Fed. Reg. 43665. Any air emissions would meet the requirements of the Clean Air Act, 42 U.S.C §§ 7401 et. seq., OWSER Directive 9355.0 -28 and PA Air Pollution Control Act 25 PA Code §§ 127.1 et. seq.. All other applicable or relevant and appropriate requirements (ARARs) would be met by the preferred alternative. The preferred alternative also contained administrative measures such as deed restrictions, fencing, aquifer use restrictions, supply of treated water to the onsite residents, as well as residential well monitoring, surface water and sediment monitoring, groundwater monitoring and a five-year review requirement. The groundwater remediation period was estimated for 30 years with a present worth cost of $9,156,950 for the impermeable cap and the treatment system. It would take approximately 14 months to implement this alternative.

In response to requests from the public, EPA extended the Public Comment Period an additional 30 days, for a total of 60 days to close on September 20, 1990. During this time, EPA held an informal meeting with elected officials from Union Township, representatives from citizen groups in Pennsylvania and Maryland, and a representative from the Maryland Department of the Environment to answer questions and receive comments on the alternatives in the Proposed Plan. As required by Sections 113 and 117 of CERCLA, EPA also held a Public Meeting to present the findings of the RI/FS and Proposed Plan and answer any questions

concerning the Site. This meeting, which was preceded by a press conference and a briefing for state, federal and local elected officials, was held on September 13, 1990. It was originally scheduled to be held on August 15, 1990 and was rescheduled to September 13, 1990 in response to requests from the public. The public was notified of the change in the meeting date via newspaper, radio and phone calls. At these meetings, EPA presented the RI/FS report findings, and the Proposed Plan which was EPA's preferred remedial action alternative. Comments and questions were received and documented.

Judging from the comments received during the Public Comment Period, the Maryland Department of the Environment and PADER generally support and accept EPA's preferred alternative of an impermeable cap and ground water extraction and treatment. The State of Maryland made some suggested modifications concerning landfill closure and site inspections. Although, citizens, citizen groups or their consultants stated rejection of EPA's preferred alternative, some stated that they felt the RI was not sufficiently comprehensive to design an effective remedy. In particular, they questioned the ability of EPA to design an inclusive remedy based on the analysis of one round of sampling and a data set that was not inclusive of all residential wells that have historically shown contamination. Residents in the area requested that additional sampling of residential wells, testing for contaminants at absolute values, and bottled water to protect their health be added to the remedial action plan. Maryland residents and local elected officials were not supportive of a remedial action that does not include offsite remediation of Maryland residential wells and Maryland monitoring wells. Many citizens and representatives of citizen groups expressed concern with any remedial action plan that would include cooperation between EPA and PADER or the owners of Keystone. Community confidence was low in the ability of EPA to monitor effectively the work of PADER and/or the owners of Keystone. Local citizen participation in the monitoring effort was desired.

In addition to the Public Meeting, comments were received on the RI/FS and Proposed Plan through and after the close of the Public Comment Period. A large volume of comments were received and reviewed by EPA. Several studies were submitted by the Potentially Responsible Parties (PRPs) which did not accept the finding of the RI/FS or support the preferred alternative. Several PRPs commented that the installation of a cap would impede the remediation of the groundwater extraction and treatment system. The PRPs noted that the treatment of metals in the groundwater was unnecessary as the metals are naturally occurring and not site-related.

In response to the public concerns over offsite contamination, especially in the residential wells, and the validity of the data concerning the need to treat metals in the groundwater, the preferred alternative was changed from a final action to an

interim action. It was decided that a second Operable Unit would address offsite contamination. Also, in response to the public concerns over their drinking water, EPA will be working with members of the communities in both Maryland and Pennsylvania to develop a sampling plan for the residential wells in the areas. This sampling, which will use lower detection levels for contaminants of concern, will occur in the next several months after the development of the sampling plan and the attainment of funding. It will take into consideration historical data on the residential wells as requested by the public.

B. BACKGROUND ON COMMUNITY INVOLVEMENT

Community involvement at the Keystone Sanitation Landfill began when contamination was discovered at the site in 1983. This, as well as increased press coverage of the landfill, resulted in the formation of Citizens Urge Rescue of the Environment (C.U.R.E.). In 1984 the citizens of Carroll County, Maryland formed People Against Contamination of the Environment (P.A.C.E.). Both groups have spent much time and money reviewing site information and gathering technical data. The primary community concerns, as documented in the community relations plan, were as follows:

1. The citizens were concerned that their drinking water was contaminated by the Keystone Landfill. The citizens felt that the information on ground water testing did not indicate the true quality of area drinking water. In addition, at least one citizen group requested that a health study be done in the Keystone area to address the citizens' health concerns.

2. Citizens expressed distrust for state environmental agencies, such as the Pennsylvania Department of Environmental Resources and Maryland's Department of the Environment. They questioned the accuracy of government released information and the sincerity of community interaction efforts.

3. Several local resident paid to have their well water tested privately, and sent the results to EPA. Citizens have expressed anger and disappointment that this data was not referenced by EPA in further studies that were done.

4. Many citizens and local officials have expressed their concerns that all potentially responsible parties (PRPs) be located. They have requested that local industries not be penalized for following what, at the time, was proper and legal disposal methods recommended by PADER. They have implied that those industries that have broken the laws should be held responsible for cleanup costs.

RESPONSIVENESS SUMMARY
KEYSTONE SANITATION LANDFILL SITE
COMMENTS ON THE RI/FS REPORTS

The following summarizes and responds to comments received concerning the RI/FS Proposed Plan, and Administrative Record for the Response Sanitation Landfill Site (Keystone Site or Site). In some cases, similar comments were received from a number of commentors. In such cases the comments were addressed only once.

PUBLIC MEETING

1. How will EPA monitor future work performed by the PRPs or governmental agencies?

   EPA Response: EPA monitors all work performed during the Remedial Design and Remedial Action through the Remedial Project Manager, the EPA Technical Support Personnel, EPA oversight contractors and document reviews. All work must be in accordance with local, state and federal statues, regulations and ordinances.

2. What is the extent of the contaminant plume and will the Proposed Plan address it?

   EPA Response: The RI testing revealed that the extent and magnitude of offsite groundwater contamination is small. Some monitoring wells downgradient of the landfill contained small quantities of contaminants but these were in wells located close to the landfill. The proposed plan will prevent the future releases of contaminants to the groundwater. Ground-water extraction wells and a treatment plant will reduce the contaminants in the groundwater. The extraction wells will contain the contaminated plume and prevent future pulses of contamination from reaching the residential wells. Levels of offsite contaminants in the groundwater will decrease as a result of natural processes. A second operable unit will address offsite contamination.

3. Will EPA provide bottled water and filters for people in the area?

   EPA Response: The testing conducted for the RI has shown that offsite residential wells in the area are not affected by the Site. Only the onsite residents has contaminant levels which exceeded the PA Drinking Water Standard and will be supplied with an inhome treatment system for their drinking water. Monitoring wells placed near the landfill showed no or low levels of contamination. As the sampling of the residential wells did not reveal contamination, at

this point in time, EPA will not provide bottled water or filters. Should future testing reveal problems, we will reconsider this alternative. Testing of the residential wells in the area around the Site with lower detection limits will take place in the near future. If this sampling indicates a need for bottled water by exceeding the MCLs or the risk range, EPA will consider it. In addition, pursuant to the Selected Remedy, the residential wells around the Site will be sampled quarterly in the first year and annually thereafter.

4. Will EPA obtain an accurate population count of the area?

EPA Response: While the population of the area may have changed since the RI/FS study began, the findings and conclusions are not affected by the actual population of the area. Increasing the number of people in the area would not change the proposed plan nor influence the calculation of risk from the site; thus another population count is not necessary.

5. What is the basis for using analytical results that exceeded the holding time?

EPA Response: Only data that passes the data validation process were used in the reports. In this particular case, if the holding time is exceeded by only a short period of time, the data is still valid. If the data validation experts had determined that the data was compromised, it would have been so noted and would not have been used in the RI/FS.

6. The detection limits are too broad to detect most chemicals in the groundwater.

EPA Response: The detection limits used at the Site are the same that are used across the country to evaluate Superfund sites. These detection limits are set nationally for the Contract Laboratory Program by EPA. Lower detection limits will be used for the sampling conducted on the residential wells in the near future and during the Design Operations for detection of contaminants below the MCLs or risk range.

7. Can you really clean up this site?

EPA Response: The Proposed Plan will effectively remediate the Site. The cap will prevent direct contact with contaminants that may be at the surface, will prevent airborne contaminants from migrating, and will reduce the amount of precipitation entering the landfill. The groundwater extraction and treatment system will prevent the migration of contaminants in groundwater and restore groundwater to it most beneficial use.

8. Will EPA designate the aquifer as a sole-source aquifer?

EPA Response: EPA cannot "at the stroke of a pen" designate an aquifer as sole-source. Any state, municipal or local government, political subdivision or planning entity that identifies a critical aquifer protection area over which it has authority may apply to EPA for selection of an area as a sole-source aquifer.

9. EPA should not discharge the treated groundwater to surface waters but should transport it to a treatment center.

EPA Response: The treated groundwater will meet all ARARs for surface water discharge. The discharge should have little impact on the physical or chemical characteristics of the surface water body. The quantity of groundwater that will be treated initially is too large to be hauled offsite. However, once the cap is in place, it is anticipated that the quantity of groundwater extracted will decrease to such levels that offsite treatment may be feasible. If this decrease occurs, EPA with concurrence from the Commonwealth of Pennsylvania may issue an Explanation of Non-Significant Difference to change the remedy to offsite treatment of the groundwater.

10. Will EPA perform air monitoring and test for methane?

EPA Response: Air monitoring may be conducted during the Design Phase if determined to be necessary. It will be conducted during the construction of the cap, extraction wells and treatment as part of the Health and Safety Plan for the Site. During the operations, an active gas extraction system will be installed between the existing landfill and the impermeable cap to prevent the buildup of methane gas.

11. Could springs located under the landfill affect the remedy?

EPA Response: If a spring is located under the landfill, it will mix with the groundwater and be extracted by the groundwater treatment system. It will not affect the remedy.

12. Will the pressure of the cap affect the subsurface conditions?

EPA Response: The cap may have some subsidence over time. During the design, this will be taken into consideration and contingencies in the design will address it.

13. Has EPA conducted a health study for the community?

The Agency for Toxic Substances and Disease Registry (ATSDR) conducted a study in November 1988. In addition, a risk

assessment was performed for the site. The risk assessment documented the effects of the contaminants found at the Site under a variety of situations. Both documents can be found in the Administrative Record located at the Hanover Public Library.

CITIZEN GROUPS CONSULTANTS AND PUBLIC AGENCIES

14. We disagree with the conclusion in the reports regarding the lack of impact to the flora in the area. Aerial photographs of the Site for the past several years detect on the south side of the landfill beginning around 1986 to the present, an area of impact emanating from the landfill in the field bordered by Line Road, and located on the ridge midway between the Brown land and Biemiller Road. The pictures enclosed show close up, the impact to various crops planted over the past few years. Another area of impact can be seen by the pictures of the woods located in the southeast corner of the Keystone Landfill. These were taken in August of 1986 and again in August 1988 when a cluster of trees turned brown and consequently died. This was in the area of the spray irrigation system. The last three pictures taken in July 1985, show water pouring from the landfill to the south across Line Road and saturating the adjacent field immediately following a summer storm. This occurred quite frequently. Again, we call your attention to the adverse impact on the soybeans. Testing of the soil in that area by EPA that year detected VOCs and chromium in the soil.

EPA Response: No vegetation was deemed to be adversely affected as a result of contaminants from the Site based on observations made during the RI. The contaminants found in the areas identified in the comment are not found in concentrations that would be toxic to vegetation. In addition, the location of these areas are such that the vegetation may be affected by too much water. The constant watering as a result of the spray irrigation system and storm water flowing in the drainage in the field may be having a negative effect on the vegetation.

15. Another area of our concern involves the EPA location of surface water sampling sites for both the current study and the proposed future water sampling to monitor stream conditions. Because of the dilution factor, the rapid volatilization of the VOCs particularly in warm weather, and varying weather conditions, it is difficult to monitor the off-site contamination. We have found that if the water is tested at the point where it exits from the ground, the chances of detecting the contamination are greatly improved, providing a clearer picture of the problem. Thus, we would suggest selecting sampling points closer to the discharge areas.

EPA Response: The Proposed Plan addresses concerns regarding the offsite migration of contaminants via surface water. The system will be designed to intercept contaminants at the edge of the capped area, thereby preventing contaminants from reaching any surface water. The location of future surface water samples to monitor surface water considerations have not been determined. Future sample locations will attempt to obtain samples from groundwater discharges.

16. These groundwater exit points are a source to measure contaminant migration. We wish your comments as to whether any soil or water sampling points were chosen with this in mind. The site investigation done in 1984 indicated a leachate seep along the Brown property land about 200 yards south of Line Road. The State of Maryland sampling of that area also indicated leachate contamination. Private sampling has detected VOC contamination there. Yet, there were no EPA samplings at all done on this area for the remedial investigation study. Considering the numerous discharge areas located downgradient of the landfill, it would be prudent to take a closer look at this documented path of contaminant migration.

EPA Response: Samples collected in this area included 3 surface water, 2 sediment, 2 residential wells, and 7 groundwater. These samples are sufficient to characterize the impacts of any contaminants migrating from the Site. In addition, the proposed plan will significantly reduce releases from the landfill. Additional sampling of the surface water and sediments will take place during the Design and Operational Phase.

17. The Tethys Report clearly shows that there are serious deficiencies in the analytical data. This illustrates the need for more testing and analysis before alternatives can reasonably be decided upon.

EPA Response: No data with serious deficiencies have been used in the preparation of the RI or FS Reports. All suspect data were identified by independent data validators and none of the suspect data were used in the reports. However, additional samples will be collected prior to and during the Design Phase of the project.

18. The failure to include and submit to public comment the proposed groundwater recovery plan is a serious deficiency of the study. A groundwater extraction and treatment plan needs to be developed giving details of the number and location of recovery wells, their depths, and design before meaningful comment can be made on this important phase of the proposed remediation. Spray irrigation must be eliminated as a means of treatment in view of the serious

environmental and health risks associated with such treatment.

EPA Response: We agree that the details of the groundwater extraction system are important. However, the purpose of the FS is to present conceptual designs, estimate costs, and evaluate the alternatives against a given set of criteria. A detailed design of the selected alternative is made prior to implementation. The public will have an opportunity to comment on the design of the selected alternative once the design is completed. Spray irrigation is not a part of the proposed plan.

19. Given the fact that the data do not show conclusively or with a reasonable degree of certainty that the wells in the area will not be at risk, even assuming a competent groundwater remediation plan is developed, the selected alternative should include the requirement of providing an alternative public drinking water supply to nearby residents.

EPA Response: The data show that the wells in the area of the Site are not currently contaminated. The remediation plan will insure that in the future no contaminants that could potentially contaminate the groundwater will leave the site. Additionally, EPA plans to sample residential wells in the area of the Site using a lower detection level in the near future. If the sampling reveals contaminant above the MCLs or the risk range, bottled water will be considered. Sampling of the groundwater, surface water and sediment will also take place during the Design and Operations.

20. As a minimum, in view of the serious problems with groundwater, EPA should insist upon a multi-media cap. The extra cost is a small percentage of the total and is warranted by the seriousness of this problem.

EPA Response: No serious problems with the downgradient groundwater have been identified at the Site. The use of a single layer cap will provide the protection necessary to prevent direct contact and infiltration of precipitation. There is no discernible difference in overall protectiveness between a multi media cap and a single layer cap at this Site. In addition, the single layer cap may be more reliable and easier to construct and monitor due to its simpler construction and fewer layers. The second Operable Unit will address offsite contamination.

21. The problem of soil contamination caused by the existing and inadequate spray irrigation system should be addressed more thoroughly.

EPA Response: The soil in the spray irrigation area was fully characterized. Sixteen soil samples were collected

this area. Additionally the soil in this area will be excavated as source remediation, placed on top of landfill and capped.

22. More attention must be paid to analyzing and improving the existing leachate control system so that periodic outbreaks of leachate that have been experienced in the past will not occur in the future. The report does not address this problem, and it must do so.

EPA Response: The existing leachate collection system will not be utilized in the future. Any leachate emanating from the landfill will be reduced by the cap and collected in the groundwater extraction system.

23. Waste and sediment leaving the site have been observed and documented by numerous citizens, and yet the report ignores these facts. This problems must be analyzed, and corrected.

EPA Response: All streams in the vicinity of the landfill were sampled and some contaminants were identified. The proposed groundwater collection system and placement of an impermeable cap will be designed to prevent contaminants from migrating from the landfill and into the areas streams. No significant contamination problems were detected in the areas surface water or sediments.

24. The failure to adequately characterize the waste which exists on the site is a serious deficiency. EPA's own early reports indicated much industrial and hazardous wastes was disposed of at this site. The failure to assess this potential for contamination must be rectified before this study can move forward.

EPA Response: Early reports indicate that some industrial waste had been disposed of in the landfill. Characterization of the landfill would not provide any additional information that would affect the selection of a remedy. The effect of the wastes in the landfill were documented in the RI Report. The proposed remedy provides sufficient protection against future releases of many compounds. EPA guidance does state that sampling of nearby groundwater and soil is sufficient characterization for large landfills and waste sampling is not necessary. Also sampling of the waste could cause contamination by breaching isolated pockets. It could also be a concern during the boring operations for the health and safety of the remedial workers, onsite residents and workers.

25. The maps, charts and figures were generally well drawn, easy to understand, and pertinent. However, a minor problem was noted on the potentiometric surface map presented at figure 3-8 and 4-15, which did not show the measurement points used to generate it. Also, a discrepancy was found to exist in

the 740 ft. contour line along the match lines connecting the other potentiometric surface map at Plates 1 and 2.

EPA Response: The water level measurements used to construct the potentiometer map are given in Table 3-4. The upper groundwater contour line on Plate 2 should not have been shown. Because of the topographic high located near Line Road, the 740 contours on Plate 1 and 2 should not be considered to be the same continuous contour.

26. The water and soil chemical quality assessments were thorough and were sufficient to assess the extent to which pollutants are migrating from the Site. The few quality assurance/quality control (QA/QC) problems indicated (such as the appearance of some common lab contaminants in some of the samples including blanks) did not hamper the validity of the assessments. However, some additional attempts to explain anomalies which were not attributable to the landfill could have been made, such as pointing out the agricultural nature of the areas where pesticide residues were observed. These occurrences might otherwise be disturbing to residents of the area, to whom the probable reason for the presence of these compounds might not be immediately apparent. Other examples are the discussion of the base/neutral- and acid-extractable (BNA) organic chemicals such as anthracene and fluoranthene, which are commonly present in asphalt, coal residues and petroleum products such as gasoline and used lubricating oil; and Bis-(2-ethylhexyl) phthalate, a plasticizer used in PVC, which may be observed in wells of low yield such as MD-MW-1 and 8 due to the inability to fully purge them prior to sampling.

EPA Response: The rural nature of the area does result in potential sources of contaminants other than the landfill. Where appropriate these other potential sources were identified.

27. The Applicable or Relevant and Appropriate Requirements (ARAR) review did not include Maryland law, although the planned activities could conceivably impact on Maryland. Examples of possible infringements could include sediment control, water pollution and possibly even groundwater appropriations codes. It is noted that Pennsylvania and Federal laws and regulations appear to be generally protective of our concerns, and conceptual approval at this stage will not affect our ability to enforce our codes if the need arises. However, we do request continued involvement in the remedial process including review of design documents and construction activities, particularly if any changes in the proposed design are introduced.

EPA Response: The State of Maryland will continue to have an active consultation role in the design and implementation of the Proposed Plan. All Maryland ARARs will be considered

for activities which are conducted in operable Unit 2 or which may impact on the State.

28. Reference was made in the RI to Keystone being tasked by a Consent Adjudication with PADER to direct similar investigations focused mainly on site. To date, a detailed, technically sound, comprehensive investigation has not been satisfactorily completed for the landfill site. Is this a reference to a future study or to past incomplete studies already carried out?

EPA Response: This was a reference to the Keystone study submitted to PADER in January 1990.

29. A previous report prepared by Buchart-Horn concluded that no deep regional aquifer flow exists, and that fractures in bedrock close at depths of 25 to 100 feet. This conclusion was proven to be incorrect. Data collected during the RI and expressed in graphic form in Figures 4-5, 4-6, 4-8, and 4-13 clearly show fractured zones in the bedrock at depths as great as 280 feet below the land surface. These fractured zones would be capable and available for the deep transmission of groundwater and any contaminants it may contain.

EPA Response: Nearly all rock contains fractures or structure capable of containing water. However the fractures in the bedrock at the Keystone Site are small and transmit little water. This is evident by the small quantities of water in the deep wells, the results of the packer tests, the slow recharge of these wells, and the lack of contaminants in the samples from the wells.

30. The RI stated that the Keystone Site is situated on a drainage divide created by a northeast-trending bedrock ridge. This statement is not supported by a topographic map of the site which is presented in Figure 2-2. In that figure, the bedrock ridge is clearly trending in a northwest direction.

EPA Response: The drainage divide does tend to be northwest east of the Site. South of the site the divide tends to be east-west. Southwest of the site the divide tends to be in a northeast direction.

31. It was assumed that the 0.10 and 0.20 inch slot size of the screens used for well construction as stated on pages 3-19 and 3-20 were in reality actually 0.010 and 0.020 inches in size.

EPA Response: The screen sizes were 0.010 and 0.020 inches.

32. The RI Investigation considered residential well RW-13 and RW-15 to be background locations, and subsequently used this

consideration in interpreting water chemistry data. Both RW-13 and RW-15 are clearly shown on Figures 3-5 and 3-8 as being hydrogeologically downgradient from the landfill. For this reason, they should not be considered to be reflective of background conditions.

EPA Response: Residential wells RW-13 and RW-15 were considered to be background locations due to their distance from the Site and because historically contaminants were not found in onsite wells located on that side of the Site. However, when analyzing the data, organic compounds found in these wells were not considered to be naturally occurring. During the Design phase, additional sampling will be conducted to determine a background sample more representative of the area.

33. The RI repeatedly stated that all VOCs and inorganic analyses were successfully analyzed in all soil samples, surface water and sediment samples, and groundwater samples. These statements were immediately followed by long lists of qualifiers and disclaimers regarding the validity of the data. So many disclaimers were made that the validity of the entire chemical data bank for all analyses must be called into question. This is critically important. All of the contents of both the RI and FS reports hinged on the validity of the chemical analyses. Since so much of the data were disqualified, why wasn't a second round of samples collected for all sampling points and reanalyzed following better laboratory QA/QC procedures?

EPA Response: The laboratory QA/QC procedures were the same that are followed at all Superfund sites nationwide. Few of the data had qualifiers which made the data unusable. The data that was not useable did not compromise the investigation or the results and conclusions drawn. To the contrary, the qualifiers on the data indicate that the QA/QC procedures were effective and of the highest quality. Additional samples will be collected from the monitoring wells, residential wells, the surface water and sediment during the design phases.

34. Offsite soil sampling locations SL-19, SL-20, and SL-21 were considered in the RI to be background. If one refers to both the potentiometric map and the topographic map presented in Figures 3-8 and 2-2, respectively, it becomes apparent that all three of these locations lie downgradient from the landfill and should not be considered to be reflective of background soil conditions.

EPA Response: Because the landfill is the highest point in the area, all offsite areas lie downslope of the landfill. However, when surface water drainage patterns on the landfill, the location of drainage ditches, and the localized topography are taken into account, the locations

of these soil samples are reflective of background conditions.

35. Nineteen BNA's were detected in soil samples collected within the landfill site. Nine BNA's were detected in soils collected offsite. The RI investigation seemed to be too quick to rule-out a connection between on site activities and offsite soil contamination.

EPA Response: Many of the compounds detected offsite were also detected at the background locations. In addition, no pattern of detection was evident that would indicate the landfill as the source of these contaminants (except in the area of the spray irrigation system). In addition, the compound detected are often found in chemicals that are used on farms.

36. Since barium and manganese have been detected in relatively high concentrations in some local residential wells, why weren't these elements tested in onsite and offsite soils to help answer the question of their origin.

EPA Response: Barium and manganese were analyzed for in all samples and were accounted for in the risk assessment. Both are naturally occurring in soil and rock. Barium was found in leachable concentrations in the bedrock.

37. RI states that offsite residential wells RW2, RW4, and RW11 had the largest number of metals detected. It may be more than a coincidence that RW4 and RW11 are two of the closest residential wells to the landfill, and that K8 which is close to RW11 was one of two on site wells with relatively high metal concentrations.

EPA Response: Four metals were detected in each of these wells. Two of these metals, copper and zinc, were found in all groundwater, soil and sediment samples. These metals are considered to be naturally occurring. Three different metals were detected in the three wells. These metals were not detected in any of the other residential wells and are therefore not considered to be Site related.

38. A significant amount of data has been collected over the past several years by both local residents, private laboratories, and the Pennsylvania Department of Environmental Resources. This data is available and should have been but apparently wasn't reviewed during the completion of the RI/FS activities.

EPA Response: These data were reviewed and evaluated during the RI/FS Workplan preparation and are available in the Administrative Record. The results of this review was incorporated in the Workplan and helped to form the basis

for the field investigation.

39. Why does every page in Chapter 7 of the RI contain this statement "DRAFT: Do not CITE or QUOTE." This warning implies that none of the contaminant fate and transport information or the conclusions based thereon are final, including the feasibility study results.
EPA Response: At the time that the RI Report was released, the risk assessment was in draft form and awaiting a final EPA review. That review has since taken place. The final risk assessment differs little in its conclusions and does not affect the results or conclusions of the FS.

40. It is also believed that the RI was much too limited in scope. The results contained therein simply represent a snapshot in time. Since only one set of data was collected, it is unknown whether the worst contamination problems have past and things are improving, or whether more problems will be expressed in the future and the worst is yet to come.

EPA Response: Historical data collected by local residents, private consultants and the PADER were reviewed and evaluated during the preparation of the RI/FS Workplan. Additional samples will be collected. In the interim prior to design, samples will be taken of the residential wells in the area. During the Design Phase, more samples will be taken of the monitoring wells, and residential wells. Soils, surface water and sediments sample may also be obtained if necessary during the Design. During the remediation, constant monitoring of the monitoring wells, residential wells, surface water & sediment will be taking place. Through the collection of all this data, EPA will be able to not only monitor the remediation process but make necessary changes as warranted to reach the remediation goals.

41. There should have been an onsite waste characterization program completed at the landfill, more offsite wells installed, more residential wells sampled, and more stream and sediment samples collected. There should have been several rounds of samples collected from each point, not just one. Aquatic organisms in nearby streams were completely omitted from the investigation even though off-site surface waters were found to be contaminated. Finally, the very poor laboratory QA/QC procedures which invalidated so much of the chemical results, especially organic compounds, have made this entire RI/FS of questionable value.

EPA Response: The extent of sampling conducted for the RI provides the data necessary to determine the extent of contamination, estimate the potential risks posed by the Site, and evaluate potential remedial alternatives. Additional sampling will be conducted during the pre-design

and design phases of the project. The sampling results did not show widespread contamination in the streams that would be detrimental to aquatic organisms. The laboratory QA/QC procedures were the same that are followed at all Superfund sites nationwide. Few of the data had qualifiers which made the data unusable. The data that was not useable did not compromise the investigation or the results and conclusions drawn. On the contrary, the qualifiers on the data indicate that the QA/QC procedures were effective and of the highest quality.

PRP CONSULTANTS

REMCOR Comments

42. Page 1-7; This appears to be the most detailed discussion of the irrigation system in the entire Remedial Investigation (RI), yet specific information regarding its operation is missing (i.e., pumping rate, application area, depth of leachate collection system.)

EPA Response: EPA's RI was primarily concerned with how the system affected contaminant transport via groundwater and soils, not to investigate the operations of the irrigation system.

43. Page 1-8; The RI indicates the first study was conducted by the U.S. Environmental Protection Agency (EPA) in 1984, yet monitoring wells have been at the site since 1974. What data were collected during that period and what do they indicate? Who installed the wells and why are they still being sampled?

EPA Response: Previous investigations were described and evaluated in the Workplan for the Site as indicated in the RI Reportand are contained in the Administrative Record. Monitoring wells were installed at the Site by Keystone in response to PADER landfill requirements to monitor the groundwater. Data obtained from these wells indicated the presence of VOCs in the groundwater. Most recently, these wells were sampled as a result of a study by Keystone required by a Consent Adjudication for PADER.

44. Page 1-8; The EPA presents limited descriptions and data from previous investigations. However, none of this data is ever correlated with that generated during the RI. This is a serious oversight that could have significantly affected the RI's conclusions. Specifically, no effort was made to confirm the effectiveness of continuing on-site remedial efforts.

EPA Response: The objective of the RI was not to determine the effectiveness of onsite remedial effort but to determine whether contamination exists and is migrating offsite. The previous data base was reviewed and used in the development

of the Workplan.

45. Table 2-2 (Page 2-8); Neither Todd, 1980 nor Freeze and Cherry, 1979 was included in Section 9.0, References. These references contain much "state-of-the-art" information and are generally recognized as extremely valuable tools for this type of study.

EPA Response: These references were noted in the text.

46. Page 3-1; No data are provided to evaluate the adequacy and accuracy of the fracture trace analysis.

EPA Response: The fracture trace analysis was used merely as a screening technique and was only one of several techniques used to identify well locations. The photographs used to develop the fracture trace analysis were noted.

47. Section 3.3 General; The geophysical techniques used in the investigation are not referenced and should be.

EPA Response: The techniques used for the geophysical investigations were described in the text and specifically Appendix A.

48. Section 3.3 General; This section does not provide a clear description of why and how the areas used in the surface geophysical investigation were selected.

EPA Response: Literature concerning the area of the Site showed that groundwater flow in the area of the landfill generally follows the surface topography. As such, the surface geophysical investigations were performed in the valleys where the monitor well locations were proposed in the RI/FS Workplan. The surface geophysical investigations were used as an aid in further locating the wells within the valley areas identified in the Workplan. Areas were selected by using fracture trace analysis and field reconnaisance. The objective of the survey was to effectively place monitoring wells in fracture zones.

49. Section 3.6 General; This section, describing the packer tests, is a bit unclear because results are included. Results were not included in the previous sections discussing surface geophysical technique. More importantly, none of the results from the tests have been quantified. Information on zones that accepted water (Page 3-11) is important, but it is equally important to know how much water and how rapidly the water was accepted.

EPA Response: None of the zones on which packer tests were performed accepted large quantities of water. The packer tests were not intended to provide quantitative data concerning the aquifer characteristics, but were a screening

technique to be used along with borehole geophysics and observations made during drilling for locating the well screens.

59. Section 3.6 General; No packer test was conducted in Well EI, which is reported to be downgradient of Keystone Sanitation Company, Inc. (Keystone) Well 2. This would have provided useful information regarding hydrogeologic interconnection between the eastern portion of the landfill and the Maryland Wells 1,2, and 3.

EPA Response: EPA obtained sufficient information to make a remedial action decision. This decision provides extraction wells for the eastern portion and towards MD 1, 2, and 3 as contamination was detected in this area. Additional sampling and studying of this area will be conducted during the Design Phase and in the investigation for Operable Unit 2.

60. Section 3.7 General; Well locations A,B, and C (Sections 3.7.1, 3.7.2, and 3.7.3, respectively) are located "...along the major structural trend." This appears to be based on Figure 4-2. However, are they placed along major structures (e.g., a major fracture)? If so, the feature is never presented in figure form. This is unclear. Also, why were wells at locations A and E considered contingency wells (Page 3-12)? How could they be located for optimal effectiveness before analytical data were collected?

EPA Response: All EPA installed monitor wells were placed via the surface resistivity surveys described in Appendix A of the RI report. Although well A and E were to be considered contingent and drilled if sampling analysis from the other wells indicated a need, EPA decided to save mobilization cost and drill all the wells at once.

61. Page 3-16; Well location DI is south of the tributary to Piney Creek. What is the basis on which this location was selected? The State of Maryland (Page 1-10) indicated that ground water in the area south of the tributary "could not be affected by landfill contamination" because of differences in hydraulic head. No evidence is presented to support a contrary conclusion; therefore, it appears that this well was ineffective in meeting the objectives of the study.

EPA Response: Well DI was placed south of the tributary to Piney Creek in order to support the assertion that the tributary is a groundwater divide. The water level measured in this well was higher than the levels in cluster C, which is located north of the tributary, and therefore supports the contention that the tributary is a groundwater divide. As stated in the Workplan on p. 5-3-7, Well D-1 was installed for the purpose of determining the hydraulic

gradient in this area as the Maryland residents were concerned with contamination from the landfill.

62. Pages 3-17 and 3-18; Wells at locations F and I are intended to provide background water quality data. It cannot be determined if these are appropriate locations based on Figure 3-8 (potentiometric surface map) because none of the wells have been located. Likewise, Plates 3 and 5 present improbable contour lines (i.e., contour lines of the same elevation that intersect) at the 740-foot elevation.

EPA Response: Please refer to the response for Comment #13.

63. Page 3-18; All figures indicate that location H is offsite, yet the text indicates the well is onsite. Where is this well located?

EPA Response: Well location H is located adjacent to the Site and is considered to be representative of conditions at K1.

64. Page 3-19; No justification is given for constructing every well of stainless steel. The data indicate that polyvinyl chloride (PVC) would have sufficed and would most certainly have been less expensive.

EPA Response: The community insisted on the use of stainless steel wells during their comments on the Workplan. There is a concern that PVC wells may leach VOC contaminants in the ppb range. The use of stainless steel alleviates this technical concern.

65. Page 3-2-; The reviewer must assume the three wells installed in 1987 were Keystone Wells 6,7, and 8 and that those are the PVC wells. If this is the case, how were Keystone Wells 1 through 5 constructed (e.e., diameter and type of casing):

EPA Response: Keystone well construction details are contained in the Workplan as well as in reports prepared by Keystone.

66. Table 3-2 (Page 3-22); Elevations of the Keystone and Maryland wells are not provided in the text or a figure. Therefore, correlation of hydrogeologic and analytical data with wells installed during the RI is difficult, if not impossible.

EPA Response: Well elevations were not available for all the Keystone and Maryland monitoring wells. The measurements from the RI wells were used to develop the potentiometric maps.

67. Section 3.8.1 General; The RI is not clear on why

approximately 37 percent of surface soil samples are collected onsite when the Executive Summary (Page ES-2) indicates the focus of the RI would be offsite. In addition, the number of samples collected in the areas of the residential wells is not sufficient to make any determination regarding the source of any potential contamination in those areas. In fact, the effects of two potential sources of any subsurface contamination, septic tanks, and underground storage tanks, would probably not have been identified even if the samples were collected from immediately above such a structure. Data from these samples are misleading because of the their extremely limited nature. Finally, the three background samples appear to be adjacent to roadways. These are poor background locations because of the increased possibility of elevated metals and semivolatile concentrations due to vehicular traffic and effects of road maintenance operations (e.g., surface tarring and chemical vegetation control). No rationale was given for how analytical parameters were chosen. In addition, factors governing surface runoff such as type of vegetative cover, moisture content of soil, or irrigation area were not discussed. A sample of the irrigation water should have been analyzed for correlation with the soil data.

EPA Response: Soil samples were collected near residential wells only if suspect areas were observed when collecting the water sample. Since no offsite residential well was considered contaminated, the soil samples collected near the wells were not extensively evaluated. Background samples are selected not to be clean but to be representative of the area. The analytical parameters selected were those standard for EPA Superfund sites. A sample of the irrigation water was not taken as K1 was sampled which would be representative of the irrigation water.

68. Table 3-3 (Page 3-26); Source and data of maximum contaminant levels (MCLs) need to be referenced. Have only final MCLs been used or have MCLs at various stages of finalization been used (e.g., those designated as proposed, draft, etc.)? Similarly, "Primary MCL" needs to be defined.

EPA Response: The source of the MCLs is the Federal Safe Drinking Water Act. (See 42 C.F.R. §300f et.seq.). Primary MCLs refers to enforceable standards which apply to specific contaminants which EPA has determined have an adverse health effect on humans. These are usually referred to as MCLs. The MCLs used are the most current promulgated laws.

69. Page 3-28; No reason has been provided for conducting grain size analysis on three sediment samples. This has not been adequately described and is confusing.

EPA Response: Contamination in sediments is primarily fou

in the fine size fraction. Grain size analysis which determines the size of sediment grains is a crucial part of sediment sampling protocol.

70. Section 3.8 General; No rationale was given for the selection of analytical parameters.

EPA Response: The selection of analytical parameters was done in the Workplan and was consistent with normal Superfund site protocol utilizing the Target Compound List (TCL) for organics and Target Analyte List (TAL) for inorganics. In addition, dichlorofluoromethane was analyzed as it had previously been detected in MD and is common landfill contaminant.

71. Page 3-29; What types of pumps and bailers were used to collect the ground water samples, and how were they decontaminated?

EPA Response: Stainless steel submersible pumps were used to purge the wells prior to sampling. Teflon bailers were used to collect the samples. The decontamination procedures were as follows:

- Soap and potable water wash
- Rinse with potable water
- Rinse with Optima grade methanol
- Rinse with high purity, analyte free water
- Air dry overnight when possible

72. Page 3-29; It is unclear whether a water elevation was determined in the wells from which no samples were collected due to obstructions (Keystone Well 2 and Maryland Well 7). If water levels were obtained, a water sample could be collected by some means (e.g., a narrow bailer).

EPA Response: Water samples could not be collected for K2 and MD7 due to obstructions. However, water levels were taken in all wells.

73. Page 3-29; Why were no ground water samples analyzed for dissolved metals or turbidity? These results could have been used to assist in determining if well installation activities were a likely source of any metals contamination.

EPA Response: Answered in other responses. Filterable and suspended solids were analyzed on the water samples.

74. Page 3-31; Residential well sampling techniques have not been referenced.

EPA Response: Residential well sampling techniques were presented in the Field Operations Plan for the Site.

75. Page 3-33; Why was only water level data plotted from the RI's shallow wells (Figure 3-8 and Plates 3 and 5) used Using data from the appropriate Keystone and Maryland wells would have provided a more controlled/accurate representation of the potentiometric surface. Water levels from the intermediate and deep wells should have been plotted to assist in assessing vertical hydraulic conductivity and ground water flow directions in the bed rock where flow is presumably controlled by secondary permeability.

EPA Response: Shallow and intermediate wells represent different flow regimes. A map combining their water levels is only representative of regional, not local flow.

76. Page 3-33; The objectives of the pump test at Keystone wells were to "...determine the aquifer characteristics at the site and to qualitatively investigate if Keystone Well 1 and the Mundorf Spring were hydraulically interconnected." Buchart-Horn, Inc. (B-H) presumably conducted a pumping test on this well earlier, why was another one conducted here? Was there some reason to question the results of the B-H test? Similarly, is water from the spray irrigation system drawn from this well or is this well in the zone of influence of the irrigation well? In either case, what measures were taken to ensure that the aquifer was in steady state?

EPA Response: Precipitation at the Site during EPA pumping test prevented the use of the test data for determination of aquifer characteristics. Buchart-Horn's pump (B-H) test was performed to determine if the aquifer could be sufficiently pumped as a clean-up tool. B-H's test was for approximately 72 hours, which is sufficient time to reach steady state conditions. It is standard EPA practice to conduct a pump test in a RI to obtain information to make our conclusions. As the test failed, B & H's data was examined and considered sufficient not to warrant the expense of another pump test.

77. Page 3-33; Regarding the objective of determining whether there is interconnection with the spring, it is questionable that this could have been determined in clear weather. This is due to the relatively large drawdown required to affect a measurable change in water level and flow at the spring. The determination was virtually impossible when precipitation and surface runoff enter the picture. The spring itself must be described: is it one seep or a series of seeps - Has it been influenced by man (e.g., has it been piped)?

EPA Response: Due to problems with the pump test EPA was unable to determine the effect of the ground water system on Mundorf Spring. This will be evaluated during the Second

Operable Unit and/or Design.

78. Page 3-38; No determination regarding the presence of wetlands has been made. Although reference has been made to their delineation here and on Page 4-62, no documentation has been provided to support any conclusion regarding the occurrence of wetlands.

EPA Response: A wetland determination was conducted in May 1990 by the U.S. EPA. Although this information was not contained in the RI report, it is available in the Administrative Record. Wetlands were found in several areas near the Site and no impact was indicated from the Site.

79. Figure 4-1 (Page 4-2); This figure is titled "Landfill Surface Features," yet very few surface features are shown.

EPA Response: This figure indicates the shape of the landfill and location of major streams and roads, it was not meant to be a topographic map of the landfill.

80. Page 4-3; The photographs and maps used to perform the fracture trace analysis must be referenced, along with their respective scales. Similarly, it is unclear when photographs were taken. It is stated on this page that photographs were taken in August 1985, yet Section 3.1 (Page 3-1) states that photographs were taken in April 1989.

EPA Response: Photographs from both years were used; however the 1985 photographs were the primary source for the fracture trace analysis. The scales of the photographs are the same as the figure. This information is found on pages 4-4 to 4-5 in the RI report.

81. Page 4-5; The discussion of ground water flow paths, as determined for the fracture trace analysis, is confusing. Up to this point, the RI has indicated that flow is controlled by primary permeability (Figure 3-8 and discussions of well locations in Section 3.7). However, in this section, the RI states that flow may be deflected along the strike (direction) of schistosity (foliations or layers of coarse minerals). Do they mean that two flow regimes exist in the aquifer? For example, the first is in the saprolite (weathered bedrock), which is controlled by primary permeability and, to a lesser extent, secondary permeability. The second regime is in the bedrock where flow is predominantly controlled by secondary permeability.

EPA Response: This was to indicate that groundwater does not flow equally in all directions from the landfill due to its position on a hill. Instead the groundwater flow is controlled by the regional strike and local structures such as valleys.

82 Page 4-5; References are needed where "typical" resistivities are presented.

EPA Response: The reference is noted in Table 4-1.

83. Section 4.4.3 General; At location C, the RI states the resistance of the third layer, 600 ohmmeter, is indicative of high water or weathered rock. Yet this resistivity seems high compared with data presented in Table 4-1.

EPA Response: The discussion of the 600 ohm-m value merely suggested the it may the result of high water. The value is in the range of a shale or metamorphic rock, as shown on Table 4-1.

84. Section 4.5 General; It appears that much of the information throughout the geology section was derived from the literature, yet no references are cited. Was an extensive mineralogical study of the bedrock and overburden conducted during the RI? If not, the source of the information should be cited. If it was performed, then methods and techniques should be described.

EPA Response: The material presented in this section is based on the work performed at the site during the RI. No detailed mineralogical study was performed, other that the core analysis.

85. Figure 4-5 (Page 4-17); This cross section indicates that the thickness of the saprolite is relatively uniform. However, the text on Page 4-19 states "The saprolite is of variable thickness and ranges from a thin veneer on ridge tops to 30 feet in thickness in drainage areas and valley bottoms." This is a confusing discrepancy that must be explained.

EPA Response: The cross section was constructed from wells located in valley areas near the Site. The thickness of the saprolite on ridges is based on other reports describing the area.

86. Section 4.5 General; Certain core samples from the bedrock were analyzed for extraction procedure toxicity and total metals. However, none of the samples from the saprolite were analyzed for parameters that could have been used in calculating contaminant mobility through the media (e.g., organic carbon content, cation exchange capacity).

EPA Response: Sampling the groundwater in the deep aquifer gives a much more realistic answer in determining contaminant mobility (i.e., indicates whether there is contamination) than calculating physical parameters.

87. Page 4-48; The RI states, at this point, that the hydrology of the site is dominated by two regimes. However, no data or discussion are presented regarding how the two regimes are interrelated except that well yields decrease with depth (Figure 4-14). No hydrogeologic parameters have been determined from this study. The hydraulic conductivities used in calculating velocity span 5 orders of magnitude and no reference for this information has been cited. Similarly, the values used for the area and outflow rate variables in the specific discharge equations have not been defined. The reviewer recalculated average ground water velocities using the equation presented, the range of hydraulic conductivities, the hydraulic gradient, and a porosity of 38 percent (instead of 0.38 percent as presented). The range calculated was 3.16×10^{-4} feet per day (ft/day) to 32 ft/day. This is significantly different than the range of 4.4×10^{-4} ft/day and 4.4 ft/day presented in the RI.

EPA Response: The difference in the calculated values could be as a result of using different wells to calculate the gradient. The wells used in the RI were H and B.

88. Page 5-7; The theory that the base/neutral and acids in soil around the irrigation system ". . . may be a result of the spray system configuration" needs to be further described.

EPA Response: A greater number and higher concentration of these compound were found in this area than in other areas where soil samples were collected. The significant difference was the presence of the spray irrigation system.

89. Page 5-22; The statement is made that the source of the metals in offsite surface water was not site-related. Conversely, it is mentioned that volatile organic compound (VOC) contamination is site-related. Neither of these claims are substantiated.

EPA Response: Because there was no discernable pattern of inorganics detection in groundwater samples from offsite monitoring wells, the Site was not considered to be the source. Because volatile organics were detected in K1 and cluster H and are typical constituents of landfills, the landfill was considered to be the source of these compounds.

90. Section 5 General; General comment - What is a site-related contaminant? Is there information available that has sufficiently characterized the material in and beneath the landfill?

EPA Response: A site related contaminant refers to contaminants detected onsite and detected in a migration pattern in an offsite locations indicating it may have come

from the Site. No information was obtained during the RI to characterize the waste.

91. Table 5-5 (Page 5-25); Range of mercury concentrations (0.2 to 0.4 parts per billion [ppb]) is incorrect. Keystone Well 8 sample contained 3 ppb mercury according to analytical data.

EPA Response: Table 5-5 and Figure 5-5 are both incorrect for mercury. The level detected at K8 was 2.5 ppm as stated in the RI on pages 5-32 and in Appendix E, Volume III. Corrections will be made to the RI through the issuance of errata sheets to the Administrative Record for the appropriate document.

92. Page 5-30; An inference is made in the last paragraph that VOC contamination at MD-2 (approximately 1,500 feet south of the site) is related to the site because it is on the same structural trend as Keystone Well 1. Therefore, Keystone Well 2 (from which no sample was collected) should also be on the same structural "trend." However, no contamination has been identified in any of the wells identified by the RI as being downgradient of Keystone Well 2. In fact, Maryland Well 2 was never mentioned as being downgradient of Keystone Well 2. If these wells are on a controlling structure, why wasn't a well placed closer to the site? The RI's conclusion is not substantiated by the data.

EPA Response: Maryland Well 2 is downgradient of K2. Well E was placed close to the Site and is located between K2 and Maryland Well 2. Page 3-17 of the RI states it is downgradient of K2.

93. Page 5-32; The last sentence in the first paragraph indicates that the ground water sample for Keystone Well 5 contained 1,3200 micrograms per liter (2ug/l) copper, which exceeded the "Federal Standard" of 1,000 ug/l. However, Table 5-6 indicates there is no federal MCL for copper. Which is correct and what is a "Federal Standard?"

EPA Response: Although there is no primary MCL for copper usually referenced to as Federal MCL, there is a federal standard which is the secondary MCL. The secondary MCL is used to regulate the aesthetic quality of drinking water. The text should read secondary MCL, not Federal Standard.

94. Page 5-39; No VOCs were identified in any off-site residential wells, even though several wells (RW-4, RW-5, and RW-8) appear to be situated on the "dominant structural trend." No mention is made of this in any conclusions relating to the other off-site wells, which were installed during the RI and appear to be contaminated.

EPA Response: The RI did note that contamination in the

offsite residential wells was not found during the RI.

95. Section 6.0 General; In general, this section lacks references, particularly Table 6-2.

EPA Response: The primary source of data for Section 6.0 is EPA's "Water Related Environmental Fate of 129 Priority Pollutants, Vol.1".

96. Page 6-6; Contaminant persistence in the environment is usually defined by its half-life degradation rates under various conditions such as hydrolysis, oxidation, biodegradation, etc. Organic carbon and soil water partition coefficients usually refer to contaminant mobility. Persistence and mobility data indicate how long a contaminant will stay in the environment and the direction it will move. Unfortunately, these parameters were discussed generally in qualitative terms rather than quantitatively.

EPA Response: No response needed.

97. Table 6-2 (Page 6-9); No source of the fate and transport data is cited.

EPA Response: Answered in Response 95.

98. Page 6-10; The statement is made that "Ground water analysis has confirmed VOC contamination emanating from the Keystone site." This is not true. The data show only that VOCs were present in several samples from off-site wells. The total lack of hydrogeologic data precludes such a statement from being made regarding the source, however likely a source the landfill may be. The RI has given no explanation for the fact that VOCs were not identified in other downgradient wells (e.g., MW-EI, MD-1, MD-3, RW-3, RW-5, etc.). It appears that the RI authors are basing their interpretation of the site hydrogeology on the analytical data rather than results from an adequate investigation of aquifer characteristics. Finally, the underlying deficiency in making any interpretation of where the source is located is that it is unclear which direction ground water is flowing from the site. Does it flow radially from the site, as indicated from the figures, or does it flow along the "dominant structural trend," which has not been clearly defined.

EPA Response: Groundwater flows from the site in several directions due to its location on a topographic high. The primary flow paths are valleys originating near the landfill. This flow regime contrasts to typical situations where groundwater flows through a site in a single direction. No explanation can be given for why VOCs were

not identified in other downgradient wells without being speculative. It could be none were present or none were present at that depth. The RI was to provide facts.

99. Page 6-11; The section on surface water is unclear. How many springs were identified? Did any of them dry seasonally? What are their elevations, etc?

EPA Response: Detailed information concerning springs in the area was not collected. This information can be addressed in the second Operable Unit for offsite contamination.

100. The landfill was identified as a source area based on groundwater sampling at the perimeter. No sampling within the landfill was performed during the RI, so no waste characterization is available (other than historical data). In order to definitively identify it as a source, additional sampling and analysis within the landfill is required to characterize and quantify the landfill material.

EPA Response: Please refer to comment No. 24

101. As stated in Section 2.2.2.3 (Page 2-4), "chemical-specific applicable or relevant and appropriate requirements (ARARs) do not exist for the contaminants present in soil or sediment at the Keystone Sanitation Company, Inc. site, based on a review of federal and state regulations."

Direct contact risks have not been calculated for the soils in the spray irrigation area. Remedial action objectives should not be established unless there is a risk exceeding the point of departure.

Risks exceeding the point to departure were not identified for surface soils. Remedial action objectives and ARARs are not identified in the absence of risk.

EPA Response: The sampling revealed that a release of contaminants has occurred as a result of the spray irrigation system. The remedial action objectives for soils in the spray irrigation area are intended to provide protection of human health and the environment from potential risks in addition to remediating the release.

102. The list of contaminants of concern for ground water identified in the remedial action objectives (Section 2.2.3.4) is different from those identified in the risk assessment (Section 1.5). The risk assessment must clearly define those contaminants which contribute to an incremental increased cancer risk greater than 1×10^{-6}. That information can then be used to identify the remedial action objectives. This issue is further discussed in constituents of concern.

EPA Response: Risk is not the only criterion used to determine contaminants of concern with regard to remediation, specifically treatment. The risk assessment identified contaminants which pose excess cancer risks. The lists in the FS also include compounds in the groundwater that may affect the implementation or operation of a treatment process.

103. A definitive list of the contaminants of concern must be clearly defined in the risk assessment and adequately supported by the RI data. This same list can also be used in the evaluation of remediation alternatives.

EPA Response: The previously collected data was considered in the development of the Workplan and can be found on this Administrative Record. Due to questions concerning QA/QC, it can not be quantitatively used in the remedial decisions. However, this information is considered important and can be used to substantiate data from the RI. The objective of the RI was to determine contaminant migration from the Site. Data generated would determine the need for remedial action and be used in developing and evaluating remedial alternatives.

104. Page 2-13, ARARs; Is the Resource Conservation and Recovery Act (RCRA) an ARAR? This site was a municipal solid waste (MSW) landfill, not a hazardous waste treatment, storage, or disposal facility. They should develop their ARARs more carefully to show why RCRA, etc., are ARARs.

EPA Response: EPA guidance identifies RCRA as an ARAR for Superfund landfill sites. Therefore, RCRA was noted as a potential ARAR for this Site. However, the cap design was based upon PA Municipal Landfill Closure, not RCRA, as RCRA, is not considered to be applicable to the Site. But the Offsite Land Disposal requirements in 40CFR 268.1-268.50 are be considered relevant and appropriate for the disposal of the sludges from the air stripper.

105. Page 2-15, RCRA; Have characteristic hazardous wastes been identified at the site? Remcor is not aware of any sampling at the site. The constituents of concern are probably the result of MSW disposal or pre-RCRA disposal.

EPA Response: The landfill itself was not sampled, and characteristic wastes were not identified at the Site.

106. Section 2.2.2, General; Overall, the ARAR's discussion and development are very poor. Direct applicability of the ARARs has not been properly developed.

EPA Response: EPA disagrees and feels that all applicable or relevant and appropriate requirements were properly

identified and used at this Site.

107. Sections 2.4 and 2.5, Technology Identification and Screening; In the identification and screening of technology types and process options sections of the FS (Sections 2.4 and 2.5), five potential feasible options were unjustifiably rejected. These options should be used as parts of the developed remedial action alternatives (Table 2-8, Page 2-59) and further considered in the detailed evaluation of alternatives.

EPA Response: Each of the "five potential feasible options" addressed in Remcor's comments have been explicitly discussed in various sections of the FS. To clarify:

- EPA determined that there was no need to relocate the onsite residents since the risk is coming from the ingestion of groundwater which can be treated. Relocating the On-Site Residents - The residents are the PRPs and may choose to relocate if desired. As an option, this is considered much more expensive and more difficult to administer than point-of-use treatment.

- Subsurface drains - These were not rejected, but were not used for costing purposes. During the design, this process option will be further evaluated.

- Activated Carbon Adsorption - Since only VOCs are a concern at this point in time, air stripping was determined to be less costly but equally effective for VOC removal at the site.

- Discharge to Groundwater - This is a more costly means of effluent discharge and not necessary based on technical considerations.

- Conventional Excavation - This process option was not rejected (see page 2-50).

108. Section 3.3, Description of Alternatives; Remcor has seven comments on the selected alternatives (Section 3.3), which were identified as a result of the screening process. These comments are related to the technical appropriateness and feasibility of the alternatives. Most of the comments relate back to the rejected options identified in Comment

EPA Response: See previous response.

109. Appendix C, Cost Estimates; After a review of the cost estimate tables shown in Appendix C, Remcor has found the U.S. Environmental Protection Agency (EPA) cost estimates be seriously flawed. The EPA's costs are significantly

underestimated, as discussed below and shown in Table 1 of this attachment:

- o A contingency of only 10 percent is not adequate for cost estimates based on preliminary planning of remediation alternatives. Changes in the scope of work due to design refinements, estimated quantities, permit requirements, and site conditions are likely to occur. Remcor feels a contingency of 20 percent would be more appropriate.

- o The capital cost estimate for the single-layer clay cap is grossly underestimated. Remcor estimates a construction price of $10.5 million compared to the original estimate of $4.9 million. The increase in cost is due to an error in the estimated quantity of filter fabric and sand, and in the in-place unit costs for top soil, common borrow, and clay. Details of Remcor's estimated costs are shown in Table 1.

- o The capital cost estimate for the multimedia cap is also grossly underestimated. Remcor estimates a construction price of $10.9 million compared to $6.5 million. This underestimate is due to error on the same five items as the single-layer cap. Details of these additional costs are also shown in Table 1.

EPA Response: The cost estimates proposed by Remcor reflect a difference in design and in costs of materials. The FS cost estimate is based on a preliminary design to meet PADER and/or RCRA regulations, and on discussions with PADER officials regarding commonly accepted practices for landfill closures in Pennsylvania. Remcor apparently has increased the thickness of various layers resulting in an increase in material cost. The unit costs used for clay and compaction, topsoil and spreading, and common borrow were obtained from vendors and costing guides. A 10% contingency is standard for preliminary designs. As stated in EPA RI/FS guidance, the FS is expected to provide an accuracy of +50 percent to -30 percent for the "study estimate" costs.

R. E. Wright

110. Resistivity electrode spacing was not sufficient to reliably permit location of bedrock fracture zones; since the depth to bedrock ranged from 20 to 40 feet.

EPA Response: R.E. Wright (REWAI) reviewed the Work Plan for both the Borough of Littlestown (4/14/88) and for Alloy Rods (4/28/88). In the former, REWAI had no comments regarding the geophysics, whereas in the latter, REWAI only suggested that EPA use resistivity to determine monitor well locations. Because the use of resistivity for fracture delineation must be very precise, EPA had its Environmental

Monitoring Systems Laboratory in Las Vegas acquire the service of Gregory Hempen, a geophysicists with the St. Louis Corps of Engineers to perform the survey. Mr. Hempen is a CPG with many years of experience in the field of geophysics and is currently the president of the AEG.

Mr. Hempen used both Wenner and Dipole-Dipole profiling to detect fracture signatures for monitor well placement. Although the Wenner arrays spacing may have been too large, the data did show that the water path through the zone was influenced by bedrock fractures. However the Dipole-Dipole array was used to confirm this suspicion. The Dipole-Dipole array depth had a 50-foot spread and multiple depths so that depth to bedrock was assured.

111. Borehole geophysics did not utilize the temperature logging required by the Work Plan to recognize the location of water-bearing zones and determine the presence and direction of vertical groundwater flow in the boreholes.

EPA Response: Although temperature logging was not performed during the RI, a suite of other geophysical logs, packer tests and cores were performed for fracture delineation.

112. Historical on-site groundwater quality data was not integrated into the RI.

EPA Response: Historical onsite groundwater quality data was used in the development of the Workplan and included in Section 1 of the RI. The RI was to focus on offsite problems to determine if contamination was migrating offsite. This was done as Keystone was already evaluating the onsite contamination under a Consent Adjudication with PADER.

113. EPA has arrived at RI results which do not support the alternative proposed.

EPA Response: The RI has shown that there is enough water in the weathered zone to support a pump and treat system. Additionally, Buchart-Horn, Keystone's consultant, has proposed the same remedy as EPA, pump and treat, in its January 1990 Supplemental Groundwater Plan.

114. The FS requires more of a clean up than necessary because EPA did not take into consideration the fact that Keystone's on site bedrock wells were open for long intervals causing incorrect determination of specific contaminant migration patterns in multiple aquifers.

EPA Response: The fact that the K-series wells are open for long intervals only serves as stronger evidence that groundwater cleanup is necessary because such long intervals

dilute and under-estimate contaminant concentrations. Since other sources of contamination in the area do not exist, it

is possible that onsite clean up may require more, not less, of an effort.

115. Filtered Samples should have been taken.

EPA Response: EPA agrees and will be resampling the surface water, residential wells, sediment and groundwater taking both filtered and non filtered samples. This data will be used in the Remedial Design.

116. The well heads were not secured properly.

EPA Response: The wells were secured after construction was completed. It was noted during the public meeting that the wells may presently be unsecured. EPA will address this problem and redevelop wells as needed in the future.

117. The pump test data is not valid due to problems conducting the test.

EPA Response: EPA agrees that there were problems with the 72 hour pump test, and this was reported in the RI. However, Buchart-Horn's pump tests, which ran successfully indicated that remediation of the aquifer via pump and treat is feasible. This remedy is consistent with that suggested by EPA.

118. REWAI has questioned EPA's understanding of the site geology because REWAI purports that EPA has correlated bedrock foliation to former layering on P 4-20, 2nd paragraph in the RI.

EPA Response: The 2nd paragraph on p 4-20 in the RI notes that "Metamorphism has imparted a distinct, continuous slatey cleavage (foliation) subparallel to the original sedimentary bedding. Cleavage is subparallel to the original sedimentary bedding". The narrative does not purport what REWAI has indicated. The statements have not indicated that foliation can be correlated to former bedding.

119. EPA's fracture trace analysis was used only to place wells in valleys and the aerial photos used were of little use due to vegetative cover.

EPA Response: EPA did not indicate in the RI that valleys were used solely as evidence of fracture traces. EPA used aerial photos to identify potential locations for monitor wells, then field verified those locations with surface

geophysics and examination of natural outcrops and other surface features. Additionally, the presence of vegetation can help identify fractures.

120. Problems with EPA's pump test resulted in little information.

EPA Response: Although there were problems with EPA's pump test results as noted in the RI, the Buchart-Horn investigation, which successfully completed pump tests in 1990, clearly indicated that the aquifer could be stressed due to pumping and that such a remedy is feasible for Keystone. This information is more useful that K values within proper orders of magnitude.

121. The RI vacillates between alternative models of groundwater flow.

EPA Response: Water moves differently in unconsolidated saprolite and consolidated bedrock. The RI has stated this as two appropriate models for groundwater flow.

122. No mention was made of whether the aquifer was confined or unconfined.

EPA Response: EPA used Buchart-Horn's 1990 pump test data which reported the aquifer as unconfined.

123. The depth of the proposed recovery wells is not correct.

EPA Response: EPA's has indicated that the exact specifications for the pump and treat system will be detailed in the Design documents which will be made available to the public for review and comment.

R. H. Sheppard Co.

124. A sufficient number of background samples were not collected to establish naturally occurring levels of barium, cadmium, chromium, and, lead.

EPA Response: The three background soil locations, two background surface water and sediment locations, and two background groundwater locations are sufficient to establish levels of naturally occurring inorganics. In addition, rock from the cores was analyzed for inorganics. General references concerning typical ranges of inorganics in a region cannot be used to support contaminant decisions at a Superfund site.

125. Barium, cadmium, chromium, and lead should not be considered contaminants of concern in soil.

EPA Response: No remedial action is proposed specifically as a results of the occurrence of these inorganics.in soil

samples.

126. Barium, cadmium, chromium, and lead should not be considered contaminants of concern in surface water since insufficient background samples were collected and regional background values should have been used.

EPA Response: These compounds were not found in concentrations significantly above ARARs in the surface water. Also see previous response concerning background samples.

127. Background surface water samples should have been collected west of the site.

EPA Response: The streams located west of the site are down slope and originate near the landfill. For this reason, background samples could not be collected west of the landfill.

128. Barium should not be considered a contaminant of concern in sediment as the concentrations found were less than reported background values for the region.

EPA Response: Regional background values reported in the literature are not used to establish background locations at a particular site. Sufficient background samples were collected to establish local background conditions.

129. Barium, cadmium, chromium, and lead should not be considered contaminants of concern in groundwater based on its presences in the rock and soil, and frequency of detection.

EPA Response: While metals detected in the groundwater at offsite areas are not a present concern, metal were detected in onsite wells. Thus, the nature of landfill waste, and the concern for future releases require that a treatment system capable of removing a range of metals from the groundwater be provided.

130. Barium, cadmium, chromium, and lead should not be considered contaminants of concern in residential wells based on its presences in the rock and soil, and frequency of detection.

EPA Response: The residential wells in the area were found not to be contaminated as a result of the site.

Littletown Hardware

131. Chemical composition of selected core intervals and EP TOX of selected core intervals were analyzed in the ppm range, not the ppb range that is required for Water Samples. Thus, this data is of little utility.

EPA Response: The EP toxicity conducted on the core samples show that arsenic and barium may be leachable under some circumstances. It was a qualitative analysis, not quantitative.

132. Water samples for metals analysis were not filtered prior to preservation.

EPA Response: It was not required in the Workplan. Future sampling during the Design and Operation Phases will consist of filtered and nonfiltered samples. These analysis will be used for the design of the treatment system.

133. During well development, Littlestown Water was used although the water was sampled the RI did not provide information regarding the condition of the tank that transported the water, the length of time the water remained in the tank at the Site, or whether the sample was obtained when the water was loaded or unloaded. These questions are important if the tank was constructed of reactive material.

EPA Response: The tank was constructed of non-reactive plastic material.

134. EPA should consider the use of buffered distilled water for well development as the use of Littlestown water as a development fluid may have caused invasion into the formation and formed complexes which remained in the formation.

EPA Response: The potential for potable uncontaminated water to cause contamination problems in an aquifer is minuscule. There is no research in this area that EPA is aware of that has determined that this is a problem. Additionally, the purging of wells before sampling prevents purging of stagnant potentially "reactive" water from analysis.

135. The sandpack for the monitor wells consisted of pre-washed, graded 10/20 silica sand. The pre-wash fluid was not discussed and an analysis of the sand for organic and inorganic constituents was not presented for the sand pelletized bentonite seal or cement bentonite grout.

EPA Response: The sandpack, bentonite, and cement used for monitor well installation was all GSF approved and NS standard.

136. Duplicate samples were collected from monitor wells BS and FS. It is not explained in the RI whether one sample was collected at each well, preserved and then split into two samples for analysis or whether two samples were collected at each location. The suspended solids result from MW-BS is

3x greater than the duplicate and 2x as great for MW-FS.

EPA Response: The duplicate samples were collected independently. Natural variations in the suspended solids are not considered to be significant.

137. Results for the monitor wells were presented on Table 7-1 in the RI. This table noted that antimony was detected in 2 of 30 samples, which is inconsistent with that reported on Table 5-3A in the RI.

EPA Response: Editorial problems such as these will be addressed by placing errata sheets in the Administrative Record with the RI and FS.

138. The computation of background coverage for barium for monitor wells F and I is incorrect.

EPA Response: The comment is noted and will be checked.

139. Table S-3A in the RI does not indicate that general water quality analysis samples were not taken at MW-AI and MW-GI which is inconsistent from that stated in the RI on page 3-31.

EPA Response: Editorial problems such as these will be addressed by placing errata sheets in the Administrative Record with the RI and FS.

140. Page 3-29 of the RI states that all MW's except K2 and MD7 were sampled however, Table 5-3A has no data for MW-MD-1

EPA Response: Editorial problems such as these will be addressed by placing errata sheets in the Administrative Record with the RI and FS.

141. Residential well survey results should have included a description of plumbing materials or location of the tap.

EPA Response: Comment noted.

142. Residential well samples were collected after a 20 minute flushing period or until a holding tank volume was discharged. The methodology used in measuring the holding tank discharge was not described.

EPA Response: A standard formula used across the industry that determines the time required to empty one tank volume was used.

143. Calculation of a corrosion index for each residential well would give an indication of the potential for metals contribution from plumbing materials and further clarify the origin of metals in water samples. The presence of copper

and zinc in all of the samples may be partially the result of plumbing

EPA Response: The remedy does not address copper or zinc.

144. Failure to describe land use practices or conditions that may influence soil sampling results is scientifically dishonest, and a full description and disclosure are not only important but mandatory.

EPA Response: Soil sampling was done to establish how the Site affected natural soils since clean-up is based upon site related contamination. Pesticides were not historically considered to be a problem so an in depth study of former land use practices for these chemicals was not necessary to study Site cleanup.

145. Drift of spray according to prevailing winds coupled with surface runoff to nearby drainage channels may explain the presence of metals in surface water and sediment samples.

EPA Response: Yes, and this may also indicate site related contamination.

146. The pumping of K-1 has caused all of the off-site contamination.

EPA Response: K1 may have contributed to offsite contamination.

147. Will EPA place a monitoring well clusters to investigate ground water flow between K8 and K4, between K4 and K7 and between K1 and K2.

EPA Response: At this time, it has not been determined where the wells will be placed. This decision will be made during the Design Phase after additional studying and sampling of the area has taken place. The public will be given an opportunity to comment on the design.

GEOSERVICES

148. Page ES-1 Paragraph 3: C.C. Johnson and Malholtra (CCJM) states that the RI was implemented to supplement previous reports. However, data from previous reports were not included in the RI or the FS. Therefore,the purpose of the RI was not met by subsequent activity on the project. In the same paragraph, it is stated that the primary objectives were to evaluate impacts although existing laboratory data were not included in the evaluation. The CCJM study relied completely on samples which were collected during the single sampling event and which included a limited number of wells

relative to those sampled during previous investigations. Had CCJM included the existing database in the analysis, the significance of anomalously high trace metals concentrations could have been evaluated and subsequent mistakes and erroneous conclusions founded upon this data could have been avoided. In addition, had CCJM relied on existing data, the RI/FS process and subsequent report would have been more thorough, more accurate and less costly.

EPA Response: The previously existing data base was evaluated in the Work Plan for the Site and is available in the Administrative Record. A major problem with the previously existing data base is the lack of information concerning data validation and QA/QC procedures. This problem is compounded by the number of sources of the data.

149. Page ES-1 Paragraph 5: It is stated that surficial and subsurface shallow soils were sampled to determine if offsite soils had been affected by contaminant migration from the site. Additionally, it is stated in the same paragraph that surface water and sediment samples were taken along with ground water samples to determine the extent of contamination emanating from the site.

The report concludes that no site related contaminants were detected in offsite soils near the site or along surface drainages. Additionally, the report concludes that no site-related BNAs, pesticides, or PCB were detected in surface water or sediments, and that metals which were detected above fresh water chronic water quality criteria bore no direct connection to the Keystone site. The report also concluded that no site related pesticides or PCBs were detected in ground water from off site monitor wells. Although several metals were detected in off site monitoring wells, CCJM concluded that their occurrence was random and apparently not site-related. The report further concluded that the relative abundance of metals in shallow monitor wells may result from natural weathering processes. The report also concluded that there was no indication of metal contamination emanating from the Keystone site and in nearby residential wells. Finally, metals contamination was not detected in any on site surface soils.

Clearly, in accordance with this information, the most recent soils and groundwater sampling data indicate that no release or threat of release of metals has occurred, either to onsite soils, to offsite soils, or to either ground water, surface water, or stream sediments. In the absence of any observed release or threat of release, there is no need to consider design of a remedial system although under the circumstances, monitoring or other precautionary measures may be considered prudent. Additionally, assessment of risks to human populations or to the environment must be carefully evaluated within the overall

context of the actual site conditions.

EPA Response: While there is no direct risk to human health and the environment from the identified metals in offsite areas, there is potential for metals migration from the landfill based on metals found in onsite wells and characteristic of the landfill in general.

150. Page ES-5/ES-6 Paragraph 8: The report states that exposure pathways include groundwater, surface water, and soil routes by means of inhalation of airborne particles originating from site soil waste or due to dermal contact. We have clearly shown in previous sections of the report that metals concentrations are not present as a dissolved phase but rather as a particulate phase within the aqueous regime. Therefore, dermal contact could only be established due to showering, bathing, or swimming in extremely turbid water. Additionally, metals concentrations in particulate matter within the leachate are little different from naturally occurring metals concentrations in soils and rock materials which constitute the geologic setting of the region.

EPA Response: The metal concentration does exist as a particulate phase within the aqueous regime. These particulates can be inhaled during showering.

151. Page ES-6 Paragraph 2: Several metals are listed as major contaminants which include chromium, nickel, cadmium, and beryllium. These compounds are immobile in the natural environment due to their existence as a solid phase. Therefore, trace metals present no more of a potential risk to human health than does naturally occurring bedrock or soil particulates derived from the regional bedrock.

EPA Response: Responded to previously in Comment No. 150. Dissolved trace metals can potentially pose a problem at any Superfund site.

152. Page 1-1: One of the stated objectives of the RI was to develop a cost effective remedial action plan. Development of a more than $10 million remedial alternative involving groundwater extraction, capping, and construction of a water treatment plant to treat contaminants in which neither a contaminant release nor threat of release has been observed, can hardly be regarded as cost effective.

EPA Response: The remedy primarily addresses the risk from on-site VOC contamination while preventing any further metal migration from the site. As reflected in the RI, EPA has documented the release of a hazardous substance from the Site.

153. Page 1-9 Paragraph 1: The CCJM states that EPA/NUS found elevated levels of lead, chromium, cadmium and mercury in

site monitor wells during the 1984 investigation. These sample results have been conclusively identified as statistical outliers representing the concentrations of particulate matter within an unfiltered sample. Furthermore, subsequent sampling demonstrated that these measurements were entirely non-reproducible and therefore unreliable. Therefore, no such elevated levels of lead, chromium, cadmium, or mercury can be considered to have been detected when included with the sampling and preservation protocol which was employed.

EPA Response: EPA detected the presence of inorganic contamination in the RI. The remedy in the Proposed Plan addresses this concern. Additional sampling during the Design Phase will include both filtered and nonfiltered samples. It may be determined in the Design Phase based on new sampling results that metal treatment is not necessary.

154. Page 1-11 Paragraph 3: CCJM states that review of the previously existing database shows that there is insufficient information to define the hydrogeologic regime and to characterize the extent of existing contamination. This statement immediately follows the conclusions developed by the State of Maryland in its 1986 report which provides a number of conclusions regarding the three-dimensional configuration of the groundwater flow system dominating the area. The Maryland report provides a detailed discussion of the vertical and horizontal extent of the flow system relative to discharge of groundwater derived from Keystone Landfill.

Additionally, CCJM offers no explanation for omission of the data from hundreds of ground water samples which had been collected at the time of report preparation and prior to the sampling event conducted by CCJM. As will be developed below, the stated purpose of collecting additional information (to determine potential contaminant migration routes) was not served by the subsequent investigations since CCJM failed to conduct a single successful test of aquifer characteristics or to provide any meaningful additional data by which the Keystone ground water flow system could be further refined.

EPA Response: As indicated in a earlier comment and an earlier response, the existing data was evaluated and the quality of the data was questioned. Sufficient information as reflected in the RI/FS is available to evaluate the groundwater flow systems in the area of the Keystone site.

155. Page 2-9 Paragraphs 1 and 2: CCJM states that aquifer tests by Keystone and the State of Maryland, as well as a pumping test conducted by Buchart-Horn, were used to determine aquifer properties or to characterize the hydraulic behavior of wells completed within the site aquifer at the site.

Although CCJM claim that the existing database was insufficient to define the hydrogeologic regime at the site, the existing database is repeatedly cited to define the site hydrogeologic regime. This is in contrast to the almost complete omission of any assessment completed by CCJM. We therefore question the need for the additional work completed by CCJM embodied in the RI or, in fact, the need for any additional work at the present time.

EPA Response: The study completed by Buchart-Horn was not sufficient to study the offsite contamination. The RI study and data was necessary and did provide sufficient information to make a remedial decision. The pump test data by B & H further supports this decision.

156. Pages 3-1 to 3-20: An extensive program of surface and borehole geophysics was conducted, presumably for the purpose of monitor well siting and delineation of aquifer characteristics. Whereas no evaluation of the three-dimensional ground water flow regime or the vertical distribution of ground water contaminants is presented anywhere within the report, we see the extensive geophysical program described in this section to be wholly unnecessary and blindly extravagant.

EPA Response: The purpose of the surface geophysics was for monitor well placement, whereas the borehole geophysics were used for determination of bedrock fracture zones. This type of work is routinely preformed at Superfund sites in fractured bedrock.

157. Page 3-20 Paragraph 3: The report states that, although the wells were fully developed, some wells continued to produce pale yellowish-brown water indicating a high percentage of particulate matter. When sampled under the protocol employed by CCJM, such samples could only produce anomalously high metals concentrations not representative of dissolved aqueous phase metals.

EPA Response: Additional sampling well take place during the Design Phase which will include filtered and unfiltered samples. The final design of the treatment system will be determined by these results.

158. Page 3-28 Paragraph 1: CCJM states that surface water samples were collected from well-mixed (flowing) reaches of streams or springs by direct immersion of a sample container. While CCJM states that some effort was made to avoid collection of suspended materials by sampling surface water prior to sampling sediment, streams draining the region characteristically contained significant quantities of suspended materials due to the fine grained nature of the soils which mantle the region and which are drained by the streams. Suspended materials are especially present

following rainfall events. The presence of suspended materials in stream water (particularly those in well flowing reaches of streams or springs) imparts a characteristic green or brown color to the streams of Southeastern Pennsylvania. Again, unfiltered samples collected from streams draining the area and preserved using a pH of 2 could only be expected to contain elevated levels of metals. Actual concentrations of metals is dependent on the volume of particulate matter collected along with the sample and processed during laboratory analyses.

EPA Response: The surface and sediment samples of the RI provided sufficient information for the proper remedy. Additional sampling of the surface water and sediments will be done during the design and on a regular basis as indicated in the Proposed Plan. This information can verify the presence of metals. The proposed remedy does not remediate the surface water or sediment directly, but indirectly by lessening the amount of groundwater discharge.

159. Page 3-29 Paragraph 2: During a description of the sample collection procedure, it is noted that the well cases, was pumped dry rather than fully purged. Cavitation of the well normally results in a significant increase of the volume of particulate matter in the well water. This would again lead to excessive metals concentrations due to sample collection procedure rather than as an accurate measure of metals content of groundwater in the vicinity of the well.

EPA Response: The slow recharge rate of the bedrock is the reason the well was pumped dry. This has the same effect as purging 3 to 5 well volumes in a more transmissive aquifer.

160. Page 3-33 Paragraph 3: A seventy-two hour constant rate pumping test was conducted to determine aquifer characteristics at the site. During the test, response of water levels in 11 wells and a spring were monitored continuously. The results of the pumping test were reported in a subsequent section with the success of the test characterized by distorted drawdown results. During the test, only the pumped well and a single observation well displayed decreasing water levels. Other wells showed an increase in water levels due to rainfall effects. Additional comments relative to the inadequacy and folly of the RI pumping test are included in a subsequent comment.

EPA Response: Please refer to comment No. 76.

161. Page 4-1 Paragraphs 2 and 3: The report states that precipitation falling on the landfill can flow northward over ground surface or seep downward into the landfill to the groundwater below. In following paragraph, it is stated that no eroded gullies or seeps were visible at the landfill. It is presumed therefore, that CCJM envisions

precipitation draining the landfill as a sheet of water over the ground surface rather than collecting in any gullies, seeps or swales. This circumstance is highly unlikely and actual site conditions provide little potential for transport of surficial materials from the landfill by sheet wash.

EPA Response: Sheet wash was not implied in the report. What was noted was that the landfill cover material does not appear to be eroding.

162. Pages 4-5 to 4-15: Surface geophysics are discussed in order to identify the three-dimensional structural framework in the vicinity of the landfill. As would be expected, discrete fracture zones are present within the area and the depth to fresh bedrock varies significantly throughout the area. The summary presented at the end of the section states that weathered near surface rock may be the dominant aquifer until major fractured/weathered zones are encountered. In both cases, the report concluded that major avenues of groundwater migration are through significantly weathered zones presumably containing an abundance of clay minerals and iron oxides which are the normal weathering products of the rocks which underlie the area. Both materials have been previously cited as primary adsorption sites for metals adsorption. Significant mobility of trace metals through these materials is, therefore, not possible under these conditions.

EPA Response: There is a potential for metal to migrate from the site. This will be further investigated through the filtered and unfiltered samples taken during the Design Phase and through the investigation of Operable Unit 2.

163. Page 4-16 Figure 4-3: The figure summarizes the geology of the area indicating that the saprolite is composed of weathered schist and that the schist itself is composed of chlorite, muscovite, and finely disseminated pyrite along with other minerals. Chlorite, muscovite, and pyrite have been shown to contain extremely high concentrations of trace metals. These concentrations are high enough to be expressed as weight percent rather than as ppm. Therefore, the entire saprolitic sequence must be regarded as a source of trace metals which are elsewhere identified as contaminants of concern by CCJM.

EPA Response: The report indicates that this may be the case in some instances.

164. Page 4-19: Fracture zones are characterized as ranging in thickness from 1-inch to approximately 1-foot and containing crushed schist with small amounts of finely braided rock material (clayey gouge). Additionally (in the third paragraph of Page 4-19), saprolith is characterized as a

pale yellowish brown clayey soil containing remnant schist and quartz fragments. In the following sentence it is characterized as consisting of reddish-brown, brownish-gray and pale grayish-green clay and heavily weathered schist. In all cases, the areas through which groundwater migration is focused is associated with clay minerals and iron oxides (imparting the reddish or brownish coloration to the clayey sequences). Materials underlying the site represent an enormous volume of potential adsorption sites for any trace metals which would be transported as a dissolved phase in ground water migrating through these areas. Furthermore, not only are adsorption sites found everywhere within the aquifer, but the aquifer itself represents an enormous source of trace metals by virtue of the minerals contained within the sequence.

EPA Response: The comment seems to say that there is a background presence of metals in the groundwater and at the same time there are sufficient adsorption sites that no metal can be present in the groundwater. There is potential for metals to migrate from the site. This will be further investigated through the filtered and unfiltered samples taken in the Design Phase and through the investigation for the Operable Unit 2.

165. Page 4-20 Paragraph 1: The report states that chemical analyses were performed on rock cores from boreholes and that these analyses indicated that only barium and chloride were readily leachable from rock. During bench testing by GeoServices, Ltd., soils present within the area were shown to represent a significant source of chromium, lead, and nickel when leached with a strongly acidic solution such as the solution in which the samples were preserved. Therefore, although the minerals are present in the materials which were cored by CCJM, their own analyses demonstrate that those minerals are immobile. Finally, trace metals are present both in the landfill leachate and in virgin soils within the same naturally occurring minerals and mineral phases which are present in the rocks underlying the site.

EPA Response: The EP Toxicity testing conducted on the core samples show that arsenic and barium may be leachable under some circumstances.

166. Page 4-21 Table 4-2: Chromium and lead were detected in the two cored intervals at maximum concentrations of 77.6 and 73.5 ppm respectively. These data are consistent with those reported by the State of Maryland for similar analyses. As was previously demonstrated, digestion of these samples as a consequence of the preservation process employed by CCJM causes anomalously high dissolved metals concentrations in aqueous samples when particulate matter is included in the samples which are analyzed.

EPA Response: The comment in noted. EPA proposed remedy does address the metals as they were detected at the Site and offsite in the RI. However, during the Design Phase, additional sampling of the monitoring wells will take place to substantiate the need for metal treatment and to aid in the design of the unit processes.

167. Page 4-22 Table 4-3: Table 4-3 is a summary of the EP Toxicity analyses of selected core intervals which indicates that chromium and lead were not present in the leachate. EP Toxicity analyses of materials deposited in the landfill by Alloy Rods showed similar results. Again, little difference exists between the behavior of materials placed in the landfill by Alloy Rods and naturally occurring materials which characterize the environment. There is no justification, therefore, to conclude that materials placed in the landfill by Alloy Rods represent any potential threat to human health or the environment. Such thinking would require one to conclude that similar threat is present throughout the region as a result of the chemical composition of the rocks through which groundwater flow is concentrated.

EPA Response: The RI/FS or proposed plan makes no conclusion concerning Alloy Rods involvement with this Site.

168. Section 4.6 Page 4-20 to 4-28: The entire section is a discussion of the results of a borehole geophysics survey conducted on monitoring wells drilled by CCJM. The discussion is largely academic and duplicates information concerning water bearing zones which should have been available from well logs from the geologist who logged the borings. Normally, water bearing zones are recognized and logged by the geologist present during well construction and are recognized by the appearance of additional water emanating from the hole, the physical characteristics of the cuttings produced during drilling, and other features.

EPA Response: The small quantity of water encountered in the deep boreholes and the size and extent of the fractures prevented the identification of all potential water bearing zones during the drilling. Borehole geophysics was performed to assess water bearing fracture zones and its use was supported by the communities in Pennsylvania and Maryland.

169. Page 4-29: The comparison of geophysical logs with core descriptions was based on the relationship between various geophysical factors to features observed during core examination. No new information was provided by the application of borehole geophysics and therefore, this application represents an unnecessary and extravagant expense.

EPA Response: The borehole geophysics which is normal protocol for Superfund provided a relatively inexpensive means of evaluating subsurface conditions in all of the boreholes. Borehole geophysics was performed to assess water bearing fracture zones and its use was supported by the communities in PA & MD.

170. Section 4.7 Hydrogeology: As a general comment to this section, CCJM concludes that most of the water occurs at depths generally less than 45 ft and is contained in the saturated saprolite and weathered schist. Additionally, CCJM concludes that porosity and hydraulic conductivity decrease significantly with depth and that little water is contained within the unweathered schist. Therefore, the ground water flow system emanating from Keystone Landfill is strongly controlled by topographic divides (both ridge crests and valley axes) which limits any recharge migration regardless of its chemical makeup.

EPA Response: Although the groundwater flow from the Keystone site is strongly controlled by topographic divide, it does not prevent recharge from occurring.

171. Page 4-53: An attempt is made to estimate groundwater velocity in the absence of any direct measurement by CCJM of porosity or hydraulic conductivity of any of the units present at the site. CCJM assumes that hydraulic conductivity ranges between 10^{-2} to 10^{3} gpd/ft^2 (a range of 5 orders of magnitude) and that porosity is 0.38 percent. Under these conditions, CCJM estimates that groundwater velocity ranges between 4.4×10^{-4} to 4.4 ft/day. This range of estimated velocity (between 2-inches and nearly a third of a mile/year) represents little more than a guess at groundwater velocity. Such an estimation of the critical hydraulic parameters upon which any risk assessment or subsequent remedial system design is based constitutes a blatant misapplication of scientific method and is completely inappropriate to remedial system design. This is especially onerous where the primary stated motivation of the design is to protect human health and the environment.

EPA Response: A detailed evaluation and determination of aquifer parameters was not planned at the Site and does not affect the evaluation of the site as presented. These parameters will be obtained, if necessary, during the remedial design phase.

172. Page 4-54 Paragraph 2: CCJM discuss the Buchart-Horn pumping test and concludes that the storage values reported by Buchart-Horn are low for unconfined aquifers. On the contrary, the storativity values reported by Buchart-Horn are typical for unconfined bedrock aquifer or where flow through fractures affects the numerical magnitude of the storativity value. In such situations, storativity is a

reflection of a degree to which observation wells are hydraulically connected to the pumping well, rather than reflecting the storage capacity of the aquifer.

EPA Response: No response needed.

173. Page 4-54 Paragraph 3: The CCJM study further summarizes the Buchart-Horn report stating that the flow regime of the pumping well was linear along strike rather than radial across strike. It is unclear what CCJM is attempting to indicate by this statement in that the flow system in the immediate vicinity of a single fracture is linear within a discrete distance from the fracture, and thereafter becomes radial. There is no relationship between flow system configuration and bedrock strike as indicated by this statement. Statements offered by CCJM in this and the preceding paragraph indicate an extremely limited understanding of the hydraulic system in the vicinity of a pumping well in fractured rock terrain. Furthermore, CCJM's demonstrated lack of understanding of fractured rock hydraulics is a direct precursor of problems with design of a groundwater capture system in such terrain.

EPA Response: The statement was meant to indicate that the aquifer response to the pumping test was reflective of fractured bedrock.

174. Page 4-154, Section 4.7.2.1 - RI Pumping Test: During the CCJM pumping test, only the pumping well and a single observation well displayed decreasing water levels due to pumping. All other wells showed a significant increase in water levels during the pumping test as a result of a rainfall event. If the rainfall event was the sole failing of the test, the test should have been rescheduled in that the characterization of the hydrogeologic regime was the stated reason for conducting the remedial investigation. Data is not presented in the CCJM report concerning the pumping rate which was employed at the pumping well nor were any calculations offered in data that was available. It is therefore difficult to assess what the actual cause of the pumping test failure was, although based on review of Buchart-Horn pumping test data results and upon GeoServices, Ltd. experience within the Wissahickon Formation, the observation well configuration relative to the discharge rate at the pumping well was probably too widely spaced to allow any significant drawdown results to occur in the observation wells as a result of pumping. Therefore, failure of the CCJM pumping test was based on an improper pumping test design as opposed to an untimely rainfall event.

EPA Response: EPA has noted the failure of the pump test in

the RI due to precipitation. To avoid additional costs, Buchart-Horn pump test data was reviewed and found sufficient for the needs of the investigation.

175. Page 4-56 Paragraph 2: CCJM postulates that a hydraulic connection exists between well K-1 and Mundorf Spring on the basis of topographic and potentiometric relations. The placement of this conjecture in the section on pumping test analysis results is curious in that the statement is not supported by any quantitative measurements developed by CCJM, especially not by the pumping test completed by CCJM. Therefore, there is no basis for this statement.

EPA Response: The figure does in fact indicate the connection between K1 and Mundorf Spring. The spring is in the same valley as K1, is downslope from K1, and is downgradient from K1.

The pump test was originally designed to provide quantitative information regarding the connection between the Spring and groundwater.

176. Page 4-62: CCJM states that no signs of stressed vegetation, damaged crops, or extreme environmental concerns were observed during a site visit to the site and surrounding area. This is not surprising and is consistent with the absence of any observed release of contaminants from the landfill.

EPA Response: The fact that no environmental damage to flora or fauna was noted during a site visit does not preclude a possibility of groundwater contamination. Additionally VOC contamination was noted in the on-site drinking water well which indicates a release.

177. Page 4-62 Paragraph 4: CCJM reports that the streams are less than three ft wide and only a few inches deep. Therefore, risks associated with swimming in streams which drain the area, dermal contact with stream water, and ingestion of stream water appear non-existent.

EPA Response: The dermal contact risk from exposure to surface water was noted in the Risk Assessment as being 2×10^{-8}.

178. Page 4-65 Paragraph 1: CCJM notes that stream sediment contains a significant portion of clay sized particles with relatively strong exchange capacities. The sediments also contain high contents of total organic carbon. Again, any aqueous phased metals present in stream water would be quickly and irreversibly adsorbed onto stream sediments, if such materials were present.

EPA Response: Although metals may soak onto fine particles, the rate of sorption depends upon other important water quality criteria. The resampling of surface water and sediment that will be conducted in the future should clarify this issue.

179. Page 5-9 Table 5-1 Entitled "Compound/Analytes Detected in On Site Soil Samples": CCJM indicates that the range of chromium on site soil samples fell between 13.4 and 22.6 ppb. Lead ranged between 9.2 and 80 ppb and nickel ranged between 6.1 and 29.1 ppb. These concentrations should be evaluated in the context of naturally occurring metals levels in off-site soils and bedrock as reported by both CCJM, and the University of Maryland. In all cases, trace metals concentrations in on- site soils were at least an order of magnitude less than those in background samples. Therefore, trace metals in site soils can hardly be considered to represent a release or to constitute any threat to the human health or environment. Furthermore, it is noted that these samples were collected (or include samples collected) in the spray irrigation area in which landfill leachate was directly discharged in an attempt to control VOCs. Therefore, these soils represent worst case circumstances relative to metals contamination.

EPA Response: Additional sampling of the groundwater during the Design Phase will obtain both filtered and unfiltered samples. If the results determines that metals are naturally occurring, the treatment system design could change to treat only VOCs.

180. Page 5-12 Paragraph 5: The report states that all Toxic Analyte List (TAL) metals except cadmium, silver, and cyanide were detected in onsite soil samples. The report correctly notes that all metals detected on site were also detected in core samples. However, the report states that metals were detected in similar concentration ranges in core samples, which is inaccurate. Metals present in core samples were measured at the ppm range while metals present in soils were measured at the ppb range. Therefore, metal concentrations in the cores with three orders of magnitude (1000 times) higher than those in on site soils. (sic) CCJM's failure to distinguish between ppm and ppb is symptomatic of the carelessness which characterizes the entire remedial investigation.

EPA Response: The report should have noted that the detected metals in the cores were in ppm; the higher detection was for qualitative information only.

181. Page 5-13 Paragraph 2: Concentration ranges for offsite samples are noted to be similar to those for onsite samples. Therefore, there is no difference between metals .

concentrations in soils onsite or offsite indicating that no release has occurred to soils at either location.

EPA Response: There does appear to be similar concentration in the onsite and offsite soils. However, it is evident that a release has occurred to the groundwater. The most probable source would be the landfilled wastes, not the soils surrounding the landfill.

182. Page 5-14 Paragraph 4: CCJM notes that surface water samples were taken from locations with clear flowing water. The water depths were between 6 and 12 inches. As has been previously described, stream sediment samples characteristically contain a significant portion of clay as well as other fine grained materials. Therefore, even though the water may have appeared clear during sampling, the presence of the flowing water indicates that sufficient entrainment velocity was present to suspend fine grained particles in the stream water sample. Additionally, in that these samples were unfiltered, it is obvious that the sample contained particulate matter. As has been previously described, particulate matter, especially chlorite and other clay minerals which are platy in nature and easily suspended, contain significant concentrations of trace metals. Assuming that the stream samples were preserved in a solution of pH 2, it is only natural that metals concentrations would appear in laboratory analyses.

EPA Response: The proposed remedy does not provide for remediation of surface waters and sediments. EPA will be resampling the surface water (filtered & unfiltered) and sediment in the future because of these concerns and to clarify the issue.

183. Page 5-18 Section 5.4.3: The report states that chromium, copper, and lead were all detected at sample location SW-16. In the case of lead at sample locations SW-11 and SW-15 lead concentrations were less than 20 ppb. CCJM states that these concentrations of these metals were above the fresh water chronic water quality criteria (AWQC). Additionally, mercury was detected at several sample locations and zinc was also detected at SW-I6 at nearly 68 ppb. The report concludes that the pattern of metals occurrence indicates that the source is not site related. Therefore, the occurrence of metals as a result of laboratory analyses and their exceeding the AWQC is completely immaterial to an evaluation of a release of contaminants to surface waters in the vicinity of the site. We are gratified to find that, in at least one case, CCJM has correctly recognized that minor metals concentrations in a sampling media are not site related. We do note, however, that CCJM felt it necessary to qualify this statement with the modifiers "not likely" (5-22) and "probably" (5-23). The word "clearly" should be substituted for both modifiers.

EPA Response: The AWQC was exceeded at the site and is of concern to EPA. A second Operable Unit for offsite contamination will further investigate this concern. It has not been totally ruled out that the metals are coming from Keystone.

184. Page 5-23 Paragraph 4: CCJM correctly states that Keystone wells were constructed as open boreholes with 20 ft of surficial slotted casing. Therefore, wells K-1 through K-8 provide a direct communication between unconsolidated fine grained landfill materials, soils, and the well bore. Vigorous pumping of the well in order to purge the well bore prior to sample collection could result in entrainment of a significant volume of particulate matter. Again, preservation in an acidic media results in generation of dissolved phase metals which are not present within the groundwater regime.

EPA Response: The wells were not vigorously pumped during purging, but at a slow rate. It is standard EPA practice to purge wells at a slower rate than at which they are developed in order to avoid turbid samples.

185. Pages 5-24 and 5-29; Tables 5-5 and 5-6: These tables summarize analyses detected in on-site and off-site monitor wells respectively. We note that the magnitude of maximum metals concentration is similar in both settings indicating little difference between sample populations. However, the presentation of the range of all measured concentrations overshadows the anomalous nature of metals concentration maxima. In all cases, the concentration maxima listed by CCJM represent anomalous and irreproducable (sic) events. These events are related to inclusion of particulate matter in samples extracted from the wells and the preservation protocol employed by CCJM. Therefore, any conclusions based on these results must be regarded with extreme caution and in context of the artificial nature of the analytical results.

EPA Response: The data collected in the RI is sufficient on which to base the selection of the remedy. EPA's resampling activities in the future will include both filtered and unfiltered samples. This data will be used to determine the design.

186. Page 5-27; Figure 5.5: Chromium concentrations in excess of the MCL are indicated at wells MW-AS and well K-5. Well K-5 is a well from which the leachate residuum sample was collected. Because of the method of casing, the well induces fine grained soil materials into the sample. This well contains an abundance of particulate matter when pumped. Additionally, the low yield of the well results in cavitation of the pump during the course of sample·

collection further leading to introduction of a high volume of particulate matter. Well MW-AS was constructed during the course of the CCJM study.

EPA Response: Chromium was detected above MCLs in MW-AS. This well was properly constructed and was properly pumped to prevent cavitation of the pump.

187. As noted by the State of Maryland report, and from the statistical analyses presented in this report, newly constructed wells typically contain significant volumes of particulate matter as a result of incomplete well development following construction. Unfiltered samples reflect the inclusion of particulate matter in the sample during laboratory analysis. Finally, mercury is indicated at well K-8 at a concentration of 3 ppb. Mercury concentrations in rain water are also within this order of magnitude. In all three cases, the data are not reproducible which would be the case if a plume containing dissolved metals was present at the landfill. These data further demonstrate that no observed release of metals from the landfill has occurred.

EPA Response: At this time, there is no data to support that the release of metal is not from the landfill. The data collected is sufficient on which to base the selected remedy. Future sampling activities will include both filtered and unfiltered samples and will be used in the Remedial Design.

188. Page 5-31 Paragraph 5: The report states that chromium was the only metal that exceeds the federal MCL and was collected at well K-5. We again reference previous comments regarding the volume of particulate matter present in well K-5 and the lack of reproducibility of any analytical results from that location. A filtered sample from well K-5 collected at the time of leachate residuum collection yielded a concentration of chromium below detection limits.

EPA Response: This comment should have said chromium was the only metal that exceeds MCLs and was collected at K5 and MW-AS. See response to Comment No. 186.

189. Page 5-32 Paragraph 1: CCJM correctly acknowledged that metals were randomly distributed in off-site areas. This is an indication that no metals bearing plume is emanating from the landfill. High concentrations represent point source anomalies. These specific metals maxima have been identified with statistical outliers resulting from inclusion of particulate matter in water samples.

EPA Response: Please refer to Comment No. 187.

190. Page 5-32 Paragraph 2: The occurrence of mercury, chromium, and copper at Keystone wells K-8 and K-5 has been previously referenced. These concentrations are due to the fact that samples were not filtered prior to collection and were preserved at a pH of 2. Additionally, observed mercury levels were within the same range of mercury measured in normal rainfall.

EPA Response: Please refer to Comment No. 187. The level of mercury detected exceeded the MCL and is of concern to EPA.

191. Page 5-33 Paragraph 3: The CCJM report concludes that metal detected in off-site monitor wells are random and apparently not site related. The report further concludes that the relative abundance of metals in shallow monitor wells may result from natural weathering processes. We agree with this conclusion but again would omit any indefinite modifiers in that the mineralogical analyses and chemical analyses previously described in this report clearly indicate that metals originate from naturally occurring materials in the Keystone environment or exist as a solid phase due to adsorption from solution. In this case, no difference exists between particles containing metals which originate from adsorption or metals that originate from natural processes.

EPA Response: Please refer to Comment No. 187.

192. Page 5-39 Paragraph 2: CCJM states that chromium, copper, and zinc were detected in the RW-1 sample. Although RW-1 is a residential well, it is completed near the geographic center of the landfill and therefore, can not be considered as representative of potential residential well conditions. Any risk assessment based on the chemistry of well RW-1 should be considered as a risk assessment of exposure to landfill leachate. The well is operated by the owner of the landfill. Chromium concentration was 3 ppb while copper and zinc were 26 and 3000 respectively. Considering the location of the well, metals levels are extremely low, supporting the non-existent mobility of chromium demonstrated in previous sections of this report. CCJM notes that copper and zinc were detected in all residential well samples. Additionally, the report had previously stated that off-site occurrence of metals was random and not site related. Therefore, it is interpreted that the presence of copper and zinc in RW-1 and in other off site residential wells reflects the presence copper and zinc plumbing fixtures rather than copper and zinc in ground water. Finally, the inclusion of well RW-1 as a residential well is questioned in that it is similar to the monitoring wells located at the landfill and is completed in the heart of the area for which leachate generation is assumed.

EPA Response: RW1 was constructed for residential purposes and is used for residential purposes. As the comment states, results indicate that organics and inorganics can and do enter the groundwater.

193. Page 5-40 Paragraph 5: CCJM states that no indication was found of metal contamination emanating from the Keystone site in the nearby residential wells. This further demonstrates that no release of contaminants has been observed under any circumstances or by any investigator. Therefore, it is clear that no direct remedial action for metals is necessary.

EPA Response: The remedial action for metals is based on the potential for inorganics to migrate offsite and the uncertainty of the source of offsite inorganic contamination. Additional sampling during the Design Phase will substantiate the need for the inorganic treatment. The second Operable Unit will address the offsite contamination.

194. Page 6-5 Paragraph 7: CCJM lists five potential contaminant transport routes. Because of the physical and chemical nature of metals behavior in the environment, none of the transport routes postulated by CCJM are realistic. Each one is examined below:

- CCJM: "Leaching from contaminated landfill wastes to the underlying ground water." As has been demonstrated during both mineralogical analyses and bench testing, metals present within the landfill environment are strongly bound to hydrous iron oxide particles or to mineral particles which are present within the leachate solution. Therefore, metals can only migrate adsorbed onto a particulate phase. Metal concentrations present are quickly adsorbed on the particles of the landfill leachate. However, in the absence of these particles, metals would be quickly removed from solution by adsorption onto iron oxides and clay minerals which have been documented to line fractures through which bedrock flow is concentrated. Therefore, no route exists between landfill leachate and the ground water regime.

- CCJM: "Volatilization of contaminants from the landfill waste to the atmosphere." Metals are not volatile and therefore will not, under any conditions, volatilize to the atmosphere.

- CCJM: "Discharge from ground water into nearby surface water." Again, discharge transport by ground water could only be as an adsorbed phase on particulate matter because of the volume of aquifer between the landfill and any surface water body to which discharge would occur. Any

particulate matter present within the ground water regime will be filtered out by the aquifer. Additionally, the extremely slow rate of ground water migration is insufficient to entrain particulate matter. Finally, whereas fracture planes are lined with clay minerals and hydrous iron oxides as a result of weathering along those surfaces, any metals present in solution will be directly adsorbed by those materials limiting migration in the groundwater regime.

- CCJM: "Surface water/sediment interaction." As opposed to a leaching from sediments to surface water the reverse process would occur even if metals were present as a dissolved phase in surface water. This phenomenon is caused by the presence of organic materials, clays, and iron oxides within the stream sediments. These materials have an extremely strong affinity for trace metal adsorption and attenuation.

- CCJM: "Discharge from groundwater to surface soil." It is assumed that CCJM is referencing volatilization of organic compounds from ground water to overlying surface soils. However, as previously stated, metals are not volatile. CCJM may also be referencing discharge from ground water to soils surrounding springs or seeps.

  However, we offer the same comments as referenced above. No known mechanism could lead to a discharge of metals from groundwater to surficial soils.

EPA Response: In response to the bulleted item above: No. 1 - Metal particles in the landfill leachate will mix with the ground; No. 2 - Organic contaminants do volatilize to the atmosphere; No. 3 - The discharge of metals to the surface water may be limited but is possible and No. 4 - The surface water metals would be adsorbed to the sediments and No. 5 - This could also refer to contaminated groundwater contacting clean soils in the vadose zone.

195. Page 6-6 Paragraph 4: CCJM states that clays tend to absorb anions and that metals such as chromium and arsenic tend to be mobile in the environment. As demonstrated in our evaluation of mineralogy and chemical behavior of metals, hydrous iron oxides bear a strong affinity for anions such as chromium or arsenic and therefore, results in the adsorption in these compounds from solution. Finally, it has been demonstrated that metals are immobile in the Keystone landfill site environment as well as in the surrounding ground water regime.

EPA Response: Please refer to Comment No. 187.

196. Page 6-8 Paragraphs 1 and 43: CCJM states that chromium was detected in monitor wells and surface water samples, above federal MCLs and AWQC. Lead was detected in all media sampled and was above AWQC in three surface water samples. We question these statements in that CCJM themselves acknowledged that off-site occurrence in metals in off-site media is random and not site related even though AWQC is locally exceeded. Finally, we have demonstrated in several different ways that chromium maxima are limited to monitor wells improperly completed in fine-grained sediments and directly open to the landfill (Keystone monitoring wells) or in recently constructed wells. Again, it has been conclusively demonstrated that no such chromium release occurred.

EPA Response: EPA's monitoring wells were not improperly completed in fine grained sediments. The statement only notes where detection exceeded standards which are of concern to EPA. It does not acknowledge the source of the metals. However, chromium was detected in onsite wells upgradient from the offsite well detection location. Although a concern, it cannot be directly attributed to a source. The second Operable Unit will address the offsite contamination concern.

197. Page 6-11 Paragraph 5: CCJM states that there are indications that contaminants from the landfill are migrating into surface water as a result of groundwater discharge or surface runoff. As previously stated and conclusively demonstrated, this has never been observed in any media, including surface water in the vicinity of the site, or as surface runoff.

EPA Response: Please refer to Comments No. 158 and 178.

198. Page 6-12 Paragraph 5: CCJM states that contaminants adsorb onto and desorb from sediments in springs and tributary channels. Again, no release of metals from surface water or stream sediments has been observed nor is there any likelihood of any such a release as previously described.

EPA Response: Please refer to Comments No. 158 and 178.

CITIZENS COMMENTS

199. Citizens are entitled to an equal voice with EPA, in developing and implementing a cleanup program

EPA Response: In accordance with Sections 113 and 117 of CERCLA, 42 U.S.C.§§ 9613 and 9617 EPA allows the citizens an opportunity to participate in the developing and implantation of a cleanup program during the required public

comments periods for the RI/FS and the Proposed Plan. In addition, EPA will also provide the opportunity for the public to comment on the Remedial Design.

200. Any plan, in order to be acceptable must include offsite cleanup.

EPA Response: At this time, the RI date did not indicate offsite contamination that presented a significant health risk to human health and the environment. The current proposal allow the contaminants offsite to naturally be diluted and degrade while preventing any further contamination through the use of extraction wells. An additional study is being planned by EPA to further investigate the offsite contamination in the second Operable Unit and the current proposal is considered an interim remedy as opposed to a final remedy.

203. Citizens feel a health survey should be done of the community.

EPA Response: EPA plans to pursue this request through the Agency for Toxic Substances and Disease Registry.

204. Can a true line be drawn around 35 acres and say the real onsite contamination is restricted within these lines?

EPA Response: The answer is no. The site has been defined as onsite and offsite for the effort of the RI.

205. Why weren't all the wells in a 3 mile radius tested?

EPA Response: Although the population count for the Hazard Ranking Score was calculated for a three mile radius of the Site, this is not meant to imply that all people within this radius will be affected by the site. In any investigation, the residents closest to the site are sampled with a gradual widening radius of sampling until no contaminants are detected. The purpose is to determine if the residents are being affected by the site, not to determine necessarily if they have good water quality. Many contaminants which may be detected in this three mile radius may be from another source which is not purpose of this investigation.

206. The Risk Assessment was an error, how can you have an accurate assessment if the data is erroneous?
EPA RESPONSE: The data used in the Risk Assessment was not erroneous. It was the technical methodology which required modifications. These modifications did not change the total risk at the site from the 10^{-4} risk range and therefore did not change the remedial decision requiring a response action.

207. The RI failed to meet its primary objective regarding

offsite contamination and therefore, the development of a remedial action cannot forth go unless it is an interim action.

EPA Response: The RI did meet its primary objective to determine if contamination is migrating offsite. Adequate information was obtained to determine a need for a response to stop the migration of contaminated groundwater. The proposed plan could be considered an interim action as a second operable unit will study further offsite contamination concerns.

208. Numerous comments were received concerning corrections to statement made in the RI concerning site history, population, size of landfill, and leachate disposal should be placed in the public record.

EPA RESPONSES: All comments will be placed in the Administrative Record in the Hanover Public Library.

209. Soil sampling did not adequately evaluate the area north and northwest of Clouser Rd and west between locations SL-12 and SL-12 and Sl-17.

EPA Response: Previous EPA investigation revealed contaminant migrating from east and south of the Site so more samples were taken on these sides. However, adequate sampling was conducted of the north and northwest areas to characterize them. Additionally, the Operable Unit 2 will further investigate this area.

210. Does the presence of contaminants (BNAs) in offsite Residential wells indicate hydrogeologic communication between the landfill and the residential wells? Where do the BNAs come from?

EPA Response: No, the presence of BNA in the residential wells do not indicate hydrogeologic communication between the residential wells and the landfill. Only 3 BNAs were detected in 1 onsite well. The source of BNAs in the residential wells is unknown.

211 The extent of the off groundwater contamination has not been determined.

EPA Response: A second operable unit will address the offsite groundwater contamination.

212. Will EPA honor the request to do sampling in a one mile radius as soon as possible?

EPA Response: EPA plans to do additional residential well sampling as soon as possible. Members of the community have been asked to assist in the development of the sampling.

determination has been made on the radius of the sampling. Surface water and sediments will take place during the Design Phase.

213. Identification of contaminant pathways and receptors has not been shown.

EPA Response: Both personnel from EPA and EPA's contractor ICF were involved with the environmental assessment including a sensitive receptor survey for this site. Contaminant pathways and potential receptors were identified. Data from the RI revealed little impact to the terrestrial plants and/or wildlife near the Site.

214. How can the RI identify pathways and receptors if deeper residential wells have not been investigated?

EPA Response: The additional residential sampling will take into consideration this comment concerning sampling the deeper residential wells. This will also be considered in the investigation of second operable unit for offsite groundwater contamination.

215. Why didn't the RI consider the 2 area proposed surface impoundment?

EPA Response: The focus of the RI was to investigate contamination from the Keystone Site. The surface impoundments would be outside the scope of work and inappropriate for this investigation.

216. Will EPA require Keystone to give us water.

EPA Response: At this time, there has not been determined a need to supply residents with water. Should it be determined that such need exists, EPA will consider its enforcement options in obtaining a PRP response or would supply the water or supply the water through federal action.

217. Will data gap in the nature and extent of contamination be filled in by a continued RI?

EPA Response: Additional sampling will take place in the predesign and design phase.

218. Groundwater sampling is not sufficient to monitor offsite flow and fractures.

EPA Response: The purpose of groundwater sampling was to assess contamination in discrete fractured intervals. Sampling does not monitor flow; water level measurements taken during the RI determine groundwater flow. Additionally the purpose of sampling is not to monitor fractures; EPA's wells were carefully placed and drilled i

fractured zones so that proper samples could be obtained.

219. How can the nature of subsurface geologic structure be complete considering data gaps?

EPA Response: The data gaps noted during the RI were for groundwater sampling only. Surface geophysics, using borehole geophysics and packer testing of monitor wells was much more than sufficient for characterizing the geologic structure at this site.

220. Why weren't all of the wells in a 3-mile radius tested? The onsite area should be enlarged to include the 2 1/2 to 3-mile radius around the site.

EPA Response: The 3 mile radius population count around a Superfund site is used by the EPA in the Hazard Ranking System (HRS), as a screening tool for a comparison of population of all sites on the National Priorities List (NPL) for the purpose of prioritization. However, the "3-mile radius" does not mean that all of the population within this distance is affected by the site. The purpose of the Remedial Investigation (RI) is to identify the extent of contamination and potentially affected receptors. For most Superfund sites across the county receptors affected by ground-water contamination level less than 2 miles from a site.

221. Why is there not concern over each new residential well being drilled?

EPA Response: If the local population is concerned about contamination in new domestic well the local government should require either testing or a moratorium period of residential well drilling the area. It is not in EPA's jurisdiction to prevent the drilling of new wells. However, the EPA has worked with other counties in Pennsylvania (e.g. Chester County) in this issue and would be willing to do the same with the appropriate local governments in the vicinity of the Keystone site.

222. If Mr. Noel's well at 600 feet is the most contaminated, should the test wells be considerably deeper?

EPA Response: The residential wells in this area are drilled very deep in order to obtain water from many fracture zones as well as to provide a means for storage of groundwater in the well during periods of non use. Thus, the contamination found in Mr. Noel's well is not necessarily from fractures at 600 feet, but from fractures shallower in the aquifer. The purpose of the monitor well drilled by the EPA was to assess which discrete fracture zones were contaminated EPA's monitor wells were drilled to approximately 300 feet to assess the depth of contamination:

it is highly improbable for contamination to have migrated in fractured intervals greater than 300 feet all across the area without leaving a trace in EPA's deep offsite monitor wells.

223. Can you guarantee the proposal will correct the problem in writing?

EPA Response: All of EPA's decisions are documented and available to the public for review. EPA's proposed plan has noted the time frame expected for clean-up as well as contingency plans if problems arise with the remedy.

224. How do you determine community acceptance?

EPA Response: In accordance with Sections 113 and 117 of CERCLA, information from EPA's public meeting as well as comments sent in to EPA concerning the RI/FS and Proposed Plan are carefully evaluated to determine community acceptance. Opinions of elected officials and community groups are also carefully evaluated.

RISK ASSESSMENT COMMENTS

225. Page 7-1 Paragraph 1: CCJM states that risk assessments are performed to evaluate the impact of the no action remedial alternative and to assess if actual or threatened releases pose risks to individuals under current or future exposure circumstances. As has been demonstrated, no actual release of hazardous substances from the landfill has been observed to date, even though monitoring of ground water and other site media has been conducted for nearly a decade. At the present time, the landfill is inactive indicating that no new mechanisms or contaminants will be introduced into the landfill. Therefore, in that no release has been observed during the period when the landfill was active, or in the ensuing time during which monitoring has been conducted, there is no reason to believe that such a release of metals could occur. Additionally, CCJM has failed to identify plausible routes of metals migration from the landfill or to cite any plausible mechanism of contaminant release. As stated by CCJM, the purposes for conducting a risk assessment are not present at Keystone Landfill. Therefore, such an assessment, if motivated by these criteria is unwarranted.

EPA Response: The sampling data collected at and near the landfill during the RI attest to the fact that a release has occurred and there is a threat of future release from the Site.

226. Page 7-1 Paragraph 6: CCJM states that data used in the

evaluation were limited to those collected by CCJM. No reasons were given for excluding the hundreds of chemical analyses collected over previous investigations. The limitation of analytical measurements to a single sampling event eliminates the possibility of evaluating the data for reproducibility, significance, or in the context of the temporal framework. As has been demonstrated, evaluation of specific concentration maxima within the temporal and spatial framework of the existing database is critical in developing a reasonably accurate understanding of metals behavior in the environment and the effects of sample collection procedures and preservation protocol on reported values. Additionally, the omission of previously collected data results in an order of magnitude decrease in the number of values included in the sample population. This prohibits a statistically significant evaluation of background levels or the development of statistical parameters such as concentration percentile values at specific locations or within specific populations.

EPA Response: The chemical data to be used for risk assessment have to meet a certain data quality level per EPA's guidance; the samples should be analyzed by a EPA certified laboratory and the data should also be validated. The data collected by CCJM met this requirement. The protocols have generally not been followed for data previously collected making them unusable for the risk assessment.

227. Page 7-3 Paragraph 3: Background concentration levels of inorganic contaminants were developed (according to CCJM) by averaging naturally occurring levels. These average background concentration levels to identify contaminants as those of concern. In all cases, regardless of media, background samples were limited to between two and five samples. Very little statistical significance can be ascribed to such a small sample population.

EPA Response: Although the sample set used to define background concentrations was not large it still has utility for screening out chemicals present at naturally occurring concentrations.

228. Page 7-4 Paragraph 2: CCJM states that inorganic analytes known to be required human trace or macronutrients were not included in the selection of contaminants of concern. However, chromium, which is an essential human nutrient, was included.

EPA Response: Although chromium is an essential nutrient it also exhibits high toxicity and since acceptable dietary levels are not known it was conservatively retained for evaluation in the risk assessment. This is in accordance with EPA guidance cited on the Risk Assessment on page 5-

23.(EPA 1989 p. 5-23).

229. Page 7-5 Paragraph 2: Two of the three samples identified by CCJM as background samples are referenced as minor hot spots by CCJM. We fail to understand how a background sample could also represent a hot spot.

EPA Response: Background sampling stations were chosen on site specific geographical and hydrogeological characteristics at each sampling station; stations "least likely to be affected by the site" were chosen. This does not mean the station will be free from contaminants or that the contaminants are necessarily site related. Accordingly, the presence of organic chemicals in background samples was not considered sufficient reason to eliminate those detected at the site from evaluation in the quantitative risk assessment, since their presence could be the result of site contaminants. Moreover, use of data from the two background sampling stations (SL-20 and SL-21) has resulted in nine metals being eliminated from consideration in the risk assessment (Table 7-1).

230. Pages 7-6 to 7-12: Applying an erroneous procedure for identification of contaminants of concern, CCJM identifies some 15 metals as contaminants of concern for the Keystone site even though most have never been observed in excess of the MCL for ground water. In fact, most of the metals identified as contaminants of concern by CCJM have not been previously mentioned in the RI (outside of listing of analytes).

EPA Response: The designation of a chemical as a contaminant of concern does not imply that it exceeds an MCL or other indicators of risk. Such measures of risk are not to be used in selecting chemicals of concern according to EPA in their risk assessment guidance (EPA 1989); chemicals of concern are those chemicals that are selected for evaluation in the risk assessment for their potential to cause risk at significant levels. In most risk assessments only a few chemicals of concern contribute significantly to risk at a site although their presence is indicative of contamination.

231. Page 7-25 Section 7.3: Section 7.3 is a discussion of a selection of exposure pathways in identification of populations at risk. It is important to recognize in reviewing this entire section that, where metals have been observed at elevated levels, they have been present in either naturally occurring solid phases or adsorbed onto hydrous iron oxides, present as a solid phase. Therefore, exposure pathways must include an avenue by which contact is established with turbid water. Metals concentration in naturally occurring minerals outside the influence of the

site are similar to those present in particulate matter suspended in wells completed at the site (for example well K-5). Exposure to such compounds simply constitutes exposure to muddy turbid water. This is particularly important when considering any of the routes involved including intake of groundwater or surface water by ingestion; showering or swimming in ground water or surface water; inhalation of particles; or intake as food. Because most humans are generally wary of turbid water, exposure to such discolored or turbid water in any of the aforementioned circumstances is extremely unlikely. Furthermore, since metals concentration in solid phases present in landfill leachate are similar to those present in naturally occurring materials, exposure to landfill leachate represents no more of a threat than does exposure to naturally occurring turbid water, although most people would probably avoid both.

EPA Response: The concern at the Site is from the presence of organic contamination in the groundwater. The orgnaic contamination in the groundwater results in a 5×10^{-4} risk from the site.

232. Page 7-28: CCJM states that the most likely potential exposed population includes the family residing on site, Keystone site employees, trespassers on site, remedial workers, and nearby residents. Exposure to the family residing on site and Keystone site employees presumably is via drinking of water generated from well RW-1 which is completed in the landfill. Although common sense should preclude use of such a well as a drinking water source, a more than $10 million remedial alternative is hardly justified in order to renovate well RW-1. Additionally, such an expenditure is clearly not warranted for the sake of keeping Keystone Sanitation Company in business or to protect the health of trespassers on site, beyond issuing warnings, fencing the sites, and taking other precautionary measures.

Exposure of a trespasser on the site to ground water is extremely unlikely in that monitoring wells are locked. No power is supplied to pumps in the wells and access is otherwise not provided to the site water regime. Furthermore, site soils are not contaminated with metals (as documented by CCJM and other studies) and, therefore, dermal contact with soils by site trespassers is also unlikely. This unlikelihood is further strengthened by the fact that the sites is completely covered by grass and bare soils are not exposed. Finally, whereas no release of contaminated ground water is likely, nor has such a release been observed, no route exists between the site and residences surrounding the site. Therefore, exposure to off site is simply not possible. Even if such exposure was possible, monitoring and point source treatment could be employed to limit such exposure.

EPA Response: The PRP comments that "Exposure of a trespasser on the site to groundwater is extremely unlikely in that monitoring wells are locked...,". The risk assessment did not indicate that groundwater is a potential exposure route for trespassers. The total carcinogenic risk for site trespassers is estimated to be $7x10^{-7}$ by exposure to the surface soil and surface water only.

This comment concerning risks associated with the off-site residents has been dealt with in another response (see Responses to Wright Associates, Inc.). In short, the off-site residents poses essentially the same risks as that for the site trespassers, i.e., very minimal.

233. Section 7.5-Risk Characterization: The risk assessment was performed to evaluate the risk to on-site adults(Page 7-43 Paragraph 8). Additionally, although no on-site ground water is consumed by residents, on-site ground water samples were used in the risk assessment when calculating ground water exposure concentrations. It should, therefore, be remembered that the risk assessment is based on direct consumption of landfill leachate.

EPA Response: The risk assessment is not based on direct consumption of landfill leachate. It is based upon the consumption of the contaminated groundwater due to leaching from the landfill.

234. Pages 7-46 to 7-50: These subsections are presented by CCJM to discuss risks posed by exposure to soils, sediments, and surface water. However, no release of metals to any of these media, either on-site or off-site, has been observed. The identification of risks through these routes indicates the misapplication of the risk assessment process by CCJM.

EPA Response: As summarized in the Risk Assessment Report (Table 7-15), groundwater contributed 99.86% of cancer risk. The impact of soil, sediment, and surface water was minimal.

235. Page 7-52: This discussion is presented to estimate the risks due to inhalation during showering with contaminated ground water. This section must be taken into context that the ground water in question is landfill leachate and that risks presented in this section refer to showering in landfill leachate for 30 years for adults and 5 years for children under 6. Such an assessment is clearly not reasonable in that showering in landfill leachate is outside of the realm of conceivable possibilities.

EPA Response: As it has been mentioned, this baseline risks assessment was performed in accordance with EPA guidance (EPA 1989). And it should be stated again that groundwater but not leachate was assessed (see Comment 233).

236. Page 7-53: Similarly, an evaluation is presented for ingestion of contaminated ground water (drinking landfill leachate) which is based on consumption of two liters of landfill leachate every day for 30 years. It is difficult to imagine a circumstance where an individual would drink two liters of landfill leachate and happily shower in landfill leachate for a 30 year period.

EPA Response: Please refer to Comment No. 233.

237. Page 7-55: The quantitative risk characterizations identify various metals as posing risks to human health. It must be remembered that risks are based on showering and consuming liberal quantities of landfill leachate over a 30 year period. That such an estimate is based on an almost comical circumstance, reflects failure by CCJM to integrate analytical measurements and other technical data involving potential exposure routes to yield a reasonable evaluation of the risks posed by actual site conditions. The process of risk characterization employed by CCJM involves a progressive and consistent distancing of the assessment from reality by subsequent layers of erroneous assumptions. Under these circumstances, the entire risk assessment must be regarded as suspect.

EPA Response: Please refer to Comment No. 233.

238. Page 7-77 - Site Trespassers; CCJM indicates that adult trespassers could be exposed to inhalation, ingestion, or dermal contact with surface soil and surface water. First, there is no surface water at the site: secondly, it is likely that should such surface water be present it is unlikely an adult trespasser would choose to swim in it. Finally, there is no path between inhalation or ingestion of soils by an accidental process. Again, the circumstances cited by CCJM are, at best, ludicrous.

EPA Response: Risks associated with site trespassers are minimal (see Comment No. 232).

239. Page 7-92 Table 7-26: Metals are identified as chemicals of concern in the surface soil, surface water, and sediment environments although no elevated concentrations of any of the metals cited has been measured in any case in any of the media cited by CCJM. Identification of these metals as chemicals of concern defies reality and indicates the reckless application of the risk assessment process by CCJM.

EPA Response: Again, surface soil, surface water, and sediment are not major media of concern. They only presented a total of 0.14% of cancer risk of the entire Site

240. Page 7-1; The term "qualifiers" in the last sentence should be defined. Which qualifiers were carried through the data evaluation process?

EPA Response: Qualifiers carried through the data evaluation process were identified in the Risk Assessment Report.

241. Page 7-3; Background levels of contaminants need to be explained in greater detail. Where do the background samples come from and how were they compared to site samples?

EPA Response: Background stations and samples were discussed in great detail throughout this RI report. Also see other responses.

242. Page 7-4; The terms "on-site and affected by the site" and "background" are confusing. Are the background samples off site? If not, are they not also considered "on-site or affected by the site?"

EPA Response: Background samples are considered to be offsite.

243. Background samples are SL-19, SL-20, and SL-21. However, in the third paragraph from the bottom, "other minor hot spots are represented by ... SL-20 and SL-21 ..." How can the same samples be background and minor hot spots simultaneously?

EPA Response: Background sampling stations were chosen based on site specific geographical and hydrogeological characteristics at each sampling station; stations "least likely to be affected by the site" were chosen. This does not mean the station will free from contamination or the contaminants are site related. Accordingly, the presence of organic chemicals in background samples was not considered sufficient reason to eliminate those detected at the site from evaluation in the quantitative risk assessment, since their presence could be the result of site contaminants. Moreover, use of data from the two background sampling stations (SL-20 and SL-21) has resulted in nine metals being eliminated from consideration in the risk assessment (Table 7-1).How were the data utilized? Were surface samples and deep (12 inches to 18 inches) averaged together?

EPA Response: All surface soil samples were averaged together.

244. Page 7-6; Frequency of detection should be define. What percentage is "frequency?"

EPA Response: Frequency of detection is the number of detects versus the total number of samples for that media.

245. Page 7-7; The brief discussion of surface water analyses is confusing and should be elaborated. The level of detail in this discussion is much less than that for the soil samples, possibly contributing to the confusion.

EPA Response: Surface water analyses were discussed in great detail in the previous RI sections.

246. Page 7-9; Were the concentrations of methylene chloride and acetone 10 times greater than that detected in the blanks? In addition, Figure 3-1 should be Figure 3-2.

EPA Response: Yes (see Appendix).

247. Page 7-7; Figure 3-4 should be Figure 3-5.
Page 7-8; Figure 3-4 should be Figure 3-5. This should not be a blank page.
Page 7-10; Figure 3-5 should be Figure 3-7.

EPA Response: Corrections will be made to the document through errata sheets placed in the Administrative Record.

248. Were the data for shallow, intermediate, and deep samples all averaged together? The level of detail in this discussion (residential wells) was less than the surface soil discussion.

EPA Response: The data for all the wells were averaged together.

249. Page 7-11; Again, were all the samples averaged together? Why were residential well data and ground water data combined if they were sampled separately?

EPA Response: Because residential wells and monitoring wells are all located downgradient of the site, they were grouped together in the calculation of quantitative risk

250. Table 7-1; Why are antimony, silver, and selenium contaminants of concern when there frequency of detection is 3/19, 1/36, and 2/19, respectively? There are may compounds in this table that are denoted as compounds of concern with a low frequency of detection.

EPA Response: For chemicals that were detected, but infrequently, a conservative approach was used in retaining infrequently detected chemicals in the risk assessment. This conservatism in determining chemicals of concern is in accordance with current US EPA guidance (Dec. 1989). The infrequent detection of a chemical at a site does not automatically imply that its presence should be ignored. Infrequent detected chemicals that may be present at toxicologically significant concentrations.

251. Page 7-26; The third paragraph from the bottom should be contiguous with the second paragraph from the bottom.

EPA Response: No response needed.

252. Page 7-29; The brief discussion of ingestion of contaminated biota (plants and animals) and food is untrue. Even without biota and food sampling, uptake into plants and animals, such as cows, can be estimated using bioconcentration/bioaccumulation factors available in the literature. This analysis would be especially important if the surrounding farmland were used for grazing animals in which compounds can bioconcentrate in the muscle, fat, and milk. (It is unclear from the report whether the farmland is used for crop growth and/or grazing animals.)

EPA Response: The soil sampling in the field near the spray irrigation system did not show contaminants at a level of concern for crops.

253. Section 7.4 General; All acronyms should be defined before using them to aid the reader. This comment applies to all of Section 7.4.

EPA Response: The acronyms were defined when first used.

254. Page 7-30; The following acronyms are not defined:

- o NOEL- No observed Effect Level
- o HEA- Health Effects Assessment
- o CAG- Cancer Assessment Group.

EPA Response: No response needed.

255. Page 7-31; Which type chromium is actually at the site? Using the more toxic chromium VI may not adequately represent the site contaminants. What is the reference for the 9.6 cubic meters inhalation rate used for employees?

EPA Response: The analyses refer to total chromium, it is conservative and reasonable to use chronic criteria for hexavalent chromium in estimating the risk caused by chromium.

256. Page 7-32; The following acronyms are not defined:
- o ADI - Acceptable Daily Intake
- o ADL - ???

EPA Response: ADL is a typo of ADI.

257. Page 7-32; Why is the toxicity value for nickel refinery dust used in this analysis? Is there refinery dust at the site? If not, the toxicity value for nickel should be that for

inorganic nickel compounds.

EPA Response: There are only two nickel compounds having slope factors, namely nickel refinery dust and nickel subsulfide (HEAST). It is believed that toxicity value for nickel refinery dust is more appropriate in this case.

258. Page 7-33; The reference for the ingestion reference dose (RfD) for zinc is incorrect (EPA, 1989d). This is the Exposure Factors Handbook reference, which does not contain any toxicity values.

EPA Response: The reference should be EPA 1989c.

259. Page 7-33; The following acronym is not defined:

- NAS - National Academy of Science.

EPA Response: No response needed.

260. Page 7-34; In the second paragraph from the top, the Ames assay should be described.

EPA Response: The Ames test is microorganism test.

261. Page 7-34; "Carb Disulfide" should be "carbon disulfide." If a no observable effect level for inhalation exposure was determined, then an inhalation RfD was developed. Is the RfD for carbon disulfide for oral exposure or inhalation exposure? This discussion is confusing.

EPA Response: No inhalation exposure RfD has been derived for carbon disulfide. EPA has derived an oral RfD of 0.1 mg/kg/day (HEAST, 1990).

262. Page 7-35; The Following acronyms are not defined:

- TWA - Time-Weighted Average
- I.p.- intraperitoneal
- MTD -

EPA Response: MTD is median toxic dose.

263. Page 7-36; The first sentence of the fourth paragraph from the top does not make sense. The terms "A," "H," and "S" should be defined when modifying uncertainty factors.

EPA Response: 10A: uncertainty factor of 10 in the extrapolation of dose levels from animals to humans.

10H: uncertainty factor of 10 in the threshold for sensitive humans.

10S: uncertainty in the effect of duration when extrapolating from subcronic to chronic exposure.

264. Page 7-37; The following acronym is not defined:

- NCI - National Cancer Institute (NTP is defined when used in test, why not NCI?)

EPA Response: No response needed.

265. Page 7-37; The first paragraph refers to EPA, 1986. Which EPA, 1986 is meant, a, b, or c? For all ethylene/ethene compounds, the spelling should be consistent, either all ethylene or all ethene. 1,1,1-trichloroethane should be 1,1,1-trichloroethane. This paragraph is difficult to follow.

EPA Response: No response needed.

266. Page 7-38; There is a group within EPA that has been establishing noncancer toxicity values for the noncarcinogenic polynuclear aromatic hydrocarbons. These values have not yet been entered into the IRIS database, but are verified RfDs and are available over the telephone. Therefore, toxicity values for anthracene and fluoranthene, as well as naphthalene and phenanthrene, are available.

EPA Response: RfDs for PAH are under evaluation by USEPA and furthermore, they were taken out from both IRIS (may 1990) and HEAST (first/second quarter, 1990). Accordingly, no values for the compounds were available for use.

267. Page 7-39; Why all the white space on this space?

EPA Response: Reproduction error.

268. Page 7-41; In Section 7.4.4, Migration is spelled migration.

EPA Response: No response needed.

269. Page 7-41; The following acronym is not defined:

- s.c. - subcutaneous.

EPA Response: No response needed.

270. Page 7-43; The following acronym is not defined:

- FDA Food and Drug Administration.

EPA Response: No response needed.

271. Table 7-3 (Page 7-44); Pennsylvania is spelled incorrectly (Pennsylvania).

EPA Response: No response needed.

272. Page 7-45; Why all the white space on this page?

EPA Response: Reproduction error.

273. Page 7-45; The multiplication signs are missing from all equations in Section 7.5.1.

EPA Response: Word processing error.

274. Page 7-47; What is the value for AT?

EPA Response: The values for AT depend upon the exposure duration for chronic and subchronic exposure [365 days x exposure duration (years)] and carcinogenic effect (365 days/year x 70 years).

275. Page 7-48; The discussion on the box model is confusing. Also, a box model may not be appropriate for this analysis.

What does "resussion" mean?

EPA Response: Box model is not the most sophisticated model to assess the impacts of particulate emissions from site surfaces due to wind as discussed in the text. However, because of a general lack of accurate/reliable predictive air dispersion models for concentrations near or within the source and site-specific airborne concentrations for the essential model calibration work, a site-specific model cannot be established at present. The box model, a recognized model by USEPA as appropriate, is adopted for a first-cut approximation for estimating contaminant concentrations near and within the site as an area source. The box model is fully discussed in detailed in Section 7.5.1.3. Resussion refers to particle movement in the air.

276. Page 7-49: H should be approximately 6 feet.

EPA Response: No response needed.

277. Page 7-51; The assumption that both adults and children shower 365 days per year is an overestimate (especially for children under age 6). It is apparent that the EPA did not use their own guidance when arriving at this assumption [i.e., data found in the EPA's Exposure Factor Handbook (1989)]. This raises the question of whether the most

realistic and relevant data were used in determining potential risk.

What is the reference for the percent volatilized for the various compound types (bottom of Page 7-52)?

EPA Response: Conservative assumptions and best engineering judgement were made for this analysis.

278. Page 7-53; Further explain the box model used in determining the shower air concentration.

For the drinking water pathway, water ingestion of 1.4 liters per day could be used as noted in the Exposure Factors Handbook (EPA, 1989.

EPA Response: Please refer to Comment No. 276 concerning the box model. According to "Risk Assessment Guidance for Superfund; Vol 1; Human Health Evaluation Manual (Part A), Dec. 1989", 2 liters should be used.

279. Page 7-54; The equations on this page are typed incorrectly. The summation signs are missing.

EPA Response: No response necessary.

280. Page 7-55; When summing (adding together of results from a calculation) hazard indices, only those compounds with the same end point should be added (i.e., only compounds that affect only the kidneys or only the liver or only the central nervous system). Summing all hazard indices can be done as a screening measure; however, if the value is over unity, which is 1, the compounds should be separated out according to target organ (EPA, 1986, "Guidelines for the Health Risk Assessment of Chemical Mixtures, "Federal Register, 51:34014-24025).

EPA Response: When the total hazard index for an exposed individual or group of individuals exceeds unity, there may be concern for potential noncancer health effects. For multiple exposure pathways, the hazard index can exceed unity even if no single exposure pathway hazard index exceeds unity and if combining exposure pathways has resulted in combining hazard indices based on different chemicals, one may need to consider segregating the contributions of the different chemicals according to major effects. This was done in the risk assessment.

281. Table 7-4 is missing from this report.

EPA Response: No response necessary.

282. It is unlikely that carcinogenic inhalation risks from inorganic compounds during showering would be 2 to 3 orders

of magnitude higher than the carcinogenic inhalation risks from 1,1-dichloroethylene and vinyl chloride. This is also true for the noncarcinogenic compounds. The hazard indices for barium and manganese should not be 1 to 3 orders of magnitude higher than the hazard indices for 1,1-dichloroethane or 1,1,1-trichloroethane.

EPA Response: In the final document (Sep. 1990), the inhalation risk has been recalculated and the risk associated with inorganics has decreased by 2 orders of magnitude. However, this recalculation did not reduce the risk at the site from the 10^{-4} requiring a remedial action.

283. Table 7-7 (Page 7-60); Lead is not considered a carcinogenic compound. Phenanthrene is also not a carcinogenic compound. Neither of these chemicals should be present on this table.

EPA Response: Lead is considered to be carcinogenic chemical by EPA Region III (see toxicology profile in the text also).

284. Page 7-77; The table on this page has typographical errors.

EPA Response: No response needed.

285. Page 7-78; Add a space between Section 7.5.4.3 and Site Trespassers.

EPA Response: No response needed.

286. Page 7-83; In the last paragraph, the phrase "for because" should be modified.

EPA Response: No response needed.

287. Page 7-85; As stated in the comment for Page 7-55, all hazard indices are not additive. Thus, the sentence on this page, "Health effects, whether carcinogenic or noncarcinogenic, are assumed to be additive for all contaminants of concern," is untrue.

EPA Response: This statement refers to uncertainty associated with quantitative risk estimates. Please refer to Comment No. 280 for additional responses.

288. Page 7-93; It is possible to determine a more realistic scenario pertaining to the amount of site water a deer might ingest. Since the size of the home range of the deer is known (2 to 3 square miles, as stated in the report) and the size of the site area is also known, a ratio of the two areas can be taken to determine the percentage of the site that is in the home range of the deer.

EPA Response: It is possible to estimate the percentage of

a deer's home range comprised by a site. However, a more appropriate estimation of the amount of drinking water obtained onsite is not possible. Deer do not obtain water from all available water sources within their home range: they are more likely to utilize a few select watering spots. Likewise, they do not equally utilize each of the preferred spots. Since the preferred watering spots and percentage of these spots located at or near the Keystone site are not known, it was conservatively assumed for the purposes of this assessment that a deer obtains 50 percent of its water from onsite sources.

It should be noted that if a deer obtained 100 percent of its water from onsite sources, the surface water exposure concentrations would still be far below the representative drinking water limits (obtained by dividing the drinking water limits in the table by a factor of two). Therefore, a more detailed analysis would not change the conclusions of the environmental assessment.

289. This comment is in narrative form and questions many of the assumptions made in the risk assessment. See R.E. Wright comments, pages 33-36.

EPA Response: See previous comments concerning the analysis of chromium in the risk assessment.

The choice of children under 6 years of age as site trespassers is not unreasonable. This group would have higher potential exposures than teenagers. Even with this reasonable worst case scenario the total subchronic noncarcinogenic risk was estimated to be well below 1 (i.e., 0.019).

In the final risk assessment (Sep. 1990), daily water consumption for children was modified to 1 liter per day. The assumption of children to take showers daily 365 per year is a conservative and reasonable approach since some families may not have a bath tub available.

Soil at the Keystone site is more clay-like than sandy. Therefore we believe that the use of the soil adherence factor for clay is more appropriate than that for potting soil.

Use of the national average for swimming frequency (7 days/year is inconsistent with EPA guidance (EPA 1989) which directs that 95 or 95th percentile exposure frequency values be used for risk calculations.

Although ingestion of surface water without swimming is less likely, it still may take place.

It is generally true that inorganics will not vaporize from

shower water. However, it is possible for inorganics to be entrained as very small particles in water droplets. In the final RI report (September 1990) 0.01% of the inorganics in groundwater was assumed to be available for inhalation. These compounds contributed 4% to the total LECR for this pathway.

290. This comment is in narrative form and relates to miscellaneous issues concerning the risk assessment. For the detailed comments see the R.E Wright comments, pages 36-39.

EPA Response: Background sampling stations were chosen based on site specific geographical and hydrogeological characteristics at each sampling station; stations "least likely to be affected by the site" were chosen. Accordingly, the presence of organic chemicals in background samples was not considered sufficient reason to eliminate those detected at the site from evaluation in the quantitative risk assessment, since their presence could be the result of site contaminants.

For chemicals that were infrequently detected, a conservative approach was used in retaining them in the risk assessment. This conservatism in determining chemicals of concern is in accordance with current USEPA guidance (Dec. 1989). The infrequent detection of a chemical at a site does not automatically imply that its presence should be ignored since infrequently detected chemicals may be present at toxicologically significant concentrations. This can best be achieved using a conservative approach. The PRP agreed that vinyl chloride was present at the site but questioned how widespread it was. Vinyl chloride was detected in groundwater in 2/45 samples (4 and 40 ug/l) with SQL ranges from 10 to 50 ug/l. The exposure concentration was calculated to be 10 ug/l (still below the SQL). In accordance with USEPA guidance, vinyl chloride needs to be assessed. Assuming an exposure concentration of 10 ug/l, the LECR was determined to be $3x10^{-4}$ in groundwater for vinyl chloride. Even if it were reduced to 5 ug/l, vinyl chloride would still present an LECR of $1.5x10^{-4}$.

Chrysene was detected in monitoring well MW-CD with a concentration of 4 ug/l at 1/29 samples. It was not screened out from consideration in the quantitative risk assessment in groundwater because it was also detected in surface soil in 9/36 samples (exposure concentration 202 ug/kg). Nevertheless, since no toxicological criteria were available for chrysene it was not included in the calculation of risk.

The relatively clean groundwater from offsite residential wells does not appear to be affected by the onsite groundwater contamination because of the site specific

hydrology characteristics. Thus, the risk associated with groundwater is insignificant. The total risk associated with the site for offsite residents should be essentially the same as that for site trespassers.

List of Tables was misprinted for Table 19, 20, and 20.

Deed and zoning restrictions cannot be considered in a baseline risk assessment. According to the National Contingency Plan (40 CFR Part 300), a baseline risk assessment is an assessment of the risks from the site in the absence of remedial alternatives (which include institutional controls such as deed and zoning restrictions. The effect of such controls may be considered in the evaluation of alternatives during the feasibility study but not as part of the baseline risk assessment.

291. This comment is in narrative form and includes various concerns regarding the selection of contaminants of concern. in the Risk Assessment (See Semmes, Bowen and Semmes comments, pages 3-1 through 3-8).

EPA Response: The MCL is not an acceptable criterion to use in the selection of contaminants of concern (see EPA guidance on risk assessment, Dec. 1989). Data on the regional naturally occurring levels of contaminants should only be used as a reference or indicator in the selection of contaminants of concern because the variation at different locations is significant in some cases. However, site specific background information is preferable and since this was available, it was used.

A different statistical approach for determining whether a chemical was elevated above background (EPA Region III specific method) was employed in the final risk assessment (September 1990). As a result, barium was identified as a contaminant of concern in surface water, sediment, and groundwater; cadmium was identified as a contaminant of concern in groundwater; and chromium was identified as a contaminant of concern in surface water and groundwater.

292. What is the definition of surface soils.

EPA Response: The EPA definition of surface soil differs from site to site (depending on site-specific characteristics). However, soil to a depth of 18 in. can be reasonably considered to be surface soil since it is not uncommon for contaminants to reach 12-18 in. below the surface offsite through surface run-off.

293. Data with qualifiers should not be used in the risk assessment.

EPA Response: According to EPA guidance (EPA, December,

1989), data labelled with the qualifier "J" should be included in quantitative risk assessments. Also, data for MW-MD1 are given in the Appendix.

294. The exposure assumptions presented in the risk assessment are not realistic.

EPA Response: The choice of children under 6 years of age as site trespassers is not unreasonable. This group would have higher potential exposures than teenagers. Even with this reasonable worst case scenario the total subchronic noncarcinogenic risk was estimated to be well below 1 (i.e., 0.019) (Also see previous responses).

Avoiding lengthy calculations, the risk for onsite workers (the worst case scenario) was simply adapted to adult site trespassers to show that there was no significant risk (LECR 7×10^{-7}).

Ingestion of surface water could happen regardless of the size of the stream. Also, the risk values associated with surface water near the site are insignificant (carcinogenic risk, 0.004%; chronic effect, 0.002%; and subchronic effect, 0.001% of the total risk).

Generally, inorganics will not vaporize from the water into the bathroom air during showering, since the shower water temperature is approximately 50°C. However, it is possible for inorganics to be entrained (very small particles of water droplets) in air through elevated temperatures and showering activities (i.e. shower spray). In the final RI report, 0.01% of the inorganic entrainment was utilized to estimate the inhalation risk associated with groundwater during showering. Inorganics contributed 4% to the LECR of 4×10^{-4}.

The units in these equations are correct. No response is necessary.

295. The individual chromium species should be identified and used for risk assessment.

EPA Response: Since the analyses refer to total chromium, it is conservative and reasonable to use chronic criteria for hexavalent chromium in estimating the risk caused by chromium.

296. These comments relate to several issues related to risk characterization.

EPA Response: Information on the carcinogenic risk for ingestion of groundwater is summarized in Table 7-7. Because ingestion of groundwater and inhalation of groundwater while showering are two different pathways, th

were discussed separately in the quantitative risk assessment.

The risk for cadmium exposure while showering was reduced to 2×10^{-8} in the final risk assessment (September 1990). See previous responses.

In the final risk assessment, the values for the carcinogenic risk, chronic effect, and subchronic effect via chronic inhalation while showering were reduced to 1×10^{-4}, 0.044, and 0.016, respectively.

It is EPA Region III's policies that when an oral slope factor is not available, inhalation slope factor could be employed as a conservative measurement.

Page 7-2; Capitalize "I" in the second bullet from the top of the page.
Page 7-5; Figure 3-3 should be Figure 3-4.

FEASIBILITY STUDY

297. In light of the extensive comment concerning the inadequacies and technical errors which plague the entire RI report by CCJM, a similarly exhaustive review of the feasibility study will be here. Any remedial system design based upon the remedial investigation completed by CCJM could only suffer from the same flaws reviewed in the RI. Additionally, combined errors in various sections of the remedial investigation would only serve to compound the technical inadequacy of the feasibility study.

An evaluation of CCJM remedial system alternatives was conducted during the course of numerical model evaluation and presented in a previous section of this report. No additional comment is, therefore, necessary to demonstrate the technical inadequacy of any remedial design based on this RI. In that CCJM based the treatment system design, in part, upon limited ground water sampling results in which metals were entrained in the sample during monitor well purging, treatment was designed under the erroneous assumption that particulate matter represents a dissolved phase which must be accommodated by treatment.

Whereas metals present within the landfill environment are present as a solid phase, subsequent precipitation, or other treatment system design elements are unnecessary. In fact, given the fact that there has been no observed release of metals from the landfill, and that such a release is not possible by any means other than direct extraction of particulate matter during the course of monitoring and recovery well pumping, the treatment process itself represents the only possible route by which metals could

escape from the landfill environment to environment outside of the landfill. If treatment is required, it would only be required as a by product of VOC treatment which, in light of the type of compounds present, should be limited to air stripping.

Relative to the alleged presence of trace metals at the Keystone Landfill site. the RI/FS firmly supports one and only one conclusion - the only reasonable remedial action supported by the evidence is the no-action alternative.

EPA Response: The feasibility study is not designed to provide a definite, detailed design. Instead it is a conceptual design used to estimate costs and evaluate alternatives. The data obtained during the RI indicate that a release of hazardous substances has occurred from the site. The levels of metals and VOCS detected were sufficient to warrant the treatments of these contaminants during the remediation. As indicated in the Risk Assessment, the risk from this site to human health exceed 10^{-4} risk range and therefore a remedial response is required to be protective of human health. The no-action alternative would allow the contaminant plume to further migrate offsite.

D. REMAINING CONCERNS

Several remaining issues were expressed during the Public Comment Period and are as follows:

1. Citizens are concerned that one round of groundwater sampling was not representative of the problems in the area residential wells which have historically shown contamination. In addition, they want EPA to supply them with bottled water.

EPA Response: In response to the citizen concern, EPA will be conducting another round of residential well sampling in the next several months. This sampling will use a detection level below the MCLs or risk levels for the contaminants of concern such as vinyl chloride. The sampling plan will be developed with assistance from members of the communities in Pennsylvania and Maryland using historical data on the residential wells in the area that they have collected, data from the State of Maryland sampling events, data from PADER sampling events and data from the RI. If the sampling results from this next round of residential well sampling indicates that contaminants are present above MCLs or acceptable risk levels, EPA will consider providing water or a treatment system to the affected residents.

2. PRPs are concerned that a release of metals to the groundwater from the Site is not possible and has not occurred. Therefore, metal treatment is not necessary and in some cases, contend that the Site only warrants a No Action remedy.

EPA Response: From the Risk Assessment, it was determined that a risk of 5×10^{-4} exists at the Site from the ingestion of groundwater. This level of risk requires a remedial action response and therefore, a No Action remedy would not be appropriate. Levels of metals have been detected onsite and offsite above the MCLs. Due to the presence of the metals above the MCLs, it was determined that metal treatment would be a component of the groundwater treatment. However, additional sampling of the groundwater obtaining both filtered and unfiltered samples will be conducted during the Remedial Design. The data from these samples will be used in the design of the groundwater treatment and further substantiate the need for metal treatment. If the data determines that the metal treatment is not necessary, EPA will issue an Explanation of Non Significant Differences to modify the Selected Remedy.

3. The community and local officials want to be kept better informed and more involved in the Site activities and decisions.

EPA Response: EPA has recognized the concerns of the community and the local officials and will keep them informed and involved in all the Site activities and decisions.

4. The citizens want a health study conducted in the area.

EPA Response: EPA will make a request to the Agency for Toxic Substances and Disease Registry (ATSDR) to conduct an additional health study in the area. ATSDR conducted a health study in November 1988. In addition, a Risk Assessment will be conducted in the investigation of the Operable Unit 2 to evaluate risks specifically to the offsite residential wells.

5. The citizens are concerned over allowing the PRPs to implement the remedy and any involvement from PADER and the State of Maryland.

EPA Response: EPA will be actively involved in the monitoring of all activities conducted at the Site either by the PRP contractors or federally financed contractors. The monitoring will involve the Remedial Project Manager, the EPA Technical Support Staff, and EPA's oversight contractor and consist of direct supervision of site activities, review of the data collected and interaction with local residents. EPA is also interested in getting local residents involved in the monitoring activities as they have indicated their willingness.

6. The citizens and local official do not feel that the study was comprehensive enough and that additional studies should be conducted on the Site.

EPA Response; EPA has changed the Selected Remedy from a final action ROD to an interim action ROD. A second Operable Unit will investigate the offsite contamination. In addition, a sampling of residential wells will take place in the near future in response to the concern over the need for EPA to supply bottled water.

COMMONWEALTH OF PENNSYLVANIA
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BUREAU OF WASTE MANAGEMENT
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September 27, 1990

Mr. Edwin B. Erickson
Regional Administrator
US EPA, Region III
841 Chestnut Building
Philadelphia, PA 19107

Re: Record of Decision (ROD) Concurrence
Keystone Sanitation Company Site, Union Township, Adams County

Dear Mr. Erickson:

The Record of Decision for the final remedy will address remediation of groundwater contamination at the perimeter by eliminating or reducing the risks through engineering and institutional controls.

The major components of the selected remedy include:

1. Installation and maintenance of an impermeable cap and gas collection system over the 40 acre landfill.

2. Installation and maintenance of groundwater extraction wells and a treatment plant to reduce the concentrations of volatile organic compounds and metals in the groundwater.

3. Installation and maintenance of a fence around the site.

4. Monitoring the groundwater in monitoring and residential wells.

5. Monitoring surface water and sediments.

6. Initiation of deed restrictions regarding present and future site activities including limitations on construction and aquifer use.

7. Conduct a five year review to assess the effectiveness of the remedy to reduce the risks to human health and the environment.

I hereby concur with the EPA's proposed remedy, with the following conditions:

- EPA will assure that the Department is provided an opportunity to fully participate in any negotiations with responsible parties.
- The Department will be given the opportunity to concur with decisions related to the design of the remedial action and to assure compliance with DER design specific ARARs.
- The Department's position is that its design standards are ARARs pursuant to SARA Section 121, and we will reserve our right to enforce those design standards.
- The Department will reserve our right and responsibility to take independent enforcement actions pursuant to state and federal law.
- This concurrence with the selected remedial action is not intended to provide any assurance pursuant to SARA Section 104(c)(3).
- The Department agrees with the proposed remediation which provides that "background" quality is the objective of the groundwater remediation plan. In the event that EPA modifies its position on the cleanup standard, and deviates from background quality as the standard, the Department will withdraw its concurrence. At that time, EPA must demonstrate the impracticability of achieving background quality and give the Department a meaningful opportunity to reconcur.

If you have any questions regarding this matter please do not hesitate to contact me at the above listed number.

Sincerely,

Hugh V. Archer, Ph.D., P.E.,
Director Harrisburg Region