the location and influence of Spring Creek at the easterly end of the contaminant plume is significant with respect to providing a potential termination point for the plume.

It has been determined that the bedrock beneath the spill site and Study Area contains both high angle and horizontal fractures that can readily transmit groundwater. Water level measurements collected over a 10-month period indicate that the bedrock underlying the spill site and Study Area contains features that inhibit groundwater movement as well as features that transmit water readily. Both of these conditions are demonstrated by the water level measurements collected in the wells located at and in the immediate vicinity of the spill site. Groundwater levels in the Study Area are at their highest in the spring and drop throughout the summer to their lowest levels in the late summer and early fall. Groundwater in the vicinity of Mud Creek behaves dynamically in the spring, with Mud Creek responding rather dramatically to the influx of both groundwater and surface water from either or both snowmelt and precipitation events. The dynamic behavior of groundwater and surface water in the vicinity of Mud Creek in the spring is due, in part, to the fact that the groundwater levels have approached their highest level by slow recovery and rise over the winter months. With the addition of the springtime influx of groundwater, the water levels in the already full basin rise rapidly and overflow onto the land and to the northeast out the Mud Creek valley. Spring Creek's discharge, on the other hand, remains relatively stable throughout the year in response to a base level flow provided by numerous springs.

The discussion of analytical results presented in Section 6.0 provides an indication of how the general pattern of groundwater movement has influenced the relative levels of TCE at many of the locations sampled during the RI. A more focused discussion of groundwater movement and contaminant migration is presented in Section 7.0. An understanding of the mechanism(s) of mobilization and migration of the plume is also critical to the evaluation of alternatives to remediate, i.e., to remove or control the remaining source of TCE and the dissolved phase plume.

6.0 ANALYTICAL RESULTS

6.1 HISTORICAL SAMPLING AND ANALYTICAL DATA

In 1991, the NYSDOH sampled a number of domestic wells located between the Village of Caledonia and the spill site. This sampling was conducted in relation to an investigation of contamination present in the Caledonia municipal wells located to the east of the village, and awareness of the LVRR derailment-related spill of TCE. As a result of this sampling, a number of domestic wells were found to be contaminated with TCE. The sampling program was expanded to include locations in a three county (Genesee, Livingston and Monroe) area between the spill site and the villages of Mumford and Caledonia. Additional wells containing traces or elevated levels of TCE were discovered within this area, and extending from Gulf Road/Flint Hill Road (Monroe County) on the north to Route 5 on the south. Appendix B (Volume III of this RI) contains tables of historical TCE sampling results by NYSDOH and three county health departments in 1991 and 1992 (Tables B-G = Genesee, B-L = Livingston and B-M = Monroe). Tables B-G2, B-L2 and B-M2 also contain the results of DUNN's initial domestic well sampling conducted in December 1992. Refer to Section 6.2.2. for more details of this sampling event. Although not "historical" in the context of this subsection, Tables B-G3 through B-M4 present the TCE results for all domestic well sampling conducted by NYSDOH and DUNN in 1993 and 1994.

6.2 INITIAL RI (PHASE B) SAMPLING AND ANALYTICAL DATA

6.2.1 Initial Environmental Sampling and Analytical Data

An initial round of environmental sampling took place in December 1992, as part of a preliminary assessment of Site and Study Area conditions. Environmental samples were collected from drainageways (surface water, sediment), ponds (surface water, sediment), springs and seeps. These samples were collected from areas or specific locations suspected of being contaminated, as well as areas expected to be free of contamination. These areas or locations consisted of potential contaminant migration pathways, potential groundwater discharge points and points expected to be outside the limits of contamination, thereby providing evidence of ambient or background conditions. A list of the initial environmental sampling locations and the reason(s) for their selection is as follows:

Location		Reason(s)
SED-1	Mud Creek valley upstream of "swallet"	To provide an indication of relict contamination resulting from historical impact of the spill on the Mud Creek valley upstream of the mainline railroad fill.

Note: This section of the valley was dry during sampling such that a companion surface water sample could not be collected at this location.

Location		Reason(s)
SW-2 SED-2	Mud Creek valley in "swallet"	To confirm results of previous sampling by NYSDEC and to monitor surface water quality in the "swallet" on a seasonal basis. A companion sediment sample was also collected to identify relict contamination in the bottom of the "swallet".
SPR-3	Mud Creek falls	To determine baseline water quality at a perennial bedrock spring/seep in Mud Creek falls.
SPR-4	Mud Creek gorge	To determine water quality in springs/seeps entering the Mud Creek gorge downstream of the spill site.
SPR-5	Oatka Creek valley upstream of the confluence of Mud and Oatka Creeks	To identify potential routes of contaminant migration to Oatka Creek and /or to establish ambient/background surface water/spring water quality.
SED-6	Pond in the Mud Creek gorge	To identify relict contamination in the Mud Creek gorge. Surface water samples were not collected at this time.
SPR-7	Spring in Mud Creek gorge just upstream of pond	To determine water quality in springs/seeps entering the Mud Creek gorge downstream of the spill site.
SED-8	Mud Creek gorge northeast of Pond	To identify relict contamination in the Mud Creek gorge.
SPR-9	Oatka Creek valley upstream of the confluence of Mud and Oatka Creeks	To identify potential routes of contaminant migration to Oatka Creek and /or to establish ambient/background surface water/spring water quality.
SPR-10	Oatka Creek valley west of Spring Creek confluence with Oatka Creek	To identify potential routes of contaminant migration to Oatka Creek and /or to establish ambient/background surface water/spring water quality.
SPR-11	Spring Creek headwaters in MacKay Park west of Spring Street. Spring "boils" out of creek bottom.	To identify water quality at potential discharge point (receiving water body) of the groundwater dissolved phase plume.

Location		Reason(s)
SPR-12	Middle section of Spring Creek, south of Chessie RR line, on west side of creek.	To identify water quality at potential discharge point (receiving water body) of the groundwater dissolved phase plume.
SPR-13	Seep in abandoned quarry face north of Knickerbocker Hotel.	To determine water quality and potential groundwater migration pathways away from the spill site.
SW-14 SED-14	Pond north of Genesee Country Inn, north of George Street (Rte. 147) in Village of Mumford.	To identify potential existing and/or relict contamination in a potential receiving water body for the dissolved phase groundwater plume (via Spring Creek).

Tables 6-1A, 6-1B and 6-2 summarize the VOC and cyanide analytical results of the December 1992 initial environmental sampling event. A map showing the sampling location and details of the event are provided in DUNN's report entitled Domestic Well and Initial Environmental Sampling Report, dated May 1993. Many of the locations are shown on Plate 2.

6.2.2 Initial Domestic Well Sampling and Analytical Data

Several domestic wells were also sampled in December 1992, during Phase B of the remedial investigation. All but one of the domestic wells were located almost directly south of the spill site along Route 5. These wells, consisting of those with the deepest reported depths in the area, were sampled to check for the possible down dip migration of NAPL and/or a dissolved phase plume. The other domestic well was at a former residence at 8389 Gulf Road. This abandoned well was reported to be 70 feet deep (Marshall, 1971). When "sounded" by DUNN staff in 1992, the well "bottom" was approximately 39 feet deep and the depth to water was 22.5 feet below the ground surface. Two samples were collected from this well, one "intermediate" sample from just below the top of the water column (30 feet) and one "deep" sample from the bottom of the well. Table 6-3 identifies the well locations and their reported depths. Table 6-4 summarizes the volatiles results of DUNN's initial domestic well sampling event in December, 1992. Cyanide results are summarized on Table 6-2. Details of the event are provided in the Domestic Well and Initial Environmental Sampling Report, dated May 1993. The domestic well sampling locations are shown on Figure 3-1.

6.3 RI (PHASE C) SAMPLING AND ANALYTICAL DATA

6.3.1 Environmental Sampling and Analytical Data

6.3.1.1 Spring/ Surface Water Sampling and Analytical Data

6.3.1.1.1 Round 1 - July 1993

In July 1993, six spring samples and four surface water samples were collected and analyzed for volatile organics by EPA Method 8010, and for cyanide by the NYSDEC, ASP, CLP methodology. The analytical results are summarized in Table 6-5. Sampling locations are shown on Plate 2. The Spring No. 5 (SPR-5) sample of the July 1993 sampling event was not collected at the same location as the SPR-5 sample collected in December of 1992, and reported in the Domestic Well and Initial Environmental Sampling Report dated May 1993. To avoid further confusion, the July 1993, Spring No. 5 sampling point was redesignated as Spring No. 20 (SPR-20) in subsequent sampling events (Rounds 2 through 5). Similarly, Spring No. 11A became SPR-18 in subsequent events.

The analytical results from this sampling event revealed that trichloroethene was detected in samples SPR-4, SPR-5 (SPR-20), SPR-12, and surface water sample SWFH-1, at concentrations that exceeded or were equal to the NYSDEC human water source based surface water guidance value of 3 μg/l. The SPR-4, SPR-5 (SPR-20), and SPR-12 samples also exceeded the NYSDEC human health bioaccumulation (ingestion of fish) based surface water guidance value of 11 μg/l. Low concentrations, i.e. below the applicable surface water guidance values, of trichloroethene were detected in samples SPR-11A (SPR-18), SW-14 and SW-15. The compound trichloro-fluoromethane was detected in sample SPR-12 at an estimated concentration that was below the laboratory quantitation limit. There is no NYSDEC surface water standard for this compound. This compound is not considered to be related to the derailment/spill.

The three environmental samples analyzed for cyanide [SPR-4, SPR-5 (SPR-20) and SW-2] were all reported below the laboratory reporting limit (10 μg/l). The results are summarized in Table 6-6.

6.3.1.1.2 Round 2 - November 1993

The volatile organic analytical results from the November 1993 (Round 2) sampling event are summarized in Table 6-7. The results indicated that samples SPR-4, SPR-12, SPR-20 and SPR-L23S exhibited TCE concentrations that exceeded the surface water guidance value (3 μg/l). The highest concentration was detected in the SPR-20 sample (400 μg/l), which was collected from a location downstream of the Site in Mud Creek. The SPR-4 sample, collected from a location approximately 2,700 feet downstream of the Site in the Mud Creek valley, exhibited a concentration of 98 μg/l of TCE. Spring No. 12, located approximately 3.5 miles east of the Site and opposite (west of) the Caledonia State Fish Hatchery, exhibited a TCE concentration of 99 μg/l. TCE was also detected in the SPR-L23S sample, which was collected from a location adjacent to Spring

Creek, approximately 3.75 miles east of the Site and approximately 2,000 feet upstream (south) of the fish hatchery, at a concentration of 3.3 μg/l.

The SWFH-1 sample, collected from Spring Creek at the fish hatchery, exhibited concentrations of 1,1-dichloroethene (0.9 μg/l) and tetrachloroethene (2.6 μg/l) that exceeded their respective surface water guidance values for protection of human health with respect to drinking water supplies. Neither of these compounds is considered to be related to the derailment/spill.

Trichloroflouromethane and carbon tetrachloride were detected in the SPR-4 sample. The carbon tetrachloride concentration (3 μg/l) exceeded the groundwater standard (0.4 μg/l), which is based on human health effects related to use of the water as a drinking water source. Carbon tetrachloride has been reported as a contaminant of reagent grade TCE. However, neither compound has been consistently detected in samples that contain TCE. Therefore, neither the trichlorofluoromethane nor the carbon tetrachloride are considered to be related to the derailment/spill.

Sample SPR-12 exhibited a 1,2-dichloroethene concentration (6 μg/l) that exceeded the surface water guidance value (5 μg/l), which is based on human health effects related to use of the water as a drinking water source. 1,2-dichloroethene is a known degradation product of TCE.

The November 1993 (Round 2) TCE concentrations detected in samples SPR-4, SPR-12, SPR-19, SPR-20 and SW-2 are consistent with the July 1993 (Round 1) sample results. The low estimated concentrations of carbon tetrachloride and trichloroflouromethane detected in the November 1993, SPR-4 sample were not detected in the January 1994, SPR-4 sample. The TCE detected in the July 1993, SWFH-1 sample was not detected in the November 1993, SWFH-1 sample, and the 1,1-dichloroethene and tetrachloroethene detected in the November 1993, SWFH-1 sample were not detected in the July 1993, SWFH-1 sample. The trichloro-fluoromethane, carbon tetrachloride, 1,1-dichloroethene and tetrachloroethene are not considered to be derailment/spill-related contaminants.

Cyanide was analyzed for in three environmental samples (SPR-4, SPR-20 and SW-2). The samples were collected from the same locations as the Round 1 cyanide samples. All of these samples were again reported as being less than the laboratory reporting limit (10 μg/l) and are consistent with the Round 1 results. The results are summarized in Table 6-6..

6.3.1.1.3 Round 3 - January 1994

Samples were collected from six springs, during the January 1994 (Round 3) sampling event. The analytical results for spring samples SPR-4, SPR-11, SPR-12, SPR-18, SPR-20 and SPR-L23S are summarized in Table 6-8. The analytical results revealed that TCE concentrations in the SPR-4, SPR-12, SPR-20 and SPR-L23S again exceeded the surface water standard of 3 μg/l.

The January 1994, SPR-4, SPR-11, SPR-12 and SPR-20, TCE concentrations were consistent with the July 1993 sample results. The January 1994 TCE concentrations in samples SPR-4, SPR-12 and SPR-20 were also consistent with the November 1993 sample results, as was the SPR-L23S result. The low, estimated concentration of TCE detected in the July 1993, SPR-18 sample was not detected

in the January 1994 sample. The low, estimated concentrations of carbon tetrachloride and trichlorofluoromethane detected in the November 1993, SPR-4 sample were not detected in the July 1993 sample or the January 1994, SPR-4 samples. As previously stated these compounds are not considered to be related to the derailment/spill.

Spring samples SPR-4 and SPR- 20 were also analyzed for cyanide, with both results reported as non-detect at a detection limit of 10μg/l. The cyanide results are summarized in Table 6-6.

6.3.1.1.4 Round 4 - April 1994

Samples were collected from 13 springs and 6 surface water locations during the April 1994 (Round 4) sampling event. Eight of the locations were also sampled and analyzed for cyanide. The volatile organic analytical results are summarized in Table 6-9. The surface water/spring analytical results from April 1994 revealed that TCE was detected in samples SPR-3, SPR-4, SPR-7, SPR-12, SPR-20, SPR-20A, SPR-21, SPR-L23S, SW-2, and SW-17 at concentrations that exceeded the surface water guidance value. Chlorobenzene and 1,1,1-trichloroethane were detected in the SPR-3 sample at concentrations that exceeded the chlorobenzene surface water standard (5 μg/l) for protection of aquatic life and the 1,1,1-trichloroethane surface water guidance value for protection of human health associated with ingestion of water. The reported 1,1,1,-trichloroethane concentration is suspected of being laboratory-derived and is not considered to be spill-related. Chlorobenzene is also not considered to be a derailment/spill-related contaminant and has not generally been detected in samples that have consistently exhibited TCE.

Carbon tetrachloride and chlorobenzene were detected in the SPR-20A sample at concentrations that exceeded the surface water standard. The chlorobenzene concentration (5.9 μg/l) was estimated and only slightly above the surface water standard (5 μg/l). Methylene chloride and trichlorofluoromethane were detected in the SPR-22 sample at concentrations below the groundwater standard. Methylene chloride is a common laboratory contaminant and was detected in laboratory blanks associated with this sampling event. Therefore, the detection of methylene chloride in this sample is considered suspect and is, most likely, laboratory-derived. As previously stated, trichloroflouromethane is not considered to be a derailment/spill-related contaminant.

Samples SPR-3, SPR-4, SPR-7, SPR-20, SPR-20A and SW-2 were collected downstream of the spill site in the Mud Creek drainageway. The TCE concentrations in all six of these samples exceeded the surface water guidance value. Samples had not previously been collected from the SPR-7 (since December 1992) and SPR-20A locations. The SPR-20A location is in close proximity to SPR-20, but is suspected of representing a different direction and source of groundwater flow.

TCE was not detected in the November 1993, SPR-3 and SW-2 samples. The SPR-3 TCE concentration (270 μg/l) was significantly higher than the surface water guidance value. Spring No. 3 is located 2,000 feet northeast and downgradient of the spill site, adjacent to Mud Creek falls. The April 1994, SW-2 TCE concentration (3.7 μg/l) was only slightly greater than the surface water guidance value (3 μg/l). SW-2 is located in Mud Creek, approximately 600 feet southeast of the spill site. The TCE concentration (40 μg/l) detected in the April 1994, SPR-4 sample was half the

November 1993 TCE concentration, but was consistent with the July 1993, and January 1994, SPR-4 TCE concentrations. The April 1994, SPR-7 concentration (39 μg/l) exceeded the surface water guidance value of 3 μg/l. As stated above, this was the first time the SPR-7 location had contained water and could be sampled since the December 1992 sampling event, when the TCE result was 130 μg/l. The SPR-7 sampling location is approximately 345 feet from the SPR-4 sampling location. The TCE results for samples SPR-4 and SPR-7 were very similar, i.e. essentially the same, at 40 μg/l and 39 μg/l, respectively. The April 1994 TCE concentration from SPR-20 was also less than the reported concentrations from the July 1993, November 1993, and January 1994 samples; however, the April 1994, SPR-20 TCE concentration was still significantly elevated with respect to the surface water guidance value. The lower results for the April 1994, SPR-4, SPR-7 and SPR-20 samples could be related to the higher water levels and greater dilution at this time of year.

Sample SW-16 was collected from Mud Creek upstream of the spill site. This sample was considered to represent background or ambient conditions in the Mud Creek drainageway. Sample SW-17 was collected from the end of a quarry pumpout discharge pipe on the Dolomite Products Company property. Neither of these locations had been sampled prior to the April 1994 monitoring event. No volatile organic compounds were detected in the SW-16 sample. TCE was detected in the SW-17 sample at a concentration (80 μg/l) that exceeded both the groundwater standard (5 μg/l) and the surface water guidance value (3 μg/l). The data indicate that the quarry discharge water has been impacted by TCE, probably related to the derailment/spill. This water enters Mud Creek approximately 3,000 feet upstream (south) of the spill site.

The April 1994 analytical results from SPR-11 and SPR-18 are generally consistent with the July 1993 and January 1994 sampling events. SPR-11 and SPR-18 are located approximately 4 miles east southeast of the spill site in the vicinity of the headwaters of Spring Creek, in the Village of Caledonia. Volatile organic compounds have not been detected in any of the SPR-11 samples throughout the sampling program. SPR-11 was not sampled in November 1993. With the exception of a low estimated concentration of TCE in the July 1993, SPR-18 sample, volatile organic compounds have not been detected in any of the SPR-18 samples throughout the sampling program.

The April 1994 analytical results from SPR-L23S are consistent with results from samples previously collected at this location (November 1993 and January 1994). TCE concentrations from this location have ranged from 3.3 μg/l to 4.9 μg/l and have consistently been slightly higher than the surface water guidance value (3 μg/l). No other volatile organic compounds have been detected in the samples from the SPR-L23S location.

The April 1994 analytical results from sample SPR-12 indicated that, consistent with previous results from samples collected at this location (July 1993, November 1993, and January 1994), the reported TCE concentration exceeded the surface water guidance value. Although the April 1994 TCE concentration was the lowest reported to date, the reported concentration (64 μg/l) is consistent with past results. With the exception of a low concentration of trichlorofluoromethane reported in the July 1993 sample, no other volatile organic compounds have been detected in samples collected from the SPR-12 location. As previously discussed, trichlorofluormethane is not considered a derailment/spill-related contaminant.

Surface water samples SW-22, SW-23 and SW-25 were collected from locations south of Route 5, southeast of, and approximately 2, 2, and 3 miles, respectively, from the spill site. Samples had not been collected from these locations prior to the April 1994 sampling event because they had been dry. The analytical results indicated that no volatile organic compounds were present in the SW-23 and SW-25 samples. Low, estimated concentrations, below the surface water standard, of trichlorofluoromethane and methylene chloride were detected in the SW-22 sample. Methylene chloride is a common laboratory contaminant and was detected in laboratory blanks associated with the April 1994 sampling event. The methylene chloride is, most likely, laboratory-derived. Neither trichlorofluoromethane nor methylene chloride are considered to be derailment/spill-related contaminants.

Samples SPR-21 and SPR-26 were collected approximately 3.8 miles east-southeast of the Site, approximately 700 feet west of, and near the headwaters of Spring Creek. Samples had not been collected from these locations prior to the April 1994 sampling event because these locations had been dry and had not previously been identified. The analytical results indicated that no volatile organic compounds were present in the SPR-26 sample. TCE was detected in the SPR-21 sample at a concentration of 1,900 μg/l. This was the highest TCE concentration detected in any spring or surface water sample collected throughout the Study Area. An attempt was made to collect a confirmatory sample at this location in June 1994 after the analytical results had been received and validated. The location was dry, however, and a sample could not be collected at that time.

Samples SPR-19 and SPR-24 were collected between Lime Rock Road and Spring Street, north of Route 5, approximately 3.07 and 2.17 miles, respectively, east of the spill site. Neither location had been sampled prior to the April 1994 sampling event. Analytical results revealed that, with the exception of a low concentration of TCE in sample SPR-24 (1.7 μg/l), no volatile organic compounds were detected in samples from either location.

Samples from eight springs and surface water locations (SPR-3, SPR-4, SPR-7, SPR-20, SPR-20A, SW-2, SW-16 and SW-17) were analyzed for cyanide. All reported results were below the laboratory detection limit (10 μg/l). The results for the SPR-4 and SPR-20 samples were consistent with previous results. Refer to Table 6-6 for a summary of the cyanide results.

6.3.1.1.5 Round 5 - July 1994

In July 1994, surface water/ spring samples were collected from locations SPR-4, SPR-20A, SW-17, SW-6B and SW-6C in the Mud Creek drainageway and SPR-11, SPR-12, SPR-18, SPR-19, SPR-19A and SPR-23S in the Spring Creek drainage area. The SW-6B and SW-6C samples were collected from the gorge pond at locations that had not previously been sampled. Sample SW-6B was collected from the south side of a dike located approximately a third of the way along the length of the pond. Sample SW-6C was collected from behind (south of) the dam located at the north end of the pond, farthest from the point where Mud Creek enters the pond. Spring 19A is located upstream of the original Spring 19. The samples were analyzed for volatile organic compounds but not for cyanide. The analytical results for the Round 5 spring/surface water samples are summarized on Table 6-10.

The July 1994 analytical results from the samples collected in the Mud Creek drainageway revealed that TCE was detected in all the samples at concentrations that exceeded the surface water guidance value. The TCE concentration detected in the SPR-20A sample (530 μg/l) was significantly higher than the TCE value detected in the April 1994 sample from this location (95 μg/l). The TCE concentration detected in the SPR-4 sample was consistent with historical data from this spring. Cis-1,2-DCE was detected in the SPR-20 A sample (6 μg/l) at a concentration that exceeded the surface water guidance value (5 μg/l) for protection of human health with respect to water consumption.

TCE was detected in samples SW-6B and SW-6C at 29 μg/l and 6 μg/l, respectively, both of which exceeded the surface water guidance value (3 μg/l). The lower concentration detected in the SW-6C sample may indicate that TCE concentrations in the pond are diluted as the distance from the springs in Mud Creek increases.

TCE was detected in the SW-17 sample at a concentration of 29 μg/l, which exceeds the surface water guidance value (3 μg/l). The July 1994 concentration was lower than the concentration detected in the April 1994 sample (89 μg/l). As previously mentioned, SW-17 is the discharge from the quarry located southwest of the spill site.

Analytical results from the samples collected in the Spring Creek drainage area revealed that TCE was detected above or at the surface water guidance value in samples from SPR-12 (46 μg/l), and SPR-L23S (3 μg/l). TCE was also detected at low, estimated concentrations, below the surface water guidance value, in the SPR-18 and the SPR-19A samples. The July 1994, SPR-12 and SPR-23S TCE concentrations were generally consistent with historical data from these locations. However, the July 1994, SPR-12 TCE concentration was the lowest reported to date.

6.3.1.2 Sediment Sampling and Analytical Data

Sediment samples were collected during the July 1993, November 1993, and July 1994 sampling events. The July 1993 through April 1994 samples were analyzed for volatile organic compounds only. The July 1994 sediment samples were analyzed for volatiles and cyanide. In July 1993, one sediment sample (SED 15) was collected from a backwater area of a tributary to Spring Creek on property between Route 147 (George Street) and Oatka Creek. This location was approximately 700 feet southwest and upstream of the confluence of Spring Creek with Oatka Creek. The sample was analyzed for volatile organics by EPA Method 8010. In November 1993, four sediment samples were collected from a pond located behind (north of) the Genesee Country Inn, on Route 147 in Mumford. Two samples were collected from two different locations in the pond for a total of four samples. At each location, a sample was collected from a depth of 0-6 inches and 12-18 inches. Samples were analyzed for volatile organics (EPA Method 8010) and total organic carbon (TOC). In July 1994, sediment samples were collected from three locations in the Mud Creek channel and two locations in the gorge pond. The sediment samples collected in the Mud Creek drainageway were collected at surface water locations SW-2, SW-3 and SW-6A. The two samples collected from the pond were collected at locations SW-6B and SW-6C.

The volatile organic analytical results for the July 1993, November 1993, and July 1994 samples are summarized in Tables 6-5, 6-11 and 6-12, respectively. The cyanide results are summarized on Table 6-6. The sampling locations are indicated on Plate 2.

Analytical results from sample SED-15, collected in July 1993, indicated that, with the exception of low, estimated concentrations of dichlorodifluoromethane and 1,3-dichlorobenzene, no volatile organic compounds were detected in this sediment sample. Neither of these compounds are considered to be compounds that are related to the derailment/spill.

Analytical results from the November 1993, SED-14 A-D samples indicated that, with the exception of acetone in the SED-14A and SED-14B samples, no volatile organic compounds were detected in the samples. Acetone is a common laboratory contaminant and the result is suspected of being laboratory-derived and not related to the derailment/spill. Total organic carbon concentrations ranged from 23,000 mg/kg to 100,000 mg/kg. The wide variation in TOC content is common and, most likely, due to the nature of the sediment material. The top six inches of the pond sediment contained a high content of organic material, such as leaves and other vegetative matter, in a highly decomposed state, and, therefore, exhibited high TOC concentrations. The 12-18 inch samples contained a significantly smaller quantity of decaying organic material and exhibited a lower TOC concentration.

The July 1994 sediment volatile organic analytical results indicated that low concentrations of TCE were detected in the SED-2 (5 μg/kg) and SED-3 (4 μg/kg) samples. Cis-1,2-DCE was detected in the SED-2, SED-6A, SED-6B and SED-6C samples at concentrations of 4 μg/kg, 58 μg/kg, 90 μg/kg and 19 μg/kg, respectively. Toluene was detected in the SED-6B sample at a low estimated concentration of 6 μg/kg. Toluene is not considered to be related to the derailment/spill. The detection of cis-1,2-DCE in the sediment samples indicates that limited biotic, most likely anaerobic, degradation of TCE to Cis-1,2-DCE has occurred. All sediment sample TCE and cis-1,2-DCE concentrations were less than the site-specific sediment criteria values for TCE and cis-1,2-DCE. Sediment criteria were calculated as part of the Fish and Wildlife Impact Analysis (Section 9.0). The site-specific sediment criteria derivations are presented and further discussed in that section.

The sediment samples collected during this phase of the RI were not analyzed for cyanide, with the exception of Round 5 (July 1994) samples from the SED-3, and SED-6B and SED-6C locations. All of the Round 5 cyanide results were ND (see Table 6-6).

6.3.2 Domestic Well Sampling and Analytical Data

As part of the RI, groundwater was collected from domestic wells in a three-county area; Genesee (G), Livingston (L) and Monroe (M). The samples were analyzed for volatile organics by EPA SW-846, Method 8010. Selected samples were also analyzed for cyanide by the NYSDEC, ASP, CLP methodology. Samples were collected from 21 domestic wells in November 1993, 15 wells in January 1994, 11 wells in April 1994 and 11 wells in July 1994. The domestic well analytical results are summarized in Tables 6-13 through 6-17.

6.3.2.1 Round 2 - November 1993

The November 1993 domestic well volatile organic analytical results are presented in Table 6-13 by the county in which the well is located (6-13G, 6-13L and 6-13M). The analytical results indicated that TCE was detected in thirteen of the twenty-two wells sampled, at concentrations that exceeded the New York State Department of Health (NYSDOH) drinking water standard of 5 μg/l. TCE was detected in four of the wells at concentrations less than the drinking water standard. TCE was not detected in five of the wells.

The highest TCE concentration (2,000 μg/l) was detected in well DWG1, which is located approximately 1,500 feet east of the spill site. Groundwater from well DWG9, located on Church Road approximately 3,400 feet southeast of the spill site, exhibited the second highest TCE concentration (1,100 μg/l). TCE was detected in the groundwater from well DW-5S and DW-5D (shallow and deep pump in the same well) at concentrations of 890 μg/l and 480 μg/l, respectively. Groundwater from well DWL1, located approximately 1.6 miles southeast of the Site, exhibited a TCE concentration of 100 μg/l. TCE was detected in well DWM14, located approximately 1.8 miles east of the Site, at a concentration of 23 μg/l. Wells DWM26 and DWM35, which are located just west of Spring Street and approximately 3.8 miles east of the Site, exhibited TCE concentrations of 36 μg/l and 20 μg/l, respectively. TCE was detected in well DWL2, located 2.1 miles southeast of the Site, along Route 5, at 12 μg/l.

Domestic wells DWM2, DWM3 and DWM13 exhibited TCE concentrations of 5.3 μg/l, 5.8 μg/l and 6.4 μg/l, respectively, that were slightly greater than the drinking water standard. Wells DWM2 and DWM3 are located approximately 3,800 feet east northeast of the spill site. Well DWM13 is located approximately 1.82 miles east of the spill site.

Groundwater from domestic wells DWL15, DWL23 and DWL31 exhibited TCE at concentrations below the drinking water standard. The DWL15 result was a very low estimated concentration (0.5 μg/l). The DWL23 and the DWL31 TCE concentrations, 4.4 μg/l and 4.8 μg/l, respectively, were just below the drinking water standard of 5 μg/l. Well DWL15 is located approximately 2.4 miles southeast of the Site. Wells DWL23 and DWL31 are located east of Spring Street, in the Spring Creek drainage area.

TCE was not detected in the groundwater from well DWG8. TCE was detected at a low estimated concentration (0.9 μg/l) in well DWG10 and at 7.3 μg/l, slightly above the drinking water standard, in well DWG11. All three of these wells are located along Church Road, in the vicinity of well DWG9, which exhibited a TCE concentration of 1,100 μg/l. TCE was not detected in the samples from DWG2, DWL4, DWM1 or DWM27. Well DWG2 is located approximately 500 feet northeast of the spill site. Well DWL4 is located approximately 2 miles southeast of the spill site. Well DWM1 is located approximately 1.2 miles east of the spill site. Well DWM27 is located just east of Spring Street in the vicinity of wells DWM26 and DWM35, both of which exhibited TCE concentrations above the drinking water standard.

The compound 1,1,1-trichloroethane was detected in the groundwater from domestic wells DWG2, DWG8, DWG10, DWG11, DWL1, DWL23, DWL31 and DWM2. With the exception of the DWL1 value (7.7 μg/l) all 1,1,1-trichloroethane concentrations were well below the drinking water standard of 5 μg/l. Although 1,1,1-trichloroethane has been reported as a contaminant in commercial TCE products, the reported 1,1,1-trichloroethane is not considered to be related to the derailment/spill. This compound has been detected in laboratory method blanks associated with this project. Although 1,1,1-trichloroethane was not detected in the laboratory method blank associated with these samples, laboratory contamination of samples is typically a random occurrence. Additionally, the 1,1,1-trichloroethane was detected in some wells (DWG2, DWG8, DWG10, DWG11, DWL23, DWL31, DWM2) in which TCE was not detected, or was detected at low concentrations.

Groundwater from wells DWM2, DWM13 and DWM26 exhibited low concentrations of methylene chloride that were below the drinking water standard of 5 μg/l. Methylene chloride is a common laboratory contaminant and was detected in laboratory method blanks associated with this sampling event, although not in the method blank associated with these samples. As previously stated, laboratory contamination of samples is generally random in nature. The reported methylene chloride values are considered suspect and not related to the derailment/spill.

Trichlorofluoromethane was detected in groundwater from wells DWM2, DWM13 and DWM35; carbon tetrachloride was detected in groundwater from wells DWM2; bromodichloromethane in groundwater from well DWM35; tetrachloroethene in groundwater from DWM3 and chlorobenzene in groundwater from wells DWM2 and DWM27. All concentrations were below the applicable drinking water standard. Trichlorofluoromethane has been detected in laboratory method blanks associated with this project. Chlorobenzene, tetrachloroethene and bromodichloromethane are not degradation products or common contaminants of TCE. Although carbon tetrachloride has been reported as a contaminant of reagent-grade TCE, this compound has not been frequently detected in samples from wells that consistently exhibit TCE. These compounds are, therefore, not considered to be related to the derailment/spill.

In November 1993, four domestic well samples were analyzed for cyanide; DWG1, DWG2, DWG5S and DWG5D. With the exception of DWG1, all sample groundwater cyanide results were less than the reporting limit of 10 μg/l. Cyanide was detected in groundwater from well DWG1 at a concentration of 11.2 μg/l, which is below the drinking water standard of 200 μg/l and the NYSDEC groundwater standard of 100 μg/l. The domestic well cyanide results for all the rounds are summarized on Table 6-14.

6.3.2.2 Round 3 - January 1994

In January 1994, 16 groundwater samples were collected from 15 domestic wells [including the Dolomite Products Company quarry pumping well equipped with two pumps (G-5S and G-5D)]. All samples were analyzed for volatile organics and four of the well samples were also analyzed for cyanide. Volatile organic analytical results are summarized in Table 6-15 (6-15G, 6-15L and 6-15M).

The analytical results indicate that TCE was detected in the groundwater samples from wells DWG1, DWG2, DWG5S, DWG5D, DWG9, DWG10, DWM2, DWM13, DWM26, DWM35, DWL1, DWL2, DWL6, DWL10 and DWL31, at concentrations that exceeded the drinking water standard (5 μg/l). Consistent with the November 1993 analytical results, the highest TCE concentrations were reported in the groundwater samples from wells DWG1 (3,100 μg/l), DWG9 (1,200 μg/l), and DWG5S and DWG5D (1,500 μg/l and 1,300 μg/l, respectively).

The January 1994 data from wells DWG2 and DWG10 exhibited TCE concentrations of 540 μg/l and 270 μg/l, respectively. These results are significantly different than the November 1993 TCE values from these two locations (DWG2, <1.0 μg/l; DWG10, 0.9 μg/l). The DWG1, DWG5S, DWG5D and DWG9, January 1994 TCE concentration are considerably higher than the corresponding November 1993 concentrations.

Carbon tetrachloride and 1,1,1-trichloroethane were reported in the January 1994, DWG9 groundwater sample at concentrations that exceeded the drinking water standard. However, although these two compounds were not detected in the method blank associated with this sample, they were detected in other laboratory method blanks associated with this sampling event. The reported results are, therefore, considered suspect. If, as suspected, these two compounds are laboratory-derived, the reported high concentrations are associated with multiplication of the laboratory contamination by the sample dilution factor of 100. Based on the sample dilution factor of 100, the actual concentration of laboratory-derived carbon tetrachloride and 1,1,1-trichloroethane would have been 1.60 μg/l and 0.51 μg/l, respectively. Neither of these compounds was detected in the November 1993, DWG9 sample.

Chlorobenzene was detected in the January 1994 samples from DWG9 and DWG5D at concentrations that exceeded the drinking water standard. Chlorobenzene is not a contaminant of TCE and was not detected in the November 1993 samples from these wells. The detection of chlorobenzene in these wells is not considered to be related to the derailment/spill.

Tetrachloroethene and 1,1,1-trichloroethane were detected in the January 1994 groundwater sample from well DWG2, at concentrations that exceeded the drinking water standard. The tetrachloroethene is not considered to be related to the derailment/spill. This compound has not been consistently detected in groundwater samples that have consistently exhibited elevated concentrations of TCE. As previously mentioned, the detection of 1,1,1-trichloroethane is considered to be laboratory-derived.

The TCE concentrations reported in the January 1994 groundwater samples from DWM2, DWM13, DWM26 and DWM35 are generally consistent with the November 1993 data. The compound 1,1,1-trichloroethane was detected in the January 1994 sample from DWM1 at a low estimated concentration, below the drinking water standard. The detection of this compound is considered suspect and possibly laboratory-derived; 1,1,1-trichloroethane was detected in other laboratory method blanks associated with this sampling event.

The January 1994 TCE concentrations from the DWL1, DWL2 and DWL31 groundwater samples were consistent with the November 1993 data.

In January 1994, groundwater samples from wells DWG1, DWG2, DWG5S and DWG5D were analyzed for cyanide. Cyanide was not detected in any of the samples at or above the laboratory reporting limit of 10 μg/l. Cyanide analytical results are summarized on Table 6-14.

6.3.2.3 Round 4 - April 1994

In April 1994, 12 groundwater samples from 11 locations (including the pumping well located at the Dolomite Products Company quarry equipped with two pumps) were collected and analyzed for volatile organics. Samples from the quarry pumping well (DWG5S and DWG5D) and DWG2 were analyzed for cyanide. Volatile organic analytical results are summarized in Table 6-16 (6-16G, 6-16L and 6-16M).

The analytical results indicate that all 12 samples exhibited TCE concentrations that exceeded the drinking water standard. The TCE result from the April 1994 , DWG2 sample (7,200 μg/l) was significantly higher than either the November 1993 or January 1994 sample TCE concentrations. The April 1994 TCE concentrations reported in the DWG5S and DWG5D samples (16 μg/l and 45 μg/l, respectively) were significantly lower than the TCE concentrations detected in the November 1993 and January 1994 samples from these two locations. The April 1994, DWG9 TCE concentration (670 μg/l) was approximately half the November 1993 and January 1994 TCE concentrations. The April 1994 TCE concentrations reported in the DWL1 and DWL6 samples were consistent with the concentrations reported in the January 1994 samples.

In April 1994, groundwater samples from wells DWG2, DWG5S and DWG5D were analyzed for cyanide. Cyanide was detected in sample DWG2 (19.1 ppb) above the laboratory reporting limit of 10 ppb. This was the first time cyanide had been detected in a sample from this well. The other two well samples (DWG5S and 5D) did not contain cyanide above the laboratory reporting limit. The results for these two wells were consistent with the other two times samples from these wells had been analyzed for cyanide (Rounds 2 and 3). The cyanide results are summarized on Table 6-14.

6.3.2.4 Round 5 - July 1994

In July 1994, 12 groundwater samples were collected from 11 locations (including the quarry well, shallow and deep pumps). All samples were analyzed for volatile organics. Two samples, DWG1 and DWG2, were analyzed for cyanide by the NYSDEC ASP/CLP procedure. The volatile organic analytical results are summarized in Table 6-17 (6-17G, 6-17L and 6-17M).

Groundwater from wells DWG1, DWG2, DWG5S, DWG5D, DWL1, DWL14 and DWM9 all exhibited TCE concentrations that exceeded the drinking water standard (5 μg/l). Trichloroflouromethane was detected in the groundwater samples from wells DWL14 (9.8 μg/l) and DWG5S (27 μg/l) at estimated concentrations that exceeded the drinking water standard (5 μg/l). Carbon tetrachloride was detected at an estimated concentration (9 μg/l) in the groundwater sample

6.3.3.1 Well Cluster DC-1

The DC-1 well cluster is located directly at the spill site. Well DC-1A is an open-hole well that extends down into the Falkirk member of the Bertie Formation. Well DC-1B is screened in the Falkirk and wells DC-1C and DC-1D are screened in the Camillus Formation; DC-1C is screened in the upper Camillus and DC-1D is screened in the lower Camillus.

Analytical results for well cluster DC-1 revealed that all four monitoring wells (DC-1A through 1D = samples MW1-A, MW1-B, MW1-C and MW1-D) exhibited trichloroethene concentrations that exceeded the groundwater standard of 5 μg/l during all four sampling events. Groundwater from monitoring well DC-1A, the "shallow" open-hole monitoring well (sample MW1-A), generally exhibited the highest concentration of TCE. Concentrations ranged from a low of 1,100 μg/l (January 1994) to a high of 58,000 μg/l (April 1994). TCE concentrations in the other three monitoring wells consistently, and significantly, decreased over the four monitoring events, with the possible exception of DC-1B (sample MW1-B), which exhibited results of 280 μg/l and 20 μg/l in the July 1994 sample and field duplicate, respectively. The range of decreasing TCE concentrations in the other DC-1 cluster monitoring wells are as follow: DC-1B, 380 μg/l to 76 μg/l; DC-1C, 38,000 μg/l to 95 μg/l; DC-1D, 9,400 μg/l to 560 μg/l.

The November 1993 sample from monitoring well DC-1B (MW1-B) exhibited concentrations of carbon tetrachloride and chlorobenzene, and DC-1C (sample MW1-C), a bromomethane concentration that exceeded their respective groundwater standards. These compounds are not considered related to the derailment/spill. Although carbon tetrachloride has been identified as a contaminant in commercial grade TCE, this compound has not been consistently detected in monitoring wells containing TCE.

Estimated concentrations of 1,1,2,2-tetrachloroethane and 1,2-dichloropropane were detected in the January 1994 groundwater sample from DC-1C (sample MW1-C) at concentrations above their groundwater standards. These two compounds are not considered related to the derailment/spill. Groundwater from monitoring well DC-1D (sample MW1-D) exhibited a cis-1,2-dichloroethene concentration (200 μg/l) that was elevated with respect to the groundwater standard (5 μg/l). This compound is a known degradation product of TCE and is considered to be a potential derailment/spill-related compound.

Carbon tetrachloride was detected in the April 1994 and July 1994, MW1-A samples, at estimated concentrations (5,000 μg/l, April 1994; and 97 μg/l, July 1994)) that exceeded the groundwater standard (5 μg/l). The reported concentrations were at or below the laboratory reporting limit, which was elevated due to the sample dilution related to the high TCE concentrations. Carbon tetrachloride has been reported as a contaminant of reagent grade TCE. Carbon tetrachloride has also been detected in laboratory blanks associated with this project. Any carbon tetrachloride associated with the laboratory would be magnified in samples that required dilution, due to the multiplication of the laboratory carbon tetrachloride concentration by the sample dilution factor. As previously discussed, carbon tetrachloride is not considered to be a derailment/spill-related compound.

from well DWL1. Neither trichlorofluoromethane nor carbon tetrachloride are considered to be related to the derailment/spill.

The July 1994 TCE results from wells DWG1, DWG9 and DWL1 were generally consistent with historical data from these three locations. TCE concentrations in groundwater from DWG2, DWG5S and DWG5D have generally exhibited fluctuating concentrations. The July 1994 TCE results from the DWG5S and DWG5D are consistent with the November 1993 results from these two locations. The July 1994 TCE concentrations from wells DWL4, DWL15 and DWM1 are consistent with the November 1993 TCE results, which was the only other time samples were collected from these locations.

Cyanide was detected in both the DWG1 and DWG2 July 1994 groundwater samples. Cyanide has previously been detected in both of these monitoring wells during one of the previous three sampling events, but not during the same event (see Table 6-14). All of the cyanide concentrations have been well below the drinking water standard of 200 μg/l.

6.3.3 Monitoring Well Sampling and Analytical Data by Well Cluster Round 2 to 5: November 1993; and January, April, and July 1994

During Round 2 through 5 (November 1993, January 1994, April 1994, and July 1994) sampling events, groundwater samples were collected from the monitoring wells and analyzed for volatile organics by either EPA SW 846, Method 8010 or by NYSDEC CLP ASP 91-1 methodology. Some of the samples exhibiting higher concentrations of contaminants were analyzed by EPA Method 8240 due to laboratory instrument availability and the need to analyze the samples within the required holding time. Selected samples were also analyzed for cyanide.

Monitoring well (groundwater) analytical results for cyanide are summarized in Table 6-14. Analytical results for TCE and related compounds; cis- and trans-1,2-dichloroethene and monochloroethene (vinyl chloride), are summarized in Table 6-18. Analytical results for all volatile organic compounds are summarized in Tables T-RD2 through T-RD5 in Appendix T. Since some of the monitoring well samples were analyzed by different methods, the continuity of sample numbers in the appendix tables may not be consecutive. Where the numbering is not consecutive, the last page in the set of tables for a particular round will contain the apparently missing results.

In order to compare analytical results within a well cluster over time, the analytical data in this section are discussed on a cluster by cluster basis for the four Phase C groundwater sampling events (Rounds 2 through 5). The well clusters and individual wells within a cluster are designated DC-1 and DC-1A, DC-1B, DC-1C, DC-1D etc. Samples collected from the wells were, however, labeled with the standard monitoring well (MW) designation, e.g. MW1-A, MW1-B, MW1-C, MW1-D. When referring to a well, the DC prefix has been used in the following discussion whereas, when referring to a sample, the MW prefix has been used.

Cis-1,2-DCE was detected in the July 1994, DC-1B (MW1-B) groundwater sample at a concentration of 30 μg/l. Cis-1,2-DCE was not detected in the DC-1B (MW1-B) groundwater samples from the three previous sampling events.

Cyanide was detected in the November 1993 and April 1994, MW1-A groundwater samples at concentrations (November 1993, 530 μg/l; April 1994, 143 μg/l) that exceeded the groundwater standard (100 μg/l). Cyanide was not detected in the January 1994, MW1-A groundwater sample but was detected in the July 1994 sample at a concentration (15.8 μg/l) that was below the groundwater standard. Refer to Table 6-14 for a summary of the cyanide results.

6.3.3.2 Well Cluster DC-2

The DC-2 well cluster is located just north of and adjacent to the spill site. Well DC-2A is an open-hole well within the Clarence member of the Onondaga Formation. Well DC-2B screens primarily the Falkirk, but also includes the overlying Bois Blanc Formation and the Scajaquada member of the Bertie Formation, and extends up into the Edgecliff member of the Onondaga Formation. Well DC-2C is screened primarily in the Camillus but also extends up into the basal Falkirk. Well DC-2D is screened entirely in the Camillus Formation.

Groundwater analytical results for the DC-2 well cluster indicated that all four monitoring wells at this location exhibited TCE concentrations that exceeded the groundwater standard (5 μg/l) for three of the four sampling events. The lone exception was the July 1994, MW2-C sample that was not detected at the reporting limit of 1 μg/l. With the exception of the April 1994 groundwater monitoring event, samples from well DC-2C exhibited the highest TCE concentrations. DC-2A is the shallow open-hole monitoring well at the DC-2 cluster. TCE concentrations in the MW2-A samples, which represent a zone of perched water, ranged from 380 μg/l to 2,500 E μg/l. The highest concentration (2,500 μg/l) was reported in the July 1994 sample.

The range of TCE concentrations in the other DC-2 monitoring wells is as follows: DC-2B, 120 μg/l to 3,100 μg/l; DC-2C, 9.8 μg/l to 190 μg/l; DC-2D, 140 μg/l to 1,800 μg/l. For the DC-2B, DC-2C and DC-2D well samples, the highest TCE concentrations were detected in the April 1994 samples. The lowest TCE concentrations were detected in the January 1994, DC-2C and DC-2D well samples.

The November 1993, DC-2A well sample exhibited cis-1,2-dichloroethene and chloroform concentrations that exceeded their groundwater standards (5 μg/l). Cis-1,2 dichloroethene was also detected in the November 1993, DC-2D sample at a concentration that exceeded the groundwater standard. Low concentrations, below the groundwater standard, of cis-1,2-dichloroethene and chlorobenzene were detected in the November 1993, DC-2B and DC-2C samples. The November 1993, DC-2C sample exhibited a low tetrachloroethene concentration that was below the groundwater standard (5 μg/l). Cis-1,2-DCE is a degradation product of TCE and is considered to be potentially related to the derailment/spill. Chlorobenzene has been detected in laboratory blanks associated with this investigation and may be laboratory-related. The chloroform, chlorobenzene and tetrachloroethene are not considered to be related to the derailment/spill.

Cis-1,2-dichloroethene was detected in the January 1994, DC-2A and DC-2D samples at concentrations that exceeded the groundwater standard. Cis-1,2-dichloroethene was also detected in the January 1994, DC-2B and DC-2C samples, and trans-1,2-dichloroethene, 1,1,1-trichloroethane, 1,l,2-trichloroethane and trans-1,3-dichloropropane were detected in the January 1994, DC-2D sample. These compounds were detected at concentrations that were below their respective groundwater standards. The 1,1,1-trichloroethane reported in the DC-2D sample may be laboratory-derived. This compound, while not detected in the laboratory blank associated with the DC-2D sample, was detected in other laboratory method blanks associated with the January 1994 sampling event. With the exception of the cis-1,2-DCE, these compounds are not considered to be related to the derailment/spill.

The April 1994, DC-2D sample exhibited a cis-1,2-dichloroethene concentration that exceeded the groundwater standard. The April 1994, DC-2A, DC-2B and DC-2C samples exhibited estimated concentrations of 1,1,1-trichloroethane, and the DC-2B sample an estimated concentration of 2-chloroethylvinylether, that exceeded their respective groundwater standard. With the exception of the cis-1,2-DCE, the presence of these compounds in the samples is considered to be potentially laboratory-derived and not related to the derailment/spill.

The compound 1,1,1-trichloroethane was detected in the July 1994, DC-2B groundwater sample. This compound was also detected in a method blank associated with this sampling event and is, most likely, laboratory-derived. The July 1994 groundwater sample from well DC-2D exhibited cis-1,2-DCE at a concentration of 120 μg/l. Cis-1,2-DCE has been consistently detected in the groundwater from well DC-2D. Cis-1,2-DCE is a degradation product of TCE and the data indicate that there is, most likely, some limited degradation of TCE at this location.

Samples from well DC-2A were analyzed for cyanide for the November 1993, and January and April 1994 rounds. Samples from well DC-2B were analyzed for cyanide for the November 1993 and January 1994 rounds. Samples from wells DC-2C and DC-2D were analyzed for cyanide for the November 1993 round only. All analytical results for well cluster DC-2 were "non-detect" (ND) at a detection limit of 10 μg/l (see Table 6-14).

6.3.3.3 Well Cluster DC-3

The analytical results for the cluster DC-3 monitoring wells, which are located approximately 1,250 feet southeast of the spill site, revealed that groundwater from monitoring well DC-3B exhibited TCE concentrations that exceeded the groundwater standard during all four sampling events. Groundwater from well DC-3B exhibited the highest TCE concentrations at this cluster for three of the four sampling rounds. Well DC-3B is screened in the Falkirk member of the Bertie Formation. The DC-3B TCE concentrations ranged from 490 μg/l to 990 μg/l. The concentrations decreased from the November 1993 sample to the April 1994 sample, but increased again in the July 1994 sample. These variations could be related to the relative (and seasonal) water levels in these wells.

The November 1993 groundwater sample from well DC-3A exhibited a TCE concentration (6.6 μg/l) that slightly exceeded the groundwater standard. The TCE concentrations detected in the

January 1994 and April 1994 samples were below the groundwater standard. TCE concentrations in the DC-3A samples decreased from a high in November 1993 to a low in April 1994. A dramatic increase in the TCE concentration at this well was noted in the July 1994 sample (8600μg/l). Monitoring well DC-3A is an open-hole well through the Clarence member of the Onondaga Formation, down across the Edgecliff member of the Onondaga Formation and into the Bois Blanc Formation. TCE concentrations in the DC-3C samples followed a pattern opposite that of the DC-3A samples; i.e. concentrations increased from a low in November 1993, (2.1 μg/l) to a high of 120 μg/l in April 1994, and then decreased in July 1994, (8.8 μg/l). The January, April and July 1994, DC-3C TCE concentrations exceeded the groundwater standard. Well DC-3C is screened in the upper part of the Camillus. TCE concentrations in the DC-3D groundwater samples followed the same pattern as the DC-3A samples. The DC-3D TCE concentrations decreased from a high of 13 μg/l in November 1993, to non-detect in April 1994, and 1.1 μg/l in July 1994. Well DC-3D is screened in the lower part of the Camillus Formation.

Tetrachloroethene and carbon tetrachloride were detected in the January 1994, DC-3B and April 1994, DC-3B groundwater samples, respectively, at estimated concentrations of 45 μg/l and 28 μg/l, respectively. These levels exceeded their respective groundwater standards. The compound 1,1,1-trichloroethane was reported in the April 1994, DC-3A groundwater sample at an estimated concentration that was below the groundwater standard. The reported concentrations of these compounds are suspected of being related to laboratory contamination and are not considered to be related to the derailment/spill.

Samples from the four wells in the DC-3 cluster were analyzed for cyanide in the November 1993 round only. All results were ND at a detection limit of 10 μg/l (see Table 6-14).

6.3.3.4 Well Cluster DC-4

The DC-4 monitoring well cluster is located approximately 1,000 feet west of the spill site and was designed to be an upgradient location. However, water level measurements obtained during a ten month monitoring period indicate that, at certain times of the year, wells in this cluster could be hydraulically downgradient of the spill site. The detection of chemical compounds in some of the cluster DC-4 monitoring wells (see below) could also indicate a source of contamination west of this cluster. Monitoring well DC-4A is an open-hole well advanced down into the Edgecliff member of the Onondaga Formation. Well DC-4B is screened primarily in the Falkirk but extends up into the Edgecliff. Well DC-4C is screened in the Camillus and DC-4D is screened in both the Camillus and the Syracuse Formation, which is located below the Camillus.

The analytical results for the DC-4 cluster monitoring wells indicated that TCE was not detected in any of the DC-4A or the DC-4B groundwater samples during the four monitoring events. Well DC-4A monitors a zone of perched water and is isolated from the lower water-bearing zones at this cluster location. The November 1993, and the January 1994, groundwater samples from monitoring well DC-4C exhibited TCE at concentrations (17 μg/l and 6.7 μg/l, respectively) that exceeded the groundwater standard. TCE was not detected in the April 1994 or July 1994, DC-4C groundwater samples. TCE concentrations in groundwater from monitoring well DC-4D followed a pattern

similar to well DC-4C. The November 1993, DC-4D TCE concentration (18 μg/l) exceeded the groundwater standard. TCE was detected at a low concentration, below the groundwater standard, in the January 1994, DC-4D sample. TCE was not detected in the April or July 1994, DC-4D groundwater sample.

The November 1993 groundwater data indicated the presence of low concentrations, below the groundwater standard, of tetrachloroethene in the DC-4C and DC-4D groundwater samples and low, estimated concentrations, also below the groundwater standard, of 1,1,1,2-tetrachlorethane, in the DC-4B and DC-4C groundwater samples. Additionally, low, estimated concentrations, below the groundwater standard, of chlorobenzene, carbon tetrachloride and trans-1,2-dichloroethene, were reported in the November 1993, DC-4D groundwater sample. Low, estimated concentrations of chlorobenzene, below the groundwater standard, were reported in the April 1994, groundwater samples from monitoring wells DC-4B and DC-4D. Carbon tetrachloride was detected in the April 1994, DC-4D groundwater sample at a concentration that was below the groundwater standard. Although carbon tetrachloride has been reported as a contaminant of reagent grade TCE, the April 1994, DC-4D sample did not contain TCE. The reported carbon tetrachloride in this sample is, most likely, not related to the derailment/spill site. Methylene chloride was detected in the DC-4C April 1994, groundwater sample at a concentration (6.25 μg/l) that was slightly higher than the groundwater standard. The detection of this compound in this sample is considered, most likely, to be related to laboratory contamination and not derailment/spill-related. The presence of the tetrachloroethene and 1,1,1,2-tetrachloroethane are also not considered to be related to the derailment/spill. Trans-1,2-dichloroethene is a known degradation product of TCE and the presence of this compound in the DC-4C and DC-4D samples may be derailment/spill-related.

Samples from the four wells in the DC-4 cluster were analyzed for cyanide in the November 1993 round only, with the exception of well DC-4A (MW4-A sample), which was also analyzed for cyanide in the July 1994 round. All results were ND at a detection limit of 10 μg/l (see Table 6-14).

6.3.3.5 Well Cluster DC-5

The DC-5 well cluster is located approximately 500 feet directly south of the spill site. Monitoring well DC-5A is an open-hole well installed down to the Edgecliff member of the Onondaga Formation. Monitoring well DC-5B is screened across the Edgecliff and Falkirk. Wells DC-5C and DC-5D are screened in the Camillus Formation.

Groundwater analytical data from the monitoring wells at the DC-5 cluster indicated that all four monitoring wells exhibited TCE concentrations above the groundwater standard in each of the four groundwater samples collected from the wells. Groundwater from monitoring well DC-5A consistently exhibited the highest TCE concentrations, which ranged from 1,300E μg/l to 20,000 μg/l. The concentrations increased from November 1993 to April 1994, but decreased in July 1994, to the lowest level detected in this well in any of the four sampling events (1,300E μg/l). The TCE concentrations in groundwater from monitoring wells DC-5B, DC-5C and DC-5D all decreased in concentration from November 1993, to April 1994. The TCE concentration increased again in well DC-5B in July 1994, whereas the concentrations in DC-5C and DC-5D remained about the same as

in April 1994. The TCE concentration ranges were as follows: DC-5B, 120 μg/l to 760 μg/l; DC-5C, 20 μg/l to 470 μg/l; DC-5D, 18 μg/l to 580 μg/l.

In addition to TCE, carbon tetrachloride and chlorobenzene were detected in the November 1993 groundwater sample from monitoring well DC-5D at concentrations that exceeded their groundwater standards. Neither of these compounds was detected in groundwater collected from this well during the January or April 1994 events. The January 1994 groundwater sample from monitoring well DC-5B exhibited estimated concentrations of 1,2-dichloropropane and cis-1,2-dichloroethene that exceeded the groundwater standard; cis-1,2-dichloroethene is a known degradation product of TCE. 1,2-dichloroethene (total) was detected in the January 1994, DC-5D sample at a concentration that was below the groundwater standard. Trans-1,3-dichloropropene was detected in the January 1994, DC-5C sample at a concentration (49 μg/l) that exceeded the groundwater standard. Trichloroflouromethane was detected in both the January 1994, DC-5B and DC-5C groundwater samples, at concentrations that exceeded the groundwater standard. Toluene and benzene were detected at estimated concentrations (both 0.7JV) in the July 1994, DC-5A groundwater sample, and toluene was detected in the July 1994, DC-5B groundwater sample at an estimated concentration (also 0.7JV). The compound 1,2-dichloroethene (total) was detected in the July 1994, DC-5A and DC-5B groundwater samples at 21 and 2 μg/l, respectively; the DC-5A concentration exceeded the groundwater standard. Cis-1,2-dichloroethene was also detected in the August 1994, Well DC-C and Well DC-D resamples at 39 and 350 μg/l, respectively. The result for sample Well DC-D (350 μg/l) is an estimated value. All of these compounds, with the exception of the dichloroethene, are not considered to be related to the derailment/spill. Many are potentially laboratory-derived.

Cyanide was detected in the November 1993, DC-5A (Well DC-A) groundwater sample, at a concentration (111 μg/l) that exceeded the groundwater standard of 100 μg/l. Cyanide was not detected in the January 1994 sample, was detected in the April 1994, Well DC-A field duplicate at a concentration (12.2 μg/l) that was just above the laboratory reporting limit (10 μg/l), and was detected in the July 1994, Well DC-A sample, at a concentration of 29.4 μg/l. Samples from monitoring wells DC-5B, DC-5C and DC-5D were analyzed for cyanide during Rounds 1 and 2. The well DC-5B (Well DC-B) sample was also analyzed for cyanide in Rounds 4 and 5. The well DC-5B sample contained cyanide at levels, below the groundwater standard, during Round 1 (29.6 μg/l) and Round 5 (25.8 μg/l), but was reported as ND at the laboratory reporting limit of 10 μg/l during Rounds 2 and 3. The Round 2 and 3 results for samples from wells DC-5C and DC-5D were all ND at the reporting limit (10 μg/l). Refer to Table 6-14 for a summary of the cyanide results for all sampling rounds.

6.3.3.6 Well Cluster DC-6

The DC-6 monitoring well cluster is located approximately 1,800 feet east of the spill site. Monitoring well DC-6A is an open-hole well, completed from the ground surface down into the Edgecliff member of the Onondaga Formation. Well DC-6B is screened primarily in the Falkirk and extends up into the Bois Blanc Formation. Well DC-6C is screened in the upper Camillus, just below the Falkirk. Well DC-6D is screened in the lower part of the Camillus Formation.

The groundwater analytical data from the DC-6 cluster indicated that groundwater from monitoring well DC-6B (Bois Blanc/Falkirk) generally exhibited the highest TCE concentrations detected in any of the DC-6 cluster groundwater samples. The one exception to this trend was in April 1994, when the DC-6A sample (MW6-A) exhibited a TCE concentration of 980 μg/l, which was higher than the DC-6B well sample (MW6-B) concentration of 480 μg/l. All of the DC-6A and DC-6B groundwater samples exhibited TCE concentrations that were significantly elevated with respect to the groundwater standard. Monitoring well DC-6A was dry in November 1993, and, therefore, a sample could not be collected at that time.

TCE was not detected in the November 1993, DC-6C sample (MW6-C) and was detected at a concentration (3.6 μg/l) below the groundwater standard in the January 1994 sample. However, the April and July 1994 groundwater samples from monitoring well DC-6C (MW6-C) exhibited TCE concentrations (32 and 22 μg/l respectively) that exceeded the groundwater standard. The groundwater data from well DC-6D revealed that the November 1993 TCE concentration (26 μg/l) exceeded the groundwater standard. TCE was not detected in the January 1994, DC-6D bailer sample, however, it was detected at a concentration (7.9 μg/l) slightly above the groundwater standard in the sample collected using the WaTerra system. TCE was detected at a concentration (4.3 μg/l) just below the groundwater standard in the April 1994 sample and was not detected in the July 1994 sample.

The November 1993 analytical data revealed that groundwater from monitoring well DC-6B exhibited an estimated concentration of bromomethane (100 μg/l) that exceeded the groundwater standard. Groundwater from well DC-6D exhibited a concentration of cis-1,2-dichloroethene (6.6 μg/l) that was slightly higher than the groundwater standard, and a 1,1,1-trichloroethane concentration that was below the groundwater standard. Neither bromomethane nor 1,1,1-trichloroethane are considered to be related to the derailment/spill. The compound 1,1,1-trichlorethane has been detected in laboratory method blanks associated with this project.

Carbon tetrachloride was detected at an estimated concentration (14 μg/l) in the January 1994, DC-6A groundwater sample (MW6-A), which exceeded the groundwater standard. Methylene chloride was detected in the January 1994, DC-6B sample (MW6-B) at a concentration that exceeded the groundwater standard. Methylene chloride is a common laboratory contaminant and was detected in the laboratory blank associated with this sample. The methylene chloride reported in this sample is, therefore, considered to be laboratory-derived. Cis-1,2-dichloroethene was detected in the January 1994 WaTerra sample collected from monitoring well DC-6D, at a concentration (7.6 μg/l) that exceeded the groundwater standard. Cis -1,2-DCE was also detected in the July 1994, DC-6D groundwater sample (MW6-D) at an estimated concentration (0.9 μg/l), below the groundwater standard.

Trichlorofluoromethane was detected in the April 1994, DC-6C groundwater sample (MW6-C) at a low, estimated, concentration that was below the groundwater standard. This compound is not considered to be related to the derailment/spill.

Cyanide has not been detected in any of the samples collected from the cluster DC-6 wells (see Table 6-14).

6.3.3.7 Well DC-7

Well DC-7 is located in a closed depression, 2,900 feet east-southeast of the spill site and just to the west of Church Road.

This well was sampled in November 1993, and April and July 1994, but was not sampled in January 1994. This well has always been ND for all volatile organic compounds; it was not tested for cyanide during the four sampling events.

6.3.3.7R Well Cluster DC-7R

The DC-7R well cluster is located approximately 3,100 feet southeast of the spill site and just west of Church Road. Well DC-7RA is an open-hole well that was completed into the upper part of the Falkirk member of the Bertie Formation. Monitoring well DC-7RB is screened in the Falkirk, and wells DC-7RC and DC-7RD are screened in the Camillus Formation.

Monitoring well DC-7RB consistently exhibited TCE concentrations that were higher than the concentrations detected in the other DC-7R monitoring wells, and that were elevated with respect to the groundwater standard. The DC-7RB TCE concentrations ranged from 350 μg/l to 490 μg/l. Well DC-7RA was dry in November 1993; however, samples were obtained in January, April and July 1994. These three samples exhibited TCE concentrations that exceeded the groundwater standard (January, 140 μg/l; April, 8.1 μg/l; July, 130 μg/l). The DC-7RC TCE concentrations were also consistently elevated with respect to the groundwater standard, and ranged from 27μg/l to 130 μg/l. TCE was not detected in any of the DC-7RD groundwater samples (MW7-RD) during the four sampling rounds.

The November 1993 groundwater sample from monitoring well DC-7RC (MW7-RC) exhibited low concentration of bromodichloromethane that was below the groundwater guidance value. The compound 1,1,1,2-tetrachloroethane was detected in the November 1994, DC-7RD sample, at an estimated concentration that was below the groundwater standard. Bromodichloromethane was detected in the January 1994, DC-7RA sample (MW7-RA) at a concentration that was below the groundwater guidance value. The April 1994 groundwater sample from monitoring well DC-7RB (MW7-RB) exhibited estimated concentrations of carbon tetrachloride (17 μg/l) and chlorobenzene (18 μg/l), that exceeded their respective groundwater standards. The compound 1,1,1-trichloroethane was detected in the July 1994 groundwater samples from monitoring wells DC-7RB and DC-7RC. The MW7-RC concentration exceeded the groundwater standard. 1,1,1-trichloroethane was not detected in any other DC-7RB or DC-7RC well groundwater sample. Bromodichloromethane was detected in the July 1994, MW7-RD sample at a concentration that was below the groundwater standard. Bromodichloromethane, 1,1,1,2-tetrachloroethane, carbon

tetrachloride, chlorobenzene and 1,1,1-trichloroethane are not considered to be related to the derailment/spill.

Cis-1,2-dichloroethene was detected in the groundwater sample from monitoring well DC-7RC (MW7-4C) at an estimated concentration below the groundwater standard. Cis-1,2-DCE is considered to be a potential derailment/spill-related compound.

Groundwater samples collected from the wells in cluster DC-7RA have not been analyzed for cyanide.

6.3.3.8 Well Cluster DC-8

The DC-8 monitoring well cluster is located approximately 1.36 miles east-northeast of the spill site, south of Flint Hill Road (Monroe County). Well DC-8A is an open-hole well completed down into the Scajaquada member of the Bertie Formation. The water in this well represents a perched water-bearing zone that is apparently not connected to the deeper water-bearing zone(s) at the location of this cluster. This is demonstrated by the fact that well DC-8B was dry during the November 1993, and January and July 1994 sampling events. Well DC-8B is screened primarily in the Falkirk and extends up into the Scajaquada. Well DC-8C is screened in the upper part of the Camillus and extends up into the Falkirk. Well DC-8D is screened in the lower part of the Camillus Formation.

The groundwater analytical results from the DC-8 cluster revealed that the highest TCE concentration in the four monitoring wells in this cluster was detected in groundwater from monitoring well DC-8B (basal Scajaquada/Falkirk). TCE was detected in the April 1994, DC-8B groundwater sample (MW8-B), the only time that this well could be sampled, at a concentration of 88 μg/l. As previously indicated, the DC-8B monitoring well was dry during the November 1993, and January and July 1994 sampling events and, therefore, samples could not be collected during these events. Groundwater collected from monitoring well DC-8C during the four monitoring events exhibited TCE concentrations that exceeded the groundwater standard. Concentrations ranged from 5.2 μg/l to 58 μg/l and increased in concentration from a low in November 1993, to a high in April 1994, and then decreased in July 1994. TCE was not detected in any of the well DC-8D groundwater samples and was only

detected in the April 1994, well DC-8A sample (MW8-A), at a concentration (1.8 μg/l), that was below the groundwater standard.

Two additional compounds, 1,1-dichloroethene and chlorobenzene, were detected in the April 1994, DC-8A groundwater sample, at concentrations below their groundwater standards. Neither of these compounds is considered to be related to the derailment/spill.

Groundwater samples collected from the wells in cluster DC-8 have not been analyzed for cyanide during any of the four sampling events.

6.3.3.9 Well Cluster DC-9

The DC-9 well cluster is located approximately 1.8 miles east of the spill site, west of Lime Rock Road. Well DC-9A is screened in both the Falkirk and the Camillus. Well DC-9B is screened primarily in the Camillus and extends down into the Syracuse. Well DC-9C is screened entirely in the Syracuse Formation.

Groundwater analytical data from the monitoring wells located at the DC-9 cluster indicated that the January, April and July 1994, well DC-9A, TCE concentrations (16 μg/l, 20 μg/l and 16 μg/l respectively) were elevated with respect to the groundwater standard, and were also the highest concentrations detected at this cluster. TCE was also detected at concentrations that exceeded the groundwater standard in the January 1994, well DC-9B sample (8.1 μg/l) and the April 1994, well DC-9C sample (5.9 μg/l). TCE was detected at low concentrations (below the groundwater standard) in the November 1993, well DC-9A sample, the April 1994, well DC-9B sample and the November 1993, and January and July 1994, well DC-9C samples. TCE was not detected in the November 1993 and July 1994 samples from monitoring well DC-9B.

Groundwater samples collected from the wells in cluster DC-9 have not been analyzed for cyanide during any of the four sampling events.

6.3.3.10 Well Cluster DC-10

The DC-10 well cluster is located approximately 1.4 miles east-southeast of the spill site. Monitoring well DC-10A is an open-hole well completed down into the Scajaquada member of the Bertie Formation. Well DC-10B, which exhibited the highest TCE concentrations at this cluster, is screened entirely in the Falkirk member of the Bertie Formation. Well DC-10C is screened primarily in the Camillus Formation and extends slightly up into the Falkirk. Monitoring well DC-10D is screened in the Camillus.

The analytical results from the DC-10 cluster revealed that groundwater from well DC-10B (Falkirk) consistently exhibited the highest TCE concentrations detected at this cluster. TCE concentrations in groundwater from well DC-10B exceeded the groundwater standard and ranged from 38 μg/l (January 1994) to 51 μg/l (April 1994). The November 1993 groundwater sample from monitoring well DC-10C exhibited a TCE concentration (20 μg/l) that exceeded the groundwater standard. The DC-10C TCE concentrations decreased over the next two sampling events; the January 1994 concentration of 17 μg/l (collected with the WaTerra system; the bailer sample TCE concentration was 3.9 μg/l) exceeded the groundwater standard; however, the April 1994 concentration of 2.2 μg/l was below the groundwater standard.

TCE was not detected at elevated concentrations (above the groundwater standard) in either the DC-10A or the DC-10D samples (MW10-A and MW10-D respectively). TCE concentrations in the DC-10A samples ranged from a low of 0.5 μg/l (January 1994) to 3.4 μg/l (April 1994). Well DC-10A was dry in November 1993 and July 1994. TCE concentrations in groundwater from monitoring

well DC-10D decreased over time from a high of 3.2 μg/l in the November 1993 sample to ND in the April and July 1994 samples.

Tetrachloroethene was detected in the November 1993, well DC-10D sample at a concentration (11 μg/l) that exceeded the groundwater standard, and in the January 1994, well DC-10D sample at a concentration (0.6 μg/l) that was below the groundwater standard. The compound 2-butanone was detected in the July 1994 groundwater sample from monitoring well DC-10C. Neither tetrachloroethene nor 2-butanone are considered to be related to the derailment/spill.

Groundwater samples collected from the wells in cluster DC-10 have not been analyzed for cyanide during any of the four sampling events.

6.3.3.11 Well Pair DC-11

The DC-11 well pair is located approximately 1.5 miles southeast of the spill site. Well DC-11A is screened from the Clarence down through the Edgecliff and Bois Blanc and into the Scajaquada member of the Bertie Formation. Well DC-11B is screened in the upper/mid Camillus Formation.

TCE results from the two wells located at the DC-11 cluster revealed that TCE was not detected at or above the laboratory reporting limit (1 μg/l) in any of the four samples collected from monitoring well DC-11A. TCE was detected in the well DC-11B groundwater samples from three of the four sampling events, gradually decreasing from a high of 16 μg/l in November 1933 to ND in July 1994. Only the November 1993 sample (16 μg/l) exceeded the groundwater standard. TCE was detected in the January and April 1994, well DC-11B samples at low concentrations, below the groundwater standard and just above the laboratory reporting limit (January 1994, 1.9 μg/l; April 1994, 1.1μg/l), and was ND in July 1994.

Tetrachloroethene was detected in the November 1993, well DC-11B sample at a concentration (6.2 μg/l) that exceeded the groundwater standard and at an estimated concentration, below the groundwater standard, in the January 1994, well DC-11B sample. The compound 1,1,1-trichloroethane was detected in the January 1994, well DC-11A sample at an estimated concentration (0.5 μg/l) that was below the groundwater standard. The reported concentration of 1,1,1-TCA is potentially related to laboratory contamination. Neither tetrachloroethene nor 1,1,1-trichloroethane are considered to be derailment/spill-related compounds.

Groundwater samples collected from the wells in cluster DC-11 have not been analyzed for cyanide during any of the four sampling events.

6.3.3.12 Well Cluster DC-12

The DC-12 well cluster is located approximately 2.3 miles southeast of the spill site near the intersection of McIntyre Road and Route 5. Monitoring well DC-12A is an open-hole well completed down to the bottom of the Edgecliff member of the Onondaga Formation. Well DC-12B, which exhibited elevated TCE concentrations, is screened primarily in the Falkirk but extends up

into the Scajaquada. Well DC-12C, which also exhibited elevated TCE concentrations, is screened primarily in the Camillus Formation but extends up into the Falkirk. Monitoring well DC-12D is screened entirely in the mid-Camillus.

Analytical results from the DC-12 cluster indicated that groundwater from monitoring well DC-12B exhibited TCE concentrations that exceeded the groundwater standard in all of the four quarterly samples. DC-12C also exhibited TCE concentrations that exceeded the groundwater standard in November 1993, and January and April 1994, but was ND in July 1994. Monitoring well DC-12B and DC-12C, TCE concentrations ranged from 27 μg/l to 51 μg/l and ND to 80 μg/l, respectively. The bailer samples collected from well DC-12B increased from a low (27 μg/l) in November 1993, to a high (46 μg/l) in April 1994, while the well DC-12C concentrations decreased over time. Although TCE was detected in all of the well DC-12A and DC-12D groundwater samples, with the exception of the July 1994, well DC-12A sample that was ND at a detection limit of 10 μg/l, the concentrations were consistently below the groundwater standard.

Dichlorodifuoromethane was detected in the November 1993, well DC-12C sample at an estimated concentration (2.8 μg/l) that was below the groundwater standard. Chloroform was detected in the January 1994, well DC-12A groundwater sample at an estimated concentration that was also below the groundwater standard. Neither of these compounds are considered to be related to the derailment/spill.

Groundwater samples collected from the wells in cluster DC-12 have not been analyzed for cyanide during any of the four sampling events.

6.3.3.13 Well Pair DC-13

The DC-13 well pair is located approximately 3.3 miles east of the spill site and 350 feet west of Spring Street. Monitoring well DC-13A is screened in the middle portion of the Camillus Formation and well DC-13B is screened across portions of both the Camillus and Syracuse Formations (lower Camillus/upper Syracuse).

Analytical results from the two DC-13 wells revealed that the groundwater samples from both wells consistently exhibited TCE concentrations that exceeded the groundwater standard. The concentrations in each of the wells were very similar. TCE concentrations ranged from 12 μg/l to 26 μg/l in groundwater from well DC-13A, and 10 μg/l to 23 μg/l in groundwater from well DC-13B.

Chloroform was detected at an estimated concentration (4 μg/l), below the groundwater standard, in the January 1994 sample from well DC-13B. Chloroform is not considered to be a derailment/spill-related compound.

Groundwater samples collected from the wells in cluster DC-13 have not been analyzed for cyanide during any of the four sampling events.

6.3.3.14 Well Pair DC-14

The DC-14 well pair is located approximately 3.6 miles east-southeast of the spill site along the west side of Spring Street. Well DC-14A is screened in the Falkirk member of the Bertie Formation and DC-14B is screened in the Camillus Formation.

Analytical results from the two DC-14 monitoring wells indicated that the TCE concentrations from the four groundwater samples from each of the wells consistently exceeded the groundwater standard. The TCE concentrations detected in each of the wells were similar. TCE concentrations ranged from 6.4 μg/l to 14.0 μg/l in well DC-14A, and 8.9 μg/l to 13 μg/l in the well DC-14B groundwater samples.

Tetrachloroethane was detected in the November 1993 groundwater sample from monitoring well DC-14B. The reported concentration (0.7 μg/l)was estimated and was below the groundwater standard. Tetrachloroethene is not considered to be a derailment/spill-related compound.

Groundwater samples collected from the wells in cluster DC-14 have not been analyzed for cyanide during any of the four sampling events.

6.3.3.15 Well Pair DC-15

The DC-15 well pair is located just to the southeast of the spill site. DC-15A is an open-hole well that is completed down into the upper portion of the Falkirk member of the Bertie Formation. The highest TCE concentration detected in the DC-15A monitoring well coincided with the highest water level measured in the well during any of the sampling events (April 1994). DC-15B is screened in the upper Syracuse Formation.

Analytical results from the two DC-15 wells indicated that TCE was consistently detected at concentrations that exceeded the groundwater standard. TCE concentrations were consistently considerably higher in groundwater from monitoring well DC-15A than the well DC-15B groundwater concentrations. Well DC-15A, TCE concentrations ranged from 6,700 μg/l to 41,000 μg/l, while well DC-15B, TCE concentrations ranged from 14 μg/l to 140 μg/l. The well DC-15B concentrations decreased steadily from the November 1993 sampling event to the July 1994 sampling event.

Cis-1,2-dichloroethene was detected in the November 1993 and January 1994 groundwater samples from monitoring well DC-15A (35 μg/l) and well DC-15B (35 μg/l), respectively, at a concentration that exceeded the groundwater standard. Cis-1,2-dichloroethene is a known breakdown product of TCE and is considered to be potentially related to the derailment/spill.

The November 1993, well DC-15A sample exhibited an estimated concentration of chloroform that was below the groundwater standard. Dichlorodifluoromethane and chlorobenzene were detected in groundwater from monitoring well DC-15B in the January and April 1994 samples, respectively, at concentrations that exceeded their groundwater standards. Chloroethane and

trichlorofluoromethane were detected in the April 1994, well DC-15B groundwater sample, at estimated concentrations that were below their groundwater standards. None of these five compounds are considered to be related to the derailment/spill.

Cyanide was detected in the November 1993 (192 μg/l), and the April 1994 (82.4 μg/l), well DC-15A groundwater samples. The November 1993, well DC-15A cyanide concentration exceeded the groundwater standard of 100 μg/l. Cyanide was not detected in the January and July 1994 samples at a detection limit of 10 μg/l. The one time that a sample from well DC-15B was analyzed for cyanide (November 1993), the results was ND at the laboratory reporting limit. Refer to Table 6-14 for a summary of the cyanide results.

6.3.3.16 Well DC-16

Well DC-16, an open-hole well completed down into the Falkirk member of the Bertie Formation, is located approximately 350 feet east of the spill site. The highest TCE concentration in this well was detected in April 1994, which coincided with the highest water level measurement during any of the four sampling events.

Analytical results from monitoring well DC-16 indicated that TCE concentrations were elevated with respect to the groundwater standard during all four sampling events. Concentrations ranged from 410 μg/l to 8,500 μg/l. Cis-1,2-DCE was detected in the January 1994, well DC-16 (21 μg/l) groundwater sample at a concentration that exceed the groundwater standard. Cis-1,2-DCE is a known degradation product of TCE and is considered to be potentially related to the derailment/spill.

The November 1993, well DC-16 groundwater sample exhibited concentrations of 1,2-dichloroethane (380 μg/l), carbon tetrachloride (1,200 μg/l) and chlorobenzene (1,700 μg/l), that exceeded their respective groundwater standards. The compound 2-butanone (84 μg/l) was detected in the January 1994 sample from monitoring well DC-16.

Cyanide was not detected in the November 1993 or the July 1994 sample from well DC-16. Cyanide was, however, detected in the April 1994, well DC-16 groundwater sample at a concentration (29.8 μg/l) that was below the groundwater standard. Refer to Table 6-14 for the cyanide results.

6.3.3.17 Well Pair DC-17

Well pair DC-17 is located approximately 1,900 feet east of the spill site. Monitoring well DC-17A is an open-hole well completed down into the Falkirk member of the Bertie Formation. Well DC-17B is screened in the upper Syracuse Formation.

Analytical results from the two DC-17 monitoring wells indicated that groundwater from well DC-17A exhibited TCE concentrations that exceeded the groundwater standard in all four sampling events. Concentrations in well DC-17A ranged from 620 μg/l to 1,600 μg/l. TCE was detected at concentrations exceeding the groundwater standard in the November 1993 (370 μg/l), and the

January (110 μg/l) and July (480 μg/l) 1994 samples from monitoring well DC-17B. TCE was not detected in the April 1994 sample from well DC-17B.

With the exception of chloroform in the July 1994 sample from well DC-17B, no other volatile organic compounds were detected in the DC-17 wells during any of the four sampling rounds. Chloroform was detected in the July 1994 sample at an estimated concentration of 23 μg/l, above the groundwater standard. Chloroform is not considered to be a derailment/spill-related compound.

Cyanide was not detected in the well DC-17A and DC-17B samples collected in November 1993; the only time that samples were collected from these wells for cyanide analysis (see Table 6-14).

6.4 ANALYTICAL DATA: OVERVIEW AND SUMMARY

6.4.1 Environmental Analytical Data: Overview and Summary

6.4.1.1 Introduction

During the early phases of NYSDOH sampling of domestic wells within the Study Area, a spring on the east side of Spring Street (SPR-L23S) was sampled and analyzed for TCE. The results indicated low (< 10 μg/l) but persistent levels of TCE. This information, coupled with the results of the domestic well sampling, revealed a trend of contaminated ground and surface water along Spring Street. Based on an initial evaluation of the hydrogeologic conditions within the Study Area, and the results of NYSDOH sampling, we decided to include a variety of environmental locations/media (springs, surface water, sediment) in the sampling program. These locations supplemented the groundwater sampling locations (domestic wells and monitoring wells).

Environmental sampling was commenced in the early phase of the RI (December 1992), and was also performed during Round 1 of Phase C, prior to the installation of the monitoring wells. Each successive, comprehensive round of sampling (Rounds 2 through 5) included environmental sampling locations in the vicinity of Mud Creek and Spring Creek, as well as at other selected locations and at "locations of opportunity." Many of the environmental locations were sampled multiple times whereas, due to either need or opportunity, others were sampled only once, depending on their proximity to the spill site. The samples were analyzed either for VOCs and cyanide (near the spill site/Mud Creek) or for VOCs only (near Spring Creek and at other areas between the spill site and Spring Creek).

6.4.1.2 Specific Details

Spring / Surface Water Results

The spring and surface water analytical data indicate that TCE is the principle compound consistently detected in samples from these sources. To a lesser extent, cis-1,2-DCE and cyanide have also been detected in the spring and surface water samples. TCE and cyanide were reportedly spilled at the time of the derailment. Cis-1,2- DCE is a known breakdown product of TCE.

Samples collected from springs located in the Mud Creek drainageway, downstream from the spill site, have consistently exhibited TCE concentrations that have exceeded the NYSDEC groundwater standard (5 μg/l) and the surface water guidance value (3 μg/l). These spring samples include SPR-4, SPR-7, SPR-20 and SPR-20A. TCE was also detected in SPR-3, which is the closest spring to the spill site, during two of three sampling events. The range of TCE in the springs, in order of their distance from the Site, is as follows: SPR-3, <1 μg/l to 270 μg/l; SPR-20, 150 μg/l to 630 μg/l; SPR-20A, 95 μg/l to 530 μg/l; SPR-7, 39 μg/l to 130 μg/l; and SPR-4, 40 μg/l to 98 μg/l. The general trend is toward lower TCE concentrations with increasing distance from the spill site.

Cyanide was detected in the SPR-3 sample in December 1992 at a level (10.2 μg/l) that was just above the laboratory reporting limit of 10 μg/l. It was not detected in a subsequent sample collected in April 1994. All other spring and surface water samples analyzed for cyanide throughout the RI were reported as ND at 10 μg/l (see Table 6-4).

Surface water samples were collected from four locations in the Mud Creek drainageway. Location SW-16 is approximately 4,400 feet upstream of the spill site, and was sampled once in April 1994; TCE was not detected in this sample. The SW-2 sampling location is in the "swallet" immediately downstream of where Mud Creek crosses under the old railroad bed. Samples were collected from the SW-2 location four times and, with the exception of a result of 3.7 μg/l in the April 1994 sampling event, TCE was not detected in the SW-2 samples. Because the nearby shallow monitoring wells are so contaminated, the TCE concentrations in the swallet may appear to be inconsistent with the supposition that the swallet represents the local water table. A brief review of Table P-2 (Appendix P) shows that water levels in the swallet are consistently higher than in the nearby shallow contaminated wells. The prevailing hydraulic gradient would therefore be toward the wells, not toward the swallet.

In July 1994, two surface water samples, SW-6B and SW-6C, were collected from the gorge pond. SW-6B was collected on the south side of a dike located approximately 200 feet from where Mud Creek discharges to the pond. Sample SW-6C was collected on the south side of the dam located at the north end of the pond. TCE was detected in both sample SW-6B (29 μg/l) and SW-6C (6 μg/l) at concentrations that exceeded the surface water guidance value. Samples were collected at these two locations in October 1994 to confirm the July 1994 data. The October results were not available at the time of preparation of this report.

The spring and surface water data indicate that groundwater contaminated with TCE is discharging in the Mud Creek drainageway. Data from the gorge pond indicate that surface water TCE concentrations appear to decrease as the distance from the springs in the Mud Creek channel increases. Refer to Table 6-19 for a summary of TCE analytical results for springs and surface water in the vicinity of Mud Creek.

Samples from six spring locations and two surface water locations were collected in the Spring Creek drainage area. The analytical data indicate that TCE concentrations in two spring samples (SPR-12 and SPR-L23S) have consistently exceeded the surface water guidance value for TCE. SPR-12 is located approximately 500 feet west of Spring Creek, opposite the fish hatchery; TCE

concentrations at this location have ranged from 46 μg/l to 100 μg/l. SPR-L23S is located on Spring Creek upstream of the Caledonia State Fish Hatchery. Concentrations at this location have ranged from 3 μg/l to 4.9 μg/l. TCE has generally not been detected in the two springs, SPR-18 and SPR-11, located at the headwaters of Spring Creek. Two springs (SPR-21 and SPR-26) located between the two sets of east-west Genesee and Wyoming railroad tracks, and west of Spring Street in the Village of Caledonia, were discovered and sampled in April 1994. The SPR-26 sample did not contain TCE, whereas the SPR-21 sample contained 1,900 μg/l of TCE. This elevated TCE level is greater than any other TCE result east of Church Road (except domestic well DWG9), and significantly higher than any result previously detected in the area of Spring Creek. These springs could not be resampled since they were dry several weeks later when the results were received and validated. It is anticipated that this spring will not be sampled again until March or April of 1995. The significance and interpretation of this result with respect to the TCE plume near Spring Creek is presently indeterminable.

With the exception of the SPR-21 result, the data indicate that the TCE concentrations increase downstream (from south to north) along Spring Creek. Due to the southerly dip of the rock strata, the northernmost springs originate in deeper bedrock formations (Camillus rather than Falkirk). This trend is also evident in monitoring wells DC-13 and DC-14 and in the domestic wells along Spring Street (see Sections 6.4.2 and 6.4.3).

Surface water samples were collected from Spring Creek at the Caledonia State Fish Hatchery (location SWFH-1) during Round 1 and 2. The concentrations were 3 μg/l and non-detect at 1.3 μg/l, respectively. One sample was collected from a ponded area of Spring Creek (sample location SW-14) located approximately 3,000 feet downstream from the fish hatchery, behind (north of) the Genesee Country Inn; TCE was not detected in this sample. Refer to Table 6-20 for a summary of TCE results in spring and surface water samples collected in the vicinity of Spring Creek.

The Spring Creek drainage area spring samples indicate that groundwater contaminated with TCE is discharging to the surface in the area of Spring Creek. The surface water samples from Spring Creek indicate that TCE concentrations in Spring Creek are rapidly attenuated or diluted. The significance of the TCE detected in the Spring Creek surface waters is further described in Section 9.0, Fish and Wildlife Impact Analysis.

Sediment Results

Sediment samples were collected from both the Mud Creek and Spring Creek drainageways. The analytical data reveal that TCE was detected at relatively low concentrations (5-12 μg/l) in the Mud Creek drainageway sediment samples, with the exception of the SED-2 sample collected from the "swallet" in December 1992. The concentration was an estimated value of 71 μg/l. Cis-1,2-DCE was detected at low concentrations in the two samples collected from the gorge pond in December 1992, and also in the samples collected during Round 5 (July 1994). The detection of cis-1,2-DCE in the pond samples indicates that there is potentially some biological degradation of TCE occurring in the pond sediments. The significance of the detected concentrations, with respect to potential

impacts on human health, and fish and wildlife, is discussed in Section 8.0 and Section 9.0, respectively.

In the Spring Creek drainageway, sediment samples were collected from the ponded area of Spring Creek located behind (north of) the Genesee Country Inn. TCE was detected in one sample (SED-14) collected from the pond in December 1992 at an estimated concentration of 171 μg/l. However, TCE was not detected in samples collected from the pond in November 1993.

6.4.2 Domestic Well Results: Overview and Summary

6.4.2.1 Introduction

Historical sampling by the NYSDOH and three county health departments in 1991 and 1992 documented relatively high levels (up to 2,600 μg/l) of TCE contamination in a number of domestic wells located within 1,500 feet of the spill site. This sampling also identified numerous wells east of Church Road that also contained detectable levels of TCE, many of which were in excess of the MCL (5 μg/l). On the basis of this information, plus the results of additional sampling in early 1993, the sampling of selected domestic wells at and downgradient of the spill site was included in the scope of Phase C of the RI.

A series of domestic wells was sampled during four of the five Phase C sampling rounds, the exception being Round 1 (July 1993). As previously explained, no domestic wells were sampled at this time because they had recently been sampled (June 1993) as part of the Lehigh Valley Railroad O&M Project. The domestic wells selected for inclusion in the RI included the most highly contaminated wells in the vicinity of the spill site (G-1 and G-2), at the Dolomite Products Company quarry (G-5S and G-5D), and at four locations on Church Road (G-9 through G-12). All of these wells, with the exception of G-11 and G-12, were sampled during Rounds 2 through 5. These wells were selected in order to monitor contaminant levels on a seasonal basis as they relate to contaminant levels in the nearby monitoring wells, and as they relate to certain bedrock strata suspected of being the primary contaminant pathways between the spill site and Church Road.

A number of other wells were sampled during Rounds 2 through 5. These wells were located along Flint Hill Road (Monroe County), Flint Hill Road (Livingston County)/Lime Rock Road, Route 5, and Spring Street. These wells were selected because of their historical results, their locations relative to the monitoring well network, and to monitor seasonal changes and groundwater quality trends throughout the Study Area. Refer to Appendix S for graphic representations of the depth and stratigraphic relationships of the domestic and monitoring wells. Although not a goal of the RI domestic well sampling program, the July 1994 analytical results led to the installation of a point-of-entry treatment system on well M-4. A few domestic wells located near the spill site (G-1, G-2, G-5S and G-5D) were also sampled for cyanide analysis during the monitoring program. All of these well were sampled at least three times, with the two closest to the spill site (G-1 and G-2) exhibiting detectable levels of cyanide in two rounds of sampling, and the other two (G-5S and G-5D) being ND at 10 μg/l during three rounds each.

Refer to Figure 3-1 for the domestic well locations and Plate 2 for the monitoring well locations.

6.4.2.2 Specific Details

Spill Site

The results for domestic wells G-1 and G-2 continue to demonstrate elevated levels of TCE. Since the depth of well G-1 is not known, a correlation with the closest monitoring well clusters (DC-6 and DC-17) is not possible. However, the TCE levels in well G-1 correspond quite closely with the levels detected in wells DC-6B and DC-17A. These two wells are completed to or into the middle Falkirk, respectively.

The TCE levels in well G-2, which is reported to be at least 150 feet deep, appear to generally correlate with the results from the closest monitoring well clusters (DC-2 and DC-16). The reported depth of well G-2 corresponds to the depth of wells DC-1D and DC-2D. This means that any of the contamination in the 150 feet of strata penetrated by well G-2 may be able to enter the well. This same contamination will, however, be detected at discrete intervals at well clusters DC-1 and DC-2, depending upon the depth of placement of the individual well screens at these locations (refer to Figures S-1 and S-2 in Appendix S). It should be pointed out that the results from open-hole domestic wells ("reported depths") cannot be expected to correlate exactly, or possibly not even closely, with the results from a depth-discrete screened interval. Interestingly, the highest TCE level detected in well G-2 in 1994 was in April, the same as for wells DC-1A, DC-2B and DC-16, the three closest wells to well G-2.

Sampling locations G-5S and G-5D, located at the Dolomite Products Company quarry, southwest of the spill site, may or may not be correlated with the closest monitoring well cluster (DC-5) or with the spill site well cluster (DC-1), which is the next closest cluster. This may be due to the distance between these well locations. This may also be due, in part, to the fact that samples G-5S and G-5D come from two intervals [(shallow (S) and deep (D)] within the same well. However, the generally higher contaminant levels detected in well G-5S appear to correlate with the generally higher levels in well DC-5A, whereas the lower levels in well G-5D appear to correlate with the lower levels in well DC-5B. In addition, from Round 2 (November 1993) to Round 5 (July 1994), the trends in wells G-5S and G-5D appear to follow the same relative pattern of contamination evident in wells DC-5B and DC-5C respectively. For example, the contaminant levels tend to decrease in all four wells from November 1993 to April 1994, and then increase again. The one exception to this trend is well DC-5C which remained low in July 1994. One possible explanation for this relates to the operation of the nearby quarry and the relative pumping volumes during off peak production (winter), and active pumping commencing in the spring and continuing throughout the summer production season. It is also interesting, and probably significant, to note that this trend, particularly in wells G-5S and G-5D, is opposite to that of well DC-5A, which was the most contaminated in April 1994. This trend of higher levels in April 1994 is also evident at well cluster locations DC-15 (DC-15A), DC-1 (DC-1A), DC-2 (DC-2B) and DC-16. All of these wells, with the exception of DC-2B, are open-hole wells, open to contaminant entry from any point within the well bore as water levels rise and fall. Although well DC-2B is screened, the trend may still be valid since well DC-2A

is open to a perched water-bearing zone. Refer to the appropriate figures in Appendix S for a graphic representation of the open hole and screened intervals in the monitoring wells.

As previously noted, cyanide was detected in domestic wells G-1 and G-2 during more than one sampling event. Cyanide was detected in well G1 in November 1993 and July 1994. It was not detected in January 1994 and was not analyzed for in April 1994. Cyanide was not detected in well G-2 in November 1993 and January 1994, but was detected in April and July 1994. Well G-2 is located near the spill site and well G-1 is located approximately 1,400 feet east of the spill site. The pattern of cyanide detection in these domestic wells is somewhat similar to that detected in the monitoring wells in the area of these wells. However, no definitive pattern was noted. One interesting pattern that was noted, however, was that all domestic and monitoring well samples analyzed for cyanide in January 1994 were reported as not detected at the laboratory reporting limit of 10 μg/l. This was even true for those locations where cyanide was detected in samples from previous or subsequent sampling rounds. Cyanide was not detected in samples collected from domestic wells G-5S or G-5D during any of the three rounds it was analyzed for.

Church Road

Wells G-9 and G-10 are reportedly deep enough to correspond approximately with a combination of monitoring wells DC-7RA and DC-7RB. The bottoms of wells G-11 and G-12, located farther south along Church Road, correspond to the screened interval of monitoring well DC-7RC. They are, therefore, also open to the depths monitored by wells DC-7RA and DC-7RB. Refer to Figures S-7 and S-7R in Appendix S for an indication of the relationships of the depth of these domestic and monitoring wells.

The historic (pre-1993) and recent (1993-94) results for wells G-9 and G-10 indicate that TCE levels in well G-9 are generally several times greater than those in well G-10. The contaminant levels in well G-9 have been higher than those in the DC-7RA or DC-7RB wells which, together, monitor nearly equivalent strata as the G-9 well. The contaminant levels in well G-10 have been similar to the levels in wells DC-7RA and DC-7RB. The analytical results from wells G-11 and G-12 are consistently considerably lower than wells G-9 and G-10. This general trend is also evident in well DC-7RC which, although screened, is at the same depth as the bottoms of wells G-11 and G-12.

The analytical results from wells G-9 and G-10 do not indicate a clear pattern that is reflective of seasonal changes. This is due, in part, to the somewhat inconsistent historical sampling schedule for these wells. Similarly, the analytical results also do not appear to correlate well with the pattern(s) detected at well cluster DC-7R. However, the concentrations in wells G-9, G-10, DC-7RA and DC-7RB appear to indicate lower contaminant levels in the spring of 1994. Wells north of well G-9 and south of well G-12 have remained clean throughout the historic (1991-91) and current (1993-94) sampling period, with the exception of an October 1991 "hit" in well G-8, which is located on Church Road north of well G-9.

Central Area

The impacted domestic wells along Flint Hill Road (Monroe County) have historically shown evidence of higher levels of contamination in the spring. This trend has continued during recent sampling, and corresponds with higher levels of contamination in wells DC-8B and DC-8C in April 1994. Domestic wells in the central area are generally deep enough to intercept the strata conveying contamination to wells DC-8B and DC-8C, yet wells M-1 and M-6 have consistently been free of TCE contamination. Based on the analytical results at wells DC-8B and DC-8C, it appears that the contamination present in domestic wells M-2 through M-5 is being transmitted via the Falkirk and upper Camillus geologic units. Refer to Figure S-8 in Appendix S for details of these wells.

The impacted domestic wells along Lime Rock Road (M-13 and M-14) have also historically been more contaminated in the spring, although the sampling schedule has been inconsistent. This pattern is not clearly evident in the results from the wells in cluster DC-9, located just to the west, and upgradient of, wells M-13 and M-14. The screened intervals in monitoring wells DC-9B and DC-9C correspond to the reported depths of wells M-13 and M-14, respectively. The highest level of contamination in the wells in well cluster DC-9 is in the shallowest well (DC-9A), which is screened from the lower Falkirk to the upper Camillus. The results from wells DC-9B and DC-9C do not correlate well with the results from wells M-13 and M-14; however, wells M-13 and M-14 are open across the interval screened by well DC-9A. Interestingly, however, the levels in well M-14 have historically, and recently, been higher than the levels in DC-9A. Also of interest is the fact that well M-12, located just to the north of well M-13, penetrates to a depth below that of well DC-9A yet has always been free of contamination. Refer to Figure S-9 in Appendix S for details of these wells.

Domestic wells L-1 and L-14 have historically shown levels of TCE between 100 and 200 μg/l, with the exception of calendar year 1992. This pattern has continued recently as well. The reported depth of well L-1 corresponds to the approximate midpoint of the well screen in monitoring well DC-10D. Therefore, well L-1 is open to the entry of contamination from any of the 120 feet of strata it penetrates, i.e. also from those strata monitored by wells DC-10A, DC-10B and DC-10C. The depth of well L-14 is unknown. The analytical results would indicate that the nearest zone of contamination is located approximately 65 to 85 feet below the ground surface, and enters well L-1 at that approximate depth. The seasonal pattern in well L-1 appears to indicate lower levels of TCE in the spring of the year (1991 and 1994 results), whereas the 1993 results are not definitive and the well was not sampled at this time of year in 1992. The results from nearby well cluster DC-10 provide no clear evidence of a seasonal contaminant level pattern in the area of well L-1. Refer to Figure S-10 in Appendix S for details of these wells.

Route 5

Many of the domestic wells along Route 5, from McIntyre Road to the Caledonia village limits (see Figure 3-1), penetrate to a depth equivalent to the open-hole well DC-12A or well DC-12B. These domestic wells do not demonstrate a clear pattern as to seasonal or depth-related trends. The domestic wells at the western and southern extremities of this group of wells, e.g. L-4 on the west and L-15 on the south, penetrate the apparent contaminated zone, yet they have remained clean over

the past four years. The eastern limit of the contamination has not been determined because the most easterly residence not on public water from the Village of Caledonia is the location of well L-22, and this well contains TCE. Refer to Figure S-12 in Appendix S for details of these wells.

Spring Street

There are two "groups" of wells along Spring Street; one to the south (L-23, L-28 and L-31) and one to the north (L-26, L-27 and L-33; and M-23, M-24, M-26 and M-35), that have historically been contaminated. The wells to the south of the southerly cluster (L-25, L-29 and L-30) have been only slightly contaminated (<5 μg/l), while the wells to the north of the northerly cluster (M-27, M-36 and M-37) have been clean (ND at 1 μg/l) during the same monitoring period. The southerly group of domestic wells appears to be slightly more contaminated in the spring (April to June), where results are available. However, the incompleteness of the data and the similarity of results throughout the year(s) precludes confirmation of this apparent trend. Since these wells are reportedly all relatively shallow (< 50 feet), no depth-related correlation was possible. Refer to Figure 3-1 for the locations of these domestic wells.

At first glance, the contaminant levels in wells L-26, L-27, L-33, M-23, M-24, M-26 and M-35 appear to be lower in the spring; however, because the data are not complete, this trend cannot be established with any degree of certainty. Since these wells are all reportedly less than 30 feet deep, with one possible exception (L-33 at 37 feet), no depth trend or correlation was evident. It should be pointed out that the reported depths of the slightly contaminated wells are the same as those of the more contaminated wells.

The group of northerly wells in Livingston County (L-26, L-27 and L-33) tends to exhibit higher levels of TCE (generally between 35 and 130 μg/l), than the southerly wells (L-23, L-28 and L-31) which exhibit levels < 12 μg/l. Taking this analysis one step further, the group of northerly wells in Monroe County (M-23, M-24, M-26 and M-35) tends to exhibit lower levels of TCE (<40 μg/l) than the group of northerly wells in Livingston County (L-26, L-27 and L-33). The apparent pattern is consistent with the respective DC-13 and DC-14 results described above, and the lesser pattern, i.e. the northerly Livingston and Monroe County trend, is consistent with the results obtained from sample SPR-12, which is located in proximity to the northerly Livingston County domestic wells (L-26, L-27 and L-33).

In general, the TCE levels at well cluster DC-13 (north) tend to be slightly higher than at well cluster DC-14 (south), i.e. 10 to 26 μg/l vs. 6.4 to 14 μg/l. The levels in DC-13A and DC-13B are approximately the same, as are the levels in DC-14A and DC-14B.

The wells at cluster DC-14 (south) and DC-13 (north) have failed to demonstrate depth-related seasonal trends. However, the levels of contamination in the domestic wells in each group correlate well with the general levels in the monitoring wells in the respective, nearby well cluster. Refer to Figures S-13 and S-14 in Appendix S for details of wells DC-13A, DC-13B, DC-14A, DC-14B and some of the domestic wells along Spring Street.

Additional details relating to the contaminant levels in groundwater in both the domestic wells and the monitoring wells, and an evaluation of their meaning and significance, are provided in Section 7.0 - Contaminant Fate and Transport.

6.4.3 Monitoring Well Results: Overview and Summary

6.4.3.1 Introduction

The monitoring well data may be summarized, in general terms, as follows: For a given strata, TCE concentrations are highest near the spill site, and decrease rapidly with increasing distance from the Site (see Plate 4). In the vicinity of the derailment and spill location, the TCE concentrations are highest in the Onondaga Formation, but the compound is also present in the deeper Bertie Formation and in the upper portion of the Camillus Formation. East of the spill site (DC-3 and DC-6), TCE is present in the Onondaga, but concentrations are highest in the underlying Falkirk member of the Bertie Formation. At locations east of Church Road, groundwater in the Onondaga is nearly clean, whereas TCE concentrations are highest in the Falkirk, and somewhat lower in the (deeper) upper Camillus wells. Groundwater is uniformly contaminated (i.e., at consistently low levels) in the Falkirk, Camillus, and Syracuse wells along Spring Street. The details of, and exceptions to, this generalized description of contaminant distribution are summarized in the following subsections.

6.4.3.2 Specific Details

"Open-hole" Wells

DC-4A, the upgradient well, was consistently clean.

To the extent that TCE concentrations exceeding 1% of TCE solubility in water (or 11,000 ppb) are indicative of the presence of NAPL, wells DC-1A, DC-5A and DC-15A appear to intersect strata containing residual NAPL.

DC-17A marks the known easternmost extent of the dissolved phase TCE plume with concentrations greater than 1,000 μg/l (1 ppm). It should be emphasized that open-hole well DC-17A (DC-7 also) penetrates deeper into the Falkirk than many of the wells that are screened entirely in the Falkirk. The contamination in DC-17A may reflect conditions in the Falkirk, which are discussed in the next subsection.

The three open-hole wells located east of Church Road (DC-8A, DC-10A, and DC-12A), plus DC-7 and 11A, were consistently below the MCL.

Of the 10 open-hole wells that intersect the unconformities on both sides of the Bois Blanc Formation, five are consistently below the MCL (DC-7, DC-8A, DC-10A, DC-11A, and DC-12A), and five are consistently contaminated (DC-1A, DC-7RA, DC-15A, DC-16, and DC-17A). With the exception of DC-7, the <MCL wells are located to the east of Church Road.

Most open-hole wells west of Mud Creek had their highest TCE concentrations in April 1994, when water levels were at their highest during any sampling round. Wells located between Mud Creek and Church Road had their lowest TCE concentrations in April.

Wells DC-2A and DC-3A had their highest TCE concentrations in July 1994 (2,500 and 8,600 μg/l, respectively). During the previous three rounds, concentrations in DC-3A were below 7 μg/l.

For the two rounds during which both wells DC-7 and DC-7RA were sampled (April and July 1994), only DC-7RA intercepted the dissolved phase plume. The two wells are approximately 410 feet apart.

Higher TCE levels at DC-5 and 15, in comparison to DC-16, suggests "preferential" contaminant transport toward the south and southeast within the Onondaga and uppermost Bertie. The recent (July 1994), large TCE "hit" at DC-3A (8,600 μg/l) may provide evidence of a strong seasonal pattern to such transport.

The temporal variation of TCE concentrations at DC-17A mirrors the trend at DC-6B. This reflects the condition that comparable strata were saturated in both wells during all but the April 1994 round. The April water level in DC-17A was at a point comparable to the screened interval in DC-6A. Interestingly, the April TCE concentration in DC-17A is approximately midway between the concentrations in DC-6A and DC-6B.

"Falkirk" Wells

At most wells located to the west of Church Road, TCE concentrations were lowest in April, when water levels were highest (DC-1B, DC-3B, DC-5B, DC-6B, and DC-7RB). DC-2B, a notable exception, exhibited its highest concentration in April. East of Church Road, TCE concentrations in all wells except DC-14A were highest in April (DC-8B, DC-9A, DC-10B, and DC-12B).

DC-2B and DC-6B were the only wells with TCE concentrations greater than 1 μg/l. Neither well produced samples with TCE concentrations greater than 1% of the solubility of TCE in water. It appears, therefore, that the Falkirk does not contain NAPL in the vicinity of the sampled wells. The highest TCE levels in the Falkirk were generally detected at DC-6B.

The "Falkirk" wells generally yielded the most heavily contaminated samples from clusters DC-3, DC-6, and DC-7R and those located east of Church Road. Maximum TCE concentrations ranged from 350 to 2,100 μg/l at DC-3, DC-6, and DC-7R, whereas maximum concentrations in wells east of Church Road were between 14 and 88 μg/l. Concentrations were very consistent from one sampling event to the next at well DC-7RB.

The Falkirk appears to be typically dewatered at cluster DC-8. Consequently, DC-8B has been dry most of the time and has been sampled only once (April 1994). That sample was the most contaminated (88 μg/l) of any collected at the cluster during the four sampling events.

Several "Falkirk" wells straddle one or both unconformities above and below the Bois Blanc. With the exception of DC-4B, the upgradient well, the wells are contaminated (DC-2B, DC-5B, and DC-6B).

"Upper Camillus" Wells

A pattern of systematic decreases of TCE concentrations in several wells (DC-1C, DC-1D, DC-5C, DC-5D, and DC-15B), together with the analysis of field screening results at those wells plus at well DC-2D, may indicate that the deepest open borehole at four drilling locations (DC-1, DC-2, DC-5 and DC-15) acted as a temporary conduit and allowed contamination to migrate to greater depths. Monitoring wells were installed in these boreholes soon after they were drilled such that the temporary conduit was sealed, thereby eliminating the potential for any further vertical migration through the borehole. Future sampling of these wells should help to determine if such "short-circuiting," or cross-contamination, occurred. A continued gradual and/or consistent decline in TCE concentrations would suggest that it did occur, whereas a rebound (increase) in TCE concentrations would suggest that it did not occur. Because of this particular situation, the wells listed above are excluded from the discussions of TCE trends in the rest of this subsection.

The highest TCE levels in the Camillus wells were generally detected in April 1994. The highest concentration was detected at DC-2C (190 μg/l).

Maximum TCE concentrations ranged from 13 to 80 μg/l in the wells east of Church Road (DC-8C, DC-10C, DC-11B, DC-12C and DC-14B). These concentrations are generally less than the TCE levels detected in the overlying Falkirk.

"Middle and Lower Camillus" Wells

DC-4C, the "upgradient" location, exhibited low level contamination in the first two complete sampling rounds (Rounds 2 and 3). These wells have been ND at 1 μg/l since then.

The highest TCE concentration in this series of wells was detected in November 1993 and April 1994 at DC-7RC (130 μg/l). TCE concentrations consistently exceeded the MCL at DC-7RC and DC-13A. The remaining wells almost always tested below the MCL (DC-3D, DC-6D, DC-8D, DC-9B, DC-10D and DC-12D).

"Syracuse" Wells

DC-4D, the "upgradient" location, exhibited low level contamination (18 μg/l) in the first round (November 1993) and has been ND at the MCL (5 μg/l) since then.

The highest TCE concentration was detected in DC-17B (480 μg/l) in July 1994. However, this well tested ND for TCE at 1 μg/l during the April 1994 sampling event. Consistent, low-level concentrations (less than 24 ppb) were detected in well DC-13B. TCE concentrations were generally below the MCL at the remaining locations (DC-7RD and DC-9C).

6.4.4 Seasonal (Round by Round) Overview and Summary

6.4.4.1 Introduction

The Phase C sampling program was conducted over a one year period, from July 1993 to July 1994. As previously indicated, the Phase B sampling program was designed for a particular purpose, as was Round 1 (July 1993) of Phase C. As such, and because the monitoring wells had not yet been installed, neither of these sampling events was comprehensive.

Upon completion of the installation of the monitoring wells in October 1993, a more comprehensive sampling program was initiated in November 1993. This program consisted of four rounds of sampling during the four seasons of the year; fall (Round 2 - November 1993), winter (Round 3 - January 1994), spring (Round 4 - April 1994) and summer (Round 5 - July/August 1994). The following subsections discuss the analytical results by season (round) in three general areas; Mud Creek, "Central Area" (between Church Road and Flint Hill/Lime Rock Road) and Spring Creek .

6.4.4.2 Specific Details - Round 2

The Round 2 spring/surface water, domestic well and monitoring well results provide what appears to be some correlative results as well as some apparent anomalies or inconsistencies as follows:

Mud Creek Area

The SW-2 ("swallet") result (ND) is not, nor should it be expected to be, correlative with any of the other Round 2 results.

The SPR-3 (Mud Creek falls) result (ND) from the upper Falkirk could be expected to be correlative with the results from monitoring wells DC-1B (Falkirk), DC-2B (Edgecliff to mid Falkirk), DC-6B (Edgecliff to mid Falkirk), and possibly DC-15A, DC-16(A) and DC-17A, which are all open to the upper or mid Falkirk. The depth of nearby domestic well G-1 is unknown so that the possibility of correlating the G-1 result with the environmental and monitoring well results is problematic.

The Round 2 Spring No. 3 result (ND) is not consistent with the previous (December 1992) result of 190 μg/l. It is also not consistent with the monitoring well results from those wells open to, or screened, in the Falkirk member of the Bertie Formation. For example, proceeding from the monitoring wells located closest to the SPR-3 location and moving to the south, west, and southwest, the results are as follows: DC-17A = 1,400 μg/l; DC-6B = 1,100 μg/l; DC-16 (A) = 6,800 μg/l; DC-15A = 13,000 μg/l; DC-2B = 120 μg/l; and DC-1B = 380 μg/l. It is recognized that some of these wells are open-hole wells (DC-17A, DC-16(A) and DC-15A), and obtain some water (and contamination - ?) from overlying strata. However, even the well screened over a discrete Falkirk interval (DC-2B) contained TCE, although it was the lowest result of any of those compared with SPR-3. The considerably higher results in the other wells, with the exception of DC-1B, seem to indicate that a considerable amount of contamination between the spill site and well cluster DC-17 is contained in the strata overlying the Falkirk.

Spring No. 4 is located at a lower elevation and farther down (to the northeast) in the Mud Creek valley than Spring No. 3. Spring No. 4 is projected to originate in the Camillus Formation. The SPR-4 result (98 μg/l), may be generally correlative with some of the monitoring well results, as follows:

- The SPR-4 result is somewhat similar to the results from the basal Falkirk/upper Camillus well, DC-2C (22 μg/l), and the lower Camillus DC-6D well (26 μg/l).
- The lower Camillus well at cluster DC-2 (DC-2D) contained 590 μg/l of TCE and the upper Camillus well at cluster DC-6 (DC-6C), closest to Spring No. 3, contained no TCE (ND at 1 μg/l).

A correlation could not be made with the closest domestic well (G-1) because this well is an open-hole well and its depth is unknown.

The SPR-20 sample (400 μg/l) is from a spring located in the Mud Creek valley between the SPR-3 and SPR-4 sampling locations. This spring is projected to originate in the lower Falkirk. The SPR-20 result is somewhat similar to the DC-1B (Falkirk) and DC-2B (mid Edgecliff to mid Falkirk) results of 380 and 120 μg/l, respectively. Interestingly, however, the mid Bois Blanc to mid Falkirk well (DC-6B), located closest to the SPR-20 location, contained 1,100 μg/l of TCE. The other well closest to the SPR-20 location is well DC-17A at cluster DC-17. Well DC-17A is, however, an open-hole well down to the mid Falkirk. As such, it is susceptible to introduction of contamination from any of the overlying strata. The TCE result in the well was 1,400 μg/l. This result is closer to that of well DC-6B than the SPR-20 result but, for the reason stated, it should not be considered correlative with the DC-6B result and is obviously not comparable to the SPR-20 result.

An interpretation of the domestic and monitoring well results is not conclusive because the depth of domestic well G-1 is not known. However, the well G-1 TCE result (2,000 μg/l) is somewhat similar to the results from the closest monitoring wells; DC-17A (1,400 μg/l) and DC-6B (1,000 μg/l). Therefore, some correlation may be possible in this area. The open-hole well closer to the spill site exhibited much higher TCE concentrations; DC-15 A (13,000 μg/l) and DC-16(A) (6,800 μg/l), which do not appear to correlate with the wells discussed previously.

A review of the water level graphs for well clusters DC-2 and DC-6 (Appendix Q) indicate that the Edgecliff/Bois Blanc to mid Falkirk interval is somewhat hydraulically isolated from the strata above and below. As such, the results might be expected to be correlative at locations DC-2 and DC-6. This is apparently not the case since the DC-6B result is an order of magnitude (approximately 10 times higher) than the DC-2B result. The gradients in these wells during Round 2 were into the B wells from both above and below. Also, during Round 2, there was no apparent influence from the overlying strata monitored by wells DC-2A and DC-6A because DC-2A monitors an isolated (perched) zone of water and DC-6A was dry at this time.

Central Area - Church Road to Flint Hill/Lime Rock Roads

No environmental samples were collected from this area during Round 2.

The relationship between groundwater results is discussed in Section 6.4.2 (Domestic Well Results) and 6.4.3 (Monitoring Well Results).

Spring Creek Area

As discussed in Sections 6.3.3.13, 6.3.3.14, 6.4.1.1, 6.4.2 and 6.4.3, the environmental, domestic well and monitoring well results for Round 2 are generally correlative with respect to sample location. In general, samples from wells near the south end of Spring Street exhibit low TCE concentrations (< 5 μg/l), as do those near the north end of Spring Street (M-27 and SPR-19), which were both ND in November 1993.

Spring and surface water samples, collected from the Genesee and Wyoming railroad tracks north to M-35, all exhibit levels of TCE between a low of 3.3 μg/l (SPR-L23S) and a high of 99 μg/l (SPR-12). Most groundwater (well) results from this area fall within a range of 13 to 36 μg/l.

6.4.4.3 Specific Details - Round 3

Since this round of samples was collected during extremely cold weather, only a very few environmental (spring and surface water) samples were collected at this time. The domestic and monitoring well samples were collected as planned.

Mud Creek Area

The SPR-4 result (66 μg/l), from a spring that is projected to originate in the Camillus Formation, was an order of magnitude lower than the SPR-20 result (630 μg/l). The SPR-20 sample is projected to originate in the lower portion of the Falkirk, i.e. from a point higher in elevation than the SPR-4 sampling location. The Round 3 results from these locations are not significantly different than the Round 2 results. In addition, the relative concentrations, i.e. the SPR-20 result being noticeably higher than the SPR-4 result, remained consistent during these two sampling rounds.

The groundwater (domestic and monitoring well) results vary from being quite consistent with, to being quite different than, the Round 2 results. For example, the domestic well (G-1, G-2, G-5S and G-5D) results were all higher in Round 3 than they were in Round 2, whereas the well cluster DC-1, DC-5, DC-15A and DC-16 results were all generally lower than the Round 2 results. The DC-2 well cluster results were also generally lower in Round 3 than Round 2 (with the exception of well DC-2B), but the relationship between concentrations in individual wells in the cluster remained about the same. The cluster DC-6 well results exhibited similar results in Rounds 2 and 3 with the exception of the well DC-6B results, which were higher in Round 3 than Round 2. The well DC-2A results could not be compared because well DC-2A was dry during the Round 2 sampling event. The DC-17A results for Rounds 2 and 3 were about the same at 1,400 and 1,600 μg/l, respectively.

In general, with the exception of the domestic wells and the "B" wells at well cluster locations DC-2 and DC-6, the concentrations in groundwater were lower during Round 3 than during Round 2. In some wells, the Round 3 results were considerably lower than the Round 2 results, as follows: DC-1A = 16,000 to 1,100 μg/l; DC-1C = 38,000 to 520 μg/l; DC-1D = 9,400 to 1,300 μg/l; DC-5A = 7,300 to 1,600 μg/l; DC-16 = 6,800 to 1,200 μg/l. It is possible that the drilling operations mobilized contamination that produced the higher results the first time that these wells were sampled (Round 2).

The Round 3 spring/surface water and groundwater results do not appear to be correlative. However, this fact is not deemed to be significant.

Central Area - Church Road to Flint Hill/Lime Rock Road

No environmental samples were collected from this area during Round 3.

The relationship between groundwater results is discussed in Section 6.4.2 (Domestic Well Results) and 6.4.3 (Monitoring Well Results).

Spring Creek Area

The Round 3 results for the only two sampling points that were sampled during Rounds 2 and 3 (SPR-12 and SPR-L23S) were almost identical. The SPR-12 results were also comparable to the Round 1 results. The SPR-11 result in Round 3 was identical to Round 1 (ND at 1 μg/l) and the SPR-18 result in Round 3 was basically the same as the Round 1 result (< 1 μg/l).

Where comparable, the domestic well results were basically the same during Rounds 2 and 3. The monitoring well results for Rounds 2 and 3 are basically the same and, as with Round 2, the Round 3 monitoring and domestic wells are consistent with the pattern that has been described previously under the Round 2 discussion.

The environmental and groundwater results for Round 3 followed the same pattern as the Round 2 results. No significant individual sampling location changes or general pattern changes were noted in the Round 3 results.

6.4.4.4 Specific Details - Round 4

The groundwater (domestic and monitoring well) results exhibited some changes that are considered to be significant with respect to understanding the mechanism of contaminant mobilization and migration. Refer to Section 7.0 Fate and Transport of Contaminants for further details of the significance of the Round 4 groundwater results.

Mud Creek Area

All of the comparable spring sample results in the Mud Creek valley were lower for Round 4 than for the three previous sampling rounds, with the exception of the SPR-3 result that was higher in Round 4 than any of the previous rounds (1 and 2, it was dry during Round 3). These results appear to indicate that contamination was being mobilized from the Devonian strata (Onondaga and Bois Blanc Formations) in the spring (high water table), whereas the TCE contamination in the Silurian strata (Bertie and Camillus Formations) was being diluted and/or flushed out of these strata.

The domestic well G-2 result was the highest of any previous round, whereas the G-5S and G-5D results were the lowest of any previous round. The G-2 result appears to indicate a mobilization of contamination during the period of high water levels. The G-5S and G-5D results may be indicative of dilution during high water levels, and/or relative inactivity (low pumping rates) at the quarry over the winter months. If these wells were not in use for quarry operations, the cone of influence may not have been large enough to induce or maintain the flow of groundwater and TCE from the spill site toward the quarry well.

The Round 4 results from some of the shallow monitoring wells located at or relatively close to the spill site (DC-1A, DC-2B, DC-5A, DC-15A, DC-16 and DC-17A) indicate that contamination is being mobilized from the Devonian and Silurian formations that are open to the "A" series of open-hole wells. Although it cannot be demonstrated conclusively, the DC-5A result appears to indicate that a major component of the TCE (and possibly NAPL) is present in the Devonian strata and not in the Silurian strata. With only two exceptions (DC-2D and DC-6A), the results are generally lower in the deeper wells at the spill site and in all of the wells directly to the east and north of the spill site (DC-6 and DC-17). The results from wells DC-2B, DC-6A through DC-6D and DC-17A appear to confirm the fact that mobilization of contaminants is occurring in the shallow strata, and that dilution or flushing of contaminants is occurring in deeper strata and/or at locations to the east and north of the spill site.

The Round 4 G-2 and Mud Creek spring (SPR) results appear to confirm the pattern of contaminant mobilization during periods of high water levels, and the migration of contamination to the north and northeast during these periods. It is expected that these conditions occur on an annual basis in the spring of each year.

Central Area - Church Road to Flint Hill/Lime Rock Road

All of the environmental samples collected from this area during Round 4 were expected to exhibit no evidence of TCE with the possible exception of sample SPR-24. Consistent with expectations, all results were ND at 1 μg/l with the exception of sample SPR-24 (1.7 μg/l).

The Round 4 groundwater (domestic and monitoring well) results appear to indicate a trend of lower contaminant levels from Church Road to Flint Hill/Lime Rock Road, with the exception of those wells near well cluster DC-8. At this location, the Round 4 and historical (1991 - 1993) results appear to indicate an increase in contaminant levels in the spring of the year. Refer to Section 6.4.2 and 6.4.3 for details of this pattern.

This apparently anomalous situation appears to be best explained by groundwater flow and contaminant migration along some preferential, fracture-controlled pathway during periods of high groundwater levels.

Spring Creek Area

All spring sample results for Round 4 that could be compared to previous results were generally consistent. Two newly discovered springs (SPR-21 and SPR-26) were sampled for the first time in April 1994. The SPR-26 result was ND at 1 μg/l, whereas the SPR-21 result, from a sampling point located only 100 to 150 feet away from SPR-26, exhibited a result of 1,900 μg/l. This was the highest TCE concentration ever detected east of Church Road (with the exception of domestic well G-9) and cannot be readily explained at this time. Unfortunately, the only time of the year that this spring will be flowing is in the spring of the year. Current plans are to sample this spring again as soon as it is flowing.

The groundwater (domestic and monitoring well) results are consistent with previous rounds in the context of location, depth, and relative relationships with other wells. The relationship of the groundwater results to the spring (SPR) results is similar to previous rounds. The only exception to the generally consistent pattern of spring (SPR) and groundwater results is the SPR-21 result discussed above.

6.4.4.5 Specific Details - Round 5

The Round 5 results appear to indicate a slow return to "normal" conditions following the period of high water levels in March and April.

Mud Creek Area

Only four aqueous phase (spring and surface water) environmental samples were collected in the vicinity of Mud Creek during Round 5. The SPR-4 result was between the previous low to medium water level results (December 1992, November 1993 and January 1994) and the high water level result in April 1994. The SPR-4 results for both July 1993 (Round 1) and July 1994 (Round 5) were essentially the same, i.e. 50 and 53 μg/l, respectively. The SPR-20A result was higher than the April 1994 result, the only other time that this spring had been sampled. The SW-6B and SW-6C samples were collected from new sampling locations in the gorge pond and could not be compared to previous results. However, these results are interesting in that they demonstrate the fact that TCE is continuing to migrate to the northeast, out the Mud Creek valley to Oatka Creek. They also indicate that the TCE concentrations in the gorge appear to decrease with increasing distance from the spill site.

Round 5 groundwater (domestic and monitoring) results also appear to indicate a return to normal. For example, the domestic well DW-G1, DW-G2, DW-5S and GW-5D results are similar to those reported from Round 2, slightly lower than those reported from Round 3, and significantly different than those reported from Round 4.

The results from monitoring wells at or proximate to the spill site are somewhat more inconsistent and difficult to compare from round to round. This is particularly true at well cluster locations DC-1 and DC-2. At location DC-5, the pattern of decreasing TCE concentrations with depth appears to have continued, and the high (20,000 μg/l) result in well DC-5A in April has decreased significantly. At location DC-6, the pattern of higher concentrations in well DC-6B has returned to normal from the reversed pattern in the DC-6A and DC-6B wells exhibited by the Round 4 results. The Round 5 TCE concentration in wells DC-15A, DC-16 and DC-17A also returned to a "normal" pattern following the deviations from this pattern in April 1994.

In general, the pattern of contamination exhibited by the Round 5 results is similar to that demonstrated by previous rounds with the exception of the Round 4 results. This fact lends credence to the theory that the high water levels in the spring of the year mobilize TCE contamination from the normally unsaturated bedrock formations (primarily the Devonian Bois Banc and Onondaga) and dilute or flush some of the contamination out of the Falkirk and lower strata.

Central Area - Church Road to Flint Hill/Lime Rock Road

No environmental samples were collected from this area during Round 5.

The domestic well results from Round 5 were generally consistent with previous rounds, with the exception of well M-4 on Flint Hill Road (Monroe County). This well exhibited a TCE concentration (15 μg/l) greater than the MCL (5 μg/l) for the first time in four years of sampling. This well is located between other wells (M-2, M-3 and M-5) that had previously exhibited TCE concentrations in excess of the MCL, and had been an anomaly in this regard prior to Round 5.

The Round 5 monitoring well results from this area were fairly consistent with previous rounds, other than the slight increase in TCE concentrations observed in the Falkirk and upper Camillus wells during Round 4.

In summary, the groundwater TCE concentrations returned to "normal" in July 1994.

Spring Creek Area

The Round 5 environmental samples from the Spring Creek area exhibited results generally consistent with previous rounds, with the following exceptions. The SPR-12 result was the lowest it had ever been, and the SPR-18 and SPR-19A (probably equivalent to SPR-19) both exhibited very low, estimated levels (both 0.6 μg/l) of TCE. This level is below the laboratory quantitation limit for TCE by the analytical method used (USEPA SW-846, Method 8010).

No domestic wells in the vicinity of Spring Creek were sampled during Round 5.

The Round 5 monitoring well results for this area (DC-13A and DC-13B, and DC-14 and DC-14B) are consistent with previous rounds.

6.4.5 General Overview and Summary

The environmental (spring/surface water) results exhibit a general consistency throughout the year, and by location, within the Study Area. The environmental results in the area of Mud Creek demonstrate a pattern of TCE migration from the spill site northeast in the Mud Creek valley. The TCE concentrations tend to decrease away from the spill site and away from the contaminated springs in the valley (primarily SPR-3, SPR-20 and SPR-20A). Also, the levels of TCE change in response to high and low groundwater conditions, with increases occurring in the higher elevation spring sample (SPR-3) during periods of high water and with lower levels occurring in the lower elevation spring samples (SPR-20 and SPR-20A) during the same period of high water levels.

Environmental sample results for the central part of the Study Area were all generally ND, as expected.

Environmental sample results for the Spring Creek area were very consistent throughout the Phase C sampling program conducted from July 1993 (Round 1) to July/August 1994 (Round 5). The one major exception to this pattern was the single SPR-21 result of 1,900 μg/l in April 1994. This result has not been confirmed and its significance is indeterminable at this time.

Domestic Wells

The domestic well results were also relatively consistent throughout the Study Area on a round by round basis. Some deviations to the overall pattern occurred during Round 4 (April 1994) in the vicinity of the spill site and in the central part of the Study Area. The increase in concentrations at well DWG-2 and wells east of Church Road are not necessarily related, other than the fact that they occurred at the same time of year. The elevated DWG-2 result in April is considered to be the direct result of mobilization of TCE contamination at the spill site. The slightly higher results in the central part of the Study Area, approximately 1.4 to 2.3 miles from the spill site, are not entirely understood. They may be related to the higher groundwater levels that occur during the spring of the year.

The domestic well results near Spring Creek remained consistent and essentially the same throughout the entire monitoring period. This pattern is, most likely, a result of the distance of these wells from the source, i.e., the spill site, the stability of the hydrologic regime in the vicinity of Spring Creek, and the equilibrium that has been established between these two areas in the past twenty plus years.

Monitoring Wells

Since the monitoring well sample results also reflect groundwater quality over time, they would be expected to reflect similar patterns as the domestic well results. This is generally the case, except for the fact that many of the monitoring wells are screened over a discrete interval, whereas the domestic wells are open across a longer vertical interval. In general, the results from monitoring wells in a particular area, or in a particular cluster, were fairly consistent and were also generally

consistent with the results from the domestic wells. The most notable exceptions to this pattern were the sometimes widely variable results in some of the wells in well clusters near the spill site. One of the rounds (Round 4 - April 1994) produced the most variable monitoring well results. This was true not only in the context of the results being different than the other rounds, but also in the fact that the results from individual wells in a cluster and between clusters were different than during the other rounds. Conditions during this round evidently caused the mobilization and migration of TCE contamination from shallow bedrock strata at the spill site and diluted the TCE or flushed the contamination from the lower strata.

The monitoring well results in the central and eastern portion of the Study Area were generally consistent with the domestic well results. The monitoring well results also remained generally consistent throughout the year, with a slight increase in TCE concentrations in the central portion of the Study Area in the spring. The most stable and consistent results were noted in the monitoring wells near Spring Creek. The reason for this is the same as discussed under the previous domestic well result discussion.

6.5 DATA VALIDATION PROGRAM

6.5.1 Overview and Summary

All sample analytical data were reviewed to evaluate the data quality. Data were validated by experienced DUNN data validators following USEPA validation criteria modified to include NYSDEC ASP CLP requirements. The validators meet all of the NYSDEC requirements for performing both inorganic and organic data validation. The objectives of the data validation process were to evaluate the validity of the reported sample results and to determine if the data were of sufficient quality, i.e., both valid and usable, to meet project requirements.

Data validation was performed in accordance with a program developed by DUNN, and approved by the Department, which incorporates guidelines established in the USEPA Region 2 SOP No. HW-6, Revision #8, CLP *Organics Data Review and Preliminary Review*, and SOP No. HW-2, Revision #11, *Evaluation of Metals Data for the Contract Laboratory Program (CLP)*. These documents are checklists designed to investigate the degree of accuracy and completeness exhibited by a CLP data package. For work performed under NYSDEC ASP (12/91) CLP analytical procedures, additions or changes to the general EPA validation procedures were incorporated into the process and the data were assessed according to the NYSDEC-specific requirements.

DUNN validators reviewed the appropriate data and reporting forms for the items identified below. After the entire data package had been reviewed, a narrative report and deliverables summary was prepared describing data reduction, reporting and validation procedures. Validation reports are composed of a narrative and the tabulated results of the review. Tabulation consists of the preparation of summary tables of actual sample data and any final notes of validation decision or qualification, along with any pertinent footnote references. Additionally, laboratory "Form I" sample result sheets are qualified where necessary. These reports provide an indication of the general quality of the data and identify any specific problem areas with the results. The reports also indicate

if the data are compliant, valid and usable. DUNN's Data Validation Summary/Usability reports for the analytical results from the First Phase RI have been provided to the Department under separate cover. E3I's Case Narratives and the raw analytical data, as well as DUNN's complete data validation reports, are available to the Department upon request.

Analytical Data for Volatile Organic Compounds

- Case Narrative
- Deliverable Requirements
- Holding Times
- Organic Analysis Data Sheets (Form I)
- Quantitation Reports
- Reconstructed Ion Chromatograms (GC/MS only)
- Mass Spectral Data (GC/MS only)
- EPA/NIH Mass Spectral Library Search for TICs (GC/MS only)
- Surrogate Recovery Data
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) Data
- Blank Summary Data
- Initial Calibration Data
- Continuing Calibration Data
- Tuning and Mass Calibration (GC/MS only)
- Internal Standard Areas and Retention Times

Analytical Data for Cyanide

- Case Narrative
- Deliverable Requirements
- Holding Times and Sample Preparation
- Instrument Calibration Data
- Instrument and Distillation Blank Data
- Matrix Spike Recovery Data
- Laboratory Duplicate Data
- Inorganic Analysis Data Sheets (Form I) and Associated Data
- Blind Field Duplicate Data

6.5.2 Results

As documented in the Spill Site Soil Investigation Report, validation of the analytical data for the environmental samples collected from the Site during the Spill Site Soil Investigation revealed that although some of the volatile, semivolatile and inorganic results were qualified as estimated, all of the data for these fractions are considered to be valid and usable. All pesticide/PCB data, with the exception of the results for samples Soil 7 and Soil 8, are also considered to be valid and usable. The pesticide/PCB results for samples Soil 7 and Soil 8 were rejected because the samples were extracted eight (8) days outside of the required holding time; therefore, the pesticide/PCB data for these

samples are unusable. It should be noted, however, that pesticide/PCB compounds are not considered to be derailment/spill-related contaminants.

Validation of the analytical data for the environmental samples collected from the Site during the First Phase RI revealed that, although approximately 6% of the cyanide data were qualified as estimated, all of the cyanide data are considered to be valid and usable. Approximately 31% of the volatile results were qualified as estimated, and approximately 1% of the volatile results were rejected and are unusable. It should be noted, however, that most of the results that are unusable are for the following compounds, none of which are considered to be spill-related contaminants: bromomethane, chloroethane, chloromethane, dichlorofluoromethane, methylene chloride and trichlorofluoromethane. Therefore, approximately 99.9% of the volatile results are considered valid and usable, and meet project requirements. The vinyl chloride results for 13 samples collected in April, 1994 have been rejected and are considered unusable due to elevated percent differences between the continuing calibration standard and the initial calibration standard: MW1-A, MW3-B, MW3-C, MW3-D, MW4-A, MW4-B, MW4-D, MW6-A, MW7, MW7-R, MW10-C, MW15-B and X-4. Vinyl chloride is a product of the breakdown of trichloroethene and is considered to be a potential spill-related contaminant.

In conclusion, the analytical results from the First Phase RI at the Site are of sufficient quality to meet the needs of the project. Out of a total of 10,929 sample data points for volatile organic compounds, 120 (1.1%) were rejected and are considered unusable. Out of the 120 volatile organic data points that were rejected, only 13 (0.1%) are considered to be potential spill-related contaminants. All of the 90 sample data points for cyanide from the First Phase RI are considered to be valid and usable, and meet project requirements.