



November 27, 2013

UPS Next Day

Ms. Addie Walker
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Re: Historic Hydrogeologic Data Review – Plant 1
Laurens Ceramics Site, Laurens, South Carolina
Site ID #00172

Dear Ms. Walker:

3M Company (3M) is submitting this letter in response to the South Carolina Department of Health and Environmental Control (DHEC) August 22, 2013 letter to 3M requesting evaluation of persistent detections of volatile organic compounds (VOCs) in the area of Plant 1 at the Laurens Ceramics Site, Laurens, South Carolina. This document serves as a precursor to the development of the scope of work (SOW) for focused Feasibility Studies of the referenced areas so that appropriate response measures are implemented.

This evaluation focused on VOC concentrations encountered in specific well locations at the site. VOCs have been detected in low but increasing concentrations in monitor wells MW03 and MW79, located west of former VOC sources at Plant 1. Since the locations of these wells are outside of the expected plume pathway, an additional investigation is being proposed to confirm site conditions and to evaluate the potential sources for the detected VOCs.

Recent analytical data also indicate elevated VOCs in monitor wells MW13 and MW22 at part per million levels. These wells are located immediately downgradient of former VOC source areas, including the Plant 1 wastewater pond (MW13) and the closed landfill (MW22). Based on the well locations and historic groundwater data, elevated VOC concentrations are not unexpected for these locations. However, the current lack of spatial monitoring capabilities associated with the wells, particularly well MW13, warrant additional investigation to characterize the nature and extent of the elevated VOCs so that appropriate response options may be evaluated. Figure 1 provides the location of the general layout of the Laurens Ceramics Site.

BACKGROUND

During the period from 1988 to 2002, numerous environmental assessments were conducted at Plant 1 and the closed landfill to define the site's geologic and hydrogeologic framework, and to assess the distribution and migration of VOCs in groundwater and surface water. The investigations identified areas associated with Plant 1 and the closed landfill with sufficient VOC concentrations to potentially impact local groundwater. Figure 2 provides an aerial view of Plant 1 in 1995 showing the general location of identified historic VOC source areas associated with Plant 1. Figure 4 provides a

groundwater contour map for Plant 1 showing the location of the closed landfill in relation to Plant 1 and the location of monitor wells MW13 and MW22.

Under supervision and approval by DHEC, 3M implemented corrective measures in the identified VOC source areas, including the Plant 1 wastewater pond (1995), closed landfill (1998), and a former Material Handling Area formerly referred to as the opossum pit (2006). The corrective measures included removal of residues and soil (Material Handling Area), stabilization of sludge and soil (wastewater pond), and the construction of impermeable caps over the wastewater pond and landfill. Following completion of the corrective measures, Plant 1 (including the closed landfill) was placed into a DHEC-approved groundwater monitoring program consisting of annual sampling of selected monitor wells and surface water stations. Based on the information provided by the investigation and groundwater monitoring data, the following observations are made for the area of Plant 1.

- Three hydrostratigraphic units are identified at Plant 1; the unconsolidated residuum zone, a transition zone, and competent bedrock.
- Bedrock in the area consists of biotite gneiss (west to northwest) to granite gneiss (southeast).
- Following closure of the Plant 1 wastewater pond, onsite landfill, and the former Material Handling Area associated with Plant 1, no other significant continuing sources of VOCs to groundwater have been identified at the site.
- Groundwater from Plant 1 flows radially away from an area southeast of the Plant 1 building. Groundwater in the area of the former VOC source areas is directed primarily to the southwest, combining with groundwater from the closed landfill and continuing southwest toward an un-named tributary to Reedy Fork.
- Dissolved-phase VOCs are present in groundwater associated with the former source areas at Plant 1 and the closed landfill. Due to the radial flow of groundwater from the area south of Plant 1, low concentrations of VOCs are detected in monitor wells north and west of the Plant 1 building.
- Long-term groundwater monitoring has indicated a site-wide decrease in tetrachloroethene (PCE) concentrations and an increase in associated degradation products, trichloroethene (TCE) and 1,1-dichloroethene (1,1-DCE), suggesting that PCE sources had been adequately removed and the remaining VOC groundwater plume (with no on-going source) was undergoing natural degradation and attenuation.

Monitor Well Cluster MW03 and MW79

Monitor wells MW03 and MW79 are located near the west boundary of the Laurens Ceramics Site immediately west of the Plant 1 building. Figures 2 and 4 show the locations of the wells in relation to plant structures. Due to radial groundwater flow from the area southeast of the Plant 1 building, these wells may be regarded to be downgradient of Plant 1. Figure 3 provides a historic site utilities map showing underground utilities in the area. Figure 4 provides a residuum groundwater contour map based on October 1991 groundwater data for the area. The October 1991 groundwater data

included several monitor wells that have since been closed. As a result, the 1991 groundwater data set provides a more detailed interpretation of site conditions.

Monitor well MW79 is completed within the bedrock groundwater zone with a total depth below grade (bg) of 119 feet. The well is constructed as an open-bore well with groundwater exposure from 79 feet bg to 119 feet bg. Boring lithologic data indicate the top of the bedrock transition zone at MW79 to be approximately 65 feet bg with competent bedrock occurring at approximately 69 feet bg. The depth to groundwater in well MW79 is approximately 30 feet below top of casing.

Monitor well MW03 is completed within the transition zone with a total depth of approximately 72 feet bg. The well is constructed with a 10-foot screen from 62 to 72 feet bg. Based on the depth and thickness of the transition zone for this area, well MW03 intercepts the entire transition zone and the base of the residuum zone. Groundwater in well MW03 occurs at approximately 31 feet bg.

During early investigation of the area, one additional well was constructed in the area of MW03 and MW79. The well (MW04) was completed within the residuum groundwater zone with a total depth of approximately 50 feet bg and a screen interval of approximately 35 to 50 feet bg. The well was closed after completion of the feasibility study investigation.

Early site maps from September 1991 also identify two monitor wells (MW28 and MW29) located approximately half-way between the former Material Handling Area (opossum pit) and wells MW03 and MW79 (See Figure 2). Both of the wells were constructed within the residuum groundwater zone with MW28 screened from approximately 24 feet to 39 feet bg and well MW29 screened from approximately 55 feet to 65 feet bg. By 2000, monitor well MW28 was closed. Well MW29 was closed after completion of the feasibility study investigation.

Historic analytical data for wells MW03, MW79, MW04, MW28, and MW29 are summarized in Table 1. The earliest data from September 1991 indicated non-detect conditions for VOCs at wells MW03, MW04, and MW28 with PCE identified in well MW29 at 15 µg/L. Well MW79 was not constructed at this time. Well MW29 monitored groundwater conditions at the base of the residuum groundwater zone.

By 2000, well MW79 was constructed as a bedrock well in association with well MW03 (transition well) and well MW04 (residuum well) on the west side of the property. Analytical data for groundwater samples collected in September 2000 identified PCE in monitor wells MW03 and MW79 at 1.6 µg/L and 9.5 µg/L, respectively. Monitor well MW04 was non-detect. Well MW29 located between the wells and identified VOC source areas indicated 1,1-DCE at 1.3 µg/L and PCE at 2.3 µg/L.

By 2004, residuum well MW04 was closed due to non-detect conditions; however, wells MW03 and MW79 were retained and included in the ongoing groundwater monitoring program. From 2004 to present, wells MW03 and MW79 have exhibited consistent concentrations of PCE (see Table 1). Due to the increasing concentration trends exhibited by these compounds in the wells, the area was identified by DHEC for additional investigation to confirm potential source areas and site conditions. Based on review of the investigation data available for the area, the following observations are made:

- The possible effect of underground utility trenches serving as potential conduits for the western migration of VOC-impacted groundwater was investigated. WESTON reviewed available utility maps for Plant 1 and confirmed the presence of a fire main and a potable water main extending from the south side of Plant 1 to the water tower located on the west side of the property (see Figure 3). However, review of historic analytical data from monitor wells (residuum wells MW28 and MW04) constructed near the trace of the utilities (See Figures 2 and 3) did not indicate any VOCs in shallow residuum groundwater to suggest that the utilities served as potential flow pathways.

It is more likely that the VOCs detected at monitor wells MW3 and MW79 are due to horizontal groundwater migration. This is supported by VOC analytical data for former monitor well MW29 constructed mid-way between documented VOC source areas and the MW03/MW79 well cluster. Analytical data for well MW29 identified VOCs associated with the base of the residuum groundwater zone; however, well MW28 (a shallow residuum well constructed at the same location as MW29) indicated no detectable VOCs, suggesting that VOCs at the location were restricted to the lower portion of the residuum aquifer.

- Figure 4 provides a groundwater elevation contour map for the residuum groundwater zone based on groundwater data from October 1991. The 1991 data was used in this evaluation due to the increased number of data points available at the time of the investigation allowing a more detailed interpretation of groundwater conditions. The map reflects a high point associated with groundwater elevation southeast of the Plant 1 building with radial flow northwest to southeast.

Based on the groundwater contours and the known locations of former VOC sources, dissolved-phase VOCs from the former source areas at Plant 1 would be expected to migrate primarily to the southwest. However, marginal areas adjacent and north of the former VOC sources could also affect groundwater west and northwest of Plant 1 due to radial groundwater flow conditions (See Figure 4). The detection of low concentrations of VOCs at well clusters MW03/MW79 (to the west) and MW93/MW94 (to the north) could be a result of this flow pattern.

Monitor Well MW13

Well MW13 was constructed as a residuum monitor well immediately south (downgradient) of the former Plant 1 wastewater pond (Figure 4). The well was constructed with a 10-foot screen from 46 to 56 feet bg. Deeper wells in the vicinity of well MW13 indicate the transition groundwater zone occurs approximately 90 feet bg. Groundwater in well MW13 is approximately 21 feet below top of casing.

A summary of the historic analytical data for well MW13 is provided in Table 2. Analytical data collected in September 1991 indicated a total VOC concentration of 37,035 µg/L at well MW13. In 1995, the Plant 1 wastewater pond was closed and capped. Analytical data provided in September 2000 indicated a significant decrease in VOCs with a total VOC concentration of 1,442 µg/L. Subsequent analytical data provided during the groundwater monitoring from April 2004 through present have indicated a gradual increase in total VOC concentrations at well MW13 from 1,330 µg/L in June 2004 to 7,993 µg/L in May 2013; however, the more recent data suggest VOC levels are

beginning to stabilize. Review of the specific compounds detected indicate the increases are represented primarily by 1,1-DCE, 1,1,1-trichloroethane (1,1,1-TCA), and 1,1-dichloroethane (1,1-DCA); all of which are degradation compounds of the original compound for the site, PCE.

Currently, well MW13 is one of four active residuum monitoring wells associated with the Plant 1 / closed landfill monitoring program. As a result, monitoring capabilities for the residuum groundwater zone are limited to overall site conditions.

Monitor Well MW22

Monitor well MW22 was constructed as a transition zone monitor well immediately south (downgradient) of the closed landfill (Figure 4). The well was constructed with a 10-foot screen from 48 to 58 feet bg. Boring log information for well MW22 indicates the transition groundwater zone occurs approximately 44 to 57 feet bg with bedrock occurring approximately 75 feet bg. Groundwater in the well is approximately 26 feet below top of casing.

A summary of historic analytical data for well MW22 is provided in Table 2. Analytical data collected prior to closure and capping of the landfill (December 1989 and September 1991) indicate total VOC concentrations of 94 µg/L and 100 µg/L, respectively. Data collected after closure of the landfill (September 2000) exhibited a marked increase in the total VOC concentration to 7,191 µg/L, eventually increasing to 18,120 µg/L in June 2008. Since 2008, concentrations of VOCs at the well have consistently decreased each year, such that in April 2013, the total VOCs at well MW22 were 4,271 µg/L (see Table 2). Based on the data trends observed, it is expected that VOC concentrations at well MW22 will continue to decrease. Groundwater analytical data for monitor wells downgradient (southwest) of well MW22 further suggest that the area of elevated VOCs reflected by well MW22 is restricted to the immediate area of the landfill.

SUMMARY

Review of site investigation data suggests that VOCs detected at well cluster MW03/MW79 are likely due to the lateral migration of marginally-impacted groundwater from the former VOC source areas south of Plant 1. However, since the VOC concentrations exhibited in these wells have been increasing very slowly at low levels, additional investigation upgradient to the wells is recommended to confirm the local groundwater gradient conditions and to further characterize the nature and extent of the VOC distribution.

Data provided for monitor well MW13 (located immediately downgradient of the former Plant 1 wastewater pond) suggest continued release of VOCs to local groundwater may be occurring but appear to be stabilizing. However, due to the limited number of wells available in the area of MW13, the ability to adequately characterize site conditions is not possible. As a result, additional investigation is proposed to evaluate the current nature and extent of VOC distribution associated with well MW13.

Data provided for monitor well MW22 (located immediately downgradient of the closed landfill) indicated a significant increase in VOCs occurring after closure of the landfill. This may be due to the disturbance of landfilled material during the closure stabilization activities in 1998. Regardless of the cause, data provided since June 2008 indicate VOC concentrations at well MW22 are decreasing

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significantly and it is expected that this should continue. Groundwater analytical data downgradient of the site further suggest that the elevated VOC concentrations observed at well MW22 are restricted to the immediate area of the landfill. As a result, no additional investigation is being considered in the area of the closed landfill at this time. Groundwater monitoring should be continued as part of the Plant 1 groundwater monitoring program to track the decreasing concentrations.

3M remains committed to the management of groundwater at the Laurens Ceramics Site. As a result, the findings of this evaluation will be considered during development of the technical scope for collection of additional information and field data in areas around the referenced wells MW03/MW79 and MW13 with the objective to identify localized treatment options (if any) to support the reduction of VOCs in groundwater at the site.

If you have any questions regarding this information, please call me at (651) 736-3135.

Sincerely,

P.P. J. R. K. 

Jeannie Martin
Advanced Environmental Scientist
Building 224-5W-17

Enclosures

cc: Mike Corbin - Weston
Tim Frinak - Weston
Lance Hauer - GE
Jim Kotsmith - 3M - 224-5W-17

Attachment
Figures and Tables

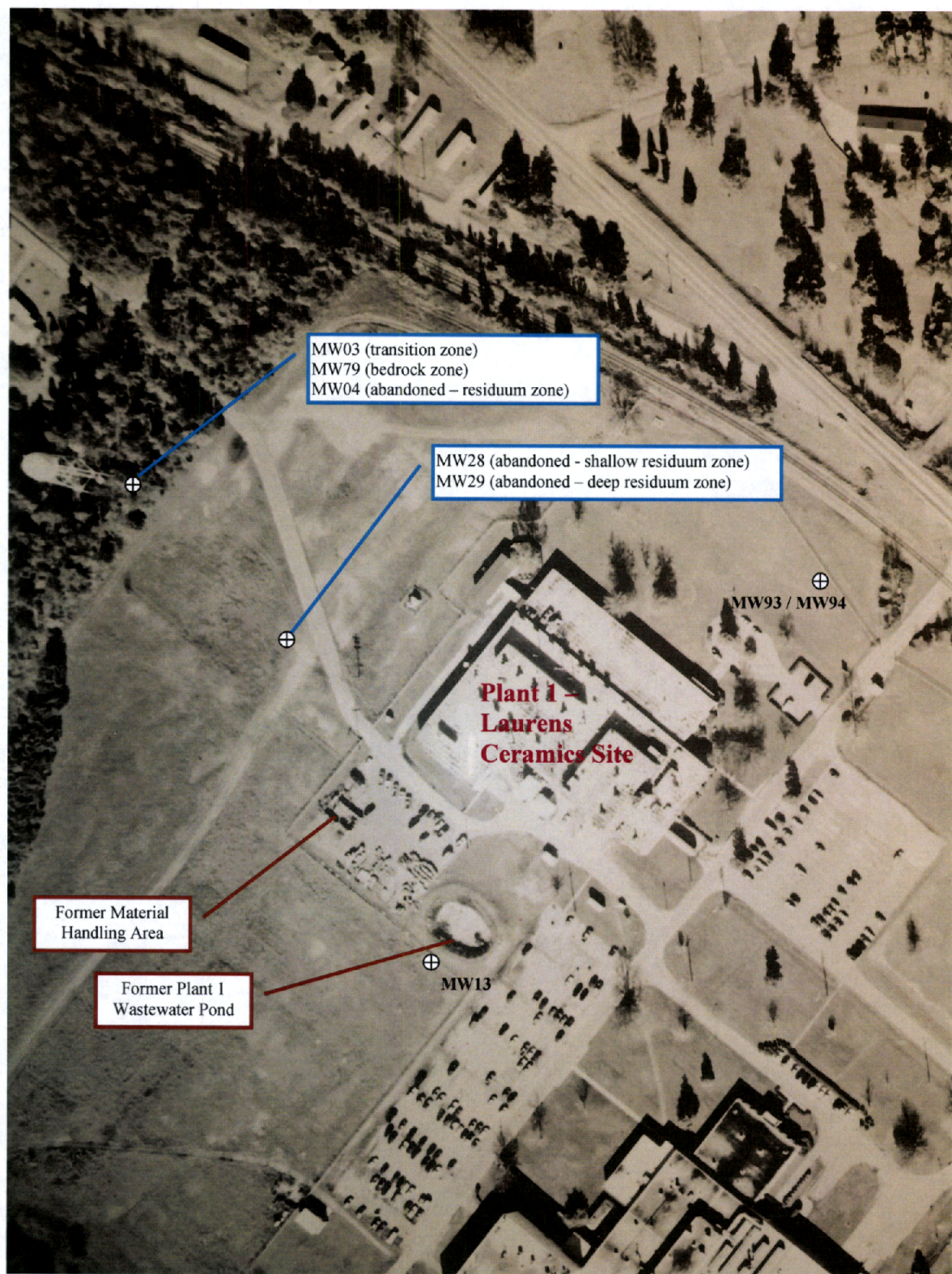
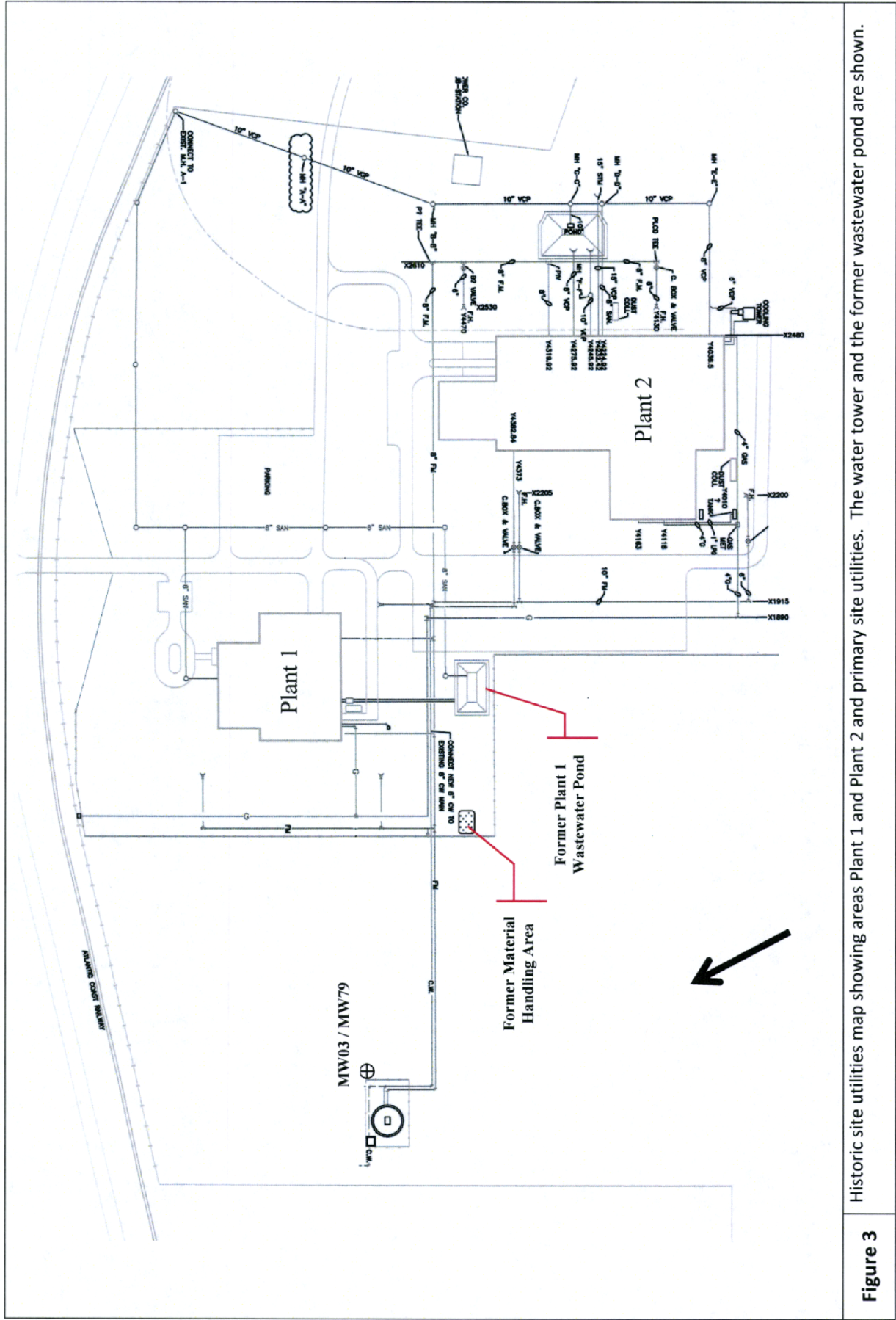


Figure 2

Aerial view of the subject property (December 1995), showing Plant 1, the former wastewater pond, material handling area, and monitor wells referenced in this document.



Historic site utilities map showing areas Plant 1 and Plant 2 and primary site utilities. The water tower and the former wastewater pond are shown.

Figure 3

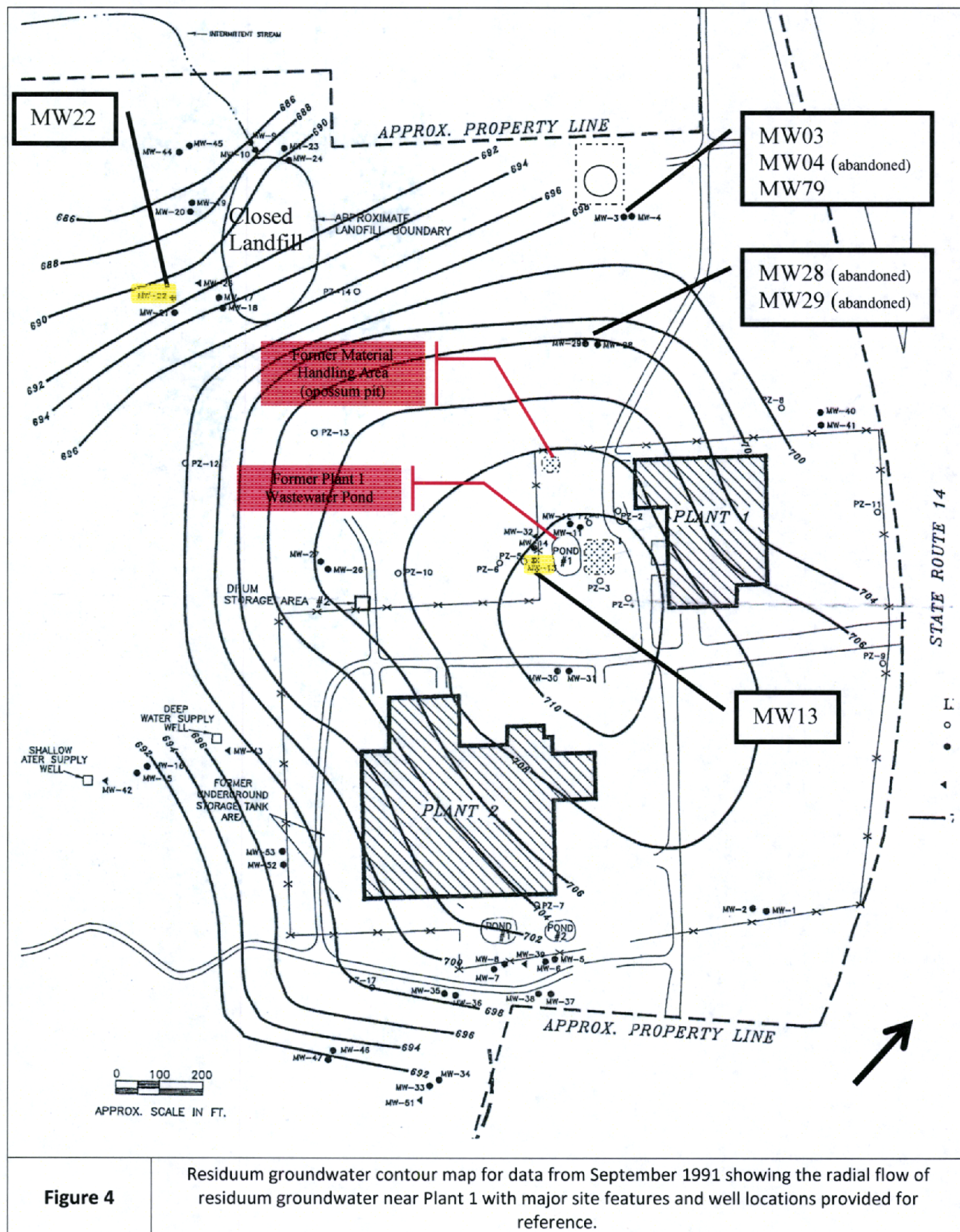


TABLE 1. Groundwater Analytical Data
(MW03 / MW79 Cluster)

	Direction ^a	West			West (mid-point)		North	
	Well ID.	MW03	MW79	MW04	MW28	MW29	MW93	MW94
	Well Type	Transition	Bedrock	Residuum	Shallow Residuum	Deep Residuum	Transition	Bedrock
SAMPLE DATE	COMPOUND							
September 1991	PCE	ND		ND	ND	15		
	TCE	ND		ND	ND	ND		
September 2000	PCE	1.6	9.5	ND		2.3		
	TCE	ND	ND	ND		ND		
	1,1-DCE	ND	ND	ND		1.3		
April 2004	PCE	2.5	15.0				ND	ND
	TCE	ND	ND				ND	ND
	1,1-DCE	ND	ND				1.5	ND
	1,1-DCA	ND	ND				ND	0.31 J
May 2006	PCE	1.2	17.0				1.5	1.2
	TCE	ND	ND				ND	ND
	1,1-DCE	ND	ND				1.9	ND
	1,1-DCA	ND	ND				ND	ND
June 2008	PCE	3.7	21.0				ND	ND
	TCE	ND	ND				ND	ND
	1,1-DCE	ND	ND				3.1	ND
	1,1-DCA	ND	ND				ND	ND
May 2010	PCE	3.6	22.0				ND	ND
	TCE	ND	0.73 J				ND	ND
	1,1-DCE	ND	ND				1.7	0.85 J
	1,1-DCA	2.6	ND				2.8	3.4
May 2012	PCE	7.0	23.0				ND	ND
	TCE	ND	0.87				ND	ND
	1,1-DCE	ND	ND				0.71 J	ND
	1,1-DCA	ND	ND				ND	1.1
April 2013	PCE	6.2	21.0				ND	ND
	TCE	ND	0.69				ND	ND
	1,1-DCE	ND	ND				1.1	0.55 J
	1,1-DCA	ND	ND				ND	0.7 J

^aDirection of well in relation to the areas of documented VOC sources.

Analytical results reported as µg/L. ND - Not Detected

J - Value below laboratory reporting limit and provided as an estimated concentration.

Shaded areas indicate well was not sampled.

**TABLE 2. Groundwater Analytical Data
(Wells MW13 and MW22)**

SAMPLE DATE	Location*	Downgradient of Former Plant 1 Wastewater Pond	Downgradient of Closed Landfill
	Well ID.	MW13	MW22
COMPOUND	Well Type	Residuuum Zone	Transition Zone
		Analytical Results (µg/L)	Analytical Results (µg/L)
December 1989	TVOC	20,292	94
	PCE	59	17
	1,1,1-TCA	2,300	10
	1,1-DCE	14,000	23
	1,1-DCA	3,300	6
	TCE	110	4
September 1991	TVOC	37,035	100
	PCE	52	35
	1,1,1-TCA	21,000	7
	1,1-DCE	13,000	16
	1,1-DCA	2,300	7
	TCE	62	4
1995	Plant 1 Wastewater Pond Closed		
1998			
September 2000	TVOC	1,442	Landfill Closed and Capped 7,191
	PCE	5	2,900
	1,1,1-TCA	330	220
	1,1-DCE	740	450
	1,1-DCA	320	240
	TCE	12	150
April 2004	TVOC	1,330	8,428
	PCE	ND	1,300
	1,1,1-TCA	210	150
	1,1-DCE	880	720
	1,1-DCA	240	520
	cis-1,2-DCE	ND	5,600
May 2006	TCE	ND	110
	TVOC	3,120	15,060
	PCE	ND	1,300
	1,1,1-TCA	580	270
	1,1-DCE	2,100	1,500
	1,1-DCA	440	790
June 2008	cis-1,2-DCE	ND	11,000
	TCE	ND	200
	TVOC	1,426	18,120
	PCE	6	850
	1,1,1-TCA	210	ND
	1,1-DCE	1,000	1,300
May 2010	1,1-DCA	210	800
	cis-1,2-DCE	ND	15,000
	TCE	ND	170
	TVOC	7,351	12,935
	PCE	25	430
	1,1,1-TCA	890	120
May 2012	1,1-DCE	5,600	1,500
	1,1-DCA	800	950
	cis-1,2-DCE	ND	9,800
	TCE	27	120
	TVOC	7,865	6,748
	PCE	60	230
April 2013	1,1,1-TCA	830	ND
	1,1-DCE	6,000	1,100
	1,1-DCA	930	560
	cis-1,2-DCE	ND	4,700
	TCE	36	67
	TVOC	7,993	4,271
	PCE	62	190
	1,1,1-TCA	870	38
	1,1-DCE	5,900	900
	1,1-DCA	1,100	420
	cis-1,2-DCE	ND	2,600
	TCE	38	57

*Direction of well in relation to the areas of documented VOC sources

Analytical results reported as µg/L

ND - Not Detected

J - Value below laboratory reporting limit and provided as an estimated concentration