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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

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April 5, 2011

MEMORANDUM

To: Isabel Rodrigues, USEPA, New York, NY
From: David Eckhardt, USGS, Ithaca, NY
Subject: Review of FS Draft Report – Cayuga County Ground Water Contamination Site

I have reviewed the Draft FS Report (dated 3/21/11) for the Cayuga County Ground Water Contamination Site prepared by CDM and find that it provides a concise description of the site and potential remedial actions. The report is well organized and fairly well written. The following comments address several technical concerns that mainly focus on the hydrogeology of the Site. They are offered with the intent to strengthen the technical issues that are presented. I have also written suggested revisions directly on several text pages, which are offered to improve the clarity, scope, and accuracy of the report.

1. Table 1-1: The table contain several inaccuracies and omissions:
   (a) The Skaneateles Formation is >75 ft thickness; the Mottville is older than the Delphi Station and should be listed below it;
   (b) The Marcellus Formation is typically about 50 feet thick and has three members – Union Springs, Cherry Valley, and Oatka Creek (oldest to youngest); its lithology is black shale with thin interbedded limestone (Cherry Valley);
   (c) The Onondaga Formation is Middle (not Lower) Devonian and forms the uppermost unit of the approximately 235-ft thick sequence of carbonate rock; the four members of the Onondaga consist of about 75 feet of crystalline and flinty limestone with some thin interbedded bentonites and argillaceous limestones; the Onondaga unconformably overlies the limestone of the Manlius Formation (not the Rondout Formation);
   (d) The Rondout is Lower (not Late) Devonian and Upper Silurian dolostone (not limestone) with some thinly interbedded shales;
   (e) The Cobleskill is limestone (not dolostone);
   (f) The Bertie Formation is dolostone and gypsum, typically about 80 feet thick, and has three members – Fiddlers Green (23 ft), Forge Hollow (50 ft), Oxbow (7 ft) (oldest to youngest); the upper 15 ft of the Forge Hollow Member has gypsum/anhydrite beds that often include highly porous and transmissive solution voids); the D5 hydrologic unit includes the lower Fiddlers Green and its contact with the underlying Camillus Shale; the D6 exists only at the EPA-14 well and does not include any Bertie units.
   (g) The Camillus is interbedded shale, dolostone, and evaporites.

(h) Note on the table that the "Stratigraphy" column corresponds to the colors of bedrock units shown in the Figure 1-5 geologic section.

2. Table 2-4: Update the Maximum Detected Concentrations.
3. Table 2-5 (and in the text): The use of grout and bentonite hole-plugging materials is not limited to depths less than 100 feet and may be considered as an important hydraulic control at this site to reduce flow rates through contaminated zones, improve the efficiency of pumped treatment, and increase surface-contact times for MNA.
4. Figure 1-1: Identify Owasco Outlet and Crane Brook, which are discussed in the text.
5. Figure 1-3: Wells B-50D5 and B-57D3 are not clearly labeled; they are both to the west of EPA-1.
6. Figure 1-3: Show locations of Powerex wells B-31D3, B32D3, and B33D3, which define a highly contaminated source area and are discussed in the text.
7. Figure 1-5:
   (a) Wells B-50D5 (adjacent to EPA-1) intersects the Camillus Shale at 238 feet bls.
   (b) Well EPA-25 intersects the Camillus Shale at 340 feet bls.
   (c) Why does the land surface not intersect the top of the wells at several points on the section (e.g., EPA-16, EPA-19, EPA-25, CY-206, CY-216, etc.)?
8. Figure 1-7:
   (a) The black vertical arrows that depict recharge should indicate that downward-moving recharge (and contaminant advection at the Powerex plant) to the deep aquifer system is controlled by downward hydraulic gradients and vertical fractures, not increased bed thickness or repeated units, as stated in the Legend explanation; also, the arrow should be vertical in the Legend;
   (b) I do not see any sample concentrations, as indicated in the Legend.
9. Figures 2-1 and 2-2: Sample data from the General Electric Co. would indicate that EPA-11 should be included in Target Area 2.
10. Page 1-10 (¶2): Why is TCE not an IC?
11. Page 1-10 (¶4): Are the concentrations reported for the D3 zone at B-33, and not B-31 and B32?
12. Page 1-12 (¶2): The occurrence of VOCs in the drinking-water supply wells at the Village of Union Springs may also be noted here.
13. Page 1-13 (¶3): Verify that the VOC contamination did not exceed MCLs at the one D6 zone (EPA-14)?

Please contact me to discuss any of the review comments. I would be happy to assist with additional review of revised materials.

Sincerely,

David A.V. Eckhardt

David A.V. Eckhardt
Research Hydrologist

Attached: Revised draft FS text pages

Suggested edits by DAE (USGS):
(9 pages)

pits was reportedly abandoned in 1962 and 1967. Several previous and ongoing investigations were conducted at the former Powerex facility under the direction of NYSDEC. The investigations identified VOC contamination in soil, groundwater, and surface water and are summarized below.

Between 1985 and 1991, a series of four investigations (Phases I through IV) were conducted at the former Powerex facility under the Resource Conservation and Recovery Act (RCRA) Corrective Action Program of NYSDEC. Samples collected from northern evaporation pit soils in 1985 and during a Phase I investigation in 1986, indicated the presence of TCE (4,400 milligrams per kilogram [mg/kg]), xylenes (6,700 mg/kg), and acetone (2,800 mg/kg) within the overburden. TCE, total 1,2-DCE, vinyl chloride, and acetone were detected in overburden and shallow bedrock wells during the Phase II investigation completed in 1987. TCE and *trans*-1,2-DCE were detected in surface water samples. TCE and *trans*-1,2-DCE were also detected in groundwater from additional wells. Results of the Phase III investigation, reported in 1988, indicated that VOCs were present in a drainage ditch located in the northwestern corner of the site and in a storm sewer west of the plant building. The Phase IV investigation was initiated in 1988 and focused on the extent of groundwater contamination within the bedrock aquifer (Dunn 1993).

In accordance with an NYSDEC Order on Consent dated March 31, 1993, an RI/FS was initiated at the former Powerex facility in 1993. The RI/FS was conducted under the auspices of the NYSDEC. Results of groundwater investigations at the former Powerex facility indicated the presence of VOCs including TCE, 1,2-DCE, vinyl chloride, acetone, toluene, xylenes, tetrachloroethene (PCE), and methylene chloride in shallow bedrock at concentrations exceeding NYSDEC groundwater standards or guidance values. Concentrations of 1,2-DCE and vinyl chloride were detected at concentrations exceeding NYSDEC groundwater quality standards in five deep monitoring wells within the Bertie formation on the former Powerex facility.

Groundwater samples collected from deep monitoring wells as part of the former Powerex RI/FS Addendum, Task 9, November 2004 sampling event, indicated concentrations of TCE (480,000 µg/L), *cis*-1,2-DCE (35, 000 µg/L), toluene (3,000 J µg/L), acetone (24,000 µg/L), and methanol (1,800 µg/L) in the deep monitoring interval (D3) of monitoring well B-31 (Figure 1-3) on the former Powerex facility. During recent investigations in 2010, TCE has been observed at concentrations of up to 508,000 µg/L at this location. Such concentrations suggest the potential presence of non-aqueous phase liquids (NAPL). A TCE concentration of 230,000 µg/L was reported in a sample collected from a recovery well (GW-PW-1) ~~on~~ the former Powerex facility on May 6, 2002 (Powerex, 2005).

show B-31 B-32 B-33 on Fig 1-3

in the shallow aquifer at

As part of an interim remedial action, a groundwater extraction and treatment system was completed in 1998 to treat VOCs in the shallow bedrock at the former Powerex facility. An interim remedial action enhancement was completed in 2001. The

groundwater treatment system is currently active and continues to extract and treat VOCs in the shallow groundwater at the former Powerex facility.

1.6 Physical Characteristics of the Study Area

1.6.1 Site-Specific Geology

The Site is located at the northern edge of the Glaciated Allegheny Plateau physiographic province, a table land cut by weathering and erosion into significant hills and valleys and greatly modified by glaciers. The geology of the area is characterized by unconsolidated glacial deposits underlain by consolidated bedrock. The unconsolidated deposits consist of glaciolacustrine clay, silt, fine sand, and glacial till ranging from approximately 5 to 77 feet thick.

Figure 1-4 provides a map of the location of geologic cross-section A-A', which extends from north of the former Powerex facility to the Village of Union Springs, near Cayuga Lake. Geologic cross-section A-A' is shown on Figure 1-5.

The bedrock units consist of a sequence of Devonian and Silurian limestone, dolostone, evaporite, shale, and sandstone formations that dip gradually southward. The youngest rocks identified during borehole logging and rock coring are the lower formations of the Middle Devonian Hamiliton Group (Skaneateles snd Marcellus Formations) which are underlain, in descending order, by the Middle Devonian Onondaga Formation, the Lower Devonian Manlius and Rondout Formations, the Upper Silurian Cobleskill Formation, Bertie Group, and Camillus Shale. The bedrock has little primary porosity; secondary porosity such as fractures and solution voids is common. In general, the deep bedrock is more fractured and more transmissive than the shallow and intermediate bedrock.

In select areas throughout the study area, USGS identified repeated stratigraphic units in some boreholes within the Marcellus, Onondaga, and Manlius Formations, most likely due to localized thrust faulting (USGS 2004). A specific example of this thrusting discussed by USGS occurs in wells on Pinckney Road and Overbrook Drive. The lower Onondaga Formation and the Manlius Formation, where not fractured or faulted, otherwise function as an aquitard across portions of the study area.

Use Bertie Formation to be consistent w/ use in Tables and Figures

The Chrysler Member of the Rondout Formation, comprised of grey interbedded dolostone and shale, underlies the Manlius. The Upper Silurian limestones of the Cobleskill Formation underlie the Rondout and overlie the dolostones of the Upper Silurian Bertie Group Formation, comprised locally of the Oxbow, Forge Hollow, and Fiddlers Green Members. The upper portion of the Forge Hollow, typically about 15 feet thick, is gypsiferous and argillaceous, and has well-developed solution voids. The Bertie Group Formation, which forms the lowermost units of the carbonate rock sequence, overlies the Upper Silurian shales of the Camillus Formation. The Camillus is the deepest unit observed in geologic logs during this RI.

1.6.2 Site-Specific Hydrogeology

Previous investigations by the EPA and USGS, including data gathered from geophysical logging, identified the typical hydrostratigraphic sequence in the study area. The following units have been defined at the Site:

- Overburden
- Shallow Bedrock (Units S1 through S3)
- Intermediate Bedrock (Units I1 and I2)
- Deep Bedrock (Units D1 through D6)

Hydraulic heads are typically highest in the shallow units (S1, S2, and S3) and lowest in the deep units (D1 through D6). The intermediate units often act as an aquitard separating the shallow and deep aquifer units. However, in some areas of the Site vertical fracturing allows the shallow units to drain into the deep units. The water level in an open borehole reflects the composite head of all the units penetrated by the borehole. However, this water level is typically dominated by the head in the most transmissive unit, which often reflects the hydraulic head of the deep bedrock units.

Shallow Bedrock (Units S1, S2, and S3)

The shallow bedrock hydrogeologic units are composed of the upper Onondaga, S1, the upper-middle Onondaga, S2, and the lower Onondaga, S3. The nominal thickness of the Onondaga in the study area is 75 feet. In southern parts of the site, the SI unit may represent the Marcellus Shale bedrock Unit.

The potentiometric data for the shallow bedrock show groundwater flows, in general, northward from Pinckney Road, towards Crane Brook and the Owasco Outlet where the shallow groundwater system discharges. Locally, the shallow zones can become de-watered suggesting that vertical fracturing has breached the underlying intermediate zone, allowing water to drain into the deep zone. Near Overbrook Drive and Pinckney Road, the water levels from open-hole residential wells suggest that vertical fractures ~~have breached~~ extend through the shallow and intermediate zones.

Intermediate Bedrock (Units I1 and I2)

The intermediate bedrock zone consists of the Manlius Formation, which is typically divided into the Upper Manlius (I1) and Lower Manlius (I2). In the study area, the Manlius often functions as an aquitard separating the shallow and deep aquifer units unless it has been breached by vertical fractures. Lower parts of the Onondaga, the entire Manlius, and sometimes the uppermost shale units of the Rondout may also serve as a significant aquitard, thereby generating significant differences in vertical head between the shallow and deep zones.

and its contact with the underlying Camillus Shale.

Deep Bedrock (Units D1 through D6)

The deep bedrock is divided into six zones. The Rondout comprises the D1 unit. The Cobleskill comprises the D2 unit. The Bertie Formation is divided into three units: the D3 zone, ~~which en~~compasses the gypsiferous unit at the top of the Forge Hollow Member, the D4 unit which is in the middle of the Bertie Formation, and the D5 unit at the bottom of the Bertie. The D6 unit is the Camillus Shale, which is the base unit in the RI. ~~Figure 1-6 shows the potentiometric surface map for the D3 zone~~ redundant w/ below.

(only at EPA-14)

The deep units consist of dolomites and limesones of the Devonian to Silurian-age Rondout and Cobleskill Formations and the Bertie ~~Group~~ Formation, with characteristics typical of many carbonate aquifers. In general, the deep bedrock is described as more fractured and more permeable than the limestones of the shallow and intermediate bedrock. Transmissivities within solution voids in the gypsiferous unit at the top of the Forge Hollow are often much higher than other units. The deep bedrock system does not appear to discharge locally based on water-level elevations, which are significantly lower than the elevation of nearby streams. Regional groundwater flow in the deep bedrock in the study area is generally to the south and southwest toward Cayuga Lake. Figure 1-6 shows the potentiometric surface map for the D3 zone in July 2007. As discussed above, the deep bedrock aquifer receives groundwater recharge through fractures connecting the deep and shallow bedrock units. As a result, water levels in the deep bedrock rise rapidly in response to precipitation events. Video logs have shown the Forge Hollow to contain significant voids, resulting in high transmissivities and typically the lowest hydraulic head within the boreholes investigated.

The additional monitoring wells installed in the area of the former Powerex facility during the RI show that groundwater flow in the deep units is to the south, toward West Genesee Street and Pinckney Road. Near Pinckney Road, groundwater flow is southwest, toward Cayuga Lake, which has the lowest water elevation in the County region.

1.6.3 Ecology

An ecological reconnaissance was conducted to characterize the terrestrial and aquatic communities associated with water bodies sampled during the RI. The Site is divided into three areas based on water bodies that were sampled during the RI, and included Owasco Outlet, Crane Brook, and springs in the Village of Union Springs. These three water bodies were selected for sampling and subsequent evaluation because they potentially receive contaminated groundwater discharge.

The United States Fish and Wildlife Service (USFWS) reported that a review of their records for the Site and surrounding areas indicated the that the bald eagle (Federally-listed threatened) and Indiana bat (endangered species) are known to occur within 27 miles of the Site. No other federally-listed threatened or endangered species are known to exist in the vicinity of the Site.

The NYSDEC reported that a review of their records for the Site and surrounding areas indicated that the following State-listed threatened or endangered species have been observed within a two-mile buffer zone of the Site: Woodland agrimony, Golden-seal, Twin-leaf, Short-eared owl, Cooper's Milkvetch, and Slender Pondweed. None of the threatened or endangered species listed above were observed, nor was any suitable habitat for these species observed during the on-site reconnaissance.

1.7 Nature and Extent of Contamination

The characterization and evaluation of the nature and extent of contamination is focused on those constituents identified as indicator contaminants (ICs) in Site groundwater, surface water, and sediment. The ICs selected for groundwater, surface water, and sediment are *cis*-1,2-DCE, *trans*-1,2-DCE, TCE, and vinyl chloride. Not TCE?

1.7.1 Overview of Groundwater Contamination

In general, the local groundwater system in the vicinity of the Site includes a shallow aquifer zone and a deep aquifer zone, separated by a confining unit or aquitard. The shallow aquifer zone is made up of overburden glacial deposits and shallow bedrock, which includes the Marcellus and Onondaga Formations. The deep aquifer zone consists of bedrock formations, which include the Rondout, Cobleskill, and members of the Bertie Group. The Manlius formation (intermediate zone) separates these two aquifer zones, and where it is massive and relatively unfractured, functions as a confining unit, along with lower parts of the Onondaga Formation and, occasionally, the uppermost shale units of the Rondout Formation. However, where the aquitard is discontinuous locally, and the shallow and deep zones are hydraulically connected.

Move ¶ from p. 1-10 to here?

~~Regional VOC data are consistent with groundwater flow~~. The groundwater data show VOC contamination extending to the southwest from Pinckney Road toward Cayuga Lake. The majority of the VOC contamination is found in the deep zone. Between the former Powerex facility and Pinckney Road, groundwater flow in the deep zone is toward the south. In this area, exceedances of VOC screening are seen in the deep intervals of the following wells (from north to south): B-31, B-32, B-33, EPA-01, EPA-02, B-43, B-47, B-49 cluster, CY-205, and CY-204. These wells define the approximate lateral extent of the VOC contamination in the deep zone in the area ~~north of Pinckney Road and~~ Overbrook Drive. In the vicinity of EPA-02 and B-33, the confining unit is apparently vertically fractured ~~breached~~, providing a potential pathway for vertical contaminant migration. TCE (43,000 µg/L) and cis-1,2-DCE (31,000 µg/L) were detected in the D3 intervals of monitoring well ~~clusters B-31, B-32, and~~ B-33, located on the former Powerex facility property, immediately north of West Genesse Street and upgradient of EPA-01 and EPA-02 (Powerex 2005). ?

South of Pinckney Road, groundwater flow is to the southwest, toward Cayuga Lake. Elevated levels of VOCs (up to 400 µg/L) are present in samples from the D2 to D5 zones of EPA-24, located southwest of Pinckney Road. The distribution of VOCs in residential well samples is also consistent with groundwater flow to the southwest in

EPA-1 ?

the area south of Pinckney Road. The highest concentrations of VOCs are found in the deep zones at the following wells (from north to south): EPA-02, the B-49 cluster, CY-204, and CY-205. In the deep aquifer zone, contaminants are transported with groundwater flow in the more transmissive deep bedrock units, particularly in the D3 gypsiferous zone of the Forge Hollow unit. Thrust faulting and fracturing near upward Pinckney Road and Overbrook Drive results in a hydraulic connection for migration of contaminants from the D3 zone into the lower Manlius ~~formation~~ (I2) and Rondout (D1) zones.

move this ¶ up to be the #2 ¶ in section 1.7.1 ?

Little contamination was found in monitoring wells in shallow zones outside the former Powerex facility. Overall, the shallow and intermediate bedrock units appear less transmissive than the deep units and wells that monitor the shallow units frequently have dry intervals. Thus, migration in the shallow bedrock is mainly limited to areas within the former Powerex facility. Significant vertical hydraulic head differences between the shallow and deep zones and the presence of localized vertical migration pathways support downward migration of contaminants from shallow sources into the deep zones. Once in the deep zone, VOCs are transported in the more transmissive deep bedrock units, particularly in the gypsiferous zone of the Forge Hollow unit (D3).

(See p. 1-10)

1.7.2 Summary of Surface Water and Sediment Contamination

No ICs were detected in surface water and sediment samples collected from Owasco Outlet and Crane Brook. A number of ICs, including TCE, PCE, *cis*-1,2-DCE, and *trans*-1,2-DCE were detected in surface water samples collected from the Village of Union Springs at concentrations exceeding screening criteria. Concentrations of cis-1,2-DCE exceeded the screening criterion of 5 µg/L in four of the nine surface water sampling locations, occurring at a maximum concentration of 18 µg/L. None of the other VOCs detected exceeded their respective screening criterion.

Surface water samples were collected from two springs and a stream associated with one of the springs. The locations were selected because they are considered potential groundwater discharge areas near Cayuga Lake. The VOCs detected in the surface water samples collected from the Village of Union Springs are similar to those detected in upgradient groundwater samples (i.e., *cis*-1,2-DCE, TCE, and *trans*-1,2-DCE) and are consistent with the discharge of contaminated groundwater to the surface. VOCs were also detected in samples collected from the Village of Union Springs public supply well, located approximately 900 feet north-northeast of the nearest spring.

1.8 Summary of Contaminant Fate and Transport

The fate of a chemical in the environment is a function of its physical and chemical properties and conditions at the Site. The potential for environmental transport is a function of the conditions at the Site, including geological and hydrogeological characteristics. The primary fate and transport aspects are summarized below.

Little or no groundwater contamination exists in the shallow zone. The groundwater contamination in the deep bedrock is highest in the D3 zone beneath the former Powerex facility. Contaminated groundwater moves downgradient in the gypsiferous D3 zone from the former Powerex facility and flows toward discharge points at or near Cayuga Lake near Union Springs. As groundwater flows downgradient in the D3 zone, contaminant concentrations decrease but do not appear to be significantly retarded by the geology.

- Groundwater discharge to surface water is a potential transport mechanism for VOCs in groundwater. Low concentrations of VOCs, similar to those detected in groundwater, were detected in springs and a creek in the Village of Union Springs.

- With the exception of the area near EPA-01, geochemical conditions in the aquifer are not conducive to reductive dechlorination of VOCs. However the presence of *cis*-1-2-DCE at high concentrations, TCE in relatively low concentration, and the presence of TCE degradation products including vinyl chloride, ethane, and ethene suggest that anaerobic reductive dechlorination is occurring or has occurred in the vicinity of the Site. It is likely that degradation of TCE is occurring near the source and that primary degradation products are being transported downgradient with minimal additional degradation.

- Site-related contaminants are not expected to bioaccumulate.

1.9 Conceptual Site Model

The Conceptual Site Model (CSM) is developed to integrate all the different types of information collected during an RI, including geology, hydrogeology, Site background and setting, and the fate and transport of contamination associated with the Site. Figure 1-7 is an illustration of the CSM for the Site.

1.9.1 Physical Setting with Respect to Groundwater Movement

Four major hydrogeologic units are present in the study area:

- Overburden
- Shallow Bedrock (S1 through S3)
- Intermediate Bedrock (I1 and I2)
- Deep Bedrock (D1 through D6)

There is considerable potential for downward flow of VOCs from the shallow to the deep bedrock units. Vertical hydraulic head differences between the upper and lower bedrock units can exceed 80 feet. Where massive and relatively unfractured, the intermediate bedrock units act as a confining unit. However, the lower aquifer units respond rapidly to infiltrating rainwater and snow melt, indicating that vertical connections exist in areas where the confining unit is breached. The confining unit appears to be breached at EPA-02 (downgradient of the former Powerex facility), at B-

33 (at the former Powerex facility), and at CY-204 and CY-205 (along Overbrook Drive and Pinckney Road). Evidence from downhole logging of vertical connections between the shallow and deep bedrock units include highly fractured bedrock and high-angle fractures at EPA-02 and thrust faulting and highy fractured bedrock in the vicinity of Pinckney Road. VOCs that reach the more transmissive, deep bedrock units migrate downgradient with groundwater flow to the south and then southwest, toward Cayuga Lake, the lowest water elevation in the study area.

Groundwater flow in the shallow bedrock units is variable, generally flowing toward local discharge areas such as streams. From north of the former Powerex facility south to Pinckney Road, groundwater flow in the shallow bedrock units is to the north, toward Crane Brook and Owasco Outlet. The shallow bedrock units are de-watered in some areas, which suggests that, locally, groundwater drains from the shallow to the deep units. From EPA-19 south to Pinckney Road, groundwater flow in the deep bedrock is to the south, toward Pinckney Road. South of Pinckney Road, the deep bedrock groundwater flow is toward the southwest and Cayuga Lake. Springs and seeps fed by discharging groundwater were observed in the Village of Union Springs, which borders Cayuga Lake.

(None in D6 at EPA-14?)

VOC contamination was primarily detected in groundwater samples from the deep bedrock units (D1 through ~~D6~~ D5 zones). In the area between West Genesee Street and Pinckney Road, VOC contamination is confined to a relatively narrow area defined by monitoring wells EPA-01, EPA-02, EPA-09, B-43, B-47, B-49, CY-204, and CY-205, with EPA-01 and EPA-02 consistently showing the highest VOC concentrations in historical and RI groundwater samples. This contaminant distribution is consistent with southward groundwater flow in the deep bedrock. At Pinckney Road, the relatively narrow plume widens, extending to the east and west along Pinckney Road and Overbrook Drive.

South of Pinckney Road, groundwater in the deep bedrock flows to the southwest, toward Cayuga Lake and the Village of Union Springs. VOCs in this area occur primarily in the deep bedrock units. VOC data from numerous residential wells collected from 1999 through 2007 by CCDOH show a VOC distribution consistent with groundwater flow to the southwest. Data from monitoring well EPA-24 and residential wells sampled in 2006 and logged by USGS show the general distribution of VOCs in the area south and west of Pinckney Road.

1.9.2 Potential Contaminant Sources

TCE was used and disposed in open pits at the former Powerex facility, currently a NYSDEC State Superfund Site, located on West Genesee Street. A groundwater extraction and treatment system is currently operating at the former Powerex facility to treat VOCs in the shallow bedrock. Concentrations of TCE (230,000 µg/L) and *cis*-1,2-DCE (82,000 µg/L) have been detected in an extraction well (GW-PW-01) ~~on~~ in the shallow aquifer at the former Powerex facility (Powerex 2005).

The former Powerex facility is considered to be a source of the VOCs in groundwater at the Site. Deep (D3) zones at monitoring wells EPA-01 and EPA-02, located approximately 900 feet south of the former Powerex facility, have the highest concentrations of VOCs of all RI monitoring wells in the study area. Groundwater flow in the deep bedrock at the former Powerex facility is to the south, toward West Genesee Street and Pinckney Road. Monitoring wells downgradient of the former Powerex facility, including EPA-01, EPA-02, CY-204, CY-205, B-43, B-47, and B-49, show concentrations of VOCs, principally *cis*-1,2-DCE, exceeding screening criteria in the deep bedrock units. VOCs, including *cis*-1,2-DCE, TCE, and vinyl chloride, in the deep bedrock monitoring wells are similar to those detected in samples from the shallow and deep zones at the Former Powerex facility.

1.9.3 Expected Transport and Fate of Site Contaminants

The expected fate and transport of Site contaminants in groundwater, air, surface water, and sediment is discussed below.

Groundwater

Liquid chlorinated solvents such as TCE released to the ground surface can migrate downward through the unsaturated zone in a relatively linear pattern, with minimal dispersion from the discharge location. Once the liquid chlorinated solvents such as TCE encounter the water table, the solvent will dissolve into the groundwater and move in the direction of groundwater flow. Depending on the quantity released, not all of the TCE will dissolve and it will continue moving downward under the force of gravity as a dense non-aqueous phase liquid (DNAPL). TCE concentrations greater than 300,000 µg/L, which is indicative of the presence of DNAPL, were detected in samples from monitoring wells B-31(D3) and B-32(D3) on the former Powerex facility (Powerex 2005). VOCs in the dissolved phase generally are weakly adsorbed and tend to move with groundwater flow. In highly transmissive bedrock where adsorption is expected to be low, such as in the gypsiferous void interval of the Forge Hollow, VOCs can migrate at high rates.

Evaluation of MNA parameters suggest that conditions ~~at~~ over much of the Site are not conducive to reductive dechlorination of VOCs. However, based on the elevated concentrations of *cis*-1,2-DCE and relatively low concentrations of TCE in groundwater, it appears that degradation is occurring, possibly closer to the source where conditions may be more favorable for degradation to occur. The primary degradation products then migrate downgradient in the aquifer with little subsequent degradation.

Air

TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride are volatile organic chemicals. As such, they volatilize to the atmosphere and, in the unsaturated soil zone, to the pore spaces between soil particles. Vapors move through the unsaturated zone pore spaces and bedrock spaces. As vapors move through the unsaturated zone, they can enter structures, such as homes, affecting air quality. In general, at the Site, VOCs are in the deep bedrock units at depths greater than 100 feet bgs. In addition, in areas where the