DRAFT FINAL REMEDIAL INVESTIGATION

BALDWIN PLACE MALL
SOMERS, NEW YORK

Volume 4
Appendices M through Q

Prepared for
Big V Supermarkets, Inc.
Florida, New York

AUGUST 1994

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APPENDIX M

FISH AND WILDLIFE IMPACT ANALYSIS
(JAY FAIN & ASSOCIATES)

DRAFT
FISH AND WILDLIFE IMPACT ANALYSIS FOR THE BALDWIN PLACE MALL TOWN OF SOMERS WESTCHESTER COUNTY, NEW YORK

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FEBRUARY, 1994

EXECUTIVE SUMMARY

1. This report has been prepared as partial fulfillment of the requirements outlined in the WORK PLAN - REMEDIAL INVESTIGATION/FEASIBILITY STUDY prepared for the Baldwin Place Mall, Somers, New York, by Vincent Uhl Associates and dated May, 1992. Specifically, this report addresses Section 6.3.4 of the WORK PLAN, Fish and Wildlife Habitat Assessment.

2. The purpose of Step I of the Fish and Wildlife Habitat Assessment and Impact Analysis in the context of the Work Plan is to identify the fish and wildlife resources present in the vicinity of the site and to provide a qualitative assessment of that resource.

3. Two wetland communities were found on the Baldwin Place Mall site. Field investigation of these areas did not disclose the presence of any Federal or State listed rare or endangered plant species on the site.

4. Correspondence with the NY Natural Heritage Program (March 5, 1993) did not identify any resident endangered, threatened, or species of special concern within the boundaries of the study area.

5. The most significant fish and wildlife resource, both within the one-half mile radius study area and within two miles downstream of the site, is the Muscoot River including the Amawalk Reservoir, and its associated wetlands, open water, and riparian areas. The Muscoot River is the main collector stream for all flow in the Muscoot River sub-basin of the Croton River Basin. All surface flow from the Baldwin Place site is confined to the Muscoot River sub-basin.

6. The purpose of Step II of the Fish and Wildlife Impact analysis was to determine if there has been, or may be, potential impacts of site-related constituents on fish and wildlife resources. This determination was made by conducting a *Pathway Analysis*.

7. The results of the *Pathway Analysis* from surface water and sediment sampling showed that the impact was minimal. This finding was confirmed in the Environmental Standards, Inc., (ESI) report entitled "Draft Baseline Risk Assessment For the Baldwin Place Mall Site in Somers, New York" which concludes that "This analyses demonstrated that no ecological risks exist as a consequence of contamination and release of contamination at the site." Based on the finding of no impact to fish and wildlife resources, further studies are not warranted.

TABLE OF CONTENTS

I. INTRODUCTION

The following report has been prepared as partial fulfillment of the requirements outlined in the WORK PLAN - REMEDIAL INVESTIGATION/FEASIBILITY STUDY prepared for the Baldwin Place Mall, Somers, New York, by Vincent Uhl Associates and dated May, 1992. Specifically, this report addresses Section 6.3.4 of the WORK PLAN, Fish and Wildlife Habitat Assessment.

The purpose of Step I of the Fish and Wildlife Habitat Assessment and Impact Analysis in the context of the Work Plan is to identify the fish and wildlife resources present in the vicinity of the site and to provide a qualitative assessment of that resource. As outlined in the Work Plan, the Step I study included the following elements:

Topographic Map - A topographic map has been prepared based on USGS 7.5 minute topographic series documenting NYSDEC Significant Habitats, other habitats that may support rare, threatened or endangered species, species of special concern, regulated wetlands, wild and scenic rivers, lakes and other waterbodies within a two-mile radius of the site perimeter.

Covertype Map - A covertype map has been prepared for the area within one-half mile of the site perimeter. This map illustrates major vegetative communities including forested and emergent wetlands, terrestrial and aquatic habitats based on vegetative covertypes, NYSDEC Significant Habitats and other land use features.

Description of Resources - Fish and Wildlife species known or expected to be associated with the identified covertypes and aquatic habitats within the study area are identified.

<u>Value of Resources</u> - A qualitative assessment of the general habitat value to associated fauna within a one-half mile radius of the Baldwin Place Mall is provided. Also included is a qualitative assessment of the value of the resource to humans for recreational and economic activities.

The purpose of Step II of the Fish and Wildlife Impact analysis is to determine if there has been or may be potential impacts of site-related constituents on fish and wildlife resources. This determination was made by conducting a Pathway analysis. Demonstration of minimal impact using the Pathway analysis eliminated the need for additional analyses.

The NYS ECL Article 27, Title 13 establishes NYSDEC as the agency responsible for the identification and remediation of inactive hazardous waste sites. The Division of Fish and Wildlife is responsible for the evaluation of the threat to fish and wildlife populations within the remediation process. This report has been prepared to assist the Division of Fish and Wildlife, in association with the Division of Hazardous Waste Remediation to assess the specific risk(s) associated with the Baldwin Place site. This report has been prepared in accordance with the Division of Fish and Wildlife Technical and Administrative Guidance Memorandum (TAGM); Fish and Wildlife Impact Analysis at Inactive Hazardous Waste Sites: Guidance Document for Conducting Environmental Risk Assessments, dated June 18, 1991.

II. NATURAL RESOURCES - STUDY SITE CHARACTERISTICS

A. STUDY SITE

PART I - REGIONAL SETTING

Located in the northeast corner of Westchester and southeast corner of Putnam Counties, the 16 square mile topographic study area is typical of the land use patterns throughout upper Westchester and lower Putnam Counties. Land use ranges from high density residential and commercial to protected New York City watershed lands.

Physiography and Site Drainage

Topography is generally hilly to rolling with elevations ranging from a low point of 410± feet above mean sea level at the Amawalk Reservoir, to a high point of 783 feet above sea level at the top of the knoll located along the western edge of the study area. While the entire study area drains eventually to the Hudson River, two principal watershed divides occur within the 4 sq. mi. study area. The Upper Hudson River Basin drains the extreme north-western corner of the area, while the Croton River Basin drains the remainder of the study area. The Croton River Basin in turn can be further divided into three sub-basins; the Hallocks Mill Brook sub-basin comprising the western one-third of the area; the Muscoot River sub-basin comprising the central one-third of the study area; and the Plum Brook sub-basin which constitutes the remainder of the study area. The Baldwin Place Mall site is contained in the Muscoot River sub-basin.

Geology and Soils

According to the Westchester County Environmental Management Council's Geologic Features Map (1982) and other sources, the underlying geology of the county is basically a complex series of dense metamorphic rocks with igneous intrusions. These rocks are varied in composition and have been highly distorted, folded and fractured by repeated periods of stress and movement in the earths crust. The topographic shape and form of the Croton River basin directly reflects the structural and variations in composition of the bedrock. Transportation routes, population and land use patterns have conformed, in general, to these topographic patterns.

Soils in the area developed from the altered and weathered surface zone in glacial sediment and exposed bedrock. Soils on hilltops generally developed in a thin mantle of glacial till which overlies the bedrock and are generally comprised of the Charlton-Chatfield or Paxton complex. Soils that developed in valleys and along stream corridors developed in deeper deposits of glacial outwash. Bedrock outcrops occur frequently throughout the county as knobs and steep-sided ledge. The wetland soils are generally deep organic and mineral deposits, with bedrock usually deeper than 6 feet.

Land Use History

Westchester County exhibits land use patterns that are more typical of southern New England than the majority of New York State. The land here was first cleared for agricultural use over 200 years ago and then abandoned due to poor soil fertility and competition from other agricultural markets. Old roads, stone walls and rectangular land use patterns remain as indicators of former agricultural use. Left fallow, reforestation occurred rapidly along with development for residential and commercial uses. While most of the land south of Interstate 287 is urbanized, 26% of the total land use in the county is considered openspace. Of this amount, approximately 21,000 acres are in New York City watershed lands and an additional 13,625 acres are in county parklands.

PART II - BALDWIN PLACE SITE CHARACTERISTICS

The Baldwin Place Mall site is located in the center of the 16 sq. mi. study area. The roughly square 27.8 acre parcel has frontage along County Route 6 and 118. The site is currently occupied by a mall with various retail stores and offices, mostly vacant. The vast majority of the site is urban land with coverage either in the form of buildings or pavement. However, two small wetland areas are found on the site. These areas are described in the wetlands section below.

The Baldwin Place Mall is located in a commercial zone. Surrounding land use along the frontage of Route 6 and 118 is commercial, the area to the east is residential and includes single family residences.

Physiography and Site Drainage

The site is characterized by relatively gentle topography. Elevations on the site range from a high point of 520 feet above sea level at the northeast corner of the property, to a low of 480 feet above sea level at the northwest corner of the property near the McDonalds restaurant.

The Baldwin Place Mall is bounded by two small intermittent stream systems. The first system, an un-named stream (Eastern stream) flows north to south along the eastern property boundary. Adjacent to the site, this stream has been split into two channels by an abandoned railroad bed; the western channel accepts treated sewage effluent just before leaving the site. This system drains to a series of man-made ponds just south of the Baldwin Place Mall property. Approximately one-mile from the site in the vicinity of Koegel Park, the stream course joins with a named Class A-T stream - the Muscoot River. The Muscoot River drains shortly there after into the Amawalk Reservoir before eventually joining with the Hudson River. The Muscoot River and Amawalk Reservoir are part of the New York City Croton Reservoir system, a Public Water Supply Watershed area. At the time of the field investigation of the site, April 15, 1993, flows in the western channel of the eastern stream were below 5 cfs. This stream is not identified on DEC stream segment maps.

A south to north flowing stream, also un-named (Western Stream), traverses the western portion of the site. This stream has its headwaters just south of the Mall site. Upon entering the Mall site from the south the stream continues in a culvert underneath the property before joining with a natural streambed just north of Route 6 in the vicinity of the McDonalds restaurant. This stream flows northwest where at approximately 1,000 feet from the site it flows through Kennard Pond (H-31-P50d) and Lake Baldwin (H-31-P50c), and ultimately into the Muscoot River (H-31- P44-14) approximately 3,500 feet from where the stream crosses under Route 6.

Geology and Soils

The Baldwin Place Mall is located within the Hudson Highland Geologic Region, which is underlain by metamorphic rocks of Precambrian age. The stratigraphy beneath the site consists of Hudson Highland granitic-gneiss bedrock overlain by glacial till deposits.

Soils on the site are predominantly of the Paxton complex and are characterized by a dense basal till layer. According to drilling logs provided by Vincent Uhl Associates the thickness of the unconsolidated material beneath the site varies considerably between 5 and 80 feet deep.

Wetland Descriptions

Two wetland communities were found on the Baldwin Place Mall site. Field investigation of these areas did not disclose the presence of any Federal or State listed rare or endangered plant species on the site. A list of observed plant species, including common and botanical names, is attached as **Appendix A** in this report.

The wetlands on the Baldwin Place Mall site encompass a total of 0.59 acres, or 2 percent of the total area of 27.8 acres. In general, the on-site wetlands have diminished functions and values due to past mismanagement and abuse including direct filling, removal of surface soil horizons and associated vegetation.

1. **Drainage Ditch/Intermittent Stream Corridor**

The extreme eastern edge of the site is bordered by an area of somewhat poorly and poorly drained soils which support facultative and obligate wetland vegetation. The first 700 feet of this system (ending approximately at the 498 foot contour) is a man-made ditch that was dug at the time of the construction of the original shopping center. This channel varies from being well defined near

NYS Route 118 to being virtually non-existent further downstream. The source of water for this drainage ditch is from runoff from adjacent upland areas including NYS Route 118. The water table is perched rather than apparent.

Most of the vegetation associated with this ditch is representative of recent site disturbance rather than wetland soil conditions. Trees are of sapling size and consist mainly of black locust. Shrubs include silky dogwood, staghorn sumac, multiflora rose, and pussy willow. Blackberry, goldenrod, and pokeweed form the herbaceous plant layer.

Below the 498 foot contour, the character of the system changes from that of a drainage ditch to that of an intermittent stream corridor. Flows to this system are augmented by storm water flows from the shopping center parking lot and from the intermittent stream course (the western channel of the eastern stream) that enters the system beneath the railroad trestle in the southeast corner of the property. The dominant vegetation type associated with this system is phragmites, a highly invasive species that is usually indicative of recent disturbance. Other vegetation includes purple loosestrife, silky dogwood, multiflora rose, black locust, spicebush, water plantain red-osier dogwood, skunk cabbage and tussock sedge.

The source of water for the intermittent stream course is from overland and subsurface flows from adjacent upland areas. The water table is at or near the surface (within 6 inches) for most of the growing season.

The **Drainage Ditch/Intermittent Stream Corridor** wetland system comprises 0.48 acres of the subject property.

2. Shrub Swamp

The northeast corner of the Baldwin Place Mall site borders on an area of somewhat poorly and poorly drained soils which supports typical wetland vegetation. The poorly drained nature of the soils discourages vigorous tree growth, largely limiting the vegetation to a shrub and herbaceous layer. Shrubs include red-osier dogwood, shrub willow, and multiflora rose. The herb layer is highly sporadic, varying from skunk cabbage and tussock sedge in poorly drained areas, to purple loosestrife, phragmites, cattails, and various other rushes, sedges, and grasses in the somewhat poorly drained soils. The water table in this wetland is perched, rather than apparent indicating the presence of an underlying subsoil consisting of compact glacial till.

The wetland border adjacent to the existing shopping center parking lot is largely composed of fill and other debris that has been historically deposited. Vegetation in these fill areas is consistent with disturbed sites and includes phragmites, cottonwood, black locust, and purple loosestrife.

The **Shrub Swamp** wetland system includes 0.11 acres of the property.

B. Site Maps

1. **Topographic Map** - A topographic map showing the location of the site and an area within a two mile radius of the site was prepared using the Mohegan Lake, NY (1956, Photorevised 1981) and Croton Falls, NY (1960, Photorevised 1981) USGS 7.5 minute topographic series. This information was photographically enlarged to a scale of 1 in. = 1000 ft. and used as a base upon which the following fish and wildlife resource information was placed:

Resource	Source
Covertypes	1990 Aerial Photogrametry
Waterbodies	Westchester County Environmental Atlas
Streams	Westchester County Environmental Atlas NYSDEC Stream Segment Map
Regulated Wetlands	National Wetland Inventory Maps (Federal) NYSDEC Freshwater Wetlands Map Town of Somers Wetlands Map Aerial Photogrametry
Significant Habitats	NYSDEC Significant Habitats Unit

2. **Covertype Map** - A covertype map showing the location of the site and an area within a one-half mile radius of the site was prepared using the Mohegan Lake, NY (1956, Photorevised 1981) and Croton Falls, NY (1960, Photorevised 1981) USGS 7.5 minute topographic series. This information was photographically enlarged to a scale of 1 in. = 500 ft. and used as a base upon which the following covertype information was placed:

Resource	Source
Covertypes	1990 Aerial Photogrametry
Waterbodies	Westchester County Environmental Atlas
Streams	Westchester County Environmental Atlas NYSDEC Stream Segment Map
Regulated Wetlands	National Wetland Inventory Maps (Federal) NYSDEC Freshwater Wetlands Map Town of Somers Wetlands Map Aerial Photogrametry
Significant Habitats	NYSDEC Significant Habitats Unit

The characteristics and attributes of individually mapped covertypes and aquatic resources are described in Chapter III of this report.

III. NATURAL RESOURCES - FISH AND WILDLIFE

A. FISH AND WILDLIFE RESOURCES AND COVERTYPES

Covertype and Aquatic Habitat Map

Based on available resource information, the following land use and habitat covertypes and aquatic habitats within one half mile of the perimeter of the Baldwin Place site were identified and mapped at a scale of 1 in. = 500 ft. (Appendix B).

Linear Features

This unit includes terrestrial systems of transportation of a linear nature.

Roads - Includes Interstate and State Highways, and secondary road systems, light duty roads and trails.

Utility Corridors - Includes above and below ground telephone, electric, and gas pipelines and transmission lines

Railroads - Includes railway corridors.

Water Resources

This unit includes all hydrological features large enough to be included on a USGS topographic map. In most cases specific water resource characteristics including vegetative and hydrologic attributes can be ascertained through interpretation of the NWI Classification Codes.

Waterbody - Any enclosed body of water be it natural or man-made including lakes, ponds, and reservoirs.

Perennial Stream - This category includes rivers, streams, creeks and other linear water bodies that flow at the surface throughout the year.

Intermittent Stream - Any stream that drys up for part of the year with normal rainfall is classified in this category.

Open-Canopy Wetland - Includes emergent and submergent marshlands.

Forested Wetland - Includes wetlands with a closed deciduous canopy.

Cultural Features

This unit includes land use features of a cultural nature.

Residential - Residential land use includes single and multi-family residential structures to isolated farm homesteads.

Commercial - Includes retails stores, offices, shopping centers, hotels, motels, conference centers.

Industrial - Includes manufacturing and warehouses

Construction - Includes land cleared or altered during the process of construction.

Agricultural Land

Land broadly defined as primarily for the production of food and fiber including the following.

Pasture - Land left fallow or utilized for pasture for grazing animals.

Active Cropland, Hayfield - Land harvested on an annual or semi-annual basis including row crop and forage crops.

Orchard, Tree Farms, Nurseries - Includes lands devoted to fruit or commercial nursery crop production.

Animal/Agriculture - Barnyards, barns, paddocks or other lands devoted to livestock production.

Wooded Land

Brushland, Reverting Pasture - Includes former agricultural lands undergoing the process of old field succession.

Forest - Deciduous - Includes non-needle bearing trees with a closed canopy.

Forest - Conifer - Includes needle bearing trees with a closed canopy.

Open Land

Groomed - Includes ball parks, golf courses, cemeteries and other active recreation lands.

B. FAUNA EXPECTED WITHIN EACH COVERTYPE AND AQUATIC HABITAT

This section presents findings from the data collection efforts for the Baldwin Place Mall fish and wildlife resources. The indigenous wildlife species on the site were noted during field investigations from January to June 1993. General wildlife inventories were conducted and have been supplemented from personal interviews and literature review. Actual sightings, as well as indirect evidence (scat, browse marks, burrows, nests, and tracks) were evaluated and a species list compiled. Species which were not observed but which are known to inhabit various habitats in this geographical locale were added to the list as possible residents. This list should be considered comprehensive but not exhaustive, and therefore representative of the broad range of fish and wildlife likely to be observed in the 16 sq. mi study area. For instance, The Atlas of Breeding Birds in New York State (1988) recorded 176 species of birds that breed in this region (Region 9), 159 of which were confirmed. The highly mobile and seasonal nature of avian populations contributes to the difficulty of verifying the presence/absence of individual species.

Because species and habitat relationships have been based on professional review and scientific documentation, it can be assumed that the relationships presented in the following matrices are valid. However, because of the constantly changing environment and transient nature of migratory species, exceptions to the species/habitat matrices will exist. In addition to specific wildlife lists material is presented on the generalized ecology of herptile, mammal, and bird populations. Material in this section is partially based on excerpts from the Wildlife Resources of Westchester County (1987), The Atlas of Breeding Birds of New York State (1988), Guide to Freshwater Fishes of New York (1980), and local environmental impact statements.

Herptiles

Amphibians and reptiles, known collectively as "herptiles" are among the least known and studied group of vertebrates in Westchester County. Many species are extremely secretive, well camouflaged and active depending on climatic conditions. Therefore, these animals are much harder to observe than other groups of wildlife.

Generalized Ecology

Amphibians and reptiles are "cold blooded" i.e., they have no internal mechanism to control their body temperature but must obtain warmth from their environment to function. This is most often accomplished by basking in direct sunlight or in a sunlight warmed medium such as shallow water or rock outcrops. Even the most terrestrial amphibian, the Red-Backed Salamander, lives in moist and humid microhabitats. Amphibians must seek out moisture in deference to warmth. Amphibians like toads are terrestrial when adult, but must reproduce in aquatic environments. All amphibians lay their eggs in jelly-like clusters or strings that must be kept moist to be viable.

Herptiles are closely coupled to their environment and as a result are extremely vulnerable to habitat destruction. Mobility by these animals is limited and slow. Even relatively minor changes in land use can eliminate a population.

Rivers, streams, lakes, and temporary ponds all serve as reproduction sites for amphibians. As such, filling of wetlands and water pollution can eliminate populations. Herptiles do not construct elaborate nests or dens. Instead, most make use of the most abundant cover available such as rocks, fallen leaves or other debris. Temperature, precipitation, humidity, wind conditions, and time of year all influence herptile activity.

The status of herptiles in Westchester is less secure than birds or mammals. Sixteen species, more than a third present in the County, are classified as endangered, rare or declining. Development alone is not responsible, traders and collectors often capture high numbers of species. Furthermore, amphibian populations may be declining as a result of acid rain.

HERPTILES

Species	FD	FC	BR	FW	EM	OW	RS	STATUS
	HABITAT PREFERENCE							
* Painted turtle (*Chrysemys picta*)					X	X	X	C
* Eastern box turtle (*Terrapene carolina*)	X	X	X	X	X			C
* Snapping turtle (*Chelydra serpentina*)	X	X	X	X	X	X	X	C
* Wood Turtle	X			X	X		X	
Spotted turtle (*Clemmys guttata*)					X	X		
** Northern water snake (*Nerodia sipedon*)					X	X	X	C
** Eastern milk snake (*Lampropeltis triangulum*)		X						C
* Eastern garter snake (*Thamnophis sirtalis*)	X	X	X	X				C
Eastern ribbon snake (*Thamnophis sauritus*)	X	X	X	X				C
Eastern hognose snake (*Heterodon platyrhinos*)	X	X	X	X				U
** Northern ringneck snake (*Diadophis punctatus*)	X	X	X	X				C
* Northern brown snake (*Storeria dekayi dekayi*)	X	X	X	X				C
Northern black racer (*Coluber constrictor*)	X	X	X	X				C
Black rat snake (*Elaphe obsoleta*)	X	X	X	X				U
* Red-spotted newt (*Notophthalmus virdescens*)	X	X	X	X	X			C
* Spotted Salamander (*Ambystoma maculatum*)	X	X		X	X	X	X	U
* Red-backed salamander (*Plethodon cinereus*)	X	X	X	X				A
* Two-lined salamander (*Eurycea bislineata*)						X	X	C

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* Species observed in study area
** Species likely to occupy study area, common
*** Species a potential resident, uncommon
WR = winter resident C= common
SR = summer resident A = abundant
PR = permanent resident U = uncommon
M = migratory

Wildlife Habitat Preference Abbreviations:
FD = Forest, Deciduous FC = Forest, Coniferous
BR = Brushland FW = Forested Wetland
EM = Emergent Wetlands OW = Open Water
RS = Rivers and Streams
P = Primary Habitat S = Secondary Habitat

HERPTILES (Continued)

	FD	FC	BR	FW	EM	OW	RS	STATUS
	HABITAT PREFERENCE							
Marbled Salamander (<u>Ambystoma opacum</u>)	X	X		X	X	X	X	U
Jefferson Salamander (<u>Ambystoma jeffersonianum</u>)	X	X		X	X	X	X	U
Northern Dusky Salamander (<u>Desmognathus fuscus</u>)						X	X	U
Slimy Salamander (<u>Plethodon glutinosus</u>)	X	X						U
Four toed salamander (<u>Hemidactylium scutatum</u>)	X				X			U
* Bullfrog (<u>Rana catesbeiana</u>)					X	X	X	C
* Common gray treefrog (<u>Hyla versicolor</u>)	X	X		X	X			C
Fowler's Toad (<u>Bufo woodhousei fowleri</u>)	X	X	X	X	X	X	X	C
* Spring peeper (<u>Hyla crucifer</u>)	X	X		X	X	X	X	A
* Wood frog (<u>Rana sylvatica</u>)	X	X		X	X	X	X	A
* Pickerel frog (<u>Rana palustris</u>)					X	X	X	C
* Green frog (<u>Rana clamitans</u>)					X	X	X	C
* American toad (<u>Bufo americanus</u>)	X	X	X	X	X	X	X	C

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Mammals

Of all types of wildlife, mammals probably show the highest diversity in body form. In Westchester County alone, size varies from the Masked Shrew at 0.12 ounces to White-tailed deer, which can weigh in excess of 200 pounds. Most mammals are characteristically small, secretive, and are often active only in darkness.

Generalized Ecology

Most mammals, with the exception of Hoary, Silver-haired, Red, and Big Brown bats, are non-migratory. Survival in the winter months is dependent on different strategies. Woodchucks and jumping mice are true hibernators. Squirrels, Eastern Chipmunks, and opossums are active in winter, but stay nest bound during cold and stormy weather. Deer wintering concentration areas do not normally occur in Westchester county due to the lack of severe winter weather. Bats are dormant in winter and highly sensitive to disturbance; any movement they make uses up valuable reserves.

Nesting for hibernation and other activities is frequently underground. Moles and chipmunks dig underground burrows that may be extensive. Woodchucks dig dens that are frequently used by other mammals. Red Foxes, Gray Foxes, skunks and opossums, seek out woodchuck dens, hollow trees or other suitable structures for overwintering. Although some may exist in the same den, one usually moves in after abandonment by the original occupant.

MAMMALS

	HABITAT PREFERENCE							STATUS
	FD	FC	BR	FW	EM	OW	RS	
* Virginia oppossum (*Didelphis virginiana*)	X	X	X	X				C/A
* Star-nosed mole (*Condylura cristata*)	X	X	X	X				C
* Eastern mole (*Scalopus aquaticus*)	X	X	X					C
* Short-tailed shrew (*Blarina brevicanda*)	X	X	X	X				C
* Masked shrew (*Sorex cinereus*)	X	X						C
* House mouse (*Mus musculus*)	X	X	X	X				C
* Deer mouse (*Peromyscus maniculatus*)	X	X	X					C
* Meadow vole (*Microtus pennsylvanicum*)	X	X	X					C
** Pine vole (*Microtus pinetorum*)	X	X	X					C
* Norway rat (*Rattus norvegicus*)	X	X	X	X	X	X	X	C/A
* Muskrat (*Ondatra zibethicus*)				X	X	X	X	C
* Eastern chipmunk (*Tamias striatus*)	X	X	X					C
** Red squirrel (*Tamiasciurus hudsonicus*)	X	X						C
* Gray squirrel (*Sciurus carolinensis*)	X	X		X				C
* Southern flying squirrel (*Glaucomys volans*)	X	X		X				C
* Woodchuck (*Marmota monax*)	X	X	X					C
* Eastern cottontail (*Sylvilagus floridanus*)	X	X	X	X				C

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* Species observed in study area
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MAMMALS (continued)

	HABITAT PREFERENCE							STATUS
	FD	FC	BR	FW	EM	OW	RS	
*** Porcupine (Erethizon dorsatum)	X	X						U
* Striped skunk (Mephitis mephitis)	X	X	X	X				C
* Raccoon (Procyon lotor)	X	X	X	X			X	C
* Longtail weasel (Mustela frenata)				X	X		X	U
* Red fox (Vulpes vulpes)	X	X	X					C
** Gray fox (Urocyon cinereoargenteus)	X	X	X					U
* Coyote (Canis latrans)	X	X	X	X				C
* White-tailed deer (Odocoileus virginianus)	X	X	X	X				A
* Little brown myotis (Myotis lucifugus)	X	X	X					C
** Big brown bat (Eptesicus fuscus)	X	X	X					C
** Red bat (Lasiurus borealis)	X							C
** Water shrew (Sorex palustris)				X			X	C
* Beaver (Castor canadensis)				X	X	X	X	C
** White-footed mouse (Peromyscus leucopus)			X	X				C
** Ermine (Mustela erminea)				X			X	C
** Mink (Mustela vison)				X			X	C

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Wildlife Habitat Preference Abbreviations:
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BR = Brushland FW = Forested Wetland
EM = Emergent Wetlands OW = Open Water
RS = Rivers and Streams
P = Primary Habitat S = Secondary Habitat

Birds

Birds as a group exist over a greater range than any other type of animal. The abundance of knowledge on birds, in comparison to other groups of vertebrates is partially attributable to their largely daylight existence and high visibility.

Generalized Ecology

Westchester County lies in the Atlantic Flyway, one of the three major migration corridors in the continental United States. During the spring and fall, hundreds of thousands of birds move through and over the county. Prior to migration fat is built up as an energy source.

Temperate zone songbird species frequently form large flocks during their migration, travelling by night and dropping into suitable habitat by day to feed and rest. Once spring arrives, these flocks break up and individual birds disperse over breeding areas. Continuous woodlands over 50 acres in size are critical for nesting for many species of neo-tropical migrant birds and must be preserved to insure their continuing survival.

Species that overwinter in the area forage for berries, seed, buds, or other food sources. Sparrows, juncos, grosbeaks, chickadees, and titmice are some of the more familiar types.

The status of avian life in Westchester County is highly variable. Some birds like the mocking bird and bobwhite quail are expanding the northern edge of their range into the county. Others, like the Eastern bluebird, which was once on the decline due to pesticides and competition from House Sparrows, are maintaining their numbers where proper nesting habitat is provided. Cavity nesting birds have been decreasing in number due to removal of dead trees for firewood and landscaping.

Most of the highly successful colonizers of the human dominated environments are species introduced from Europe. Starlings roost in great numbers on buildings, bridges, or other man-made structures. House sparrows forage in parks, city streets and in suburban neighborhoods. These species are considered unprotected pests because they have had a severe negative impact, through direct and indirect competition, on many native species.

Native species fare less well in urban environments. As an area becomes more developed, many species are gradually excluded for a variety of reasons including predation, nest parasitism, and forest fragmentation. Parcels of natural woodland become too isolated and too small to provide the "critical mass" needed by many birds to survive. Frequently only a handful of individuals remain, many non-native and in nuisance numbers due to lack of predators, reduced competition, and artificial food supply. The preservation of large area of native woodlands are critical to the survival to many species of native and migratory birds.

BIRDS

	HABITAT PREFERENCE							STATUS
	FD	FC	BR	FW	EM	OW	RS	
* American woodcock	X	X	X	X				SR
* Wood duck				X	X	X	X	SR
* Mallard				X	X	X	X	SR
* Turkey vulture	X	X	X					SR
Sharp-shinned Hawk	X	X	X					SR
Coopers Hawk	X	X	X					SR-R
Northern Goshawk	X	X	X					WR-R
* Broad-winged Hawk	X	X	X					SR-C
* Red-tailed hawk	X	X	X					PR
* Ruffed grouse	X	X	X					PR-C
* Rock dove			X					PR-C
* Mourning dove			X					PR-C
* Screech owl	X	X	X					PR
Great horned owl	X	X	X					PR
Chimney Swift			X					SR
Ruby-throated hummingbird	X		X					SR
Belted Kingfisher	X						X	SR
Yellow-bellied Sapsucker	X	X	X					
* Northern flicker	X	X	X					PR-C
* Pileated woodpecker	X	X						PR
* Downy woodpecker	X	X						PR-C
* Hairy woodpecker	X	X						PR
+ Eastern Wood-Pewee	X	X						SR
* Eastern kingbird	X	X	X					SR
* Great crested flycatcher	X	X	X					SR
Least Flycatcher	X	X	X					SR
* Great-crested Flycatcher	X	X	X					SR
* Eastern phoebe	X	X	X					SR-C
* Tree swallow			X		X	X	X	SR-A
* Barn swallow			X					SR-C
* Blue jay	X	X	X					PR-A
* American crow	X	X	X					PR-A
* Tufted titmouse	X	X						PR-U

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* Species observed in study area
** Species likely to occupy study area, common
*** Species a potential resident, uncommon
WR = winter resident C= common
SR = summer resident A = abundant
PR = permanent resident U = uncommon
M = migratory

Wildlife Habitat Preference Abbreviations:
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BIRDS (continued)

	HABITAT PREFERENCE							STATUS
	FD	FC	BR	FW	EM	OW	RS	
* Black capped chickadee	X	X						PR-A
* White breasted nuthatch	X	X						PR
* Brown creeper	X	X						SR
House wren			X					SR-C
Carolina Wren			X					SR
Golden-crowned Kinglet	X	X	X					PR
Ruby-crowned Kinglet	X	X						WR
* Eastern bluebird			X					SR
Veery	X	X	X					SR
* Wood thrush	X	X						SR-C
Swainson's Thrush	X	X						U
Hermit Thrush	X	X						SR
* Grey catbird	X	X	X					SR-A
* Northern mockingbird	X	X	X					PR-C
Brown thrasher	X	X	X					SR-C
* Cedar waxwing		X	X		X			PR
* Eastern starling	X	X	X	X				PR-A
* Red-eyed vireo	X	X						SR
White-eyed vireo	X	X						SR
Blue-winged Warbler	X	X	X	X				SR
Tennessee Warbler	X	X	X	X				M
Northern Parula	X	X	X	X				M
Black-throated blue warbler	X	X	X	X				M
Chestnut-sided warbler	X	X	X	X				M-U
* Magnolia warbler	X	X	X	X				M
* Yellow-rumped warbler	X	X	X	X				W-WR
Black-throated green warbler	X	X	X	X				M
* Yellow warbler	X	X	X	X				SR
Blackburnian Warbler	X	X	X	X				M
Pine Warbler	X	X	X	X				M
Palm Warbler	X	X	X	X				M
Blackpoll Warbler	X	X	X	X				M
Black-and-White Warbler	X	X	X	X				M
Cape May Warbler	X	X	X	X				M

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BIRDS (continued)

	HABITAT PREFERENCE							STATUS
	FD	FC	BR	FW	EM	OW	RS	
American Redstart	X	X		X			X	M
Worm-eating Warbler	X	X		X			X	M
Ovenbird	X	X		X			X	M
Northern Waterthrush	X	X		X			X	M
Louisiana Waterthrush	X	X		X			X	M
* Common yellowthroat	X	X		X			X	SR-A
Hooded Warbler	X	X		X			X	M
Canada Warbler	X	X		X			X	M
Scarlet Tanager	X	X		X			X	M
* Northern cardinal	X	X		X			X	PR-C
Rose-breasted grosbeak	X	X		X			X	PR
Indigo Bunting	X	X		X			X	SR
Rufous-sided towhee	X	X		X			X	SR-C
* Song sparrow	X	X		X			X	PR-C
American tree sparrow	X	X	X					WR
* Field sparrow			X					SR-A
* Chipping sparrow	X	X	X					SR
Fox sparrow	X	X	X					M
Swamp Sparrow	X	X	X		X		X	M
* Red-winged blackbird			X		X			SR-A
* Brown-headed cowbird			X					PR-C
* Common grackle	X	X	X					SR-A
* Northern oriole	X	X						SR-C
* House sparrow			X					PR-C
* American goldfinch	X	X	X					PR-C
* House finch			X					PR-C
Common loon						X		M
Pied-billed Grebe						X		M
Double-crested cormorant						X		M
American Bittern					X	X		M
Least Bittern					X	X		M
Great Blue Heron					X	X	X	M
Great Egret					X	X	X	M
Snowy Egret					X	X	X	M
Cattle Egret				X	X	X		M
Green-backed Heron				X	X	X		M
Black crowned Night Heron				X	X	X		M

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BIRDS (continued)

	HABITAT PREFERENCE								STATUS
	FD	FC	BR	FW	EM	OW	RS		
Yellow-crowned Night Heron					X	X			M
Glossy Ibis					X				M
Mute Swan					X	X			PR
Snow Goose					X	X			M
Brant					X	X			M
Canada Goose					X	X			PR
Green-winged Teal					X	X			M
American Black Duck				X	X	X	X		M
Northern Pintail					X	X			M
Blue-winged Teal					X	X			M
Northern Shoveler					X	X			M
Gadwall					X	X			M
American Wigeon					X	X			M
Canvasback					X	X			M
Redhead					X	X			M
Ring-necked Duck					X	X			M
Greater Scaup					X	X			M
Lesser Scaup					X	X			M
Oldsquaw					X	X			M
Common Goldeneye					X	X			M
Bufflehead					X	X			M
Hooded Merganser				X	X				S
Common Merganser					X	X			S
Red-breasted Merganser					X	X			S
Osprey						X			S
Northern Harrier			X		X				S
Rough legged Hawk			X						M
American Kestrel			X						M
Merlin			X						M
Ring-necked Pheasant			X						PR
Wild turkey	X	X	X	X					PR
American Coot					X	X	X	X	M
Semipalmated Plover					X	X	X		M
Killdeer			X			X			M
Greater Yellowlegs						X	X	X	M

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BIRDS (continued)

	HABITAT PREFERENCE							STATUS
	FD	FC	BR	FW	EM	OW	RS	
Lesser Yellowlegs					X	X	X	M
Semipalmated Sandpiper					X	X	X	M
Herring Gull					X	X	X	PR
Common Barn Owl			X					PR
Barred Owl	X	X	X					PR
Long-eared Owl	X	X	X					PR
Short-eared Owl	X	X	X					PR
Northern Saw-whet Owl	X	X	X	X			X	P
Common Nighthawk	X	X	X	X			X	M
Whip-poor-will	X	X	X	X			X	M
Olive-sided flycatcher	X	X		X				M
Yellow-bellied flycatcher	X	X		X				M
Least flycatcher	X	X		X				M
Horned lark			X					M
Purple Martin			X					M
Bank Swallow							X	M
Fish Crow					X	X	X	PR
Red-breasted Nuthatch	X	X		X				PR
Winter wren	X	X		X				PR
Prothonotary Warbler					X	X	X	M
Connecticut Warbler	X	X	X	X				M
Wilson's Warbler	X	X	X	X				M
Dickcissel			X					M
White throated sparrow	X	X	X	X	X		X	M
Dark eyed Junco	X	X		X				M
Bobolink			X					M
Eastern Meadowlark			X					M
Marsh wren					X	X		M
American Robin	X	X	X	X	X		X	PR
European starling	X	X	X	X	X		X	PR
Pine Grosbeak	X	X	X					M
Purple Finch	X	X	X	X			X	PR
Common Redpoll	X	X	X					M
Pine Siskin	X	X	X					M
Evening Grosbeak	X	X	X					M

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** Species likely to occupy study area, common
*** Species a potential resident, uncommon
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PR = permanent resident
M = migratory

C= common
A = abundant
U = uncommon

Wildlife Habitat Preference Abbreviations:
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Fish

Fish easily outnumber all other vertebrate animals combined. About 40,000 species exist in the world; of that number about 218 species are present in New York's fresh or brackish waters. The following is a list of fish that have been observed by NYSDEC fisheries biologists associated with the aquatic resources in the Muscoot River sub-basin between the Putnam county line and the Amawalk Reservoir.

Blacknose Dace (Rhinichthys atratulus)
Longnose Dace (Rhynichthys cataractae)
Cutlips Minnow (Exoglossum maxillingua)
Common Shiner (Notropis cornutus)
Darter (Etheostoma nigrum)
Rock Bass (Ambloplites rupestris)
Pumkinseed Sunfish (Lepmis gibbosus)
Longnose Sucker (Catostomus catostumus)
White Sucker (Catostomus commersoni)
Brook Trout (Salvelinus fontinalis)
Rainbow Trout (Salmo gairdneri)
Brown Trout (Salmo trutta)
Pickerel (Esox americanus)
Creek Chubsucker (Erimyzon oblongus)
Largemouth Bass (Micropterus salmides)
Golden Shiner (Notemigonus crysoleucas)
Creek Chub (Semotilus atromaculatus)
Common shiner (Notropis cornutus)

Endangered, Threatened and Special Concern Species

In New York State, protection of designated species and habitats is administered under section 11-05035 of the Environmental Conservation Law. Endangered species are those that are in immediate danger of extirpation in New York. Threatened species are those considered likely to become endangered in New York. Special concern species are not protected by additional legislation. It is believed these organisms could become endangered or threatened and should be watched carefully.

The New York Natural Heritage Program is intended to identify all natural and artificial ecological communities and rare species in New York State. The program concentrates on the status and distribution of rare plant and animal species and valuable natural communities because they are the most at risk to elimination in the state. Correspondence with the NY Natural Heritage Program (March 5, 1993) did not identify any resident endangered, threatened, or species of special concern within the boundaries of either the Topographic or Covertype Map. In addition, the Natural Heritage Program natural resource database was supplemented with on-site surveys and literature reviews to reinforce the environmental assessment. Based on previous knowledge of the study area, the following list of potential endangered, threatened and species of special concern and associate habitats that may occur within the 16 square mile topographic study area has been prepared.

Endangered	Habitat
Bald Eagle	Open Water/Transitory

Threatened	Habitat
Osprey	Open Water/Transitory

Special Concern	Habitat
Jefferson Salamander	Vernal Wetland/Woodlands
Spotted Salamander	Vernal Wetland/Woodlands
Spotted Turtle	Emergent Marsh/Woodlands
*Wood Turtle	Emergent Marsh/Woodlands
Eastern Hognose Snake	Woodlands
Eastern Bluebird	Newfield/Oldfield

* - confirmed, Kroger Park

IV. Value of Fish and Wildlife Resources

Chapter II of this report describes the land use type and physical characteristics within one-half mile radius of the Baldwin Place Mall site. Chapter III of this report describes the vegetative covertypes and fish and wildlife known or expected to be associated with these covertypes. This chapter provides a qualitative assessment of the valuation of the identified covertypes for fish and wildlife habitat including requirements for food, seasonal cover, bedding areas, and brooding and roosting sites. The current and potential use of the fish and wildlife resource is also described. Where possible, the qualitative significance of resources as specified in the existing Federal, State and Local regulatory framework is used to provide a value to identified resources.

Significantly, the Muscoot River is the main collector stream for all flow in the Muscoot River sub-basin of the Croton River Basin. All surface flow from the Baldwin Place site is confined to the Muscoot River sub-basin. Therefore, if Contaminate-Specific Impact Analysis is concluded to be necessary, it is recommended that future investigation be limited to the Muscoot River sub-basin.

WETLANDS

Wetlands are protected on the Federal, State and Local level because of the values they provide society. The functions and relative values of freshwater wetlands are determined by biophysical elements such as the position of the wetland on the landscape, the geology and hydrology of the site, and the substrate and vegetation of the wetland. Generally wetlands provide a wide variety of functions including habitat for fish and wildlife, environmental quality values (eg., water quality), socio-economic values (such as flood desynchronization), and recreational and aesthetic values (Table IV-1).

Federal - The US Fish and Wildlife Service has designed and conducted an inventory on much of the nation's wetlands. The goal of the National Wetland Inventory (NWI) is to generate and disseminate scientific information on the characteristics and extent of the Nation's wetlands. The information on the NWI map is an excellent source of general boundaries and characteristics. The NWI is not intended to map regulated wetlands boundaries, in part because State and Local wetland regulations vary widely. The classification of a NWI mapped wetland is coded by a series of letters and numbers. The key to this classification system is contained in Appendix B of this report. A total of 26 wetland areas ranging from just under one acre to several hundred acres were identified in the central one-half mile study area (See Covertype Map).

TABLE NO. IV-1

LIST OF MAJOR WETLAND VALUES.
(Adapted from Tiner, 1984)

- Fish and Wildlife Values
    * Fish and Shellfish Habitat
    * Waterfowl and Other Bird Habitat
    * Furbearer and Other Wildlife Habitat

- Environmental Quality Values
    * Water Quality Maintenance
        * Pollution Filter
        * Sediment Removal
        * Oxygen Production
        * Nutrient Recycling
        * Chemical and Nutrient Absorption
    * Aquatic Productivity
    * Microclimate Regulator

- Socio-Economic Values
    * Flood Control
    * Wave Damage Protection
    * Erosion Control
    * Groundwater Recharge and Water Supply
    * Timber and Other Natural products

- Recreational and Aesthetics
    * Fishing and Shellfishing
    * Hunting and Trapping
    * Passive Recreation (nature study, bird watching)
    * Boating
    * Education and Scientific Research

State - New York state regulates freshwater wetlands under Article 24 of the NYS Environmental Conservation Law. Freshwater wetland means lands and waters of the State which meet the definition provided in section 24-0107(1) of the act and have an area of at least 12.4 acres or, if smaller, have unusual local importance as determined by the commissioner. Section 664.5 establishes a system of classification that establishes four separate classes that rank wetlands according to their ability to perform wetland functions and provide wetland benefits. Class I wetlands have the highest rank, the ranking descends through Class II, II, and IV.

The following is a list of State mapped and regulated wetlands within one-half mile of the Baldwin Place Mall site.

Designation	Class
ML-10	II

The following is a list of State mapped and regulated wetlands within two miles of the Baldwin Place Mall site (See Topographic Map).

Designation	Class
A-2	II
A-3	II
A-13	II
A-23	II
ML-7	II
CF-1	II
CF-2	III
F-26	II

Local - Wetlands are regulated at the local level by the two municipalities that occur within the 16 square mile study area. The Town of Carmel, Putnam County, regulates wetlands under Chapter 62 of Local Law. The Town of Somers regulates wetlands under the "General Regulations for Environmentally Sensitive Lands." Both municipalities have prepared Town Wetland Maps that show the general location of wetlands within their boundaries. For purposes of graphic clarity locally regulated wetland have not been included on the topographic or cover type map included in this report. For the most part, the local wetland maps are duplicative of the combined information contained on the Federal NWI and State Wetland Maps.

WATERCOURSES/WATERBODIES

Watercourses and waterbodies are regulated under Article 15 of New York State Conservation Law. The classification shown on the topographic and cover type maps have been taken from NYSDEC maps based on a coding system covering all waters in the state. Water quality classifications are descriptive designations assigned under state regulations to all waters, defining the best way each body of water can be used. The following list of stream segments is alphanumerically keyed to the stream segment maps prepared by the NYSDEC. Stream classifications indicated here are from ECL 6NYCRR Part 864, dated November 11, 1992.

Map Reference No.	Classification
H-31-P44-14 Muscoot River from P50 Amawalk River to Source	A
P50 Amawalk Res.	A
P50-1, 2, 1-1, 1-2 Amawalk Res. Tribs.	B
P50f, P50c, P50d, P50e Amawalk Res. Subtribs.	B
P50g, Granite Lake	B

Muscoot river - The most significant fish and wildlife resource, both within the one-half mile radius study area and within two miles downstream of the site, is the Muscoot River including the Amawalk Reservoir, and its associated wetlands, open water, and riparian areas. This aquatic resource provides values in terms of provision of habitat to associated fauna and as a recreational and potable water resource to humans. The Muscoot River (H-31-P44-14) has received a Class A(T) rating meaning that the water is suitable for both human consumption and trout propagation and survival. The Muscoot River corridor and Amawalk Reservoir are part of the New York City Public Water Supply lands. Each spring the Muscoot River, between the Amawalk Reservoir and the Putnam county line is stocked with 400 Rainbow and 400 Brown trout providing recreational opportunities. In addition, the wide diversity of wetlands, open water, and riparian areas associated with the riverine corridor provides excellent, cover, nesting and breeding habitat for a wide variety of birds, mammals herptiles and fish.

The portion of the Muscoot River between the Putnam County Line and the Amawalk Reservoir was last surveyed by NYS DEC fisheries biologists in July 1962. At that time the following physical and chemical parameters were recorded:

Average Width	11.0 ft
Depth	1 - 2 ft
Velocity	Slow/Stagnant
Flow	2.3 cfs
Color	Clear
Turbidity	None
Bottom	Rocky, sand, silt
Habitat	
% pool	75%

Notes: Very weedy, poor habitat. Bottom had heavy growth of filamentatous algae.

Terrestrial Resources

Koegel Park - The 63 acre Koegel Park is located to the south of the Baldwin Place site, just outside of the one-half mile Covertype Map radius. The park's topography and dense woodlands make it unsuitable for active uses that require large, cleared land areas and therefore the area was designated as a passive recreational area park by the 1983 Somers Master Plan. Primary uses are nature study and hiking.

Significant Habitats

The New York Natural Heritage Program is intended to identify all natural and artificial ecological communities and rare species in New York State. The program concentrates on the status and distribution of rare plant and animal species and valuable natural communities because they are the most at risk to elimination in the state. Correspondence with the NY Natural Heritage Program (March 5, 1993) did not identify any specific areas containing resident endangered, threatened, or species of special concern within the boundaries of either the Topographic or Covertype Map.

V. PATHWAY ANALYSIS

The purpose of Step I of the Fish and Wildlife Habitat Assessment was to identify the fish and wildlife resources present in the vicinity of the Baldwin Place Mall site and to provide a qualitative assessment of that resource. Step I of this report did not draw conclusions regarding contaminant-specific impacts, rather the Step I Habitat Assessment addressed only <u>potential</u> fish and wildlife concerns associated with site conditions and/or remediation.

The Step I study concluded that all surface flow from the Baldwin Place Mall site is confined to the Muscoot River sub-basin and therefore all future studies should be confined to this watershed. The Step I study further concluded that the most significant fish and wildlife resource, both within the one-half mile radius study area and within two miles downstream of the site, is the Muscoot River including the Amawalk Reservoir, and its associated wetlands, open water, and riparian areas.

In Step II pathways of migration and exposure were identified. Predicated on the results of the pathway analysis, impact was to be assessed as minimal if (1) no significant resources or potential pathways are present, or (2) there has been no constituent migration along these pathways. Demonstration of minimal impact would eliminate the need for further analyses.

On June 2, 1993, the three surface-water/sediment (SW/SD) sample pairs from the eastern stream and the catch basin sediment sample that were specified in the RI/FS Work Plan were collected. As part of this sampling event, an additional surface-water/sediment sample pair in the western stream was collected, based on the northwest component of shallow groundwater flow toward this stream that was indicated by the 1992 preliminary assessment (Uhl, 1992a). As shown on Figure V-1, these samples were taken in the following locations:

SW/SD-01 Northern (upstream) point in the eastern stream near the location of Staff Gauge SG-1.

SW/SD-02 Intermediate point in the eastern stream at the BPM wastewater treatment plant outfall.

SW/SD-03 Southern (downstream) point in the eastern steam, near the southern site boundary.

SW/SD-04 Point in the western stream, just north of where the stream crosses under Route 6.

SD-05 Stormwater catch basin on the western part of the BPM.

The eastern stream has two channels, to the west and east of the abandoned railroad embankment (Fig. V-1). Shortly downstream of the wastewater treatment plant outfall, the eastern channel partially flows under a bridged section of the embankment of the western channel. The eastern stream samples were all collected from the western channel; sample SW/SD-03 was collected just downstream of the merge of the eastern and western channel.

The June 2, 1993 investigation by Vincent Uhl Associates demonstrated that the primary surface pathway of migration for tetrachloroethylene (PCE, the primary constituent of interest) was the western stream (Table V-1). Based on this investigation, additional constituent analysis was performed offsite in the "western stream" surface water corridor (Fig. V-1).

Surface water and sediment samples were collected on October 15, 1993 in accordance with the protocol outlined in the "Field Sampling Plan" Appendix K, Revision 0, prepared by Vincent Uhl Associates dated July 24, 1992. Three sample pairs were collected in segments of the western stream over a 1,500-foot distance, and one sample pair was collected in a tributary drainage pathway that receives contribution from the area northeast of the Baldwin Place intersection. These samples were collected based on the Route 6 commercial well results which indicated offsite PCE migration in groundwater in the western/northwestern direction. As shown on Figure V-1, four surface water-sediment sample pairs were collected at the following locations:

<u>SW/SD-06</u> Point in western stream approximately 350 feet downstream of the SW/SD-04 location.

<u>SW/SD-07</u> Point in western stream downstream of the first unnamed pond and upstream of Kennard pond.

<u>SW/SD-08</u> Point in western stream approximately midway between the outlet of Kennard Pond and Lake Baldwin.

<u>SW/SD-09</u> Near the outlet of the drainage culvert at the intersection of Kennard Road and Baldwin Place Road, in the drainage pathway that joins the western stream approximately 500 feet from this intersection.

On December 9, 1993, a second supplemental surface-water/sediment sampling event was conducted during which two sample pairs were collected in a small drainage ditch on the south side of Route 6 and west of McDonalds. This drainage ditch conveys runoff from the area west of McDonalds to a culvert that crosses under Route 6 just east of the Texaco (former Sunoco) station and ultimately empties into Lake Baldwin (Fig V-1). Seepage from the hillside directly west of McDonalds has been noted (less than 0.1 gpm) and serves as a source of flow in this drainageway. As shown on Figure V-1 the samples were collected in the following locations.

<u>SW/SD-10</u> Point in drainage ditch 50 feet downstream (west) from where the seepage begins.

<u>SW/SD-11</u> Point in drainage ditch about 800 feet from where the seepage begins.

The results of these analyses are summarized in Table V-3.

The surface-water and sediment samples were collected during dry periods of base flow conditions. During each event, sampling proceeded from downstream to upstream locations. At each sampling location, the surface-water sample was collected first, followed by the sediment sample. During surface-water sampling care was taken to avoid disturbance of the underlying materials.

The results of the sampling indicated that a limited area within the western stream and the tributary drainage ditch (running along the south side of Route 6) are the only surface water areas adjacent to Baldwin Place Mall where site-related contaminants appear. Furthermore, constituent migration ends well before the western stream's confluence with the Muscoot River.

The ecological risk posed by the identified levels of contaminants found in each of the sampling occasions was examined by Environmental Standards, Inc., (ESI) in the "Draft Baseline Risk Assessment For the Baldwin Place Mall Site in Somers, New York" (Remedial Investigation Report, Appendix N). A summary comparison of chemicals of concern to Freshwater Chronic Values is presented in Table V-4. The ESI report concluded that the "results show that no chemical analyzed in surface water poses a risk to the freshwater aquatic life or its uses at the Baldwin Place Mall site. Results of the ecological analysis of sediment demonstrated no environmental risk". This report went on to further state that "This analysis demonstrated that no ecological risks exist as a consequence of contamination and release of contamination at the site."

CONCLUSIONS

According to the "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Site" (NYSDEC, 1991) demonstration of minimal impact from the *Pathway Analysis* eliminates the need for further analyses. The results of the *Pathway Analysis* from the October 15, 1993 sampling clearly showed that the impact was minimal. This finding was confirmed in the Environmental Standards, Inc., (ESI) report entitled "Draft Baseline Risk Assessment For the Baldwin Place Mall Site in Somers, New York" which concludes that "This analyses demonstrated that no ecological risks exist as a consequence of contamination and release of contamination at the site." Based on the finding of no impact to fish and wildlife resources, further studies are not warranted.

TABLE V-1. SUMMARY OF RI ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS IN SURFACE WATER AND SEDIMENT (FIRST EVENT); BALDWIN PLACE MALL, SOMERS, NEW YORK.

	BPM-SW-01 Eastern Stream North (SG-1)	BPM-SW-02 Eastern Stream WW Outfall	BPM-SW-03 Eastern Stream South (of Bridge)	BPM-SW-04 Western Stream Just North of Rt. 6	BPM-SW-04 R Western Stream Just North of Rt. 6	BPM-SW-04 B Field Blank	TRIP BLANK Trip Blank
SAMPLE DATE	6/2/93	6/2/93	6/2/93	6/2/93	6/2/93	6/2/93	6/2/93
TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS	ND						ND
Acetone		9 J					
Bromodichloromethane		46	31				
Chloroform		200	120				
Dibromochloromethane		11	8 J				
Methylene Chloride		1 B	1 B			1 J	
Methyl Tert Butyl Ether				18	17		
Tetrachloroethylene				1 J	1 J		
Toluene			2 J				
Xylene (Total)				7 J	6 J		
TENTATIVELY IDENTIFIED VOLATILE ORGANIC COMPOUNDS	ND*	ND*	ND*	*	*	ND*	ND*
2,3-dihydro-1H-Indene				6 J	5 J		
2,3-dihydro-4-methyl-1H-Indene				5 J			

	BPM-SD-01 Eastern Stream North (SG-1)	BPM-SD-02 Eastern Stream WW Outfall	BPM-SD-03 Eastern Stream South (of Bridge)	BPM-SD-04 Western Stream Just North of Rt. 6	BPM-SD-05 Catch Basin	BPM-SD-04 B Field Blank	TRIP BLANK Trip Blank
SAMPLE DATE	6/2/93	6/2/93	6/2/93	6/2/93	6/2/93	6/2/93	6/2/93
TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS							ND
Acetone	21 J	7 J	9 J	27 J	21 J		
Carbon Disulfide						5 J	
Chloroform		6 J					
Tetrachloroethylene				4 J			
Xylene (Total)					2 J		
TENTATIVELY IDENTIFIED VOLATILE ORGANIC COMPOUNDS				ND	ND		ND
2-Propanol	11 J R	19 J R	16 J R			7 J	

ND - None Detected.
Surface Water (SW), aqueous field blank (B) and trip blank sample concentrations are shown in micrograms per liter (µg/L).
Sediment (SD) sample concentrations are shown in micrograms per kilogram (µg/Kg), dry weight.
Only those compounds detected are shown on the table. The complete analytical data spreadsheets are provided in Appendix B.
B - Result is qualitatively suspect since this compound was detected in field and/or laboratory blanks at similar levels.
J - Quantitation is approximate due to limitations identified during data validation (below the method quantitation limit or based on QC criteria). Also used for tentatively identified compounds.
R - Unreliable result. Compound may or may not be present in sample.
* - Blank contaminants and/or laboratory artifacts are not shown.
Samples were analyzed by Envirotech Laboratories, Inc., Newburgh, New York.

TABLE V-2. SUMMARY OF RI ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS IN SURFACE WATER AND SEDIMENT (SUPPLEMENTAL EVENT); BALDWIN PLACE MALL, SOMERS, NEW YORK.

	BPM-SW-06 Western Stream Upstream of First Pond	BPM-SW-07 Western Stream Downstream of First Pond	BPM-SW-08 Western Stream Upstream of Lake Baldwin	BPM-SW-09 Drainage to Western Stream BPM Intersection	BPM-SW-08 B Field Blank	TRIP BLANK Trip Blank
SAMPLE DATE	10/15/93	10/15/93	10/15/93	10/15/93	10/15/93	10/15/93
TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS		ND	ND		ND	ND
Acetone				8 B		
Methyl Tert Butyl Ether	8 J			2 J		
Tetrachloroethylene	2 J					
TENTATIVELY IDENTIFIED VOLATILE ORGANIC COMPOUNDS	ND*	ND*	ND*	ND*	ND*	ND*

	BPM-SD-06 Western Stream Upstream of First Pond	BPM-SD-07 Western Stream Downstream of First Pond	BPM-SD-08 Western Stream Upstream of Lake Baldwin	BPM-SD-09 Drainage to Western Stream BPM Intersection	BPM-SD-08 B Field Blank	TRIP BLANK Trip Blank
SAMPLE DATE	10/15/93	10/15/93	10/15/93	10/15/93	10/15/93	10/15/93
TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS	ND					ND
Acetone		38	58 J			
Methylene Chloride				9 J		
1,1,1-Trichloroethane					1 J	
TENTATIVELY IDENTIFIED VOLATILE ORGANIC COMPOUNDS	ND		ND	ND	ND	ND*
Unknowns (Total)		14 J				

ND - None Detected.
Surface Water (SW), aqueous field blank (B) and trip blank sample concentrations are shown in micrograms per liter (µg/L).
Sediment (SD) sample concentrations are shown in micrograms per kilogram (µg/Kg), dry weight.
Only those compounds detected are shown on the table. The complete analytical data spreadsheets are provided in Appendix B.
B - Result is qualitatively suspect since this compound was detected in field and/or laboratory blanks at similar levels.
J - Quantitation is approximate due to limitations identified during data validation (below the method quantitation limit or based on QC criteria). Also used for tentatively identified compounds.
* - Blank contaminants and/or laboratory artifacts are not shown.
Samples were analyzed by Envirotech Laboratories, Inc., Newburgh, New York.

Vincent Uhl Associates

TABLE V-3. **SUMMARY OF RI ANALYTICAL RESULTS FOR VOLATILE ORGANIC COMPOUNDS IN SURFACE WATER AND SEDIMENT (SUPPLEMENTAL EVENT): BALDWIN PLACE MALL, SOMERS, NEW YORK.**

	BPM-SW-10 Drainage to Western Stream Near Seepage at Route 6	BPM-SW-11 Drainage to Western Stream West on Route 6	TRIP BLANK Trip Blank
SAMPLE DATE	12/9/93	12/9/93	12/9/93
TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS		ND	ND
Tetrachloroethylene	1 J		
TENTATIVELY IDENTIFIED VOLATILE ORGANIC COMPOUNDS	ND*	ND*	ND*

	BPM-SD-10 Drainage to Western Stream Near Seepage at Route 6	BPM-SD-11 Drainage to Western Stream West on Route 6	TRIP BLANK Trip Blank
SAMPLE DATE	12/9/93	12/9/93	12/9/93
TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS		ND	ND
Acetone	8 J		
Tetrachloroethylene	4 J		
TENTATIVELY IDENTIFIED VOLATILE ORGANIC COMPOUNDS		ND*	ND*
Unknowns (Total)	7 J*		

ND - None Detected.
Surface Water (SW), aqueous field blank (B) and trip blank sample concentrations are shown in micrograms per liter (µg/L).
Sediment (SD) sample concentrations are shown in micrograms per kilogram (µg/Kg), dry weight.
Only those compounds detected are shown on the table. The complete analytical data spreadsheets are provided in Appendix B.
B - Result is qualitatively suspect since this compound was detected in field and/or laboratory blanks at similar levels.
J - Quantitation is approximate due to limitations identified during data validation (below the method quantitation limit or based on QC criteria). Also used for tentatively identified compounds.
* - Blank contaminants and/or laboratory artifacts are not shown.
Samples were analyzed by Envirotech Laboratories, Inc., Newburgh, New York.

Vincent Uhl Associates

Table V-4
Comparison of Maximum Concentrations in Surface Water and Sediment with Freshwater Ambient Water Quality Criteria and Provisional Sediment Criteria, Respectively.
Big V Supermarkets, Baldwin Place Mall, NY

Chemical	Maximum Conc. Detected in Surface Water (mg/l)	Chronic AWQCs Protective of Freshwater Organisms(1) (mg/l)	Maximum Conc. Detected in Sediment (mg/kg)	Provisional Sediment Criteria (2) (mg/kg)	Do any Concs. Exceed AWQCs or Sediment Criteria?
Acetone	ND	NA	0.0481	NA	
Methylene chloride	ND	1.24 (a)	0.009	0.769 (a)	no
Tetrachloroethylene	0.002	0.84 (b)	0.004	6.05	no
Xylene (total)	0.00594	5.01 (c,d)	ND		no

(1) Ambient Water Quality Criteria from EPA's Quality Criteria for Water, 1986.
(2) Provisional Sediment Criteria Methodology (McCall, et al,. 1983)
ND = Not Detected in Media of Concern
NA = Not Available
(a) Criteria for chloroform is provided on a provisional basis as EPA has not developed any criteria for methylene chloride.
(b) Insufficient data to develop criteria. Value presented is the Lowest Observed Effect Level (LOEL).
(c) Criteria for toluene is provided on a provisional basis as EPA has not developed any criteria for xylene.
(d) Provisional Chronic Criteria generated from chronic/acute ratio of numerous chemically-related compounds.

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APPENDIX A

PLANT LIST WITH BOTANICAL NOMENCLATURE

The following plant species were identified on the Baldwin Place site during field investigation from January to July, 1993. No rare or endangered plant species were identified.

TREES

Red maple (Acer rubrum)
American elm (Ulmus americana)
White ash (Fraxinus americanus)
Black cherry (Prunus serotina)
Black locust (Robinia pseudoacacia)
Cottonwood (Populus deltoides)

SHRUBS

Spicebush (Lindera benzoin)
Winterberry (Ilex verticillata)
Arrowwood (Viburnum dentatum)
Tartarian honeysuckle (Lonicera tartarica)
Grey-stemmed dogwwod (Cornus racemosa)
Staghorn sumac (Rhus typhina)
Pussy willow (Salix discolor)
Multiflora rose (Rosa multiflora)

HERBACEOUS PLANTS AND VINES

Jewelweed (Impatiens capensis)
Tusseck sedge (Carex stricta)
Skunk cabbage (Symplocarpus foetidus)
Purple loosetrife (Lythrum salicaria)
Swamp loostrife (Decodon verticillatus)
Blackberry (Rubus alleghaniensis)
Phragmites (Phragmites autralis)
Pokeweed (Phytolacca americana)
Goldenrod (Solidago spp.)

FERNS

Cinnamon fern (Osmunda cinnamomea)
Sensitive fern (Onoclea sensibilis)
Marsh fern (Thelypteris palustris)

APPENDIX N

**BASELINE RISK ASSESSMENT
(ENVIRONMENTAL STANDARDS, INC.)**

Environmental Standards, Inc.

BASELINE RISK ASSESSMENT FOR THE

BALDWIN PLACE MALL SITE IN SOMERS, NEW YORK

August, 1994

Prepared for:

BIG V SUPERMARKETS, INC.
FLORIDA, NEW YORK

Prepared by:

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

EXECUTIVE SUMMARY

This baseline risk assessment presents an analysis of potential risks to human health and the environment, associated with exposures to site-related chemical constituents, under current and potential future site conditions at the Baldwin Place Mall site, Somers, New York based on all the Remedial Investigation (RI) sampling data. The contamination source area of concern at the site has been identified in the RI as an alleyway near the backdoor of the dry cleaners located on-site. The area was previously used to store tetrachloroethylene (PCE) drums. Dry cleaning processing was performed at the site until at least May 1991.

The water supply for Baldwin Place Mall consists of two production wells located on the south part of the site. A granular activated carbon (GAC) filter system was installed on the production wells in April 1989 to remove PCE and trichloroethylene (TCE) concentrations from the water supply. The McDonalds restaurant well, also located on-site, is presently equipped with a GAC filter system to remove methyl tert-butyl ether (MTBE) and PCE. GAC filters have, additionally, been installed by Big V Supermarkets at seven nearby residential homes and two commercial establishments where PCE concentrations in groundwater exceed the applicable drinking water standard, the Maximum Contaminant Level (MCL), of 0.005 mg/l.

At this time all residential and commercial water supplies analyzed during the RI are currently meeting MCLs and are, therefore, adequately protected. This is assuming that regular maintenance on the existing GAC filter systems will continue. It is also assumed that the GAC filters will not be dismantled until the groundwater has been remediated or an alternate water supply provided. Additionally, if any further residential wells detect levels of PCE attributable to the site above the MCL of 0.005 mg/l, a GAC filter will be installed or an alternate water supply provided. The combined total hazard index for this group of exposed individuals is estimated to be 0.08, which is well below unity, and indicates no possible health hazards other than very minimal added risk of cancer (which may be zero).

Under the assumption that the concentrations of constituents detected in the residential, commercial and on-site deep monitoring wells would be used for future domestic use (without any treatment), a carcinogenic risk of 5×10^{-5} is estimated. This risk, while within EPA's acceptable target risk range of 1×10^{-4} to 1×10^{-6}, exceeds the *de minimis* benchmark level of 1×10^{-6}. The combined hazard index for the future residents is estimated to be 1.0. This scenario was incorporated into the risk assessment to indicate that groundwater remediation is necessary to ensure future residential use of groundwater.

Under potential future conditions, construction workers are estimated to incur an upper bound cancer risk of 1×10^{-5} and a hazard index of 6.0, and future office workers in a future building constructed over areas of soil contamination are estimated to incur a cancer risk of 9×10^{-6} and a hazard index of 2.0. These potential cancer risk and adverse health hazards are all attributable to PCE contamination in the soil near the dry cleaners. An analysis of the RI soil sampling data indicates that the risk is associated with the concentrations in two soil borings TB-1 and TB-2.

The results of the ecological assessment of the surface water in the vicinity of the site indicate that no chemical analyzed in surface water poses a risk to the freshwater aquatic life or its uses at the Baldwin Place Mall site. Results of the ecological analysis of sediment, additionally demonstrated no environmental risk.

1.0 INTRODUCTION

This baseline risk assessment presents an analysis of potential risks to human health and the environment, associated with exposures to site-related chemical constituents, under current and potential future site conditions at the Baldwin Place Mall site, Somers, New York based on all Remedial Investigation (RI) sampling data. The results of the assessment are used to document the magnitude of risk associated with a site, and to identify the major contributors to that risk, in order to support a "no-action" alternative where appropriate, or to determine whether additional remediation is necessary to be protective of human health and the environment.

The site is approximately 28-acres in area and is bounded by U.S. Route 6 on the northwest, undeveloped property on the west and south boundaries, an abandoned railroad embankment on the east and Route 118 on the north. The RI prepared by Vincent Uhl Associates, Inc. presents a site map in Figure 2-1.

Baldwin Place Mall was constructed in 1965. According to historical photographs, an orchard was present on the site before the development of Baldwin Place Mall. Big V Supermarkets, Inc. purchased the site in July 1986. Currently, most of the mall is vacant and the few existing tenants consist of a post-office, commercial offices and various retail stores including a dry cleaners.

Additionally, a McDonalds restaurant and an Exxon service station are located on the northwest section of the site. Two residences (only one is currently tenanted) are situated in the northeast part of the site. The sanitary wastewater from the mall is handled by an on-site treatment plant located on the southeast part of the site.

The contamination source area of concern has been identified in the RI as an alleyway near the backdoor of the dry cleaners located on-site. The area was previously used to store tetrachloroethylene (PCE) drums and the asphalt in this area is very deteriorated, possibly due to PCE spills. Dry cleaning processing is currently being performed off-site. However, until at least May 1991 processing occurred at Baldwin Place Mall dry cleaners.

In addition to the Baldwin Place Mall site as a source of contamination of groundwater, three of the four service stations located near the site along Route 6 (Exxon, Citgo and Texaco) have active groundwater recovery systems in place to recover gasoline constituents currently contaminating groundwater.

The baseline risk assessment was prepared following accepted U.S. Environmental Protection Agency (EPA) procedures and guidelines (EPA, 1989a). The assessment estimates risk by utilizing conservative point estimates of exposure parameters. Parameters are selected in order that the resulting exposure estimate represents the reasonable maximum exposure (defined as the maximum exposure reasonably expected to occur under a given set of conditions.) The comprehensive approach used in risk assessment is designed to estimate risks posed by soil, surface water, ground water, and air pathways.

2.0 METHODOLOGY

The process of collecting and assessing human health risk information is adapted from well-established chemical risk assessment principles and procedures (*e.g.*, EPA's *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual,* 1989a). Risk assessment is a continually evolving discipline which incorporates information gained from past experience and ongoing scientific research. The process traditionally involves four basic steps:

1) Data Evaluation - the preparation of relevant and appropriate data sets used as the basis of the risk assessment.

2) Exposure Assessment - the identification of relevant exposure pathways and populations at probable risk, estimation of exposure-point concentrations, and estimation of average daily intakes.

3) Toxicity Assessment - the determination of chemical dose-response relationships and daily intake levels at which no adverse effects (or unacceptable cancer risks) can reasonably be anticipated to result.

4) Risk Characterization - a comparison of estimated daily chemical intake levels with acceptable daily intake levels to generate quantitative expressions of hazard (for noncarcinogens) and the upper limits of probability of causing cancer (for carcinogens).

Site-specific data are used, wherever available, in the risk assessment process. When specific information is lacking, conservative assumptions or default values, generally representing a reasonable maximum exposure scenario (or toxic threshold), are utilized. This affords additional margins of safety which will almost certainly result in overestimation of risk or underestimation of acceptable chemical residue concentrations.

Various EPA guidance documents (*e.g.*, *Exposure Factors Handbook*, 1989b) provide recommendations on the use of certain conservative default assumptions (exposure coefficients) for risk assessment purposes. In general, these recommended values have been applied in this exercise. Where scientific information is available regarding specific exposure or toxicity parameters, this is preferred over the use or worst-case or default assumptions, as stated in the National Contingency Plan (1988).

The specific assessment methods utilized in this analysis for each of the outlined basic steps are detailed in the following sections.

3.0 DATA EVALUATION

3.1 Site-Soil Characterization

Data from all the RI soil boring samples in the unsaturated zone were combined for estimation of site-wide soil. It is assumed that soil from all intervals of the unsaturated zone could become "surface" soil in the future, due to movement and/or mixing of soil during site preparation activities. This data set is appropriate for estimating the potential risks posed by direct soil contact to construction workers, and inhalation exposure by nearby residents. For the purpose of this assessment, it was also conservatively assumed that children will be exposed to the same concentrations in soil. Soil data relevant to plausible exposures are comprised of all RI samples collected to depths from 0 to 4 feet. Results from all RI borings in the unsaturated zone were combined to calculate a mean, standard deviation, and upper 95th confidence limit on the mean (UCL).

A few pesticide compounds were detected in the soil. These compounds were not included in the risk assessment of Baldwin Place Mall, as the constituents of concern are the dry cleaners-related compounds. The pesticide compounds may have originated from the agricultural land use of the site prior to the construction of the Baldwin Place Mall. The dry cleaner-related compounds are all volatile organic compounds (VOCs) (*e.g.*, PCE and its breakdown products, TCE and 1,2-dichloroethylene). In addition, polyaromatic hydrocarbons (PAHs) were not included in the risk assessment. PAHs were only detected in TB-6 which represents an on-site background sample and were not detected in any other soil boring results. This indicates that the isolated PAH contamination is not site-related.

3.2 Groundwater Characterization

The water supply for Baldwin Place Mall consists of two production wells located on the south part of the site. A granular activated carbon (GAC) filter system was installed on the production wells in April 1989 to remove PCE and TCE concentrations from the water supply. According to Leggette, Brashears & Graham (1988), the two on-site residences are also connected to the site water supply system.

The Exxon service station located on-site has an operating groundwater remediation system. The remediation system consists of two recovery wells, one shallow and one in bedrock, to recover groundwater containing dissolved petroleum hydrocarbon components (BTEX) and a gasoline additive, methyl tert-butyl ether (MTBE). The McDonalds restaurant well, also located on-site, is presently equipped with a GAC filter system to remove MTBE and PCE contamination.

According to the RI:

> The dry cleaner-related compounds (PCE and its breakdown products TCE and 1,2-DCE) are the constituents of concern in groundwater at the BPM site, and their concentration distribution is consistent with a sole contaminant source at the dry cleaners. As a result of the groundwater divide, these compounds are emanating in both the southeasterly and westerly directions from the dry cleaners proximity.
>
> Comparable PCE concentrations are present in monitoring wells located to both the southeast and west of the shallow groundwater divide near the dry cleaners. The highest PCE concentrations detected [in onsite monitoring wells outside of the source area] were 910 μg/l in southeastern well MW-5D and 850 μg/l in

western well MW-9S. TCE (up to 190 $\mu g/l$) and 1,2-DCE (up to 61 $\mu g/l$) concentrations were also detected in southeastern and western monitoring wells.

In the east/southeastern part of the site, downward migration of contaminants from the shallow groundwater in the glacial till into the weathered bedrock/ bedrock occurs within a very short distance from the source area as demonstrated by the concentrations in Monitoring Well MW-5D. Monitoring Wells MW-3D and MW-3DD appear to be just east of the area in the bedrock aquifer that is the primary southeastern constituent migration pathway.

In the western part of the site, the finding of the highest concentrations at the MW-9 cluster is consistent with the shallow water-level contours which indicate that this well cluster is located directly downgradient of the dry cleaners. The vertical component of groundwater flow is more gentle here than on the east/southeastern part of the site, and this is reflected in the Monitoring Well MW-9S PCE concentration which is higher than in deeper well MW-9D. The MW-7 and MW-1 cluster locations appear to be just north, and MW-10 well cluster location just south of the primary western constituent migration pathway.

[The shallow groundwater] divide is evident under normal BPM pumping conditions, and also when the mall wells have been shut down for an extended period. Groundwater flow from the divide is to the southeast and west/northwest. The sustained pumping of PW-1 may begin to capture shallow groundwater in the weathered bedrock over the western portion of the site.

Water-level measurements made in the deeper monitoring well network provide an understanding of the extent to which the BPM production wells serve to capture deeper flow. Under present BPM pumping conditions, the mall wells appear to be capturing groundwater over a portion of the site with a component of groundwater flow to the southeast. The regional water-level contour map for the bedrock system confirms the presence of a deeper groundwater divide onsite under non-pumping conditions with flow components to the southeast and west/northwest.

GAC filters have been installed by Big V Supermarkets at seven residential homes on Meadow Park Road and Tomahawk Street (RW-05, 07, 08, 09, 10, 15 and 16) to the southeast of the Baldwin Place Mall where the concentrations in groundwater exceed the applicable drinking water standard, the Maximum Contaminant Level (MCL), for PCE of 0.005 mg/l. The New York State Department of Environmental Conservation (NYSDEC)/New York State Department of Health (NYSDOH) guideline for PCE in drinking water is also 0.005 mg/l. The seven residential homes on Meadow Park Road and Tomahawk Street with GAC filters maintained by Big V Supermarkets have non-detectable concentrations of PCE in the treated water. The groundwater concentrations in the eleven remaining residential wells (RW-01, 02, 03, 04, 06, 11, 12, 13, 14, 17, 18) were mostly non-detectable concentrations, and the four wells with detectable concentrations did not exceed MCLs. One residence (with non-detectable concentrations of PCE) has a GAC filter installed by the property owner (RW-13). While all PCE concentrations were below the MCL of 0.005 mg/l, in order to document that under current conditions (assuming continued use of GAC filters) no unacceptable potential human health risk exists, the current residential scenario was included. The concentrations of PCE and TCE were assumed to be their respective MCLs (both 0.005 mg/l.) GAC filters were also installed at two commercial locations by Big V Supermarkets on Route 6 (CW-20 and 21) in April, 1993. Two additional commercial locations on Route 6 (CW-22 and 23) also have GAC filters installed by the property owners.

The nearest public supply system is the Lake Baldwin system located about 1,800 feet from the western site boundary. No treatment has been required for this system (see RI Section 6.1.8).

All the RI groundwater concentrations for residential wells sampled in February, 1993, commercial wells sampled in March, 1993 and deep monitoring wells sampled in August/September, 1992 and/or May, 1993 were utilized in the groundwater assessment of future potable groundwater use. The constituent concentrations of the deep monitoring wells that were sampled twice (both in August/September, 1992 and May, 1993) were averaged in order to provide one concentration that was incorporated into the statistical analysis of all the wells.

The deep monitoring well concentrations were used for the future potable groundwater assessment since a future residential well at/near the site would in all likelihood be completed in bedrock. This is based on (1) Westchester County's requirement of 30 feet of casing for wells used for water supply purposes; and (2) the fact that the required yield for residential use could not be derived from the low permeability glacial till deposits would make it necessary to complete the well (as are the existing wells in the area) in the underlying bedrock unit.

MTBE was detected in several monitoring wells. This constituent was not incorporated into the risk assessment, as this contamination originates from the surrounding gas stations.

Table 1 presents a comparison of the maximum concentrations detected in residential and commercial wells before and after GAC filtration, and also compares the upper 95% concentration of the site-wide average groundwater concentration with federal and NYSDEC/ NYSDOH MCLs. Inorganic compounds were not included in the exposure assessment of groundwater in the risk assessment because no contamination with inorganic compounds is known to have occurred at the facility and the primary concern is related to the release of volatile organic solvents. In addition, with the exception of naturally-occurring iron, manganese and sodium, the concentrations of inorganics detected do not exceed Primary or Secondary drinking water standards.

3.3 Surface Water and Sediment Characterization

The surface waters in the vicinity of the Baldwin Place Mall site include an unnamed north-to-south flowing stream (eastern stream) to the east of the site, an unnamed south-to-north flowing stream (western stream) that is diverted under the mall and parking lot, and discharges into a relatively steep ravine and valley just north of Route 6, and a tributary drainage ditch that runs along the south side of Route 6 west of the site (refer to Figure 3-7 in RI report). The western stream and the tributary drainage ditch are the only nearby surface waters that appear to be impacted by the site-related constituents. Contact with the sediment will most likely occur where the children are playing in the surface water. Surface water and sediment RI results sampled from the western stream (SW/SD 04, 06 through 08) in June and October, 1993 and from the tributary drainage ditch that runs along the south side of Route 6 in December, 1993 (SW/SD 10 and 11) were utilized for assessing a child's exposure to these media. The maximum concentrations detected in these samples were utilized as the concentration of concern in the risk assessment. MTBE was detected in several surface water sample results. This constituent was not incorporated into the risk assessment, as this contamination originates from the surrounding gas stations. Several pesticide and inorganic compounds were detected in both surface water and sediment sampling results and PAHs were detected only in the sediment results. However, these compounds were not included in the analysis of surface water and sediment because no contamination with pesticide, PAH and inorganic compounds is known to have occurred at the facility and the primary concern is related to the release of volatile organic solvents.

3.4 Presentation of Data Sets

EPA recommends using an upper limit of the 95th percentile confidence interval on the arithmetic average concentration or the maximum concentration of a chemical in any given medium, whichever is lower, as the best estimate of reasonable maximum exposure concentration (EPA, 1989a). Where a substance identified at least once in a given medium was not detected in a sample, it was conservatively assumed to be nonetheless present at a concentration equivalent to one-half its method detection limit (MDL). Chemicals that were not detected in any sample from a particular medium were eliminated from further consideration in accordance with EPA guidelines. Table 6 presents the statistical analysis for groundwater and soil.

According to EPA guidelines, "if inorganic chemicals are present at the site at naturally-occurring levels, they may be eliminated from the quantitative risk assessment." The soil boring TB-6 represents an on-site background sample. The maximum concentrations detected in soils at the Baldwin Place Mall site were compared with local background concentrations and naturally-occurring levels observed in eastern U.S. soils as reported by the U.S. Geological Survey (Shacklette and Boerngen, 1984). Table 2 presents a comparison of the maximum concentrations detected on site with the concentrations detected in TB-6 and the mean concentration reported in native, unpolluted soils. If a constituent is detected at a concentration that is below ten times the naturally-occurring average concentration, then the constituent is of no concern and is eliminated from further consideration. This methodology was utilized by LaGoy and Schultz (1993) who determined whether metals at a mining site were above background levels by comparing the average on-site concentrations with either ten times or 100 times average background concentrations in the area. However, if a chemical is detected above ten times the average naturally-occurring (background) concentrations, the constituent is not eliminated from the risk assessment although it does not necessarily indicate that the constituent is a health problem. Examination of Table 2 reveals that all of the inorganic compounds in site soils, except lead and potassium were detected at levels below the local background concentrations. Analytically, there is no difference between the maximum site soil concentration of 4 ppm for lead and 3 ppm reported in the on-site background sample. Both lead and potassium concentrations are well below ten times the local background concentrations and, additionally, are unremarkable as they both are far below the median typical concentration in unpolluted, native soils of the eastern United States. As a result, all the inorganic compounds detected in the soil are considered to be present at background concentrations and are eliminated from the risk assessment.

This method of screening inorganics for "background" status is regarded as arbitrary, but highly conservative. That is, it is unlikely that any metals eliminated by this procedure would pose potential health or environmental hazards. No contamination with inorganics is known to have occurred at the facility and the primary concern is related to the release of volatile organic solvents.

4.0 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate the type, magnitude, frequency, and duration of exposures to the chemicals of potential concern that are present at or migrating from the Baldwin Place Mall site. The exposure scenarios chosen are identified given both current and potential future activities at the site. The current-use scenario encompasses consideration of the risks posed to nearby residents. Potential future-use scenarios encompass consideration of the risks posed to site construction workers, office workers, children and nearby residents. An analysis of all potential pathways is given in Table 3. The following pathways are considered to be a comprehensive assessment of potential risks under current and future conditions and are quantitatively addressed in this assessment:

- Dermal contact and ingestion of soil by construction workers;
- Volatile emissions via excavation and grading activities with subsequent inhalation by construction workers;
- Inhalation of volatile organic emissions from site unsaturated soils by current residents;
- Inhalation of vapors from soil infiltrating into a future building foundation by office workers.
- Dermal contact and ingestion of soil by children;
- Inhalation of volatile organic emissions from site soil by children;
- Dermal contact and ingestion of sediments in western stream and tributary drainage ditch by children;
- Dermal contact and ingestion of surface water in western stream and tributary drainage ditch by children swimming;
- Inhalation of volatile organic emissions from surface water by children swimming;
- Ingestion and dermal contact of contaminants in ground water by current residents who utilize a domestic well adjacent to the property boundary (concentrations in groundwater assumed to equal MCLs);
- Inhalation of contaminants volatilized from ground water by current residents during household use of contaminated domestic well water (concentrations in groundwater assumed to equal MCLs);
- Ingestion and dermal contact of contaminants in ground water by future residents who utilize a domestic well adjacent to the property boundary (no GAC filtration assumed); and
- Inhalation of contaminants volatilized from ground water by future residents during household use of contaminated domestic well water (no GAC filtration assumed).

Exposure parameters for construction worker, current resident, adventurous children, future resident and future worker scenarios are presented in Table 4. A sensitivity analysis of these parameters is presented in Table 5. Standard EPA default exposure assumptions were applied to all scenarios when available, otherwise appropriate scientifically defensible values were applied as specified below. The exposure parameters necessary for evaluation of volatile emissions required development for inhalation of vapors from soil by construction workers during excavation, and for current residents and children, for infiltration of vapors through a future building foundation, for inhalation of vapors from surface water by children, and for current and future household use of groundwater. The parameters for these exposure scenarios are presented below.

4.1 Emission of Volatiles During Construction Activities

Emission of volatilized contaminants during excavation and grading activities is estimated by applying a "soils handling agitation factor" to the estimate of volatile emissions during baseline conditions. This methodology is currently endorsed in US EPA's *Air/Superfund Technical Guidance Series, Volume III, Estimation of Emissions during Cleanup Activities at Superfund Sites*, and agitation factors are provided. An average agitation factor of 50 resulting from excavation activities by a bulldozer was applied to the volatile emission rates estimated for baseline conditions.

Volatile emission rates under baseline conditions are determined according to the default algorithm presented in EPA's *Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual, Part B, Development of Risk-Based Preliminary Remediation Goals* (1991), for soil-to-air volatilization under commercial/industrial land use conditions. EPA utilized conservative standard parameter values to develop a default soil-to-air volatilization factor (VF). The VF is utilized under an assumption that contaminant concentrations in soil are homogenous from soil surface to a depth of concern (*i.e.*, depth at ground water or impenetrable layer) and that the contaminated material is not covered by contaminant-free soil material or other cover. This may be an appropriate assumption only during excavation activities by construction workers .

4.2 Emissions of Volatilized Contaminants to Off-Site Residents and Infiltration of Vapors through a Future Building Foundation

Volatile releases from contaminated unsaturated soil were estimated using the following equation developed by the EPA to estimate volatile releases from covered landfills containing toxic materials (U.S. EPA, 1988):

$$E = D_i C_{si} A \, P_t^{4/3} M_i / d_{sc} \qquad \textbf{Eq. 1}$$

where:

E	=	emission rate of component *i* (g/sec.)
D_i	=	diffusion coefficient of component *i* in air (cm^2/sec.)
C_{si}	=	saturation vapor concentration of compound *i* (g/cm^3)
A	=	exposed area (cm^2)
P_t	=	total soil porosity (dimensionless)
M_i	=	mole fraction of compound *i* in the waste (gmole/gmole)
d_{sc}	=	effective depth of soil cover (cm)

Diffusion coefficients were provided through PCGEMS U.S. EPA Office of Toxic Substances Graphical Exposure Modeling System, or calculated according to Lyman *et al.* (1982). The compound-specific saturation vapor concentration was determined using the following equation (EPA, 1988):

$$C_{si} = pMW_i/RT$$

where:

C_{si}	=	saturation vapor concentration of compound *i* (g/cm^3)
p	=	vapor pressure of component *i* (mm Hg)
MW_i	=	molecular weight of component *i* (g/mole)
R	=	molar gas constant (62,361 mm Hg-cm^3/mole-°K)
T	=	absolute temperature (°K)

The emission rates were calculated at 25°C. The exposed area of contamination for off-site residents is approximately 15 m × 15 m (2.25×10^6 cm^2) in the alley by the dry cleaners. A total soil porosity of 0.35 was used, consistent with EPA's recommended default value (U.S.

EPA, 1991), and an effective depth of soil cover of 10 cm was conservatively assumed to exist between the contaminated soil and the surface. The area is mostly covered with asphalt, although bare soil is visible where sample borings were taken and the asphalt has deteriorated.

A representative office building was assumed to have an exposed area of 1.4×10^6 cm^2 (30 ft. × 50 ft.). A total soil porosity of 0.35 was used, consistent with EPA's recommended default value (U.S. EPA, 1991), although a much lower soil porosity is likely for soils supporting a building, which would reduce vapor diffusivity and rate of emissions. An effective depth of soil cover of one foot (30.48 cm) of clean fill was assumed to be placed between the contaminated soil and the foundation of the building. M_i can be approximated by the weight fraction of compound i in the soil mixture, with little loss in accuracy.

Infiltration of vapors into a building foundation from contaminated unsaturated soil is analyzed in this risk assessment instead of infiltration of vapors into a building foundation from contaminated groundwater for a number of reasons. The localized high levels of PCE in groundwater originated from solvent release(s) in a discrete area of soil in the alley behind the dry cleaners. The concentrations in the unsaturated soil were measured during the RI sampling in April, 1993. These soil concentrations are the net result of contributions of PCE from two sources: PCE originally absorbed onto soil particles as a result of the original release(s), and PCE volatilized from groundwater. PCE from each source may be present in three forms: adsorbed onto organic carbon present in soil, dissolved in soil moisture, and in volatilized form in pore space air. Steady-state conditions can be assumed, *e.g.*, equilibrium between these three forms has been achieved. The soil concentration that the laboratory reports is a bulk soil concentration consisting of the concentrations detected in all three forms; the pore spaces, volatilized onto the soil, and dissolved in soil moisture. By modeling the infiltration of vapors from VOCs present in soil, any contribution from VOCs dissolved in groundwater in the saturated zone are, therefore, accounted for. As a result, modeling VOC release from the soil matrix is the appropriate basis for estimating total VOC release into air via diffusion processes. It should also be noted that infiltration of vapors into a building foundation would likely be less in areas that do not have elevated concentrations in the unsaturated soil, because the clean soil would serve to retard constituent migration.

4.3 Dispersion of Volatilized Contaminants to an Off-Site Resident

The average ambient air concentration of the VOCs at the point of interest is determined by EPA's dispersion algorithm as outlined in the *Superfund Exposure Assessment Manual* (SEAM; EPA, 1988).

$$C_a = E\,CF / (\sigma_z\,\sigma_y\,\pi\,\mu)$$

where:

C_a	=	Average ambient air concentration at receptor point (mg/m^3)
E	=	emission rate (g/sec)
CF	=	conversion factor from g to mg (mg/g)
σ_z and σ_y	=	vertical and horizontal dispersion coefficients determined from Figures 3-5 and 3-6 of SEAM (EPA, 1988, p. 43-44), utilizing an average stability class (C). For the residence, located about 0.18 km to the east of the source area center, the values for σ_z and σ_y are 12 m and 19 m, respectively,
π	=	3.14 (unitless)
μ	=	average wind velocity (m/sec): a value of 3.3 m/sec is given by PCGEMS STAR data for station 1471 Newburgh/Stewart, NY for the period 1965-69.

The frequency of wind from a direction which is upwind of the source area is 0.165 given by PCGEMS STAR data for frequency of winds from sector W. This downwind frequency is incorporated into the intake equation.

4.4 Dispersion of Vapors Throughout the Building

Dispersion of the vapors infiltrating through foundation of the building was estimated using the following equation:

$$C_a = E\,CF\,K\,(1/Vol)(1/XR)$$

where:

C_a	=	concentration of compound *i* in the building interior air, in a given hour (mg/m^3)

E	=	emission rate of component i into the interior building space (g/sec)
CF	=	conversion factor (g to mg)
K	=	conversion factor (seconds to hours)
Vol	=	interior volume of constructed building (m^3)
XR	=	exchange rate of fresh air (# of complete building air volume exchanges/hr.)

It was assumed that the foundation is of soil and not concrete. A more realistic analysis would address the impedance of vapors by a concrete foundation. Emission rates are calculated using Equation 1 of Section 4.2 and the parameters utilized in the equation are also described in Section 4.2. The interior volume of the building is assumed to be 340 m^3 (30 ft.×50 ft.×8 ft). It was assumed that the offices have approximately 10 air exchanges/hour.

4.5 Dermal Contact and Incidental Ingestion of Soil to On-Site Child

All of the compounds of potential concern at the site are volatile, therefore, the dermal and incidental ingestion pathways are likely to be insignificant. VOCs present in soil which adheres to warm skin exposed to air would rapidly evaporate before significant percutaneous absorption of VOCs or transfer of the soil to food or the mouth would occur. Nevertheless, for the purpose of this risk assessment, incidental ingestion of VOCs in soil was assumed to be complete with no loss of the VOC from the skin surface to ambient air. A soil ingestion rate of 100 mg/day was assumed as recommended in U.S. EPA's *Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"* (1991c).

For dermal absorption, a soil loading rate of 0.51 mg/cm^2 (Lepow *et al.*, 1974) was utilized and an exposed skin surface area of 4601 cm^2. An absorption fraction of 1% for VOCs was conservatively assumed. Higher absorption fractions are possible but only under circumstances where exposed skin is immersed into VOC-contaminated soil repeatedly and for prolonged periods of time.

Other assumptions utilized are summarized in Tables 4, 14 and 15.

4.6 Emission of Volatilized Contaminants from Soil to On-site Child

Volatile emission rates under baseline conditions are determined according to the default algorithm presented in EPA's *Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual, Part B, Development of Risk-Based Preliminary Remediation Goals* (1991), for soil-to-air volatilization under commercial/industrial land use conditions. EPA utilized conservative standard parameter values to develop a default soil-to-air volatilization factor (VF). The VF is utilized under an assumption that contaminant concentrations in soil are homogenous from soil surface to a depth of concern (*i.e.*, depth at groundwater or impenetrable layer) and that the contaminated material is not covered by contaminant-free soil material or other cover. The model conservatively assumes that for nine years of exposure, the child inhales a constant amount of contamination in air. The concentrations of VOCs in soil that are available for volatilization, however, will realistically dissipate over time. In addition, the site is currently largely covered by asphalt and following site development in the future, the site will almost certainly be paved entirely. Asphalt cover would be expected to dramatically reduce vapor emissions from unsaturated soils.

4.7 Emission of Volatilized Contaminants from Surface Water to a Child while Swimming

VOCs released from the surface water are estimated using the following equation developed by the EPA to estimate volatile releases from lagoons containing toxic materials (U.S. EPA, 1988).

$$E_i = K_i C_s A$$

where:

E_i = emission rate of component i (g/sec)
K_i = overall mass transfer coefficient of component i (cm/sec)
C_s = liquid phase concentration of compound i (g/cm^3)
A = exposed area (cm^2)

Overall mass transfer coefficients for volatile chemicals detected at the site were calculated according to Lyman *et al.* (1982). The exposed area of surface water (swimming zone) was assumed to be 10m by 30m (3×10^6 cm^2). The emission rates were calculated at 25°C.

4.8 Dispersion of Volatilized Contaminants from Surface Water to a Child while Swimming

Gaussian models are conventionally used to determine downwind concentrations from the emission rate estimated. However, in this scenario, such models have limited applicability when the receptor(s) is at or very near the source of emission. In this case, a child, for example, is in the surface water directly within the area of emissions of vapors. Average ambient air concentrations in this circumstance are estimated by use of a near-field box model (U.S. EPA, 1988). This model assumes uniform wind speed and uniform mixing throughout the box. The release and mixing of VOCs or respirable dusts in ambient air is estimated as follows:

$$C_a = \frac{E\ CF}{W_b\ H_b\ \mu_m}$$

where:

C_a	=	concentration of contaminant in ambient air (mg/m^3)
E	=	emission rate of contaminant (g/sec)
CF	=	conversion factor g to mg
W_b	=	width of box in crosswind dimension within the area of residual contaminant in soil (m)
H_b	=	downwind height of box (m)
μ_m	=	average wind speed through the box (m/sec)

The value of H_b in this calculation is determined by the downwind distance and the atmospheric turbulence at ground level, which determines the trajectory of a release from the upwind edge of the source of vapor emissions. For neutral atmospheric conditions, the height at the downwind boundary may be expressed by the following function:

$$z = 6.25\ r\ [H_b/r \times \ln (H_b/r) - 1.58\ H_b/r + 1.58]$$

where:

z	=	downwind distance to boundary (m)
r	=	a terrain-dependent roughness height (m)

The area of the stream that a child could be exposed to is assumed to be 3×10^6 cm^2 (30m × 10m). The downwind distance is, therefore, 30 m. The greater the roughness height, the greater the wind turbulence and contaminant dilution (*i.e.*, the height of the box increases). For the purposes of this risk assessment, it is conservatively assumed that r = 0.01 meters. The height of the box is calculated to be 1.5m. An average wind speed of 1 m/sec was conservatively assumed to be present along the stream.

4.9 Estimation of Exposure Point Concentrations due to Current and Future Household Use of Affected Ground Water

Exposure modelling is required to determine the extent of inhalation of volatilized contaminants in the home due to current and future residential use of ground water. A three-compartment model developed by McKone (1989) is used to simulate the 24-hour concentration profiles of VOCs in the shower, bathroom, and remaining household air volumes as a result of residential water use. A daily ingestion rate of 2 liters of water per day (75% of which is from the home tap), for 30 years is assumed in accordance with EPA's recommended default values (EPA, 1989a; 1989b). Table 19 presents the results of current residential use and Table 20 presents the future use scenario.

4.10 Estimation of Chemical Intakes

Chemical intake is expressed as the amount of the agent at the exchange boundaries of an organism (*i.e.*, skin, lungs, gut) which is available for systemic absorption. A dose is defined as the amount of a substance (usually measured in milligrams, or mg) absorbed per unit of body weight of the receptor (usually expressed in units of kilogram, or kg). If the exposure occurs over time, the total exposure can be divided by the time period of interest to obtain an average exposure rate (*e.g.*, mg/kg/day). The equation, as defined by EPA, for estimating a time-weighted average intake is:

$$\text{intake} = \frac{C \times CR \times EF \times ED}{BW \times AT}$$

where:

C	=	chemical concentration at the exposure point (*e.g.*, mg/m^3 air)
CR	=	contact rate (*e.g.*, m^3/hr)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight of exposed individual (kg)
AT	=	averaging time (period over which exposure is averaged, usually measured in days)

The values and assumptions applied for each exposure pathway identified for the Baldwin Place Mall site are summarized in Table 4.

Intakes due to contact with contaminated materials vary, depending to a large extent on the physicochemical properties of the contaminant. Highly volatile chemicals are rapidly released into the air, and inhalation of vapors represents the primary route of exposure. Dermal absorption or incidental ingestion of VOCs generally is negligible because these chemicals do not remain absorbed onto a thin, air-exposed film of dirt or water on warm skin over a significant period of time (Howd *et.al*, 1990).

5.0 TOXICITY ASSESSMENT

Toxicity assessment includes the determination of acceptable intakes for each of the selected chemicals over the duration of the identified exposure pathway. The level of intake of a chemical that can be regarded as acceptable will depend upon the frequency and duration of the intake. The acceptable intake of a substance which accumulates in the body will be much lower when the dose is continuous over many years (such as ingestion of drinking water) than when the dose is short-term and tolerable (such as inhalation of vapors during excavation). It is imperative, then, that the appropriate acceptable intake be matched with the applicable exposure pathway.

A number of sources of toxicity information exist, and they may vary in the strength of their scientific evidence. A protocol was established for the determination of acceptable intakes, defining a hierarchy of sources to be consulted and the methodology for determination of toxicity values. The protocol was developed with the intent that it follows current U.S. EPA philosophy, and it employs methodologies adopted and/or developed by the National Academy of Sciences. Toxicity values for the chemicals of concern at the site were obtained with reference to the following hierarchy of sources:

1) Toxicity values were obtained from the Integrated Risk Information System (IRIS) database. This database contains the Reference Doses (RfDs) and Cancer Potency Factors (CPFs) which have been verified by EPA's RfD and Carcinogen Risk Assessment Verification Endeavor (CRAVE) workgroups, and is, thus, the agency's preferred source for toxicity values. IRIS supersedes all other information sources.

2) For toxicity values which are unavailable on IRIS the next most current source of information is the Health Effects Assessment Summary Tables (HEAST), a quarterly publication from the EPA. HEAST contains interim as well as verified RfDs and CPFs. Supporting toxicity information for verified values is provided in an extensive reference section of HEAST.

3) Toxicity values that could not be determined in either IRIS or HEAST were derived from data in toxicological profiles for individual compounds as compiled by the Agency for Toxic Substances and Disease Registry (ATSDR). These documents provide results from a number of toxicological studies along with the methodologies and assumptions used in the studies. Toxicological values for a given compound were derived from the study summarizing the best available data or the set of data which exhibited either the lowest value for Lowest-Observed-Adverse-Effect-Level (LOAEL) or the highest No-Observed-Adverse-Effect-Level (NOAEL). The LOAEL is the lowest dosage at which some effect is shown. The NOAEL is the dosage at which no observed adverse effect or response is noted. Derivation of the acceptable daily intake incorporated uncertainty factors for: extrapolation of data from animals to humans, calculation of the human-equivalent dose, and interspecies variability in sensitivity of the toxicant.

4) If a toxicological profile from ATSDR was not available, toxicity data were obtained in a literature search of EPA sources in the following order:

   a) Health Assessment Documents
   b) Health Effects Assessments
   c) Health Advisories

d) Registry of Toxic Effects of Chemical Substances (RTECS) and Hazardous Substances Data Bank (HSDB).

5) If the above sources could not provide data, Toxline and other related databases and journals were searched for relevant dose-response studies upon which to derive toxicity values, using sound, defensible principles of toxicology.

6) If the above sources could not provide data, toxicity values were derived from Threshold Limit Values (TLVs). Acceptable intake levels can be derived from TLVs by correcting for continuous exposure and dividing by appropriate and conservative safety factors.

7) If toxicity data did not exist in any of the above sources, LD_{50} data for a given compound were compiled. The lowest oral LD_{50} value for any species was divided by appropriate safety factors, depending upon the anticipated length of exposure.

8) For chemicals which lack any toxicity information, the concept of structure-activity relationships was applied. This concept allows the derivation of an acceptable intake for a chemical by inference and analogy to closely related compounds. Professional judgement is tempered with conservatism in these instances.

Toxicity indices were developed for all site-related contaminants in order that potential risks posed by all contaminants could be quantitatively evaluated with the objective of minimizing inherent uncertainty in the process, and these are presented in Table 7. Of the 84 toxicity values required for complete evaluation of all chemicals found at the site, 44 toxicity values required derivation. The process of determining the acceptable intakes for which no toxicity values were available from IRIS or HEAST is documented for each relevant chemical and is presented in Appendix A (Toxicity Profiles). U.S. EPA's Science Advisory Board offered an opinion that the weight-of-evidence for the carcinogenicity of PCE and TCE is on C-B2 continuum. Group C constituents are defined as possible human carcinogens (limited evidence of carcinogenicity in animals in the absence of human data) and Group B2 constituents are probable human carcinogens (usually a combination of sufficient evidence in animals and inadequate data in humans.) U.S. EPA previously published cancer slope factors for PCE and TCE, however, the values have been withdrawn from IRIS and HEAST. In the interim, before new values are published, EPA requests that the Superfund Health Risk Technical Support Center is contacted for information. This information recommends utilizing values published by U.S. EPA in the Health Assessment Documents and Addenda for Tetrachloroethylene and Trichloroethylene (1985, 1987). Accordingly, the risk assessment utilizes these recommended cancer slope factors presented in Table 7.

6.0 RISK CHARACTERIZATION

The objective of the risk characterization is to combine the results of the exposure and toxicity assessments in a quantitative evaluation of risk. The estimated intakes calculated for each exposure pathway considered and each chemical of concern are compared to acceptable intake levels (risk reference doses [RfDs]) for noncarcinogenic effects. RfDs have been developed by the EPA for chronic (*e.g.*, lifetime) and/or subchronic exposure to chemicals based on the most sensitive noncarcinogenic effects. As presented in the previous section, the chronic RfD for a chemical is an estimate of a lifetime daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. The potential for non-cancer health effects is evaluated by comparing an exposure level over a specified time period with the RfD derived by the EPA for a similar exposure period. This ratio of exposure to toxicity is called the hazard quotient.

The non-cancer hazard quotient assumes that there is a threshold level of exposure (*i.e.*, RfD) below which it is unlikely for even the most sensitive populations to experience adverse health effects. If the exposure level exceeds the threshold (*i.e.*, the hazard quotient exceeds a value greater than 1.0), there may be concern for potential non-cancer effects (*viz.*, the greater the value of the hazard quotient above unity, the greater the level of concern for potential health impacts).

To assess the overall potential for non-cancer effects posed by multiple chemicals, a hazard index (HI) is derived by summing the individual hazard quotients. This approach assumes additivity of critical effects of multiple chemicals. This is appropriate only for compounds that induce the same effect by the same mechanism of action. This conservative approach may significantly overestimate the actual potential for adverse health impacts.

In cancer risk assessment, EPA has required the use of the upper limit which produces an estimate of risk that has a 95 percent probability of exceeding the actual risk, which may, in fact, be zero. For exposures to multiple carcinogens, the upper limits of cancer risks are summed to derive a total cancer risk. However, EPA recognizes that it is not technically appropriate to sum upper confidence limits of the risk to produce a realistic total probability, but requires this approach be used.

Summaries of the combined hazard indices and upper-bound lifetime cancer risks resulting from exposure to site-related chemicals of concentrations determined during the current sampling survey (baseline risk assessment) are presented in Table 8. Risk calculations for the various chemicals and individual pathways are presented in Tables 9 through 23 at the end of this section.

Cancer risks posed to future construction workers via exposure through all pathways and all chemicals is estimated to be 1×10^{-5} (*i.e.*, one case of cancer in one hundred thousand exposed individuals). This risk, while within EPA's acceptable target risk range of 1×10^{-4} to 1×10^{-6}, exceeds the *de minimis* benchmark level of 1×10^{-6}. The combined hazard index for the construction worker is estimated to be 6.0 which exceeds the threshold benchmark of 1.0. All of the cancer risk and hazard quantity is attributable to the inhalation pathway for tetrachloroethylene.

Future office workers via exposure through infiltration of vapors through a future building foundation are estimated to incur a combined cancer risk of 9×10^{-6}, and a hazard index of 2.0. All of the cancer risk and hazard quantity is attributable to tetrachloroethylene.

Nearby residents (residence time of 30 years) are estimated to incur a combined excess risk of cancer of about 4×10^{-6} (3×10^{-6} attributable to PCE and 1×10^{-6} to TCE) under current conditions, which slightly exceeds the *de minimis* benchmark level of 1×10^{-6}. The risk is attributable only to groundwater pathways which utilized the federal and NYSDEC/NYSDOH MCLs for PCE and TCE as the groundwater concentrations. Assuming the concentrations of

PCE and TCE are both 0.005 mg/l for current residents is a conservative assumption because for the wells with existing GAC filtration, PCE and TCE are not detected in the treated water, and none of the wells without filter systems exceed the MCLs of 0.005 mg/l. The upper 95th UCLs are, therefore, more likely to be much lower than 0.005 mg/l.

As the National Contingency Plan (NCP) states, the Applicable or Relevant and Appropriate Requirement (ARAR) for groundwater that is currently a source of drinking water are federal non-zero Maximum Contaminant Level Goals (MCLGs), MCLs, or the state drinking water standards. At this time all residences are currently meeting MCLs and are, therefore, adequately protected. This is assuming that regular maintenance on the GAC filter systems will continue. It is also assumed that the GAC filters will not be dismantled until the groundwater has been remediated or an alternate water supply provided. Additionally, if any further residential wells detect levels of PCE attributable to the site above the MCL of 0.005 mg/l, a GAC filter will be installed or an alternate water supply provided. The combined total hazard index for this group of exposed individuals is estimated to be 0.08, which is well below unity, and indicates no possible health hazards other than very minimal added risk of cancer (which may be zero).

Under the assumption that the concentrations of constituents detected in the residential wells, commercial wells and deep monitoring wells would be of future potable groundwater use (without any treatment), a carcinogenic risk of 5×10^{-5} is estimated. This risk, while within EPA's acceptable target risk range of 1×10^{-4} to 1×10^{-6}, exceeds the *de minimis* benchmark level of 1×10^{-6}. The combined hazard index for the future residents is estimated to be 1.0. This scenario was incorporated into the risk assessment to indicate that groundwater remediation is necessary to ensure future residential use of groundwater.

Children are estimated to incur a combined cancer risk of 5×10^{-7}, which is below the *de minimis* benchmark level of 1×10^{-6}. The total combined hazard index for this population is estimated to be 0.2, indicating that no adverse health effects can be anticipated even under reasonable maximum conditions of exposure. This population incorporated soil, sediment and surface water media and the results indicate that no remediation of any media is necessary under the children exposure scenarios. The results of the exposure scenarios for children for incidental ingestion, dermal absorption and inhalation of vapors from soil, incidental ingestion and dermal absorption from sediment, and incidental ingestion, dermal absorption and inhalation of vapors from surface water are presented in Table 8. The combined risk was calculated utilizing the exposure assumptions presented in Table 4 and the exposure scenarios are presented in Tables 14 through 18, and 21 through 23.

7.0 UNCERTAINTY ANALYSIS

Risk assessment uses a wide array of information sources and techniques. Even in those rare circumstances where chemical intake for an exposed individual may be measured relatively precisely, assumption will still be required to evaluate the associated risk. Generally, data are not available for critical aspects of the risk assessment, and the use of professional judgement, inferences based on analogy, the use of default values, model estimation techniques, *etc.*, result in significant uncertainty of varying degrees.

The expressions of risk in this assessment are not probabilistic, but conditional: based on the conditions represented by the single-point values selected for the analysis. This section is intended to identify and qualitatively or quantitatively evaluate the more salient site-specific uncertainties and their potential influence on the credibility of the estimated site risks.

Uncertainties in data analysis include analytical error, selection of compounds of concern, adequacy of sampling design, *etc*. Generally, there is far less uncertainty in this phase of the risk assessment process than other aspects contribute. It is the upper 95 percent confidence limit of the average concentration that is utilized in risk assessment. This will likely result in overestimation of risk. Oftentimes, only a portion of detected chemicals are carried through the risk assessment process, because there may not be EPA-published toxicity values or chemicals are eliminated for other reasons (U.S. EPA, 1989a). Obviously, this could result in an underestimation or risk. However, all organic contaminants identified in all media and relevant to the site were evaluated in this Draft Baseline Risk Assessment.

In general, where models were applied, conservative assumptions or EPA's default algorithms were employed which would likely result in overestimation or risks. EPA-approved models were employed where appropriate. Other assumptions utilized are consistent with a highly conservative approach and will likely overestimate risk. For example, in evaluating vapor intrusion into buildings constructed in the future, it was assumed that no concrete floor or barrier would be present to impede vapor intrusion into indoor air. This substantially overestimates the actual risks posed to future office workers. Table 5 summarizes the parameters utilized in the risk assessment, and provides an indication of where they may fall on a population distribution.

EPA's IRIS states that the uncertainty associated with RfD values for noncarcinogenic endpoints of toxicity "span perhaps an order of magnitude." In fact, the uncertainty of extrapolating dose-response data from animals to humans with the application of multiple safety factors (100 to 10,000 or more) is likely to be several orders of magnitude. Current policies for deriving RfD values will often result in an overestimation of risk by up to three orders of magnitude.

The uncertainty associated with estimation of cancer risk contributes by far the major source of potential error and uncertainty. It is beyond the scope of this analysis to explore this toxicity assessment factor in any detail. However, a few salient points are addressed. Some chemicals classified as carcinogens have been shown to produce an increased incidence of cancer in mice but not rats, for example. If the mouse is not an adequate model for the rat, it may be wondered how reliable a model it is for human beings. The assumption of linearity and a non-threshold phenomenon in the dose versus risk relationship may not be valid and could result in very large overestimation of actual cancer risk, if any even exists at low doses in humans.

EPA (Cothern, *et al.*, 1984) evaluated the uncertainty of cancer risk estimates due to TCE and several other related VOCs in public drinking water supplies. These EPA scientists concluded that the largest uncertainty in the calculations is due to the choice of model (Multistage, Weiball, Logit, Probit, *etc.*, used in extrapolating risk to low doses) and is 5 to 6 orders of magnitude. Also, if a single model were chosen (assumed to be valid), the overall uncertainty risk estimates would be 2 to 3 orders of magnitude. Additionally, the exposure estimates contribute at most an order of magnitude to the uncertainty. The EPA scientists concluded that it would appear that until a particular compound's mechanisms of cancer are better known, the uncertainty in the toxicity will not likely be improved.

8.0 ECOLOGICAL RISK ASSESSMENT METHODOLOGIES

The ecological risk assessment process utilizes surface water and sediment data in an analysis of ecological impacts posed by chemicals of concern to the Baldwin Place Mall site. This analysis demonstrated that no ecological risks exist as a consequence of contamination and release of contamination at the site.

The relevant surface water hydrology consists of the eastern stream, western stream (North of Route 6) and the tributary drainage ditch that runs along the south side of Route 6 west of the site. A limited area within the western stream and the tributary drainage ditch are the only nearby areas of surface waters that appear to be impacted by site-related constituents. Samples SW-4 and SW-6 through SW-8 were collected from the western stream surface water-body in June and October, 1993. Samples SW-10 and SW-11 were collected from the tributary drainage ditch in December, 1993.

The maximum concentrations detected in surface water were compared to Ambient Water Quality Criteria based on the following hierarchy of sources:

1) Freshwater Chronic Criteria as presented in EPA's *Quality Criteria for Water* (1986).
2) Freshwater Chronic Values as presented in EPA's *Quality Criteria for Water* (1986). These values are Lowest Observed Effect Levels approved by EPA to substitute for Freshwater Chronic Criteria.
3) If Freshwater Chronic Values were not available for a chemical but Freshwater Acute Values were available, provisional values were calculated by defining a freshwater-acute-to-chronic criteria relationship. For structurally related chemicals (*viz.*, chlorinated alkanes/alkenes) where EPA has established both

Freshwater Acute and Chronic Values, ratios were determined and an upper 95 percent confidence limit of the average of these ratios was determined. This upper bound acute-to-chronic ratio was then applied to those chemicals where only acute values are listed by EPA to derive provisional Freshwater Chronic Values.

4) In the case where neither a Freshwater Chronic Value nor a Freshwater Acute Value was provided a provisional value was generated by applying the acute-to-chronic ratio described above to a Freshwater Acute Value of similar structure.

A summary comparison of chemicals of concern to Freshwater Chronic Values is presented in Table 24. These results show that no chemical analyzed in surface water poses a risk to the freshwater aquatic life or its uses at the Baldwin Place Mall site.

EPA is currently pursuing efforts to develop and publish sediment quality criteria for some of the 65 pollutants or pollutant categories designated as toxic under Section 307(a) of the Clean Water Act. EPA, however, has not published national sediment criteria for the chemicals of concern. The methodology selected by EPA for determination of Sediment Quality Criteria (and generally regarded as technically-sound) is the "equilibrium partitioning", or EqP approach. In such an approach, a Sediment Quality Criteria is backcalculated from an acceptable pore water concentration, using a simple partitioning model based on the organic carbon partition coefficient, or Koc. The equation is as follows:

$$SQC = Kd\ FCV$$

where:

SQC	=	Sediment Quality Criteria (mg/kg sediment)
Kd	=	partition coefficient (l/kg)
FCV	=	chemical specific no-effect concentration in water (mg/l)

The absolute value of chemical-specific Kd can vary widely for different soils and sediments. EPA (1991a) derives Kd values by multiplying chemical-specific Koc values by the organic carbon content of soil. A default of 0.02 as recommended by EPA (1991a) was utilized as the organic carbon content of soil. Chronic Ambient Water Quality Criteria for the protection of freshwater aquatic organisms were utilized as the FCVs.

The maximum concentrations detected in the sediment in the western stream and the tributary drainage ditch were compared to the provisionally derived SQCs. Results of the ecological analysis of sediment demonstrates no environmental risk as presented in Table 24. Volatiles such as acetone and methylene chloride found in sediment at the site do not pose a threat to the environment due to the fact that they are present at very low concentrations in sediments, and are often found as laboratory artifacts.

9.0 CONCLUSIONS

The baseline risk assessment of the Baldwin Place Mall site was performed in accordance with applicable EPA guidelines. Under future conditions, construction workers are estimated to incur an upper bound cancer risk of 1×10^{-5} and a hazard index of 6.0, and future office workers in a future building constructed over areas of soil contamination are estimated to incur a cancer risk of 9×10^{-6}. These potential cancer risk and adverse health hazards are all attributable to PCE contamination in the soil near the dry cleaners. An analysis of the soil sampling data indicate that the risk is associated with the concentrations in two soil borings TB-1 and TB-2.

The National Contingency Plan (NCP) states, the Applicable or Relevant and Appropriate Requirement (ARAR) for groundwater that is currently a source of drinking water are federal non-zero MCLGs, MCLs, or the state drinking water standards. Under the assumption that the concentrations of constituents detected in the residential wells, commercial wells and deep monitoring wells would be of future potable groundwater use (without any treatment), ground water in the deeper aquifer could pose a potential health concern. However, at this time all residences are currently meeting MCLs and are, therefore, afforded adequate protection according to NYSDEC/NYSDOH and EPA. It is also assumed that the existing GAC filters will not be dismantled until the groundwater has been remediated or an alternate water supply provided. Additionally, if any further residential wells detect levels of PCE attributable to the site above the MCL of 0.005 mg/l, a GAC filter will be installed or an alternate water supply provided.

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TABLES

Table 1

Comparison of Maximum Conc. Detected in Residential and Commercial Wells Before and After GAC Filter and Upper 95 % Conc. of Site-wide Groundwater with Maximum Contaminant Levels

Big V Supermarkets, Baldwin Place Mall, NY

Chemical	Maximum Conc. Detected in Groundwater Before GAC Filter (a) (mg/l)	Maximum Conc. Detected in Groundwater After GAC Filter (a) (mg/l)	Site-wide Upper 95% or Max. Conc. of Groundwater (b) (mg/l)	Site-wide Upper 95% Conc. of Groundwater (b) (mg/l)	Federal Maximum Contaminant Levels (MCLs) (mg/l)	Status	NYSDOH Maximum Contaminant Levels (MCLs) (mg/l)
Acetone	ND	ND	0.006		na		0.05
Carbon Disulfide	ND	ND	0.001		na		0.05
total 1,2-Dichloroethylene	ND	ND	0.005		0.07	F (cis)	0.005
Methylene chloride	ND	ND	0.009		0.005	F	0.005
Styrene	ND	ND	0.002		0.1	F	0.005
Tetrachloroethylene	0.048	ND	0.09		0.005	F	0.005
Toluene	ND	ND	0.005		1	F	0.005
Trichloroethylene	0.004	ND	0.008		0.005	F	0.005
bis(2-Ethylhexyl)phthalate	NA	NA	0.009		0.006	F	0.05
			Total Inorganics	Dissolved Inorganics			
Aluminum	NA	NA	0.90	ND	na		na
Arsenic	NA	NA	0.001	ND	0.05	R	0.05
Barium	NA	NA	0.24	0.20	2	F	2
Calcium	NA	NA	72.4	75.0	na		na
Chromium	NA	NA	0.007	0.005	0.1	F	0.1
Cobalt	NA	NA	0.010	0.005	na		na
Copper	NA	NA	0.018	ND	1.3	AL	1.3 (c)
Iron	NA	NA	30.6	3.39	0.3	SMCL F	0.3 (d)
Lead	NA	NA	0.014	ND	0.015	AL	0.015 (e)
Magnesium	NA	NA	21.8	25.1	na		na
Manganese	NA	NA	0.56	0.54	0.05	SMCL F	0.3
Potassium	NA	NA	87.9	77.0	na		na
Selenium	NA	NA	0.002	0.002	0.05	F	0.01
Sodium	NA	NA	46.0	50.4	20	DWEL	NDL
Thallium	NA	NA	0.004	ND	0.002	F	na

(a) Residential and Commercial wells
(b) Upper 95% concentration of samples from residential, commercial and deep monitoring wells.
(c) The copper action level is exceeded if the concentration of copper in more than 10% of one liter first draw tap water samples collected during any monitoring period exceeds 1.3 mg/l.
(d) If iron and manganese are present, the total conentration of both should not exceed 0.5 mg/l. Higher levels may be allowed by the State when justified by the supplier of water.
(e) The lead action level is exceeded if the concentration of lead in more than 10% of one liter first draw tap water samples collected . during any monitoring period exceeds 0.015 mg/l.

ND = Not detected
NA = Not analyzed
na = Not available
F = Final value
cis = No MCL has been published for total 1,2-dichloroethylene, the value is for the cis-isomer.
R = Under review
AL = Action level
SMCL = Secondary Maximum Contaminant Level
DWEL = Drinking Water Equivalent Level -guidance value only
NDL = No designation limits. Water containing more than 20 mg/l of sodium should not be used for drinking by people on severly restricted sodium diets. Water containing more than 270 mg/l of sodium should not be used for drinking by people on moderately restricted sodium diets.

Table 2

Comparison of Maximum Detected Inorganic Concentrations in Soil with On-site Background Concentrations and with Naturally Occuring Inorganic Concentrations in the United States

Big V Supermarkets, Baldwin Place Mall, NY

Chemical	Maximum Detected On-Site Conc. in Soil (mg/kg)	On-Site Background Conc. in Soil (a) (mg/kg)	Naturally Occuring Inorganic Average Conc. in U.S. (mg/kg)	Source
Aluminum	1,730	2,610	71,000	1
Barium	44	61	500	1
Cadmium	1	2	0.5	2
Calcium	2,580	2,650	24,000	1 & 3
Chromium	5	6	100	2
Copper	4	5	30	1
Iron	1,870	3,430	40,000	1 & 4
Lead	4	3	29	5
Magnesium	1,250	1,740	5,000	1
Manganese	120	202	1,000	1, 2 & 4
Potassium	331	133	14,000	1
Sodium	12	396	5,000	1
Vanadium	7	10	100	1, 2 & 3
Zinc	1	17	90	1 & 4

(a) TB-6 is an on-site background soil boring

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Ta 3 Part 1 of 2
Exposure Pathways Analysis
Big V Supermarkets, Baldwin Place Mall, NY

Media	Source	Transport Mechanism	Exposure Point	Exposure Route	Exposed Population	Selected for Analysis	Data Set to be Used	Exposure Assumptions
Soil/sediment	Spills, leaks	Infiltration	On-site	Dermal contact w/ Ingestion	Construction Worker	Yes	Soil in Unsaturated Zone	Occupational
	Spills, leaks	Infiltration	On-site	Dermal contact w/ Ingestion	Future Resident (adult)	No - future residential use is highly improbable	N/A	N/A
	Spills, leaks	Infiltration	On-site	Dermal contact w/ Ingestion	Future Worker	No - access to soil is limited, majority of site is paved	N/A	N/A
	Spills, leaks	Infiltration	On-site	Dermal contact w/ Ingestion	Current Worker	No - access to soil is limited, majority of site is paved	N/A	N/A
	Spills, leaks	Infiltration	On-site	Dermal contact w/ Ingestion	Children	Yes	Soil in Unsaturated Zone	Recreational
	Contaminated soil, water-borne contaminants	Runoff	Stream	Dermal contact w/ Ingestion	Children	Yes	Sediments	Recreational
Surface Water	Contaminated soil, water-borne contaminants	Runoff	Stream	Dermal contact w/ Ingestion	Children	Yes	Surface water	Recreational
Groundwater	Contaminated soil	Advection, dispersion	Off-site residential well	Ingestion Dermal contact Inhalation	Current resident	Yes Yes Yes	MCLs	Residential
	Contaminated soil	Advection, dispersion	Off-site residential well	Ingestion Dermal contact Inhalation	Future resident	Yes Yes Yes	Residential, Commercial and Deep Monitoring wells	Residential
Air	Volatilized contaminants from soil	Dispersion	On-site	Inhalation	Construction Worker	Yes	Soil in Unsaturated Zone	Occupational
	Volatilized contaminants from soil	Dispersion	On-site	Inhalation	Future Worker	Yes	Soil in Unsaturated Zone	Occupational

Ta[illegible] 3 Part 2 of 2
Exposure Pathways Analysis
Big V Supermarkets, Baldwin Place Mall, NY

Media	Source	Transport Mechanism	Exposure Point	Exposure Route	Exposed Population	Selected for Analysis	Data Set to be Used	Exposure Assumptions
Air	Volatilized contaminants from soil	Dispersion	On-site	Inhalation	Future Resident (adult)	No - future residential use is highly improbable	N/A	N/A
	Volatilized contaminants from soil	Dispersion	Off-site	Inhalation	Current Resident	Yes	Soil in Unsaturated Zone	Residential
	Volatilized contaminants from soil	Dispersion	On-site	Inhalation	Current Worker	No - area of exposed soil is limited, majority of site is paved	N/A	N/A
	Volatilized contaminants from soil	Dispersion	On-site	Inhalation	Children	Yes	Soil in Unsaturated Zone	Recreational
	Volatilized contaminants from surface water	Dispersion	Stream	Inhalation	Children	Yes	Surface water	Recreational

N/A Not Applicable

Ta[illegible] part 1 of 3

Parameters Used in the Quantitative Assessment of Potential Intakes

Big V Supermarkets, Baldwin Place Mall, NY

Scenario	Contact Rate	Exposure Frequency and Duration	Absorption	Body Weight	Averaging Time
Ingestion of Soil - Occupational Use (associated with dermal contact) Construction Workers	Ingestion Rate: 50 mg/day (7)	125 shifts/year (1) over 1 year (1)	Matrix Effects: Volatiles - 1 (1)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 1 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Dermal Exposure to Contaminants in Soil - Occupational Use Construction Worker	Fraction surface area available: 10% (1) Total surface area: 20,000 cm2 (2)	125 shifts/year (1) over 1 year (1) Adherence: 0.51mg/cm2 (4)	0.01 for volatiles (5)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 1 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation of Vapors during Excavation Activities Construction Workers	Inhalation Rates: 20 m3/shift (7)	125 shifts/year (1) over 1 year (1)	Alveolar absorp.: 0.5 or 1.0 (8)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 1 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation of Vapors from Soil - Residential Use Current Adult Residents	Inhalation Rates: 20 m3/day (7)	350 days/year (3) 30 years (3)	Alveolar absorp.: 0.5 or 1.0 (8)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation of Vapors in Building from Soil - Occupational Use Future Workers	Inhalation Rates: 20 m3/shift (11)	250 days/year (11) 25 years (11)	Alveolar absorp.: 0.5 or 1.0 (8)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 25 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Ingestion of Soil (associated with dermal contact) Children, ages 6-15 years	Ingestion Rate: 100 mg/day (7)	15 days/year (12) 9 years (1)	Matrix Effects: Volatiles - 1 (1)	52 kg (13)	For noncarcinogenic effects: Exposure is averaged over 9 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Dermal Exposure to Contaminants in Soil - Recreational Use Children, ages 6-15 years	Fraction surface area available: 31.3% (2) Total surface area: 14,700 cm2 (2)	15 days/year (12) 9 years (1) Adherence Factor: 0.51 mg/cm2 (4)	0.01 for volatiles (5)	52 kg (13)	For noncarcinogenic effects: Exposure is averaged over 9 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation of Vapors from Soil - Recreational Use Children, ages 6-15 years	Inhalation Rate: 1.5 m3/hour (2)	10 hours/day (1) 15 days/year (12) 9 years (1)	Alveolar absorp.: 0.5 or 1.0 (8)	52 kg (13)	For noncarcinogenic effects: Exposure is averaged over 9 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime

Ta , part 2 of 3

Parameters Used in the Quantitative Assessment of Potential Intakes
Big V Supermarkets, Baldwin Place Mall, NY

Scenario	Contact Rate	Exposure Frequency and Duration	Absorption	Body Weight	Averaging Time
Ingestion of Sediment (associated with dermal contact) Children, ages 6-15 years	Ingestion Rate: 100 mg/day (7)	3 days/year (12) 9 years (1)	Matrix Effects: Volatiles - 1 (1)	52 kg (13)	For noncarcinogenic effects: Exposure is averaged over 9 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Dermal Exposure to Contaminants in Sediment - Recreational Use Children, ages 6-15 years	Fraction surface area available: 31.3% (2) Total surface area: 14,700 cm2 (2)	3 days/year (12) 9 years (1) Adherence Factor: 0.51 mg/cm2 (4)	0.01 for volatiles (5)	52 kg (13)	For noncarcinogenic effects: Exposure is averaged over 9 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Ingestion Exposure to Contaminants in Groundwater - Residential Use Current Adult Resident	Fluid Ingestion Rate: 2 liters/day (3) Intake of home water fraction: 0.75 (2)	Daily (1) 30 years (3)	100% absorption (1)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Dermal Exposure to Contaminants in Groundwater - Residential Use Current Adult Resident	Fraction surface area available: 90% (1) Total surface area: 20,000 cm2 (2)	Daily (1) 12 minutes/day (3)	Permeability m/hr chemical specific (9)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation Exposure to Contaminants in Groundwater - Shower Residential Use Current Adult Resident	Inhalation Rate: 0.625 m3/hr (7)	Daily (1) 12 minutes/day (3)	100% absorption (7)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation Exposure to Contaminants in Groundwater - Bathroom Residential Use Current Adult Resident	Inhalation Rate: 0.625 m3/hr (7)	Daily (1) 20 minutes/day (10)	100% absorption (7)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation Exposure to Contaminants in Groundwater - Whole House Residential Use Current Adult Resident	Inhalation Rate: 0.625 m3/hr (7)	Daily (1) 20 hrs/day (10)	100% absorption (7)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Ingestion Exposure to Contaminants in Groundwater - Residential Use Future Adult Resident	Fluid Ingestion Rate: 2 liters/day (3) Intake of home water fraction: 0.75 (2)	Daily (1) 30 years (3)	100% absorption (1)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime

Ta[illegible] part 3 of 3

Parameters Used in the Quantitative Assessment of Potential Intakes
Big V Supermarkets, Baldwin Place Mall, NY

Scenario	Contact Rate	Exposure Frequency and Duration	Absorption	Body Weight	Averaging Time
Dermal Exposure to Contaminants in Groundwater - Residential Use ***Future Adult Resident***	Fraction surface area available: 90% (1) Total surface area: 20,000 cm2 (2)	Daily (1) 12 minutes/day (3)	Permeability m/hr chemical specific (9)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation Exposure to Contaminants in Groundwater - Shower Residential Use ***Future Adult Resident***	Inhalation Rate: 0.625 m3/hr (7)	Daily (1) 12 minutes/day (3)	100% absorption (7)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation Exposure to Contaminants in Groundwater - Bathroom Residential Use ***Future Adult Resident***	Inhalation Rate: 0.625 m3/hr (7)	Daily (1) 20 minutes/day (10)	100% absorption (7)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation Exposure to Contaminants in Groundwater - Whole House Residential Use ***Future Adult Resident***	Inhalation Rate: 0.625 m3/hr (7)	Daily (1) 20 hrs/day (10)	100% absorption (7)	70 kg (3)	For noncarcinogenic effects: Exposure is averaged over 30 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Ingestion Exposure to Surface Water ***Recreational Use*** ***Children, ages 6-15 years***	Contact Rate: 0.05 liters/hr (3)	2 hours/event (3) 7 events/year (3) 9 years (3)	100% absorption (3)	52 kg (13)	For noncarcinogenic effects: Exposure is averaged over 9 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Dermal Exposure to Surface Water ***Recreational Use*** ***Children, ages 6-15 years***	Fraction surface area available: 31.3% (2) Total surface area: 14,700 cm2 (2)	2 hours/event (3) 7 events/year (3) 9 years (3)	PC - skin permeability from (9)	52 kg (13)	For noncarcinogenic effects: Exposure is averaged over 9 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime
Inhalation Exposure to Surface Water ***Recreational Use*** ***Children, ages 6-15 years***	Inhalation Rate: 1.5 m3/hour (2)	2 hours/event (3) 7 events/year (3) 9 years (3)	Alveolar absorp.: 0.5 or 1.0 (8)	52 kg (13)	For noncarcinogenic effects: Exposure is averaged over 9 year period; exposure is of chronic duration For carcinogenic effects: Exposure is averaged over a 70-year lifetime

Notes:
(1) Reasonable Maximum
(2) U.S. EPA 1989, Exposure Factors Handbook
(3) U.S. EPA 1989, Risk Assessment Guidance for Superfund, Part A
(4) Lepow 1974
(5) Correspondence with Roy Smith, Toxicologist, PhD, EPA Region III
(6) Yang 1989
(7) U.S. EPA 1991, Human Health Evalulation Manual, Supplemental Guidance
(8) Dependent upon whether toxicity indices were derived on an absorbed or administered dose
(9)U.S. EPA 1991, Interim Guidance for Dermal Exposure Assessment, Guy and Brounagh permeability estimation
(10) McKone, T.E. and K.T. Bogen 1991, Predicting the Uncertainties in Risk Assessment
(11) U.S. EPA 1991, Risk Assessment Guidance for Superfund, Parts B and C
(12) U.S. EPA 1989, Air/Superfund National Technical Guidance Study Series - 152 days/year a child spends outside
assumed 10% of the time outside will be spent trespassing, and assumed 20% of the trespassing time will be in surface water and sediment
(13) U.S. EPA 1985, Development of Statistical Distributions or Ranges of Standard Factors Used in Exposure Assessment

Table 5 Part 1 of 3
Parameters Used in Risk Assessment
Big V Supermarket, Baldwin Place Mall, NY

Parameter	Parameter Value	Under Estimate	Mean or 50th Percentile	EPA Default	EPA Document	90 - 95th Percentile Over Estimate
Construction Worker and Future Worker						
Total adult Surface area (cm2)	20,000				X	X
Fraction of skin available for exposure in soil	10%		X			
Adherence factor (mg/cm2)	0.51		X			
Absorption Factor for volatiles (rate/hr)	1%		X			
Matrix Effect for volatiles	100%					X
Body Weight (kg)	70			X		
Ingestion Rate (mg/day)	50			X		
Inhalation Rate - all adults (m3/day)	20			X		
Exposure Frequency for construction workers (shifts/year)	125		X			
Exposure Duration for construction workers (years)	1					X
Exposure Frequency for future workers (days/year)	250			X		
Exposure Duration for future workers (years)	25			X		
Human Lifespan (years)	70				X	

Table 5 Part 2 of 3
Parameters Used in Risk Assessment
Big V Supermarket, Baldwin Place Mall, NY

Parameter	Parameter Value	Under Estimate	Mean or 50th Percentile	EPA Default	EPA Document	90 - 95th Percentile Over Estimate
Children ages 6-15						
Total child surface area(cm2)	14,700				X	X
Fraction of skin available for exposure face, arms, hands, lower legs and feet	31.3%		X		X	
Adherence factor - soil (mg/cm2)	0.51		X			
Absorption Factor for volatiles (rate/hr)	1%		X			
Matrix Effect for volatiles	100%					X
Body Weight (kg)	52				X	X
Ingestion Rate for soil and sediment (mg/day)	100			X		
Ingestion Rate for surface water (liters/hr)	0.05				X	
Inhalation Rate (m3/hr)	1.5				X	X
Exposure time in soil (hours/day)	10					
Exposure time in surface water (hours/event)	2				X	
Exposure frequency in sediment (days/year)	3		X			
Exposure frequency in surface water (days/year)	7				X	
Exposure frequency in soil (days/year)	15		X			
Exposure duration in soil, sediment and surface water (year)	9					X

Table 5 Part 3 of 3
Parameters Used in Risk Assessment
Big V Supermarket, Baldwin Place Mall, NY

Parameter	Parameter Value	Under Estimate	Mean or 50th Percentile	EPA Default	EPA Document	90 - 95th Percentile Over Estimate
Adult Resident - Groundwater Use						
Ingestion Rate of fluid (l/day)	2			X		X
Fraction of fluid ingested that is water from the home	75%		X		X	
Surface area of body (m2)	2			X		X
Inhalation rate (m3/hr)	0.625 m3/hr				X	
Exposure time during bathing (hrs/day)	0.2			X		X
Exposure time in bathroom (hrs/day)	0.33		X			
Body Weight (kg)	70			X		
Shower water use rate (l/hr)	480		X			
Bathroom water use rate (l\hr)	480		X			
Total household water use rate (l/hr)	40		X			
Air exchange rate in the shower (m3/hr)	12		X			
Air exchange rate in the bathroorm (m3/hr)	54		X			
Air exchange rate in the house (m3/hr)	750		X			
Skin permeability	chemical specific		X			
Total adult Surface area (cm2)	20,000				X	X
Fraction of skin available for exposure during bathing	90%		X			
Exposure Frequency for current and future residents (days/year)	350			X		
Exposure Duration for current and future residents (years)	30			X		
Adult Resident - Soil						
Inhalation Rate (m3/day)	20			X		
Exposure Frequency for current and future residents (days/year)	350			X		
Exposure Duration for current and future residents (years)	30			X		
Body Weight (kg)	70			X		

Table 6
Statistical Analysis For All Media
Big V Supermarkets, Baldwin Place Mall, NY

GROUNDWATER

Chemical	Count	Mean ug/l	STDevp ug/l	STDerr ug/l	Upper 95 ug/l	Max Detect ug/l
Acetone	34	5.49E+00	3.32E+00	5.77E-01	6.44E+00	1.80E+01
Carbon Disulfide	34	4.09E+00	1.79E+00	3.12E-01	4.60E+00	1.00E+00
total 1,2-Dichloroethylene	34	4.11E+00	2.12E+00	3.70E-01	4.72E+00	1.00E+01
Methylene chloride	34	6.27E+00	8.49E+00	1.48E+00	8.70E+00	4.73E+01
Styrene	34	4.16E+00	1.71E+00	2.98E-01	4.65E+00	2.00E+00
Tetrachloroethylene	34	4.90E+01	1.53E+02	2.66E+01	9.28E+01	8.75E+02
Toluene	34	4.19E+00	1.78E+00	3.10E-01	4.70E+00	7.00E+00
Trichloroethylene	34	5.31E+00	9.25E+00	1.61E+00	7.96E+00	5.70E+01
bis(2-Ethylhexyl)phthalate	5	6.60E+00	2.33E+00	1.17E+00	9.09E+00	1.10E+01
TOTAL INORGANICS						
Aluminum	5	4.66E+02	4.03E+02	2.01E+02	8.95E+02	1.20E+03
Arsenic	5	8.76E-01	4.52E-01	2.26E-01	1.36E+00	1.78E+00
Barium	5	1.50E+02	8.31E+01	4.15E+01	2.39E+02	2.96E+02
Calcium	5	5.29E+04	1.83E+04	9.13E+03	7.24E+04	8.28E+04
Chromium	5	4.82E+00	2.14E+00	1.07E+00	7.10E+00	9.10E+00
Cobalt	5	4.56E+00	5.42E+00	2.71E+00	1.03E+01	1.54E+01
Copper	5	6.18E+00	1.11E+01	5.53E+00	1.80E+01	2.83E+01
Iron	5	1.35E+04	1.61E+04	8.05E+03	3.06E+04	4.26E+04
Lead	5	8.67E+00	6.59E+00	3.30E+00	1.57E+01	1.43E+01
Magnesium	5	1.39E+04	7.36E+03	3.68E+03	2.18E+04	2.38E+04
Manganese	5	3.24E+02	2.25E+02	1.12E+02	5.64E+02	6.39E+02
Potassium	5	4.34E+04	4.17E+04	2.09E+04	8.79E+04	1.08E+05
Selenium	5	1.02E+00	5.40E-01	2.70E-01	1.60E+00	2.10E+00
Sodium	5	3.25E+04	1.27E+04	6.34E+03	4.60E+04	5.10E+04
Thallium	5	1.37E+00	2.07E+00	1.04E+00	3.59E+00	5.50E+00
DISSOLVED INORGANICS						
Barium	4	1.31E+02	5.02E+01	2.90E+01	2.00E+02	1.85E+02
Calcium	4	5.26E+04	1.65E+04	9.54E+03	7.50E+04	7.43E+04
Chromium	4	4.27E+00	8.99E-01	5.19E-01	5.49E+00	5.83E+00
Cobalt	4	2.66E+00	1.41E+00	8.13E-01	4.57E+00	5.10E+00
Iron	4	1.18E+03	1.62E+03	9.38E+02	3.39E+03	3.98E+03
Magnesium	4	1.56E+04	7.02E+03	4.05E+03	2.51E+04	2.29E+04
Manganese	4	2.83E+02	1.91E+02	1.10E+02	5.42E+02	5.16E+02
Potassium	4	3.01E+04	3.45E+04	1.99E+04	7.70E+04	8.92E+04
Selenium	4	9.88E-01	4.11E-01	2.38E-01	1.55E+00	1.70E+00
Sodium	4	3.27E+04	1.30E+04	7.52E+03	5.04E+04	5.06E+04

SOIL

Chemical	Count	Mean ug/kg	STDevp ug/kg	STDerr ug/kg	Upper 95 ug/kg	Max Detect ug/kg
Acetone	14	9.36E+00	8.18E+00	2.27E+00	1.34E+01	3.30E+01
Chlorobenzene	14	5.32E+00	6.44E-01	1.79E-01	5.64E+00	3.00E+00
Chloroethane	14	5.25E+00	9.01E-01	2.50E-01	5.69E+00	2.00E+00
total 1,2-Dichloroethylene	14	5.61E+00	3.86E-01	1.07E-01	5.80E+00	7.00E+00
Ethylbenzene	14	5.54E+00	1.29E-01	3.57E-02	5.60E+00	6.00E+00
Tetrachloroethylene	14	1.34E+05	3.41E+05	9.45E+04	3.01E+05	1.20E+06
Toluene	14	5.61E+00	3.86E-01	1.07E-01	5.80E+00	7.00E+00
1,1,1-Trichloroethane	14	4.68E+00	1.59E+00	4.40E-01	5.46E+00	2.00E+00
Trichloroethylene	14	2.35E+01	6.56E+01	1.82E+01	5.58E+01	2.60E+02
Xylene (total)	14	5.29E+00	6.47E-01	1.79E-01	5.60E+00	5.00E+00

Table 7

Risk Reference Dose Values and Cancer Slope Factors for all Chemicals in the Exposure Scenarios

Big V Supermarkets, Baldwin Place Mall, NY

Chemical	Oral Chronic Rfd mg/kg/day		Inhalation Chronic Rfd mg/kg/day		Oral Subchronic Rfd mg/kg/day		Inhalation Subchronic Rfd mg/kg/day		Dermal Chronic RfD mg/kg/day	Dermal Subchronic RfD mg/kg/day	Oral CSF 1/(mg/kg/day)		Inhalation CSF 1/(mg/kg/day)		EPA Cancer Group Oral	EPA Cancer Group Inhalation
Acetone	1.00E-01	IRIS	3.00E+00	Pa	1.00E+00	H	3.00E+01	Pa	1.00E-01	1.00E+00						
Carbon Disulfide	1.00E-01	IRIS	2.90E-03	HE	1.00E-01	H	2.90E-03	HE	1.00E-01	1.00E-01						
Chlorobenzene	2.00E-02	IRIS	5.00E-03	H2	2.00E-01	(2)	5.00E-02	(2)	2.00E-02	2.00E-01						
Chloroethane	1.50E+00	Pa	2.90E+00	IE	1.50E+00	Pa	2.90E+00	HE	1.50E+00	1.50E+00						
total 1,2-Dichloroethylene	9.00E-03	H	1.40E-02	Pa	9.00E-03	H	1.40E-01	Pa	1.00E-02	1.00E-01						
Ethylbenzene	1.00E-01	IRIS	2.90E-01	IE	1.00E+00	(2)	2.90E-01	(2)	1.00E-01	1.00E+00						
Methylene chloride	6.00E-02	IRIS	8.60E-01	HE	6.00E-02	H	8.60E-01	HE	6.00E-02	6.00E-02	7.50E-03	IRIS	1.65E-03	IRIS	B2 IRIS	B2 IRIS
Styrene	2.00E-01	IRIS	3.00E-01	IE	2.00E+00	(2)	1.00E+00	HE	2.00E-01	2.00E+00						
Tetrachloroethylene	1.00E-02	IRIS	8.00E-03	Pa	1.00E-01	H	8.00E-02	Pa	1.00E-02	1.00E-01	5.20E-02	(1)	2.00E-03	(1)	C-B2	C-B2
Toluene	2.00E-01	IRIS	1.00E-01	IRIS	2.00E+00	H	1.00E-01	(2)	2.00E-01	2.00E+00						
1,1,1-Trichloroethane	9.00E-02	Pa(92)	3.00E-01	(2)	9.00E-01	(2)	3.00E+00	Pa(92)	9.00E-02	9.00E-01						
Trichloroethylene	7.40E-03	Pa	5.30E-02	Pa	1.80E-02	Pa	5.30E-01	Pa	7.55E-03	1.84E-02	1.10E-02	(1)	6.00E-03	(1)	C-B2	C-B2
Xylene (total)	2.00E+00	IRIS	8.00E-01	Pa	4.00E+00	(2)	8.00E-01	Pa	2.17E+00	4.35E+00						
bis(2-Ethylhexyl)phthalate	2.00E-02	IRIS	2.00E-02	Ps	2.00E-02	(2)	2.00E-02	Ps	2.22E-02	2.22E-02	1.40E-02	IRIS			B2 IRIS	

(1) Values are published by U.S. EPA (1985, 1987) - Health Assessment Documents for Tetrachloroethylene or Trichloroethylene and Addenda. In 1988 the Agency's Science Advisory Board offered an opinion that the weight-of-evidence was on C-B2 continuum.
(2) Subchronic values are withdrawn from HEAST (1993). These previously published values can be considered provisional values until new values are published.
H Values are published in HEAST.
HE Values are published in HEAST as RfC values and are converted by ESI to RfD values.
IRIS Values are available in IRIS.
IE Values are available in IRIS as RfC values and are converted by ESI to RfD values.
Pa Provisional, administered dose.
Pa(92) Provisional, administered doses that were published values in HEAST 1992.
Ps Provisional, absorbed dose.
A Human Carcinogen.
B2 Probable Human Carcinogen (usually a combination of sufficient evidence in animals and inadequate data in humans).
C Possible Human Carcinogen (limited evidence of carcinogenicity in animals in the absence of human data).

Table 8
Summary of Hazard and Risk Calculations
Big V Supermarkets, Baldwin Place Mall, NY

Source/Pathway	Potentially Exposed Population	Total Hazard Index Upperbound	Total Cancer Risk Upperbound
Incidental Ingestion of soil	Construction Worker	7E-04	5E-08
Dermal Absorption from soil	Construction Worker	2E-04	1E-08
Inhalation of vapors due to excavation activities	Construction Worker	6E+00	1E-05
	Sub-Total	6E+00	1E-05
Inhalation of vapors from soil	Current Resident	7E-04	5E-09
Ingestion of groundwater	Current Resident	1E-02	1E-06
Dermal Absorption from groundwater	Current Resident	8E-03	1E-06
Inhalation of vapors and airborne chemicals from groundwater	Current Resident	6E-02	1E-06
	Sub-Total	8E-02	4E-06 (a)
Inhalation of vapors from soil infiltrating through building foundation	Future Worker	2E+00	9E-06
	Sub-Total	2E+00	9E-06
Incidental Ingestion of soil	Children	2E-03	2E-07
Dermal Absorption from soil	Children	6E-04	4E-08
Inhalation of vapors from soil	Children	1E-01	3E-07
Incidental Ingestion of sediment	Children	2E-08	6E-13
Dermal Absorption from sediment	Children	4E-09	1E-13
Incidental Ingestion of surface water	Children	7E-06	5E-10
Dermal Absorption from surface water	Children	3E-04	2E-08
Inhalation of vapors from surface water	Children	2E-06	4E-12
	Sub-Total	2E-01	5E-07
Ingestion of groundwater	Future Resident	1E-01	2E-05
Dermal Absorption from groundwater	Future Resident	1E-01	2E-05
Inhalation of vapors and airborne chemicals from groundwater	Future Resident	1E+00	8E-06
	Sub-Total	1E+00	5E-05

(a) Risk is attributable only to groundwater pathways which utilized Federal and NYSDEC/NYSDOH MCLs for Tetrachloroethylene and Trichloroethylene.

Table 9

Calculations of Hazard Indices and Cancer Risks for Ingestion of Site Soil During Excavation Activities by Construction Workers

Big V Supermarkets, Baldwin Place Mall, NY

Intake (mg/kg/day) = $\frac{Cs*IR*EF*ED*CF*ME}{BW*AT*365}$

Cs = Concentration in soil (mg/kg)=	chemical specific	
IR = Ingestion rate (mg/day)=	50	U.S. EPA 1991 HHEM Supplemental Guidance
EF = Exposure frequency (days/year)=	125	Reasonable Maximum
ED = Exposure duration (years) =	1	Reasonable Maximum
CF = Conversion factor (1 kg/1,000,000 mg)=	1.00E-06	
BW = Body weight (kg)=	70	U.S. EPA 1989 RAGS
AT = Averaging time for noncarcinogenic effects (years)=	1	Reasonable Maximum
and for carcinogenic effects (years)=	70	U.S. EPA 1989 RAGS
365 = Number of days per year (days/year)=	365	
Matrix Effect - Volatiles=	1	Reasonable Maximum

Chemical	Upper 95th Percentile of the Mean Conc. or Max Conc. mg/kg	Average Daily Intake (non-cancer) (mg/kg/day)	Sub-Chronic Oral RfD (mg/kg/day)	Hazard Index	Average Lifetime Daily Intake (cancer) (mg/kg/day)	Oral Slope Factor (risk units per mg/kg/day)	Cancer Risk
Acetone	1.34E-02	3.27E-09	1.00E+00	3.27E-09	4.67E-11		
Chlorobenzene	3.00E-03	7.34E-10	2.00E-01	3.67E-09	1.05E-11		
Chloroethane	2.00E-03	4.89E-10	1.50E+00	3.26E-10	6.99E-12		
total 1,2-Dichloroethylene	5.80E-03	1.42E-09	9.00E-03	1.58E-07	2.03E-11		
Ethylbenzene	5.60E-03	1.37E-09	1.00E+00	1.37E-09	1.96E-11		
Tetrachloroethylene	3.01E+02	7.37E-05	1.00E-01	7.37E-04	1.05E-06	5.20E-02	5.47E-08
Toluene	5.80E-03	1.42E-09	2.00E+00	7.09E-10	2.03E-11		
1,1,1-Trichloroethane	2.00E-03	4.89E-10	9.00E-01	5.44E-10	6.99E-12		
Trichloroethylene	5.58E-02	1.36E-08	1.80E-02	7.58E-07	1.95E-10	1.10E-02	2.14E-12
Xylene (total)	5.00E-03	1.22E-09	4.00E+00	3.06E-10	1.75E-11		
			Total Hazard Index =	7E-04		Total Cancer Risk =	5E-08

Table 10

Calculations of Hazard Indices and Cancer Risk of Dermal Exposure to Site Soil During Excavation Activities by Construction Workers

Big V Supermarkets, Baldwin Place Mall, NY

Intake (mg/kg/day) = $\frac{Cs*SA*AF*ABS*EF*ED*CF}{BW*AT*365}$

Cs = Concentration in soil (mg/kg)=	chemical specific	
Adult skin surface area available for exposure (cm2)=	2000	
Total Adult Surface area(cm2)=	20000	U.S. EPA 1989 Exposure Factors Handbook
Fraction of skin surface area available for exposure=	0.1	Reasonable Maximum
AF =Soil Adherence Factor (mg/cm2)=	0.51	Lepow 1974
ABS for volatiles=	0.01	Roy Smith EPA Region III
EF = Exposure frequency (days/year)=	125	Reasonable Maximum
ED = Exposure duration (years)=	1	Reasonable Maximum
CF = Conversion factor (1 kg/1,000,000 mg)=	1.00E-06	
BW = Body weight (kg)=	70	U.S. EPA 1989 RAGS
AT = Averaging time for noncarcinogenic effects (years)=	1	Reasonable Maximum
and for carcinogenic effects (years)=	70	U.S. EPA 1989 RAGS
365 = Number of days per year (days/year)=	365	

Chemical	Upper 95th Percentile of the Mean Conc. or Max Conc. mg/kg	Average Daily Intake (non-cancer) (mg/kg/day)	Subchronic Dermal RfD (mg/kg/day)	Hazard Index	Average Lifetime Daily Intake (cancer) (mg/kg/day)	Slope Factor (risk units per mg/kg/day)	Cancer Risk
Acetone	1.34E-02	6.67E-10	1.00E+00	6.67E-10	9.54E-12		
Chlorobenzene	3.00E-03	1.50E-10	2.00E-01	7.49E-10	2.14E-12		
Chloroethane	2.00E-03	9.98E-11	1.50E+00	6.65E-11	1.43E-12		
total 1,2-Dichloroethylene	5.80E-03	2.89E-10	1.00E-01	2.89E-09	4.13E-12		
Ethylbenzene	5.60E-03	2.79E-10	1.00E+00	2.79E-10	3.99E-12		
Tetrachloroethylene	3.01E+02	1.50E-05	1.00E-01	1.50E-04	2.15E-07	5.20E-02	1.12E-08
Toluene	5.80E-03	2.89E-10	2.00E+00	1.45E-10	4.13E-12		
1,1,1-Trichloroethane	2.00E-03	9.98E-11	9.00E-01	1.11E-10	1.43E-12		
Trichloroethylene	5.58E-02	2.78E-09	1.84E-02	1.51E-07	3.97E-11	1.10E-02	4.37E-13
Xylene (total)	5.00E-03	2.50E-10	4.35E+00	5.74E-11	3.56E-12		
			Total Hazard Index =	2E-04		Total Cancer Risk =	1E-08

Table 11

Calculations of Hazard Indices and Cancer Risks Posed to Construction Workers During Excavation Activities via Inhalation of Vapors from Site Soil

Big V Supermarkets, Baldwin Place Mall, NY

CA = Concentration in Air (mg/m3) = Cs*Ag*VR

Cs = Concentration in soil (mg/kg)= chem. specific
Ag = Agitation Factor (unitless) = 50
VR = Volatilization Factor (kg/m3) = chem. specific

Intake (mg/kg/day) = $\frac{CA * IRA * EF * ED}{BW * AT * 365}$

CA = Concentration in air (mg/m3)=	chemical specific	
IRA = Inhalation rate (m3/shift)=	20	U.S. EPA 1991 HHEM Sup. Guidance
EF = Exposure frequency (shifts/year)=	125	Reasonable Maximum
ED = Exposure duration (year)=	1	Reasonable Maximum
BW = Body weight (kg)=	70	U.S. EPA 1989 RAGS
AT = Averaging time for noncarcinogenic effects (years)=	1	Reasonable Maximum
and for carcinogenic effects (years)=	70	U.S. EPA 1989 RAGS
365 = Number of days per year=	365	

Chemical	Upper 95% of the Mean Conc. or Max. Conc. mg/kg	Agitation Factor (1) (unitless)	Volatilization Rate (kg/cu.m)	Modelled Air Conc. (mg/m3)	Chronic Daily Intake (mg/kg/day)	Subchronic Inhalation RfD (mg/kg/day)	Hazard Index	Lifetime Chronic Daily Intake (mg/kg/day)	Inhalation Slope Factor	Cancer Risk
Acetone	1.34E-02	5.00E+01	1.20E-04	8.03E-05	7.86E-06	3.00E+01	2.62E-07	1.12E-07		
Chlorobenzene	3.00E-03	5.00E+01	1.14E-04	1.70E-05	1.67E-06	5.00E-02	3.34E-05	2.38E-08		
Chloroethane	2.00E-03	5.00E+01	1.37E-03	1.37E-04	1.34E-05	2.90E+00	4.63E-06	1.92E-07		
total 1,2-Dichloroethylene	5.80E-03	5.00E+01	3.63E-04	1.05E-04	1.03E-05	1.40E-01	7.36E-05	1.47E-07		
Ethylbenzene	5.60E-03	5.00E+01	7.81E-05	2.19E-05	2.14E-06	2.90E-01	7.38E-06	3.06E-08		
Tetrachloroethylene	3.01E+02	5.00E+01	3.34E-04	5.03E+00	4.93E-01	8.00E-02	6.16E+00	7.04E-03	2.00E-03	1.41E-05
Toluene	5.80E-03	5.00E+01	1.57E-04	4.55E-05	4.45E-06	1.00E-01	4.45E-05	6.36E-08		
1,1,1-Trichloroethane	2.00E-03	5.00E+01	3.76E-04	3.76E-05	3.68E-06	3.00E+00	1.23E-06	5.26E-08		
Trichloroethylene	5.58E-02	5.00E+01	3.29E-04	9.17E-04	8.98E-05	5.30E-01	1.69E-04	1.28E-06	6.00E-03	7.69E-09
Xylene	5.00E-03	5.00E+01	1.76E-04	4.39E-05	4.30E-06	8.00E-01	5.38E-06	6.14E-08		
						Total Hazard Index=	6E+00		Total Cancer Risk=	1E-05

(1) Air/Superfund Technical Guidance Volume III

Table 12

Inhalation Exposure to Nearest Residents from Vapors Released from the Site Contaminated Soil under Current Conditions

Big V Supermarkets, Baldwin Place Mall, NY

E = Emission Rate of Component (g/sec) = Di*Csi*A*(Pt^4/3)*Mi / Dsc

Csi = saturation vapor conc. (g/cu. cm) = pMWi / RT

Di - Diffusion coefficient in air (cm^2/sec)	chem specific
Csi - Saturation vapor concentration (g/cu. cm)	chem specific
A - Exposed area (cm^2)	2.25E+06
Pt - Total soil porosity (dimensionless)	0.35
Mi - Mole fraction of compound in the waste	chem specific
Dsc - Effective depth of soil cover (cm)	10
p - compound vapor pressure (mm Hg)	chem specific
MW - compound mol. wt. (g/mol)	chem specific
R - Molar gas constant (mm Hg-cu. m/mol-K)	62,361
T - absolute temp. (Kelvin)	298

CA = Concentration in Air (mg/cu.m) = E*CF/(pi*sig-y*sig-z*mu)

E = Emission Rate of Component (g/sec)		chem specific
CF = Conversion Factor g to mg =	mg/g	1000
pi =		3.14159
sig-y =	meters	19
sig-z =	meters	12
mu = mean wind speed =	m/sec	3.3

Intake (mg/kg/day) = CA*IR*EF*ED*AF*DW / BW*AT*365

IR = Inhalation Rate =	cu.m/day	20
EF = Exposure frequency =	days/yr.	350
ED = Exposure duration =	years	30
AF= absorption freq. = admin or absorb dose =		1 or 0.5
DW = Freq. of wind from direction that is directly upwind from both source and residence =		0.165
BW = Body Weight =	kg	70
AT = Averaging time for noncarcinogenic effects	years	30
and for carcinogenic effects	years	70

Chemical	Contaminant Emission Rate (g/sec)	Concentration in Air (mg/cu.m)	Average Daily Intake (non-cancer) (mg/kg/day)	Inhalation Chronic RfD (mg/kg/day)	Hazard Quotient	Average Lifetime Daily Intake (cancer) (mg/kg/day)	Inhalation Slope Factor (risk units per mg/kg/day)	Upper Bound Carcinogenic Risk
Acetone	6.63E-08	2.81E-08	1.27E-09	3.00E+00	4.23E-10	5.43E-10		
Chlorobenzene	9.78E-10	4.14E-10	1.87E-11	5.00E-03	3.74E-09	8.01E-12		
Chloroethane	5.09E-08	2.15E-08	9.73E-10	2.90E+00	3.35E-10	4.17E-10		
total 1,2-Dichloroethene	3.66E-08	1.55E-08	7.00E-10	1.40E-02	5.00E-08	3.00E-10		
Ethylbenzene	9.17E-10	3.88E-10	1.75E-11	2.90E-01	6.05E-11	7.52E-12		
Tetrachloroethylene	2.85E-04	1.20E-04	5.44E-06	8.00E-03	6.80E-04	2.33E-06	2.00E-03	4.66E-09
Toluene	3.60E-09	1.52E-09	6.89E-11	1.00E-01	6.89E-10	2.95E-11		
1,1,1-Trichloroethane	9.85E-09	4.17E-09	1.88E-10	3.00E-01	6.28E-10	8.07E-11		
Trichloroethylene	1.34E-07	5.69E-08	2.57E-09	5.30E-02	4.85E-08	1.10E-09	6.00E-03	6.61E-12
Xylene	1.17E-09	4.95E-10	2.24E-11	8.00E-01	2.80E-11	9.59E-12		
				Total Hazard Index =	7E-04		Total Cancer Risk =	5E-09

Table 13

Calculations of Hazard Indices and Cancer Risks to Future Workers due to Inhalation of Vapors Infiltrating Through Building Foundation

Big V Supermarkets, Baldwin Place Mall, NY

Intake (mg/kg/day) = (CA*IR*EF*ED*AF) / (BW*AT*365)

CA=conc. in air (mg/cu.m)= E*K*CF*(1/Vol)*(1/XR)

CA-conc. in air =	mg/cu.m	chem specific	
IR-inhalation rate=	cu.m/day	20	
EF-exposure frequency=	days/year	250	
ED-exposure duration=	years	25	
AF-absorption factor (admin/absorbed)=	unitless	0.5	1
BW-body weight=	kg	70	
AT-averaging time carc./non-carc.=	years	70	25
365-365 days/year=	days/year	365	
E-emission rate=	g/sec	chem specific	
K-conversion factor=	sec/hr	3600	
CF - conversion factor =	mg/g	1000	
Vol-interior volume of building=	cu.m	340	
XR-air exchange rate=	exch/hr	10	

E = Emission Rate (g/sec)= (Di*Csi*A*(Pt^4/3)*Mi) / Dsc

Csi=saturation vapor conc. (g/cu.cm)= (p*MW) / (R*T)

Di-compound diff. coeff. in air=	sq.cm./sec	chem specific	
Csi-saturation vapor conc.=	g/cu.cm	chem specific	
A-exposed area (floor size)=	sq.cm	1.40E+06	
Pt-total soil porosity=	unitless	0.35	(EPA 1988a)
Mi-mole fraction of compound in soil=	gmol/gmol	chem specific	
Dsc-effective depth of soil cover=	cm	30.48	(1 ft of clean fill)
p-compound vapor press.=	mm-Hg	chem specific	
MW-compound mol. wt.=	mg/mol	chem specific	
R-molar gas constant - mm-Hg-cu.cm/mol-K=		62361	
T-absolute temp.=	Kelvin	298	

Chemical	Upper 95% Conc. or Max. Conc. in Soil mg/kg	Csi-Saturation Vapor Conc. g/cu.m	E Emission Rate g/sec	CA Conc. in Air mg/cu.m	Average Daily Intake mg/kg/day	Chronic Inhalation RfD mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Inhalation Slope Factor risk units/ mg/kg/day	Cancer Risk
Acetone	1.34E-02	8.43E-04	1.36E-08	1.44E-05	2.81E-06	3.00E+00	9.38E-07	1.01E-06		
Chlorobenzene	3.00E-03	7.27E-05	2.00E-10	2.12E-07	4.15E-08	5.00E-03	8.30E-06	1.48E-08		
Chloroethane	2.00E-03	4.17E-03	1.04E-08	1.10E-05	2.16E-06	2.90E+00	7.45E-07	7.71E-07		
total 1,2-Dichloroethylene	5.80E-03	1.09E-03	7.72E-09	8.18E-06	1.60E-06	1.40E-02	1.14E-04	5.72E-07		
Ethylbenzene	5.60E-03	4.00E-05	1.88E-10	1.99E-07	3.89E-08	2.90E-01	1.34E-07	1.39E-08		
Tetrachloroethylene	3.01E+02	1.61E-04	5.83E-05	6.17E-02	1.21E-02	8.00E-03	1.51E+00	4.31E-03	2.00E-03	8.63E-06
Toluene	5.80E-03	1.39E-04	7.38E-10	7.81E-07	1.53E-07	1.00E-01	1.53E-06	5.46E-08		
1,1,1-Trichloroethane	2.00E-03	8.61E-04	2.02E-09	2.14E-06	4.18E-07	3.00E-01	1.39E-06	1.49E-07		
Trichloroethylene	5.58E-02	4.10E-04	2.75E-08	2.92E-05	5.70E-06	5.30E-02	1.08E-04	2.04E-06	6.00E-03	1.22E-08
Xylene (total)	5.00E-03	5.71E-05	2.40E-10	2.54E-07	4.97E-08	8.00E-01	6.21E-08	1.77E-08		
						Total Hazard Index:	2E+00		Total Cancer Risk:	9E-06

Table 14

Calculations of Hazards and Risks due to Ingestion of Site Surface Soil by Children, Ages 6-15
Big V Supermarkets, Baldwin Place Mall, NY

Intake (mg/kg/day) = $\frac{Cs*IR*EF*ED*CF*ME}{BW*AT*365}$

Cs = Concentration in soil=	chemical specific	
IR = Ingestion rate(mg/day)=	100	U.S. EPA 1991 HHEM Supplemental Guidance
EF = Exposure frequency(events/year)=	15	U.S. EPA 1985 MAECS, Vol. 2 (1)
ED = Exposure duration(years)=	9	Reasonable maximum
CF = Conversion factor (1 kg/1,000,000 mg)(kg/mg)=	1.00E-06	
BW = Body weight (kg)=	52	Statistical Distributions, EPA 1985
AT = Averaging time for noncarcinogenic effects(years)=	9	Reasonable maximum
and for carcinogenic effects(years)=	70	U.S. EPA 1989 RAGS
Days per year=	365	
Matrix Effect - Volatiles=	1	Reasonable Maximum

Chemical	Upper 95th Percentile of the Mean Conc. or Max. Conc. mg/kg	Average Daily Intake (non-cancer) (mg/kg/day)	Chronic Oral RfD (mg/kg/day)	Hazard Index	Average Lifetime Daily Intake (cancer) (mg/kg/day)	Oral Cancer Slope Factor (risk units per mg/kg/day)	Cancer Risk
Acetone	1.34E-02	1.06E-09	1.00E-01	1.06E-08	1.36E-10		
Chlorobenzene	3.00E-03	2.37E-10	2.00E-02	1.19E-08	3.05E-11		
Chloroethane	2.00E-03	1.58E-10	1.50E+00	1.05E-10	2.03E-11		
total 1,2-Dichloroethylene	5.80E-03	4.58E-10	9.00E-03	5.09E-08	5.89E-11		
Ethylbenzene	5.60E-03	4.42E-10	1.00E-01	4.42E-09	5.69E-11		
Tetrachloroethylene	3.01E+02	2.38E-05	1.00E-02	2.38E-03	3.06E-06	5.20E-02	1.59E-07
Toluene	5.80E-03	4.58E-10	2.00E-01	2.29E-09	5.89E-11		
1,1,1-Trichloroethane	2.00E-03	1.58E-10	9.00E-02	1.76E-09	2.03E-11		
Trichloroethylene	5.58E-02	4.41E-09	7.40E-03	5.95E-07	5.67E-10	1.10E-02	6.23E-12
Xylene (total)	5.00E-03	3.95E-10	2.00E+00	1.98E-10	5.08E-11		
			Total Hazard Index =	2E-03		Total Cancer Risk =	2E-07

(1) EF =10% of time outside is spent trespassing (152 days spent outside - U.S. EPA 1985 Methods for Assessing Exposure to Chem. Sub., Vol. 2)

Table 15

Calculation of Hazard and Risk due to Dermal Exposure to Site Soil by Children, Ages 6-15
Big V Supermarkets, Baldwin Place Mall, NY

Dermal Absorbed Dose (mg/kg/day) = $\frac{Cs*SA*AF*ABS*EF*ED*CF}{BW*AT*365}$

Cs = Concentration in soil=	chemical specific	
SA=Surface area available for exposure (cm2) =	4601	
Total child (ages 6-15 years) surface area(cm^2)=	14700	Exposure Factors Handbook
Fraction of skin available for exposure=	0.313	Exposure Factors Handbook
AF = Adherence factor (mg/cm^2)=	0.51	Lepow 1974
ABS for volatiles=	0.01	Roy Smith PhD, Region III EPA
EF = Exposure frequency(events/year)=	15	U.S. EPA 1985 MAECS, Vol. 2 (1)
ED = Exposure duration(years)=	9	Reasonable maximum
CF = Conversion factor (1 kg/1,000,000 mg)(kg/mg)=	1.00E-06	
BW = Body weight(kg)=	52	Statistical Distributions, EPA 1985
AT = Averaging time for noncarcinogenic effects(year)=	9	Reasonable maximum
and for carcinogenic effects(year)=	70	U.S. EPA 1989 RAGS
Days per year=	365	

Chemical	Upper 95th Percentile of the Mean Conc. or Max. Conc. mg/kg	Average Daily Intake (non-cancer) (mg/kg/day)	Chronic Dermal RfD (mg/kg/day)	Hazard Index	Average Lifetime Daily Intake (cancer) (mg/kg/day)	Slope Factor (risk units per mg/kg/day)	Cancer Risk
Acetone	1.34E-02	2.48E-10	1.00E-01	2.48E-09	3.19E-11		
Chlorobenzene	3.00E-03	5.56E-11	2.00E-02	2.78E-09	7.15E-12		
Chloroethane	2.00E-03	3.71E-11	1.50E+00	2.47E-11	4.77E-12		
total 1,2-Dichloroethylene	5.80E-03	1.08E-10	1.00E-02	1.08E-08	1.38E-11		
Ethylbenzene	5.60E-03	1.04E-10	1.00E-01	1.04E-09	1.33E-11		
Tetrachloroethylene	3.01E+02	5.58E-06	1.00E-02	5.58E-04	7.18E-07	5.20E-02	3.73E-08
Toluene	5.80E-03	1.08E-10	2.00E-01	5.38E-10	1.38E-11		
1,1,1-Trichloroethane	2.00E-03	3.71E-11	9.00E-02	4.12E-10	4.77E-12		
Trichloroethylene	5.58E-02	1.03E-09	7.55E-03	1.37E-07	1.33E-10	1.10E-02	1.46E-12
Xylene (total)	5.00E-03	9.27E-11	2.17E+00	4.27E-11	1.19E-11		
		Total Hazard Index =		6E-04		Total Cancer Risk=	4E-08

(1) EF =10% of time outside is spent trespassing (152 days spent outside - U.S. EPA 1985 Methods for Assessing Exposure to Chem. Sub., Vol. 2)

Table 16

Calculation of Hazards and Risks due to Inhalation of Vapors from Site Soil by Children, Ages 6-15. Using the U.S. EPA RAGS 1991 Parts B Default Risk Equations for Non-carcinogenic and Carcinogenic Effects

Big V Supermarkets, Baldwin Place Mall, NY

$$\text{Intake (mg/kg/day)} = \frac{C*ET*EF*ED*IR*(1/VF)}{BW*AT*365}$$

Cs=Concentration in Soil (mg/kg)=	chemical specific	
IR=Inhalation Rate(m^3/hr)=	1.5	U.S. EPA 1989 Exposure Factors Handbook (1)
ET=Exposure Time(hrs/event)=	10	Reasonable maximum
EF=Exposure Frequency(event/year)=	15	U.S. EPA 1985 MAECS, Vol. 2 (2)
ED=Exposure duration(year)=	9	Reasonable maximum
VF=Volatilization factor=	chemical specific	
BW=Body Weight(kg)=	52	Statistical Distributions, EPA 1985
AT = Averaging time for noncarcinogenic effects(years)=	9	Reasonable Maximum
and for carcinogenic effects(year)=	70	U.S. EPA 1989 RAGS
Days per year=	365	

Chemical	Upper 95% of the Mean Conc. or Max. Conc. mg/kg	Average Daily Intake (non-cancer) (mg/kg/day)	Chronic RfD Inhalation (mg/kg/day)	Hazard Index	Lifetime Average Daily Intake (m.kg/day)	Inhalation Cancer Slope Factor	Cancer Risk
Acetone	1.34E-02	1.90E-08	3.00E+00	6.32E-09	2.44E-09		
Chlorobenzene	3.00E-03	4.03E-09	5.00E-03	8.06E-07	5.18E-10		
Chloroethane	2.00E-03	3.24E-08	2.90E+00	1.12E-08	4.17E-09		
total 1,2-Dichloroethylene	5.80E-03	2.49E-08	1.40E-02	1.78E-06	3.20E-09		
Ethylbenzene	5.60E-03	5.17E-09	2.90E-01	1.78E-08	6.65E-10		
Tetrachloroethylene	3.01E+02	1.19E-03	8.00E-03	1.49E-01	1.53E-04	2.00E-03	3.06E-07
Toluene	5.80E-03	1.07E-08	1.00E-01	1.07E-07	1.38E-09		
1,1,1-Trichloroethane	2.00E-03	8.90E-09	3.00E-01	2.97E-08	1.14E-09		
Trichloroethylene	5.58E-02	2.17E-07	5.30E-02	4.09E-06	2.79E-08	6.00E-03	1.67E-10
Xylene (total)	5.00E-03	1.04E-08	8.00E-01	1.30E-08	1.34E-09		
			Total Hazard Index =	1E-01		Total Cancer Risk =	3E-07

(1) Inhalation rate is an average of male children ages 11 to 13 years, during moderate to heavy activity
(2) EF =10% of time outside is spent trespassing (152 days spent outside - U.S. EPA 1985 Methods for Assessing Exposure to Chem. Sub., Vol. 2)

Table 17
Calculations of Hazards and Risks due to Ingestion of Sediment by Children, 6-15 years old
Big V Supermarkets, Baldwin Place Mall, NY

Ingestion Intake(mg/kg/day)= $\frac{Cs*IngR*EF*ED*CF*ME}{BW*AT*365}$

Cs=concentration in sediment=	chemical specific	
IngR=ingestion rate(mg/day)=	100	U.S. EPA 1991 HHEM Supplemental Guidances
EF=exposure frequency=(days/year)=	3	(1)
ED=exposure duration(years)=	9	Reasonable maximum
Conversion Factor (kg/10^6mg)=	1.00E-06	
BW=child body weight(kg)=	52	Statistical Distributions, EPA 1985
AT=averaging time for non-carcinogenic effect(years)=	9	Reasonable maximum
AT=averaging time for carcinogenic effect(years)=	70	U.S. EPA 1989 RAGS
Days per year=	365	
Matrix Effect - Volatiles=	1	Reasonable Maximum

Chemical	Maximum Conc. Detected in Sediment (mg/kg)	Average Daily Intake (non-cancer) (mg/kg/day)	Chronic Oral RfD (mg/kg/day)	Hazard Quotient	Average Lifetime Daily Intake (cancer) (mg/kg/day)	Oral Cancer Potency Factor (risk units per mg/kg/day)	Upper Bound Cancer Risk
Acetone	5.80E-02	9.17E-10	1.00E-01	9.17E-09	1.18E-10		
Methylene chloride	9.00E-03	1.42E-10	6.00E-02	2.37E-09	1.83E-11	7.50E-03	1.37E-13
Tetrachloroethylene	4.00E-03	6.32E-11	1.00E-02	6.32E-09	8.13E-12	5.20E-02	4.23E-13
			Total Hazard Quotient=	2E-08		Total Cancer Risk=	6E-13

(1) EF =10% of time outside (152 days) is spent trespassing; 20% of time trespassing is spent in sediment

Table 18

Calculations of Hazards and Risks due to Dermal Exposure of Children 6-15 years old to Sediment
Big V Supermarkets, Baldwin Place Mall, NY

Dermal exposure(mg/kg/day)= $\frac{Cs*SA*F*ABS*EF*ED*CF}{BW*AT*365}$

Cs=concentration in sediment=	chemical specific	
SA=Surface area	4601	
Total skin surface area of a child age 6-15 (cm2)=	14700	Exposure Factors Handbook
Fraction of skin surface area available for exposure=	0.313	Exposure Factors Handbook
AF=adherence factor(mg/cm^2)=	0.51	Lepow 1974
ABS=absorption factor for volatiles=	0.01	Roy Smith PhD Region III EPA
EF=exposure frequency=(days/year)=	3	(1)
ED=exposure duration(years)=	9	Reasonable maximum
Conversion factor (kg/mg)=	1.00E-06	
BW=child body weight(kg)=	52	Statistical Distributions, EPA 1985
AT=averaging time for non-carcinogenic effect(day)=	9	Reasonable maximum
AT=averaging time for carcinogenic effect(day)=	70	U.S. EPA 1989 RAGS
Days per year=	365	

Chemical	Maximum Conc. Detected in Sediment (mg/kg)	Average Daily Intake (non-cancer) (mg/kg/day)	Chronic Dermal RfD (mg/kg/day)	Hazard Quotient	Average Lifetime Daily Intake (cancer) (mg/kg/day)	Oral Cancer Potency Factor (risk units per mg/kg/day)	Upper Bound Cancer Risk
Acetone	5.80E-02	2.15E-10	1.00E-01	2.15E-09	2.77E-11		
Methylene chloride	9.00E-03	3.34E-11	6.00E-02	5.56E-10	4.29E-12	7.50E-03	3.22E-14
Tetrachloroethylene	4.00E-03	1.48E-11	1.00E-02	1.48E-09	1.91E-12	5.20E-02	9.92E-14
			Total Hazard Quotient=	4E-09		Total Cancer Risk=	1E-13

(1) EF =10% of time outside (152 days) is spent trespassing; 20% of time trespassing is spent in sediment

Table 19 part 1 of 5
Calculation of Hazard and Risk Associated with Current Residential Contact with Groundwater
Big V Supermarkets, Baldwin Place Mall, NY

Ingestion of Groundwater in the Home

Daily Intake=	mg/kg/day	(Cgw * IRw * %VOC * fr / BW) * (EF * ED)/(DY *AT)	
Cgw - conc. in groundwater=	mg/l	chem specific	
IRw - ingestion rate of water=	l/day	2	(EPA 1989 RAGS)
%VOC - % VOC retained in drinking water=	dimensionless	0.5	(EPA 1991 RAGS Part B)
fr - fraction of daily fluid intake from home tap=	dimensionless	0.75	(EPA 1989 EFH)
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/yer	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)

Chemical	Federal and NYSDOH MCLs mg/l	Average Daily Intake mg/kg/day	Oral Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Oral Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Tetrachloroethylene	5.00E-03	5.14E-05	1.00E-02	5.14E-03	2.20E-05	5.20E-02	1.14E-06
Trichloroethylene	5.00E-03	5.14E-05	7.40E-03	6.94E-03	2.20E-05	1.10E-02	2.42E-07
			Total Hazard Quotient:	1E-02		Total Cancer Risk:	1E-06

Table 19 part 2 of 5

Calculation of Hazard and Risk Associated with Current Residential Contact with Groundwater

Big V Supermarkets, Baldwin Place Mall, NY

Dermal Contact with Groundwater in the Home

Daily Intake= mg/kg/day (Cgw * SA *fs* Kp *ETs * %VOC * CF / BW) * (EF * ED)/(DY *AT)

Cgw - conc. in groundwater=	mg/l	chem specific	
SA - total adult skin surface area=	m^2	2	(EPA 1989 RAGS)
fs - fraction of skin in contact w/ water while bathing=	dimensionless	0.9	Reasonable Maximum
Kp - dermal permeability constant=	m/hr	chem specific	(EPA 1991 IG for Derm)
ETs - exposure time in shower=	hr/day	0.2	(EPA 1989 RAGS, McKone 1991)
%VOC - % VOC retained in bathing water=	dimensionless	0.5	(EPA 1991 RAGS Part B)
CF - conversion factor=	l/m^3	1000	
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/year	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)

Chemical	Federal and NYSDOH MCLs mg/l	Kp Dermal Permeabl. Constant m/hr	Average Daily Intake mg/kg/day	Dermal Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Tetrachloroethylene	5.00E-03	4.00E-03	4.93E-05	1.00E-02	4.93E-03	2.11E-05	5.20E-02	1.10E-06
Trichloroethylene	5.00E-03	2.00E-03	2.47E-05	7.55E-03	3.27E-03	1.06E-05	1.10E-02	1.16E-07
			Total Hazard Quotient:		8E-03		Total Cancer Risk:	1E-06

Table 19 part 3 of 5

Calculation of Hazard and Risk Associated with Current Residential Contact with Groundwater

Big V Supermarkets, Baldwin Place Mall, NY

Inhalation Contact with VOC's from Groundwater in Shower

Daily Intake=	mg/kg/day	Cgw * ((Cshower/Cgw) * BR * ETs / BW) * (EF * ED)/(DY *AT)
Cshower/Cgw - conc. in shower air to conc. in gw=	l/m³	Wsh * øx / VRsh
øx - chem mass transfer efficency=	unitless	ørn * (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for radon ÷ (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for chem

Cgw - conc. in groundwater=	mg/l	chem specific	
BR - breathing rate=	m3/hr	0.625	(EPA HHEM SG 1991)
ETs - exposure time in shower=	hr/day	0.2	(EPA 1989 RAGS, McKone 1991)
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/year	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)
Wsh - shower water use rate=	l/hr	480	(McKone 1991)
VRsh - shower air exchange rate=	m3/hr	12	(McKone 1991)
ørn - transfer efficiency for radon=	dimensionless	0.7	(McKone 1987)
Dl for radon - diffus. coeff. in water=	m2/sec	1.40E-09	(McKone 1987)
Da for radon - diffus. coeff. in air=	m2/sec	2.00E-05	(McKone 1987)
H for radon=	atm-m3/mol	0.092	(McKone 1987)
R - ideal gas constant=	atm-m3/mol-K	8.20E-05	
T - temperature=	K	298	
Dl for chem - diffus. coeff. in water=	m2/sec	chem specific	
Da for chem - diffus. coeff. in air=	m2/sec	chem specific	
H for chem - Henry's Law constant=	atm-m3/mol	chem specific	

Chemical	Federal and NYSDOH MCLs mg/l	øx Chem. Mass Transfer Coeff.	Csh/Cgw Air conc. over GW conc. l/m3	Average Daily Intake mg/kg/day	Inhalation Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Inhalation Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Tetrachloroethylene	5.00E-03	7.70E-01	3.08E+01	2.64E-04	8.00E-03	3.30E-02	1.13E-04	2.00E-03	2.26E-07
Trichloroethylene	5.00E-03	7.46E-01	2.99E+01	2.56E-04	5.30E-02	4.82E-03	1.10E-04	6.00E-03	6.57E-07
					Total Hazard Quotient:	4E-02		Total Cancer Risk:	9E-07

Table 19 part 4 of 5
Calculation of Hazard and Risk Associated with Current Residential Contact with Groundwater
Big V Supermarkets, Baldwin Place Mall, NY

Inhalation Contact with VOC's from Groundwater in Bathroom

Daily Intake=	mg/kg/day	Cgw * ((Cbath/Cgw) * BR * ETb / BW) * (EF * ED)/(DY *AT)
Cbath/Cgw - conc. in bathroom air to conc. in gw=	l/m³	Wsh * øx / VRbath
øx - chem mass transfer efficency=	unitless	ørn * (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for radon ÷ (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for chem

Cgw - conc. in groundwater=	mg/l	chem specific	
BR - breathing rate=	m3/hr	0.625	(EPA HHEM SG 1991)
ETb - exposure time in bathroom=	hr/day	0.33	(McKone 1991)
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/year	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)
Wsh - shower water use rate=	l/hr	480	(McKone 1991)
VRbath - bathroom air exchange rate=	m3/hr	54	(McKone 1991)
ørn - transfer efficiency for radon=	dimensionless	0.7	(McKone 1987)
Dl for radon - diffus. coeff. in water=	m2/sec	1.40E-09	(McKone 1987)
Da for radon - diffus. coeff. in air=	m2/sec	2.00E-05	(McKone 1987)
H for radon=	atm-m3/mol	0.092	(McKone 1987)
R - ideal gas constant=	atm-m3/mol-K	8.20E-05	
T - temperature=	K	298	
Dl for chem - diffus. coeff. in water=	m2/sec	chem specific	
Da for chem - diffus. coeff. in air=	m2/sec	chem specific	
H for chem - Henry's Law constant=	atm-m3/mol	chem specific	

Chemical	Federal and NYSDOH MCLs mg/l	øx Chem. Mass Transfer Coeff.	Csh/Cgw Air conc. over GW conc. l/m3	Average Daily Intake mg/kg/day	Inhalation Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Inhalation Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Tetrachloroethylene	5.00E-03	7.70E-01	6.84E+00	9.67E-05	8.00E-03	1.21E-02	4.14E-05	2.00E-03	8.29E-08
Trichloroethylene	5.00E-03	7.46E-01	6.63E+00	9.37E-05	5.30E-02	1.77E-03	4.02E-05	6.00E-03	2.41E-07
				Total Hazard Quotient:		1E-02		Total Cancer Risk:	3E-07

Table 19 part 5 of 5

Calculation of Hazard and Risk Associated with Current Residential Contact with Groundwater

Big V Supermarkets, Baldwin Place Mall, NY

Inhalation Contact with VOC's from Groundwater in Whole House

Daily Intake=	mg/kg/day	Cgw * ((Chouse/Cgw) * BR * ETh / BW) * (EF * ED)/(DY *AT)	
Chouse/Cgw - conc. in whole house air to conc. in gw=	l/m³	Whouse * øx / VRhouse	
øx - chem mass transfer efficency=	unitless	ørn * (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for radon ÷ (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for chem	
Cgw - conc. in groundwater=	mg/l	chem specific	
BR - breathing rate=	m3/hr	0.625	(EPA HHEM SG 1991)
ETh - exposure time in house=	hr/day	14	(McKone 1991)
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/year	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)
Whouse - whole house water use rate=	l/hr	40	(McKone 1991)
VRhouse - whole house air exchange rate=	m3/hr	750	(McKone 1991)
ørn - transfer efficiency for radon=	dimensionless	0.7	(McKone 1987)
Dl for radon - diffus. coeff. in water=	m2/sec	1.40E-09	(McKone 1987)
Da for radon - diffus. coeff. in air=	m2/sec	2.00E-05	(McKone 1987)
H for radon=	atm-m3/mol	0.092	(McKone 1987)
R - ideal gas constant=	atm-m3/mol-K	8.20E-05	
T - temperature=	K	298	
Dl for chem - diffus. coeff. in water=	m2/sec	chem specific	
Da for chem - diffus. coeff. in air=	m2/sec	chem specific	
H for chem - Henry's Law constant=	atm-m3/mol	chem specific	

Chemical	Federal and NYSDOH MCLs mg/l	øx Chem. Mass Transfer Coeff.	Csh/Cgw Air conc. over GW conc. l/m3	Average Daily Intake mg/kg/day	Inhalation Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Inhalation Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Tetrachloroethylene	5.00E-03	7.70E-01	4.11E-02	2.46E-05	8.00E-03	3.08E-03	1.05E-05	2.00E-03	2.11E-08
Trichloroethylene	5.00E-03	7.46E-01	3.98E-02	2.39E-05	5.30E-02	4.50E-04	1.02E-05	6.00E-03	6.13E-08
					Total Hazard Quotient:	4E-03		Total Cancer Risk:	8E-08

Table 20 part 1 of 5
Calculation of Hazard and Risk Associated with Future Residential Contact with Groundwater
Big V Supermarkets, Baldwin Place Mall, NY

Ingestion of Groundwater in the Home

Daily Intake=	mg/kg/day	(Cgw * IRw * %VOC * fr / BW) * (EF * ED)/(DY *AT)	
Cgw - conc. in groundwater=	mg/l	chem specific	
IRw - ingestion rate of water=	l/day	2	(EPA 1989 RAGS)
%VOC - % VOC retained in drinking water=	dimensionless	0.5	(EPA 1991 RAGS Part B)
fr - fraction of daily fluid intake from home tap=	dimensionless	0.75	(EPA 1989 EFH)
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/yer	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)

Chemical	Cgw Chem. Conc. in GW mg/l	Average Daily Intake mg/kg/day	Oral Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Oral Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Acetone	6.44E-03	6.62E-05	1.00E-01	6.62E-04	2.84E-05		
Carbon Disulfide	1.00E-03	1.03E-05	1.00E-01	1.03E-04	4.40E-06		
total 1,2-Dichloroethylene	4.72E-03	4.85E-05	9.00E-03	5.39E-03	2.08E-05		
Methylene chloride	8.70E-03	8.94E-05	6.00E-02	1.49E-03	3.83E-05	7.50E-03	2.87E-07
Styrene	2.00E-03	2.05E-05	2.00E-01	1.03E-04	8.81E-06		
Tetrachloroethylene	9.28E-02	9.54E-04	1.00E-02	9.54E-02	4.09E-04	5.20E-02	2.13E-05
Toluene	4.70E-03	4.83E-05	2.00E-01	2.42E-04	2.07E-05		
Trichloroethylene	7.96E-03	8.18E-05	7.40E-03	1.11E-02	3.50E-05	1.10E-02	3.85E-07
bis(2-Ethylhexyl)phthalate	9.09E-03	9.34E-05	2.00E-02	4.67E-03	4.00E-05	1.40E-02	5.60E-07
			Total Hazard Quotient:	1E-01		Total Cancer Risk:	2E-05

Table 20 part 2 of 5
Calculation of Hazard and Risk Associated with Future Residential Contact with Groundwater
Big V Supermarkets, Baldwin Place Mall, NY

Dermal Contact with Groundwater in the Home

Daily Intake=	mg/kg/day	(Cgw * SA *fs* Kp *ETs * %VOC * CF / BW) * (EF * ED)/(DY *AT)	
Cgw - conc. in groundwater=	mg/l	chem specific	
SA - total adult skin surface area=	m^2	2	(EPA 1989 RAGS)
fs - fraction of skin in contact w/ water while bathing=	dimensionless	0.9	Reasonable Maximum
Kp - dermal permeability constant=	m/hr	chem specific	(EPA 1991 IG for Derm)
ETs - exposure time in shower=	hr/day	0.2	(EPA 1989 RAGS, McKone 1991)
%VOC - % VOC retained in bathing water=	dimensionless	0.5	(EPA 1991 RAGS Part B)
CF - conversion factor=	l/m^3	1000	
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/year	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)

Chemical	Cgw Chem. Conc. in GW mg/l	Kp Dermal Permeabl. Constant m/hr	Average Daily Intake mg/kg/day	Dermal Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Acetone	6.44E-03	4.56E-06	7.24E-08	1.00E-01	7.24E-07	3.10E-08		
Carbon Disulfide	1.00E-03	5.30E-03	1.31E-05	1.00E-01	1.31E-04	5.60E-06		
total 1,2-Dichloroethylene	4.72E-03	1.30E-05	1.51E-07	1.00E-02	1.51E-05	6.49E-08		
Methylene chloride	8.70E-03	4.50E-05	9.66E-07	6.00E-02	1.61E-05	4.14E-07	7.50E-03	3.10E-09
Styrene	2.00E-03	6.50E-03	3.21E-05	2.00E-01	1.60E-04	1.37E-05		
Tetrachloroethylene	9.28E-02	4.00E-03	9.15E-04	1.00E-02	9.15E-02	3.92E-04	5.20E-02	2.04E-05
Toluene	4.70E-03	1.00E-02	1.16E-04	2.00E-01	5.80E-04	4.97E-05		
Trichloroethylene	7.96E-03	2.00E-03	3.93E-05	7.55E-03	5.20E-03	1.68E-05	1.10E-02	1.85E-07
bis(2-Ethylhexyl)phthalate	9.09E-03	1.54E-03	3.46E-05	2.22E-02	1.56E-03	1.48E-05	1.40E-02	2.08E-07
				Total Hazard Quotient:	1E-01		Total Cancer Risk:	2E-05

Table 20 part 3 of 5
Calculation of Hazard and Risk Associated with Future Residential Contact with Groundwater
Big V Supermarkets, Baldwin Place Mall, NY

Inhalation Contact with VOC's from Groundwater in Shower

Daily Intake=	mg/kg/day	Cgw * ((Cshower/Cgw) * BR * ETs / BW) * (EF * ED)/(DY *AT)	
Cshower/Cgw - conc. in shower air to conc. in gw=	l/m³	Wsh * øx / VRsh	
øx - chem mass transfer efficency=	unitless	ørn * (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for radon ÷ (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for chem	
Cgw - conc. in groundwater=	mg/l	chem specific	
BR - breathing rate=	m3/hr	0.625	(EPA HHEM SG 1991)
ETs - exposure time in shower=	hr/day	0.2	(EPA 1989 RAGS, McKone 1991)
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/year	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)
Wsh - shower water use rate=	l/hr	480	(McKone 1991)
VRsh - shower air exchange rate=	m3/hr	12	(McKone 1991)
ørn - transfer efficiency for radon=	dimensionless	0.7	(McKone 1987)
Dl for radon - diffus. coeff. in water=	m2/sec	1.40E-09	(McKone 1987)
Da for radon - diffus. coeff. in air=	m2/sec	2.00E-05	(McKone 1987)
H for radon=	atm-m3/mol	0.092	(McKone 1987)
R - ideal gas constant=	atm-m3/mol-K	8.20E-05	
T - temperature=	K	298	
Dl for chem - diffus. coeff. in water=	m2/sec	chem specific	
Da for chem - diffus. coeff. in air=	m2/sec	chem specific	
H for chem - Henry's Law constant=	atm-m3/mol	chem specific	

Chemical	Cgw Chem. Conc. in GW mg/l	øx Chem. Mass Transfer Coeff.	Csh/Cgw Air conc. over GW conc. l/m3	Average Daily Intake mg/kg/day	Inhalation Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Inhalation Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Acetone	6.44E-03	2.93E-01	1.17E+01	1.29E-04	3.00E+00	4.31E-05	5.54E-05		
Carbon Disulfide	1.00E-03	6.59E-01	2.63E+01	4.51E-05	2.90E-03	1.56E-02	1.93E-05		
total 1,2-Dichloroethylene	4.72E-03	7.21E-01	2.89E+01	2.33E-04	1.40E-02	1.67E-02	1.00E-04		
Methylene chloride	8.70E-03	8.15E-01	3.26E+01	4.86E-04	8.60E-01	5.65E-04	2.08E-04	1.65E-03	3.42E-07
Styrene	2.00E-03	5.01E-01	2.00E+01	6.86E-05	3.00E-01	2.29E-04	2.94E-05		
Tetrachloroethylene	9.28E-02	7.70E-01	3.08E+01	4.90E-03	8.00E-03	6.12E-01	2.10E-03	2.00E-03	4.20E-06
Toluene	4.70E-03	5.25E-01	2.10E+01	1.69E-04	1.00E-01	1.69E-03	7.24E-05		
Trichloroethylene	7.96E-03	7.46E-01	2.99E+01	4.07E-04	5.30E-02	7.68E-03	1.74E-04	6.00E-03	1.05E-06
bis(2-Ethylhexyl)phthalate	9.09E-03	5.95E-03	2.38E-01	3.70E-06	2.00E-02	1.85E-04	1.59E-06		

Total Hazard Quotient: 7E-01 Total Cancer Risk: 6E-06

Table 20 part 4 of 5
Calculation of Hazard and Risk Associated with Future Residential Contact with Groundwater
Big V Supermarkets, Baldwin Place Mall, NY

Inhalation Contact with VOC's from Groundwater in Bathroom

Daily Intake=	mg/kg/day	Cgw * ((Cbath/Cgw) * BR * ETb / BW) * (EF * ED)/(DY *AT)	
Cbath/Cgw - conc. in bathroom air to conc. in gw=	l/m³	Wsh * øx / VRbath	
øx - chem mass transfer efficency=	unitless	ørn * (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for radon ÷ (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for chem	
Cgw - conc. in groundwater=	mg/l	chem specific	
BR - breathing rate=	m3/hr	0.625	(EPA HHEM SG 1991)
ETb - exposure time in bathroom=	hr/day	0.33	(McKone 1991)
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/year	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)
Wsh - shower water use rate=	l/hr	480	(McKone 1991)
VRbath - bathroom air exchange rate=	m3/hr	54	(McKone 1991)
ørn - transfer efficiency for radon=	dimensionless	0.7	(McKone 1987)
Dl for radon - diffus. coeff. in water=	m2/sec	1.40E-09	(McKone 1987)
Da for radon - diffus. coeff. in air=	m2/sec	2.00E-05	(McKone 1987)
H for radon=	atm-m3/mol	0.092	(McKone 1987)
R - ideal gas constant=	atm-m3/mol-K	8.20E-05	
T - temperature=	K	298	
Dl for chem - diffus. coeff. in water=	m2/sec	chem specific	
Da for chem - diffus. coeff. in air=	m2/sec	chem specific	
H for chem - Henry's Law constant=	atm-m3/mol	chem specific	

Chemical	Cgw Chem. Conc. in GW mg/l	øx Chem. Mass Transfer Coeff.	Csh/Cgw Air conc. over GW conc. l/m3	Average Daily Intake mg/kg/day	Inhalation Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Inhalation Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Acetone	6.44E-03	2.93E-01	2.61E+00	4.74E-05	3.00E+00	1.58E-05	2.03E-05		
Carbon Disulfide	1.00E-03	6.59E-01	5.85E+00	1.65E-05	2.90E-03	5.70E-03	7.09E-06		
total 1,2-Dichloroethylene	4.72E-03	7.21E-01	6.41E+00	8.55E-05	1.40E-02	6.11E-03	3.66E-05		
Methylene chloride	8.70E-03	8.15E-01	7.24E+00	1.78E-04	8.60E-01	2.07E-04	7.63E-05	1.65E-03	1.26E-07
Styrene	2.00E-03	5.01E-01	4.45E+00	2.51E-05	3.00E-01	8.38E-05	1.08E-05		
Tetrachloroethylene	9.28E-02	7.70E-01	6.84E+00	1.80E-03	8.00E-03	2.24E-01	7.69E-04	2.00E-03	1.54E-06
Toluene	4.70E-03	5.25E-01	4.67E+00	6.20E-05	1.00E-01	6.20E-04	2.66E-05		
Trichloroethylene	7.96E-03	7.46E-01	6.63E+00	1.49E-04	5.30E-02	2.82E-03	6.39E-05	6.00E-03	3.84E-07
bis(2-Ethylhexyl)phthalate	9.09E-03	5.95E-03	5.29E-02	1.36E-06	2.00E-02	6.79E-05	5.82E-07		

Total Hazard Quotient: 2E-01 Total Cancer Risk: 2E-06

Table 20 part 5 of 5
Calculation of Hazard and Risk Associated with Future Residential Contact with Groundwater
Big V Supermarkets, Baldwin Place Mall, NY

Inhalation Contact with VOC's from Groundwater in Whole House

Daily Intake=	mg/kg/day	Cgw * ((Chouse/Cgw) * BR * ETh / BW) * (EF * ED)/(DY *AT)	
Chouse/Cgw - conc. in whole house air to conc. in gw=	l/m³	Whouse * øx / VRhouse	
øx - chem mass transfer efficency=	unitless	ørn * (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for radon ÷ (2.5/Dl^2/3 + RT/(Da^2/3 * H)) for chem	
Cgw - conc. in groundwater=	mg/l	chem specific	
BR - breathing rate=	m3/hr	0.625	(EPA HHEM SG 1991)
ETh - exposure time in house=	hr/day	14	(McKone 1991)
BW - body weight=	kg	70	(EPA 1989 RAGS)
EF- exposure frequency=	day/year	350	(EPA HHEM SG 1991)
ED - exposure duration=	year	30	(EPA HHEM SG 1991)
DY - days per year=	day/year	365	Reasonable Maximum
AT- ave. time: non-carc=	year	30	(EPA HHEM SG 1991)
AT - ave. time: carc=	year	70	(EPA 1989 RAGS)
Whouse - whole house water use rate=	l/hr	40	(McKone 1991)
VRhouse - whole house air exchange rate=	m3/hr	750	(McKone 1991)
ørn - transfer efficiency for radon=	dimensionless	0.7	(McKone 1987)
Dl for radon - diffus. coeff. in water=	m2/sec	1.40E-09	(McKone 1987)
Da for radon - diffus. coeff. in air=	m2/sec	2.00E-05	(McKone 1987)
H for radon=	atm-m3/mol	0.092	(McKone 1987)
R - ideal gas constant=	atm-m3/mol-K	8.20E-05	
T - temperature=	K	298	
Dl for chem - diffus. coeff. in water=	m2/sec	chem specific	
Da for chem - diffus. coeff. in air=	m2/sec	chem specific	
H for chem - Henry's Law constant=	atm-m3/mol	chem specific	

Chemical	Cgw Chem. Conc. in GW mg/l	øx Chem. Mass Transfer Coeff.	Csh/Cgw Air conc. over GW conc. l/m3	Average Daily Intake mg/kg/day	Inhalation Reference Dose mg/kg/day	Hazard Index	Lifetime Average Daily Intake mg/kg/day	Inhalation Cancer Slope Factor 1/(mg/kg/day)	Cancer Risk
Acetone	6.44E-03	2.93E-01	1.56E-02	1.21E-05	3.00E+00	4.02E-06	5.17E-06		
Carbon Disulfide	1.00E-03	6.59E-01	3.51E-02	4.21E-06	2.90E-03	1.45E-03	1.80E-06		
total 1,2-Dichloroethylene	4.72E-03	7.21E-01	3.85E-02	2.18E-05	1.40E-02	1.55E-03	9.33E-06		
Methylene chloride	8.70E-03	8.15E-01	4.35E-02	4.53E-05	8.60E-01	5.27E-05	1.94E-05	1.65E-03	3.20E-08
Styrene	2.00E-03	5.01E-01	2.67E-02	6.40E-06	3.00E-01	2.13E-05	2.74E-06		
Tetrachloroethylene	9.28E-02	7.70E-01	4.11E-02	4.57E-04	8.00E-03	5.71E-02	1.96E-04	2.00E-03	3.92E-07
Toluene	4.70E-03	5.25E-01	2.80E-02	1.58E-05	1.00E-01	1.58E-04	6.76E-06		
Trichloroethylene	7.96E-03	7.46E-01	3.98E-02	3.80E-05	5.30E-02	7.17E-04	1.63E-05	6.00E-03	9.77E-08
bis(2-Ethylhexyl)phthalate	9.09E-03	5.95E-03	3.17E-04	3.46E-07	2.00E-02	1.73E-05	1.48E-07		
					Total Hazard Quotient:	6E-02		Total Cancer Risk:	5E-07

Table 21

Calculation of Hazards and Risks due to Ingestion by Children Exposed to Contaminants in Surface Water

Big V Supermarkets, Baldwin Place Mall, NY

$$\text{Intake (mg/kg/day)} = \frac{Cw*CR*ET*EF*ED}{BW*AT*365}$$

Cs = Concentration in surface water =	chemical specific	
CR = contact rate (liters/hour) =	0.05	U.S. EPA 1989 RAGS
ET = Exposure time (hours/event) =	2	U.S. EPA 1989 RAGS
EF = Exposure frequency(events/year)=	7	U.S. EPA 1989 RAGS
ED = Exposure duration(years)=	9	Reasonable maximum
BW = Body weight (kg)=	52	Statistical Distributions, EPA 1985
AT = Averaging time for noncarcinogenic effects(years)=	9	Reasonable maximum
and for carcinogenic effects(years)=	70	U.S. EPA 1989 RAGS
Days per year=	365	

Chemical	Maximum Conc. Detected in Surface Water mg/l	Average Daily Intake (non-cancer) (mg/kg/day)	Chronic Oral RfD (mg/kg/day)	Hazard Quotient	Average Lifetime Daily Intake (cancer) (mg/kg/day)	Oral Cancer Potency Factor (risk units per mg/kg/day)	Upper Bound Cancer Risk
Tetrachloroethylene	2.00E-03	7.38E-08	1.00E-02	7.38E-06	9.48E-09	5.20E-02	4.93E-10
Xylene (total)	6.50E-03	2.40E-07	2.00E+00	1.20E-07	3.08E-08		
			Hazard Index =	7E-06		Cancer Risk =	5E-10

Table 22

Calculation of Hazards and Risks due to Dermal Absorption by Children Exposed to Contaminants in Surface Water

Big V Supermarkets, Baldwin Place Mall, NY

Intake (mg/kg/day) =	$\frac{Cs*SA*PC*ET*EF*ED*CF}{BW*AT*365}$	
Cs = Concentration in surface water =	chemical specific	
SA = Skin syrface area available for contact (cm^2) =	4601	
total surface area of children 6-15 years old(cm^2)=	14700	Stat Distributions, U.S. EPA 1985
percent surface arae of child exposed=	0.313	Stat Distributions, U.S. EPA 1985
PC = Chemical-specific Dermal Permeability Constant (cm/hr) =	chemical specific	
ET = Exposure time (hours/day) =	2	U.S. EPA 1989a
EF = Exposure frequency(days/year)=	7	U.S. EPA 1989a
ED = Exposure duration(years)=	9	Reasonable maximum
CF = Volumetric Conversion Factor for Water (1 liter/1000 cm^3) =	1.00E-03	
BW = Body weight (kg)=	52	Statistical Distributions, EPA 1985
AT = Averaging time for noncarcinogenic effects(years)=	9	Reasonable maximum
and for carcinogenic effects(years)=	70	U.S. EPA 1989a
Days per year=	365	

Chemical	Maximum Conc. Detected in Surface Water mg/l	Average Daily Intake (non-cancer) (mg/kg/day)	Chronic Oral RfD (mg/kg/day)	Hazard Quotient	Average Lifetime Daily Intake (cancer) (mg/kg/day)	Oral Cancer Potency Factor (risk units per mg/kg/day)	Upper Bound Cancer Risk
Tetrachloroethylene	2.00E-03	2.72E-06	1.00E-02	2.72E-04	3.49E-07	5.20E-02	1.82E-08
Xylene (total)	6.50E-03	7.48E-09	2.00E+00	3.74E-09	9.61E-10		
			Hazard Index =	3E-04		Cancer Risk =	2E-08

Table 23

Inhalation of Vapors by Children Ages 6- 15 While Swimming in Western Stream and Tributary Drainage Ditch
Big V Supermarkets, Baldwin Place Mall, NY

Ei = Emission Rate (g/sec)=	Ki*Cs*A		Intake (mg/kg/day)=	CA*IR*ET*EF*ED / BW*AT*365
Ki=overall mas transfer coefficient (cm/sec) =	1 / ((1/KiL) + RT/(Hi*kiG))			
			IR = Inhalation Rate (m^3/hr) =	1.5
Ki- overall mass transfer coefficient=	cm/sec	chem specific	ET = Exposure time (hours/event) =	2
Cs-liquid phase conc.=	g/cu.cm	chem specific	EF = Exposure frequency (events/year) =	7
A-exposed area (bottom)=	sq.cm	3.00E+06	ED = Exposure duration (years) =	9
KiL-liquid phase mass transfer coefficient=	cm/sec	chem specific	BW = Body Weight (kg) =	52
R-ideal gas law constant=	atm-m3/mol*K	8.20E-05	AT = averaging time for non-carcinogenic effects =	9
T-kelvin temp.absolute=	K	298	= averaging time for carcinogenic effects =	70
Hi-Henry's Law constant of compound=	atm-m3/mol	chem specific	Number of days/year =	365
kiG-gas phase mass transfer coefficient=	cm/sec	chem specific		
CA = Contaminant Conc. in Air (mg/m^3) =	Ei*CF/ (Wb*Hb*mu)			
CF = Conversion factor g to mg =	1000			
Wb = width of the "emission box" (meters) =	10			
Hb = Height of the "emission box" (meters) =	1.5			
mu = mean wind speed (m/sec) =	1			

Chemical	Maximum Conc. Detected in Surface Water mg/l	Ki overall mass trans. coefficient cm/sec	Ei Emission Rate g/sec	Concentration in Air (mg/m^3)	Average Daily Dose (mg/kg/day)	Chronic Inhalation RfD	Hazard Quotient	Lifetime Daily Average Dose (mg/kg/day)	Inhalation Cancer Slope Factor	Cancer Risk
Tetrachloroethylene	2.00E-03	3.31E-05	1.98E-07	1.32E-05	1.46E-08	8.00E-03	1.83E-06	1.88E-09	2.00E-03	3.76E-12
Xylene (mixed)	6.50E-03	4.13E-05	8.06E-07	5.37E-07	5.94E-10	8.00E-01	7.43E-10	7.64E-11		
					Total Hazard Index =		2E-06	Total Cancer Risk =		4E-12

Table 24

Comparison of Maximum Concentrations in Surface Water and Sediment with Freshwater Ambient Water Quality Criteria and Provisional Sediment Criteria, Respectively.

Big V Supermarkets, Baldwin Place Mall, NY

Chemical	Maximum Conc. Detected in Surface Water (mg/l)	Chronic AWQCs Protective of Freshwater Organisms(1) (mg/l)	Maximum Conc. Detected in Sediment (mg/kg)	Provisional Sediment Criteria (2) (mg/kg)	Do any Concs. Exceed AWQCs or Sediment Criteria?
Acetone	ND	NA	0.0481	NA	
Methylene chloride	ND	1.24 (a)	0.009	0.769 (a)	no
Tetrachloroethylene	0.002	0.84 (b)	0.004	6.05	no
Xylene (total)	0.00594	5.01 (c,d)	ND		no

(1) Ambient Water Quality Criteria from EPA's Quality Criteria for Water, 1986.

(2) Provisional Sediment Criteria Methodology (McCall, et al,. 1983)

ND = Not Detected in Media of Concern

NA = Not Available

(a) Criteria for chloroform is provided on a provisional basis as EPA has not developed any criteria for methylene chloride.

(b) Insufficient data to develop criteria. Value presented is the Lowest Observed Effect Level (LOEL).

(c) Criteria for toluene is provided on a provisional basis as EPA has not developed any criteria for xylene.

(d) Provisional Chronic Criteria generated from chronic/acute ratio of numerous chemically-related compounds.

APPENDIX A

TOXICITY PROFILES

TOXICITY PROFILE FOR ACETONE

Acetone is a colorless flammable liquid which is "one of the least toxic solvents used in industry (Krasavage *et al.*, 1982)." Acetone is a naturally occurring constituent of blood and urine (Krasavage *et al.*, 1982). Central nervous system effects such as dizziness, weakness and loss of consciousness have occurred at concentrations in air above 12,000 ppm (Ross, 1973). Acetone caused irritation of the eyes, nose and throat of humans at 500 ppm (Nelson *et al.*, 1943). The TLV for acetone is 750 ppm (1780 mg/m^3) and the PEL is 1000 ppm (2380 mg/m^3).

Oral Exposure

The U.S. EPA (IRIS, 1993; HEAST, 1993) has published both subchronic and chronic oral RfD values for acetone. The values are based on a 90-day gavage study in rats. The NOAEL, based on increased liver and kidney weight and nephrotoxicity, was 100 mg/kg/day. Utilizing an uncertainty factor of 1000 for chronic and 100 for subchronic exposures, EPA derived the following oral RfDs:

$$RfD_{c\text{-}o} = 1 \times 10^{-1} \text{ mg/kg/day}$$

$$RfD_{s\text{-}o} = 1.0 \text{ mg/kg/day}$$

Inhalation Exposure

Guinea pigs showed no irritation at 10,000 ppm (Specht *et al.*, 1939). Rats exposed to 19,000 ppm for 3 hrs/day, 5 days/week for 8 weeks showed no evidence of toxic effects (Bruckner and Peterson, 1978). A LOAEL for eye and nasal irritation in humans is 500 ppm (Nelson *et al.*, 1943). No CNS effects were observed at 1006 ppm for 8 hour daily exposures (Raleigh and McGee, 1972). These authors concluded that 100 ppm produced no untoward effects, with the exception of slight, transient irritation of the ear, nose and throat, although others (Vigilini and Zurlo, 1955) reported dizziness and loss of strength in workers exposed 3 hrs/day for 7-15 years.

The September 1984 Health Effects Assessment for Acetone (HEA) used the data of Bruckner and Peterson (1981) of 19,000 ppm (45,134 mg/m^3) as a NOAEL (there was decreased body weight, but it returned to normal 2 weeks after cessation of exposure) to develop an acceptable intake for subchronic inhalation exposure (AIS). The HEA calculated an animal dose in mg/kg/day by assuming a rat breathes 0.26 m^3/day and weighs 0.35 kg. A UF of 100 was applied to derive the AIS.

$$45{,}134\ mg/m^3 \times \frac{0.26\ m^3/day}{0.35\ kg} \times \frac{3\ hr.}{24\ hr.} \times \frac{5\ days}{7\ days} = 2{,}994\ mg/kg/day$$

$$pRfD_{s\text{-}i} = \frac{NOAEL}{100} = 30\ mg/kg/day \quad \text{(administered dose)}$$

which is only about 2% of the TLV[1].

The 1984 HEA derived an AIC_i based upon the above AIS_i by dividing by an additional safety factor of 10.

$$pRfD_{c\text{-}i} = 3.0\ mg/kg/day \quad \text{(administered dose)}$$

1. Use of provisionally derived toxicity benchmarks by persons without a recognized expertise in toxicology and/or industrial hygiene constitutes a misuse of the information presented above. Unauthorized use or interpretation of this information may result in inadequate protection of human health and is strictly prohibited. The information presented here is based on the most recent scientific literature at the time of writing (April 28, 1994).

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TOXICITY PROFILE FOR CARBON DISULFIDE

Carbon disulfide is a colorless, flammable liquid used as a solvent for lipids, sulfur, rubber, oils, phosphorous, resins and waxes (Proctor *et al.*, 1988; Sittig, 1985).

Carbon disulfide vapor at high concentrations is irritating to the eyes, skin and mucous membranes. Contact with the liquid can cause second and third degree burns (Sittig, 1985).

Carbon disulfide damages the central and peripheral nervous systems and the cardiovascular system (Proctor *et al.*, 1988). All parts of the central and peripheral nervous systems (including damage to the cranial nerves, peripheral neuropathy with paresthesias, muscle weakness in the extremities, gait disturbances and dysphagia) can occur following intoxication with carbon disulfide (Tolonen, 1975). Chronic exposure can result in insomnia, nightmares, defective memory and impotency. Atherosclerosis and coronary heart disease have been linked to carbon disulfide exposure. Atherosclerosis develops most notably in the blood vessels of the brain, myocardium and glomeruli (Sittig, 1985).

Epidemiological studies do not indicate a carcinogenic risk under moderate exposure conditions (Nurminen and Hernberg, 1984). The TLV for carbon disulfide is 10.0 ppm or 31.0 mg/m^3.

Oral Exposure

The U.S. EPA (IRIS, 1993; HEAST, 1993) has published subchronic and chronic oral risk reference dose (RfD) values for oral exposures to carbon disulfide (CS_2). EPA derived the oral RfD values on the basis of an inhalation study with rabbits (Hardin *et al.*, 1981), in which animals were exposed to 20 ppm (62.3 mg/m^3) for 6 hours/day during pregnancy and before breeding (1.6 m^3/day breathing rate and assuming an absorption factor of 0.5 to calculate a NOAEL dose of 11.0 mg/kg/day), where higher doses resulted in fetal toxicity and malformations (IRIS, 1991). The oral RfD values were developed by EPA by means of route-to-route extrapolation, utilizing an uncertainty factor of 100:

$$RfD_{c\text{-}o} = \frac{11\ mg/kg/day}{100} = 0.1\ mg/kg/day$$

$$RfD_{s\text{-}o} = 0.1\ mg/kg/day$$

These RfD values for chronic and subchronic oral exposure can be regarded as developmental risk reference doses as well.

Inhalation Exposure

The U.S. EPA has published risk reference concentrations (RfCs) for both chronic and subchronic exposures (HEAST, 1993) based on a study by Tabacova *et al.* (1978, 1983). Rats were exposed to 10 mg/m^3 for 8 hours/day during gestation. The U.S. EPA utilized an uncertainty factor of 1000 for both chronic and subchronic exposures to derive the RfCs. A NOAEL of 10 mg/m^3 was identified based on fetal toxicity.

$$RfD_{c\text{-}i} = 1 \times 10^{-2} \text{ mg/m}^3 \ (2.9 \times 10^{-3} \text{ mg/kg/day}) \ \text{(administered dose)}$$

$$RfD_{s\text{-}i} = 1 \times 10^{-2} \text{ mg/m}^3 \ (2.9 \times 10^{-3} \text{ mg/kg/day})$$

No adjustment is needed to correct for absorption efficiency. The current time-weighted average TLV is 10 ppm. The odor threshold is 0.1 to 0.2 ppm (ACGIH, 1990).

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TOXICITY PROFILE FOR CHLOROBENZENE

Chlorobenzene is a colorless liquid used in the manufacture of aniline, phenol and chloronitrobenzene and as an intermediate in the manufacture of dyestuffs and many pesticides (Sittig, 1985). Chlorobenzene may be formed during chlorination water treatment (NAS, 1977). It is very volatile and has only moderate solubility in water (500 mg/ℓ). Chlorobenzene persists in soil for 1 or 2 weeks, in air for 3.5 days and in water for less than a day (ATSDR, 1989).

Chlorobenzene is irritating to the respiratory system and is a central nervous system depressant (NAS, 1977). The liver is the primary site of organ toxicity with the observed hepatotoxicity probably caused by metabolic conversions of chlorobenzene to an epoxide and subsequent reaction with cellular macromolecules (NAS, 1983).

The TLV for chlorobenzene is 10 ppm (46 mg/m^3).

Oral Exposure

The U.S. EPA (IRIS, 1993) has published a risk reference dose value for chronic oral exposure to chlorobenzene. This value was derived from a study in which dogs were exposed to 27.3 mg/kg/day by capsule for 90 days (Monsanto, 1967).

$$RfD_{c-o} = 2 \times 10^{-2} \text{ mg/kg/day}$$

U.S. EPA (HEAST, 1992) has previously published a subchronic oral RfD value for chlorobenzene, derived from the same study as the chronic RfD value. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. The Center is in the process of deriving new subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used.

$$pRfD_{s-o} = 2 \times 10^{-1} \text{ mg/kg/day}$$

Inhalation Exposure

The U.S. EPA (HEAST, 1993) has published a risk reference concentration value for chronic inhalation exposure to chlorobenzene. The derivation is based on a study exposing rats to 75 ppm (345 mg/m^3) for 7 hours/day, 5 days/week for 120 days (53 mg/kg/day) (Dilley, 1977).

$$RfD_{c-i} = 5 \times 10^{-3} \text{ mg/kg/day (administered dose)}$$

U.S. EPA (HEAST, 1992) has previously published a subchronic inhalation RfD value for chlorobenzene, derived from the same study as the chronic RfD value. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. The Center is in the process of deriving new subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used.

$$pRfD_{s\text{-}i} = 5 \times 10^{-2} \text{ mg/kg/day (administered dose)}$$

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TOXICITY PROFILE FOR CHLOROETHANE

Chloroethane (ethyl chloride) is a colorless liquid used as a refrigerant and chemical intermediate in the manufacture of ethyl cellulose, and was formerly used as an inhalation anesthetic agent (Proctor *et al.*, 1988). At high concentrations of the vapor, chloroethane causes CNS depression similar to other halogenated hydrocarbon solvents. However, the toxicity of this monochlorinated alkane is much lower than related hydrocarbons, such as trichloroethylene, dichloroethane, *etc.*

Inhalation of 40,000 ppm by human subjects caused dizziness, eye irritation and abdominal cramps, whereas inhalation of 25,000 ppm caused incoordination (Sayers *et al.*, 1929). Exposure to 19,000 ppm resulted in mild analgesia after 12 minutes, and 13,000 ppm caused slight symptoms of inebriation (von Oettingen, 1955).

Chronic effects from industrial exposure have not been reported, although skin absorption is said to occur. In liquid form, this substance may cause frostbite.

The TLV for chloroethane is 1000 ppm (2640 mg/m^3), as is the PEL.

Inhalation Exposure

The U.S. EPA has published risk reference concentrations (RfCs) for both chronic and subchronic exposures (IRIS, 1993; HEAST, 1993) based on a developmental study by Scortichini *et al.* (1986). Mice were exposed to 1504 ppm (4000 mg/m^3) for 6 hours/day on days 6 through 15 of gestation. The U.S. EPA utilized an uncertainty factor of 300 for both chronic and subchronic exposures to derive the RfCs. A NOAEL of 4000 mg/m^3 was identified based on fetal toxicity.

$$RfD_{c\text{-}i} = 10\ mg/m^3 \times \frac{20\ m^3}{70\ kg} = 2.9\ mg/kg/day \quad \text{(administered dose)}$$

$$RfD_{s\text{-}i} = 2.9\ mg/kg/day \quad \text{(administered dose)}$$

Oral Exposure

The systemic effects of orally administered chloroethane in animals were investigated in only one study (ATSDR, 1989). No adverse effects were noted in rabbits following gavage administration of 60 doses of up to 1000 mg/kg (Adams, *et al.*, 1939). A histopathological examination was conducted, but the organs were not listed.

Based on route-to-route extrapolation, provisional oral values may be derived from the inhalation RfDs presented above[1]. It is assumed that GI absorption is complete and alveolar absorption is 50%.

$$pRfD_{c\text{-}o} = \frac{0.5}{1.0} \times pRfD_{c\text{-}i} = 0.5 \times 2.9 \text{ mg/kg/day} = 1.5 \text{ mg/kg/day}$$

$$pRfD_{s\text{-}o} = 1.5 \text{ mg/kg/day}$$

1. Use of provisionally derived toxicity benchmarks by persons without a recognized expertise in toxicology and/or industrial hygiene constitutes a misuse of the information presented above. Unauthorized use or interpretation of this information may result in inadequate protection of human health and is strictly prohibited. The information presented here is based on the most recent scientific literature at the time of writing.

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TOXICITY PROFILE FOR 1,2-DICHLOROETHYLENE (1,2-DCE)

1,2-Dichloroethylene (1,2-DCE) is a man-made colorless liquid with a sharp, harsh odor. It is used as a chemical intermediate in the manufacture of chlorinated solvents and compounds and as a low-temperature extraction solvent for organic materials, such as dyes, perfumes, lacquers and thermoplastics. There are no known consumer products that contain 1,2-DCE. Possible exposure routes include inhalation of contaminated air and ingestion of contaminated drinking water. The general population may be exposed to low levels (0.013-0.076 ppb) of 1,2-DCE via inhalation of contaminated urban air (Singh *et al.*, 1983). This corresponds to an average daily intake of 1 to 6 μg/day assuming a daily intake of 20 m^3 of air. In a survey of U.S. drinking water derived from groundwater, 16 of 466 randomly selected sites and 38 of 479 purposely selected sites contained maximum levels of 2 ppb and 120 ppb, respectively (Westrick *et al.*, 1984). The average daily intake of 1,2-DCE from drinking water is about 2.2 μg/day when the water is contaminated.

Contact with the liquid is irritating to the eyes and skin. It can act as a primary irritant producing dermatitis and irritation of mucous membranes. Vapors can produce central nervous system depression or, in milder exposures, nausea, vomiting, weakness and epigastric cramps.

Oral Exposure

The U.S. EPA (IRIS, 1993; HEAST, 1993) has published chronic and subchronic oral risk reference dose (RfD) values for mixed isomers (total 1,2-dichloroethylene) and individual *cis* and *trans* isomers. EPA (HEAST, 1993) derived chronic and subchronic RfD values for total-1,2-dichloroethylene which were adopted based on analogy from RfD values for 1,1-dichloroethylene. Oral RfDs for 1,1-dichloroethylene (1,1-DCE) are based on a 2-year study of rats administered 50 ppm (9 mg/kg/day) of 1,1-DCE in drinking water (Quast *et al.*, 1983). The published oral chronic and subchronic values for total-1,2-dichloroethylene are:

$$RfD_{c\text{-}o} = 9 \times 10^{-3} \text{ mg/kg/day}$$

$$RfD_{s\text{-}o} = 9 \times 10^{-3} \text{ mg/kg/day}$$

A 90-day gavage study in rats with the *cis*-isomer identified a NOAEL of 32 mg/kg/day for decreased hematocrit and hemoglobin (McCauley *et al.*, n.d.). Applying an uncertainty factor of 3000 for chronic and 300 for subchronic exposures, EPA derived the following RfDs:

$$RfD_{c\text{-}o}\,(cis) = \frac{32 \text{ mg/kg/day}}{3000} = 1 \times 10^{-2} \text{ mg/kg/day}$$

$$RfD_{s\text{-}o}\,(cis) = \frac{32 \text{ mg/kg/day}}{300} = 1 \times 10^{-1} \text{ mg/kg/day}$$

Barnes *et al.* (1985) performed a 90-day study exposing rats to the *trans*-isomer via their drinking water. A NOAEL of 17 mg/kg/day based on increased serum alkaline phosphatase and uncertainty factors of 1000 for chronic and 100 for subchronic were used to derive RfDs of 2×10^{-2} mg/kg/day for chronic and 2×10^{-1} mg/kg/day for subchronic exposures.

$$RfD_{c\text{-}o}\ (trans) = 2 \times 10^{-2}\ \text{mg/kg/day}$$

$$RfD_{s\text{-}o}\ (trans) = 2 \times 10^{-1}\ \text{mg/kg/day}$$

Inhalation Exposure

The U.S. EPA has not published inhalation risk reference dose (RfD) or risk reference concentration (RfC) values for 1,2-DCE (IRIS, 1993; HEAST, 1993). HSDB (1991) states that "the no effect level in animals upon prolonged inhalation exposure is at least 1000 ppm, and the supporting information of other routes of administration, the time weighted average TLV of 200 ppm may be too conservative for 1,2-dichloroethylene." Pathological changes in the liver consisting of degeneration and respiratory effects (pneumonic infiltration) have been observed in rats exposed to 200 ppm of the *trans*-isomer (Freundt *et al.*, 1977). Rats were exposed in this study for 8 hrs/day, 5 days/week for 16 weeks. No studies were located regarding the liver pathology in animals exposed to *cis*-1,2-DCE, and there is a general lack of toxicity data on the *cis*-isomer. Based on the LOAEL of 200 ppm (793 mg/m^3) identified by Freundt *et al.* (1977) and applying an uncertainty factor of 10,000 (10 for species extrapolation, 10 for sensitive human subpopulations, 10 for conversion of LOAEL to NOAEL and 10 for a less-than-lifetime study), correcting for continuous exposure and assuming a rat inhales 0.26 m^3 per day and weighs 0.35 kg, provisional values are derived as follows for both *cis*- and *trans*-1,2-DCE[1]:

$$pRfD_{c\text{-}i} = \frac{793\ \text{mg/m}^3}{10{,}000} \times \frac{0.26\ \text{m}^3}{0.35\ \text{kg}} \times \frac{5\ \text{days}}{7\ \text{days}} \times \frac{8\ \text{hours}}{24\ \text{hours}} = 1.4 \times 10^{-2}\ \text{mg/kg/day (administered dose)}$$

An uncertainty factor of 1000 (correction for study duration not necessary) was used to derive the following provisional subchronic inhalation RfD:

$$pRfD_{s\text{-}i} = 1.4 \times 10^{-1}\ \text{mg/kg/day (administered dose)}$$

Based on information located in HSDB (1991), these values will provide ample protection for inhalation exposure to total 1,2-DCE, and should be applied to the dose of 1,2-DCE which is inhaled (no correction for alveolar absorption efficiency is needed).

Neither isomer of 1,2-DCE is regarded as having sufficient weight of evidence to be classified as a potential carcinogen, *i.e.*, currently classified by the U.S. EPA in Group D--inadequate evidence to conclude the chemical is carcinogenic (Group D).

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TOXICITY PROFILE FOR ETHYLBENZENE

Ethylbenzene is a flammable liquid used as a solvent, anti-knock agent and is an intermediate in the production of styrene (Proctor *et al.*, 1988; U.S. EPA, 1985).

Ethylbenzene is absorbed readily from the gastrointestinal tract, lungs, and skin and accumulates in adipose tissue. Urinary excretion of metabolites of ethylbenzene is the major route of elimination. It is not severely toxic after acute exposure. The major effects following acute and chronic exposure include liver and kidney pathologies and nervous system disorders (U.S. EPA, 1985). Ethylbenzene is also irritating to the skin and mucous membranes (Proctor *et al.*, 1988).

The EPA has classified ethylbenzene in Group D (inadequate evidence to classify as a carcinogen). The PEL and TLV for ethylbenzene is 100 ppm (435 mg/m^3).

Oral Exposure

The EPA's Office of Drinking Water (ODW) (U.S. EPA, 1987; U.S. EPA, 1989) has set 680 ppb (0.7 mg/ℓ) as the acceptable exposure concentration of ethylbenzene in drinking water. Accordingly, the proposed MCL and MCLG is 0.7 mg/ℓ. ODW also set higher acceptable levels of ethylbenzene in water for shorter periods of drinking use (32 mg/ℓ for 1 day, 3.2 mg/ℓ for 10 days). These levels are stated to be acceptable for small children.

On the basis of a study conducted by Wolf *et al.* (1956) where rats were given 13.6 to 680 mg/kg ethylbenzene by gavage for 6 months, the U.S. EPA (IRIS, 1993) selected a NOAEL of 97.1 mg/kg/day and applied a UF of 1,000 for chronic duration to derive the following chronic oral RfD value:

$$RfD_{c\text{-}o} = 1 \times 10^{-1} \text{ mg/kg/day (Verified)}$$

U.S. EPA (HEAST, 1992) has previously published a subchronic oral RfD value for ethylbenzene, derived from the same study as the chronic RfD value. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. The Center is in the process of deriving new subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used[1].

$$pRfD_{s\text{-}o} = 1 \text{ mg/kg/day}$$

Inhalation Exposure

Systemic effects in humans included pulmonary and ocular irritation and possible hematological effects were seen in a long-term study (20 years) on workers occupationally exposed to ethylbenzene (Bardodej and Cirek, 1988). Narcosis is prominent at high doses. Target organs include lungs, liver and kidneys in animals. Momentary ocular irritation in humans has been noted at ethylbenzene concentrations as low as 230 ppm (Yant *et al.*, 1930). Lethal air concentrations (LC_{50}) were reported to be 4000 ppm (17,400 mg/m^3) and 13,367 ppm (58,146 mg/m^3) in the rat following inhalation exposures of 4 and 2 hours, respectively (Smyth *et al.*, 1962; Ivanov, 1962).

The U.S. EPA (IRIS, 1993) has published a chronic inhalation risk reference concentration (RfC) for ethylbenzene. This value is based on a study exposing rats and rabbits to 100 ppm (434 mg/m^3) for 6 to 7 hours/day, 7 days/week during days 1-19 and 1-24 of gestation, respectively (Andrew *et al.*, 1981). The NOAEL of 434 mg/m^3 was based on the lack of developmental effects in rabbits. Utilizing this NOAEL and an uncertainty factor of 300 for chronic exposure, EPA derived the following value:

$$RfD_{c\text{-}i} = 1\ mg/m^3 \times \frac{20\ m^3/day}{70\ kg} = 0.29\ mg/kg/day$$

U.S. EPA (HEAST, 1992) has previously published a subchronic inhalation RfD value for ethylbenzene, derived from the same study as the chronic RfD value. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. The Center is in the process of deriving new subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used.

$$pRfD_{s\text{-}i} = 0.29\ mg/kg/day$$

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TOXICITY PROFILE FOR METHYLENE CHLORIDE

Methylene chloride, or dichloromethane, is a colorless liquid used in the manufacture of paint and varnish removers, insecticides and fumigants, solvents, cleaners, aerosol propellants, fire extinguishers and Christmas tree bubble lights (ATSDR, 1988; Proctor *et al.*, 1988).

Most human exposures to methylene chloride occur via air. Typical U.S. ambient air levels of methylene chloride range from 30 to 50 ppt (cited in U.S. EPA, 1985). Average finished drinking water concentrations were reported to be <1 μg/L to a maximum of 3 μg/L (cited in U.S. EPA, 1985b). Methylene chloride has been detected at levels up to 8.4 mg/L in ground water at 36 Superfund hazardous waste sites (ATSDR, 1988). Very low levels of methylene chloride occur through the ingestion of decaffeinated coffee (ATSDR, 1988).

Human and animal studies indicate that the liver and central nervous system (CNS) are the major targets following exposure to methylene chloride vapors.

Oral Exposure

The U.S. EPA (IRIS, 1993; HEAST, 1993) has published both chronic and subchronic oral RfD values for methylene chloride. These values are based on liver toxicity studies conducted in male (demonstrating a NOAEL of 5.8 mg/kg/day) and female rats (6.47 mg/kg/day) who received methylene chloride for 2 years via drinking water (National Coffee Association, 1982). Utilizing an average NOAEL of 6 mg/kg/day with an uncertainty factor of 100 for both subchronic and chronic exposures, EPA's oral RfD values are :

$$RfD_{c\text{-}o} = 6 \times 10^{-2} \text{ mg/kg/day}$$

$$RfD_{s\text{-}o} = 6 \times 10^{-2} \text{ mg/kg/day}$$

Oral studies concerning the hepatotoxic effects of methylene chloride in humans are lacking. In the NCA study (1982), fatty liver changes in rodents were reported in the 125 and 250 mg/kg/day dose groups at 78 and 104 weeks of treatment. Liver toxicity was not reported in epidemiological studies and it appears that methylene chloride will not cause serious liver effects in humans unless exposure is very high (ATSDR, 1988). Oral toxicity studies concerning CNS effects are lacking for both humans and animals (ATSDR, 1988).

Inhalation Exposure

Data indicates that CNS impairment can occur in humans following acute exposure to levels of methylene chloride exceeding 300 ppm. Humans exposed to methylene chloride at >300 ppm for 5 hours exhibited decreased visual and auditory function, and various psychomotor tasks were impaired at 800 ppm (Fodor and Winneke, 1971; Winneke, 1974). Acute studies in animals support the finding of CNS impairment following inhalation exposure. Chronic exposure of humans to methylene chloride also produces CNS impairment. Workers exposed to concentrations up to 100 ppm for 6 months to 2 years experienced several CNS complaints including headaches, dizziness, nausea, memory loss, paresthesia, and loss of consciousness (Welch, 1987). Methylene chloride vapors also adversely affect the liver. Guinea pigs exposed to 5200 ppm for 6 hours had fatty infiltration (Morris *et al.*, 1979). Chronic exposure to concentrations greater than 100 ppm (100 days) produced histologic alterations of the liver cells of animals.

The U.S. EPA (HEAST, 1993) has published subchronic and chronic inhalation RfD values. A value of 3 mg/m^3 (8.6×10^{-1} mg/kg/day) is listed for both subchronic and chronic RfD values. These RfDs are based on a study in rats exposed to 200 ppm for 6 hours/day, 5 days/week for 2 years. An uncertainty factor of 100 was applied.

$$RfD_{c\text{-}i} = 3\ mg/m^3 \text{ or } 0.86\ mg/kg/day$$

$$RfD_{s\text{-}i} = 3\ mg/m^3 \text{ or } 0.86\ mg/kg/day$$

Methylene chloride is classified in Group B2 (probable human carcinogen) by EPA based on inadequate human data and sufficient evidence of carcinogenicity in animals. Mice developed increased incidences of hepatocellular neoplasms and alveolar/bronchiolar neoplasms. Salivary gland sarcomas occurred in male rats and leukemia in female rats exposed to methylene chloride. The oral CPF is 7.5×10^{-3} risk units per mg/kg/day of lifetime exposure. An inhalation slope factor is reported in IRIS as 1.6×10^{-3} risk units per mg/kg/day of lifetime exposure.

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TOXICITY PROFILE FOR STYRENE

Styrene is a colorless-to-yellowish, very refractive oily liquid which, when heated to 200°C, polymerizes to form polystyrene. It is also used in the manufacture of resins, polyesters and insulators and in drug manufacture (Sittig, 1985). The Food and Drug Administration (FDA) permits styrene to be used as a direct additive for synthetic flavoring and an indirect additive in polyester resins, ion-exchange membranes and in rubber articles (5% by weight maximum) intended for use with foods (ATSDR, 1990).

Styrene liquid and vapor are irritating to the eyes, nose, throat and skin. Acute exposure to high concentrations may produce irritation of the mucous membranes of the upper respiratory tract, nose and mouth, followed by symptoms of narcosis, cramps and death due to respiratory center paralysis. Effects of short-term exposure to styrene under laboratory conditions include prolonged reaction time and decreased manual dexterity (Sittig, 1985). Urinary excretion of metabolites of styrene is the major route of elimination (ATSDR, 1990).

The TLV for styrene is 50 ppm (213 mg/m^3).

Oral Exposure

The U.S. EPA (IRIS, 1993) has published a risk reference dose value for chronic oral exposure to styrene. This value was derived from a study conducted by Quast *et al.* (1979) where dogs were administered 200 mg/kg/day styrene by gavage for 19 months.

$$RfD_{c\text{-}o} = 2 \times 10^{-1} \text{ mg/kg/day}$$

U.S. EPA (HEAST, 1992) has previously published a subchronic oral RfD value for styrene, derived from the same study as the chronic RfD value. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. The Center is in the process of deriving new subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used.

$$pRfD_{s\text{-}o} = 2 \times 10^{0} \text{ mg/kg/day}$$

Inhalation Exposure

The U.S. EPA (IRIS, 1993; HEAST, 1993) has published risk reference concentration values for the inhalation pathway of chronic and subchronic exposure to styrene. A commonly reported neuropsychological effect of styrene exposure is altered psychomotor functions (Harkonen *et al.* 1978, Lindstrom *et al.*, 1976, Mutti *et al.*, 1984). Mutti *et al.*. (1984) studied the relationship between occupational exposure to styrene and neuropsychological function. They reported that verbal learning skills were significantly impaired in workers exposed to mean daily concentrations of styrene greater than 25 ppm (this value is based on calculations of urinary metabolites). The mean exposure duration was 8.6 years and the estimated exposure frequency was 8 hours/day.

A NOAEL of 25 ppm was identified from this study and adjusted to the lower 95% confidence limit listed in Guillemin et al. (1982), which was 88%, 25 ppm times 0.88 equals 22 ppm (94 mg/m^3). The NOAEL(human equivalent concentration - HEC) was calculated using an 8-hour TWA occupational exposure.

$$\text{NOAEL(HEC)} = 94\ mg/m^3 \times \frac{10\ m^3/day}{20\ m^3/day} \times \frac{5\ days}{7\ days} = 34\ mg/m^3$$

Utilizing the NOAEL(HEC) and applying an uncertainty factor of 30 for chronic exposure and 10 for subchronic exposure, EPA derived the following values:

RfD_{c-i} = 1.0 mg/m^3 or 0.3 mg/kg/day (administered dose)

RfD_{s-i} = 3.0 mg/m^3 or 1.0 mg/kg/day (administered dose)

A carcinogen assessment of styrene is currently under review (IRIS, 1993).

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TOXICITY PROFILE FOR TETRACHLOROETHYLENE

Tetrachloroethylene is a colorless, nonflammable liquid used as a solvent, dry-cleaning agent and degreaser (Sittig, 1985). In a summary of U.S. groundwater analyses from both federal and state studies, tetrachloroethylene was found in 14-26% of all samples analyzed (Dyksen and Hess, 1982). An analysis of the EPA STORET database found that tetrachloroethylene was detected in 38% of 9323 surface water reporting stations nationwide (Staples *et al.*, 1985). Tetrachloroethylene has also been found in milk, cheese, butter, meat, fruits and vegetables (McConnell *et al.*, 1975).

Acute exposure to very high levels may result in central nervous system depression, liver damage and anesthetic death (Sittig, 1985). Chronic exposure may cause peripheral neuropathy and is carcinogenic in animals (Proctor *et al.*, 1988). Chronic oral dosing of tetrachloroethylene caused hepatocellular carcinomas in mice (NCI, 1977).

Tetrachloroethylene is classified by EPA as a Group B2 carcinogen (probable human carcinogen). The TLV is 25 ppm (170 mg/m^3).

Oral Exposure

The U.S. EPA (IRIS, 1993; HEAST, 1993) has published oral RfD values for tetrachloroethylene (PCE) based on liver effects in mice given 20 mg/kg PCE via drinking water for 5 days/week for 6 weeks (Buben and O'Flaherty, 1985; Hayes *et al.*, 1986). Utilizing a NOAEL of 14 mg/kg/day (corrected for continuous exposure) with UF values of 100 for subchronic and 1000 for chronic exposures, EPA's oral RfD values (ATSDR, 1987; Barnes *et al.*, 1987) are as follows:

$$RfD_{c\text{-}o} = 1.0 \times 10^{-2} \text{ mg/kg/day (Verified)}$$

$$RfD_{s\text{-}o} = 1.0 \times 10^{-1} \text{ mg/kg/day}$$

Tetrachloroethylene is a Group B2-classified carcinogen via both oral and inhalation exposure pathways. U.S. EPA (HEAST, 1992) has previously published an upper-bound carcinogen potency (slope) factor of 5.2×10^{-2} risk units per mg/kg/day of lifetime oral exposure. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. In the interim, before the new values are published, the previously published values will be provisionally used.

The EPA (1987) has developed the following Health Advisory guidance for drinking water:

	One Day	Ten Days	Longer Term	Drinking Water Equivalent Level (DWEL)
child	2.0 mg/ℓ	2.0 mg/ℓ	1.4 mg/ℓ	0.5 mg/ℓ
adult	-	-	5.0 mg/ℓ	0.5 mg/ℓ

An MCL of 0.005 mg/ℓ and an MCLG of zero concentration in drinking water has been proposed (U.S. EPA, 1991).

Inhalation Exposure

The U.S. EPA (IRIS, 1993; HEAST, 1993) has not published RfD values for inhalation exposure. Data regarding inhalation exposure levels in humans were incomplete, although it is reported that threshold CNS effects in humans occur at about 100 to 200 ppm for 5.5- to 7-hour exposures (dizziness, headache, incoordination) (ATSDR, 1987). An inhalation LC_{50} of 5200 ppm for 4 hours for mice was reported by Friberg *et al.* (1953). For longer-term exposures to lower concentrations, the liver and kidneys are primary target organs of toxicity.

Increased relative liver weight occurred in guinea pigs exposed to 100 ppm for 7 hours/day, 5 days/week over a period of 6 months, and hepatic histological changes were noted at air levels exceeding 200 ppm (Rowe *et al.*, 1952). No abnormalities were observed in rats, rabbits or monkeys at exposures up to 400 ppm, 7 hours/day, 5 days/week for 6 months (Rowe *et al.*, 1952).

ATSDR (1987) describes the study by Kjellstrand *et al.* (1984), who reported that mice exposed continuously for 30 days to PCE at 9 ppm exhibited liver enlargement and vacuolization of hepatocytes, as providing the lowest reported LOAEL. However, this observation may be inconsistent, as it is the only study to report a LOAEL at an order of magnitude below the NOAELs for hepatotoxicity in several species reported by numerous other investigators. For example, Carpenter (1937) found no pathological alterations in the livers or kidneys of rats exposed to 70 ppm for 8 hours/day, 5 days/week for 7 months, but histological effects were evident in the kidneys at 230 ppm. In the Rowe *et al.* (1952) study with guinea pigs, hepatic histological alterations were not observed at 100 ppm, but at levels exceeding 200 ppm, hepatic histological changes were apparent in mice and rats (Kylin *et al.*, 1965; NTP, 1986).

Continuous exposure to 60 ppm for 90 days followed by 4 months without exposure caused decreased DNA content in the frontal cerebral cortex of gerbils (Rosengren *et al.*, 1986), and continuous exposure to 120 ppm for 12 months caused other biochemical alterations in the brains of gerbils (Briving *et al.*, 1986; Kyrklund *et al.*, 1984).

Considering the effects on brain biochemistry from intermediate (but continuous) exposures of animals at air concentrations below those producing any apparent effects on the liver and kidneys in most studies, and considering the plausibility that PCE may be most toxic when administered continuously, rather than intermittently, for longer durations, it is appropriate to regard the Kjellstrand *et al.* (1984) study as revealing the lowest LOAEL. As recommended by ATSDR (1987), this study suggests that adverse effects in the liver are associated with continuous exposure to 9 ppm (60.3 mg/m^3) in mice. Assuming a mouse weighing 0.03 kg inhales 0.04 m^3 per day, and utilizing a UF of 1000 (10 for interspecies extrapolation, 10 for conversion of a LOAEL to NOAEL and 10 for human variability), a provisional subchronic inhalation RfD is derived as follows[1]:

$$pRfD_{s-i} = \frac{60.3\ mg/m^3}{1000} \times \frac{0.04\ m^3/day}{0.03\ kg} = 8.0 \times 10^{-2}\ mg/kg/day$$

For chronic inhalation, an additional UF of 10 is applied to account for less-than-lifetime data.

$$pRfD_{c-i} = \frac{60.3\ mg/m^3}{10,000} \times \frac{0.04\ m^3/day}{0.03\ kg} = 8.0 \times 10^{-3}\ mg/kg/day$$

These provisional inhalation RfD values should be compared to administered doses (*i.e.*, intake doses or air concentrations), not absorbed doses.

U.S. EPA (HEAST, 1992) has previously published an inhalation potency (slope) factor of 2.0 $\times$ 10^{-3} risk units per mg/kg/day of lifetime exposure. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. In the interim, before the new values are published, the previously published values will be provisionally used.

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1. Use of provisionally derived toxicity benchmarks by persons without a recognized expertise in toxicology and/or industrial hygiene constitutes a misuse of the information presented above. Unauthorized use or interpretation of this information may result in inadequate protection of human health and is strictly prohibited. The information presented here is based on the most recent scientific literature at the time of writing (March 31, 1994).

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TOXICITY PROFILE FOR TOLUENE

Toluene is a clear, colorless liquid whose major use is in gasoline, both as a nonisolated component and through addition of the isolated product into gasoline to improve octane ratings. Toluene is used as a solvent in paints, inks, adhesives, cleaning agents and for chemical extractions. Other minor uses include use as a feedstock in the synthesis of benzene, urethane foams, pharmaceuticals, dyes and as a solvent in cosmetic nail products.

Toluene is not likely to persist in the environment because it decomposes in soil and evaporates rapidly. Humans are primarily exposed to toluene via inhalation since nearly all toluene entering the environment is released directly to air. The largest source of toluene release is the production, transport and use of gasoline, which is 5 to 7% toluene by weight. Air typically contains from 1 to 30 $\mu g/m^3$ in suburban and urban areas. Toluene is also a common indoor air contaminant, with an average concentration of 32 $\mu g/m^3$. The primary sources of indoor contamination include cigarette smoke and household products containing toluene. The typical dose for humans by the inhalation route is 300 μg/day, with cigarettes adding another 1,000 μg/day (1 pack) (ATSDR, 1988).

The acute toxicity of toluene appears to be limited to central nervous system (CNS) depression. Acute exposure to toluene at levels sufficient to cause unconsciousness fails to produce residual organ damage in humans. Chronic exposure to moderate-to-high concentrations of toluene is associated with reversible CNS disturbances and impaired neuromuscular function (ATSDR, 1988; Proctor, *et al.*, 1988).

Oral Exposure

The U.S. EPA has published oral risk reference dose (RfD) values for both chronic and subchronic exposures (IRIS, 1993; HEAST, 1993). These values are based on an NTP (1989) study exposing rats to 312 mg/kg, 5 days/week for 13 weeks. A NOAEL of 223 mg/kg/day was identified based on liver and kidney weight changes. Utilizing an uncertainty factor of 1000 for chronic (10 for species extrapolation, 10 for sensitive human populations and 10 for a less-than-lifetime study) and 100 for subchronic exposures, and the NOAEL of 223 mg/kg/day, EPA derived the following oral toxicity values:

$$RfD_{c\text{-}o} = 2 \times 10^{-1} \text{ mg/kg/day}$$

$$RfD_{s\text{-}o} = 2 \text{ mg/kg/day}$$

Inhalation Exposure

The U.S. EPA has published an inhalation risk reference concentration (RfC) for toluene (IRIS, 1993). Foo et al. (1990) conducted a cross-sectional study involving 30 female workers exposed to toluene from glue emissions. The study identified a LOAEL for CNS effects of 332 mg/m^3. The LOAEL was adjusted for continuous exposure (119 mg/m^3), and an uncertainty factor of 300 (10 for human variability, 10 for converting from a LOAEL to a NOAEL and 3 for data base deficiencies, including the lack of data and well-characterized laboratory animal exposures evaluating neurotoxicity and respiratory) was utilized to derive chronic oral RfD value.

$$RfD_{c\text{-}i} = \frac{119\ mg/m^3}{300} \times \frac{20\ m^3}{70\ kg} = 1 \times 10^{-1}\ mg/kg/day\ \text{(administered dose)}$$

U.S. EPA (HEAST, 1992) has previously published a subchronic inhalation RfD value for toluene, derived from the same study as the chronic RfD value. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. The Center is in the process of deriving new subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used.

$$pRfD_{s\text{-}i} = 1 \times 10^{-1}\ mg/kg/day\ \text{(administered dose)}$$

The TLV for toluene is 100 ppm or 377 mg/m^3.

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TOXICITY PROFILE FOR 1,1,1-TRICHLOROETHANE

1,1,1-Trichloroethane (1,1,1-TCA) is a man-made colorless liquid used widely as a cleaner and degreaser of metals, a spot remover and a solvent of lipophilic substances. In households it may be in products such as glues and aerosol sprays. Humans are primarily exposed to 1,1,1-TCA via inhalation. In the U.S., urban air typically contains 0.1 to 1.0 ppb. Rural areas usually contain less than 0.1 ppb. Because 1,1,1-TCA is used in household and office products, levels in inside air may be greater than outside air. 1,1,1-TCA has also been found in rivers and lakes (up to 0.01 ppm), soil (up to 120 ppm), ground water (up to 12 ppm) and in public drinking water (up to 0.0035 ppm). 1,1,1-TCA has also been detected in raw, processed and prepared food products, possibly as a result of the glue used in packaging or the use of processed water containing this chemical (ATSDR, 1990b). The mean daily intake from all sources has been estimated to range from 50 to 1000 μg/day (Wallace *et al.*, 1984). Depression of the central nervous system (CNS) is the main toxic effect in humans exposed to high concentrations of 1,1,1-TCA. Chronic exposure may result in hepatotoxicity.

Oral Exposure

One case of ingestion of 1,1,1-TCA by a human has appeared in the literature (Stewart and Andrews, 1966). A 47-year-old male accidentally ingested 1 oz. of 1,1,1-TCA (about 0.6 g/kg). He became nauseated within 30 minutes and developed progressively severe vomiting and diarrhea over the next few hours. Urinalysis and clinical chemistry tests revealed minimal hepatorenal injury early in the course of hospitalization. The EPA (HEAST, 1992) has previously published both subchronic and chronic oral RfD values based on a study conducted by Torkelson *et al.* (1958). This study reported no adverse liver effects in guinea pigs exposed to 500 ppm (90 mg/kg/day by route to route extrapolation) for 7 hours/day for 6 months. Utilizing the NOAEL of 90 mg/kg/day (with uncertainty factors of 100 for subchronic and 1000 for chronic exposures) EPA derived the following RfD values:

$$pRfD_{c\text{-}o} = 9 \times 10^{-2} \text{ mg/kg/day}$$

$$pRfD_{s\text{-}o} = 9 \times 10^{-1} \text{ mg/kg/day}$$

In 1993, however, EPA has withdrawn the oral RfD values and requested that the user consult the Superfund Health Risk Technical Support Center for subchronic exposure information. The Center is in the process of deriving new subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used.

Inhalation Exposure

Inhalation of high concentrations of 1,1,1-TCA can cause irritation of the respiratory tract and depression of the CNS. Acute pulmonary congestion and edema have been reported in fatalities resulting from inhalation of 1,1,1-TCA (Caplan *et al.*, 1976). Stewart (1971) reported case histories of four individuals who were monitored clinically after being exposed to 1,1,1-TCA vapors. Recovery from the CNS depression was rapid and uneventful. Clinical experience indicates that acute high-level inhalation of 1,1,1-TCA can adversely affect the cardiovascular system of humans. Dornette and Jones (1960) used 1,1,1-TCA at 10,000 to 26,000 ppm to anesthetize surgery patients. While induction of anesthesia and recovery were rapid, cardiovascular effects included decreased systolic pressure, premature ventriculate contractions, and, in one patient, cardiac arrest.

The U.S. EPA (HEAST, 1992) has previously published subchronic and chronic inhalation RfD values for 1,1,1-TCA based on the study by Torkelson *et al.* (1958) which was also used to derive the oral RfD values. Guinea pigs were exposed to 500 ppm (304 mg/kg/day) for 7 hours/day, 5 days/week for 6 months. Utilizing the NOAEL of 304 mg/kg/day and an uncertainty factor of 100 for subchronic and 1000 for chronic exposures, EPA derived the following inhalation RfD values:

$$pRfD_{c\text{-}i} = 3 \times 10^{-1} \text{ mg/kg/day}$$

$$pRfD_{s\text{-}i} = 3 \text{ mg/kg/day}$$

In 1993, however, EPA has withdrawn the inhalation RfD values and requested that the user consult the Superfund Health Risk Technical Support Center for chronic exposure information. The Center is in the process of deriving new chronic and subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used.

1,1,1-TCA is classified in Group D by EPA (not classifiable as to human carcinogenicity).

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TOXICITY PROFILE FOR TRICHLOROETHYLENE (TCE)

Trichloroethene, or trichloroethylene, (TCE) is a nonflammable, colorless liquid with a sweet odor (Sittig, 1985). It is used as a solvent in vapor degreasing and as a dry-cleaning agent (Sittig, 1985). It is found in milk, cheese, butter, meat, oils, fats, beverages, fruits and vegetables (ATSDR, 1988). An analysis of the EPA STORET database revealed that TCE had been detected in 28% of 9295 surface water reporting stations nationwide (Staples *et al.*, 1985).

The main acute effect of TCE is central nervous system depression characterized by headaches, dizziness, tremors, nausea, vomiting, fatigue, blurred vision and intoxication similar to that of alcohol (Sittig, 1985). As reported by Sittig (1985), TCE is irritating to the skin and may cause dermatitis, irritates the eyes, nose and throat, is found to be addictive, and, given by gastric intubation, appears to cause hepatocellular carcinomas and some metastases to the lungs of mice. The TLV for TCE is 50 ppm (269 mg/m^3). TCE is classified in Group B2 (probable human carcinogen) by the EPA.

Oral Exposure

The Maximum Contaminant Level (MCL) is 0.005 mg/ℓ for TCE in public water supplies (IRIS, 1993). The U.S. EPA (IRIS, 1993; HEAST, 1993) has not provided oral or inhalation RfD values for trichloroethylene (TCE). EPA, however, derived a suggested Adjusted Acceptable Daily Intake (AADI) of 0.26 mg/ℓ for TCE in drinking water (U.S. EPA, 1984). Liver toxicity was used as the most sensitive endpoint with respect to adverse health effects, not including the potential carcinogenic risk that may result from exposure to the chemical. EPA has calculated Drinking Water Health Advisories (HAs) of 0.007 mg/kg/day as an oral RfD, and 0.3 mg/ℓ as the Drinking Water Equivalent Level (DWEL) (U.S. EPA, 1988), although no HAs are currently listed in IRIS (1993). A DWEL is defined as the medium-specific (in this case, drinking water) exposure which is interpreted to be protective for non-carcinogenic endpoints of toxicity over a lifetime of exposure.

EPA's derivation of an oral RfD of 7.35×10^{-3} mg/kg/day (U.S. EPA, 1986; U.S. EPA, 1988) provides the basis for a provisional chronic oral RfD value[1].

$$pRfD_{c\text{-}o} = 7.4 \times 10^{-3} \text{ mg/kg/day}$$

In intermediate-duration oral studies, gavage doses of 250 mg/kg caused hepatic histologic alterations (hepatocellular hypertrophy), and doses greater than 500 mg/kg caused increased relative liver weights in mice when administered 5 days/week for 3 weeks (Stott *et al.*, 1982). In a 6-month drinking water study with mice (Tucker *et al.*, 1982), urinary ketone and protein levels were increased at 393 mg/kg/day, but not at 217 mg/kg/day. In the same study, the high gavage dose produced increased relative liver weights, but no treatment-related gross pathological effects at 217 mg/kg.

Developmental and reproductive effects occur only at doses which are attributable to maternal toxicity (ATSDR, 1988). No adverse effects on fertility, reproductive performance, or reproductive system histology were noted in mice and rats in recent National Toxicology Program studies (NTP, 1985, 1986).

Immune status in mice was evaluated after 4 and 6 months of exposure to TCE via drinking water (Sanders *et al.*, 1982). Effects in females included depressed cell-mediated immunity to sheep erythrocytes at 18 mg/kg/day (the lowest dose tested) after 4 months and at 739 mg/kg/day after 6 months, depressed humoral immunity to sheep erythrocytes at 437 mg/kg/day after 4 months but not after 6 months and inhibited bone marrow stem cell colonization at 18 mg/kg/day after 4 and 6 months. No clear dose-response relationship is demonstrated by this study. ATSDR (1988), however, regards the effects seen on bone marrow at 18 mg/kg/day as representing the lowest LOAEL for intermediate-duration oral exposure. Accordingly, a provisional subchronic oral RfD value is derived on this basis, utilizing a UF of 1000 (10 for extrapolation between species, 10 for conversion of a LOAEL to a NOAEL, and 10 for human variability in sensitivity):

$$pRfD_{s\text{-}o} = \frac{18\ mg/kg/day}{1000} = 1.8 \times 10^{-2}\ mg/kg/day$$

U.S. EPA (HEAST, 1992) has previously published an upper-bound carcinogen potency (slope) factor of 1.1×10^{-2} risk units per mg/kg/day of lifetime oral exposure. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. In the interim, before the new values are published, the previously published values will be provisionally used.

Inhalation Exposure

Principal targets for inhaled TCE are the central nervous system (CNS), liver, kidney and hematological system. In experimental studies with humans, exposure to 27 ppm caused drowsiness and mucous membrane irritation and 81 ppm caused headaches after 4 hours (Nomiyama and Nomiyama, 1977). In intermediate-duration studies, liver weights were increased in mice exposed to 37 ppm (200 mg/m^3) continuously for 30 days (Kjellstrand *et al.*, 1983); in rats exposed to 55 ppm (497 mg/m^3), 8 hours/day, 5 days/week for 14 weeks (Kimerle and Eben, 1973); and in rats exposed to 50 ppm (270 mg/m^3) continuously for 12 weeks (Nomiyama *et al.*, 1986). Treatment-related effects on hepatic indices were reported by Nomiyama *et al.* (1986) (continuous exposure) but not by Kimerle and Eben (1973) (intermittent exposure). ATSDR (1988) regards the Kjellstrand *et al.* (1983) study that reported vacuolization in hepatocytes of mice continuously exposed to 37 ppm (200 mg/m^3) as the intermediate-duration LOAEL. On the other hand, Prendergast *et al.* (1967) reported no hepatic histological effects in rats, guinea pigs, rabbits, dogs or monkeys exposed continuously to 35 ppm (189 mg/m^3) for 90 days. On the basis of 37 ppm as the lowest LOAEL (rather than 35 ppm as a NOAEL), a provisional subchronic inhalation RfD is conservatively derived utilizing a UF of 500 (10 for species extrapolation, 5 for conversion of this particular LOAEL to a NOAEL and 10 for variability in human sensitivity), and assuming a 0.03 kg mouse inhales a volume of 0.04 m^3/day (U.S. EPA, 1989):

$$pRfD_{s\text{-}i} = \frac{200\ mg/m^3}{500} \times \frac{0.04\ m^3/day}{0.03\ kg} = 5.3 \times 10^{-1}\ mg/kg/day \quad \text{(administered dose)}$$

A provisional chronic inhalation risk reference dose may be derived by applying an additional UF of 10 to account for less-than-lifetime data:

$$pRfD_{c\text{-}i} = 5.3 \times 10^{-2}\ \text{(administered dose)}$$

U.S. EPA (HEAST, 1992) has previously published an inhalation slope factor of 6×10^{-3} risk units per mg/kg/day of lifetime exposure. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. In the interim, before the new values are published, the previously published values will be provisionally used.

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TOXICITY PROFILE FOR XYLENES

Xylene is a mixture of *o*-, *m*- and *p*-xylene. It is used as a solvent and in the manufacture of hydrogen peroxide, perfumes, insect repellents, epoxy resins, pharmaceuticals and leather goods (Sittig, 1985). Xylene vapor may cause irritation of the eyes, nose and throat at sufficiently high air concentrations. Repeated or prolonged skin contact with xylene, as with numerous other organic solvents, may cause drying and defatting of the skin that may lead to dermatitis. Acute exposure to high levels of xylene vapor may cause central nervous system depression and minor, reversible effects upon liver and kidneys (Sittig, 1985).

Oral Exposure

The U.S. EPA (HEAST, 1993) has published chronic oral RfD values for *o*- and *m*- isomers of xylene. U.S. EPA (IRIS, 1993) has published an oral RfD value for mixed xylenes. The xylenes RfD values are based on a study by the National Toxicology Program (NTP, 1986) which administered mixed xylenes (60.2% *m*-xylene, 13.6% *p*-xylene, 17.0% ethylbenzene and 9.1% *o*-xylene) to rats and mice 5 days per week for 103 weeks. A no-observable-adverse-effect-level (NOAEL) of 250 mg/kg of mixed xylenes was identified and adjusted for continuous exposure to 179 mg mixed xylenes/kg/day. Utilizing an uncertainty factor of 100 (10 for species extrapolation and 10 for human variability), EPA derived the following chronic oral RfD values for *o*- and *m*- isomers and mixed xylenes.

$$RfD_{c\text{-}o} = 2 \text{ mg/kg/day}$$

U.S. EPA (HEAST, 1992) has previously published subchronic oral RfD values for xylenes, derived from the same study as the chronic RfD values. In 1993, however, EPA has withdrawn the numbers and requested that the user consult the Superfund Health Risk Technical Support Center. The Center is in the process of deriving new subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used.

The previously published subchronic oral RfD value was based on the same NTP study (1986). A frank-effect-level-(FEL) of 500 mg/kg/day was identified and adusted for continuous exposure to 357 mg/kg/day. Utilizing an uncertainty factor of 100 (10 for species extrapolation and 10 for human variability), EPA (HEAST, 1992) derived the following subchronic oral RfD value for *ortho*-, *meta*- and mixed xylene isomers.

$$pRfD_{s\text{-}o} = 4 \text{ mg/kg/day}$$

The U.S. EPA (IRIS, 1993; HEAST, 1993) has not published an oral RfD value for para-xylene. In the absence of more detailed oral dose-response data for this isomer, it is recommended that the value determined by EPA for *o*- and *m*- isomers and mixed xylenes be used as provisional oral value for *p*-xylene[1].

$$pRfD_{c\text{-}o} = 2 \text{ mg/kg/day}$$

$$pRfD_{s\text{-}o} = 4 \text{ mg/kg/day}$$

Inhalation Exposure

The U.S. EPA (IRIS, 1992; HEAST, 1992) had previously published inhalation RfC values for the isomers of xylene and mixed xylenes, however, they withdrew the toxicity values from their database in 1992. ACGIH (1992) has published a TLV of 100 ppm (434 mg/m^3) for all xylene isomers. Greenburg and Moskowitz suggested a maximum allowable concentration of 200 ppm. Cook, Smyth, Elkins and Gerade all considered this value too high, and Gerade suggested 100 ppm as a more acceptable limit. It is believed that continued occupational exposure of xylene at concentrations of 100 ppm will have no significant degree of narcosis or chronic injuries (ACGIH, 1990).

Hake *et al.* (1981) conducted a study on adults of both sexes which exposed them to *p*-xylene vapor concentrations of 0, 20, 100, and 150 ppm for periods of 1, 3, and 7.5 hours in a controlled environment chamber. Repetitive vapor exposure to the current threshold limit value of 100 ppm produced no serious subjective or objective health response in the 16 subjects, nor in eight male subjects who were exposed for 5 days to 150 ppm *p*-xylene vapor (Hake *et al.*, 1981).

On the basis of this study and related studies, the TLV of 100 ppm is utilized to derive provisional inhalation RfD values for mixed xylenes and the individual isomers of xylene. During an 8-hour workday, it is anticipated that a worker may inhale 10 m^3 of air. The TLV is adjusted for continuous exposure (168 hr. ÷ 40 hr. = 4.2), to account for body weight and respiratory rate differences between adults and children (1.75) and to protect sensitive human subpopulations (10) (ACGIH, 1988). Applying these safety factors, the provisional chronic and subchronic inhalation RfD values for all isomers of xylene and mixed xylene are derived as follows:

$$pRfD_{c\text{-}i} = \frac{434 \text{ mg/m}^3\text{/day}}{10 \times 4.2} \times \frac{10 \text{ m}^3\text{/day}}{70 \text{ kg} \times 1.75} = 0.8 \text{ mg/kg/day}$$

$$pRfD_{s\text{-}i} = 0.8 \text{ mg/kg/day}$$

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REFERENCES FOR XYLENES

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TOXICITY PROFILE FOR BIS(2-ETHYLHEXYL)PHTHALATE (DEHP)

DEHP is a colorless oily liquid that is commonly used as a plasticizer (Sittig, 1985). Acute toxicity of DEHP is low, however, chronic exposure can result in adverse effects on the liver (Carpenter *et al.*, 1945; Proctor *et al.*, 1988) and testicles (Thomas and Thomas, 1984). Chronic exposure can also result in teratogenicity (Lamb *et al.*, 1987) and liver cancer (NTP, 1982) in animal studies. EPA has classified DEHP as a Group B2 carcinogen (probable human carcinogen). The TLV (TWA) for DEHP is 5 mg/m^3. The PEL set by OSHA is also 5 mg/m^3.

Oral Exposure

Animal studies for ingestion have shown the liver and testes to be the primary target organs for DEHP toxicity. Embryotoxic and fetotoxic effects have also been noted. The U.S. EPA (IRIS, 1993; HEAST, 1993) has derived a chronic oral RfD value based upon administration of DEHP in the diet of guinea pigs (0.04% of diet for 1 year; 19 mg/kg/day, increased relative liver weight). Applying a UF of 1000, EPA derived an RfD value of 2×10^{-2} mg/kg/day for both chronic and subchronic oral exposure.

$$\text{verified } RfD_{c\text{-}o} = 2 \times 10^{-2} \text{ mg/kg/day}$$

U.S. EPA (HEAST, 1992) has previously published a subchronic oral RfD value for DEHP. In 1993, however, EPA has withdrawn the number and requested that the user consult the Superfund Health Risk Technical Support Center. The Center is in the process of deriving new subchronic RfD values. In the interim, before the new values are published, the previously published values will be provisionally used.

$$pRfD_{s\text{-}o} = 2 \times 10^{-2} \text{ mg/kg/day}$$

On the basis of a 103-week dietary bioassay of DEHP in mice (NTP, 1982), the U.S. EPA (IRIS, 1992) derived an upper-bound slope factor of 1.4×10^{-2} risk units per mg/kg/day of lifetime oral exposure.

Inhalation Exposure

The U.S. EPA (IRIS, 1993; HEAST, 1993) has not published inhalation RfD values for DEHP. Absolutely no inhalation data were found for longer-term exposures to DEHP. Levels up to about 24,000 mg/m^3 produced no adverse effects (no acute lethality in rats from 1-hour exposures).

Because no inhalation toxicity studies have been documented, and because pulmonary effects are not a prominent feature of short or long-term toxic response, inhalation RfDs are most appropriately based on oral data. DEHP can be absorbed systemically via the lungs, although no quantitative data are available. More than 90% of an oral dose is absorbed. Assume conservatively that 50% of an inhaled dose is absorbed when utilizing oral RfDs (published by EPA) for inhalation exposures[1].

$$pRFD_{\substack{c\text{-}i\\ s\text{-}i}} = 2 \times 10^{-2} \text{ mg/kg/day or } 0.07 \text{ mg/m}^3 \text{ (absorbed dose)}$$

Assume absorption of 50% inhaled air and absorption of 90% from GI tract (Williams and Blanchfield, 1974). This means, when comparing absorbed doses, apply a ratio of 0.5/0.9 to inhalation intake for comparisons to the above pRfDs.

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APPENDIX O

SOURCE AREA ADDITIONAL DATA COLLECTION PROGRAM GEOLOGIC LOGS OF TEST BORINGS AND MONITORING WELL CONSTRUCTION DIAGRAMS

APPENDIX O

SOURCE AREA ADDITIONAL DATA COLLECTION PROGRAM
GEOLOGIC LOGS OF TEST BORINGS AND
MONITORING WELL CONSTRUCTION DIAGRAMS

APPENDIX O.1

GEOLOGIC LOGS OF TEST BORINGS

Project _____BIGV/BPM__ Date __11/15/93__

Location _____Baldwin Place Mall_______________________

Boring/Well Designation _____TB-16/MW-11D____________

Land Surface Elevation ________Estimated _____Surveyed

Drilling Method ___Wet Rotary____________________

Drilling Fluid ____Water from BPM Supply___________

Sampling Method __Split Spoon 2ft. long/Grab_____________

Sampling Interval __Continuous_______________________

Drilling Contractor __Samuel Stothoff________________

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
0	2	1		Sand, silt little clay, brown. Some rounded gravel, no odors, moist at tip of spoon.
2	4	1		Silty sand and clay, brown, wet, slight chemical odor.
4	6	1.8		From 4 ft.-4.5 ft.: Silty sand and clay, brown, moist, HNU=300ppm. From 4.5 ft.-5 ft.: Silty lense, approx. 0.5 ft. thick, HNU=100ppm. From 5 ft.-6 ft.: Silty sand and clay, with fine to medium gravel, rounded to subangular.
6	8	1.6		Silty sand and clay (till) with fine, rounded to subrounded gravel. Strong chemical odor.

Boring/Well Designation TB-16/MW-11D
Geologic/Drilling Activity Log

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
6	8	1.6	Continued	Average HNU=250 ppm and 5 ppm at the tip of the spoon.
8	10	2		Silty sand and and clay (till), gravel layer coarse at approx. 9 ft., sample saturated (possibly water form gravel), HNU=10-15 ppm.
10	12	2		From 10 ft.-10.7 ft.: Silty sand, saturated. From 10.7 ft.-12 ft.: Silty sand and clay (till) with fine rounded to subrounded gravel(till hard with more silt and less clay).
12	13	1.5	34/100 for 4"	Upper 1 ft. of spoon: Silty sand, below 1 ft. lense of weathered granitic material. From 13 ft.-14 ft.: Silty sand and clay (till) with rounded to subrounded gravel. No odors, HNU=0. Note: Upper 0.5 ft. may be fall in form above, augered to 14 feet.
14	15	1	8/34	Silty clay, moist at 14-15ft., silty sand at tip of spoon (15 ft.), HNU=0, no odors.
15		Grab		Attempted Shelby Tube, no penetration, tube bent. Drilling out additional 1 foot to attempt another. Sand, fine to medium, trace coarse sand, some silt.

Boring/Well Designation TB-16/MW-11D
Geologic/Drilling Activity Log

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
16	18	1.2	55-73-100/2	From 16 ft.-17.2 ft.: Till, silt, trace clay, trace sand, very fine to fine, trace gravel, fine to coarse, subrounded to subangular, green-brown, moist to wet, very dense.
18	20	0.9	67-100/3	Till, silt, trace clay, trace sand, very fine to fine, trace gravel, fine to medium, subrounded to subangular, green-brown, moist to wet, very dense.
20	22	1.0	44-100-100/2	Till, silty sand, fine, trace clay, trace gravel, fine to medium, subrounded to subangular, green-brown, moist, very dense.
22	24	0.75	92-100/1.75	Till, silty sand, very fine, trace clay, trace gravel, fine to medium, subrounded to subangular, green-brown, moist, very dense.
24	26	0.9	54-100/5	Till, silt, trace clay, trace gravel, fine to medium, subrounded to subangular, green-brown, moist, very dense.
26	28	0.7	75-100/2	Till, silt, little gravel, fine to coarse, trace sand, medium to coarse, trace clay, green-brown, moist, very dense.
28	30	0.7	65-100/2	Till, silt, little gravel, fine to medium, trace sand, medium to coarse, trace clay, green-brown, moist, very dense.

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
30	32	0.8	68-100/2.5	Till, silt, little gravel, fine to medium, angular to subangular, trace clay, trace sand, coarse, green-brown, moist, very dense.
32	34	0.8	58-100/3	Till, silty sand, very fine to fine, trace gravel, fine to medium, subrounded to subangular, trace clay, green-brown, moist, very dense.

Project _____BIGV/BPM__ Date __11/18/93__

Location ______Baldwin Place Mall________________________

Boring/Well Designation ______TB-17____________________

Land Surface Elevation _________Estimated ______Surveyed

Drilling Method ___Hollow Stem Auger______________

Drilling Fluid _____None_____________________________

Sampling Method __Split Spoon 2ft. long/Grab_____________

Sampling Interval __Continuous________________________

Drilling Contractor __Samuel Stothoff________________

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
0	2	0.6	4-7-5-6	Silt, little gravel, fine to medium, sugangular to subrounded, brown, dry, loose.
2	4	1.4	6-5-5-6	Silt, trace sand, fine to medium, trace clay, occassional gravel, fine to medium, brown, moist, loose.
4	6	0.2	2-10-14-25	Silt, trace sand, fine to medium, trace clay, occassional gravel, fine to medium, brown, moist, loose.
6	8	0.9	6-32-36-46	Till, silt, little gravel, fine to medium, subrounded to subangular, trace clay, brown, dry, very dense.

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
8	10	1.6	6-14-44-46	Till, silty sand, fine to mdeium, trace gravel, fine to medium, subrounded to subangular, trace clay, brown, moist, medium dense with lenses of sand, fine to coarse.
10	12	1.8	5-26-76-79	Upper 1 ft.: Till, silt, trace sand, fine to coarse, trace clay, trace gravel, fine, moist, medium dense, brown. Lower 1 ft.: Silt, trace sand, fine, trace clay, trace gravel, fine, brown, dry, very dense.
12	14	1.8	7-33-63-133	Till, silty sand, fine to coarse, trace gravel, fine, trace clay, lenses of sand, brown, moist, medium dense.
14	16	1.7	7-52-82-100	Till, silty sand, fine, trace clay, trace gravel, fine to medium, lenses of sand, brown, moist, medium dense.
16	18	1.0	10-53-100/3.5	Till, silt, little clay, trace sand, fine, trace gravel, fine to medium, subangular, green-brown, moist, medium dense.
18	20	1.6	12-38-70-100/1	Till, silt, little sand, very fine, little clay, trace gravel, fine to medium, subangular, with lenses of sand, fine to medium, green-brown, moist, medium dense.

Boring/Well Designation TB-17

Geologic/Drilling Activity Log

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
20	22	1.0	10-82-100/2.25	Till, silt, trace sand, fine, trace clay, trace gravel, fine to coarse, subangular to subrounded, with lenses of silty sand, fine to very fine, green-brown, medium dense, moist.
22	24	0.9	10-38-100/3.5	Till, silt, trace clay, trace gravel, fine to coarse, subangular, trace sand, coarse, green-brown, moist, medium dense.
24	26	1.0	55-100/3	Till, silt, trace clay, trace gravel, fine to coarse, subangular, trace sand, coarse, green-brown, moist, medium dense.
26	28	0.8	60-103-100/0.5	Till, silt, trace clay, little gravel, fine to coarse, subrounded to subangular, green-brown, dry, very dense.
28	30	0.8	50-100/0.5	Till, silt, trace clay, trace sand, fine, trace gravel, fine to medium, subrounded to subangular, green-brown, moist, very dense.

Project _____BIGV/BPM__ Date __12/2/93__

Location _____Baldwin Place Mall______________________

Boring/Well Designation _____TB-18___________________

Land Surface Elevation ________Estimated _____Surveyed

Drilling Method ___Hollow Stem Auger______________

Drilling Fluid _____None_____________________________

Sampling Method __Split Spoon 2ft. long/Grab_____________

Sampling Interval __Continuous________________________

Drilling Contractor __Samuel Stothoff________________

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
0	0.2			Asphalt.
0.2	2	1.0	7-17-17-11	Silt, trace sand, fine to coarse, trace clay, trace gravel, fine to coarse, brown, dry, soft.
2	4	1.2	9-7-8-8	Till, silty clay, trace sand, fine, trace gravel, fine, with lenses of sand, fine to medium, brown, moist, soft.
4	6	1.0	6-10-11-13	Till, silty clay, trace sand, fine, trace gravel, fine, with lenses of sand, fine to medium, brown, wet, soft.
6	8	1.0	14-46-53-66	Till, silt, trace clay, trace sand, fine to coarse, trace gravel, fine to coarse, angular, brown, moist to dry, very dense.

Boring/Well Designation TB-18
Geologic/Drilling Activity Log

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
8	10	1.0	34-61-53-55	Till, silt, little gravel, fine to coarse, angular, trace sand, fine to coarse, trace clay, green-brown, moist, very dense.
10	12	1.2	11-25-37-45	Till, silt, little sand, fine to coarse, little gravel, fine to medium, angular, trace clay, green-brown, moist, dense.
12	14	0	90-100/0.5	No recovery. Refusal at 12 feet. Moved location 3 feet west.
12	14	1.3	25-75-80-150/5	Till, silt, trace sand, fine to coarse, trace gravel, fine, trace clay, green-brown, dry, dense.
14	16	1.3	22-65-150/3	Till, silt, little sand, fine to coarse, little gravel, fine to coarse, subangular to angular, trace clay, green-brown, moist, dense.
16	18	0.8	65-150/4	Till, silt, little sand, fine to coarse, little gravel, fine to coarse, subangular to angular, trace clay, green-brown, moist, dense.
18	20	1.2	44-88-139-100/2.5	Till, silt, trace sand, fine to coarse, trace clay, with lenses of silty sand, very fine to fine, green-brown, moist, dense.

Boring/Well Designation TB-18
Geologic/Drilling Activity Log

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
20	22	0.7	49-71-160-100/0.5	Till, silt, trace sand, fine to coarse, trace clay, with lenses of silty sand, very fine to fine, occassional cobbles, green-brown, moist, dense.
22	24	0	118-100/1	No recovery.

Project ______BIGV/BPM__ Date __11/30/93__

Location ______Baldwin Place Mall________________________

Boring/Well Designation ______TB-19____________________

Land Surface Elevation _________Estimated ______Surveyed

Drilling Method ___Hollow Stem Auger_______________

Drilling Fluid _____None____________________________

Sampling Method __Split Spoon 2ft. long/Grab______________

Sampling Interval __Continuous_________________________

Drilling Contractor __Samuel Stothoff_________________

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
0	1			Asphalt.
1	3	1.0	7-7-6-2	Silt, little clay, trace gravel, fine to medium, black-brown, dry, loose.
3	5	0.8	3-4-3-3	Silt, little clay, trace gravel, fine to medium, brown, moist, loose. Tip of spoon contains silty sand, fine, wet.
5	7	0.6	2-3-10-6	Silt, sand, fine, trace clay, trace gravel, fine to medium, brown, wet, loose.
7	9	1.1	5-11-23-28	Upper 0.9 ft.: Sand, fine to coarse, trace silt, trace clay, occassional gravel, fine to medium, brown, wet, loose.

Boring/Well Designation TB-19
Geologic/Drilling Activity Log

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
7	9	Continued		Lower 0.2 ft.: Till, silt, little clay, trace snad, fine to coarse, trace gravel, fine, brown, moist, medium dense.
9	11	1.5	21-56-60-100/3	Till, silt, trace clay, trace sand, fine to coarse, trace gravel, fine to coarse, subrounded to subangular, brown, moist to dry, medium dense.
11	13	1.7	50-77-73-85	Till, silt,little sand, fine to coarse, trace gravel, fine, subangular, trace clay, green-brown, dry, dense.
13	15	1.7	22-32-82-56	Upper 1.1 ft.: Till, silt, trace clay, trace gravel, fine, brown, wet, soft. Lower 0.6 ft.: Till, silt, little sand, fine to coarse, trace clay, trace gravel, fine to medium, lenses of sand, fine, green-brown, dense.
15	17	1.6	53-57-100/4	Till, silt, little clay, trace sand, fine to medium, trace gravel, fine, with lenses of sand, green-brown, moist to wet, medium dense to dense.
17	19	1.5	60-66-100/3	Till, silt, trace sand, fine, trace clay, trace gravel, fine to medium, with lenses of silty sand, green-brown, moist to wet, medium dense.

Boring/Well Designation TB-19
Geologic/Drilling Activity Log

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
19	21	1.0	76-100/4.5	Till, silty sand, fine, trace clay, trace sand, fine to coarse, trace gravel, fine to medium, subrounded, green-brown, medium dense, moist.
21	23	0.4	100/3	Till, silty sand, fine, trace clay, trace sand, fine to coarse, trace gravel, fine to medium, subrounded, green-brown, medium dense, moist.
23	25	0.9	69-100/4.5	Till, silt, little sand, fine to coarse, little clay, little gravel, fine to coarse, green-brown, moist, dense.

Geologic/Drilling Activity Log

Project _____BIGV/BPM__ Date __12/1/93__

Location _____Baldwin Place Mall______________________

Boring/Well Designation _____TB-20___________________

Land Surface Elevation ________Estimated _____Surveyed

Drilling Method ___Tripod________________________

Drilling Fluid ____None___________________________

Sampling Method __Split Spoon 2ft. long/Grab_____________

Sampling Interval __Continuous______________________

Drilling Contractor __Samuel Stothoff________________

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
0	2	1.1		Silt, trace clay, trace sand, fine to coarse, trace gravel, fine, brown, moist, loose.
2	4	1.5		Silty clay, trace sand, fine to coarse, trace gravel, fine, brown, moist, soft.
4	6	1.6		Upper 0.3 ft.: Silty clay, trace sand, fine to coarse, trace gravel, fine, wet, soft. Lower 1.3 ft.: Till, silt, litle sand, fine to coarse, little gravel, fine to coarse, brown, medium dense, moist.
6	8	1.2	8-16-52-25	Till, silt, little sand, fine to coarse, trace gravel, fine, trace clay, brown, moist, dense.

Boring/Well Designation TB-20
Geologic/Drilling Activity Log

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
8	10	1.7	15-33-53-57	Till, silt, little clay, little sand, fine to coarse, little gravel, fine to medium, angular, green-brown, moist, dense.
				Note: Sounded hole at 9 feet and decided to take a spoon from 9 to 11 feet.
9	11	0	100/5	No recovery.

Project ______BIGV/BPM__ Date __12/1/93__

Location ______Baldwin Place Mall________________________

Boring/Well Designation ______TB-21_________________

Land Surface Elevation _________Estimated ______Surveyed

Drilling Method ____Tripod______________________

Drilling Fluid _____None________________________

Sampling Method __Split Spoon 2ft. long/Grab_____________

Sampling Interval __Continuous______________________

Drilling Contractor __Samuel Stothoff________________

From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
0	2	1.0	6-5-8-7	Till, silt, little clay, little sand, fine to medium, trace gravel, fine to medium, brown, wet soft.
2	4	1.0	6-9-10-8	Till, clayey silt, trace sand, fine, trace gravel, fine to medium, with lenses of sand, fine to coarse, brown, wet, soft.
4	6	1.2	15-34-70-45	Till, silt, little sand, fine to coarse, little gravel, fine to medium, angular, trace clay, green-brown, moist, dense.
6	8	0	19-30-50-100	No recovery.
6	8	0	100/5.5	Attempted another spoon at this interval; refusal. No recovery.

Geologic/Drilling Activity Log

Project _____BIGV/BPM__ Date __12/2/93__

Location _____Baldwin Place Mall______________________

Boring/Well Designation _____TB-22_________________

Land Surface Elevation ________Estimated _____Surveyed

Drilling Method ___Tripod______________________

Drilling Fluid _____None________________________

Sampling Method __Split Spoon 2ft. long/Grab_____________

Sampling Interval __Continuous______________________

Drilling Contractor __Samuel Stothoff________________

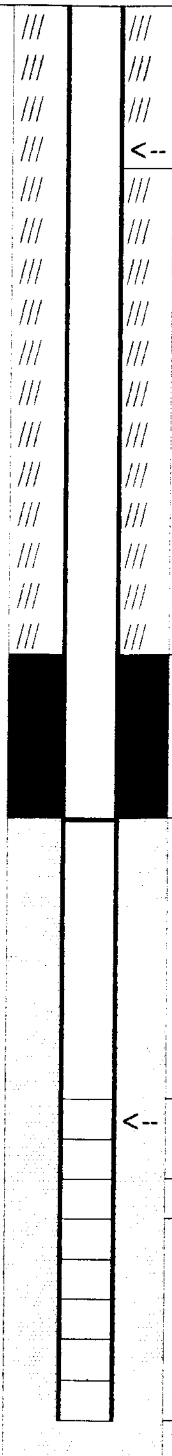
From (ft)	To (ft)	Sample Recovery (ft)	Time/Hydraulic Pressure or Blow Counts per 6-inch interval	Sample Description
1	3	1.6	3-4-5-7	Silty clay, little gravel, fine to medium, brown, moist, soft.
3	5	0.6	7-9-8-9	Silty clay, little gravel, fine to medium, brown, moist, soft.
5	7	0.2	121/6	Silty clay, trace gravel, fine, lenses of sand, fine to medium, brown, moist, soft.
5.5	7.5	0.4	300-47/18	Silty clay, trace gravel, fine, lenses of sand, fine to medium, brown, moist, soft. Refusal.

APPENDIX O.2

MONITORING WELL CONSTRUCTION DIAGRAMS

UNCONSOLIDATED WELL CONSTRUCTION LOG

LAND SURFACE



8 inch diameter drilled hole

<-- Well casing
4 inch diameter
Stainless steel

☐ Backfill
☑ Grout 0-1 ft

1 ft

Bentonite ☐ slurry ☑ pellets

2 ft

4 ft

<-- Well Screen
4 inch diameter
Stainless steel
20 slot

☑ Sand Pack #0

14 ft

14 ft

Project: BIG V/BPM Well: MW-11S
Town/City: Baldwin Place
County: Westchester State: NY
Permit No.: N/A
Land-Surface Elevation and Datum: 603.33 feet (amsl) ☑ Surveyed ☐ Estimated

Installation Dates: November 18, 1993
Drilling Method: Hollow Stem Auger
Drilling Contractor: Samuel Stothoff
Drilling Fluid: None

Development Technique and Date: Bailer & Centrifugal pump 11-29-93

Fluid Loss During Drilling: N/A
Water Removed During Development: ~100 Gallons
Static Depth to Water: 2.85 ft. bmp
Pumping Depth to Water:
Pumping Duration:
Average Yield: 2 gpm
Specific Capacity:
Well Purpose: Monitoring Groundwater Quality

Remarks: amsl = above mean sea level
bmp = below measuring point
(top of 4-inch diameter steel casing)
gpm = gallons per minute

*Note: Flush mount cover installed.

Prepared By: J. Gomez

UNCONSOLIDATED WELL CONSTRUCTION LOG

Project	BIG V/BPM	Well	MW-11D
Town/City	Baldwin Place		
County	Westchester	State	NY
Permit No.:	N/A		
Land-Surface Elevation and Datum	603.23 feet (amsl)	☑ Surveyed ☐ Estimated	

Installation Dates: November 15-18, 1993
Drilling Method: Auger to 14 feet/Wet Rotary
Drilling Contractor: Samuel Stothoff
Drilling Fluid: Water

Development Technique and Date: Bailer 11-29-93

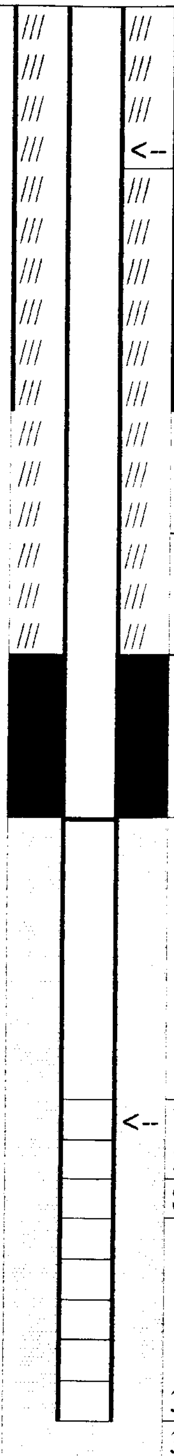
Fluid Loss During Drilling: N/A
Water Removed During Development: ~25 Gallons
Static Depth to Water: 3.45 ft. bmp
Pumping Depth to Water:
Pumping Duration:
Average Yield:
Specific Capacity:
Well Purpose: Monitoring Groundwater Quality

Remarks: amsl = above mean sea level
bmp = below measuring point
(top of 2-inch diameter steel casing)
gpm = gallons per minute

*Note: Flush mount cover installed.
Six-inch Protective casing grouted in
12-inch borehole to 14 feet bgs.

Prepared By: J. Gomez

LAND SURFACE



12 inch diameter drilled hole to 14 ft. bgs
<-- Well casing
2 inch diameter
Stainless steel

☐ Backfill
☑ Grout 0-14 ft
<-14 ft 6-inch Protective casing

6 inch diameter drilled hole

17 ft

Bentonite ☐ slurry ☑ pellets
19 ft

22 ft
<-- Well Screen
2 inch diameter
Stainless steel
20 slot

☑ Sand Pack #0

32 ft
32 ft

APPENDIX P

SOURCE AREA ADDITIONAL DATA COLLECTION PROGRAM
SOIL AND GROUNDWATER SAMPLES DATA REPORTS
(ENVIROTEST LABORATORIES)

APPENDIX P

SOURCE AREA ADDITIONAL DATA COLLECTION PROGRAM SOIL AND GROUNDWATER SAMPLES DATA REPORTS

P.1 SOURCE AREA TEST BORING SOIL SAMPLES
(Collected November 15-19 and November 30 - December 2, 1993).

P.2 SOURCE AREA MONITORING WELL SAMPLES
(Collected December 22, 1993).

APPENDIX P.1

SOURCE AREA TEST BORING SOIL SAMPLES
(Collected November 15 - 19 and November 30 - December 2, 1993)

ANALYTICAL REPORT

Vincent Uhl Associates, Inc.
Jackie Baron
1078 Taylorsville Road
Po Box 93
Washington Crossin PA 18977

Report Date:	10-JAN-94
Project:	STANDARD
Lab Number:	130377
Sample Number(s):	130377-01
	to
	130377-05

Ronald A. Bayer
Laboratory Director

EnviroTest
Laboratories Inc.

315 Fullerton Avenue
Newburgh, NY 12550
(914) 562-0890
FAX (914) 562-0841

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID: BPM-TB-16(6-8FT.)

ETL Sample Number: 130377-01

Client Name: Vincent Uhl Associates,Inc.

Project Name: STANDARD

% Solid: 91.2

Matrix: 3 Soil/Sldg

Sample Wt/Vol: 10000ul

Level: MED

Date Collected: 15-NOV-93

Date Received: 16-NOV-93

Date Extracted:

Date Analyzed: 20-NOV-93

Report Date: 10-JAN-94

Column: RTX-502.2

Lab File Id:

Dilution Factor: 1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	11000		U
79-01-6	Trichloroethene	11000		U
127-18-4	Tetrachloroethene	11000	130000	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(8-10FT)	Date Collected:	15-NOV-93
ETL Sample Number:	130377-02	Date Received:	16-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	22-NOV-93
% Solid:	90.7	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	1g	Lab File Id:	
Level:	LOW	Dilution Factor:	5.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	5.5		U
79-01-6	Trichloroethene	5.5	7.9	
127-18-4	Tetrachloroethene	5.5	160	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(10-10.7)	Date Collected:	15-NOV-93
ETL Sample Number:	130377-03	Date Received:	16-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	20-NOV-93
% Solid:	89.5	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	RTX-502.2
Sample Wt/Vol:	10000UL	Lab File Id:	
Level:	MED	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	11000		U
79-01-6	Trichloroethene	11000		U
127-18-4	Tetrachloroethene	11000	500000	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(12-13)	Date Collected:	15-NOV-93
ETL Sample Number:	130377-04	Date Received:	16-NOV-93
Client Name:	Vincent Uhl Associates, Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	20-NOV-93
% Solid:	89.4	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	RTX-502.2
Sample Wt/Vol:	10000UL	Lab File Id:	
Level:	MED	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	11000		U
79-01-6	Trichloroethene	11000		U
127-18-4	Tetrachloroethene	11000	270000	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(14-15)	Date Collected:	15-NOV-93
ETL Sample Number:	130377-05	Date Received:	16-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	20-NOV-93
% Solid:	86.3	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	RTX-502.2
Sample Wt/Vol:	10000UL	Lab File Id:	
Level:	MED	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	120000		U
79-01-6	Trichloroethene	120000		U
127-18-4	Tetrachloroethene	120000	1300000	

EnviroTest Laboratories Inc.

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ANALYTICAL REPORT

Vincent Uhl Associates,Inc.
Jackie Baron
1078 Taylorsville Road
Po Box 93
Washington Crossin PA 18977

Report Date:	22-DEC-93
Project:	STANDARD
Lab Number:	130423
Sample Number(s):	130423-01
	to
	130423-04

Ronald A. Bayer
Laboratory Director

EnviroTest Laboratories Inc.
315 Fullerton Avenue
Newburgh, NY 12550
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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(16-18 FT.)	Date Collected:	16-NOV-93
ETL Sample Number:	130423-01	Date Received:	17-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	22-NOV-93
% Solid:	90.0	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	3.1	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(18-20 FT.)	Date Collected:	16-NOV-93
ETL Sample Number:	130423-02	Date Received:	17-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	22-NOV-93
% Solid:	88.2	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	6.2	

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(22-24 FT.)	Date Collected:	16-NOV-93
ETL Sample Number:	130423-03	Date Received:	17-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	22-NOV-93
% Solid:	90.5	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	1.2	

A N A L Y T I C A L   R E P O R T

Vincent Uhl Associates,Inc.
Jackie Baron
1078 Taylorsville Road
Po Box 93
Washington Crossin PA 18977

Report Date:	22-DEC-93
Project:	STANDARD
Lab Number:	130485
Sample Number(s):	130485-01
	to
	130485-03

Ronald A. Bayer PC
Laboratory Director

EnviroTest Laboratories Inc.
315 Fullerton Avenue
Newburgh, NY 12550
(914) 562-0890
FAX (914) 562-0841

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(26'-28')	Date Collected:	17-NOV-93
ETL Sample Number:	130485-01	Date Received:	18-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	23-NOV-93
% Solid:	88.8	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	5.9	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(30'-32')	Date Collected:	17-NOV-93
ETL Sample Number:	130485-02	Date Received:	18-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	24-NOV-93
% Solid:	90.4	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	1g	Lab File Id:	
Level:	LOW	Dilution Factor:	5.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	5.5		U
79-01-6	Trichloroethene	5.5		U
127-18-4	Tetrachloroethene	5.5	250	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-16(32'-34')	Date Collected:	17-NOV-93
ETL Sample Number:	130485-03	Date Received:	18-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	23-NOV-93
% Solid:	88.9	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit	Conc.	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	3.1	U

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ANALYTICAL REPORT

Vincent Uhl Associates, Inc.
Jackie Baron
1078 Taylorsville Road
Po Box 93
Washington Crossin PA 18977

Report Date:	22-DEC-93
Project:	STANDARD
Lab Number:	130591
Sample Number(s):	130591-01
	to
	130591-10

Ronald A. Bayer
Laboratory Director
PC

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(1'-2')	Date Collected:	18-NOV-93
ETL Sample Number:	130591-01	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	24-NOV-93
% Solid:	91.6	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	1% SP-1000
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1	1.1	
127-18-4	Tetrachloroethene	1.1	130	

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THERMO ANALYTICAL, INC./ERG
525 Avis Drive, Suite 7
Ann Arbor, Michigan 48108

Phone: (313) 662-3104

ENVIROTEST LABORATORIES
315 FULLERTON AVE.
NEWBURGH, NY. 12550

Attn: RICHARD BAYER

Purchase Order: 5766
Invoice Number:

Order #: E3-11-311
Date: 12/15/93 09:31
Work ID: NOVEMBER
Date Received: 11/30/93
Date Completed: 12/14/93

Client Code: ENVIROTEST

SAMPLE IDENTIFICATION

Sample Number	Sample Description	Sample Number	Sample Description
01	130591-01	02	130591-02

SR=See attached report ND=Nondetected, detection limit is in () (=Compound or element was not detected at or above specified detection limit in () N/A=Not applicable *=Average of duplicate runs.

Barbara Simpson
Certified By

Sample: 01A 130591-01 Collected:

Test Description	Result	Limit	Units	Analyzed	By
TOTAL ORGANIC CARBON	2400*		mg/Kg	12/13/93	CP

Sample: 02A 130591-02 Collected:

Test Description	Result	Limit	Units	Analyzed	By
TOTAL ORGANIC CARBON	1400		mg/Kg	12/13/93	CP

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(2'-4')	Date Collected:	18-NOV-93
ETL Sample Number:	130591-02	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	23-NOV-93
% Solid:	89.5	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	1% SP-1000
Sample Wt/Vol:	1g	Lab File Id:	
Level:	LOW	Dilution Factor:	5.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	5.6		U
79-01-6	Trichloroethene	5.6		U
127-18-4	Tetrachloroethene	5.6	160	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(8'-10')	Date Collected:	18-NOV-93
ETL Sample Number:	130591-03	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	24-NOV-93
Project Name:	STANDARD	Date Analyzed:	
% Solid:	89.0	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	10000UL	Lab File Id:	
Level:	MED	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1100		U
79-01-6	Trichloroethene	1100		U
127-18-4	Tetrachloroethene	1100	43000	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(14'-16')	Date Collected:	18-NOV-93
ETL Sample Number:	130591-04	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	24-NOV-93
% Solid:	89.9	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	1% SP-1000
Sample Wt/Vol:	1.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	5.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	5.6		U
79-01-6	Trichloroethene	5.6		U
127-18-4	Tetrachloroethene	5.6	190	U

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(16'-18')	Date Collected:	19-NOV-93
ETL Sample Number:	130591-05	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	24-NOV-93
% Solid:	88.8	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	1% SP-1000
Sample Wt/Vol:	0.5g	Lab File Id:	
Level:	LOW	Dilution Factor:	10.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	11		U
79-01-6	Trichloroethene	11		U
127-18-4	Tetrachloroethene	11	2200	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(18'-20')	Date Collected:	19-NOV-93
ETL Sample Number:	130591-06	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	24-NOV-93
% Solid:	89.3	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	10000UL	Lab File Id:	
Level:	MED	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1100		U
79-01-6	Trichloroethene	1100		U
127-18-4	Tetrachloroethene	1100	1700	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(20'-22')	Date Collected:	19-NOV-93
ETL Sample Number:	130591-07	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	24-NOV-93
% Solid:	88.7	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	10000UL	Lab File Id:	
Level:	MED	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	230		U
79-01-6	Trichloroethene	230		U
127-18-4	Tetrachloroethene	230	6100	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(24'-26')	Date Collected:	19-NOV-93
ETL Sample Number:	130591-08	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates, Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	23-NOV-93
% Solid:	91.0	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	1% SP-1000
Sample Wt/Vol:	5.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	40	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(28'-30')	Date Collected:	19-NOV-93
ETL Sample Number:	130591-09	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	23-NOV-93
% Solid:	91.8	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	1% SP-1000
Sample Wt/Vol:	5.0 g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	40	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-17(FB)	Date Collected:	19-NOV-93
ETL Sample Number:	130591-10	Date Received:	19-NOV-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	01-DEC-93
% Solid:	NA	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5.0ml	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/l	Conc. ug/l	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1		U
79-01-6	Trichloroethene	1		U
127-18-4	Tetrachloroethene	1		U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK20
Client ID: VBLK20
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 11/20/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK22
Client ID: VBLK22
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 11/22/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK23
Client ID: VBLK23
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 11/23/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK24
Client ID: VBLK24
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 11/24/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK01
Client ID: VBLK01
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 12/1/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLKA1
Client ID: VBLKA1
Project Name: Baldwin Place Mall
Instrument ID: MS1
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 11/22/93
Report Date: 12/16/93
Level: Low
Column: 1%SP1000 CarbopackB
Lab File ID: V5934
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLKA2
Client ID: VBLKA2
Project Name: Baldwin Place Mall
Instrument ID: MS1
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 11/23/93
Report Date: 12/16/93
Level: Low
Column: 1%SP1000 Carbopack B
Lab File ID: V5948
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLKA3
Client ID: VBLKA3
Project Name: Baldwin Place Mall
Instrument ID: MS1
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 11/24/93
Report Date: 12/16/93
Level: Low
Column: 1%SP1000 CarbopackB
Lab File ID: V5960
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

CASE NARRATIVE
Client: Vincent Uhl Associates
Date 12/22/93
ETL Lab No. 130377, 130423, 130485, 130591

Volatile Organics

Sample Dilutions

The following samples were methanol diluted at the indicated amount due to compounds that exceeded the linear calibration range:

BPM-TB-16(6-8ft) (130377-01): 10000x
BPM-TB-16(10-10.7) (130377-03): 10000x
BPM-TB-16(12-13) (130377-04): 10000x
BPM-TB-16(14-15) (130377-05): 100000x
(130591-03): 1000x
(130591-06): 1000x
(130591-07): 200x

The following samples were diluted at the indicated amount due to compounds that exceeded the linear calibration range:

BPM-TB-17(2-4') (130591-02): 5x
BPM-TB-17(14-16') (130591-04): 5x
BPM-TB-17(16-18') (130591-05): 10x
BPM-TB-16(8-10') (130377-02): 5x
BPM-TB-16(30-32') (130485-02): 5x

Holding Time

The following sample was analyzed 3 days out of the acceptable holding time:

BPM-TB-17(FB) (130591-10)

Method Analysis

As per the chain of custody, the samples were analyzed for total-1,2-dichloroethene, trichloroethene, and tetrachloroethene.

Other

Due to a laboratory oversight, sample number BPM-TB-16FB (130423-04) was not analyzed. A review of the sample batching procedure has been conducted with the appropriate laboratory personnel.

VOLATILE SURROGATE RECOVERY

Client: Vincent Uhl Associates

Lab Numbers: 130337 130423 130485 130591

Laboratory: EnviroTest Labs

ETL SAMPLE NO.	S1 (BCM)	S2 (BCP)	S3 (BFB)
Blank	83		78
130337-01	83		80
130337-03	69		80
130337-04	88		85
130337-05	88		85
Blank		99	108
130423-01		97	97
130423-02		95	94
130423-03		77	76
Blank		87	90
130485-01		95	100
130485-03		91	87
Blank		91	98
130591-03		99	112
130591-06		71	71
130591-07		102	105
Blank		88	88
130591-10		98	97

		QC LIMITS
S1 (BCP)	= Bromochloromethane	(61-129)
S2 (BCP)	= 2-Bromo-1-chloropropane	(62-130)
S3 (BFB)	= 4-Bromofluorobenzene	(62-139)

VOLATILE SURROGATE RECOVERY

Client: Vincent Uhl Associates　　Lab Numbers: 130377
130485
130591

Laboratory: EnviroTest Labs

	ETL LAB NO.	S1 (TOL)#	S2 (BFB)#	S3 (DCE)#	OTHER	TOT OUT
01	Blank	101	98	98		0
02	130377-02	126	74	105		0
03						
04	Blank	100	102	101		0
05	130591-08	134	71	97		0
06	130591-09	132	71	99		0
07						
08	Blank	99	102	100		0
09	130591-01	126	74	102		0
10	130591-04	98	100	107		0
11	130591-05	79	100	99		0
12						
13	130485-02	129	72	101		0
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

	QC LIMITS
S1 (TOL) = Toluene-d8	(84-138)
S2 (BFB) = Bromofluorobenzene	(59-113)
S3 (DCE) = 1,2-Dichloroethane-d4	(70-121)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D Surrogates diluted out

3B

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Client Name: Vincent Uhl Associates   Project Name: Baldwin Place Mall

Lab Name: Envirotest Labs Inc.

Matrix Spike - ETL Sample No.: 130605

COMPOUND	SPIKE ADDED (ug/kg)	SAMPLE CONCENTRATION (ug/kg)	MS CONCENTRATION (ug/kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	54.70	00.00	64.28	118	59-172
Trichloroethene	54.70	00.00	60.43	110	62-137
Benzene	54.70	00.00	60.03	110	66-142
Toluene	54.70	00.00	63.73	117	59-139
Chlorobenzene	54.70	00.00	61.33	112	60-133

COMPOUND	SPIKE ADDED (ug/kg)	MSD CONCENTRATION (ug/kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	54.70	58.69	107	9.8	22	59-172
Trichloroethene	54.70	57.00	104	5.6	24	62-137
Benzene	54.70	56.21	103	6.6	21	66-142
Toluene	54.70	63.49	116	0.9	21	59-139
Chlorobenzene	54.70	54.85	100	11.3	21	60-133

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of qc limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

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A N A L Y T I C A L   R E P O R T

Vincent Uhl Associates, Inc.
Jackie Baron
1078 Taylorsville Road
Po Box 93
Washington Crossin PA 18977

Report Date:	22-DEC-93
Project:	STANDARD
Lab Number:	130884
Sample Number(s):	130884-01
	to
	130884-05

Ronald A. Bayer
Laboratory Director

EnviroTest Laboratories Inc.

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-19(1'-3')	Date Collected:	30-NOV-93
ETL Sample Number:	130884-01	Date Received:	01-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	03-DEC-93
% Solid:	90.1	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1		U

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FAX (914) 562-0841

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID: BPM-TB-19(7'-9')
ETL Sample Number: 130884-02
Client Name: Vincent Uhl Associates, Inc.
Project Name: STANDARD
% Solid: 86.5
Matrix: 3 Soil/Sldg
Sample Wt/Vol: 5g
Level: LOW

Date Collected: 30-NOV-93
Date Received: 01-DEC-93
Date Extracted:
Date Analyzed: 03-DEC-93
Report Date: 22-DEC-93
Column: DB-624
Lab File Id:
Dilution Factor: 1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.2		U
79-01-6	Trichloroethene	1.2		U
127-18-4	Tetrachloroethene	1.2	2.1	

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THERMO ANALYTICAL, INC./ERG
525 Avis Drive, Suite 7
Ann Arbor, Michigan 48108

Phone: (313) 662-3104

ENVIROTEST LABORATORIES
315 FULLERTON AVE.
NEWBURGH, NY. 12550

Attn: RICHARD BAYER

Purchase Order: 5777
Invoice Number:

Order #: E3-12-019
Date: 12/15/93 09:31
Work ID: DECEMBER
Date Received: 12/02/93
Date Completed: 12/14/93

Client Code: ENVIROTEST

SAMPLE IDENTIFICATION

Sample Number	Sample Description	Sample Number	Sample Description
01	130884-01		

SR=See attached report ND=Nondetected, detection limit is in () <=Compound or element was not detected at or above specified detection limit in () N/A=Not applicable *=Average of duplicate runs.

Barbara Semon
Certified By

Sample: 01A 130884-01 Collected:

Test Description	Result	Limit	Units	Analyzed	By
TOTAL ORGANIC CARBON	2000		mg/Kg	12/13/93	CP

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-19(13'-15')	Date Collected:	30-NOV-93
ETL Sample Number:	130884-03	Date Received:	01-DEC-93
Client Name:	Vincent Uhl Associates, Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	03-DEC-93
% Solid:	91.5	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1		U

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-19(19'-21')	Date Collected:	30-NOV-93
ETL Sample Number:	130884-04	Date Received:	01-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	03-DEC-93
% Solid:	90.5	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1		U

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-19(23'-25')	Date Collected:	30-NOV-93
ETL Sample Number:	130884-05	Date Received:	01-DEC-93
Client Name:	Vincent Uhl Associates, Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	03-DEC-93
% Solid:	91.2	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1		U

EnviroTest Laboratories Inc.

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ANALYTICAL REPORT

Vincent Uhl Associates,inc.
Jackie Baron
1078 Taylorsville Road
Po Box 93
Washington Crossin PA 18977

Report Date:	22-DEC-93
Project:	STANDARD
Lab Number:	131020
Sample Number(s):	131020-01
	to
	131020-11

Ronald A. Bayer
Laboratory Director

EnviroTest Laboratories Inc.
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Newburgh, NY 12550
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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-18(0-2')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-01	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	08-DEC-93
% Solid:	92.2	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1		U

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525 Avis Drive, Suite 7
Ann Arbor, Michigan 48108

Phone: (313) 662-3104

ENVIROTEST LABORATORIES
315 FULLERTON AVE.
NEWBURGH, NY. 12550

Attn: RICHARD BAYER

Purchase Order: 5781
Invoice Number:

Order #: E3-12-056
Date: 12/15/93 09:30
Work ID: DECEMBER
Date Received: 12/07/93
Date Completed: 12/14/93

Client Code: ENVIROTEST

SAMPLE IDENTIFICATION

Sample Number	Sample Description	Sample Number	Sample Description
01	131020-01		

SR=See attached report ND=Nondetected, detection limit is in () <=Compound or element was not detected at or above specified detection limit in () N/A=Not applicable *=Average of duplicate runs.

Barbara Jensen
Certified By

Sample: 01A 131020-01 Collected:

Test Description	Result	Limit	Units	Analyzed	By
TOTAL ORGANIC CARBON	900		mg/Kg	12/13/93	CP

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-18(6-8')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-02	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	08-DEC-93
% Solid:	90.2	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	1.8	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-18(10-12')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-03	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	09-DEC-93
% Solid:	92.4	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1		U

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-18(12-14')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-04	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	09-DEC-93
% Solid:	93.5	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	2.2	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-18(14-16')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-05	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	09-DEC-93
% Solid:	90.3	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	7.2	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-18(16-18')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-06	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	09-DEC-93
% Solid:	91.5	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	34	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-18(20-22')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-07	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates, Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	09-DEC-93
% Solid:	89.4	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	6.6	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-22(1-3')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-08	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates, Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	09-DEC-93
% Solid:	87.7	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	12	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-22(3-5')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-09	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	10-DEC-93
% Solid:	88.9	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	1.2	

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-22(5-7')	Date Collected:	02-DEC-93
ETL Sample Number:	131020-10	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	10-DEC-93
% Solid:	89.1	Report Date:	22-DEC-93
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	3	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-22FB	Date Collected:	02-DEC-93
ETL Sample Number:	131020-11	Date Received:	03-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	07-DEC-93
% Solid:	NA	Report Date:	22-DEC-93
Matrix:	2 GW/WW	Column:	DB-624
Sample Wt/Vol:	5ml	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/l	Conc. ug/l	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1		U
79-01-6	Trichloroethene	1		U
127-18-4	Tetrachloroethene	1		U

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ANALYTICAL REPORT

Vincent Uhl Associates, Inc.
Jackie Baron
1078 Taylorsville Road
Po Box 93
Washington Crossin PA 18977

Report Date:	10-JAN-94
Project:	STANDARD
Lab Number:	130939
Sample Number(s):	130939-01
	to
	130939-09

Ronald A. Bayer
Laboratory Director

EnviroTest Laboratories Inc.
315 Fullerton Avenue
Newburgh, NY 12550
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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-20(0-2')	Date Collected:	01-DEC-93
ETL Sample Number:	130939-01	Date Received:	02-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	06-DEC-93
% Solid:	88.9	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1		U

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-20(2-4')	Date Collected:	01-DEC-93
ETL Sample Number:	130939-02	Date Received:	02-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	06-DEC-93
% Solid:	87.9	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	2.3	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-20-(4-6')	Date Collected:	01-DEC-93
ETL Sample Number:	130939-03	Date Received:	02-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	06-DEC-93
% Solid:	89.2	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	4.7	

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-20(6-8')	Date Collected:	01-DEC-93
ETL Sample Number:	130939-04	Date Received:	02-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	07-DEC-93
% Solid:	87.4	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	8.2	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-20(8-10')	Date Collected:	01-DEC-93
ETL Sample Number:	130939-05	Date Received:	02-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	07-DEC-93
% Solid:	90.2	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1	4.4	

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-21(0-2')	Date Collected:	01-DEC-93
ETL Sample Number:	130939-06	Date Received:	02-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	08-DEC-93
% Solid:	88.0	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1		U

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-21(2-4')	Date Collected:	01-DEC-93
ETL Sample Number:	130939-07	Date Received:	02-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	08-DEC-93
% Solid:	86.8	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.2		U
79-01-6	Trichloroethene	1.2		U
127-18-4	Tetrachloroethene	1.2		U

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-21(4-6')	Date Collected:	01-DEC-93
ETL Sample Number:	130939-08	Date Received:	02-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	08-DEC-93
% Solid:	88.6	Report Date:	10-JAN-94
Matrix:	3 Soil/Sldg	Column:	DB-624
Sample Wt/Vol:	5.0g	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/kg	Conc. ug/kg	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1.1		U
79-01-6	Trichloroethene	1.1		U
127-18-4	Tetrachloroethene	1.1		U

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-TB-20FB	Date Collected:	01-DEC-93
ETL Sample Number:	130939-09	Date Received:	02-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	07-DEC-93
% Solid:	NA	Report Date:	10-JAN-94
Matrix:	2 GW/WW	Column:	DB-624
Sample Wt/Vol:	5.0ml	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/l	Conc. ug/l	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1		U
79-01-6	Trichloroethene	1		U
127-18-4	Tetrachloroethene	1		U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK03
Client ID: VBLK03
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 12/3/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK06
Client ID: VBLK06
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 12/6/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK07
Client ID: VBLK07
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 12/7/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK08
Client ID: VBLK08
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 12/8/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK09
Client ID: VBLK09
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 12/9/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK10
Client ID: VBLK10
Project Name: Baldwin Place Mall
Instrument ID: Varian 3700
% Solid:
Matrix: Soil
Sample Wt/vol: 5.0g

Date Collected:
Date Received:
Date Analyzed: 12/10/93
Report Date: 12/16/93
Level: Low
Column: DB-624
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/kg	Conc. ug/kg
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

CASE NARRATIVE
Client: Vincent Uhl Associates
Date 12/22/93
ETL Lab No. 130884, 130939, 131020

Volatile Organics

Method Analytes

As per the chain of custody, the samples were analyzed for total-1,2-dichloroethene, trichloroethene, and tetrachloroethene.

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VOLATILE SURROGATE RECOVERY

Client: Vincent Uhl Associates   Lab Numbers: 130884
130939
131020

Laboratory: EnviroTest Labs

ETL SAMPLE NO.	S1 (BCM)	S2 (BCP)	S3 (BFB)
Blank		94	97
130884-01		86	77
130884-02		76	62
130884-03		72	73
130884-04		96	97
130884-05		104	94
Blank		92	92
130939-01		83	80
130939-02		95	99
130939-03		94	99
Blank		89	86
130939-04		92	89
130939-05		88	89
130939-09		100	103
131020-11		103	109
Blank		95	105
130939-06		94	87
130939-07		88	91
130939-08		77	78
131020-01		82	84
131020-02		83	80
Blank		83	87
131020-03		84	87
131020-04		83	84
131020-05		81	83
131020-06		78	72
131020-07		87	86
131020-08		88	62
Blank		92	93
131020-09		86	89
131020-10		85	81

		QC LIMITS
S1 (BCP)	= Bromochloromethane	(61-129)
S2 (BCP)	= 2-Bromo-1-chloropropane	(62-130)
S3 (BFB)	= 4-Bromofluorobenzene	(62-139)

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SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Client Name: Vincent Uhl Project Name: Baldwin Place

Lab Name: Envirotest Labs Inc.

Matrix Spike - ETL Sample No.: 130939-02

COMPOUND	SPIKE ADDED (ug/kg)	SAMPLE CONCENTRATION (ug/kg)	MS CONCENTRATION (ug/kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	11.38	00.00	11.38	100	28-167
Trichloroethene	11.38	00.00	11.60	102	35-146
Methylene chloride	11.38	00.00	10.81	95	25-162
Tetrachloroethene	11.38	2.3	13.06	115	26-152
Chlorobenzene	11.38	00.00	12.51	110	38-150

COMPOUND	SPIKE ADDED (ug/kg)	MSD CONCENTRATION (ug/kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	11.38	10.13	89	11.6	41	28-167
Trichloroethene	11.38	10.24	90	12.5	28	35-146
Methylene chloride	11.38	8.99	79	18.4	27	25-162
Tetrachloroethene	11.38	10.78	95	19.0	35	26-152
Chlorobenzene	11.38	11.60	102	7.5	32	38-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of qc limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

FORM III VOA-1 3/90

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Client Name: Vincent Uhl Project Name: Baldwin Place

Lab Name: Envirotest Labs Inc.

Matrix Spike - ETL Sample No.: 131020-10

COMPOUND	SPIKE ADDED (ug/kg)	SAMPLE CONCENTRATION (ug/kg)	MS CONCENTRATION (ug/kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	11.22	00.00	10.44	93	28-167
Trichloroethene	11.22	00.00	9.88	88	35-146
Methylene chloride	11.22	00.00	9.88	88	25-162
Tetrachloroethene	11.22	3.0	11.25	100	26-152
Chlorobenzene	11.22	00.00	11.34	101	38-150

COMPOUND	SPIKE ADDED (ug/kg)	MSD CONCENTRATION (ug/kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	11.22	8.42	75	21.4	41	28-167
Trichloroethene	11.22	8.87	79	10.8	28	35-146
Methylene chloride	11.22	8.42	75	16.0	27	25-162
Tetrachloroethene	11.22	9.35	83	18.6	35	26-152
Chlorobenzene	11.22	9.43	84	18.4	32	38-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of qc limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

FORM III VOA-1 3/90

APPENDIX P.2

SOURCE AREA MONITORING WELL SAMPLES
(Collected December 22, 1993)

ANALYTICAL REPORT

Vincent Uhl Associates, Inc.
Jackie Baron
1078 Taylorsville Road
Po Box 93
Washington Crossin PA 18977

Report Date: 10-JAN-94

Project: STANDARD

Lab Number: 131805

Sample Number(s): 131805-01 to 131805-05

Ronald A. [illegible]
Laboratory Director

EnviroTest Laboratories Inc.
315 Fullerton Avenue
Newburgh, NY 12550
(914) 562-0890
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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-MW-11S	Date Collected:	22-DEC-93
ETL Sample Number:	131805-02	Date Received:	23-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	29-DEC-93
% Solid:	NA	Report Date:	10-JAN-94
Matrix:	2 GW/WW	Column:	RTX-502.2
Sample Wt/Vol:	0.5ml	Lab File Id:	
Level:	LOW	Dilution Factor:	10.00

CAS NO.	Compound	Detection Limit ug/l	Conc. ug/l	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	10		U
79-01-6	Trichloroethene	10	160	
127-18-4	Tetrachloroethene	10	44000	E

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: 131805-02DL
Client ID: BPM-MW-11S
Project Name: BPM
Instrument ID: Varian 3400
% Solid:
Matrix: Water
Sample Wt/vol: 0.005ml

Date Collected: 12/22/93
Date Received: 12/23/93
Date Analyzed: 12/30/93
Report Date: 1/10/94
Level: Low
Column: Rtx-502.2 0.53mm
Lab File ID:
Dilution Factor: 1000

CAS NO.	COMPOUND	Detection Limit ug/l	Conc. ug/l
540-59-0	1,2-Dichloroethene, total	1000	U
79-01-6	Trichloroethene	1000	U
127-18-4	Tetrachloroethene	1000	24000 D

FORM I VOA

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-MW-11SR	Date Collected:	22-DEC-93
ETL Sample Number:	131805-03	Date Received:	23-DEC-93
Client Name:	Vincent Uhl Associates, Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	29-DEC-93
% Solid:	NA	Report Date:	10-JAN-94
Matrix:	2 GW/WW	Column:	RTX-502.2
Sample Wt/Vol:	0.5ml	Lab File Id:	
Level:	LOW	Dilution Factor:	10.00

CAS NO.	Compound	Detection Limit ug/l	Conc. ug/l	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	10		U
79-01-6	Trichloroethene	10	170	
127-18-4	Tetrachloroethene	10	4800	E

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: 131805-03DL
Client ID: BPM-MW-11SR
Project Name: BPM
Instrument ID: Varian 3400
% Solid:
Matrix: Water
Sample Wt/vol: 0.005ml

Date Collected: 12/22/93
Date Received: 12/23/93
Date Analyzed: 12/30/93
Report Date: 1/10/94
Level: Low
Column: Rtx-502.2 0.53mm
Lab File ID:
Dilution Factor: 1000

CAS NO.	COMPOUND	Detection Limit ug/l	Conc. ug/l
540-59-0	1,2-Dichloroethene, total	1000	U
79-01-6	Trichloroethene	1000	U
127-18-4	Tetrachloroethene	1000	24000 D

FORM I VOA

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Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	BPM-MW-11D	Date Collected:	22-DEC-93
ETL Sample Number:	131805-04	Date Received:	23-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	29-DEC-93
% Solid:	NA	Report Date:	10-JAN-94
Matrix:	2 GW/WW	Column:	RTX-502.2
Sample Wt/Vol:	0.5ml	Lab File Id:	
Level:	LOW	Dilution Factor:	10.00

CAS NO.	Compound	Detection Limit ug/l	Conc. ug/l	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	10		U
79-01-6	Trichloroethene	10	15	
127-18-4	Tetrachloroethene	10	2400	E

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: 131805-04DL
Client ID: BPM-MW-11D
Project Name: BPM
Instrument ID: Varian 3400
% Solid:
Matrix: Water
Sample Wt/vol: 0.025ml

Date Collected: 12/22/93
Date Received: 12/23/93
Date Analyzed: 12/29/93
Report Date: 1/10/94
Level: Low
Column: Rtx-502.2 0.53mm
Lab File ID:
Dilution Factor: 200

CAS NO.	COMPOUND	Detection Limit ug/l	Conc. ug/l
540-59-0	1,2-Dichloroethene, total	200	U
79-01-6	Trichloroethene	200	U
127-18-4	Tetrachloroethene	200	3200 D

FORM I VOA

Volatile Organics Analysis Data Sheet
Form I VOA

Client ID:	TRIP BLANK	Date Collected:	20-DEC-93
ETL Sample Number:	131805-05	Date Received:	23-DEC-93
Client Name:	Vincent Uhl Associates,Inc.	Date Extracted:	
Project Name:	STANDARD	Date Analyzed:	29-DEC-93
% Solid:	NA	Report Date:	10-JAN-94
Matrix:	2 GW/WW	Column:	RTX-502.2
Sample Wt/Vol:	5ml	Lab File Id:	
Level:	LOW	Dilution Factor:	1.00

CAS NO.	Compound	Detection Limit ug/l	Conc. ug/l	Data Qualifier
540-59-0	Total-1,2-Dichloroethene	1		U
79-01-6	Trichloroethene	1		U
127-18-4	Tetrachloroethene	1		U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK28
Client ID: VBLK28
Project Name: BPM
Instrument ID: Varian 3400
% Solid:
Matrix: Water
Sample Wt/vol: 5.0ml

Date Collected:
Date Received:
Date Analyzed: 12/28/93
Report Date: 1/10/94
Level: Low
Column: Rtx-502.2 0.53mm
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/l	Conc. ug/l
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK29
Client ID: VBLK29
Project Name: BPM
Instrument ID: Varian 3400
% Solid:
Matrix: Water
Sample Wt/vol: 5.0ml

Date Collected:
Date Received:
Date Analyzed: 12/29/93
Report Date: 1/10/94
Level: Low
Column: Rtx-502.2 0.53mm
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/l	Conc. ug/l
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Name: Vincent Uhl Associates, Inc.
ETL Sample Number: VBLK30
Client ID: VBLK30
Project Name: BPM
Instrument ID: Varian 3400
% Solid:
Matrix: Water
Sample Wt/vol: 5.0ml

Date Collected:
Date Received:
Date Analyzed: 12/30/93
Report Date: 1/10/94
Level: Low
Column: Rtx-502.2 0.53mm
Lab File ID:
Dilution Factor: 1

CAS NO.	COMPOUND	Detection Limit ug/l	Conc. ug/l
540-59-0	1,2-Dichloroethene, total	1	U
79-01-6	Trichloroethene	1	U
127-18-4	Tetrachloroethene	1	U

FORM I VOA

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VOLATILE SURROGATE RECOVERY

Method 8010

Client Name: Vincent Uhl Associates, Inc.
Lab Numbers: 131805
Level: Low
Laboratory: EnviroTest Laboratories, Inc.

EPA SAMPLE NO.	ETL SAMPLE NO.	S2 (BFB)	S3 (BCM)
VBLK28	VBLK28	93	95
VEPA28	VEPA28	135	111
Trip Blank	131805-05	78	90
BPM-MW-11S	131805-02	95	95
BPM-MW-11SR	131805-03	101	93
BPM-MW-11D	131805-04	89	91

QC LIMITS

S1 (BCP)	=	2-Bromo-1-chloropropane	(62-130)
S2 (BFB)	=	4-Bromofluorobenzene	(62-134)
S3 (BCM)	=	Bromochloromethane	(61-129)

FORM II VOA-1

VOLATILE SURROGATE RECOVERY

Method 8010

Client Name: Vincent Uhl Associates, Inc.
Lab Numbers: 131805
Level: Low
Laboratory: EnviroTest Laboratories, Inc.

EPA SAMPLE NO.	ETL SAMPLE NO.	S2 (BFB)	S3 (BCM)
VBLK29	VBLK29	93	91
BPM-MW-11D	131805-04DL	106	97

QC LIMITS
S1 (BCP) = 2-Bromo-1-chloropropane (62-130)
S2 (BFB) = 4-Bromofluorobenzene (62-134)
S3 (BCM) = Bromochloromethane (61-129)

FORM II VOA-1

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VOLATILE SURROGATE RECOVERY

Method 8010

Client Name: Vincent Uhl Associates, Inc.
Lab Numbers: 131805
Level: Low
Laboratory: EnviroTest Laboratories, Inc.

EPA SAMPLE NO.	ETL SAMPLE NO.	S2 (BFB)	S3 (BCM)
VBLK30	VBLK30	93	96
BPM-Drummed Soil	131805-01	110	101
BPM-MW-11D	131805-04MS	112	116
BPM-MW-11D	131805-04MSD	98	112
BPM-MW-11S	131805-02DL	103	100
BPM-MW-11SR	131805-03DL	101	100
BPM-Drummed Soil	131805-01DL	101	97

QC LIMITS

S1 (BCP) = 2-Bromo-1-chloropropane (62-130)
S2 (BFB) = 4-Bromofluorobenzene (62-134)
S3 (BCM) = Bromochloromethane (61-129)

FORM II VOA-1

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8010

VOLATILE WATER MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Client Name: Vincent Uhl Associates, Inc.

Lab Name: EnviroTest Laboratories Inc.

Matrix Spike ETL Sample:131805-04

Matrix Spike Client Sample ID.:BPM-MW-11D

Date of Analysis: 12/30/93

Instrument ID: Varian 3400

COMPOUND	SPIKE ADDED (ug/l)	SAMPLE CONCENTRATION (ug/l)	MS CONCENTRATION (ug/l)	MS % REC. #	QC LIMITS REC.
1,1-Dichloroethene	2000	U	1740	87.0	28-167
Trichloroethene	2000	U	1920	96.0	35-146
Methylene Chloride	2000	U	1940	97.0	25-162
Tetrachloroethene	2000	3200	5400	110.0	26-162
Chlorobenzene	2000	U	1860	93.0	38-150

COMPOUND	SPIKE ADDED (ug/l)	MSD CONCENTRATION (ug/l)	MSD % REC. #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	2000	1760	88.0	1.14	41	28-167
Trichloroethene	2000	1940	97.0	1.04	28	35-146
Methylene Chloride	2000	1960	98.0	1.03	27	25-162
Tetrachloroethene	2000	5400	110.0	0.00	35	26-162
Chlorobenzene	2000	1920	96.0	3.17	32	38-150

Column to be used to flag recovery and RPD values with an asterisk.
* Values outside of QC limits

RPD:

Spike Recovery:

COMMENTS: ______.
______.

FORM III VOA-1 1/87 Rev.

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Newburgh, NY 12550
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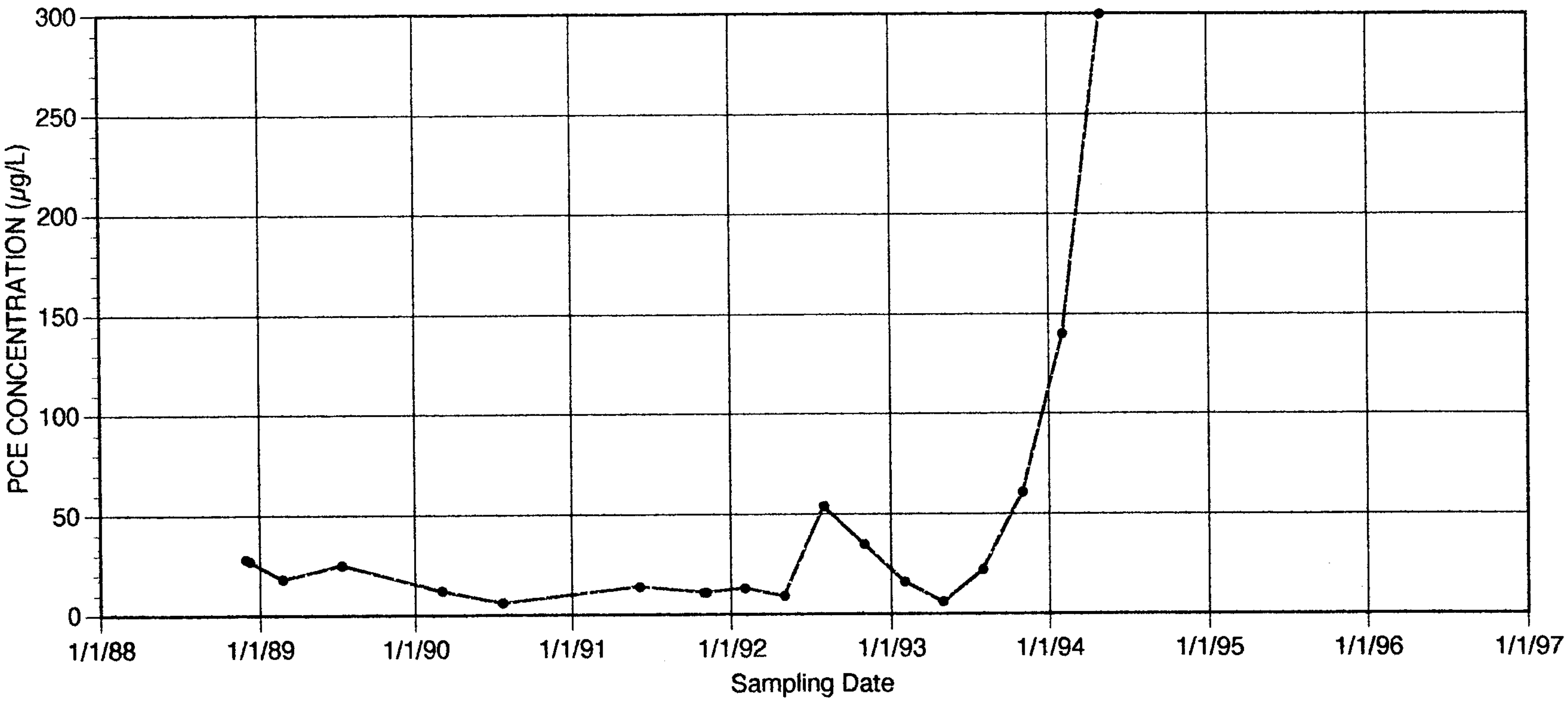
APPENDIX Q

PCE CONCENTRATION VERSUS TIME GRAPHS FOR MEADOW PARK ROAD AND ROUTE 6 RESIDENTIAL AND COMMERCIAL WELLS

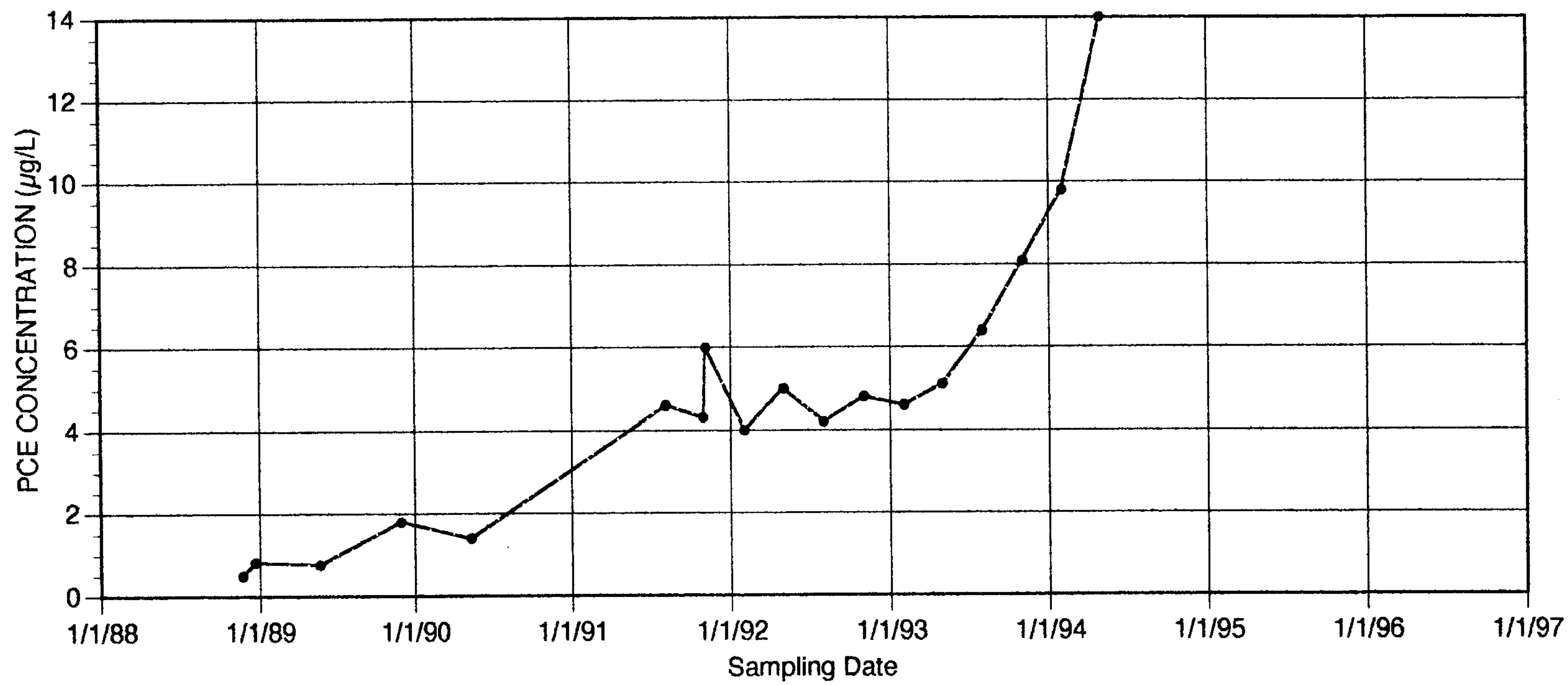
PCE Concentration Before Filters:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-5



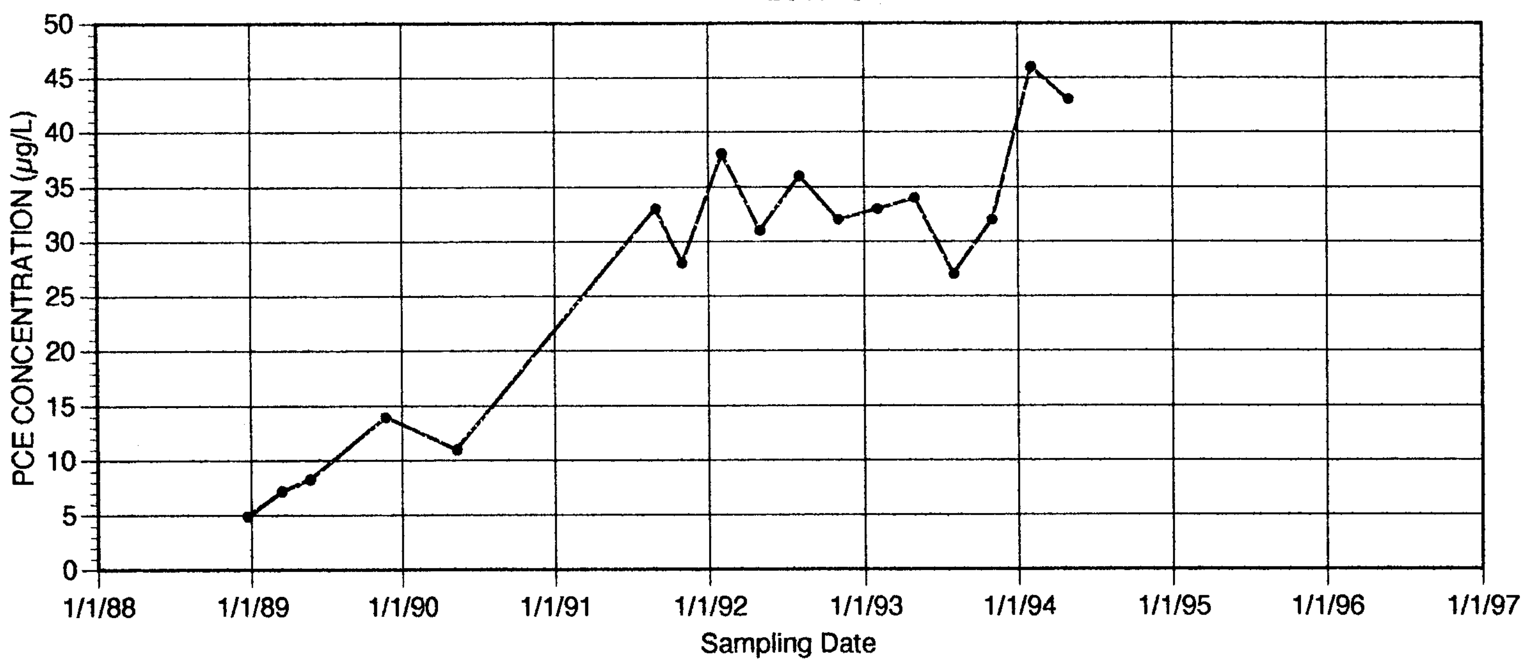
PCE Concentration Before Filters:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-7



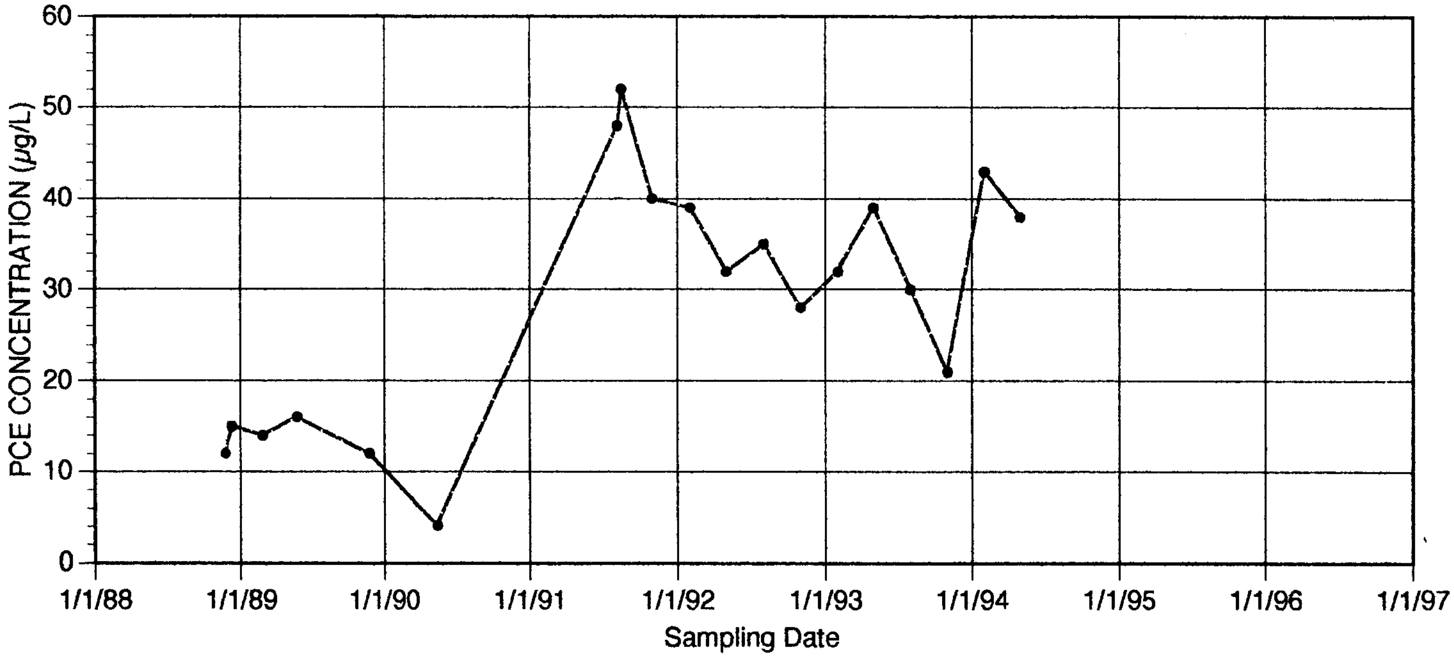
PCE Concentration Before Filters:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-8



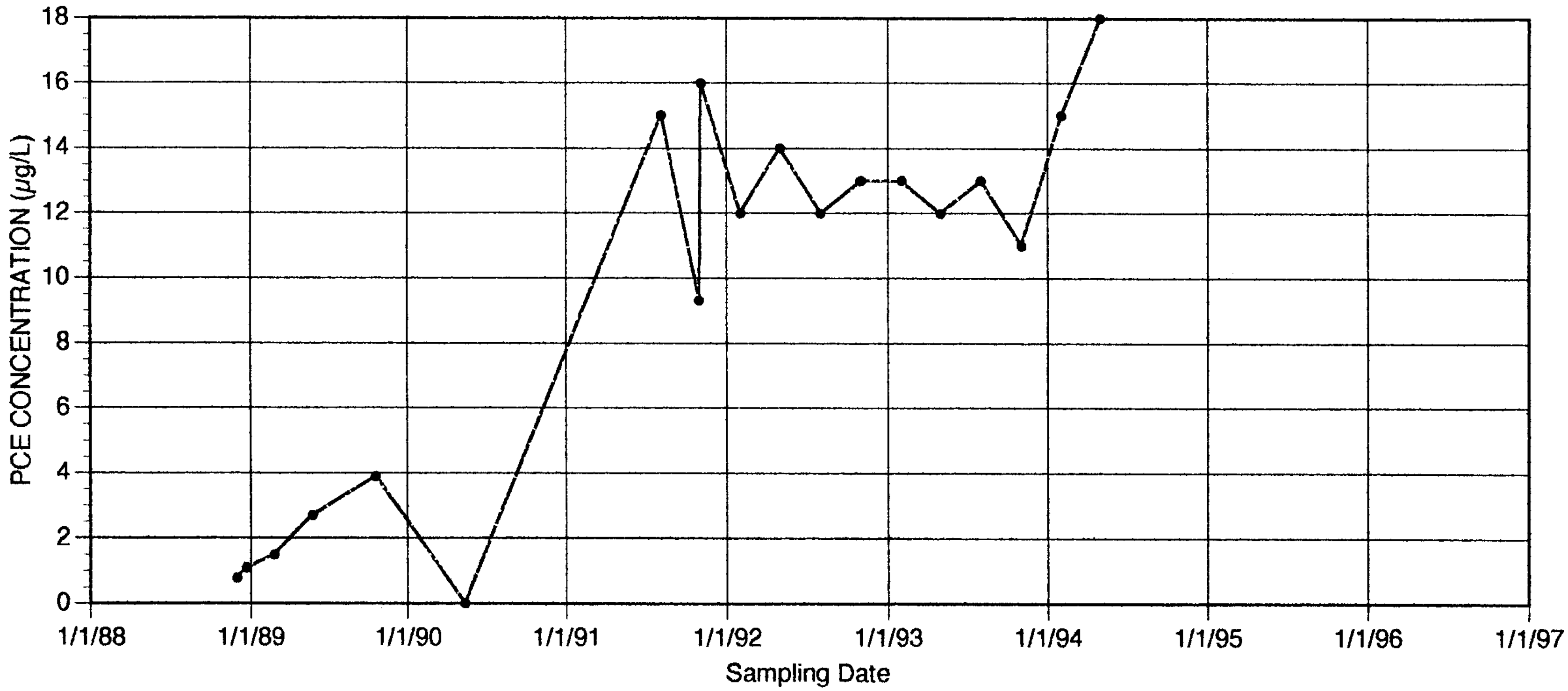
PCE Concentration Before Filters:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-9



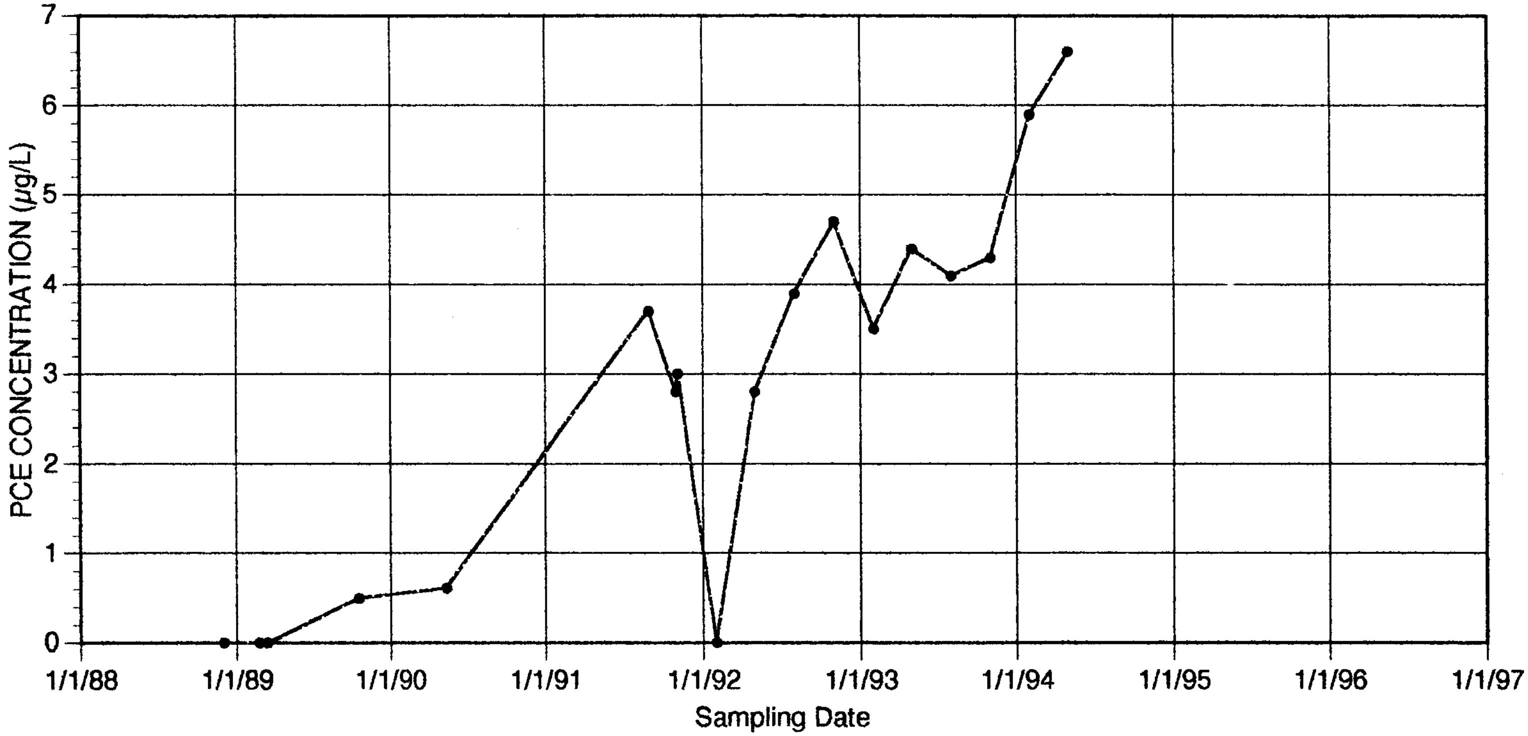
PCE Concentration Before Filters:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-10



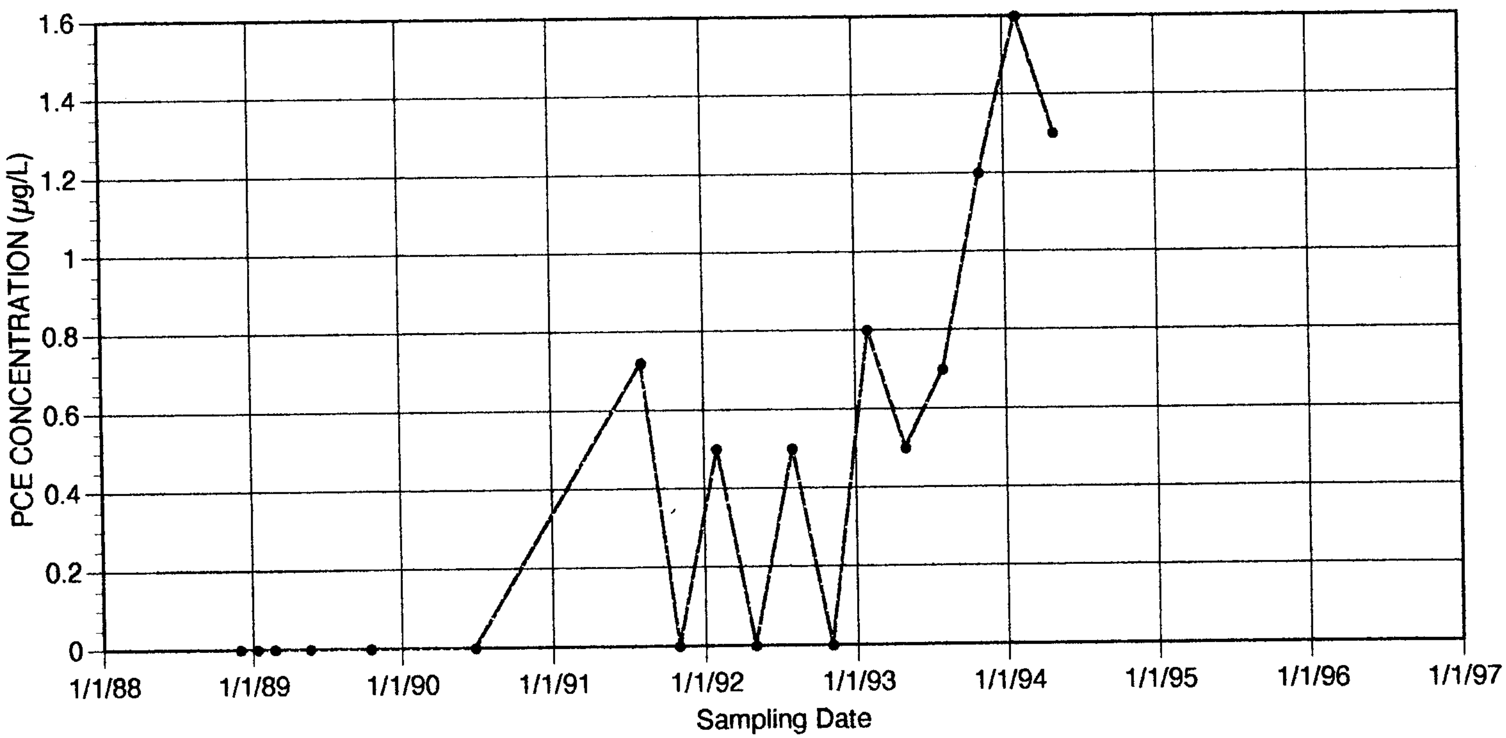
PCE Concentration Before Filters:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-11



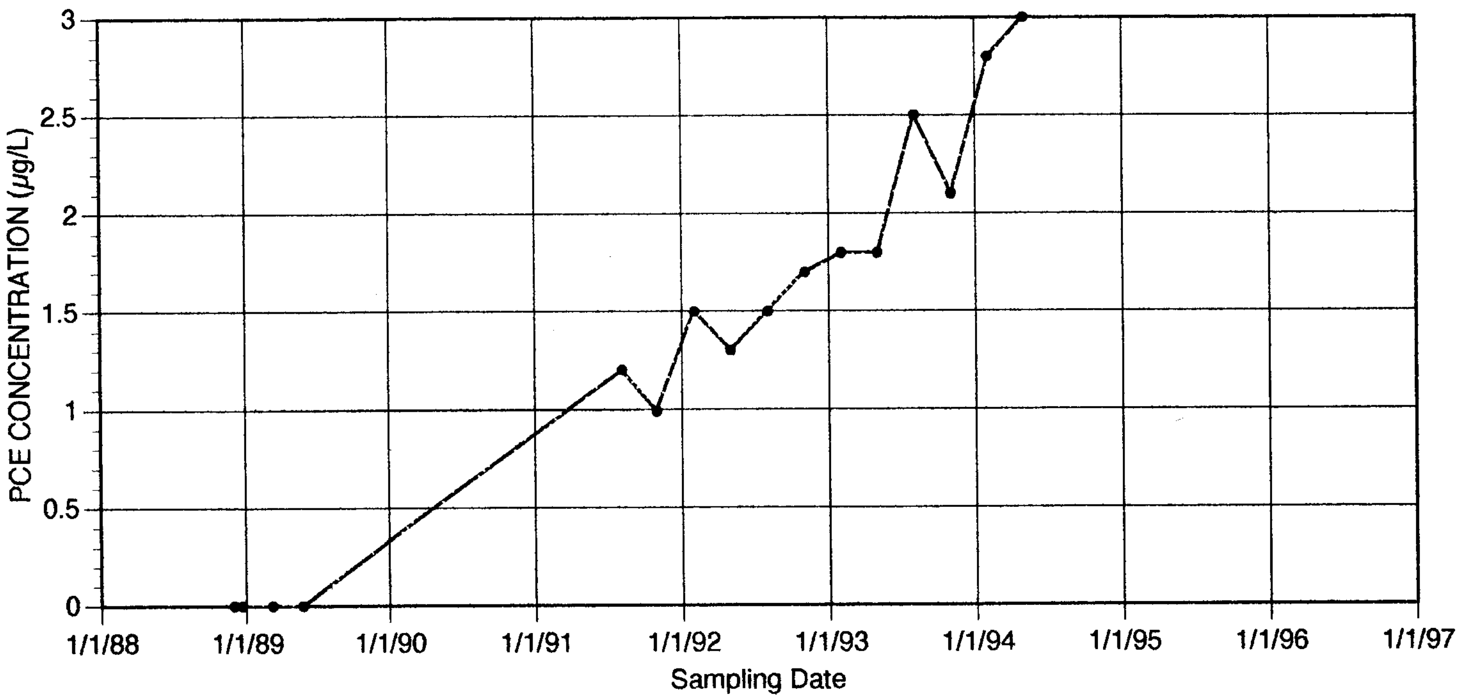
PCE Concentration:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-12



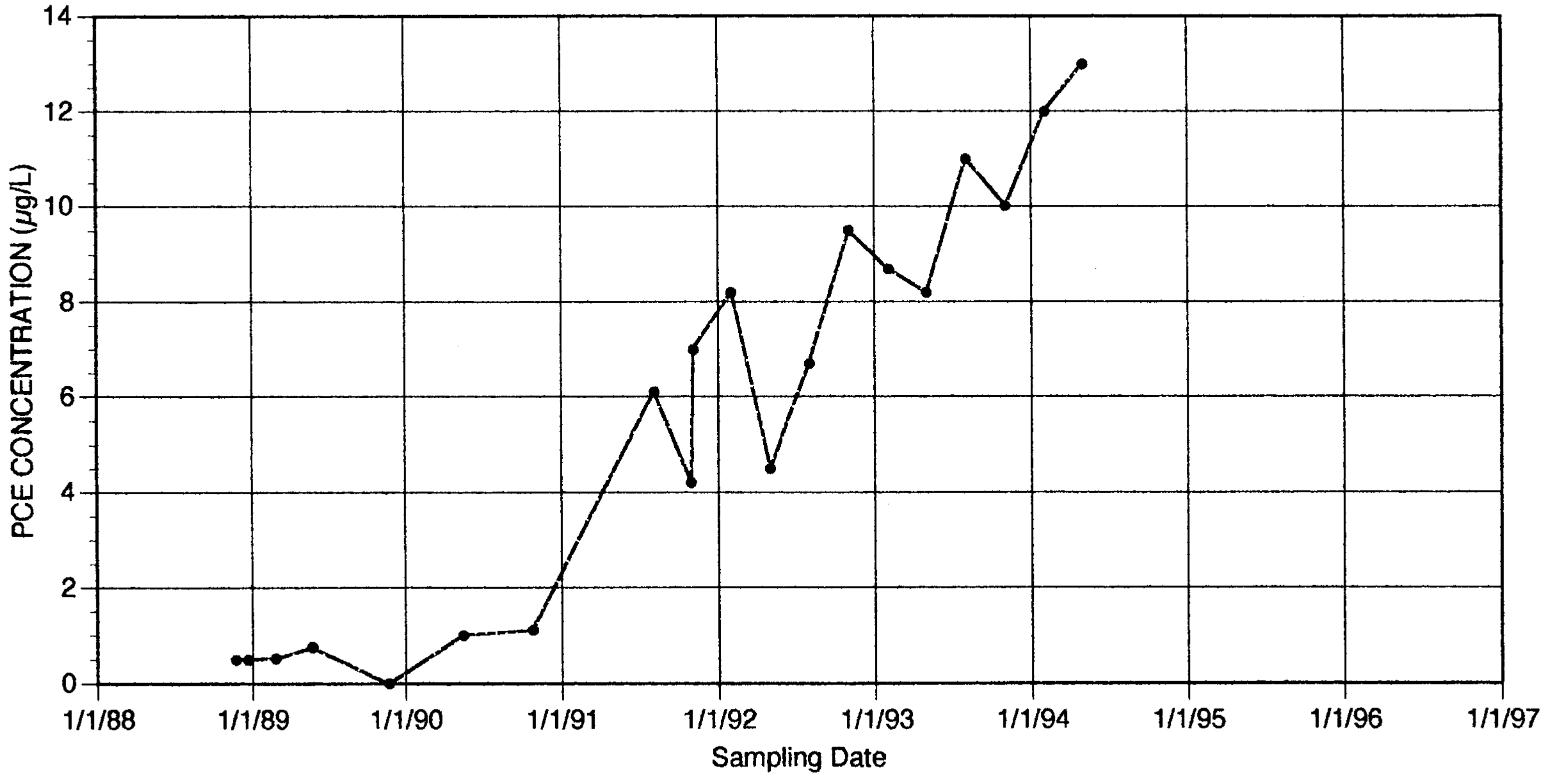
PCE Concentration:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-14



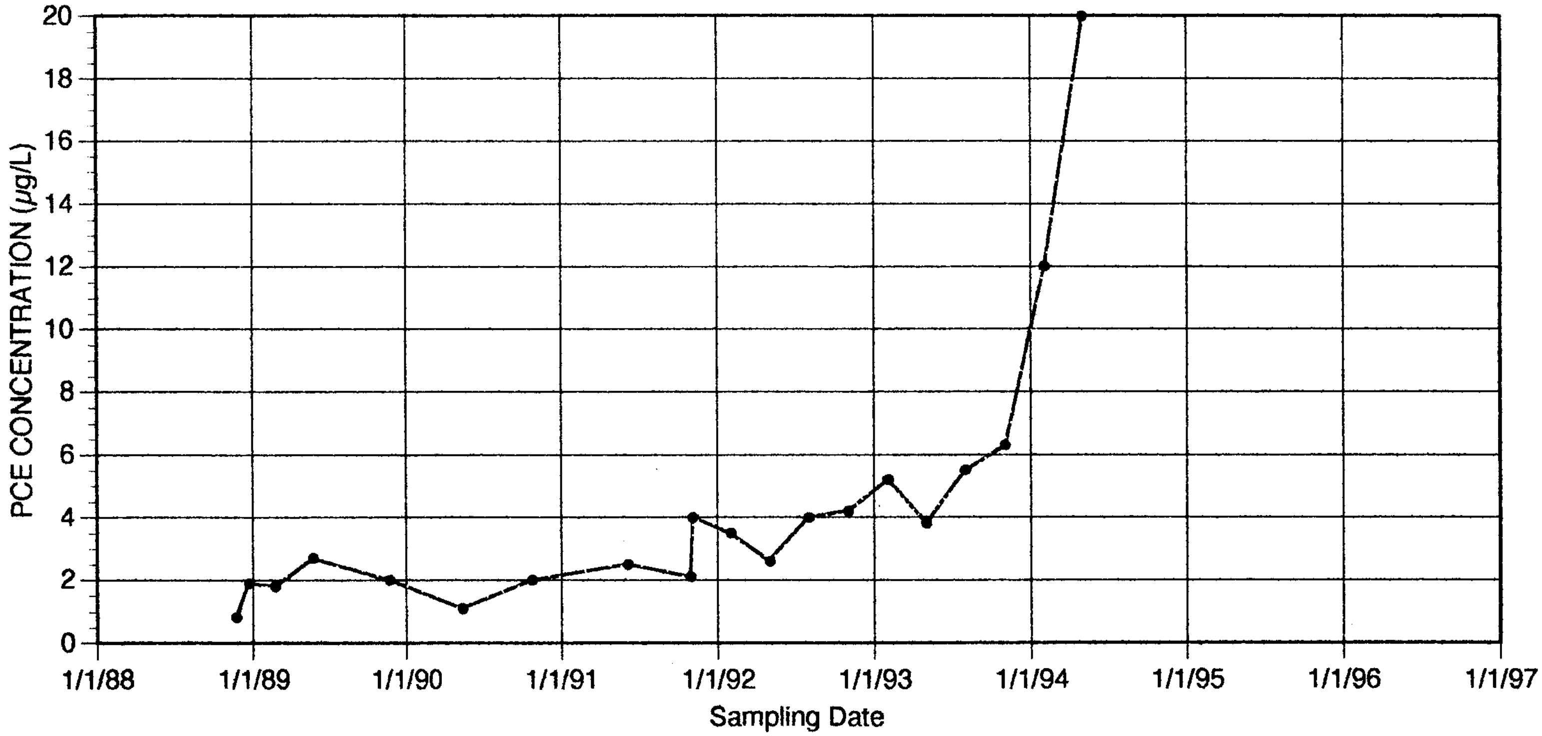
PCE Concentration Before Filters:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-15



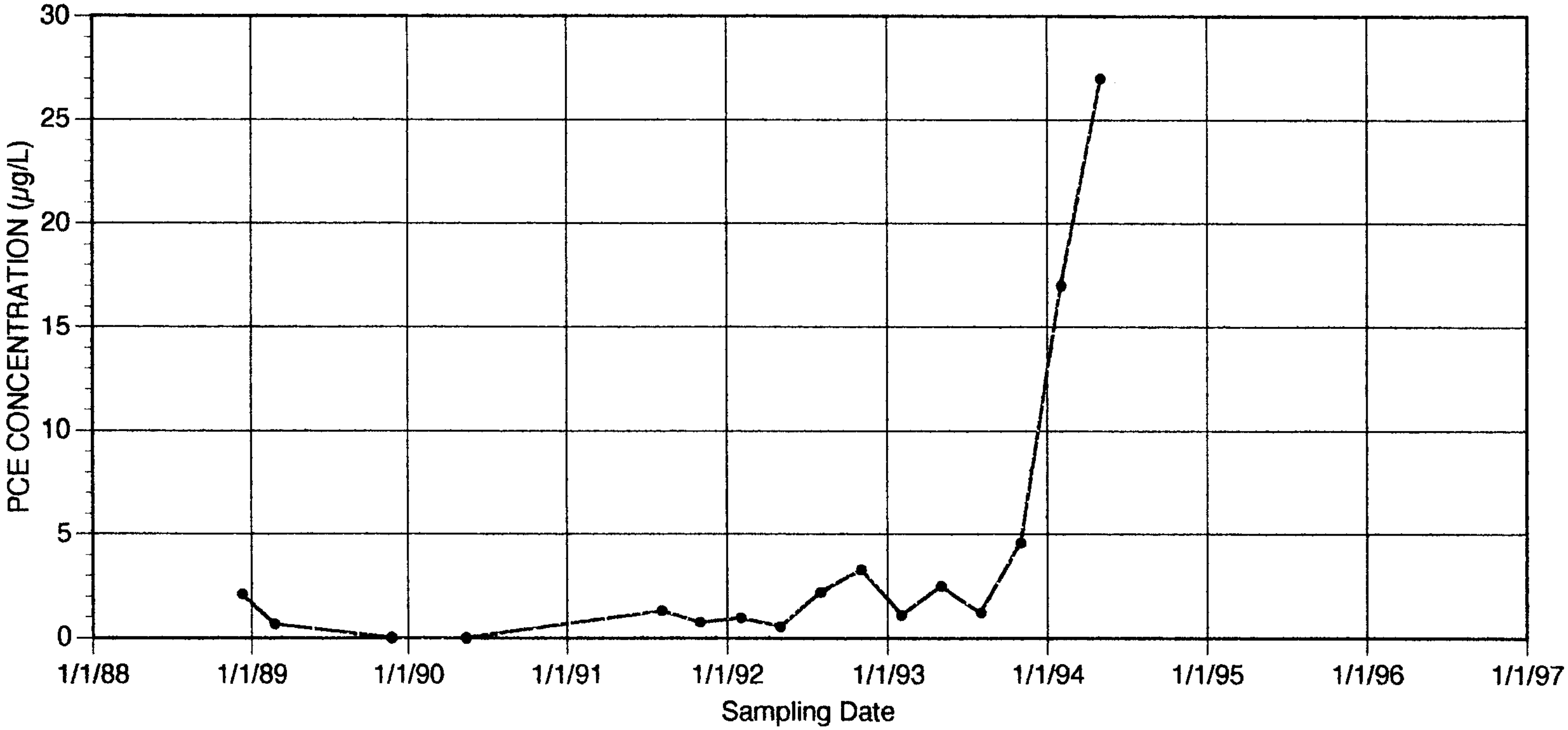
PCE Concentration Before Filters:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-16



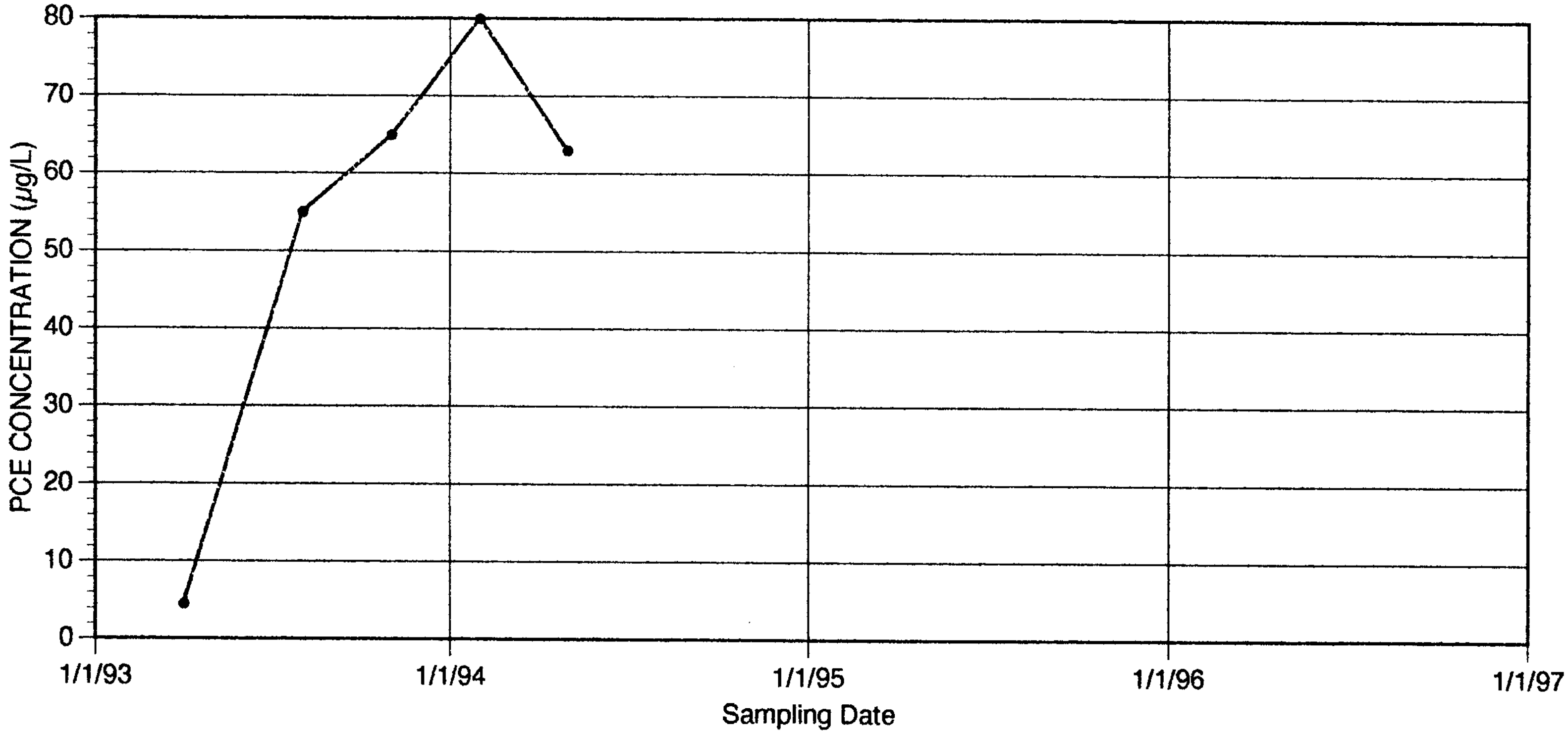
PCE Concentration Before Filters:
Residential Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

RW-17



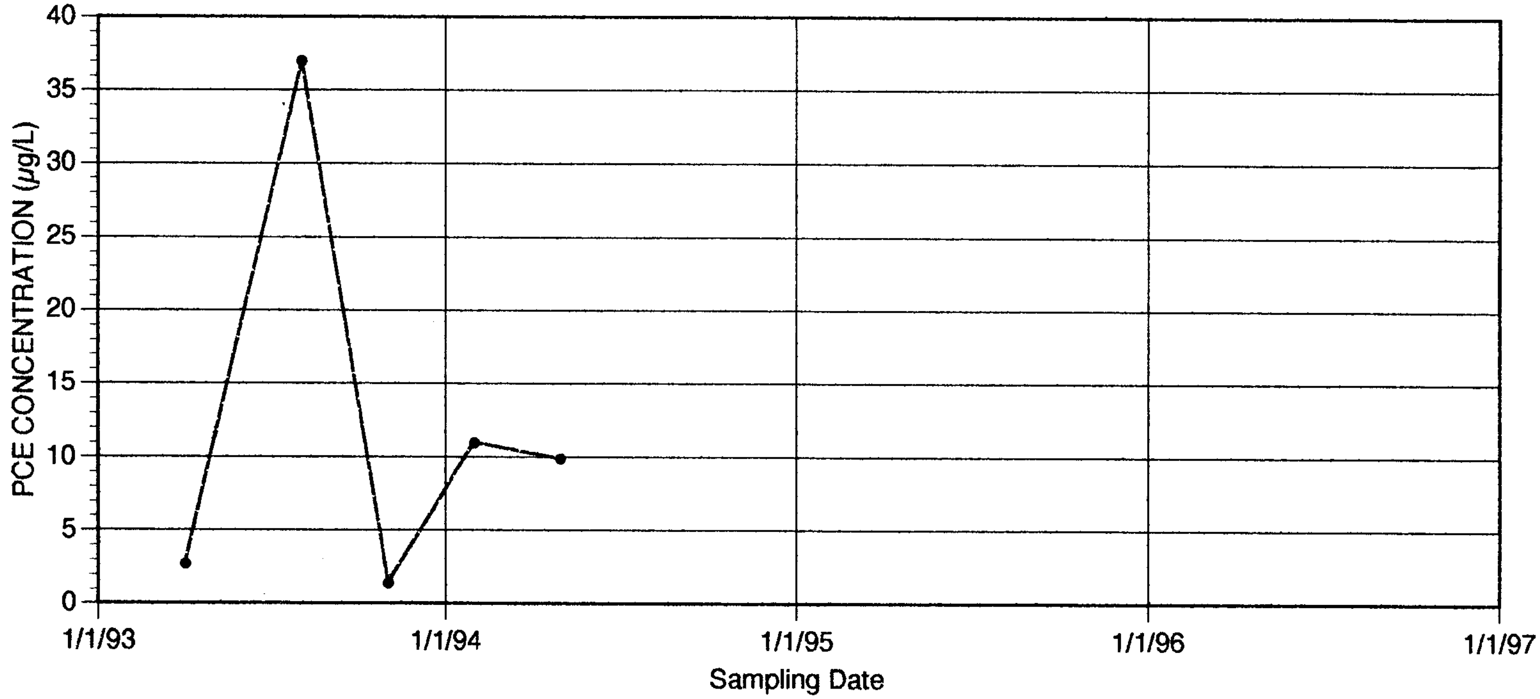
PCE Concentration Before Filters:
Commercial Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

CW-20

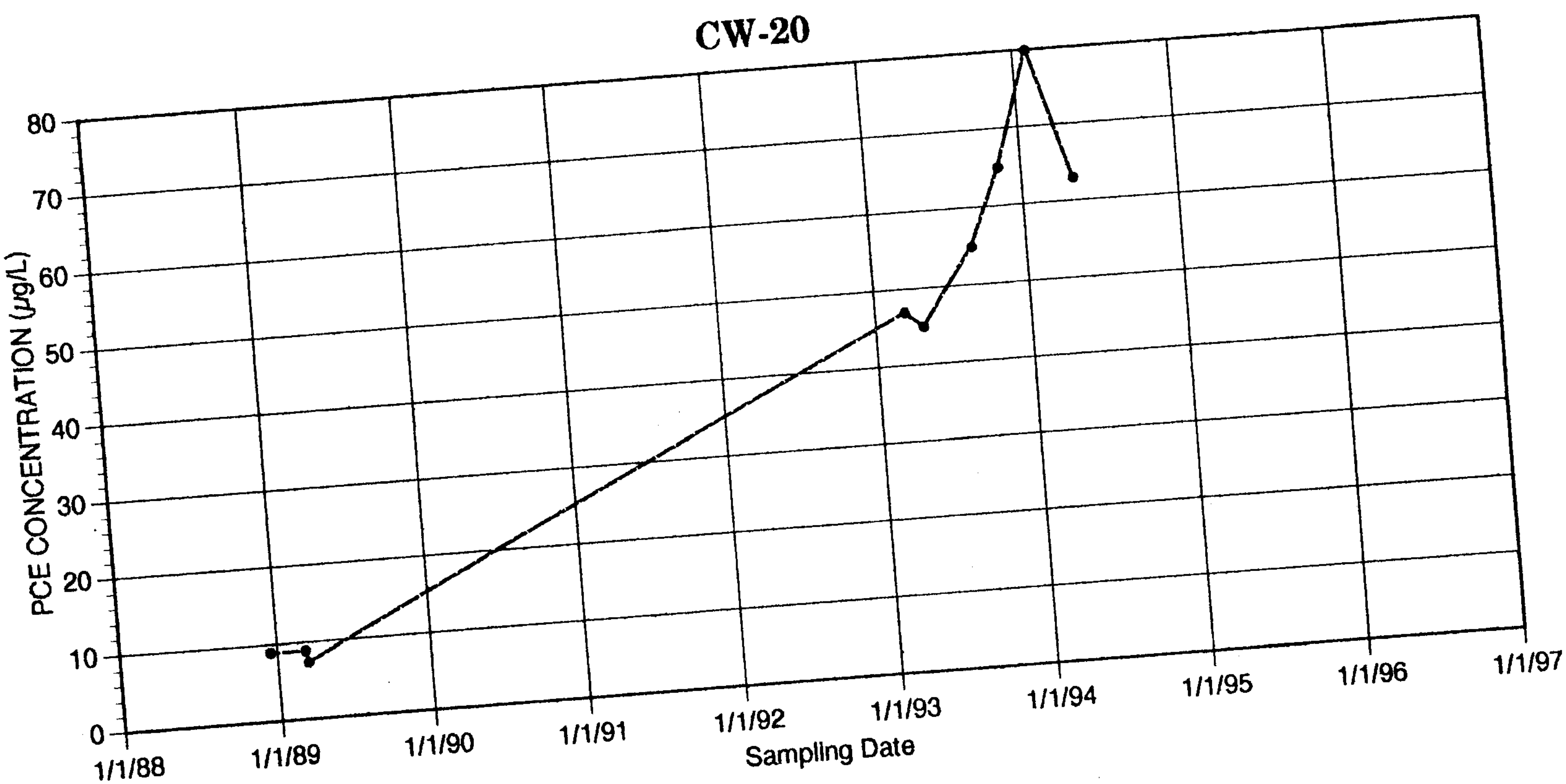


PCE Concentration Before Filters:
Commercial Wells on Meadow Park Road,
Baldwin Place Mall; Somers, New York.

CW-21



PCE Concentration Before Filters:
Commercial Wells on Route 6,
Baldwin Place Mall; Somers, New York.



...E Concentration Before Filters:
Commercial Wells on Route 6,
Baldwin Place Mall; Somers, New York.

CW-21