DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

RCRA Corrective Action
Environmental Indicator (EI) RCRAInfo code (CA725)
Current Human Exposures Under Control

Facility Name: **Frontier Chemical – Royal Avenue facility**
Facility Address: **Niagara Falls, NY**
Facility EPA ID #: **NYD043815703**

1. Has **all** available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

__X__ If yes - check here and continue with #2 below.

_____ If no - re-evaluate existing data, or

_____ if data are not available skip to #6 and enter"IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Current Human Exposures Under Control" EI

A positive "Current Human Exposures Under Control" EI determination ("YE" status code) indicates that there are no "unacceptable" human exposures to "contamination" (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The "Current Human Exposures Under Control" EI are for reasonably expected human exposures under current land- and groundwater-use conditions ONLY, and do not consider potential future land- or groundwater-use conditions or ecological receptors. The RCRA Corrective Action program's overall mission to protect human health and the environment requires that Final remedies address these issues (i.e., potential future human exposure scenarios, future land and groundwater uses, and ecological receptors).

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRAInfo national database ONLY as long as they remain true (i.e., RCRAInfo status codes must be changed when the regulatory authorities become aware of contrary information).

Background

The site dates back to 1906 when it was owned and operated by the International Minerals and Chemical Company as a caustic chlorine (mercury cell) production plant. Sludge ponds associated with this operation were utilized for liquid sludge disposal from caustic soda production.

Frontier Chemical Waste Process Inc. moved its operations from its Pendleton location (EPA # NYD043815703) to Royal Avenue in Niagara Falls. The Frontier Chemical Waste Process Corporation operated a permitted waste treatment, storage, and disposal (TSD) facility at the Royal Avenue site from 1974 to December 1992. While operating, this facility treated or stored approximately 25,000 tons of chemical wastes per year. Several major spills were documented during site operations, and in December 1992, following documented releases of hazardous waste from numerous drums, the site was ordered closed by the NYSDEC. The RCRA permit issued for the facility was revoked by the Department on April 6, 1994. The Department issued a Summary Abatement Order in December of 1992. When the facility failed to comply with the Order, the Department requested the USEPA to conduct an emergency response action at the site. This action was completed in early 1995. As part of the action, drums and tanks containing hazardous waste solvents were removed and properly disposed off-site.

The Frontier Chemical Royal Avenue site is approximately 9 acres in size and is located on the northwestern corner of the intersection of Royal Avenue and 47th Street in Niagara Falls, NY. The south and east of the site is occupied by vacant industrial properties. A residential neighborhood is approximately ½ mile west of the site. The Frontier Chemical site is in the heavily industrialized area of Niagara Falls bounded on the north by Niagara Falls Blvd, on the south by the Niagara River, and on the west by Hyde Park Blvd. Numerous other inactive hazardous waste sites are within one mile of the site. These include several Occidental Chemical waste and plant sites, as well as DuPont Chemical, Olin Chemical, and the Solvent Chemical sites. The closest residential area is located about ½ mile west and the closest off-site building is located 300 feet away.

The majority of the buildings on the site have been demolished, although some smaller buildings and structures remain. The site is completely fenced and the majority of the surface of the site covered by either concrete or blacktop. Several large areas of demolition debris also occupy areas on the surface of the site.

An 'Operable Unit' (OU) represents a portion of the site remedy that for technical or administrative reasons can be addressed separately to eliminate or mitigate a release, threat of release or exposure pathway resulting from the site contamination. At this site there are two OUs: OU1 consists of the overburden soils, overburden groundwater and upper bedrock groundwater. OU2 is the deeper bedrock groundwater.

Hydrogeological investigations at the site have identified significant organic contamination in on-site soils, and over burden and bedrock groundwater. The area of maximum overburden contamination, as evidenced by the presence of non-aqueous phase liquid (NAPL) chlorinated organics, centers around the former hazardous waste sludge settler, transfer operations, and chemical storage tanks that were used to store solvents. NAPL has been detected in bedrock monitoring wells located at the property line immediately adjacent to, and at the same elevation as, the unlined Falls Street tunnel. Dry weather flow, and nearly all wet weather flow, through the tunnel is treated. Groundwater elevation data confirm that groundwater flow across the site is toward the tunnel.

The RCRA Facility Assessment (RFA) identified 184 SWMUs and a RCRA Facility Investigation (RFI) was imposed in 1986. Interim Corrective Measures (ICMs) were approved by DEC but never imposed because of Frontier's financial insolvency. A State funded Supplemental Remedial Investigation and Feasibility Study (RI/FS) began in 2001, using site data available from previous RCRA investigations. The Supplemental RI report was approved in Nov. 2002. The FS report was approved in June 2004. The Proposed Remedial Action Plan (PRAP) for Operable Unit #1 (soils + overburden and shallow bedrock groundwater) was released in January 2006. The Record of Decision (ROD) for OU1 was issued in March 2006.

The Department will be contacting Potentially Responsible Parties (PRPs) for potential negotiation of a Remedial Design/Remedial Action Consent Order for the Royal Avenue site some time in 2006.

Geology and Hydrology: Niagara County is surrounded on three sides by fresh water sources that include Lake Ontario

to the north, Niagara River to the west, and Tonawanda Creek to the south. Drainage from the Huron Plain, which includes the site, is mostly into Tonawanda Creek, eventually emptying into the Niagara River. Based on previous groundwater investigations in the Niagara Falls area, groundwater is transmitted both in the overburden and bedrock aquifers. Due to the poor water quality and availability of municipal water from the Niagara River, groundwater is not extensively utilized as a potable water source in the Niagara Falls area.

In the overburden, groundwater flows through fill, glacial lacustrine, and basal till material. Groundwater flow direction is variable, with the topography, proximity of discharge /recharge sources, and dip of the bedrock controlling the flow direction. Based on previous studies in the Niagara Falls area, the overburden exhibits low transmissivity in comparison to the bedrock. The low permeability lacustrine and basal till soils reduce vertical infiltration of groundwater and tend to create localized perched water zones. Wells screened in these lacustrine deposits commonly exhibit hydraulic conductivities on the order of 3x10-4 feet per day.

In general, regional groundwater flow is towards the Niagara River and the Niagara Gorge. The principle water-bearing zone in the bedrock aquifer is the upper 10 to 25 feet of bedrock, which contains many closely-spaced horizontal fractures interconnected with vertical fractures. Aquifer tests performed in these horizontal fracture zones indicate hydraulic conductivities of 0.2 to 200 feet per day, with a median conductivity of 40 feet per day. Generally, transmissivity decreases with depth due to the weight of the overlying rock and a decrease in interconnection of horizontal and vertical fractures.

Recharge enters the weathered bedrock as infiltration of precipitation from the overlying glacial sediments. Recharge also enters as infiltration from the Niagara River, New York Power Authority Reservoir, and unlined city storm sewers. Vertical gradients are downward in recharge areas and are upward in discharge areas. Bedrock groundwater discharges to man-made features such as buried unlined storm sewers (Falls Street Tunnel) and the drain system surrounding the buried twin Power Authority water conduits, as well as the Niagara River.

The Frontier Chemical site is located in an industrial section of Niagara Falls, where approximately 25% of the surface area at the site is covered by grass/vegetation and the other 75% of the surface area is covered by buildings, building foundations, and pavement. Water on the grassed areas tends to collect in topographic lows before draining into the overburden. Surface drainage on the paved surfaces generally flows southward into storm sewer outfalls and then west either to the city of Niagara Falls sewage treatment facility or, during high flow conditions, directly into the Niagara River (approximately 1 mile to the west) through the Falls Street Tunnel.

The silty clay material that comprises most of the overburden is saturated, but due to the low permeability the groundwater is discontinuous. Overburden groundwater generally flows to the southwest, however, there appears to be a groundwater depression in the central portion of the site resulting in flow to the northwest, west, and southwest.

Previous investigations have identified three laterally extensive horizontal fracture zones in the upper bedrock during drilling activities. The first fracture zone (the A-fracture zone) consists of highly fractured and weathered Lockport dolomite in the upper 3 to 5 feet of the bedrock. The next fracture zone (the B-fracture zone) is a fracture zone up to 2 feet thick and is located approximately 8-10 feet below the A-zone. A downward vertical gradient exists from the A-zone to the B-zone. The next lower fracture zone (the C-fracture zone) is located approximately 20 feet below the B-zone. The C-zone has not been fully characterized. The C-zone and lower bedrock groundwater zones will be addressed in the future as part of the OU#2 characterization and remedial action.

Present and Future Planned CA Activities: The Record of Decision (ROD) for Operable Unit #1 (soils and overburden and shallow bedrock groundwater) was issued in March 2006.

The ROD contains the following remedial actions:

* Removal of existing site buildings, above grade structures, and demolition debris from the site.

* Excavation, treatment and off-site disposal of Contaminant "source area soils" (i.e. total VOCs +

monochlorotoluene (MCT) > 100ppm).

* The backfill of soil removal areas with clean soil or other suitable material.

* Completion of a clean soil or asphalt pavement cover over areas of the site which do not have concrete or asphalt cover.

* Improved storm water collection with permitted discharge to the Niagara Falls Water Board sewer system.

* Site groundwater controlled/treated in one of two ways: either an agreement with the Niagara Falls Water Board for use of Water Board utilities to provide site groundwater control/treatment; or, a site groundwater control/treatment system constructed on site, with permitted discharge of effluent to the Water Board's sewer system.

* Development of a site management plan to address residual contamination and any use restrictions.

* Imposition of an environmental easement.

* Annual certification of the institutional and engineering controls.

* Operation of components of the remedy until remedial objectives have been achieved, or until a NYSDEC determination that continued operation is not feasible.

* A long term monitoring program to evaluate effectiveness of cover and groundwater control/treatment system.

2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be "contaminated" [1] above appropriately protective risk-based "levels" (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action (from SWMUs, RUs or AOCs)?

	Yes	No	?	Rationale / Key Contaminants
Groundwater	X			VOCs, MCT, NAPL
Air (indoors) [2]		X		
Surface Soil (e.g., <2 ft)		X		
Surface Water		X		
Sediment		X		
Subsurf. Soil (e.g., >2 ft)	X			VOCs, MCT, NAPL
Air (outdoors)		X		

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriately protective risk-based "levels" (for the media, that identify risks within the acceptable risk range).

[2] Recent evidence (from the Colorado Dept. of Public Health and Environment, and others) suggest that unacceptable indoor air concentrations are more common in structures above groundwater with volatile contaminants than previously believed. This is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration necessary to be reasonably certain that indoor air (in structures located above (and adjacent to) groundwater with volatile contaminants) does not present unacceptable risks.

_____ If no (for all media) - skip to #6, and enter "YE," status code after providing or citing appropriate "levels," and referencing sufficient supporting documentation demonstrating that these "levels" are not exceeded.

__X__ If yes (for any media) - continue after identifying key contaminants in each "contaminated" medium, citing appropriate "levels" (or provide an explanation for the determination that the medium could pose an unacceptable risk), and referencing supporting documentation.

_____ If unknown (for any media) - skip to #6 and enter "IN" status code.

Rationale:

Nature of Contamination: Many soil and groundwater samples have been collected to characterize the nature and extent of contamination at the site. The main categories of contaminants that exceed their SCGs are volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs). The VOCs of concern include (but are not limited to) such compounds as acetone, trichloroethane, trichloroethene, dichloroethane, dichloroethene, tetrachloroethene, trichlorobenzene, dichlorobenzene, benzene, chlorobenzene, toluene, xylene, vinyl chloride, etc. The SVOCs of concern include (but are not limited to) such compounds as monochlorotoluene (MCT), phenol, trichlorophenol, dichlorophenol, etc.

Extent of Contamination: Chemical concentrations are reported in parts per billion (ppb) for water and parts per million (ppm) for soil. For comparison purposes, where applicable, SCGs are provided for each medium. Table 1 summarizes the degree of contamination for the contaminants of concern in subsurface soils and compares the data with the soil SCGs for the site. Tables 2, 3, 4, and 5 summarize the degree of contamination for the contaminants of concern in the site overburden, A-zone bedrock, B-zone bedrock, and C-zone bedrock groundwaters, respectively, and provides comparisons with groundwater SCGs for the site. The following are the media which were investigated and a summary of the findings of the investigation.

Groundwater: Site groundwater has been contaminated from previous spills and releases during waste storage, treatment and disposal activities. As a large percentage of the overburden soils have been contaminated by various VOCs and SVOCs, associated overburden groundwater has been similarly affected. Due to the influence of the adjacent unlined bedrock tunnels on the overburden groundwater (drawing it downward into the fractured bedrock aquifer), the majority of site contamination (both dissolved phase and NAPL) has likely migrated downward into the fractured bedrock. Groundwater impacts to each zone are discussed below. The location and influence of the Falls Street and New Road Tunnels has effectively intercepted the lateral movement of overburden and upper bedrock groundwater and prevented it from migrating off site beyond the Royal Avenue and 47th Street tunnel alignments. The effects of the Falls Street Tunnel (and the NYPA Conduits) on upper bedrock groundwater in the area has been well documented. USGS studies (1987 and 1991) and the 1992 "Niagara Falls Regional Groundwater Assessment" (performed jointly on behalf of DuPont, Olin, and Occidental) fully detail the effects.

Overburden Groundwater: Very high concentrations of VOCs are distributed over a large area of the site from the center to the southwestern corner. A sample of DNAPL containing mostly MCT was taken during a 1988 sampling event from an overburden well located in the southwestern quadrant of the site, immediately down gradient of a former sludge settler lagoon. The highest concentrations of VOCs within overburden groundwater were detected in the center of the site. MCT was detected at 264,000 ppb in one central well and total VOCs (not including MCT) were detected at 394,300 ppb at another well in the same area. Table 2 lists contaminants of concern in the overburden groundwater.

Bedrock Groundwater: The nature and extent of bedrock groundwater contamination is discussed below. Operable Unit No. 1 includes only the upper portion of the bedrock groundwater (i.e. A-zone and B-zone). The limited data related to Operable Unit No. 2 (deeper bedrock groundwater – C-zone and below) has been included in this discussion since an attempt was made to obtain C-zone bedrock groundwater quality data in the RI. Within the upper 35 feet of bedrock, 3 distinct horizontal fracture zones have been identified. The A-zone consists of the highly weathered upper 3 to 5 feet of bedrock. The B-zone is a fracture system which is up to 2 feet thick and is located approximately 8 to 10 feet below the A-zone. A downward vertical groundwater gradient exists from the A-zone to the B-zone. The C-zone is a fracture system approximately 20 feet below the B-zone. Although the C-zone has not been fully characterized, a slight upward vertical groundwater gradient has been calculated from the C-zone to the B-zone. The bedrock between the three defined horizontal fracture zones contain some vertical fractures which provide some groundwater communication between the zones. Tables 3, 4, and 5 list contaminants of concern in the bedrock groundwater.

A-zone Bedrock Groundwater: The distribution of groundwater contamination within the A-zone is widespread throughout the center, southern and southwestern portions of the site. The highest concentrations of VOCs within the A-zone groundwater unit are located in the same proximity as the overburden groundwater VOC highs. MCT was detected at 42,900 ppb and total VOCs (without MCT) were detected at up to 354,064 ppb in this area.

B-zone Bedrock Groundwater: B-zone groundwater contamination is generally less widespread that the A-zone. The influence of the Falls Street Tunnel is apparent as the highest concentrations of VOCs and MCT are present along the southern side of the site near Royal Avenue. In this area, MCT was detected at 47,400 ppb and total VOCs (without MCT) were detected at 93,271 ppb. Samples of DNAPL were obtained in 1988 from several B-zone fracture wells. These samples of DNAPL contained mostly MCT, dichlorobenzenes, trichlorobenzenes, tetrachloroethene, and trichloroethene.

C-zone Bedrock Groundwater: One of the two C-zone bedrock wells sampled (near the eastern site boundary) in the Supplemental RI did not contain VOCs at detectable concentrations. The other well (in the south-central area) contained concentrations of MCT at 4,410 ppb and total VOCs (without MCT) at 3,590 ppb. This south central site location corresponded to an area of very high B-zone contaminant concentrations. It is therefore likely that there is also extensive C-zone groundwater contamination present in the southern portion of the site. However the magnitude and extent of C-zone contamination cannot be assessed without additional groundwater investigations. Appropriate investigations of Operable Unit No 2 will be necessary to characterize the nature and extent of deeper bedrock groundwater contamination.

Indoor Air: There are several structures on the site, which are unoccupied, so this presents no human exposure. Vapor intrusion in off-site residences should not be an issue because overburden and shallow site groundwater contamination is intercepted by the adjacent Falls Street and New Road tunnels and thus there is no shallow off-site contaminant plume.

Surface soil: The majority of the site is covered with either concrete or asphalt pavement. As such, surface soil samples were not collected as part of the RI sampling program. The ROD calls for pavement/cover placement over any remaining non-paved portions of the site.

Subsurface soil: Volatile organic contamination is widespread in overburden soils in the central and south-central portions of the site. Monochlorotoluene is present in very high concentrations at the site. It is a tentatively identified compound which can be identified in VOC and SVOC sample analysis. It is also considered a contaminant of concern at several other hazardous waste sites in the Niagara Falls area. There appears to be an overburden source area of MCT in the south-western quadrant of the site, with MCT concentrations detected as high as 7,884 ppm. There is an equally large area of soil with very high concentrations of total VOCs (as high as 2,089 ppm) in the central and southern portion of the site.

It should be noted that VOC concentrations within the source areas vary with depth, and maximum VOC concentrations were detected at depths from 3 and 13 feet below ground surface. The heterogeneous nature of the

overburden contributes to the vertical and horizontal distribution of contaminants in the source areas. The extremely high concentrations of VOCs and MCT detected within overburden soils suggest that non-aqueous phase liquid (NAPL) exists within the soil matrix. Since many of the VOCs are more dense than water, it is also likely that dense NAPLs (i.e. DNAPL) are more prevalent near the bottom of the overburden soils, on or near the surface of the bedrock.

Toxicity Characteristic Leaching Procedure (TCLP) analysis, which indicated whether a media must be treated as a hazardous waste, was performed on soil samples from 3 boreholes located within the central part of the site. One of the soil samples in this area exceeded the regulatory limit for trichloroethene (2.32 ppm vs. criteria of 0.5 ppm). Given the magnitude of organic contaminant concentrations in soils at other locations, it is likely that there is a significant area of subsurface soil which would also exceed TCLP criteria, and therefore be considered hazardous waste.

References: Final Supplemental Remedial Investigation Report for the Former Frontier Chemical Waste Process, Inc., Site – Niagara Falls, New York. November 2002.

Proposed Remedial Action Plan, Frontier Chemical Royal Avenue, Operable Unit No. 1. January 2006.

Record of Decision, Frontier Chemical Royal Avenue, Operable Unit No.1, March 2006.

3. Are there **complete pathways** between "contamination" and human receptors such that exposures can be reasonably expected under the current (land- and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table

	Potential **Human Receptors** (Under Current Conditions)						
"Contaminated" Media	Residents	Workers	Day-Care	Construction	Trespassers	Recreation	Food[3]
Groundwater	No	No	No	No	No	No	No
~~Air (indoors)~~							
~~Soil (surface, e.g., <2 ft)~~							
~~Surface Water~~							
~~Sediment~~							
Soil (subsurface e.g., >2 ft)	No	No	No	No	No	No	No
~~Air (outdoors)~~							

Instructions for Summary Exposure Pathway Evaluation Table:

1. Strike-out specific Media including Human Receptors' spaces for Media which are not "contaminated") as identified in #2 above.

2. enter "yes" or "no" for potential "completeness" under each "Contaminated" Media -- Human Receptor combination (Pathway).

Note: In order to focus the evaluation to the most probable combinations some potential "Contaminated" Media - Human Receptor combinations (Pathways) do not have check spaces ("___"). While these combinations may not be probable in most situations they may be possible in some settings and should be

[3] Indirect Pathway/Receptor (e.g., vegetables, fruits, crops, meat and dairy products, fish, shellfish, etc.)

added as necessary.

__X__ If no (pathways are not complete for any contaminated media-receptor combination) - skip to #6, and enter "YE" status code, after explaining and/or referencing condition(s) in-place, whether natural or man-made, preventing a complete exposure pathway from each contaminated medium (e.g., use optional Pathway Evaluation Work Sheet to analyze major pathways).

_____ If yes (pathways are complete for any "Contaminated" Media - Human Receptor combination) - continue after providing supporting explanation.

_____ If unknown (for any "Contaminated" Media - Human Receptor combination) - skip to #6 and enter "IN" status code

Rationale:

The most concentrated contamination is located well below the ground surface where public contact with wastes is unlikely. The site is fenced and secured which minimizes the potential for public exposures to on-site contamination. Food is not grown on the site. The surrounding area of the site is mostly industrial. The nearest residence is approximately one-half mile west of the site and is supplied with public water. There are no private wells in the immediate area so exposures via drinking water are not expected. Vapor intrusion should not be an issue because there is no off-site overburden or upper bedrock groundwater contaminant plume. The ROD calls for removal of the remaining site buildings. If buildings are necessary for groundwater treatment, appropriate vapor mitigation systems will be incorporated into the design. Additionally, if construction were to take place at the site it would be undertaken with an appropriately protective occupational health and safety plan, which would minimize exposures.

References: Proposed Remedial Action Plan, Frontier Chemical Royal Avenue, Operable Unit No. 1. January 2006.

4. Can the **exposures** from any of the complete pathways identified in #3 be reasonably expected to be **"significant"**[4] (i.e., potentially "unacceptable" because exposures can be reasonably expected to be: 1) greater in magnitude (intensity, frequency and/or duration) than assumed in the derivation of the acceptable "levels" (used to identify the "contamination"); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above the acceptable "levels") could result in greater than acceptable risks)?

_____ If no (exposures can not be reasonably expected to be significant (i.e., potentially "unacceptable") for any complete exposure pathway) - skip to #6 and enter "YE" status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

_____ If yes (exposures could be reasonably expected to be "significant" (i.e., potentially "unacceptable") for any complete exposure pathway) - continue after providing a description (of each potentially "unacceptable" exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining

[4] If there is any question on whether the identified exposures are "significant" (i.e., potentially "unacceptable") consult a human health Risk Assessment specialist with appropriate education, training and experience.

complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

_____ If unknown (for any complete pathway) - skip to #6 and enter "IN" status code

Rationale and Reference(s): N/A

5. Can the "significant" **exposures** (identified in #4) be shown to be within **acceptable** limits? **N/A**

_____ If yes (all "significant" exposures have been shown to be within acceptable limits) - continue and enter "YE" after summarizing and referencing documentation justifying why all "significant" exposures to "contamination" are within acceptable limits (e.g., a site-specific Human Health Risk Assessment).

_____ If no (there are current exposures that can be reasonably expected to be "unacceptable")- continue and enter "NO" status code after providing a description of each potentially "unacceptable" exposure.

_____ If unknown (for any potentially "unacceptable" exposure) - continue and enter "IN" status code.

Rationale and Reference(s): N/A

6. Check the appropriate RCRAInfo status codes for the Current Human Exposures Under Control EI event code (CA725), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (and attach appropriate supporting documentation as well as a map of the facility):

_X_ YE - Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the information contained in this EI Determination, "Current Human Exposures" are expected to be "Under Control" at the **Frontier Chemical, Royal Avenue** facility, EPA ID # **NYD043815703**, located in **Niagara Falls, New York** under current and reasonably expected conditions. This determination represents the best understanding of conditions at the afore-mentioned facility by the State, given the most current data. This determination will be re-evaluated when the State becomes aware of significant changes at the facility.

____ NO - "Current Human Exposures" are NOT "Under Control."

____ IN - More information is needed to make a determination.

Completed by: _____ Date: 6/6/06
Jeffrey Konsella, Project Manager
Environmental Engineer II
NYSDEC Region 9 Office

Supervisor: _____ Date: 6/7/06
Greg Sutton
Environmental Engineer III
NYSDEC Region 9 Office

Director: _____ Date: 6/7/06
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Locations where References may be found:

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FINAL NOTE: THE HUMAN EXPOSURES EI IS A QUALITATIVE SCREENING OF EXPOSURES AND THE DETERMINATIONS WITHIN THIS DOCUMENT SHOULD NOT BE USED AS THE SOLE BASIS FOR RESTRICTING THE SCOPE OF MORE DETAILED (E.G., SITE-SPECIFIC) ASSESSMENTS OF RISK.

TABLE 1

Nature and Extent of Subsurface[1] Soil Contamination
2001 Sampling

SOILS	Contaminants of Concern	Concentration Range Detected (ppm)[a]	SCG[b] (ppm)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	0.002 - 510	0.8	5 of 31
	1,1 dichloroethane	0.002 - 45	0.2	5 of 31
	1,2,4 trichlorobenzene	0.002 - 140	3.4	8 of 31
	1,2 dichlorobenzene	0.002 - 680	7.9	8 of 31
	1,3 dichlorobenzene	0.002 - 210	1.6	11 of 31
	1,4 dichlorobenzene	0.002 - 430	8.5	8 of 31
	acetone	0.005 - 48	0.2	3 of 31
	benzene	0.003 - 9.8	0.06	4 of 31
	chlorobenzene	0.002 - 830	1.7	7 of 31
	tetrachloroethene	0.003 - 2700	1.4	9 of 31
	toluene	0.001 - 56	1.5	8 of 31
	trichloroethene	0.002 - 150	0.7	10 of 31
	xylenes (total)	0.001 - 40	1.2	4 of 31
Semivolatile Organic Compounds (SVOCs)	phenol	0.037 - 8.7	0.03	13 of 31
	benzo(a)anthracene	0.043 - 1.3	0.224	4 of 31
	benzo(a)pyrene	0.072 - 2.4	0.061	9 of 31
	chrysene	0.049 - 3	0.4	4 of 31
	dibenzo(a,h)anthracene	0.038 - 0.39	0.014	6 of 31
Tentatively Identified Compounds (TICs)	total monochlorotoluene	ND[c] - 7884	NA[d]	NA[d]
PCB/Pesticides	heptachlor epoxide	0.00027 - 0.22	0.02	3 of 31

Notes: [1]Only subsurface soil data available- surface soils were not sampled.
[a] ppm = parts per million, which is equivalent to milligrams per kilogram, mg/kg, in soil;
[b] SCG = standards, criteria, and guidance values;
[c]ND = non-detect
[d]NA = No SCG available for total MCT

TABLE 2
Nature and Extent of Overburden Groundwater Contamination
2001 Sampling

OVERBURDEN GW	Contaminants of Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	4 - 8500	5	11 of 29
	1,1 dichloroethane	2 - 7000	5	14 of 29
	1,2,4 trichlorobenzene	9 - 7600	5	7 of 29
	1,2 dichlorobenzene	2 - 69000	3	14 of 29
	1,2 dichloroethane	1 - 460	0.6	5 of 29
	1,3 dichlorobenzene	2 - 41000	3	12 of 29
	1,4 dichlorobenzene	2 - 43000	3	13 of 29
	acetone	6 - 5500	50	9 of 29
	benzene	2 -30000	1	9 of 29
	chlorobenzene	1 - 36000	5	13 of 29
	cis- 1,2 dichloroethene	1 - 120000	5	19 of 29
	methylene chloride	220 - 19000	5	6 of 29
	tetrachloroethene	3 - 74000	5	17 of 29
	toluene	2 - 6700	5	10 of 29
	trichloroethene	2 - 250000	5	21 of 29
	vinyl chloride	22 - 6300	2	12 of 29
	xylenes (total)	4 - 720	5	6 of 29
Semivolatile Organic Compounds (SVOCs)	phenol	6 - 4600	1[c]	7 of 12
	2,4 dichlorophenol	3 - 42	5	4 of 12
Tentatively Identified Compounds (TICs)	total monochlorotoluene	ND[d] - 135	NA[e]	NA[e]

Notes: [a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water;
[b] SCG = standards, criteria, and guidance values;
[c] 1 ppb= standard applies to sum of phenolic compounds (i.e. Total Phenols)
[d] ND = non-detect
[e] NA = No SCG available for total MCT

TABLE 3
Nature and Extent of A-Zone Bedrock Groundwater Contamination
2001 Sampling

Bedrock A-Zone GW	Contaminants of Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	47 - 18000	5	7 of 23
	1,1 dichloroethane	1 - 4300	5	12 of 23
	1,1 dichloroethene	5 - 1300	5	4 of 23
	1,2,4 trichlorobenzene	1 - 4200	5	7 of 23
	1,2 dichlorobenzene	1 - 61000	3	15 of 23
	1,2 dichloroethane	20 - 140	0.6	2 of 23
	1,3 dichlorobenzene	1 - 19000	3	14 of 23
	1,4 dichlorobenzene	2 - 26000	3	13 of 23
	acetone	13 - 3500	50	9 of 23
	benzene	4 -15000	1	15 of 23
	chlorobenzene	1 - 21000	5	16 of 23
	cis- 1,2 dichloroethene	2 - 270000	5	16 of 23
	methylene chloride	130 - 13000	5	7 of 23
	tetrachloroethene	2 - 47000	5	10 of 23
	toluene	1 - 3900	5	12 of 23
	trichloroethene	2 - 22000	5	17 of 23
	vinyl chloride	3 - 26000	2	8 of 23
	xylenes (total)	1 - 240	5	4 of 23
Semivolatile Organic Compounds (SVOCs)	phenol	1 - 4400	1[c]	13 of 18
	2,4 dichlorophenol	7 - 85	5	6 of 18
	2,4,6 trichlorophenol	1 - 64	1	5 of 18
Tentatively Identified Compounds (TICs)	total monochlorotoluene	ND[d] - 27600	NA[e]	NA[e]

Notes: [a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water;
[b] SCG = standards, criteria, and guidance values;
[c] 1 ppb= standard applies to sum of phenolic compounds (i.e. Total Phenols)
[d] ND = non-detect
[e] NA = No SCG available for total MCT

TABLE 4
Nature and Extent of B-Zone Bedrock Groundwater Contamination
2001 Sampling

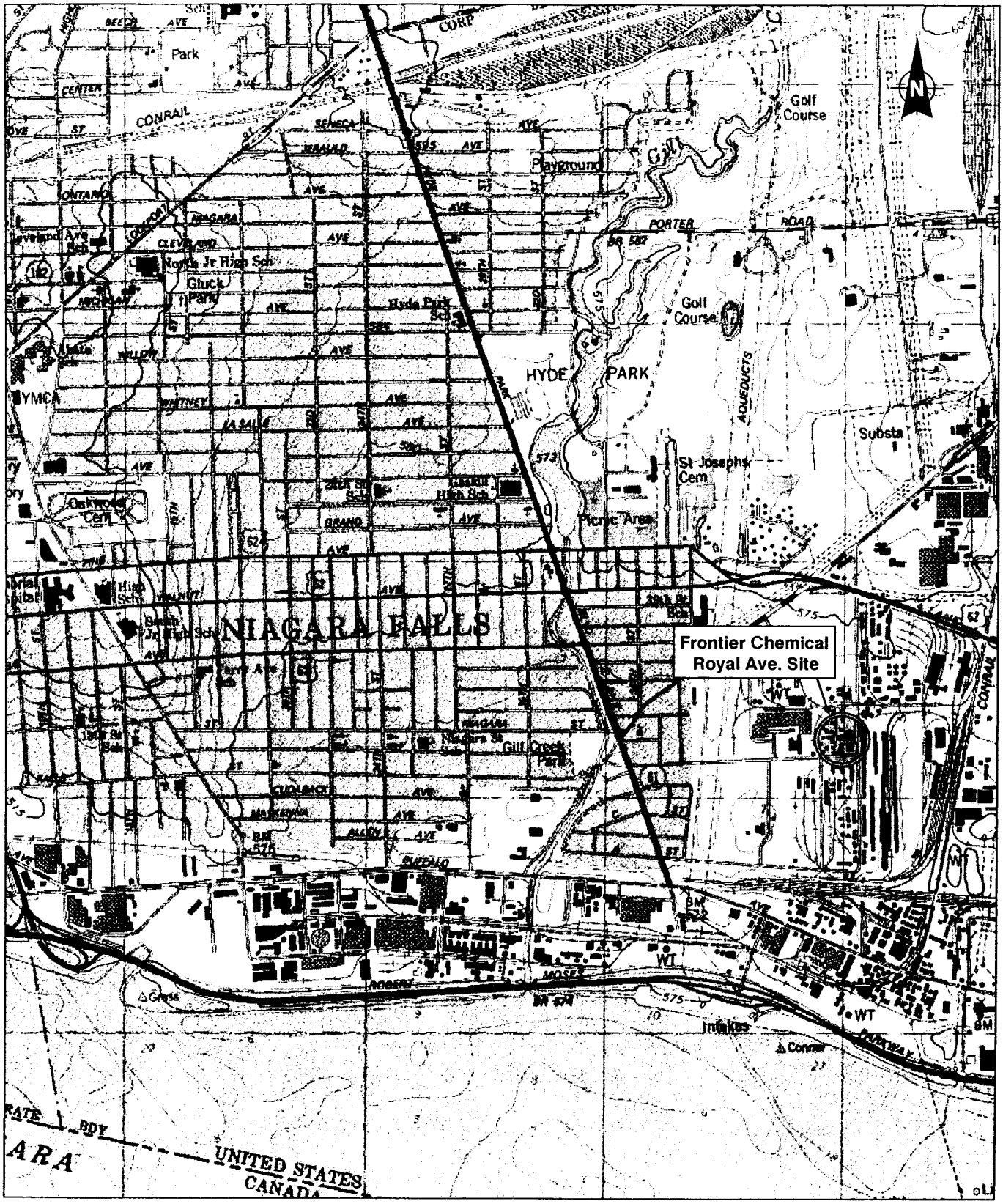
Bedrock B-Zone GW	Contaminants of Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	4 - 10000	5	7 of 18
	1,1 dichloroethane	1 - 2800	5	10 of 18
	1,2,4 trichlorobenzene	1 - 1100	5	6 of 18
	1,2 dichlorobenzene	4 - 12000	3	12 of 18
	1,3 dichlorobenzene	4 - 8400	3	12 of 18
	1,4 dichlorobenzene	7 - 9600	3	12 of 18
	acetone	3 - 8700	50	6 of 18
	benzene	5 -5100	1	12 of 18
	chlorobenzene	1 - 13000	5	13 of 18
	cis- 1,2 dichloroethene	1 - 1600	5	13 of 18
	methylene chloride	11 - 8600	5	6 of 18
	tetrachloroethene	12 - 6000	5	10 of 18
	toluene	2 - 2500	5	8 of 18
	trichloroethene	3 - 10000	5	10 of 18
	vinyl chloride	28 - 400	2	8 of 18
	xylenes (total)	2 - 360	5	2 of 18
Semivolatile Organic Compounds (SVOCs)	phenol	7 - 11000	1[c]	8 of 14
	2,4,6 trichlorophenol	1 - 170	1	4 of 14
Tentatively Identified Compounds (TICs)	total monochlorotoluene	Nd[d] - 47000	NA[e]	NA[e]

Notes: [a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water;
[b] SCG = standards, criteria, and guidance values;
[c] 1 ppb= standard applies to sum of phenolic compounds (i.e. Total Phenols)
[d] ND = non-detect
[e] NA = No SCG available for total MCT

TABLE 5
Summary of C-Zone Bedrock Groundwater Contamination
2001 Sampling

Bedrock C-Zone GW	Contaminants of Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	1,1,1 trichloroethane	ND[c] - 910	5	1 of 2
	1,1 dichloroethane	ND - 77	5	1 of 2
	1,2,4 trichlorobenzene	ND - 57	5	1 of 2
	1,2 dichlorobenzene	ND - 210	3	1 of 2
	1,3 dichlorobenzene	ND - 210	3	1 of 2
	1,4 dichlorobenzene	ND - 210	3	1 of 2
	benzene	4 -440	1	2 of 2
	chlorobenzene	ND - 680	5	1 of 2
	cis- 1,2 dichloroethene	ND - 11	5	1 of 2
	methylene chloride	ND - 100	5	1 of 2
	tetrachloroethene	ND - 95	5	1 of 2
	toluene	ND - 170	5	1 of 2
	trichloroethene	ND - 420	5	1 of 2
Semivolatile Organic Compounds (SVOCs)	phenol	ND - 31	1[d]	1 of 2
Tentatively Identified Compounds (TICs)	total monochlorotoluene	ND - 2600	NA[e]	NA[e]

Notes: [a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water;
[b] SCG = standards, criteria, and guidance values;
[c] ND = non-detect
[d] 1 ppb= standard applies to sum of phenolic compounds (i.e. Total Phenols)
[e] NA = No SCG available for total MCT

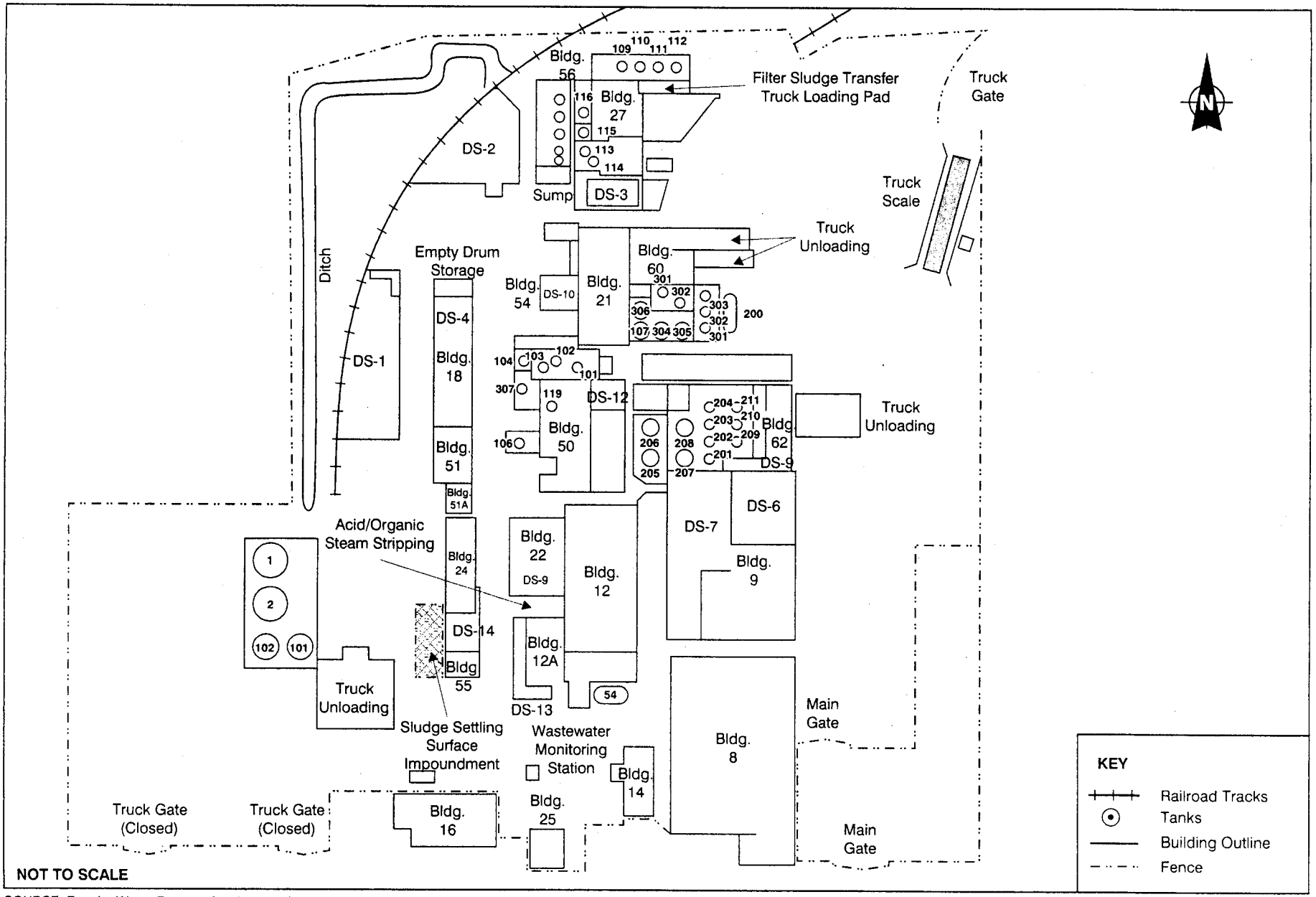


SOURCE: Niagara Falls Quadrangle, 7.5 Minute Series Topographic Map 1980.

SCALE

0 0.5 1 Mile

Figure 1 - SITE LOCATION MAP
Frontier Chemical Royal Avenue Site (#9-32-110)



SOURCE: Frontier Waste Process, Inc. historical drawings.

Figure 2 - 1984 Site Map - Frontier Chemical Royal Avenue Site (#9-32-110)

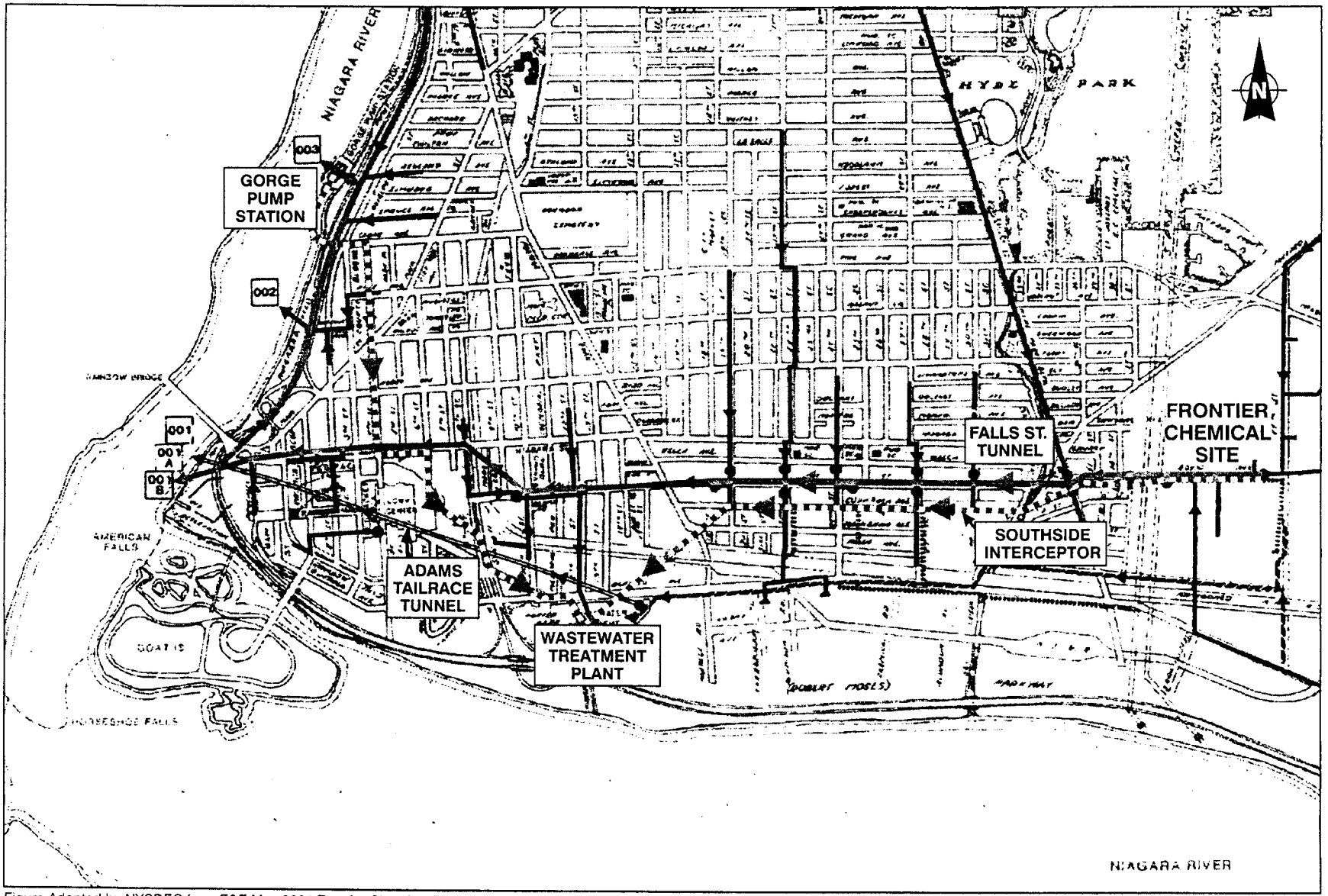


Figure Adapted by NYSDEC from E&E May 2004 Frontier Chemical Royal Avenue Feasibility Study Report

Figure 3 - Major Sewer Flows in the Vicinity of the Frontier Chemical Royal Avenue Site (#9-32-110)

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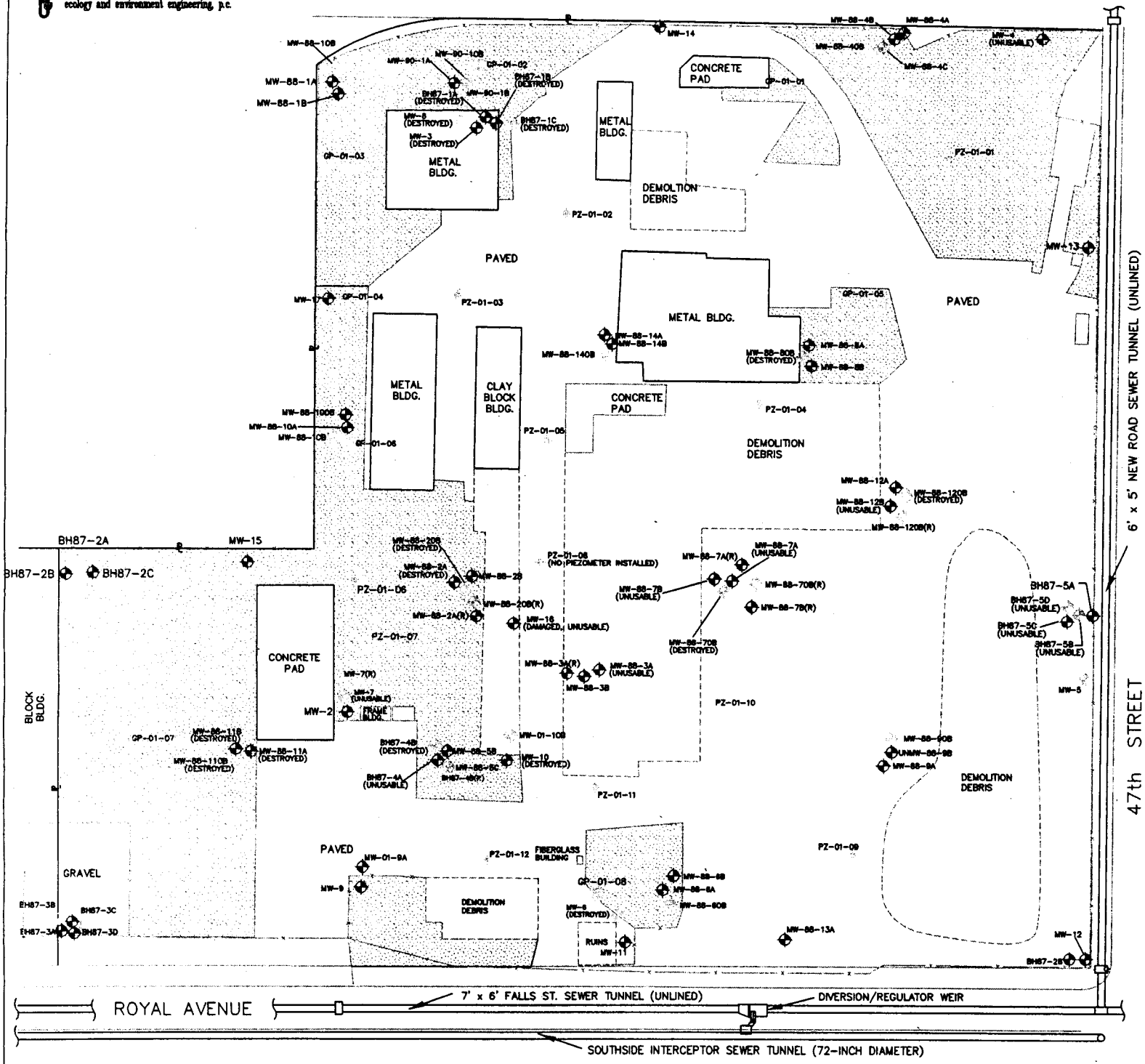


N

LEGEND

- UNPAVED AREAS
- OVERBURDEN WELL
- A-ZONE BEDROCK WELL
- B-ZONE BEDROCK WELL
- C-ZONE BEDROCK WELL
- SRI PIEZOMETER LOCATION
- SRI SOIL BORING LOCATION
- OUTLINE OF DEMOLISHED STRUCTURES/DEBRIS PILE
- OUTLINE OF BUILDING OR CONCRETE PAD

SCALE IN FEET

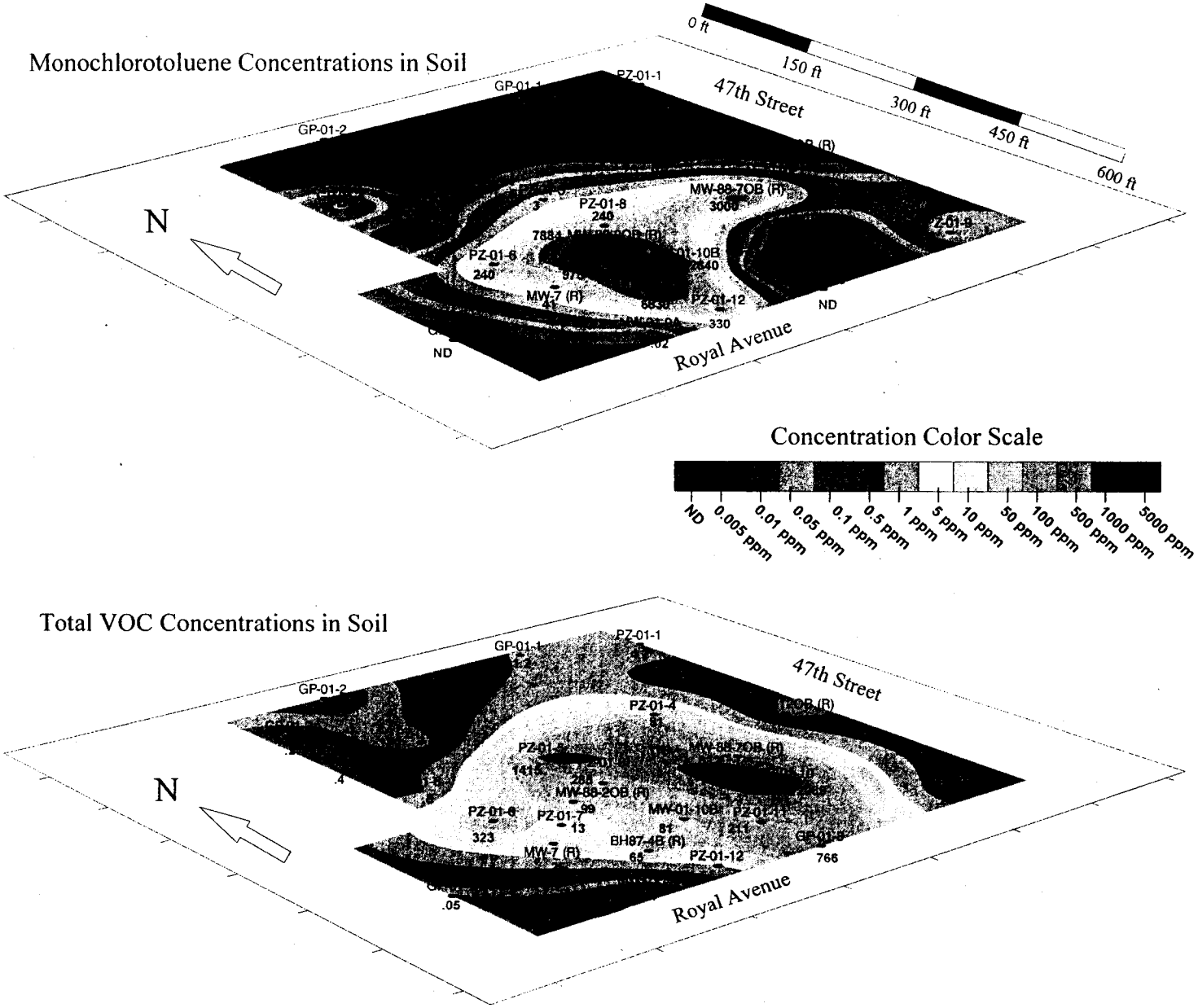
0 40 80 120

FRONTIER CHEMICAL ROYAL AVENUE SITE

Niagara Falls, NY | SITE # 9-32-110

SITE BASE MAP

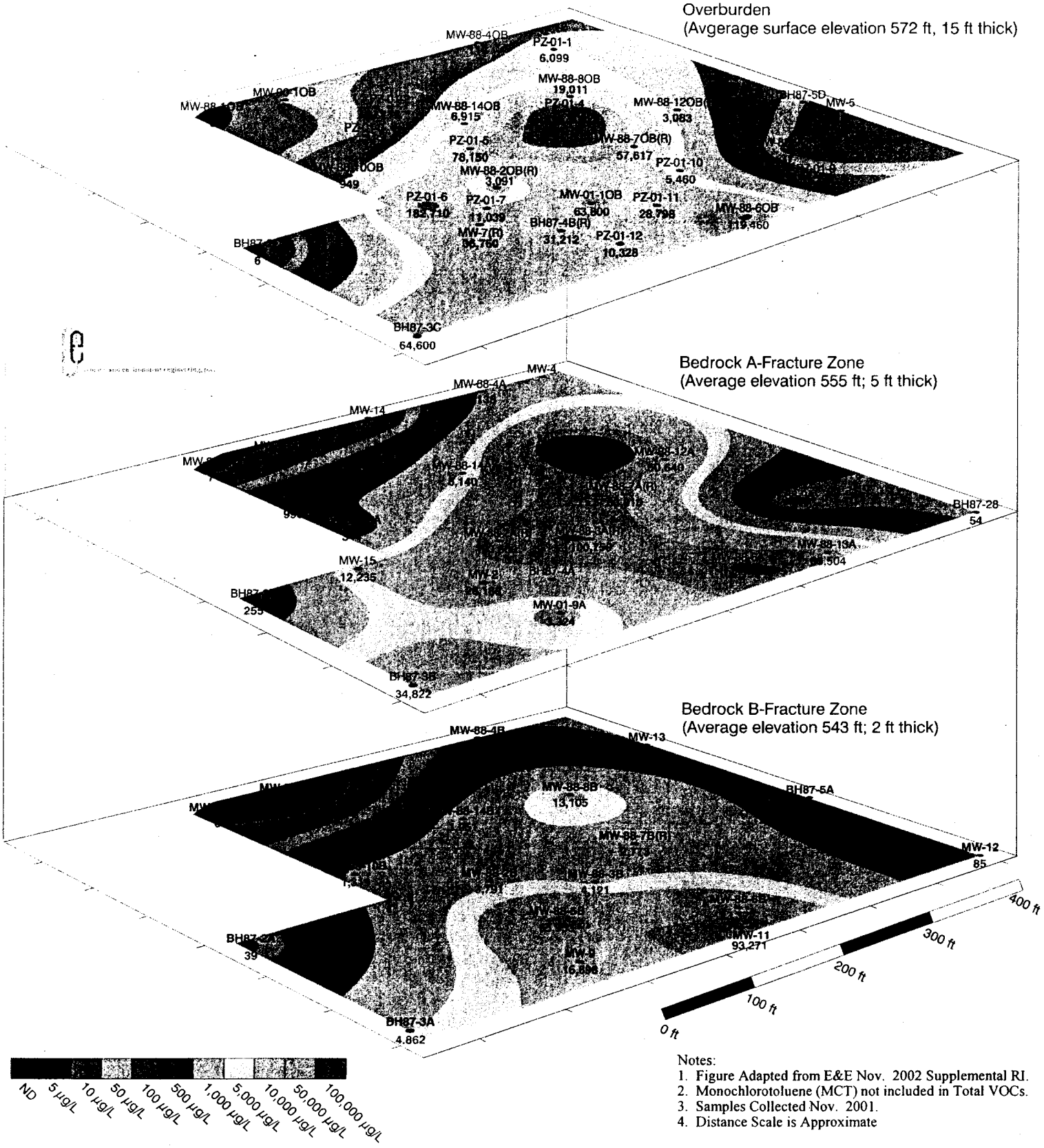
FIGURE 4



ecology and environment engineering, p.c.

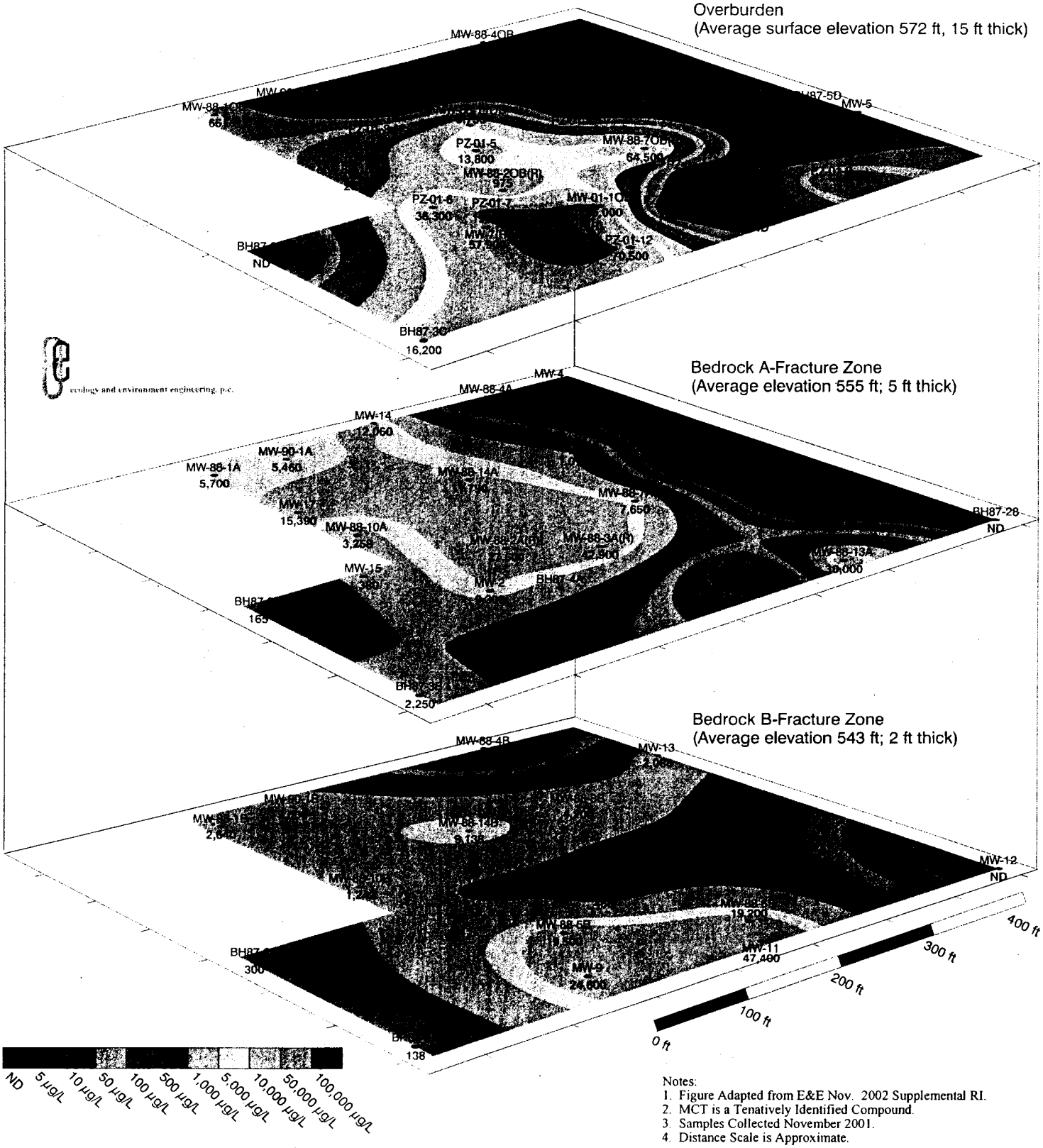
Notes:
1. Figures adapted from E&E Nov. 2002 Supplemental RI Report.
2. Monochlorotoluene (MCT) is a tenatively identified compound.
3. Samples collected November 2001.
4. Distance scale is approximate.

Figure 5 - Two-Dimensional Contour Plots of MCT and Total VOCs (minus MCT) in Soils
Frontier Chemical Royal Avenue Site (#9-32-110)



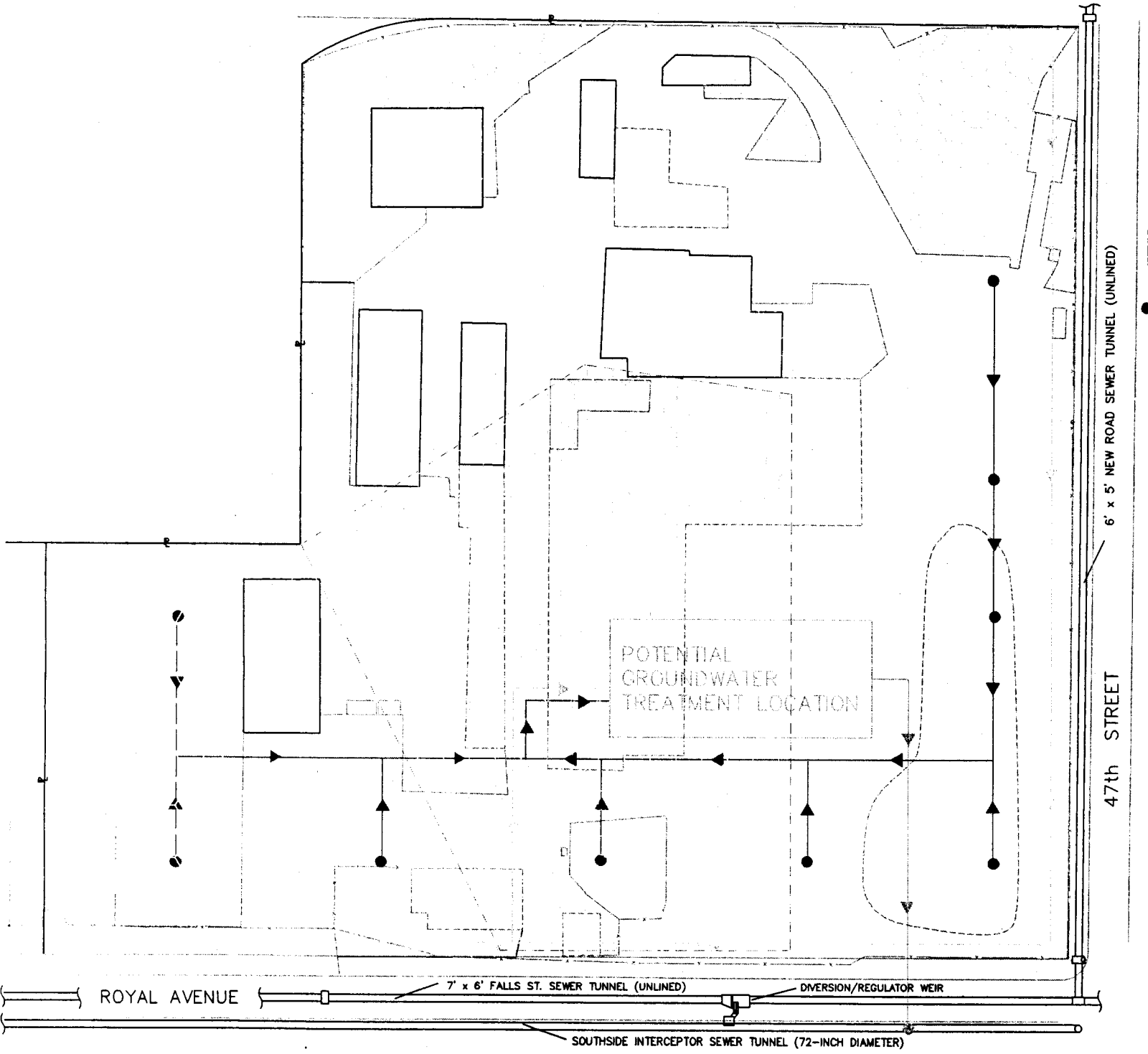
Notes:
1. Figure Adapted from E&E Nov. 2002 Supplemental RI.
2. Monochlorotoluene (MCT) not included in Total VOCs.
3. Samples Collected Nov. 2001.
4. Distance Scale is Approximate

Figure 6 - Three Dimensional View of Total VOC Concentrations (Minus MCT) in Groundwater
Frontier Chemical Royal Avenue Site (#9-32-110)



Notes:
1. Figure Adapted from E&E Nov. 2002 Supplemental RI.
2. MCT is a Tenatively Identified Compound.
3. Samples Collected November 2001.
4. Distance Scale is Approximate.

Figure 7 - Three Dimensional View of Monochlorotoluene (MCT) Concentrations in Groundwater
Frontier Chemical Royal Avenue Site (#9-32-110)



N

LEGEND

- NEW COVER AREAS (CURRENTLY UNPAVED OR SOIL REMOVAL AREAS)
- BEDROCK GROUNDWATER PUMPING WELL/PIPING
- OUTLINE OF DEMOLISHED STRUCTURES/DEBRIS PILE
- OUTLINE OF BUILDING OR CONCRETE PAD
- APPROXIMATE LIMITS OF SOIL EXCAVATION AREA (TOTAL VOCs + MCT > 100 ppm)

SCALE IN FEET

0 40 80 120

FRONTIER CHEMICAL ROYAL AVENUE SITE

Niagara Falls, NY | SITE # 9-32-110

SOIL REMOVAL & COVER SYSTEM W/GROUNDWATER CONTROL/TREATMENT

FIGURE 8