BISHOP TUBE SITE
LITTLE VALLEY CREEK SURFACE WATER AND SPRING MONITORING

SAMPLING EVENT REPORT

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I. Introduction

On May 19 and 20, 2003 field staff from the Department of Environmental Protection collected surface water samples from Little Valley Creek and its tributaries in the vicinity of the Bishop Tube HSCA site. Procedures for the conducting the sampling event were outlined in a Sampling and Analysis Plan dated April 9, 2003.

The Bishop Tube site is located in East Whiteland Township, Chester County, PA. The site is a former stainless steel tube manufacturing facility. A site location map is included as Figure 1. The Department and a former site owner (Christiana Metals) have conducted extensive environmental investigations at the site and determined that widespread severe contamination of soil and groundwater has resulted from activities at the site. The Bishop Tube property is now abandoned, and is currently being marketed for redevelopment by the current site owner (Central and Western Chester County Redevelopment Authority). Contaminants of concern include the following volatile organic compounds (VOCs): trichloroethene, tetrachloroethene, 1,1,1-trichloroethane, methylene chloride, and their breakdown products. Chlorinated VOCs were used by Bishop Tube for degreasing redrawn stainless steel tubes. The Department has detected inorganic constituents of concern in groundwater at the site including fluoride, nickel, and chromium.

The Department is evaluating environmental impacts resulting from the site contamination discussed above. The main offsite pathways associated with the site involve the transport of site contaminants in groundwater. Contaminated groundwater may impact down gradient drinking water wells or may enter the surface water through diffuse flow or springs. The area down gradient of the site is primarily served by the Philadelphia Suburban Water Company. A single private well northeast of the site is known to be contaminated with trichloroethene (TCE). The Department is currently maintaining a treatment system at this location. The Department and its contractors have conducted limited surface water and spring sampling to determine environmental impacts from the site. The site is located adjacent to Little Valley Creek, which is within the Valley Creek Basin designated as Exceptional Value Cold Water Fishery under the Department's Water Quality Standards.

II. Sampling Event Objectives

The purpose of this sampling event was to gain a synoptic set of surface water quality data in areas of Little Valley Creek potentially affected by the Bishop Tube site and its resultant groundwater contaminant plume. The Department planned to utilize data gathered during this sampling event to help evaluate site impacts to Little Valley Creek.

III. Sampling Event Summary

Surface water samples were collected on May 19 and 20, 2003 by Tom Buterbaugh and Dustin Armstrong of the Department of Environmental Protection, Environmental Cleanup Program. On May 20 Mr. Jeffery Goudsward of Penn E&R accompanied the field team while samples were collected on two properties belonging to O'Neil Properties Group. These properties were the former Worthington Steel facility located near Matthews Road and the proposed Deerfield Development located north of Lancaster Avenue.

Sample locations were selected to assess a rather long stream segment of Little Valley Creek from the Amtrak crossing, just upstream of the site, to the stream outlet on the former Worthington Steel property. This is approximately 1.5 stream miles. Samples were also collected from three tributaries of Little Valley Creek, which enter the stream in this segment and from three springs, which feed Little Valley Creek directly (two instances) or its tributaries (one instance). For purposes of this report the three unnamed tributaries to Little Valley Creek are identified as the Malin, Morehall, and Worthington Tributaries. These tributaries are identified on Figure 2 attached to this report. The spring locations and this stretch of stream were chosen because the Department has noted elevated TCE concentrations in the stretch, but no obvious source(s) could be identified. It has been speculated by several parties (including HSCA staff) that contaminants, including TCE, may be transported from the Bishop Tube site, through fractures and/or solution channels in an east-northeasterly direction. Furthermore, it is theorized that contaminated groundwater may be discharged through diffuse flow in the streambed of Little Valley Creek and/or at springs located down gradient of the site. Locations were selected to evaluate VOC concentrations at regular intervals in the stream at reproducible locations (permanent features), some of which have been sampled in the past and to evaluate areas of special interest (notably springs and tributaries). Table 1 is intended to describe the sample locations, and Figure 3 depicts the approximate sampling locations on a portion of the USGS 7.5 Minute Series Malvern Quadrangle.

Samples were shipped via overnight courier to Severn Trent Labs (STL), in Pittsburgh, PA. STL is a HSCA contract laboratory, which provides EPA Contract Lab Program (CLP) quality data packages. Samples were analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs), fluoride, nitrate, nitrite, total dissolved solids, carbonate/bicarbonate alkalinity, sulfide, sulfate, and chloride. VOCs and fluoride are considered site contaminants at Bishop Tube. The other parameters were included to compare general water chemistry in the study area.

Samples were collected in accordance with the April 9 Sampling and Analysis Plan except as follows:

1. Field equipment for measuring water temperature, pH, and specific conductivity was not it working order at the time of the sampling event. Therefore, field measurements were not taken at the sample locations.
2. A number of samples could not be collected due to a lack of flow at the following proposed locations:
   a. Tributary flowing under the power lines between Malin Rd. and Conestoga Rd. (entering from the north at Conestoga Rd.);
   b. A seep located adjacent to the Taylor Rental property just north of the Norfolk Southern right-of-way; and
   c. Two storm water outfalls located between Lancaster Ave. and Conestoga Rd. thought to be intercepting groundwater were either dry or appeared to be stagnant.
3. Due to the above modifications the sample numbering system outlined in the plan was modified and some sample numbers were skipped.
4. An additional sample was collected from a small tributary of Little Valley Creek on the former Worthington Steel property.

During the sampling event we noted significantly lower flows than noted during the pre-sampling reconnaissance. Samples were collected after the start of growing season. Conditions observed during the sampling event are likely more representative of average stream flow conditions than those observed in late-March and early-April when potential sample locations were initially identified. Based upon these observations, it is apparent that portions of Little Valley Creek in this stretch may be dry during some periods. The tributary entering the stream just west of the Morehall overpass and the spring located just upstream from the 84 Lumber property provide significant water volume contributions to Little Valley Creek. It is likely that below these two tributaries the stream is perennial. Some photographs of these tributaries and springs are included in a photo log attached to this report.

IV. Discussion of Analytical Results

Samples from this event were analyzed for TCL VOCs, fluoride, TDS, carbonate/bicarbonate alkalinity, nitrate, nitrite, sulfide, sulfate, and chloride. Sample results are presented in Table 2 and discussed in the following section.

The following VOCs were detected in surface water samples collected during this sampling event: 1,1,1-Trichloroethane (1,1,1 TCA), 1,1-Dichloroethane (1,1 DCA), 1,1-Dichloroethene (1,1 DCE), 1,2-Dichloroethene (1,2 DCE), Bromodichloromethane, Chloroform, Methyl-tert-butyl Ether (MTBE), Tetrachloroethene (PCE), Trichloroethene (TCE), and Vinyl Chloride (VC). With the exceptions of Bromodichloromethane and Chloroform (both in SP-3), each of these compounds has been detected in monitoring wells at the Bishop Tube Site. For purposes of evaluating VOCs detected in the surface water, TCE will be used as a marker compound. TCE is the primary groundwater contaminant at the site, and tends to be persistent and mobile in groundwater aquifers, several of the other detected VOCs (including 1,2 DCE, 1,1 DCE, and VC) are breakdown products of TCE. TCE was detected in all ten surface water samples collected from Little Valley Creek downstream of the site property and in each spring sample collected during the event. At eight stream and three spring locations the TCE concentration exceeded the surface water quality criteria of 2.7 ug/L. TCE was not detected in two upstream samples or in samples from two tributaries (Moorehall Rd. and Worthington Steel). The highest in-stream concentration of TCE (55 ug/L) was detected at the northeast corner of the site property. In-stream concentrations decreased with increasing distance from the site to a low of 2.7 ug/L at SW-8, just below Conestoga Rd. At SW-9 (just upstream from the mouth of a major spring originating under the house at 10 Winding Way, which enters Little Valley Creek from the north) TCE was detected at a concentration of 9.5 ug/L. The concentration of TCE in a sample collected downstream from the playground near the end of Winding Way was 18 ug/L. Below Morehall Rd. the TCE level drops to 9.8 ug/L. This decrease may result from the contribution of flow from the Morehall Rd. tributary. No VOCs were detected in stream samples from this tributary. Below the mouth of a major spring (SP-4) TCE concentrations increased to 18 ug/L. High concentrations of TCE in SP-4 (150 ug/L) probably account for the increased in-stream level. Further downstream samples collected from just above and below the culvert beneath the former Worthington Steel facility contained TCE at 7.2 ug/L.

As noted above, TCE was detected in each of the springs sampled during this event. Concentrations ranged from a low of 0.23 ug/L at SE-1 (just upgradent of the source area) to 150 ug/l at SP-4B (wetlands discharge area between Morehall Rd. and the former Worthington Steel property). SP-4 is the most significant spring directly entering Little Valley Creek in the study area. A springhouse marks the origin of SP-4, but a large wetland area is located just to the north of the springhouse and apparently results from a large area of groundwater discharge. Lower concentrations of TCE were detected in samples SP-3 and SE-1. SP-3 was collected from a fragmities wetland area located adjacent to the Summerfield Suites Hotel (20 Morehall Rd.). This spring enters the Morehall tributary of Little Valley Creek just below Lancaster Avenue. SP-3 contained TCE at a concentration of 6.5 ug/L. This sample was the only sample collected in the event found to contain Chloroform and Bromodichloromethane. These VOCs are in a group of compounds called trihalomethanes, which are chlorination byproducts. This spring is located near a swimming pool associated with the hotel. A very low concentration of TCE (0.23 ug/L J) was detected in sample SE-1, which was collected on the Bishop Tube property, just upstream from the manufacturing facility. This detection may be the result of chemical diffusion from the drum storage area, the nearest source area at the site.

Three tributaries of Little Valley Creek were sampled during this event. The only tributary sample in which TCE was detected was from the Malin tributary (SW-5). This sample was collected from near the Sunoco Terminal, where the tributary reappears after crossing beneath Malin Rd. and the Lincoln Court Shopping Center. Based upon anticipated groundwater flow direction, the low level of TCE (0.73 ug/L) detected in this sample is not likely a result of the Bishop Tube site.

In addition to VOCs, samples were analyzed for a number of other water quality parameters. Fluoride, a contaminant of concern in groundwater at the Bishop Tube site was detected in each of the samples with the exception of SW-2. The highest in-stream concentrations of fluoride were detected in samples collected from the northeast corner of the site (SW-3) to above the Morehall Rd. bridge (SW-10). These elevated concentrations of Fluoride ranged from 1.6 mg/L at SW-6 to 1.0 mg/L at SW-10. These concentrations are well below the acute lethal toxicity LC_{50} (480 hrs) of 3.6 mg/L for rainbow trout in freshwater (Neuhold and Sigler, 1960). Sub-acute effects of fluoride have been documented in salmonoides at lower concentrations including developmental effects on rainbow trout embryos (Neuhold and Sigler, 1960). Increased levels of fluoride in the Columbia River in Washington (0.3-0.5 mg/L) were shown to have caused delays in salmon migration in the vicinity of an aluminum plant, which discharged fluoride. (Damkaer and Dey, 1989) The potential effects of fluoride on aquatic invertebrates have not been fully characterized. Fluoride levels in Little Valley Creek tended to decrease with distance from the Bishop Tube property. A graphical presentation of Little Valley Creek fluoride concentrations is given in Chart 1. Concentrations of fluoride in the tributaries of Little Valley Creek ranged from 0.045 mg/L (Morehall tributary) to 0.15 mg/L (Malin tributary) In the three springs sampled during this event, fluoride concentrations ranged from 0.098 (in the spring east of Morehall Rd.) to 0.12 (in the seep located on the former Bishop Tube property).

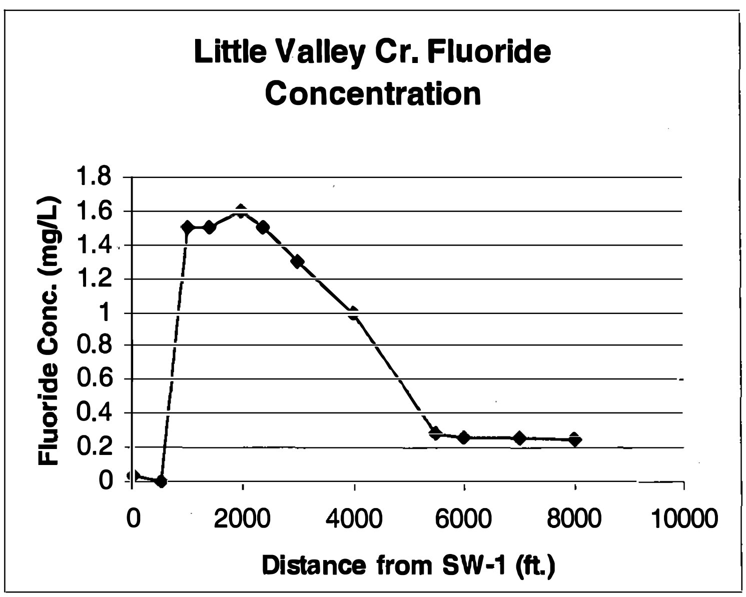

Chart 1 – May 2003 Little Valley Creek
Fluoride Concentration vs. Downstream Distance
Between Bishop Tube Site and Worthington Steel Site

Please note that each data point in the charts presented in this section represents a sample location from the May 2003 sampling event. From left to right across the charts the data points are: SW-1, SW-2, SW-3, SW-4, SW-6, SW-8, SW-9, SW-10, SW-15, SW-16, SW-17 and SW-20.

Samples from tributaries and springs are not included in the charts. Distances from SW-1 are approximate, based upon measurements from the USGS topographical map.

Evaluation of the data presented in Chart 1 indicates that elevated fluoride concentrations in Little Valley Creek are likely the result of the Bishop Tube site. Hydro fluoric and nitric acids were used at the site in the tube manufacturing process. Acid wastes were disposed of in a lagoon located on the northeastern side of the property. The lagoon was closed in the late-1970s, and is allegedly located under a receiving area subsequently added to Plant 8 (lower building).

In order to evaluate the influence of groundwater on Little Valley Creek, samples were analyzed for a number of general chemistry parameters including alkalinity. Increased bicarbonate alkalinity in groundwater results from the contact of water with the carbonate rocks found in the valley down gradient of the site. Therefore, springs and areas of Little Valley Creek receiving groundwater should contain relatively higher levels of bicarbonate and total alkalinity. To verify that total alkalinity levels can be used to assess the relative influence of groundwater on the makeup of surface water, a comparison of total alkalinity levels for springs with total alkalinity levels for surface water can be made. Results from this sampling event indeed seem to show this correlation. Total alkalinity in the springs (made-up exclusively of bicarbonate alkalinity) ranged from 94.8 mg/L to 238 mg/L. The spring located east of Morehall Road, at the lowest elevation of the three springs contained the highest level of bicarbonate/total alkalinity. This would be expected given that groundwater discharging at the bottom of the valley is likely transmitted through carbonate rocks of the Conestoga Formation. A comparison of results of samples collected from Little Valley Creek and from the springs shows that the average total alkalinity level in the 12 stream samples was 96.5 mg/L, while the average level for the three springs was 179.3 mg/L, indicating that the springs do exhibit generally higher total alkalinities than in-stream samples. Given this analysis, it would be anticipated that areas of Little Valley Creek receiving groundwater should exhibit higher levels of total alkalinity, and that the infiltration of groundwater in a stream segment would be marked by an increase in total alkalinity. Chart 2 presents total alkalinity concentration versus downstream distance from just above the site, at the AMTRAK crossing (SW-1) to the lower sample on the former Worthington Steel property (SW-20).

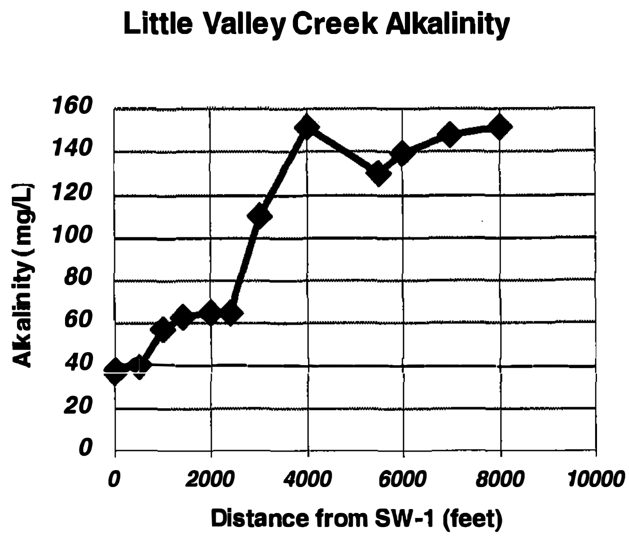

Chart 2 – May 2003 Little Valley Creek
Total Alkalinity Concentration vs. Downstream Distance
Between Bishop Tube Site and Worthington Steel Site

Chart 2 reveals that alkalinity generally increases downstream of the site. The only downward trend occurs between SW-10 and SW-15. This decrease is likely the result of the contribution of the Morehall tributary in this stream segment. Total alkalinity was reported at 86.3 mg/L in a sample from the Morehall trib just above its confluence with Little Valley Creek. Most notably areas with the maximum alkalinity increases were between SW-2 and SW-3 and between SW-8 and SW-10. Increasing alkalinity in these areas indicates that groundwater may be discharging to Little Valley Creek along the eastern site boundary and between Conestoga and Morehall Roads. Since groundwater in these areas is known to contain elevated concentrations of TCE, it is anticipated that in-stream TCE concentrations would increase in these areas. Chart 3 depicts the alkalinity levels shown in Chart 2 (in mg/L) and TCE concentrations (in ug/L)

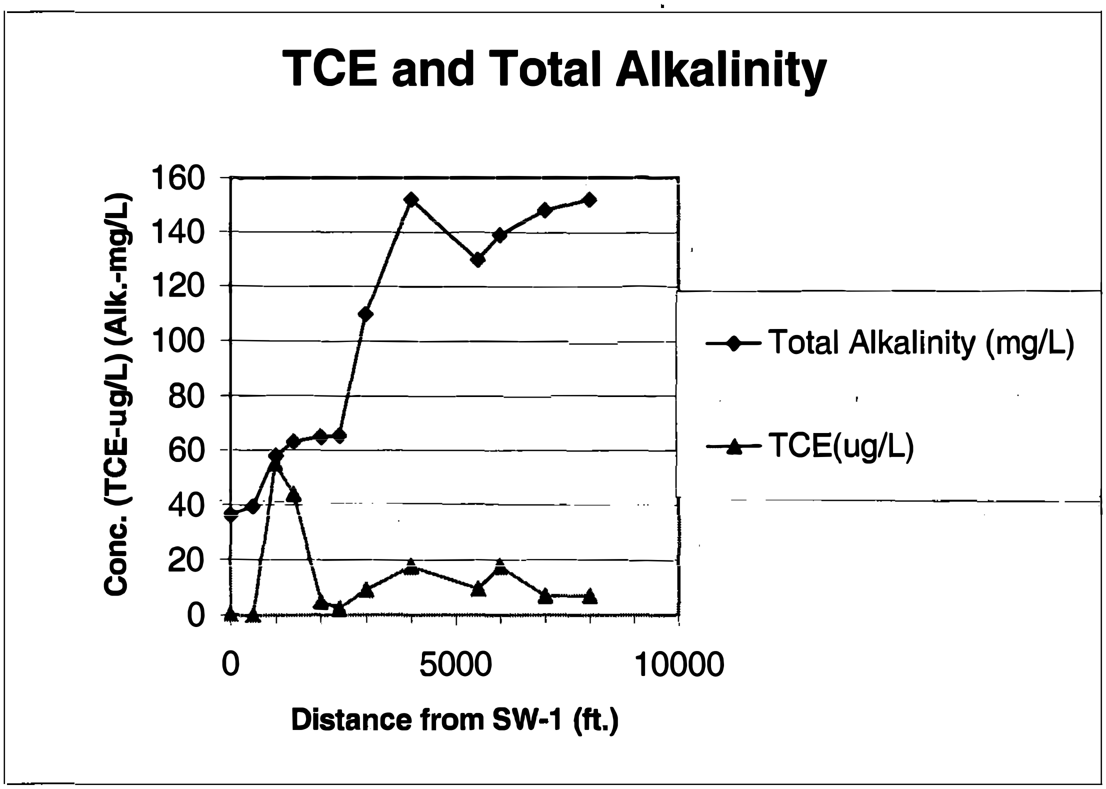

Chart 3 – May 2003 Little Valley Creek
Total Alk. (mg/L) and TCE (ug/L) Concentrations vs. Downstream Distance
Between Bishop Tube Site and Worthington Steel Site

Chart 3 depicts a strong relationship between alkalinity and TCE concentrations in Little Valley Creek. The link seems to be the strongest adjacent to the site (between SW-2 and SW-3. This is not surprising, given that the groundwater in this vicinity is highly contaminated by TCE. Two other areas of increasing TCE levels should also be noted. Between Conestoga Road (SW-8) and above Morehall Road (SW-10) alkalinity rises significantly and TCE concentrations also increase. Similar corresponding increases in alkalinity and TCE levels are apprent between SW-15 and SW-16. Interestingly, water from a large spring (SP-4) enters the creek between these locations. In-stream TCE concentrations due to groundwater discharge would be expected to vary depending on the makeup and source of the discharging water. The geologic complexity of the underlying formation makes it difficult to link contaminants to any one source. This is especially true in the case of a contaminant such as TCE, which is one of the most ubiquitous contaminants found in groundwater.

V. <u>Comparison with Groundwater Data</u>

Numerous wells have been installed to characterize potential site impacts on groundwater at the Bishop Tube site and at the Worthington Steel site. Samples from these wells and from two wells located along Conestoga Road between the sites have been analyzed for the types of volatile organic compounds detected during our May sampling event. Wells at the Bishop Tube site were sampled in April 2003 by Baker as part of the site characterization activities. Wells located along the western bank of Little Valley Creek (MW-4, 5, 6, 7, 8, 9, and 26) range in depth from 20 – 245 ft. Monitoring wells MW-4, 9, and 26 are completed in bedrock. MW-5, MW-6, MW-7, and MW-8 are overburden wells, completed above the top of bedrock, which ranges between 9 and 26 ft. below ground surface in the area bordering Little Valley Creek. Site related VOCs were detected in each of these wells in our April 2003 sampling event. In the shallow bedrock and overburden wells (approx. 20 ft.) TCE concentrations ranged from 6 – 260 ug/L. In the intermediate bedrock monitoring well MW-9, TCE was detected at a concentration of 970 ug/L. Three zones are monitored within the deep bedrock well MW-26. Concentrations in these zones ranged from 5,200 ug/L (upper zone) to 620,000 ug/L (middle zone). Generally, VOC concentrations increase with depth in these wells. In addition to VOCs samples collected from the site wells by Baker, in April 2003 were analyzed for fluoride. Fluoride concentrations in these wells ranged from 1.4 mg/L to 16.8 mg/L, and generally decreased with depth. These results suggest that elevated concentrations of fluoride and VOCs in the stream can be attributed to groundwater contamination from the Bishop Tube site.

Two wells are located approximately 0.3 mi. northeast of the site, along Conestoga Rd., and were also sampled in April by Baker. The northernmost well at 54 Conestoga Road, which is used as a residential well (equipped with a treatment system), contained TCE at a concentration of 19 ug/L. The owner of the other well located at 30 Conestoga Road had intended to use it as a water supply, but has not. This well contained TCE at a concentration of 8,700 ug/L. These wells are only about 500 ft. apart, demonstrating the wide variability of groundwater conditions in the area. It is believed that groundwater in this area flows from the direction of the Bishop Tube site toward the east-northeast and Little Valley Creek.

Wells at the Worthington Steel site were sampled in July/August 2002 (Penn E&R, 2002). TCE concentrations ranged from <1 ug/L to 170 ug/L. These results indicate that detections of VOCs in this section of Little Valley Creek may be the result of groundwater contamination in the area.

VI. Comparison with Water Quality Criteria

Water quality standards are listed in § 93.7 of 25 PA Code (Specific Water Quality Criteria), and in Appendix A, Table 1 (Water Quality Criteria for Toxic Substances) of 25 PA Code §16.102 (Approved EPA Analytical Methods and Detection Limits). This table lists continuous and maximum fish and aquatic life criteria and human health criteria for toxic substances. Section 406(c) of the Department's Land Recycling Regulations (25 Pa. Code § 250.406(c) requires diffuse surface or groundwater discharges from land recycling projects to meet the Chapter 16 criteria. Sample results exceeded the water quality standards at the majority of locations, primarily due to TCE concentrations. The water quality standard for TCE is 2.7 ug/L, and is based on its cancer risk level (CRL). This level was exceeded at SW-3, 4, 6, 9, 10, 15, 16, 17, SP-3, 4A, and 4B. In addition to TCE, water quality criteria for 1,1 DCE (0.057 ug/L) was exceeded at SW-3, 4, 10, 15, 16, 20, SP-4A and 4B and the standard for PCE (0.8 ug/L) was exceeded at SW-5, 10, SP-4A, and SP-4B. For ease of reference, applicable water quality standards are included in Table 2 and exceedances are shown in bold.

VII. Comparison with Previous Surface Water and Spring Investigations

Surface water sampling of Little Valley Creek has been conducted, in the past, by the Department's Bureau of Water Quality (1986 and 1994), the Department's General Assistance and Technical Contract (GTAC) contractor for Bishop Tube (Baker Environmental) (2001), EPA contractors investigating the Bishop Tube (1983) and Worthington Steel (1989) sites, and private consultants for owners of the Worthington Steel site (1998 and 2002). In order to facilitate the comparison of results from the May 2003 sampling event with these past sampling efforts, several samples were collected at corresponding locations. These sample points included SW-2 (just upstream of the Bishop Tube buildings), SW-3 (at the northeast property boundary of the Bishop Tube site), SW-4 (below Lancaster Ave.), SW-8 (near Conestoga Rd.), SW-10 (near the end of Winding Way, behind Vishay, Inc.), SW-14 (Morehall Trib. just above Little Valley Cr.), SP-4A (springhouse east of Morehall Rd.), SW-16 (Little Valley Cr. just downstream of the spring SP-4), SW-17 (just upstream of the Worthington Steel property), SW-19 (Worthington Trib. just upstream of Little Valley Cr.), and SW-20 (Little Valley Creek just below culvert on the former Worthington Steel property). Table 3 shows sample results from the May 2003 and past sampling events from these locations.

Table 3 presents data from VOC analyses. The table reveals that TCE and 1,1,1 TCA have been present in surface water and springs throughout the valley for more than a decade. Notably the springhouse east of Morehall Road contained TCE at a concentration of 180 ug/L in 1989, when sampling was conducted as part of the Site Inspection for Worthington Steel (NUS, 1990). The most comprehensive surface water sampling on Little Valley Creek (until this event) was conducted by field staff from the Department's Bureau of Water Quality in the first half of 1994. Concentrations of VOCs appear to have decreased at locations near the site (SW-4 and SW-8), but in-stream concentrations seem to have increased slightly at SW-16, downstream of the springhouse. The concentration detected at the source of this spring was also higher in 2003. The long-term occurrence of VOCs in Little Valley Creek may mean that a significant and persistent source of TCE and 1,1,1 TCA is responsible for the contamination. Variations in water table elevation or differences in stream flow conditions between the sampling events cannot be documented, but may play significant roles in the in-stream concentrations over time.

VIII. Conclusions

The Bishop Tube site has contributed to elevated concentrations of TCE, 1,1,1 TCA and fluoride in surface water in Little Valley Creek from the site to Lancaster Avenue. No data exists to determine if contamination resulting from the site has caused ecological impacts to Little Valley Creek in this stretch.

Groundwater, which contributes to the flow of Little Valley Creek northeast, and downstream of the Bishop Tube site, is contaminated by 1,1,1 TCA, TCE and their breakdown products. Extremely high levels of these compounds are present in groundwater at the site. Lower levels of these contaminants are present in groundwater well down gradient of the site. Since these compounds have been commonly used in industry for decades, sources other than the Bishop Tube site may contribute or be responsible for down gradient and downstream contamination.

Tributaries originating along the same ridge as the Bishop Tube site and entering Little Valley Creek downstream of the site do not contain detectable concentrations of contaminants found at the site.

Little Valley Creek receives a portion of its flow from the discharge of groundwater through the streambed and springs. Discharges from the springs sampled during this event appear to vary seasonally. In areas where groundwater is not discharging to the stream, Little Valley Creek may be intermittent. Likewise, contaminants may have a more significant impact on the stream during dry periods, when groundwater discharge is a larger component of the stream flow.

IX. Recommendations

To determine if VOCs and fluoride have adversely affected the ecology of Little Valley Creek south of Lancaster Avenue, the Department should consider conducting a biological assessment of the stream in the vicinity of the site. This survey would include collection and inventory of macro invertebrate samples.

The Department may wish to consider collecting sediment samples for additional analyses. Organisms which live in the sediments may be exposed to higher levels of site-related contaminants, if these contaminants tend to adhere to the sediment, rather than entering the water column. Baker conducted sediment sampling in 2001 that revealed elevated concentrations of VOCs in sediment adjacent to the site.

The Department may consider conducting additional sampling to determine the source of elevated TCE concentrations between Conestoga and Morehall Roads. Field measurements of temperature, specific conductivity, dissolved oxygen, and pH should be conducted to locate areas of discharging groundwater.

The Department may wish to collect additional samples of down gradient springs for water quality parameter analysis. In the future analytical parameters should include major cations and anions to allow for comparison of water chemistry between springs and with other wells.

The results of groundwater modeling currently being performed by Baker should be incorporated into our understanding of the site's impact to regional groundwater quality and the resultant quality of down gradient groundwater discharges to Little Valley Creek.

The Department may wish to collect a sample from the drainage swale north of the plant building just above its confluence with Little Valley Creek. This area has been saturated in the past, and may be an area of groundwater discharge. A sample collected from this part of the swale, as part of the 1984 Site Inspection, contained TCE at a concentration of 2,026 ug/L (NUS, 1985).

X. <u>References</u>

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TABLES

Location Number	Description
SW-1	Little Valley Creek on downstream side of the AMTRAK crossing, upstream from Bishop Tube site.
SW-2	Little Valley Creek east of the paved parking area behind Plant 5, upstream from former drum storage area.
SW-3	Little Valley Creek on upstream side of the Norfolk Southern crossing, downstream from the Bishop Tube site.
SW-4	Little Valley Creek on downstream side of the Lancaster Ave. culvert, downstream from Bishop Tube site.
SW-5	Malin tributary from the first pool downstream of Malin Rd, and south of the Sunoco Malvern Terminal, under power lines.
SW-6	Little Valley Creek mid-way between Lancaster Ave. and Conestoga Rd.
SW-8	Little Valley Creek on downstream side of Constoga Rd. culvert.
SW-9	Little Valley Creek just upstream of the mouth of the spring originating at 10 Winding Way.
SW-10	Little Valley Creek about 80 yds. Downstream from bridge to playground from the end Winding Way.
SW-12	Morehall tributary from downstream side of Lancaster Ave. Bridge. From just above waterfall.
SW-13	Morehall tributary from downstream side of culvert under power lines.
SW-14	Morehall tributary just above Little Valley Creek.
SW-15	Little Valley Creek just upstream of the mouth of the spring originating at springhose north of Norwood Industries.
SW-16	Little Valley Creek about 30 yds. downstreamstream of the mouth of the spring originating at springhose north of Norwood Industries.
SW-17	Little Valley Creek just upstream of culvert under Worthington Steel site. Above Worthington tributary.
SW-18	Worthington tributary from collection area between culvert under abandoned rail line and culvert under 84 Lumber.
SW-19	Worthington tributary just upstream of Little Valley Creek.
SW-20	Little Valley Creek from downstream end of culvert under the Worthington Steel site.
SE-1	Spring seep located just east of Plant 5 on the Bishop Tube site. (About 30 ft. west of SW-2)
SP-3	Spring/wetland area on the east side of the Summerfied Suites Extended Stay Hotel. Spring feeds Morehall tributary.
SP-4A	Spring from the springhouse north of Norwood Industries and downstream of Morehall Road bridge.
SP-4B	Spring sample from the stream originating at springhouse north of Norwood Industries, along wetland area and just upstream of Little Valley Creek.

Table 1
Bishop Tube Site
Sample Locations

	Aquatic Life Criteria (Continuous)	Aquatic Life Criteria (Maximum)	Human Health Criteria	SW-1	SE-1	SW-2	SW-3
Volatile Organics	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1,1,1-Trichloroethane	610	3000	N/A	ND	ND	ND	17
1,1-Dichloroethane	N/A	N/A	N/A	ND	ND	ND	ND
1,1-Dichloroethene	1500	7500	0.057	ND	ND	ND	**0.64**
1,2-Dichloroethene (total)	1400 (trans-)	6800 (trans-)	700 (trans-)	ND	ND	ND	14
Bromodichloromethane	N/A	N/A	N/A	ND	ND	ND	ND
Chloroform	390	1900	5.7	ND	ND	ND	ND
Methyl tert-butyl ether (MTBE)	N/A	N/A	N/A	ND	ND	ND	6
Tetrachloroethene	140	700	0.8	ND	ND	ND	0.57
Trichloroethene	450	2300	2.7	ND	0.23	ND	**55**
Vinyl chloride	N/A	N/A	2	ND	ND	ND	0.23
			Ch. 93.7 (Table 3) Criteria	SW-1	SE-1	SW-2	SW-3
Water Quality Parameters			mg/L	mg/L	mg/L	mg/L	mg/L
Bicarbonate Alkalinity				36.5	94.8	39.6	57.8
Carbonate Alkalinity				ND	ND	ND	ND
Chloride			250	48	20.5	39.8	37.1
Fluoride			2	0.034	0.12	ND	1.5
Nitrate as N			10 (plus Nitrite)	4	1.3	3.3	2.8
Nitrite				ND	ND	ND	ND
Sulfate			250	11.9	10.7	16.1	15.4
Total Alkalinity			>20	36.5	94.8	39.6	57.8
Total Dissolved Solids			500	163	143	153	153
Total Sulfide				ND	ND	ND	ND

Table 2
Surface Water Sampling Results
May 2003

Volatile Organics	SW-4 ug/L	SW-5 ug/L	SW-6 ug/L	SW-8 ug/L	SW-9 ug/L	SW-10 ug/L	SW-12 ug/L	SP-3 ug/L
1,1,1-Trichloroethane	11	ND	1	ND	1.6	2.4	ND	1.1
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	**0.23**	ND	ND	ND	ND	**0.66**	ND	ND
1,2-Dichloroethene (total)	8.9	1.4	1.6	0.82	2.3	1.3	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	0.9
Chloroform	ND	ND	ND	ND	ND	ND	ND	3.8
Methyl tert-butyl ether (MTBE)	4.4	18	3.1	1.6	1.1	0.45	ND	ND
Tetrachloroethene	ND	**5.4**	ND	ND	ND	**0.81**	ND	ND
Trichloroethene	**44**	0.73	**5**	2.7	**9.5**	**18**	ND	**6.5**
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND
	SW-4	**SW-5**	**SW-6**	**SW-8**	**SW-9**	**SW-10**	**SW-12**	**SP-3**
Water Quality Parameters	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Bicarbonate Alkalinity	63.1	271	64.9	65.3	110	152	74.6	205
Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
Chloride	37.6	223	38.7	38.4	54.4	61.2	92.6	105
Fluoride	1.5	0.15	1.6	1.5	1.3	1	0.065	0.1
Nitrate as N	2.7	1.6	2.6	2.6	2.3	2	3.6	3
Nitrite	ND	ND	ND	ND	ND	ND	ND	ND
Sulfate	15.6	29.9	15.7	15.6	21.4	23.5	18.8	51.1
Total Alkalinity	63.1	271	64.9	65.3	110	152	74.6	205
Total Dissolved Solids	168	**695**	208	175	236	268	408	**503**
Total Sulfide	ND	ND	ND	ND	ND	ND	ND	ND

Table 2
Surface Water Sampling Results
May 2003

	SW-13	SW-14	SW-15	SP-4A	SP-4B	SW-16	SW-17
Volatile Organics	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1,1,1-Trichloroethane	ND	ND	1.4	24	18	2.1	0.98
1,1-Dichloroethane	ND	ND	ND	1.6	1.2	0.37	ND
1,1-Dichloroethene	ND	ND	**0.35**	**8.2**	**5.9**	**0.27**	ND
1,2-Dichloroethene (total)	ND	ND	ND	5.5	6.3	0.39	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND
Methyl tert-butyl ether (MTBE)	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	0.37	**5.1**	**4.2**	0.49	ND
Trichloroethene	ND	ND	**9.8**	**130**	**150**	**18**	**7.2**
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND
	SW-13	SW-14	SW-15	SP-4A	SP-4B	SW-16	SW-17
Water Quality Parameters	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Bicarbonate Alkalinity	80.9	86.3	130	236	238	139	148
Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND
Chloride	92.2	94	90.9	99.9	97.3	92.2	107
Fluoride	0.045	0.046	0.29	0.098	0.098	0.26	0.26
Nitrate as N	3.4	3.3	2.5	1.4	1.5	2.5	2.5
Nitrite	ND	ND	ND	ND	ND	ND	ND
Sulfate	20.1	20.7	22.9	29.1	29.4	23.8	25.4
Total Alkalinity	80.9	86.3	130	236	238	139	148
Total Dissolved Solids	354	330	355	487	481	357	404
Total Sulfide	ND	ND	ND	ND	ND	ND	ND

Table 2
Surface Water Sampling Results
May 2003

	SW-18	SW-19	SW-20
Volatile Organics	ug/L	ug/L	ug/L
1,1,1-Trichloroethane	ND	ND	0.91
1,1-Dichloroethane	ND	ND	ND
1,1-Dichloroethene	ND	ND	**0.25**
1,2-Dichloroethene (total)	ND	ND	0.44
Bromodichloromethane	ND	ND	ND
Chloroform	ND	ND	ND
Methyl tert-butyl ether (MTBE)	ND	ND	0.31
Tetrachloroethene	ND	ND	ND
Trichloroethene	ND	ND	**7.2**
Vinyl chloride	ND	ND	ND
	SW-18	SW-19	SW-20
Water Quality Parameters	mg/L	mg/L	mg/L
Bicarbonate Alkalinity	212	210	152
Carbonate Alkalinity	ND	ND	ND
Chloride	115	115	107
Fluoride	0.059	0.06	0.25
Nitrate as N	2.3	2.1	2.5
Nitrite	ND	ND	ND
Sulfate	43.6	43.5	25.8
Total Alkalinity	212	214	152
Total Dissolved Solids	**547**	**562**	411
Total Sulfide	ND	ND	ND

Table 2
Surface Water Sampling Results
May 2003

	SW-2		SW-3		SW-4		SW-8	
year	2001	2003	2001	2003	1994	2003	1994	2003
units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1,1,1-Trichloroethane	ND	ND	18	17	13	11	2	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	0.64	4	0.23	ND	ND
1,2-Dichloroethene (total)	ND	ND	ND	14	9	8.9	ND	0.82
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND
Methyl tert-butyl ether (MTBE)	ND	ND	ND	6	2	4.4	36	1.6
Tetrachloroethene	ND	ND	ND	0.57	ND	ND	ND	ND
Trichloroethene	ND	ND	56	55	90	44	8	2.7
Vinyl chloride	ND	ND	ND	0.23	ND	ND	ND	ND
Designation	SW-UG		SW-01		ST-4		ST-3	
Reference	Baker (2002)		Baker (2002)		BWQ (1994)		BWQ (1994)	

Table 3
Historical surface water sampling
Data comparison

	SW-10		SW-14		SP-4A		
year	1986	2003	1994	2003	1989	1994	2003
units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1,1,1-Trichloroethane	1.5	2.4	ND	ND	110	26	24
1,1-Dichloroethane	ND	ND	ND	ND	3	2.2	1.6
1,1-Dichloroethene	ND	0.66	ND	ND	12	12.4	8.2
1,2-Dichloroethene (total)	ND	1.3	ND	ND	9	4.9	5.5
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND
Methyl tert-butyl ether (MTBE)	ND	0.45	0.5	ND	ND	0.5	ND
Tetrachloroethene	ND	0.81	ND	ND	11	7.2	5.1
Trichloroethene	1.5	18	1	ND	180	105	130
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND
Designation	none		ST-6		SP-1	ST-7	
Reference	BWQ (1986)		BWQ (1994)		NUS (1990)	BWQ (1994)	

Table 3
Historical surface water sampling
Data comparison

	SW-16		SW-17			SW-19		
year	1994	2003	1989	1994	2003	1994	2003	1994
units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1,1,1-Trichloroethane	ND	2.1	6	1.4	0.98	ND	ND	3.1
1,1-Dichloroethane	ND	0.37	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	0.9	0.27	ND	ND	ND	ND	ND	0.6
1,2-Dichloroethene (total)	0.6	0.39	ND	0.6	ND	ND	ND	0.7
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	0.5	ND	ND
Methyl tert-butyl ether (MTBE)	1	ND	ND	0.9	ND	ND	ND	2.4
Tetrachloroethene	0.5	0.49	ND	ND	ND	ND	ND	0.5
Trichloroethene	9.1	18	9	6.3	7.2	ND	ND	8.4
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND
Designation	ST-8		SW-3	ST-9		ST-10		ST-12
Reference	BWQ (1994)		NUS (1990)	BWQ (1994)		BWQ (1994)		BWQ (1994)

Table 3
Historical surface water sampling
Data comparison

	SW-20		
year	1998	2002	2003
units	ug/L	ug/L	ug/L
1,1,1-Trichloroethane	2	3.1	0.91
1,1-Dichloroethane	ND	ND	ND
1,1-Dichloroethene	ND	ND	0.25
1,2-Dichloroethene (total)	ND	ND	0.44
Bromodichloromethane	ND	ND	ND
Chloroform	ND	ND	ND
Methyl tert-butyl ether (MTBE)	ND	ND	0.31
Tetrachloroethene	ND	ND	ND
Trichloroethene	9	25	7.2
Vinyl chloride	ND	ND	ND
Designation	SW-3	LVC-2	
Reference	Penn E&R (2002)	Penn E&R (2002)	

Table 3
Historical surface water sampling
Data comparison

FIGURES

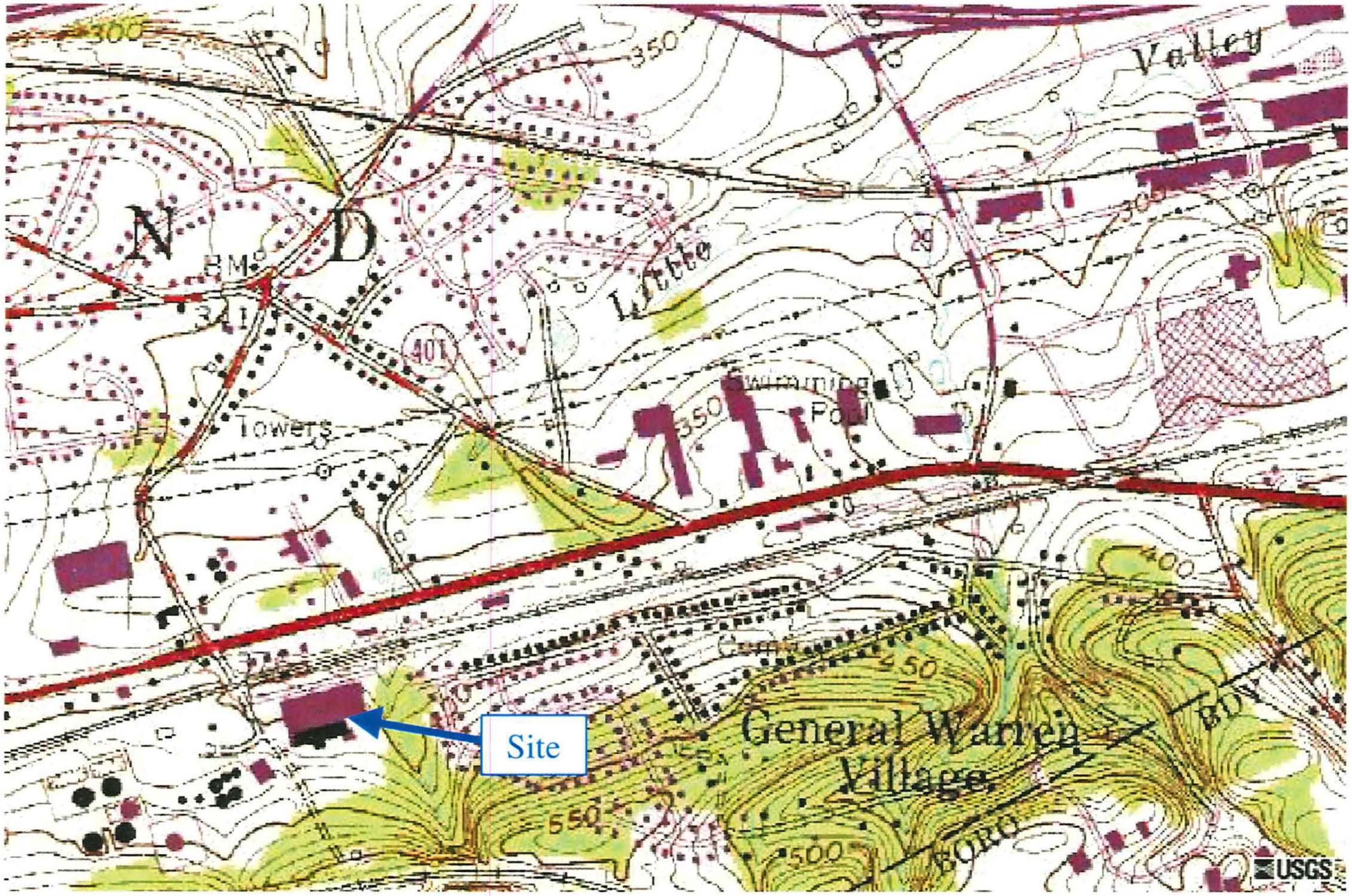

Figure 1
Bishop Tube
Site Location

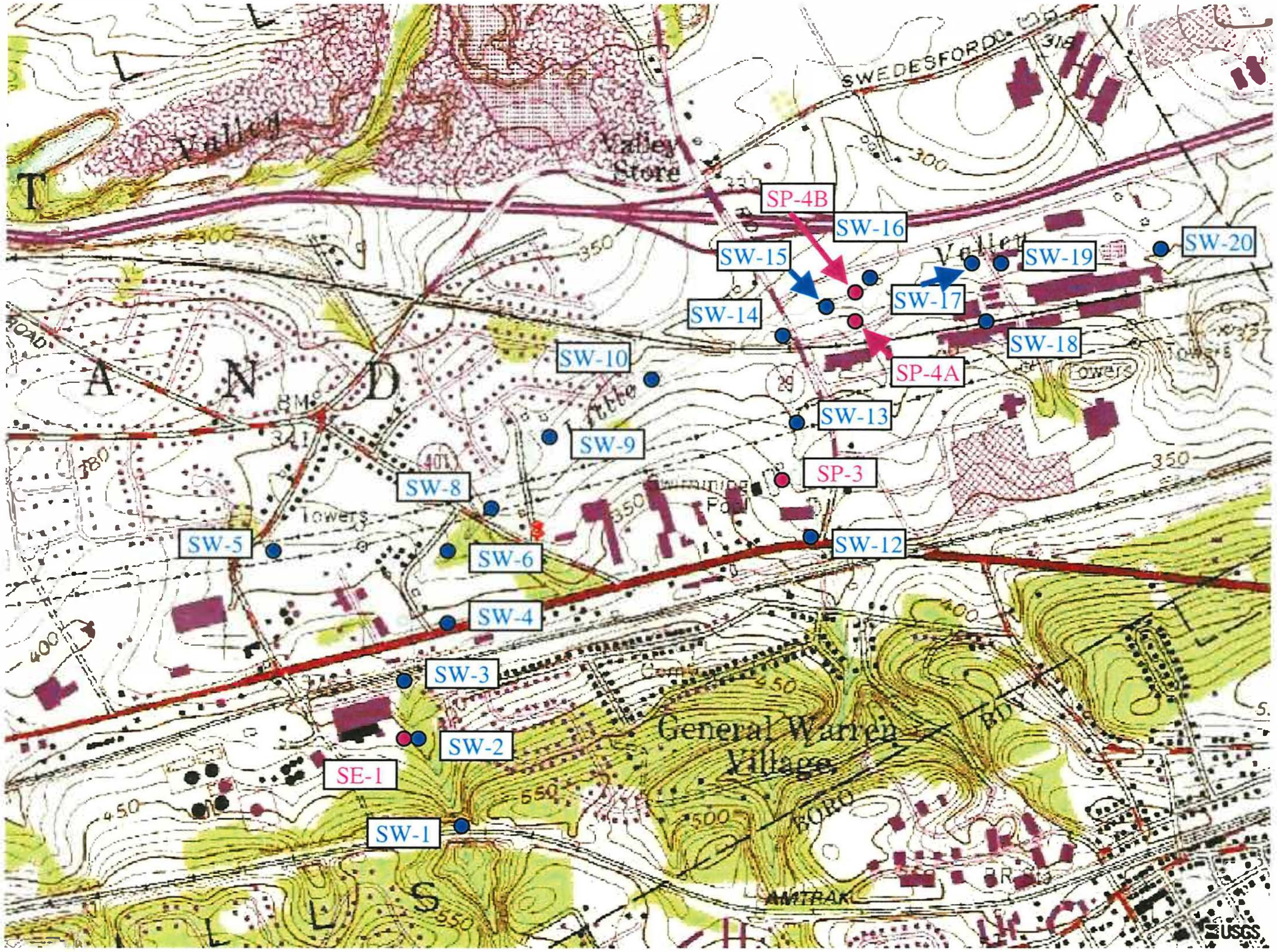

Figure 3
Bishop Tube
Sample Locations

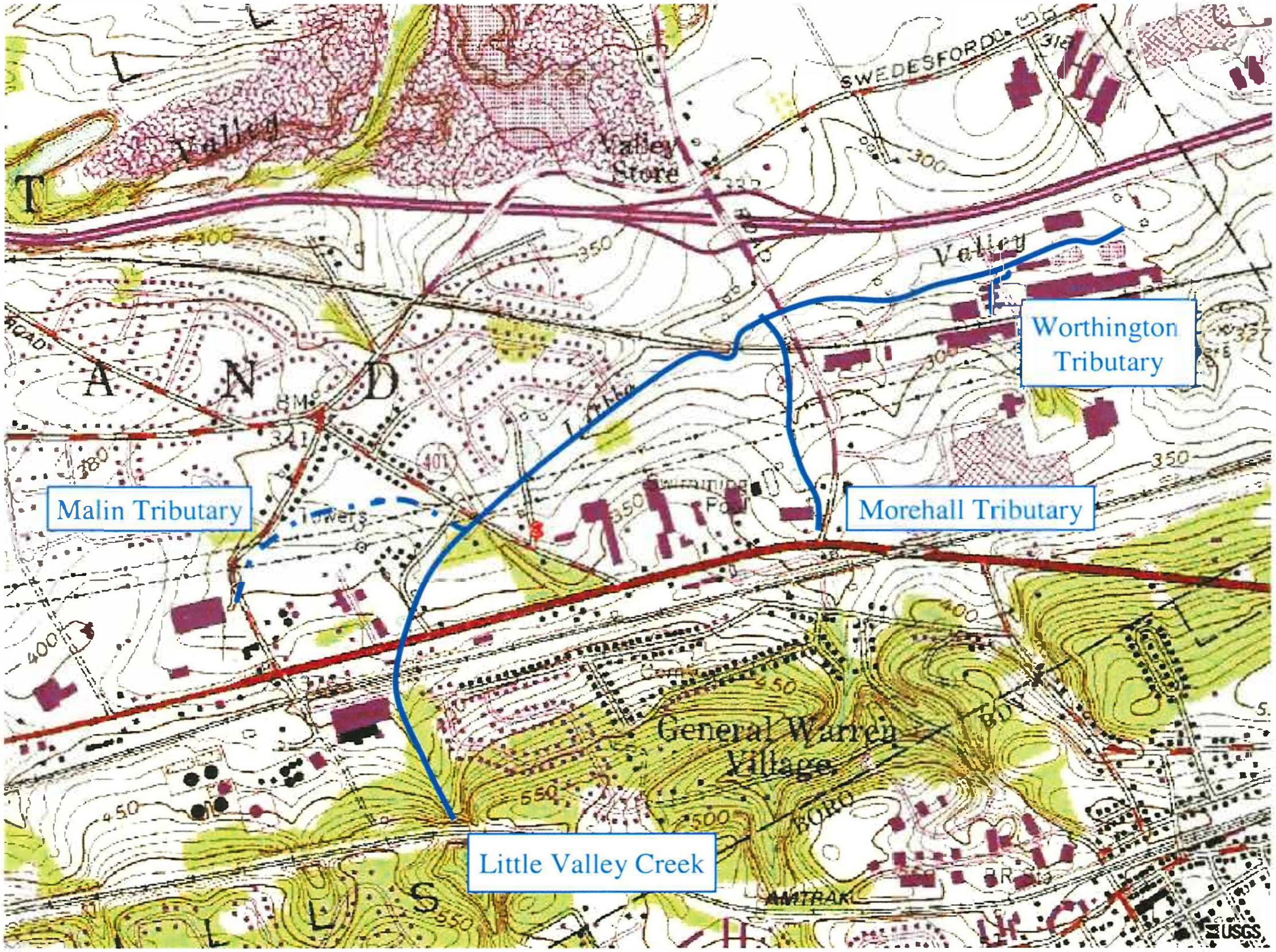

Figure 3
Bishop Tube
Tributary Names

PHOTO LOG

Photo 1: Sample Location SW-11
Morehall Rd. Tributary at Lancaster Ave.

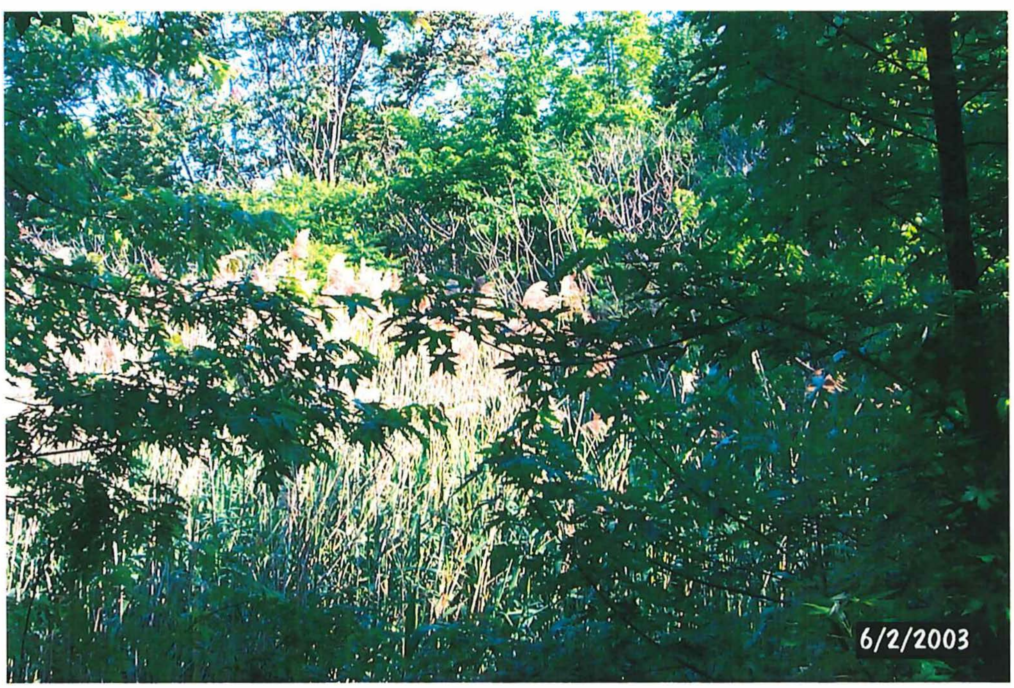

Photo 2: Sample location SP-3 near extended stay hotel.

Photo 3: Sample location SW-13. Morehall Tributary under power line. Morehall Rd. in background.

Photo 4: Sample location SP-4B. Spring area in wetland near Norwood Industries facility.