



THE CITY OF  
**Guelph**

ENVIRONMENTAL  
SERVICES  
DEPARTMENT  
Waterworks Division

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**GUELPH GAS WORKS STUDY**

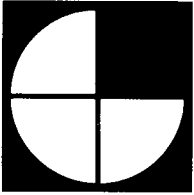
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**PREPARED FOR  
THE CITY OF GUELPH**

**PREPARED BY  
ENVIRONMENTAL STRATEGIES LIMITED**

**ESL 87-907  
JULY, 1988**

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*Professional Services  
in Environmental  
Management*

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# Environmental Strategies Limited

July 19, 1988

ESL 87-907

Mr. R.D. Funnel, P.Eng.,  
The City Engineer  
City of Guelph  
59 Carden Street  
Guelph, Ontario  
N1H 3A1

Attention: Mr. K.J. Bull, P.Eng.,

Dear Sirs:

Re: Guelph Gas Works Study

We are pleased to submit our final report for this study.

The study has determined the extent of wastes associated with the former gas works. The results suggest that there is no threat to public health and safety if the wastes remain undisturbed. However, any future site development plan should include remedial measures to address these wastes.

Thank you for allowing us to be of service.

Yours truly,

ENVIRONMENTAL STRATEGIES LIMITED

Thomas J. Kewen, M.Sc.  
Senior Hydrogeologist

TJK:tmc



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## **1.0 INTRODUCTION**

The City of Guelph is currently one of the owners of the site of the former Guelph Gas Works (Figure 1). The plant operated on Fountain Street from 1871 to 1957. The plant was then dismantled. The City's portion of the site was largely unused for several years. Lately, it was redeveloped for a municipal parking lot. The remainder of the site has been used as the offices and service yard of the Union Gas Company.

The plant site is one of 40 facilities identified in a recent study of coal gasification plant waste sites in Ontario (Intera, 1987). These sites have come under increasing environmental scrutiny since many have been found to contain coal tar or other gas plant wastes.

In 1986, Gartner Lee Limited (GLL) completed an evaluation of several former landfill areas in the City of Guelph as well as the portion of the gas works site owned by the City. A geophysical survey located gas tank foundations on the site. However, the survey did not have great enough resolution to specifically identify the presence of any wastes. It was recommended that additional site studies should be undertaken.

In August 1987, Environmental Strategies Limited (ESL, a GLL company) submitted a proposal to the City to conduct these studies. The City expected that the studies would be jointly supported by the City and Union Gas. However, Union Gas proceeded independently and the studies were limited to the City's portion of the site. The scope of the studies included soil sampling and ground water monitoring at 11 separate on-site locations. This work was completed in October, 1987.

The preliminary results of the study were discussed with the Ontario Ministry of the Environment (MOE) on November 4, 1987. The MOE agreed with the nature and methodology of the work completed but indicated that the scope of the work should be expanded off-site in order to comply with the Ministry's requirements and guidelines covering provincial funding for gas works investigations. The guidelines for provincial funding had not been developed when the original work proposal had been submitted.



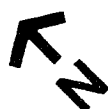
## LEGEND



Area Of Plant Site Currently  
Owned By City Of Guelph



Area Of Plant Site Currently  
Owned By Union Gas



0 200 400  
Metres

## Location of Guelph Gas Works

FIGURE

1

GUELPH GAS WORKS STUDY  
CITY OF GUELPH



The scope of the off-site work was developed through several follow-up discussions between ESL, the City and the MOE. The additional work was outlined in a letter to the City on December 15, 1987. The work included ground water monitoring along Surrey and Wellington Streets and surface water and sediment sampling in the Speed River. This work was completed during late December, 1987 and January, 1988.

The present report includes the results of all field studies conducted to date by ESL.





## **2.0 PURPOSE AND SCOPE**

The original purpose of the study was to assess the extent of gas plant wastes on-site and to provide an evaluation of their potential off-site migration. After discussion of preliminary field results with the MOE, the study was expanded to assess off-site migration of wastes and the potential presence of waste leachates in the Speed River.

The field investigations were primarily directed towards characterization of shallow ground water conditions. ESL was specifically requested by the MOE to limit boreholes and ground water monitors to shallow bedrock in order to prevent possible transport of contaminants to depth in the bedrock. The field investigations also involved sampling of surface water and sediment quality in the Speed River. The river is the ultimate receptor for shallow ground water flow and storm water sewers from the plant site.

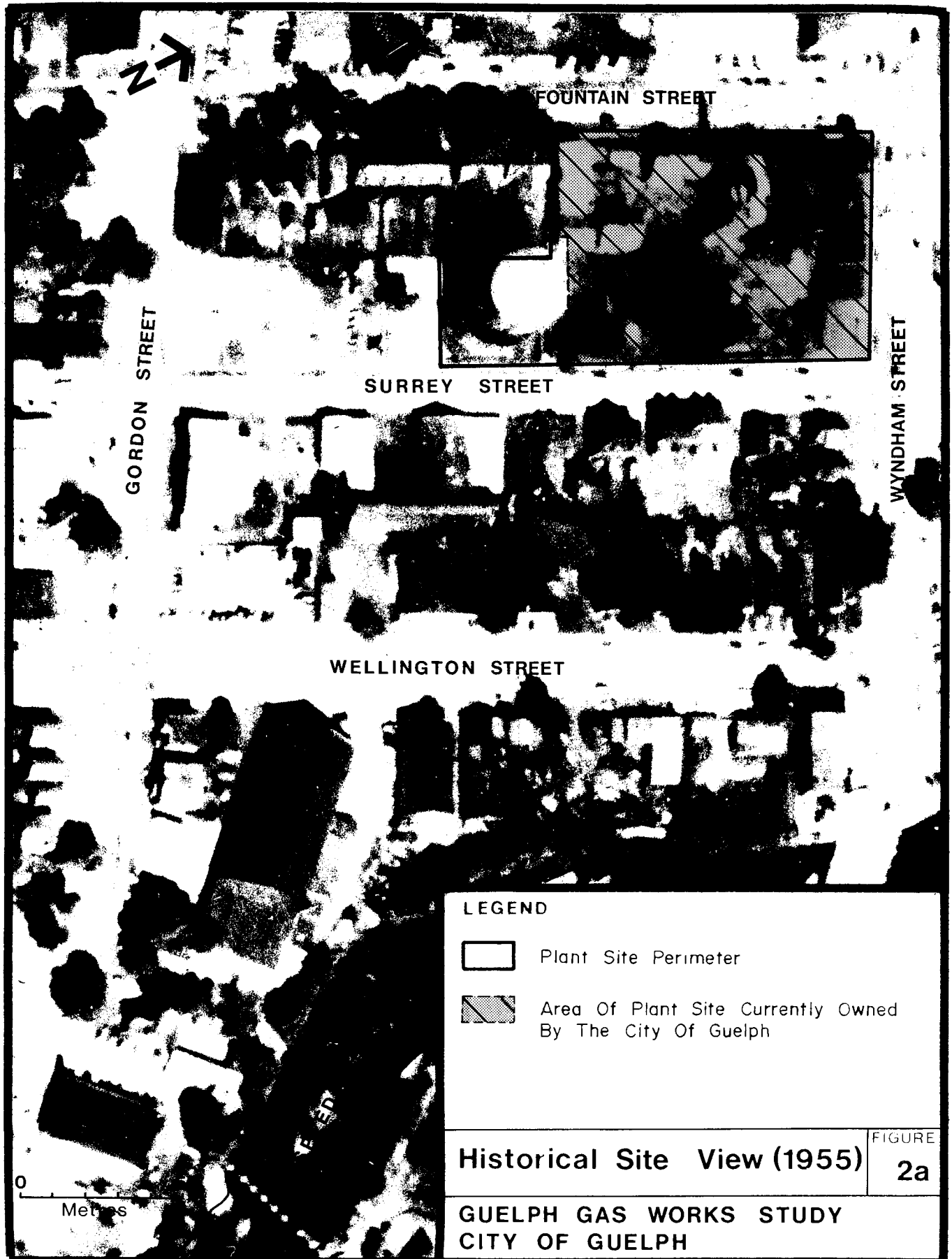


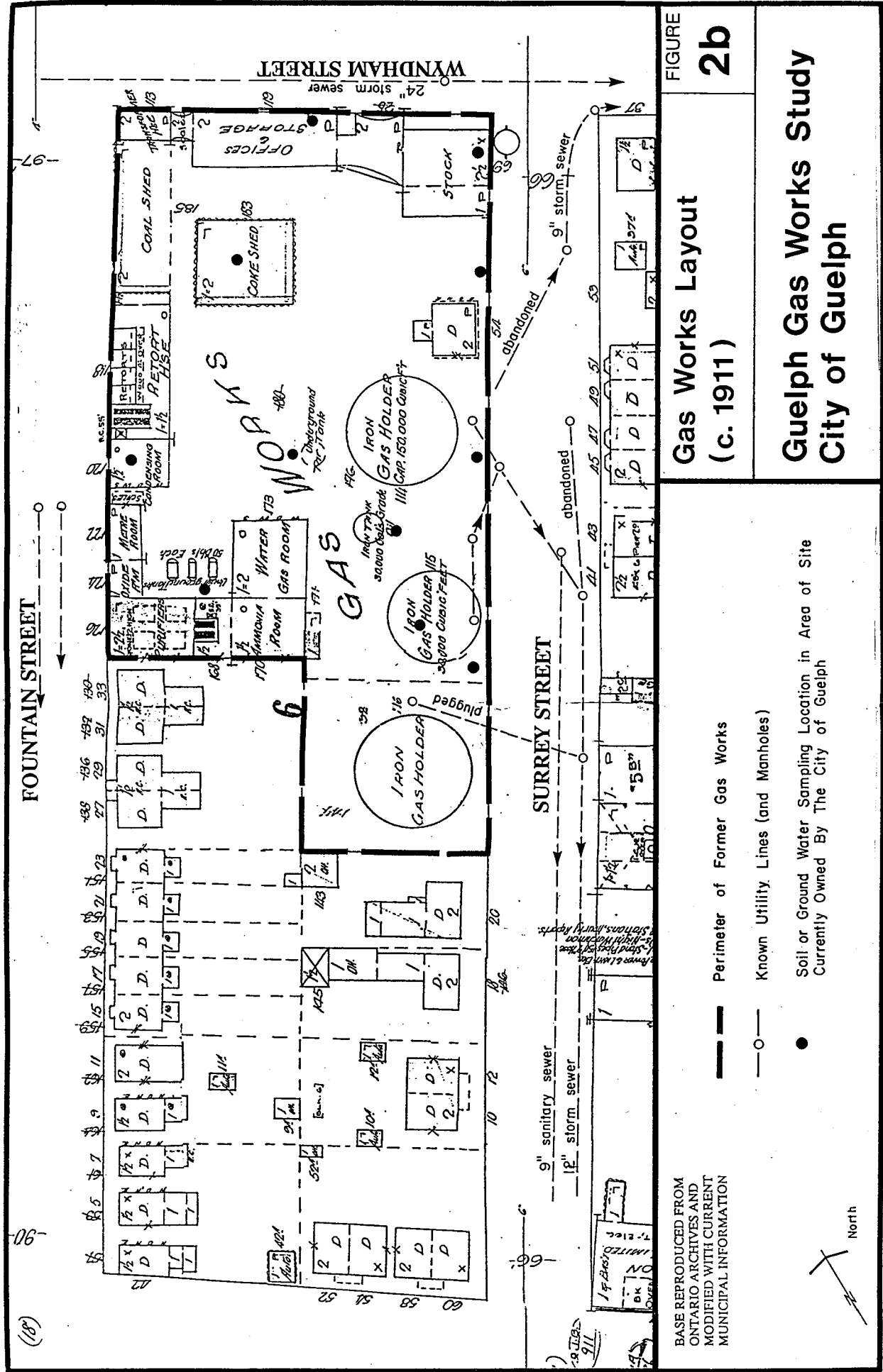
### **3.0 GENERAL SITE DESCRIPTION**

The Guelph Gas Works was a relatively large gas manufacturing operation. It was located on Fountain Street between Wyndham, Surrey and Gorden Streets (Figure 2a). The gas works ultimately covered an area of about 1 ha. It included several process buildings and 3 gas holding tanks with a total capacity in the order of 8500 cubic metres (Figure 2b). During late 1987, the City discovered a network of underground passages connecting the process buildings in the northwestern portion of the site. These passages were partially filled with sand and did not appear to contain any wastes.

The Guelph Gas Works operated from 1871 to 1957. The manufacturing process was likely "water gas" from about 1897 (Intera, 1987). The gas works had several owners. The Guelph Gas Company owned the plant from 1871 to 1903. The plant was then sold to the Guelph Light and Heat Commission. In later years, the plant was owned by the Union Gas Company. In 1957, the plant was shut down and dismantled (Intera, 1987).

The plant site is currently owned by the City of Guelph and Union Gas. The City's portion is used for the Fountain Street Municipal Parking Lot. Union Gas owns the southwestern portion of the site and uses it for an office and service yard. The land use to the northwest and east is institutional. The land use to the south and southeast is commercial and residential (Intera, 1987).







#### **4.0 RESULTS AND DISCUSSION**

Field work conducted during the course of the gas plant studies included:

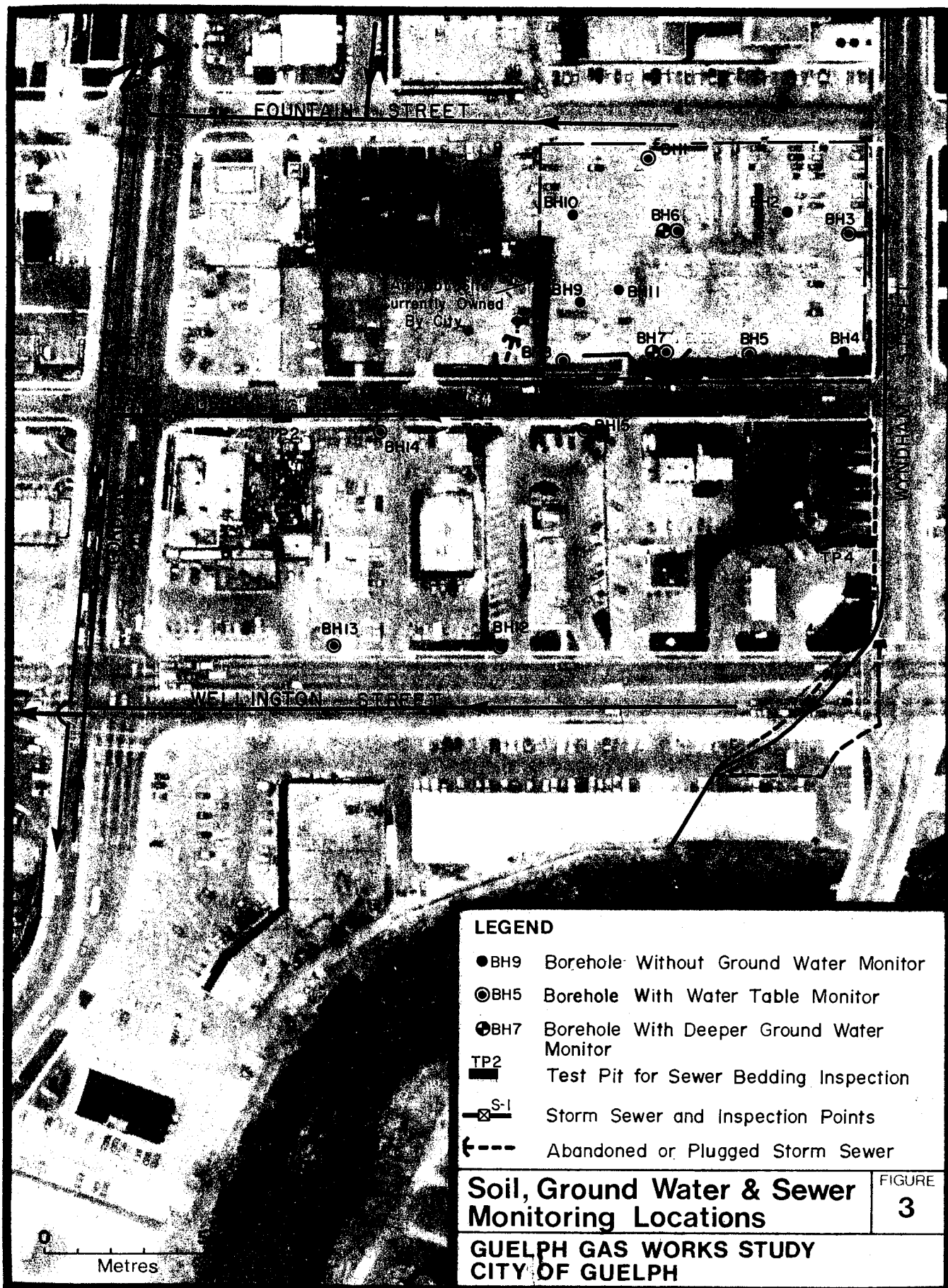
- geologic boreholes,
- installation, testing and sampling of ground water monitors,
- inspection of sewers and sewer bedding from the gas plant,
- sediment and surface water sampling downstream from sewer outfalls from the plant area into the Speed River.

The methodologies are outlined in Appendix A. Original field data is included in Appendices B to E. Appendix B includes borehole and test pit logs. Appendix C includes general ground water monitor details and ground water elevations. Appendix D includes hydraulic conductivity test results and Appendix E includes all analyses of water and sediment quality.

#### **4.1 GEOLOGY**

The geologic setting of the plant site was determined from soil sampling in 11 boreholes on-site and 4 boreholes and 3 test pits off-site (Figure 3). The locations of the on-site boreholes were chosen to provide areally representative information and to provide specific information in areas of potential gas plant waste residues. Previous geophysical studies (GLL, 1986) had outlined the bottom of the former Gas Holder Tank 115 (Figure 2b). The locations of the off-site boreholes were chosen to provide data to the southeast of the gas plant along the local downgradient dip of the bedrock surface.

The plant site is situated on granular deposits about 150 m northwest of the Speed River and about 6 m above the river stage. The granular materials originate from fill or from sandy glacial materials deposited along the banks of the Speed River.





The granular materials on-site range from 1.8 to 5.4 m thick (Figures 4 and 5). The fill is 5.4 m thick in the south corner of the site due to a local bedrock depression. The granular material beneath the plant site generally consists of brown, poorly sorted sands with some gravel. Coal cinders, slag and pitch occasionally occur in the upper metre of fill. Discoloured fill with strong hydrocarbon or ammonia odour occurs at the bedrock surface at borehole locations 5, 7, 8 and 10. The lower 4 m of fill at location 8 is saturated with tar.

The granular material in the areas investigated off-site ranges from 1.4 to 2.2 m thick. At borehole 14 and test pits 2 and 3 along Surrey Street, the upper 0.5 to 1 m of material consists of coal cinders, slag and pitch presumably associated with the plant site operations. Coal tars were not found in these materials. These test pits were specifically completed to inspect the bedding of the storm and sanitary sewer heading southwest from the site. Test pit 1 at the northeast end of Surrey Street and test pit 4 along Wyndham Street were completed to inspect the sewer bedding along the abandoned and present storm sewers heading southeast from the site. Coal tars and discoloured bedding were found at these locations.

The bedrock typically consists of a grey or yellow weathered dolomite. It has an undulating surface that dips to the south (Figures 5 and 6). A local depression in the bedrock surface at location 8 on the plant site occurs from 1.7 to 3.7 m below the surrounding bedrock. This depression appears to act as a collection point for coal tars on-site. It may be a man-made excavation rather than a natural feature.

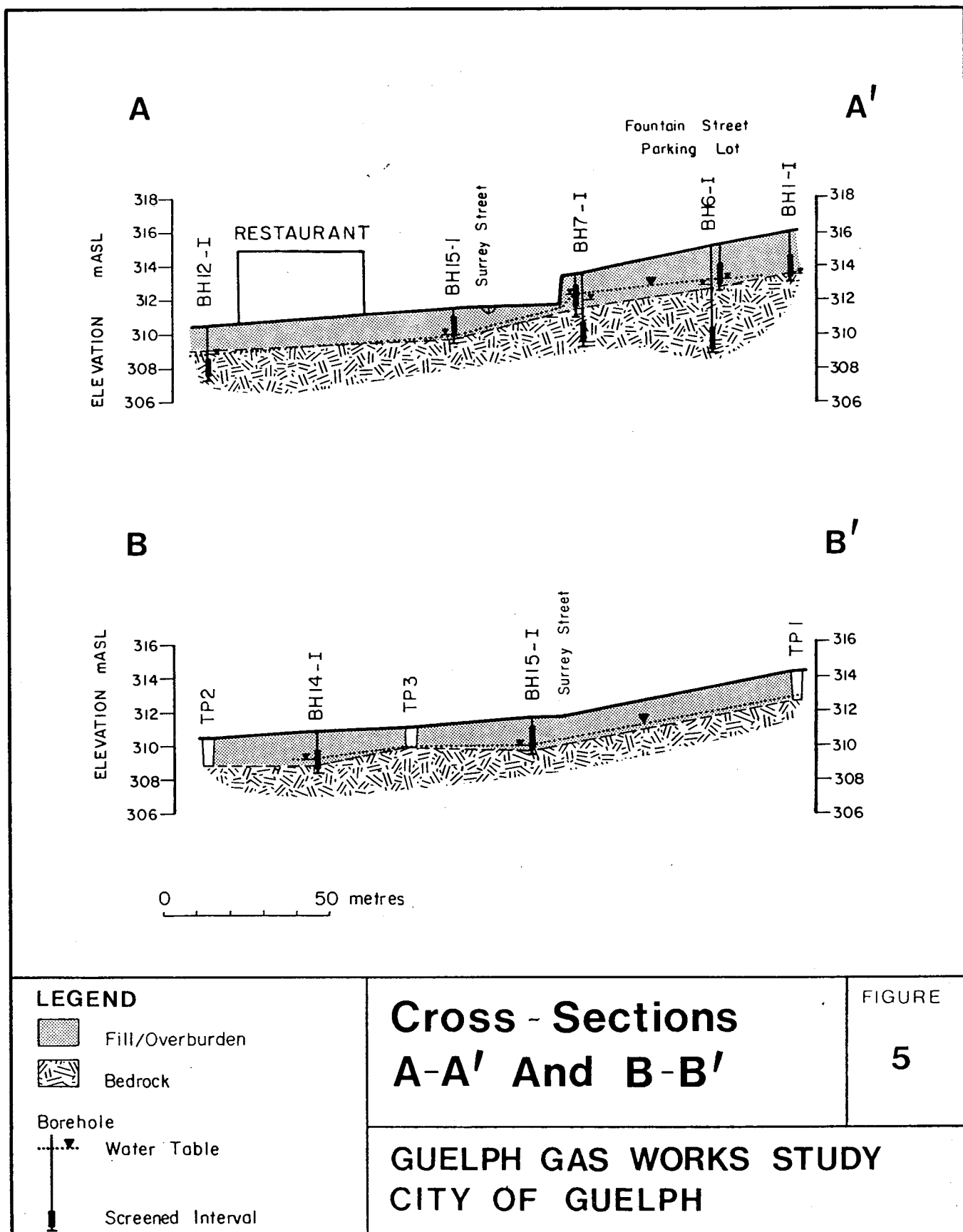
Boreholes were completed into the bedrock at locations 6 and 7 on-site and locations 12, 13, 14 and 15 off-site. Coring of the bedrock was completed at locations 6 and 7. Noticeable weathering cracks or fractures in the bedrock were found within the upper 1.5 m at these locations. Discoloration of the bedrock and free coal tar in weathering cracks in the bedrock were found at location 7.

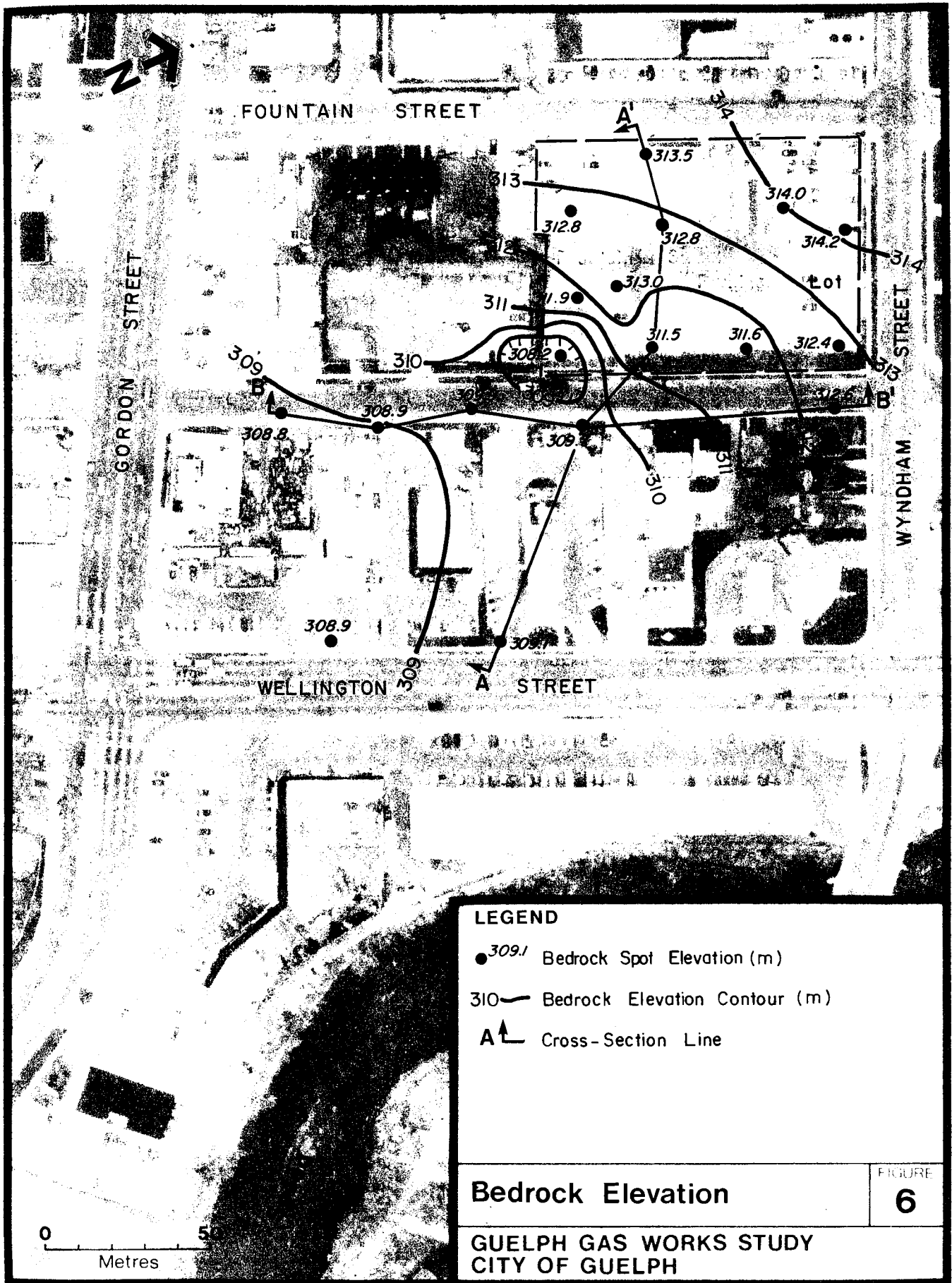
#### 4.2 HYDROGEOLOGY

The hydrogeologic setting of the plant site was determined from 8 ground water monitors installed on-site and 4 ground water monitors installed off-site along Surrey











and Wellington Streets (Table 1). The methodologies are outlined in Appendix A. Ground water monitor details, ground water elevation measurements and hydraulic conductivity results are summarized in Table 1.

Shallow ground water monitors on-site were installed at the bedrock surface to determine the water table conditions and to determine potential coal tar accumulations at the bedrock surface. Two deeper monitors were completed from 1 to 2.4 m below the bedrock surface. Off-site monitors were also installed to determine water table conditions. These monitors were installed below the bedrock surface since the water table occurred at lower elevation off-site. The water table occurred from 1 to 2.5 m below ground throughout the area.

The water table slopes to the southeast towards the Speed River (Figure 7). Shallow ground water moves in this direction. The ultimate receptor for this ground water is the Speed River. Vertically downward hydraulic gradients beneath the plant site indicates that downward ground water movement into the bedrock also occurs. The City currently operates a municipal water supply well in the bedrock approximately 1.5 km to the south of the plant site.

The water table elevations in Figure 7 were taken over several days in January since several monitor caps were frozen. Variations in the water table elevations over this period were not significant in determining the overall direction of ground water flow. A sharp drop in the water table across the retaining wall along the southern perimeter of the gas plant site suggests the wall effectively raises the water table behind it. A drop of over 2 m occurs between monitors 8 and 15 on either side of the wall.

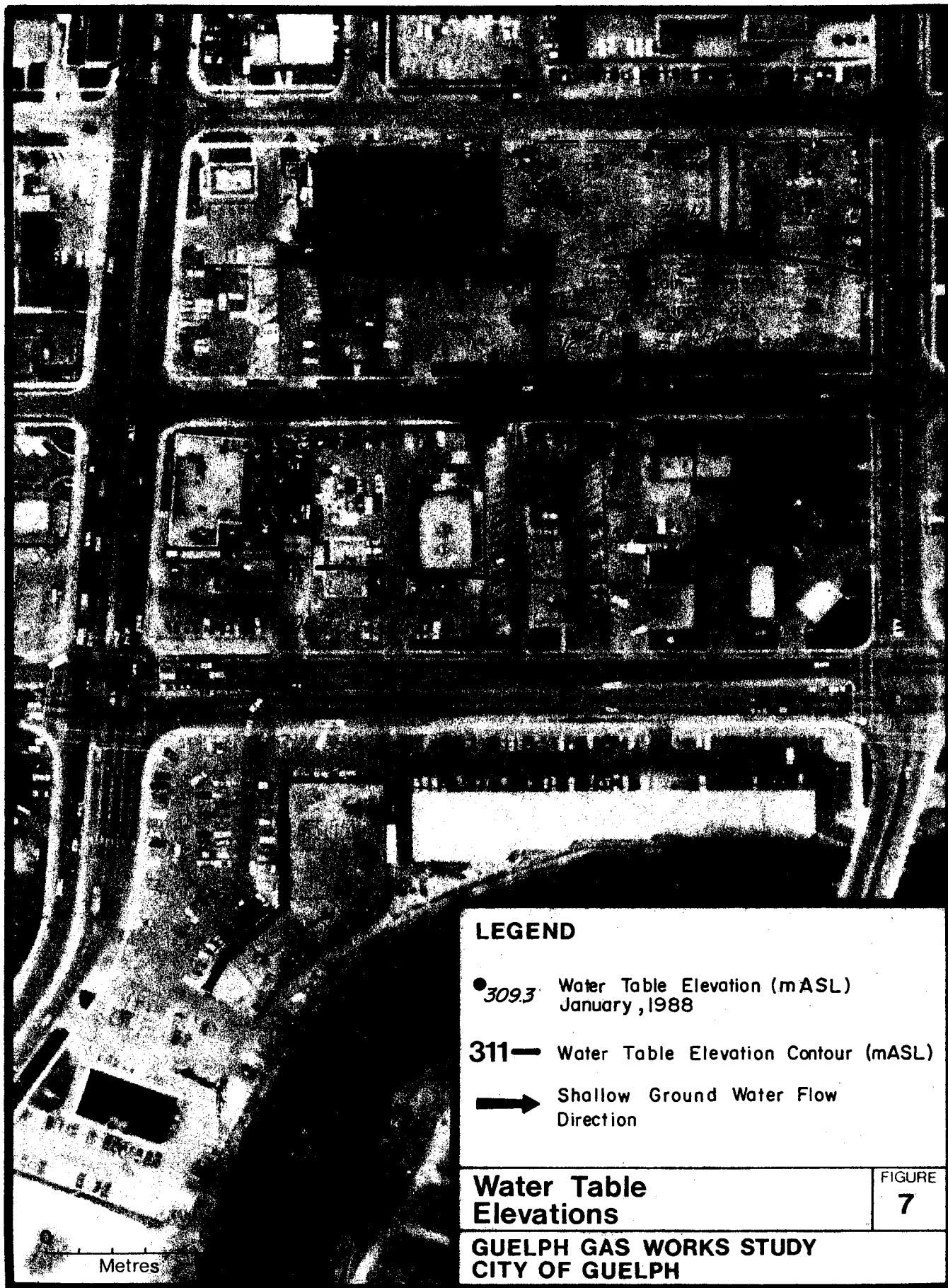
The average rate of ground water flow through the area depends upon the hydraulic gradient, the hydraulic conductivity and the effective porosity of the granular materials and the bedrock. The saturated thickness of the granular materials off-site is generally less than 0.5 metres. The rate of flow in these materials cannot be determined from the available data. The rate of flow in the upper bedrock is approximately 50 m/a using an off-site hydraulic gradient of 0.02 m/m, a hydraulic conductivity with a geometric mean of  $8 \times 10^{-6}$  m/s and an assumed effective porosity of 10%. The rate of flow is sensitive



TABLE 1 SUMMARY OF MONITOR CONSTRUCTION DETAILS, GROUND WATER ELEVATIONS AND HYDRAULIC CONDUCTIVITY

AREA	MONITOR NUMBER	FORMATION MONITORS	SCREENED INTERVAL BELOW GROUND (m)	GROUND WATER ELEVATION JAN. 13-21, 1988 (m)	HYDRAULIC CONDUCTIVITY (m/s)
NW site perimeter	1-I	overburden	1.5 - 2.7	313.36	nm
NE site perimeter	3-I	overburden	1.4 - 2.6	313.42	nm
E site perimeter	5-I	overburden	1.1 - 2.3	312.20	rr
Central site	6-I	bedrock	4.9 - 6.1	312.89	2.0 x 10 <sup>-5</sup>
	II	overburden	1.3 - 2.5	313.11	rr
E site perimeter	7-I	bedrock	2.9 - 4.1	311.98	6.4 x 10 <sup>-6</sup>
	II	overburden	0.8 - 2.0	na	na
S site	8-I	overburden	1.1 - 5.3	312.50	nm
Wellington St.	12-I	bedrock	1.8 - 3.0	308.90	4 x 10 <sup>-6</sup>
Wellington St.	13-I	bedrock	1.7 - 3.0	308.78	nm
Surrey St.	14-I	bedrock/fill	1.1 - 2.4	309.31	7 x 10 <sup>-7</sup>
Surrey St.	15-I	fill	0.6 - 1.8	309.86	nm

Note: (nm) - not measurable due to low ground water elevations  
(rr) - rapid response during testing; too fast to measure  
(na) - not available





to the values used for each of these parameters. However, the rate is great enough to easily transport gas plant waste leachates from the site.

#### 4.3 OCCURRENCE AND OFF-SITE MIGRATION OF GAS PLANT WASTES

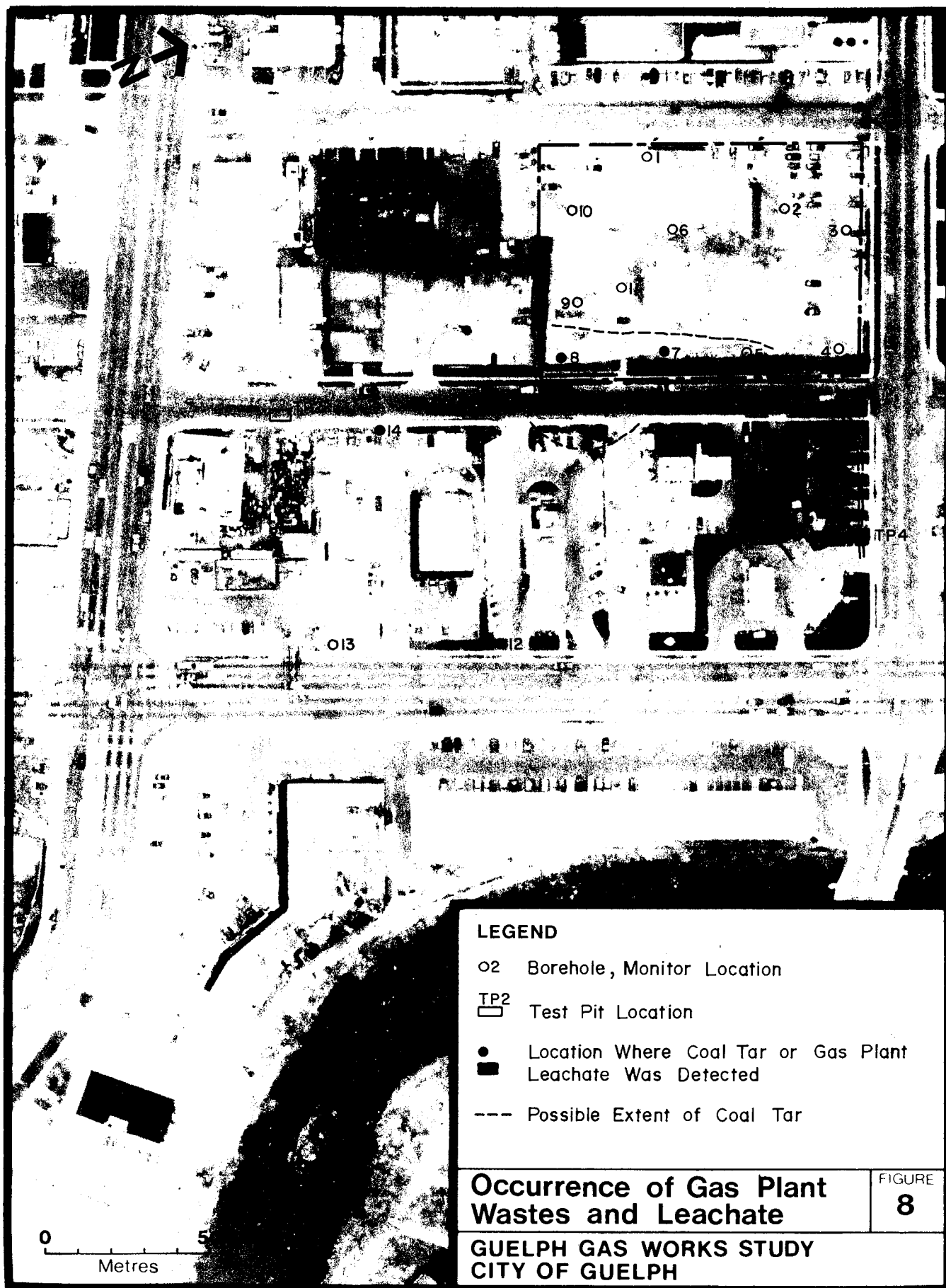
##### 4.3.1 Overview

The gas plant wastes of most interest with regard to off-site migration are associated with coal tars removed from the produced gas or spent oxides used in the purification of the gas. Coal tars are relatively immiscible and are heavier than water. They tend to "sink" through soils and migrate along lower permeability barriers such as an unweathered bedrock surface.

The major residual of coal tar on-site appears to be in the fill within the bedrock depression in the southwest corner of the site (Figure 8). This depression contains approximately 4 m of tar saturated fill. This tar had a relatively low viscosity and would be able to flow if not contained. Coal tar was detected in borehole 7 and was reported in fence post holes completed by the City along the eastern perimeter of the site (Intera, 1987). Coal tar was found in the sewer bedding beneath the abandoned storm sewer heading northeast along Surrey Street and southeast along Wyndham Street. These observations suggest that coal tar may occur downgradient from the site along the southern perimeter of the plant site.

Emulsified coal tars occur in shallow ground water at monitor location 15 across the street from the plant. Black hydrocarbon sediment was found in the sump in the basement of the apartment building across from the plant (Appendix F). However, no odours or seepage of this material in the basements were found in any of the residences along Surrey Street. There was no evidence of coal tar beneath Surrey Street in borehole 14 and test pits 2 and 3 to the south of the plant.

Phenols and polynuclear aromatic hydrocarbons (PAHs) are the leachable constituents of most interest in the coal tars. These constituents move predictably in ground water flow systems. Oxides contain leachable constituents such as ammonium and cyanide which also move predictably with ground water movement. Trace metals may be





leached from a variety of sources in a gas plant. Waste oxides or other gas plant wastes were not recognized in the fill on the plant site. Dissolved constituents from wastes on-site and from the coal tars beneath Surrey Street would generally be expected to move southeastward towards the Speed River. Some downward movement into the bedrock may also occur.

Another on-site source of waste leachates, perhaps not directly involved in the gas plant operation, was detected in the northwest corner of the site. Three small storage tanks used to exist in this area (Figure 2b). Strong gasoline odours were noted at the bedrock surface in borehole 10.

#### 4.3.2 Ground Water

Ground water sampling was conducted to provide an indication of ground water quality beneath the plant site and to the southeast and southwest of the site (Figure 8). The full suite of ground water analyses included phenols, ammonium, cyanide, ICP metals and polynuclear aromatic hydrocarbons (PAHs). A phased analytical program was conducted. The analyses conducted on each sample varied according to the location of the monitor sampled, the accessibility of the monitors during winter conditions and the volume of water in the monitors.

Sampling methodologies are outlined in Appendix A. The original laboratory results and complete quality assurance analyses from Barringer Magenta Laboratories and NOVALAB Ltd. are included in Appendix C. The results are summarized in Tables 2 to 7.

Phenols were used as the most general indicator of poor quality ground waters associated with the gas plant. Phenol analyses are available for ground water samples from monitors 5-I, 6-I, 6-II, 7-I, 7-II, 8-I, 12-I, 13-I, 14-I and 15-I (Table 2). The highest phenol concentration detected was 27,600 ug/L in monitor 8-I in the south corner perimeter of the plant site. Free coal tar was found in this monitor. Lesser concentrations were detected in off-site monitors 12-I and 15-I. Monitor 15-I is 15 m south of the plant and had a phenol concentration of 254 ug/L. Monitor 12-I is the furthest downgradient monitor from the plant, approximately 80 m from the plant, and





TABLE 2 SUMMARY OF GENERAL WATER QUALITY ANALYSIS OF GROUND WATER SAMPLES

MONITORS ON-SITE																	MONITORS ON SURREY ST.					MONITORS ON WELLINGTON ST.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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Notes: a (-) indicates not analysed  
b ODWO - Ontario Drinking Water Objectives  
c Objective for free cyanide rather than total cyanide



had a phenol concentration of 3 ug/L. Phenols were not detected in off-site monitors 13-I and 14-I.

Ammonium and cyanide are other specific indicators of ground water affected by gas plant operations. Analyses for these constituents are available for monitors 7-I, 12-I and 14-I (Table 2). The highest ammonium concentration of 26 mg/L and the highest cyanide concentration of 2680 ug/L were detected in monitor 7-I on-site. Much lower concentrations of both constituents were found in the off-site monitors 12-I and 14-I. Monitor 12-I is downgradient from the plant site. Monitor 14-I is not downgradient and may receive its dissolved constituents from the plant site fill along Surrey Street to the southwest of the plant. Trace metals were analysed in samples from monitors 7-I, 12-I and 14-I (Table 2). Anomalous but not uncommon concentrations of iron and manganese were detected. Metal concentrations (other than calcium, magnesium, sodium and potassium) generally occurred at very low levels, often less than the analytical limits of detection.

PAH analyses are available from monitors 7-I, 12-I and 15-I (Table 3). Elevated concentrations of a variety of PAH constituents occur in both monitors 7-I and 15-I. The concentrations are well in excess of the individual solubilities of these constituents and suggest the presence of emulsified coal tar in the samples analysed. Monitor 8-I contains obvious free coal tar and was not sampled. Monitor 12-I is the furthest downgradient monitor from the gas plant and had a total PAH concentration of 13.4 ug/L. The three constituents detected in this monitor were acenaphthene, fluorene and naphthalene. These constituents have the highest individual solubilities of the PAH constituents in coal tars.

The ground water quality sampling detected gas plant leachate along Surrey Street adjacent to the plant and downgradient to the southeast of the plant. Cyanide, ammonia, phenols and PAHs were each detected in ground water monitor 12-I, the furthest downgradient monitor from the plant site. All concentrations, except naphthalene, were greatly reduced compared to concentrations in monitor 15-I adjacent to the plant site. Cyanide concentrations were the least reduced. Phenol and PAH concentrations were the most reduced. These changes are consistent with the general



TABLE 3 SUMMARY OF POLYNUCLEAR AROMATIC HYDROCARBON ANALYSES OF GROUND WATER SAMPLES

CONSTITUENT	MOE(a)	MDL(b)		ON-SITE	SURREY ST		WELLINGTON ST
				BEDROCK	BEDROCK		BEDROCK
			FIELD BLANK	7-I	14-I	15-I	12-I
ACENAPHTHENE	ug/L	0.05	nd	15	nd	230	11
ACENAPHTHYLENE	ug/L	0.05	nd	290	nd	540	nd
ANTHRACENE	ug/L	0.05	nd	7.8	nd	110	nd
BENZO(A) ANTHRACENE	ug/L	0.05	nd	0.1	nd	78	nd
ABENZO(B) + BENZO(K) FLUORANTHENE	ug/L	0.05	nd	nd	nd	47	nd
BENZO(A) PYRENE	ug/L	1.0	0.05	nd	nd	58	nd
BENZO(GHI) PERYLENE	ug/L	0.1	nd	nd	nd	38	nd
CHRYSENE	ug/L	0.05	nd	0.06	nd	49	nd
DIBENZ(A,H) ANTHRACENE	ug/L	0.1	nd	nd	nd	5.9	nd
FLUORANTHENE	ug/L	0.05	nd	3.3	nd	240	nd
FLUORENE	ug/L	0.05	nd	56	nd	200	1
INDENO (1,2,3-CD) PYRENE	ug/L	0.1	nd	nd	nd	25	nd
NAPHTHALENE	ug/L	0.05	nd	270	nd	1	1.4
PHENANTHRENE	ug/L	0.05	nd	55	nd	670	nd
PYRENE	ug/L	0.05	nd	2.5	nd	250	nd

Notes (a) MOE - Ontario Ministry of the Environment Working Guideline - pers. comm. with U. Sibbul

(b) MDL - Method Detection Limit (10 x higher for monitor 15-I)



ground water mobility of these constituents. The concentration of constituents at monitor 12-I slightly exceeded the Ontario Drinking Water Objectives (ODWO) for phenols. The concentration of cyanide is less than the ODWO assuming that the cyanide detected only has a small proportion of free cyanide. Objectives for ammonia and PAHs are not established.

#### 4.3.3 Storm Sewers

Storm sewer outfalls from the gas plant into the Speed River occur in two areas (Figure 9). The earliest municipal records indicate that the plant was originally serviced by a 24" storm sewer that ran southeast along Wyndham Street to the Speed River. This sewer joined a 30" sewer south of Wellington Street and discharged into the river about 60 m from the present Wyndham Street Bridge. In 1929, a separate 9" sewer was constructed to serve only the plant. This sewer was constructed alongside the existing 24" sewer and emptied directly into the river. Between 1943 and 1952, the 24" sewer was realigned south of Wellington Street and emptied into a new 36" outfall.

Coal tars were found inside the 9" pipe and in the sewer bedding beneath the 9" and 24" storm sewers in test pit 4 about half way between the plant and the river. The bedding was found to contain coal tar. It is possible that coal tars may be found further southeast along this bedding towards the river. A sanitary sewer running southeast along the centre of Wyndham Street was not investigated.

The other storm sewer serving the gas plant was constructed in 1924 and runs southwest from the plant along Surrey Street. The sewer is still in operation and discharges into the Speed River just downstream from the present McCrae Boulevard Bridge, approximately 700 m southwest of the plant. Former residents in the area report that tarry sediments accumulated near the outfall of this sewer but it is believed they were disturbed and probably removed from the river during a channel improvement project completed by the Grand River Conservation Authority during the 1960's.

During 1986, the City detected coal tar seeping into the Surrey Street sewer from a sewer connection serving the Union Gas portion of the plant site and sealed the connection. Tarry sediments were not found in the Surrey Street sewer during



## LEGEND

- Abandoned / Plugged Storm Sewer Lines
- Storm Sewer Lines
- ▲2 River Water Sampling Locations
- ▲A River Sediment Sampling Locations
- S-1 Sewer Sampling Location
- ← Direction Of River Flow
- ▨ Plant Site Area Currently Owned By City



0 200 400  
Metres

# Monitoring Locations Speed River

FIGURE

9

**GUELPH GAS WORKS STUDY  
CITY OF GUELPH**



inspection in the present study. Coal tars were also not found in the sewer bedding of the Surrey Street sewer in test pits 2 and 3. Test pit 2 also exposed the sewer bedding of the sanitary sewer along Surrey Street and did not encounter any coal tar in this bedding.

The present loading of dissolved gas plant constituents into the river was assessed by sewer water sampling of the Surrey Street sewer from a manhole at the corner of Surrey and Gordon Streets (Table 4). The concentration of phenols was 16 ug/L. PAHs were not detected.

#### 4.3.4 Surface Water and Sediments in the Speed River

One surface water sample and two sediment samples were collected from the Speed River downstream from each of the sewer outfall areas described above. The surface water at the river sampling location to the southeast of the plant is also downstream of the reach of the river that receives present ground water flow from the gas plant.

The surface water samples were analysed for the same suite of constituents as the ground water analyses discussed in Section 4.3.2. These include phenol, ammonium, cyanide, dissolved metals and PAHs. Only cyanide was detected in the surface water samples (Table 5). To the southeast of the plant, the cyanide concentration was 6 to 10 ug/L (as total). The Ontario Provincial Water Quality Objective (PWQO) for cyanide (as free) is 5 ug/L. The PWQO is likely not exceeded assuming that the cyanide detected only has a small proportion of free cyanide. These samples were collected during the low flow period in winter. Cyanide concentrations in higher flow periods would be lower. To the southwest of the gas plant, the cyanide concentration in the surface water was 1 ug/L (as total).

The sediment samples were analysed for oil and grease, metals and PAHs. None of these analyses detected unusual concentrations specifically related to gas plant discharges into the river (Table 6). PAH concentrations only ranged from 2.2 to 15.4 ug/g (Table 7).



TABLE 4 SUMMARY OF ANALYSES OF SEWER WATER SAMPLES

CONSTITUENT	MOE(a)	MDL(b)	SAMPLE S-1, SURREY STREET (c)
PHENOLS	ug/L		16
POLYNUCLEUR AROMATICS			
ACENAPHTHENE	ug/L	0.2	nd
ACENAPHTHYLENE	ug/L	0.2	nd
ANTHRACENE	ug/L	0.2	nd
BENZO(A) ANTHRACENE	ug/L	0.4	nd
ABENZO(B) + BENZO(K) FLUORANTHENE	ug/L	0.4	nd
BENZO(A) PYRENE	ug/L	1.0	nd
BENZO(GHI) PERYLENE	ug/L	0.8	nd
CHRYSENE	ug/L	0.4	nd
DIBENZ(A,H) ANTHRACENE	ug/L	0.8	nd
FLUORANTHENE	ug/L	0.2	nd
FLUORENE	ug/L	0.2	nd
INDENO (1,2,3-CD) PYRENE	ug/L	0.8	nd
NAPHTHALENE	ug/L	0.2	nd
PHENANTHRENE	ug/L	0.2	nd
PYRENE	ug/L	0.2	nd

Notes (a) MOE - Ontario Ministry of the Environment Working Guideline - pers. comm.  
with U. Sibbul

(b) MDL - Method Detection Limit

(c) nd - not detected



TABLE 5 SUMMARY OF GENERAL WATER QUALITY ANALYSES OF SPEED RIVER SURFACE WATER SAMPLES

CONSTITUENT		PWQO(a)	Sample Downstream of Sewer Outfall Southeast of Gas Pla		Sample Downstream of Sewer Outfall Southwest of Gas Pla
General Contaminant Indicators			1	Lab Repeat	2
PHENOL	ug/L	1	<1	<1	<1
AMMONIUM (unionized)	mg/L N	0.02	0.01	0.01	0.01
CYANIDE (total)	ug/L	5 (b)	10	6	1
Dissolved Metals					
SILVER	mg/L Ag	0.0001	<0.005	<0.005	0.005
ALUMINUM	mg/L Al		0.05	0.06	0.04
BORON	mg/L B		0.018	0.017	0.018
BARIUM	mg/L Ba		0.017	0.017	0.018
BERYLLIUM	mg/L Be	0.011(c)	<0.0005	0.0007	<0.0005
CALCIUM	mg/L Ca		67.9	66.7	66.8
CADMIUM	mg/L Cd	0.0002	<0.01	<0.01	<0.01
COBALT	mg/L Co		<0.05	<0.05	<0.05
CHROMIUM	mg/L Cr	0.100	0.03	0.03	0.02
COPPER	mg/L Cu	0.005	<0.008	<0.008	<0.008
IRON	mg/L Fe	0.300	0.15	0.14	0.14
POTASSIUM	mg/L K		1.5	1.5	1.3
MAGNESIUM	mg/L Mg		20.2	20	20.5
MANGANESE	mg/L Mn		0.03	0.03	0.03
MOLYBDENUM	mg/L Mo		<0.2	<0.02	<0.2
SODIUM	mg/L Na		11.2	11.2	13.4
NICKEL	mg/L Ni	0.025	<0.05	<0.05	<0.05
PHOSPHORUS	mg/L P		<0.5	<0.5	<0.5
LEAD	mg/L Pb	0.025	0.05	0.05	<0.05
SILICON	mg/L Si		1.21	1.18	1.24
STRONTIUM	mg/L Sr		0.155	0.155	0.16
THORIUM	mg/L Th		0.18	0.18	0.15
TITANIUM	mg/L Ti		<0.005	<0.005	<0.005
VANADIUM	mg/L V		0.005	0.008	0.005
ZINC	mg/L Zn	0.030	0.02	0.01	0.02
ZIRCONIUM	mg/L Zr		<0.05	<0.05	<0.05

Notes (a) PWQO - Ontario Ministry of the Environment Provincial Water Quality Objectives  
 (b) Objectives for free cyanide rather than total cyanide  
 (c) Objective for unfiltered water with hardness less than 75 mg/L CaCO<sub>3</sub>; objective increases for harder water





TABLE 6. SUMMARY OF GENERAL WATER QUALITY ANALYSES OF SPEED  
RIVER SEDIMENT SAMPLES

CONSTITUENT		Samples Downstream of Sewer Outfall Southeast of Gas Plant			Samples Downstream of Sewer Outfall Southwest of Gas Plant	
General Contaminant Indicator		A	Lab Repeat	B	C	D
OIL & GREASE		ppm	3280	3280	6000	3540
Total Metals						
SILVER	ppm Ag	<0.5	<0.5	<0.5	<0.5	<0.5
ALUMINUM	ppm Al	27300	30500	33500	23600	31300
BORON	ppm B					
BARIUM	ppm Ba	242	277	316	234	302
BERYLLIUM	ppm Be	0.75	0.85	0.9	0.88	0.87
CALCIUM	ppm Ca	128000	139000	128000	190000	130000
CADIUM	ppm Cd	<1	<1	<1	<1	<1
COBALT	ppm Co	<5	6	9	12	8
CHROMIUM	ppm Cr	54	57	55	52	52
COPPER	ppm Cu	30	31	65	50	30
IRON	ppm Fe	36400	36100	23300	18100	20300
POTASSIUM	ppm K	8300	9500	11000	7800	10200
MAGNESIUM	ppm Mg	54400	56800	48000	31300	45600
MANGANESE	ppm Mn	964	997	1600	1490	968
MOLYBDENUM	ppm Mo	20	20	20	20	20
SODIUM	ppm Na	7900	9000	8500	3800	9600
NICKEL	ppm Ni	11	16	18	19	15
PHOSPHORUS	ppm P	630	680	1170	1400	740
LEAD	ppm Pb	180	160	195	195	145
SILICON	ppm Si					
STRONTIUM	ppm Sr	185	205	201	245	213
THORIUM	ppm Th	24	27	24	23	28
TITANIUM	ppm Ti	4960	4380	2100	1280	2530
VANADIUM	ppm V	67	64	43	38	42
ZINC	ppm Zn	209	261	97	877	48
ZIRCONIUM	ppm Zr	448	90	60	403	59



TABLE 7 SUMMARY OF POLYNUCLEAR AROMATIC HYDROCARBON  
ANALYSES OF SPEED RIVER SEDIMENT SAMPLES

CONSTITUENT	MOE(a)	MDL(b)	Sediments Downstream of Sewer Outfall Southeast of Gas Plant			Sediments Downstream of Sewer Outfall Southwest of Gas Plant	
			A	B	Lab Repeat	C	D
ACENAPHTHENE	ug/L	0.2	nd	nd	nd	nd	0.1
ACENAPHTHYLENE	ug/L	0.2	nd	0.2	nd	nd	nd
ANTHRACENE	ug/L	0.2	0.2	0.5	0.4	nd	0.4
BENZO(A) ANTHRACENE	ug/L	0.4	nd	nd	nd	0.3	1.4
ABENZO(B) + BENZO(K) FLUORANTHENE	ug/L	0.4	nd	nd	nd	0.5	1.4
BENZO(A) PYRENE	ug/L	1.0	0.8	nd	nd	nd	nd
BENZO(GHI) PERYLENE	ug/L	0.8	nd	nd	nd	nd	nd
CHRYSENE	ug/L	0.4	nd	nd	nd	0.4	1.3
DIBENZ(A,H) ANTHRACENE	ug/L	0.8	nd	nd	nd	nd	nd
FLUORANTHENE	ug/L	0.2	0.6	6.9	2.6	0.8	2.4
FLUORENE	ug/L	0.2	nd	0.2	nd	nd	0.2
INDENO (1,2,3-CD) PYRENE	ug/L	0.8	nd	nd	nd	nd	nd
NAPHTHALENE	ug/L	0.2	nd	nd	nd	nd	nd
PHENANTHRENE	ug/L	0.2	0.9	2.8	1.6	0.4	2.2
PYRENE	ug/L	0.2	0.5	4.8	2.0	0.6	1.7

Notes (a) MOE - Ontario Ministry of the Environment Working Guideline - pers. comm. with U. Sibbul  
(b) MDL - Method Detection Limit



## **5.0 SUMMARY AND CONCLUSIONS**

The Guelph Gas Works and surrounding area is underlain by 1 to 5 m of fill and overburden overlying limestone bedrock. The water table occurs from 1 to 2.5 m below ground and slopes towards the Speed River approximately 150 m to the southeast of the gas plant.

Gas plant waste residues still exist on-site. The major residual of coal tar appears within fill in a bedrock depression in the southwest corner of the site. Coal tars likely exist beneath Surrey Street along the southern perimeter of the gas plant. Coal tars were found in sewer bedding along an abandoned storm sewer leading northeast along Surrey Street and southeast along Wyndham Street. The coal tars contain leachable phenols and polynuclear aromatic hydrocarbons (PAHs). Leachable sources of ammonia and cyanide also exist in the fills on-site.

Ground water sampling detected gas plant leachate along Surrey Street adjacent to the plant and downgradient to the southeast of the plant in the direction of ground water flow. The furthest downgradient monitor was 80 m from the plant. Trace concentrations of phenols, ammonia, cyanide and PAHs were detected at this monitor. Phenols slightly exceeded Ontario Drinking Water Objectives. Ground water quality effects to the southwest of the plant were detected but likely result from gas plant fill placed along Surrey Street.

Storm sewers heading from the plant site have discharged gas plant wastes or leachates in the Speed River during the course of the plant operation. The sewer leading southeast from the plant on Wyndham Street was abandoned many years ago. Coal tar occurs within the bedding of this sewer. The sewer leading southwest from the plant on Surrey Street is still in operation. Coal tars do not occur within the bedding of this sewer. Tarry sediments accumulated near the outfall of this sewer many years ago but were removed from the river during a channel improvement project in the 1960s.



Surface water sampling in the Speed River downgradient from the plant and sewer outfalls detected trace concentrations of cyanide (as total). The PWQO is not exceeded assuming that cyanide detected only has a small proportion of free cyanide.

Sediment sampling in the Speed River adjacent to the surface water monitoring locations did not detect any anomalous sediment quality related to the plant.

The conclusions from this study are that:

- the extent of wastes associated with the plant is well defined, and
- the wastes do not presently pose a threat to public health and safety.
- the wastes should be left undisturbed until such time that any future site development plans are approved.



## 6.0 RECOMMENDATIONS

- The City should review the results of this study with the Ministry of the Environment.
- The City should notify all municipal departments of the presence and extent of coal gas wastes in the plant area. Engineering drawings of the area should be marked accordingly. Appropriate precautions should be followed during any excavation on-site or during any sewer or road work in the area. Contaminated soils removed from excavations should be replaced in the excavation and covered with clean backfill. Contaminated soil that is not replaced in excavations will have to be analyzed and disposed in accordance with Regulation 309.
- The City and Union Gas should work together with Union Gas and any future site developers to ensure appropriate remedial measures are included in any site development plan. The extent of waste removal will depend upon the proposed development but should, at least, include the material within the bedrock depression in the southwest corner of the municipal parking lot. This material will have to be analyzed and disposed in accordance with Regulation 309.



## 7.0 REFERENCES

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**APPENDIX A**  
**METHODOLOGY**

## METHODOLOGY

The purpose of the field work was to investigate the geologic and hydrogeologic setting of the former Guelph Gas works and to determine the extent of any gas plant waste residues. The work was initially conducted on-site and later extended off-site.

The field work mainly consisted of drilling and ground water monitor installation, testing and sampling. Test pits were completed to inspect the bedding beneath the storm sewers along Surrey and Wyndham Streets. Water samples were taken from the storm sewer flowing southwest along Surrey Street. Water and sediment samples were taken downgradient from two sewer outfalls from the plant site into the Speed River.

### BOREHOLE DRILLING

Drilling was carried out at a total of 15 locations during a two phased drilling program. During the first phase of drilling between September 29 and October 2, 1987, 13 boreholes were drilled at 11 locations (numbered 1 through 11) within the boundary of the Fountain Street Municipal Parking Lot. At all locations, auger holes were drilled to limestone bedrock. At locations 6 and 7, additional separate coreholes were drilled into the limestone to investigate the potential infiltration of gas plant wastes into the bedrock. During the second phase of drilling on December 14 and 15, 1987, four additional auger holes (numbered 12 through 15) were drilled south of the site along Surrey Street and Wellington Street. The geological logs for all boreholes are included in Appendix B.

The first phase of drilling was done using a Nodwell track-mounted CME 55 drill rig contracted from Dominion Soil Incorporated. The second phase of drilling was done using a trailer-mounted CME 45 drill rig contracted from Atcost Soil Drilling Incorporated.

All drilling in overburden and weathered limestone was done using 4 1/4" (10.8 cm inside diameter) hollow stem augers. Augering for each hole was conducted through a



hole in the bottom of a steel box. The box was used to contain the auger cuttings in case they were contaminated. A bentonite seal between the bottom of the box and the ground surface prevented any liquids from escaping from the box. Any cuttings found to contain coal tars were separated and stored in drums in a secured storage bin on-site. The cuttings were disposed of at Tricil in accordance with Ontario Ministry of the Environment Regulation 309.

At drill locations 6 and 7, bedrock was cored in a separate hole. After augering about 0.5 m into limestone, a 3" (7.6 cm) diameter steel casing was grouted with cement into the borehole. After allowing the grout to set overnight, coring was continued to final depth. Only clean City water was used and no chemical additives or drilling muds were required. All return water was collected and removed by City vacuum trucks if there were no detectable odors of coal tar. Otherwise, the water was stored in drums in a secured storage bin on-site and disposed of at the City of Guelph Water Pollution Control Plant.

During overburden drilling, continuous split spoon soil sampling was conducted to define the geologic materials, to locate the soil-bedrock interface and to determine the presence of any coal tar product or odors. All soil samples were sealed in brown glass sample containers with foil-lined lids.

To prevent artificial contamination of the soil during drilling, no oil or grease was used on downhole drilling equipment. Hollow stem augers were cleaned with acetone and rinsed with distilled water prior to and between each borehole. Split spoon samplers were similarly cleaned between successive samples.

#### GROUND WATER MONITOR INSTALLATION

A standpipe monitor was installed at 10 of the 15 drill locations in order to monitor water table conditions and shallow ground water quality. Monitors were installed in the bedrock at two locations. Monitors 1-I, 3-I, 5-I, 6-I, 6-II, 7-I, 7-II and 8-I were installed within the area of the former gas works; monitors 12-I, 13-I, 14-I and 15-I were installed downgradient of the gas works (Figure 3).

All monitors consisted of 50 mm diameter, Schedule 80, flush-threaded PVC pipe and #10 machine slotted screens. A sand filter was placed around the screen in each auger hole as the augers were pulled back. A 0.2 m to 0.5 m bentonite seal was placed from the filter to just below surface. The top of the sand filter and the seal were measured to ensure that the screen was fully covered with sand and that the seal was properly installed.

At all monitor locations, a protective steel casing and cap was installed at surface. For added security, an additional locking aluminum cap was fitted to the PVC pipe inside the casing. A rubber stopper was placed inside the PVC pipe to prevent water from entering the monitors.

The location of the all monitors were surveyed by the City of Guelph Works Department and tied into storm sewer manhole locations. Elevations at ground level and at the top of the monitor caps were tied into a geodetic benchmark so that bedrock elevations and water levels could be related to sewer and bedrock data from other survey drawings.

Details of the monitor installations are given in Appendix C.

#### TEST PIT EXAMINATION

Three test pits on Surrey Street and one test pit along Wyndham Street were excavated with a backhoe by the City of Guelph. This work was carried out on December 16 and 17, 1987. The purpose of this work was to investigate the bedding beneath the storm sewer for the presence of coal tar residues to determine if any product was migrating from the site along this potential pathway. The location of these test pits is shown in Figure 3. The logs of these test pits are included in Appendix B.

### MONITOR DEVELOPMENT

Ground water monitors were developed after installation to remove accumulated fines or drilling water and to promote a better inflow of clear formation water into the monitor. In this program, all monitors levels were measured between 2 and 4 weeks after installation and development. Monitors were equipped with dedicated 1/4" x 3/8" polyethylene tubing to allow for quicker, cleaner and more economical development and sampling. A peristaltic pump was used to develop the monitors until the water became clear. At least 3 boreholes volumes of water were removed. All water collected was stored on-site in drums and disposed of at the City of Guelph Water Pollution Control Plant.

### HYDROCHEMICAL SAMPLING

River water and sediment samples were collected on December 17, 1987 along the banks of the Speed River downstream from two storm sewers outfalls from the gas plant. These samples were taken to determine if any gas plant waste constituents could be detected in the river or its sediments. The results of these analyses are included in Appendix D.

Sediment samples were collected from undisturbed locations approximately one metre from shore on the same side of the river as the sewer outfalls. Samples were collected in glass bottles.

Surface water samples were collected from the water surface by partially submerging the sample bottle, approximately one metre from shore. Preservatives were added as required. Water samples for ICP (Inductively Coupled Argon Plasma Emission Spectroscopy) analysis were filtered in the field using a 0.45 micron filter.

Ground water samples were collected from 10 monitors between January 14 and 21, 1988. All monitors were purged before sampling. All monitors were sampled for phenol analysis. Selected monitors were additionally sampled for ammonium, cyanide and a complete ICP metal scan. The samples were taken using a peristaltic pump. The samples were not filtered or preserved in the field. They were filtered (if required) and

analysed at Barringer Magenta Limited within one day after collection. Water samples from four monitors were sent to NOVALAB Ltd. for analysis of PAHs (Polynuclear Aromatic Hydrocarbons). All samples were stored in a cooler during the field program.

One storm sewer water sample was taken from the storm sewer manhole at the intersection of Surrey Street and Gordon Street. The sample was analysed for phenols and PAHs to determine if any dissolved coal tar constituents presently migrate along the storm sewer from the site to the Speed River.

Three field duplicates and one trip blank of distilled water were sent to Barringer Magenta to check lab and field reproducibility of results. One trip blank of distilled water was sent to NOVALAB. The duplicates and blanks were handled and analysed in the same manner as the regular samples. The analytical results are included in Appendix D.

#### IN SITU HYDRAULIC CONDUCTIVITY TESTING

After development, sampling and restabilization of each monitor, hydraulic conductivity (or permeability) testing was carried out if the static ground water level in the monitor was not too low. This was accomplished by monitoring the water level recovery in a monitor after a sudden rise in water level from the lowering of a weighted rod into the water. Only bedrock monitors could be tested. These tests were analysed according to Hvorslev (1951) or Bouwer and Rice (1976). The results are shown in Appendix E.

**APPENDIX B**  
**BOREHOLE AND TEST PIT LOGS**

## LEGEND



Protective surface casing



Casing and casing shoe



Monitor screen



Cement seal



Peltonite seal

SS

Split Spoon Sample

GS

Grab Sample from Auger

CS

Core Barrel Sample

# BOREHOLE LOG

BOREHOLE NO. 1

**PROJECT NAME** GUELPH - GAS WORKS STUDY

DATE SEPT. 29, 1987

CLIENT CITY OF GUELPH

GEOLOGIST KHS

PROJECT NO. 87-907

**ELEVATION** 316.00mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER
0.05	ASPHALT								
	<u>FILL:</u>  black & brown with red medium sand, coal cinders and brick pieces, dry								- No odor
0.96	1  Light brown very fine sand and silt, trace clay moist grading to				1	SS	13		- Slight creosote odor from 0.7 to 1.0 m
	light brown and yellow very fine sand and fine rounded gravel, trace silt and coarse angular gravel, wet				2	SS	13		
	2				3	SS	9		- No odor
					4	SS	17		- No odor
2.49	<u>LIMESTONE:</u> light yellow Limestone weathered down to 2.74 m, saturated				5	SS	>73		- No odor
2.90	3  Borehole terminated at 2.90 m in limestone		I		6	SS	-		
									</

P - Piezometer    S - Standpipe    G - Gas Monitor

**Gartner Lee Limited**

# BOREHOLE LOG

BOREHOLE NO. 2

**PROJECT NAME** GUELPH - GAS WORKS STUDY

CLIENT CITY OF GUELPH

PROJECT NO. 87-907

**DATE** SEPT. 29, 1987

**GEOLOGIST** KHS

**ELEVATION** 316.09 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE					COMMENTS
				INTERVAL	NO.	TYPE	N' VALUE	% WATER	
0.05	ASPHALT		NO MONITOR						- No odor  

P - Piezometer      S - Standpipe      G - Gas Monitor

Gartner Lee Limited



# BOREHOLE LOG

BOREHOLE NO. 3

**PROJECT NAME** GUELPH - GAS WORKS STUDY

CLIENT CITY OF GUELPH

PROJECT NO. 87-907

DATE SEPT. 29, 1987

**GEOLOGIST** KHS

**ELEVATION** 316.05 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER
0.05	ASPHALT								
	<u>FILL:</u>  brown fine to medium gravel and medium to coarse sand, dry								
1									
1.14	red and orange medium size brick sand and fine to coarse gravel, dry to moist, crumbly								- No odor
1.83									- No odor
2	<u>LIMESTONE:</u> grey white Limestone weathered down to 2.18 m, moist								
									- No odor
2.74									
3	Borehole terminated at 2.74 m in limestone		I						

P - Piezometer    S - Standpipe    G - Gas Monitor

Gartner Lee Limited

# BOREHOLE LOG

BOREHOLE NO. 4

PROJECT NAME GUELPH - GAS WORKS STUDY

CLIENT CITY OF GUELPH

PROJECT NO. 87-907

DATE SEPT. 30, 1987

**GEOLOGIST** KHS

ELEVATION 314.20 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHIC MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS			
			INTERVAL	NO.	TYPE	N' VALUE		% WATER		
0.05	ASPHALT	NO MONITOR						- No odor		
	FILL:									
	brown medium sand, trace fine & coarse sand and fine gravel, dry		1	SS	19					
0.91	1 dark to light brown fine sand and clay, dry to								- No odor	
1.22	moist		2	SS	15					
	dark brown and red fine to medium gravel, fine to coarse sand and brick fragments, moist									
1.83	LIMESTONE: yellow		3	SS	4					- No odor
1.88	limestone, dry		4	SS	100					
					</					

P-Piezometer    S- Standpipe    G-Gas Monitor

Gartner Lee Limited

# BOREHOLE LOG

BOREHOLE NO. 5

**PROJECT NAME** GUELPH - GAS WORKS STUDY

CLIENT CITY OF GUELPH

PROJECT NO. 87-907

DATE SEPT. 30, 1987

GEOLOGIST KHS

**ELEVATION** 313.79 mASL

[illegible]

P-Piezometer    S- Standpipe    G-Gas Monitor

**Gartner Lee Limited**

# BOREHOLE LOG

BOREHOLE NO. 6-I

**PROJECT NAME** GUELPH - GAS WORKS STUDY

CLIENT CITY OF GUELPH

PROJECT NO. 87-907

**DATE** SEPT. 30 & OCT. 1, 1987

GEOLOGIST KHS

**ELEVATION** 315.21 mASL

[illegible]

P-Piezometer    S- Standpipe    G-Gas Monitor

**Gartner Lee Limited**

# BOREHOLE LOG

BOREHOLE NO. 6-I

PROJECT NAME GUELPH - GAS WORKS STUDY

DATE SEPT. 30 & OCT. 1, 198

CLIENT CITY OF GUELPH

GEOLOGIST KHS

PROJECT NO. 87-907

ELEVATION 315.21 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHIC MONITOR DETAILS & NUMBER	SAMPLE					COMMENTS	
			INTERVAL	NO.	TYPE	N' VALUE	% WATER		
6.26	LIMESTONE, grey	I	2 CORE						
	Borehole terminated at 6.26 m in limestone	I							

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

<b>BOREHOLE LOG</b>		<b>BOREHOLE NO.</b> 6-II
<b>PROJECT NAME</b> GUELPH - GAS WORKS STUDY		<b>DATE</b> SEPT. 30, 1987
<b>CLIENT</b> CITY OF GUELPH		<b>GEOLOGIST</b> KHS
<b>PROJECT NO.</b> 87-907		<b>ELEVATION</b> 315.29 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER
0.05	ASPHALT								
0.25	FILL: light brown medium sand, dry								
0.41	black fine to medium sand sized coal cinders, dry				1	SS	11		- No odor
	brown fine sand, some clay, trace silt and fine gravel, moist to wet, moderately cohesive								
1					2	SS	5		- No odor
					3	SS	5		
2					4	SS	50		- Very slight creosote odor
2.54	LIMESTONE: yellow white								- Very slight creosote odor
2.74	Limestone weathered down to 2.54 m, saturated				5	SS	65		
3	Borehole terminated at 2.74 m in limestone		II						
4									
5									

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited

# BOREHOLE LOG

BOREHOLE NO. 7-I

**PROJECT NAME** GUELPH - GAS WORKS STUDY

CLIENT CITY OF GUELPH

PROJECT NO. 87-907

**DATE** OCT. 1 & 2, 1987

**GEOLOGIST KHS.**

**ELEVATION** 313.64 mASL

[illegible]

**P - Piezometer      S - Standpipe      G - Gas Monitor**

**Gartner Lee Limited**

# BOREHOLE LOG

BOREHOLE NO. 7-II

**PROJECT NAME** GUELPH - GAS WORKS STUDY

DATE OCT. 1, 1987

CLIENT CITY OF GUELPH

GEOLOGIST KHS

PROJECT NO. 87-907

**ELEVATION** 313.62 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER
	ASPHALT								
	<u>FILL:</u> black, white and dark brown fine sand, clay and limestone fragments, trace coal cinders, dry white concrete				1	SS	33		- slight creosote odor
1	yellow white limestone and concrete fragments								- slight creosote odor
	black very fine to fine sand, some silt and clay trace fine gravel, wet				2	SS	6		- tar and strong odor of ammonia
2					3A				
	<u>LIMESTONE:</u> green limestone weathered down to 2.31 m				3B	SS	50		- limestone appears burnt
					4	SS	100		
3	Borehole terminated at 2.44 m in limestone		II						

P - Piezometer    S - Standpipe    G - Gas Monitor

Gartner Lee Limited



# BOREHOLE LOG

BOREHOLE NO. 8

PROJECT NAME GUELPH - GAS WORKS STUDY

DATE OCT. 1, 1987

CLIENT CITY OF GUELPH

GEOLOGIST KHS

PROJECT NO. 87-907

ELEVATION 313.59 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS	
			INTERVAL	NO.	TYPE	N' VALUE		% WATER
0.05	ASPHALT FILL:							
0.48	dark brown to white and red medium sand, clay and limestone fragments, dry			1	SS	37		- No odor
	red and orange medium sand sized brick debris, dry							
1.22	red brown to black and irredescent below 1.5 m, medium to coarse sand and fine to medium gravel, trace wood chips wet to saturated below 1.5 m			2	SS	11		- No odor
				3	SS	4		- Strong odor with oily black irre- descent fluid
				4	SS	14		- Strong odor tar
				5	SS	5		- Strong odor tar
	black fine to coarse sand and wood strips, tarry, saturated							
	black and yellow grey tar- covered limestone fragments saturated			6	SS	3		- Strong odor tar
	black fine to coarse sand and wood strips, tarry, saturated							
				7	SS	4		- Strong odor tar
4.87				8	SS	19		- Strong odor tar

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited

# BOREHOLE LOG

BOREHOLE NO. 8

**PROJECT NAME** GUELPH - GAS WORKS STUDY


CLIENT CITY OF GUELPH

PROJECT NO. 87-907

DATE OCT. 1, 1987

**GEOLOGIST** KHS

**ELEVATION** 313.59 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS		
				INTERVAL	NO.	TYPE	N' VALUE		% WATER	
5.38	LIMESTONE: yellow grey weathered limestone, saturated				9A				- Strong odor	
5.49				9B	SS	40				
	Borehole terminated at 5.49 m in limestone		I							
6										
				</						

P-Piezometer    S - Standpipe    G-Gas Monitor

Gartner Lee Limited

# BOREHOLE LOG

BOREHOLE NO. 9

**PROJECT NAME** GUELPH - GAS WORKS STUDY

CLIENT CITY OF GUELPH

PROJECT NO. 87-907

DATE OCT. 2, 1987

**GEOLOGIST** KHS

ELEVATION 314.04 mASL

[illegible]

**P - Piezometer    S - Standpipe    G - Gas Monitor**

**Gartner Lee Limited**

# BOREHOLE LOG

BOREHOLE NO. 10

**PROJECT NAME** GUELPH - GAS WORKS STUDY

DATE OCT. 2, 1987

CLIENT CITY OF GUELPH

GEOLOGIST KHS

PROJECT NO. 87-907

**ELEVATION** 315.25 mASL

[illegible]

P - Piezometer    S - Standpipe    G - Gas Monitor

Gartner Lee Limited

# BOREHOLE LOG

BOREHOLE NO. 11

PROJECT NAME GUELPH - GAS WORKS STUDY

CLIENT CITY OF GUELPH

PROJECT NO. 87-907

DATE OCT. 2, 1987

GEOLOGIST KHS

ELEVATION 314.14 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHIC MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS	
			INTERVAL	NO.	TYPE	N' VALUE		% WATER
0.05	ASPHALT	NO MONITOR						- Very slight creosote odor  - No odor  - Slight odor of creosote
	<u>FILL:</u>							
	brown fine sand, some clay			1	SS	14		
1.77	<u>LIMESTONE:</u>							
1.22			2	SS	54			
	Borehole terminated at 1.22 m in limestone							

# BOREHOLE LOG

BOREHOLE NO. 12

PROJECT NAME GUELPH - GAS WORKS STUDY

DATE DEC. 14, 1987

CLIENT CITY OF GUELPH

GEOLOGIST KHS

PROJECT NO. 87-907

ELEVATION 310.47 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER
	<u>FILL/OVERBURDEN:</u> brown organic topsoil and fine to medium sand and rootlets, moist								- No odor
0.76									
1	grey brown to black fine to coarse gravel and fine to coarse sand, trace clay, dry to moist				1	SS	11		- No odor
1.39									
	<u>LIMESTONE:</u> grey white weathered limestone; wet to saturated below 1.93 m				2	SS	25		- No odor
2									
					3	SS	20		- No odor
					4	SS	32		- No odor
					5	SS	98		- No odor
3.20									- Limestone could be augered to total depth
	Borehole terminated at 3.20 m in limestone		I						
4									
5									

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

# BOREHOLE LOG

BOREHOLE NO. 13

**PROJECT NAME** GUELPH - GAS WORKS STUDY

CLIENT CITY OF GUELPH

PROJECT NO. 87-907

DATE DEC. 14, 1987

GEOLOGIST KHS

**ELEVATION** 310.39 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER
	<u>FILL/OVERBURDEN:</u> brown organic topsoil and fine to medium sand and rootlets, moist								- No odor
0.76	1 black and dark brown fine sand, some clay and silt, trace organics moist				1	SS	6		- No odor
1.47	<u>LIMESTONE:</u> yellow, brown and grey weathered limestone fragments, occasional silt and rounded fine gravel near top of unit, dry to saturated below 1.98 m				2	SS	28		- No odor
					3	SS	25		- No odor
					4	SS	56		- No odor
3.15	3				5	SS	88		- No odor
	Borehole terminated at 3.15 m in limestone		I						

P-Piezometer    S- Standpipe    G-Gas Monitor

**Gartner Lee Limited**

# BOREHOLE LOG

BOREHOLE NO. 14

PROJECT NAME GUELPH - GAS WORKS STUDY







CLIENT CITY OF GUELPH

PROJECT NO. 87-907

DATE DEC. 15, 1987

GEOLOGIST KHS

ELEVATION 310.87 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS			
				INTERVAL	NO.	TYPE	N' VALUE		% WATER		
0.76	<u>FILL:</u> brown organic topsoil moist  brown, black to yellow fine sand and silt, trace fine to coarse gravel with layers of wood chips plastic debris, glass, wet to saturated below 1.22 m								- No odor		
										- No odor	
2.01	<u>LIMESTONE:</u> yellow weathered limestone and some brown fine sand, wet			1	SS	-					
2.44	Borehole terminated at 2.44 m in limestone			2	SS	-			- No odor		

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited



<b>BOREHOLE LOG</b>		<b>BOREHOLE NO.</b> 15
<b>PROJECT NAME</b> GUELPH - GAS WORKS STUDY <b>CLIENT</b> CITY OF GUELPH <b>PROJECT NO.</b> 87-907		<b>DATE</b> DEC. 15, 1987 <b>GEOLOGIST</b> KHS <b>ELEVATION</b> 311.65 mASL

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				COMMENTS	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER
	<u>FILL:</u> brown organic topsoil and rootlets, moist								- No odor
0.76									
1	dark brown to black with irredescence below 1.7 m very fine to medium sand, some silt and fine gravel trace clay, moist to wet below 1.7 m								- No odor
					1	SS	3		
					2	SS	5		- Very slight creosote odor
1.98	<u>LIMESTONE:</u> yellow limestone, wet				3	SS	100		- Slight creosote odor
2.06									
	Borehole terminated at 2.06 m		I						
3									
4									
5									

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited

# TEST PIT LOG

PROJECT NAME: GUELPH COAL GAS WORKS

PROJECT NUMBER: 87-907

TEST PIT No: TP1

LOCATION: SW CORNER OF SURREY AND WYNDHAM STREETS

APPROXIMATE DIMENSIONS = 2m x 3m

DEPTH TO WATER TABLE = 1.7m

METHOD OF EXCAVATION: BACKHOE

DATE OF EXCAVATION: DEC 17, 1987

LOGGED BY: KHS

<u>DEPTH</u> (m)	<u>DESCRIPTION</u>	<u>REMARKS</u>
0 - 0.08	<u>ASPHALT</u>	
0.08 - 0.38	<u>CONCRETE</u>	
0.38 - 1.68	<u>FILL</u> , grey, brown to black sand, gravel, some clay and rootlets,	
1.68	STORM SEWER PIPE PLACED 15cm INTO BEDROCK TRENCH	- Top of 23cm (9") Storm Sewer - Inside is 8cm of stiff black precipitate with no coal tar odor and no odor of decay
1.68 - 1.83	<u>LIMESTONE</u> , grey limestone and limestone rock fragments mixed with fine sand, weathered down to 1.83m	- Blackened Fluid along all fractures - Approximate Depth of Water Table
1.83	BOTTOM OF TEST PIT	

# TEST PIT LOG

PROJECT NAME: GUELPH COAL GAS WORKS

PROJECT NUMBER: 87-907

TEST PIT NO: TP2

LOCATION: SE CORNER OF SURREY AND GORDON STREETS

APPROXIMATE DIMENSIONS = 2m x 3m

DEPTH TO WATER TABLE = 1.22m (approximate)

METHOD OF EXCAVATION: BACKHOG

DATE OF EXCAVATION: DEC 17, 1987

LOGGED BY: KHS

<u>DEPTH</u> (m)	<u>DESCRIPTION</u>	<u>REMARKS</u>
0 - 0.10	<u>ASPHALT</u>	
0.10 - 0.41	<u>CONCRETE</u>	
0.41 - 0.61	<u>FILL</u> - dark grey coal cinders	
0.61 - 0.86	<u>FILL</u> - yellow white and blue slag and pitch	
0.86 - 0.91	<u>FILL</u> - glass debris	
0.91 - 1.22	<u>SILTY SAND</u> , light brown grey silty sand, trace to some clay with roots and rootlets	- Bottom of unit blackened occasionally
1.22 - 1.83	<u>ORGANICS AND SILTY SAND</u> dark brown organics and silty sand many rootlets	- Top of this unit coincides with approximate water table
1.83 - 2.0	<u>LIMESTONE</u> yellow white weathered limestone	- Storm Sewer laid on top of Limestone
2.0 -	BOTTOM OF TEST PIT	- No product in Sewer

# TEST PIT LOG

PROJECT NAME: GUELPH COAL GAS WORKS

PROJECT NUMBER: 87-907

TEST PIT NO: TP3

LOCATION: SOUTH SIDE OF SURREY - 60m NE OF TP2

APPROXIMATE DIMENSIONS = 3m x 3.5m

DEPTH TO WATER TABLE = 1.1m

METHOD OF EXCAVATION: BACKHOE

DATE OF EXCAVATION: DEC 18, 1987

LOGGED BY: KHS

<u>DEPTH</u> (m)	<u>DESCRIPTION</u>	<u>REMARKS</u>
0 - 0.11	<u>ASPHALT</u>	
0.11 - 0.30	<u>CONCRETE</u>	
0.30 - 0.60	<u>FILL</u> , gray and blue-white slag	No odor
0.60 - 0.68	<u>FILL</u> , black coal clumps	" "
0.68 - 0.86	<u>FILL</u> , brown sandy clay and rock fragments	
0.86 - 0.91	<u>FILL</u> , glass debris	Top of Storm Sewer at 0.76m - No evidence of Coal Tar
0.91 - 1.07	<u>ORGANICS</u> , black organics and rootlets and roots	
1.07 - 1.14	<u>SAND</u> , brown with green and rust colouring medium sand saturated	water table approximately at top of sand
1.14 - 1.22	<u>LIMESTONE</u> , gray white limestone	
1.22	BOTTOM OF TEST PIT	

# TEST PIT LOG

PROJECT NAME: GUELPH COAL GAS WORKS

PROJECT NUMBER: 87-907

TEST PIT NO: TP4

LOCATION: WEST BOULEVARD - WYNDHAM STREET,

APPROXIMATE DIMENSIONS =

DEPTH TO WATER TABLE = 1.6 m

METHOD OF EXCAVATION: BACKHOE

DATE OF EXCAVATION: APRIL 7, 1988

LOGGED BY: KHS

<u>DEPTH</u> (m)	<u>DESCRIPTION</u>	<u>REMARKS</u>
0 - 0.15	<u>TOPSOIL</u> brown silty sand, some clay, organics and rootlets, moist	
0.15 - 0.71	<u>FILL</u> dark brown fine sand, some fine to med. gravel, trace clay, moist	
0.71 - 1.45	<u>FILL</u> grey to brown + red clayey sand, slag and brick pieces, moist	- Top of 24" operating Storm Sewer at 1.32m - Top of 9" abandoned Storm Sewer at 1.22m
1.45 - 1.68	<u>FILL</u> , black med. sand, saturated	- Coal Tar Residue in pipe
1.68 - 1.91	<u>FILL</u> , brown clayey fine to med. sand trace fine gravel & coal fragments	- Strong Creosote odor - Sample 1 - No odor or colouring
1.91 - 2.06	<u>SAND</u> , green to black with white blebs med. sand with rounded cobbles at base	- black substance without odor at bottom 0.4 m. Sample 2 - BOTTOM OF PIT AT 2.06m

**APPENDIX C**  
**GROUND WATER MONITOR DETAILS**

PROJECT NAME : GUELPH GAS WORKS STUDY  
PROJECT NO. : 87-907

BOREHOLE		MONITOR		SCREENED		FILTER		SEAL		BACKFILL	
				INTERVAL		PACK					
No.	DIA.	No.	TYPE/DIA.	CASING	STICK-UP/ELEVATION	(below grade)	(below grade)	(below grade)	(below grade)	(below grade)	(below grade)
				(MATERIAL)	(t.o.l.c.)						
	(mm)		(mm)		(m A.S.L.)	(m)	(m)	(m)	(m)	(m)	(m)
ON - SITE LOCATIONS											
Overburden monitors											
1	165	1	S	51	-0.14	315.86	1.5-2.7	1.1-2.8	0.7-1.1	-	-
3	165	1	S	51	-0.10	315.95	1.4-2.6	1.1-2.4	0.7-1.1	-	-
5	165	1	S	51	-0.12	313.67	1.1-2.3	1.1-2.4	0.7-1.1	-	-
6	165	1	S	51	-0.08	315.21	1.3-2.5	1.1-2.7	0.7-1.1	-	-
7	165	1	S	51	-0.15	313.47	0.8-2.0	0.8-2.0	0.6-0.8	-	-
8	165	1	S	51	-0.25	313.34	1.1-5.3	1.1-5.4	0.7-1.1	-	-
Bedrock monitors											
6	70	1	P	51 3" STEEL	-0.07	315.14	4.9-6.1		CASING	-	-
7	70	1	P	51 3" STEEL	-0.11	313.53	2.9-4.1		0.2-3.0	-	-
SURREY STREET LOCATIONS											
14	165	1	S	51	-0.17	310.70	1.1-2.4	1.1-2.4	0.7-1.1	-	-
15	165	1	S	51	-0.16	311.49	0.6-1.8	0.6-1.9	0.4-0.6	-	-
WELLINGTON STREET LOCATIONS											
12	165	1	S	51	-0.10	310.37	1.8-3.0	1.2-3.2	0.7-1.2	-	-
13	165	1	S	51	-0.21	310.18	1.7-3.0	1.2-3.0	0.7-1.2	-	-

t.o.l.c. = top of locking cap  
m A.S.L. = meters above sea level

# GROUND WATER LEVELS

PROJECT NAME : GUELPH - GAS WORKS STUDY  
PROJECT NUMBER : 87-907

UNIT SYSTEM: METRIC  
REF. ELEV. : City of Guelph bench mark #80  
at elevation of 318.730 m ASL

DATE: OCT 15, 1987 OCT 19, 1987 JAN 13, 1988 JAN 18, 1988 JAN 19, 1988 JAN 21, 1988

BOREHOLE

TOP OF MONITOR WATER WATER WATER WATER WATER WATER WATER

MONITOR (TM) ELEV (LEVEL ELEV. /LEVEL ELEV. /LEVEL ELEV. /LEVEL ELEV. /LEVEL ELEV. /LEVEL ELEV.

NO. TYPE m ASL m BTM m ASL m BTM m ASL m BTM m ASL m BTM m ASL m BTM m ASL m BTM m ASL

1	I	S	315.86	-	-	2.53	313.33	2.50	313.36	-	-	-	-	-	-
3	I	S	315.95	2.60	(315.95)	2.47	313.48	2.53	313.42	-	-	-	-	-	-
5	I	S	313.67	1.42	312.25	1.43	312.24	1.47	312.20	-	-	1.50	312.17	-	-
6	I	P	315.14	2.26	312.88	2.27	312.87	2.20	312.94	-	-	2.26	312.89	-	-
11	I	S	315.21	2.06	313.15	2.06	313.15	N/O	N/O	N/O	N/O	2.10	313.11	-	-
7	I	P	313.53	1.62	311.91	1.58	311.95	1.63	311.90	-	-	1.55	311.98	-	-
17	I	S	313.47	1.39	312.08	1.23	312.24	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
8	I	S	313.34	0.78	312.56	0.78	312.56	0.84	312.50	-	-	-	-	-	-
12	I	S	310.37	-	-	-	-	1.47	308.90	1.48	308.89	1.49	308.88	-	-
13	I	S	310.18	-	-	-	-	N/O	N/O	N/O	N/O	N/O	N/O	1.40	308.78
14	I	S	310.70	-	-	-	-	1.63	309.07	N/O	N/O	1.40	309.31	-	-
15	I	S	311.49	-	-	-	-	1.6	309.9	N/O	N/O	N/O	N/O	1.63	309.86

P - Piezometer, S - Standpipe, BTM - Below Top of Monitor, ASL - Above Sea Level, N/O - Not Obtainable



**APPENDIX D**  
**HYDRAULIC CONDUCTIVITY TEST RESULTS**

# SLUG TEST ANALYSIS

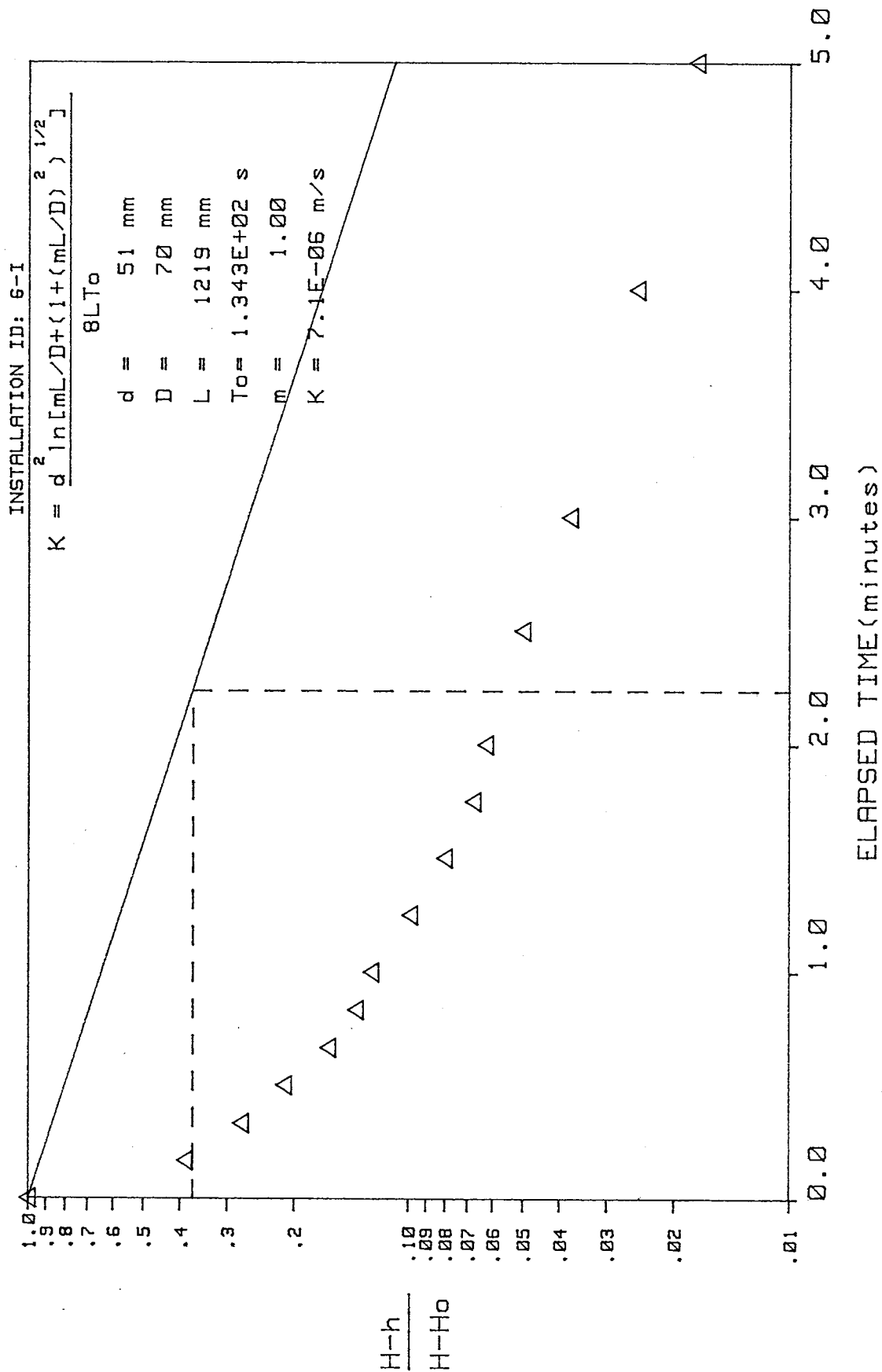
(Hvorslev's Method)

PROJECT NAME: GUELPH  
 PROJECT NUMBER: 87-907  
 INSTALLATION ID: 6-I  
 TEST START DATE: 19 JAN 1988  
 TEST START TIME: 14:25:00  
 STATIC WATER LEVEL H (mbRP): 2.255  
 INITIAL WATER LEVEL Ho (mbRP): 1.855

DATE	ACTUAL TIME	CUMULATIVE TIME (minutes)	WATER LEVEL (mbRP)	$\frac{H-h}{H-H_o}$
19 JAN 1988	14:25:00	0.00	1.85	1.00
19 JAN 1988	14:25:10	.17	2.10	.39
19 JAN 1988	14:25:20	.33	2.15	.27
19 JAN 1988	14:25:30	.50	2.17	.21
19 JAN 1988	14:25:40	.67	2.19	.16
19 JAN 1988	14:25:50	.83	2.20	.14
19 JAN 1988	14:26:00	1.00	2.21	.12
19 JAN 1988	14:26:15	1.25	2.22	.10
19 JAN 1988	14:26:30	1.50	2.22	.08
19 JAN 1988	14:26:45	1.75	2.23	.07
19 JAN 1988	14:27:00	2.00	2.23	.06
19 JAN 1988	14:27:30	2.50	2.24	.05
19 JAN 1988	14:28:00	3.00	2.24	.04
19 JAN 1988	14:29:00	4.00	2.25	.02
19 JAN 1988	14:30:00	5.00	2.25	.02

NOTE - mbRP is metres below Reference Point elevation  
 - h is reading in mbRP

# SLUG TEST ANALYSIS - HVORSLEV'S METHOD



PROJECT NAME: GUELPH COAL TAR PROJECT NUMBER: 87-907

# SLUG TEST ANALYSIS

(Hvorslev's Method)

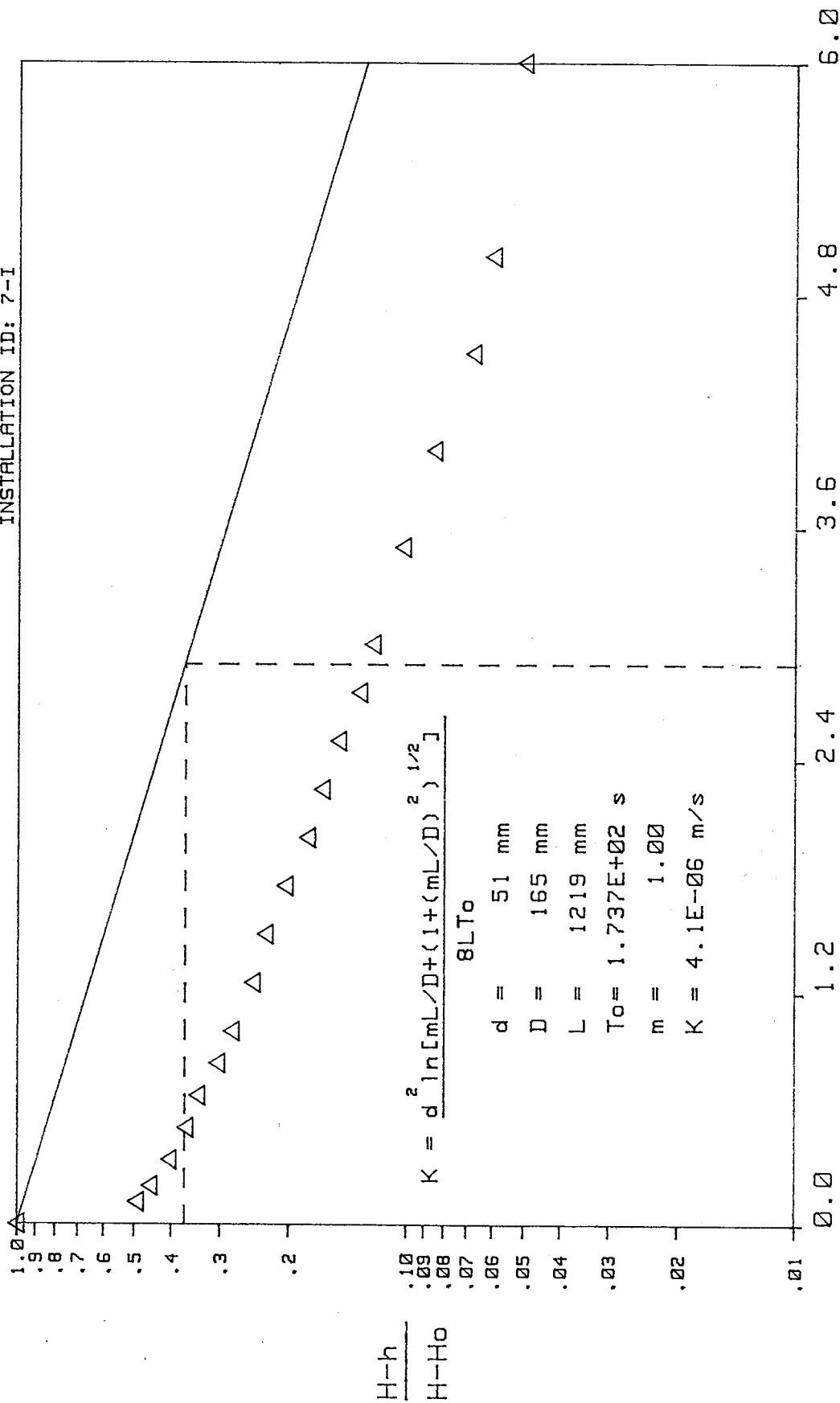
PROJECT NAME: GUELPH  
 PROJECT NUMBER: 87-907  
 INSTALLATION ID: 7-I  
 TEST START DATE: 19 JAN 1988  
 TEST START TIME: 15:44:00  
 STATIC WATER LEVEL H (mbRP): 1.552  
 INITIAL WATER LEVEL Ho (mbRP): 1.152

DATE	ACTUAL TIME	CUMULATIVE TIME (minutes)	WATER LEVEL (mbRP)	$\frac{H-h}{H-H_o}$
19 JAN 1988	15:44:00	0.00	1.15	1.00
19 JAN 1988	15:44:07	.12	1.36	.49
19 JAN 1988	15:44:12	.20	1.37	.45
19 JAN 1988	15:44:20	.33	1.39	.40
19 JAN 1988	15:44:30	.50	1.41	.37
19 JAN 1988	15:44:40	.67	1.42	.34
19 JAN 1988	15:44:50	.83	1.43	.31
19 JAN 1988	15:45:00	1.00	1.44	.28
19 JAN 1988	15:45:15	1.25	1.45	.25
19 JAN 1988	15:45:30	1.50	1.46	.23
19 JAN 1988	15:45:45	1.75	1.47	.21
19 JAN 1988	15:46:00	2.00	1.48	.18
19 JAN 1988	15:46:15	2.25	1.49	.17
19 JAN 1988	15:46:30	2.50	1.49	.15
19 JAN 1988	15:46:45	2.75	1.50	.13
19 JAN 1988	15:47:00	3.00	1.50	.12
19 JAN 1988	15:47:30	3.50	1.51	.10
19 JAN 1988	15:48:00	4.00	1.52	.09
19 JAN 1988	15:48:30	4.50	1.53	.07
19 JAN 1988	15:49:00	5.00	1.53	.06
19 JAN 1988	15:50:00	6.00	1.53	.05

NOTE - mbRP is metres below Reference Point elevation  
 - h is reading in mbRP

# SLUG TEST ANALYSIS - HVORSLEV'S METHOD

INSTALLATION ID: 7-I



ELAPSED TIME (minutes)

PROJECT NAME: GUELPH COAL TAR PROJECT NUMBER: 87-907

# SLUG TEST ANALYSIS

AFTER BOUWER & RICE, WATER RESOURCES RESEARCH, 1976

PROJECT NAME: GUELPH  
 PROJECT NUMBER: 87-907  
 INSTALLATION ID: 12-I  
 TEST START DATE: 18 JAN 1988  
 TEST START TIME: 18:12:00  
 STATIC WATER LEVEL (mbRP): 1.485  
 INITIAL WATER LEVEL (mbRP): 1.085

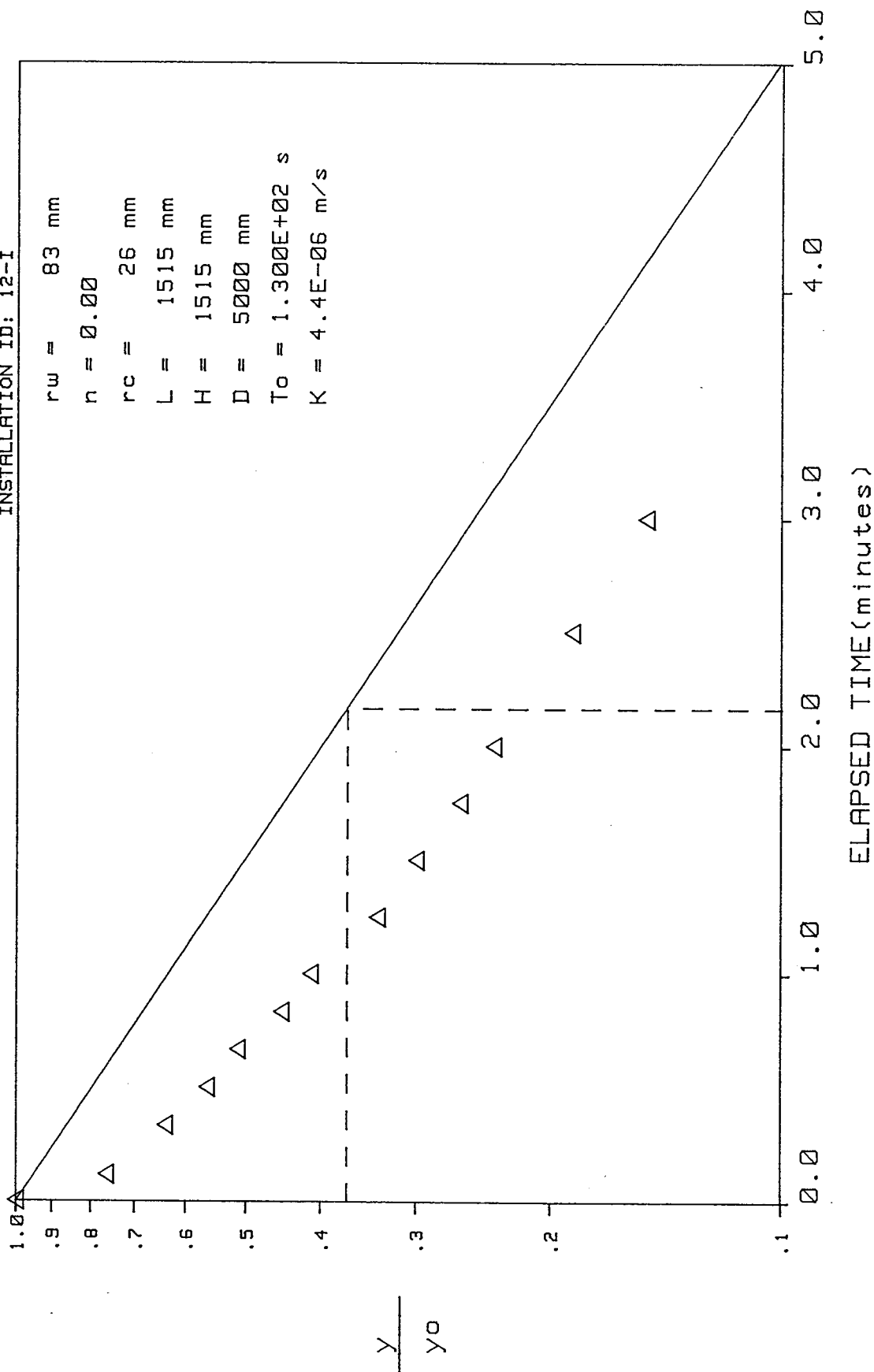
DATE	ACTUAL TIME	CUMULATIVE TIME (minutes)	WATER LEVEL (mbRP)	$\frac{y}{y_0}$
18 JAN 1988	18:12:00	0.00	1.08	1.00
18 JAN 1988	18:12:07	.12	1.18	.76
18 JAN 1988	18:12:20	.33	1.23	.64
18 JAN 1988	18:12:30	.50	1.26	.56
18 JAN 1988	18:12:40	.67	1.28	.51
18 JAN 1988	18:12:50	.83	1.31	.45
18 JAN 1988	18:13:00	1.00	1.32	.41
18 JAN 1988	18:13:15	1.25	1.35	.34
18 JAN 1988	18:13:30	1.50	1.37	.30
18 JAN 1988	18:13:45	1.75	1.38	.26
18 JAN 1988	18:14:00	2.00	1.39	.24
18 JAN 1988	18:14:30	2.50	1.41	.19
18 JAN 1988	18:15:00	3.00	1.43	.15

NOTE - mbRP is metres below Reference Point elevation

# SLUG TEST ANALYSIS

BOUWER AND RICE, WATER RESOURCES RESEARCH, 1976

INSTALLATION ID: 12-I



PROJECT NAME: GUELPH COAL TAR PROJECT NUMBER: 87-907

# SLUG TEST ANALYSIS

AFTER BOUWER & RICE, WATER RESOURCES RESEARCH, 1976

PROJECT NAME: GUELPH  
 PROJECT NUMBER: 87-907  
 INSTALLATION ID: 14-I  
 TEST START DATE: 19 JAN 1988  
 TEST START TIME: 09:58:00  
 STATIC WATER LEVEL (mbRP): 1.395  
 INITIAL WATER LEVEL (mbRP): 1.145

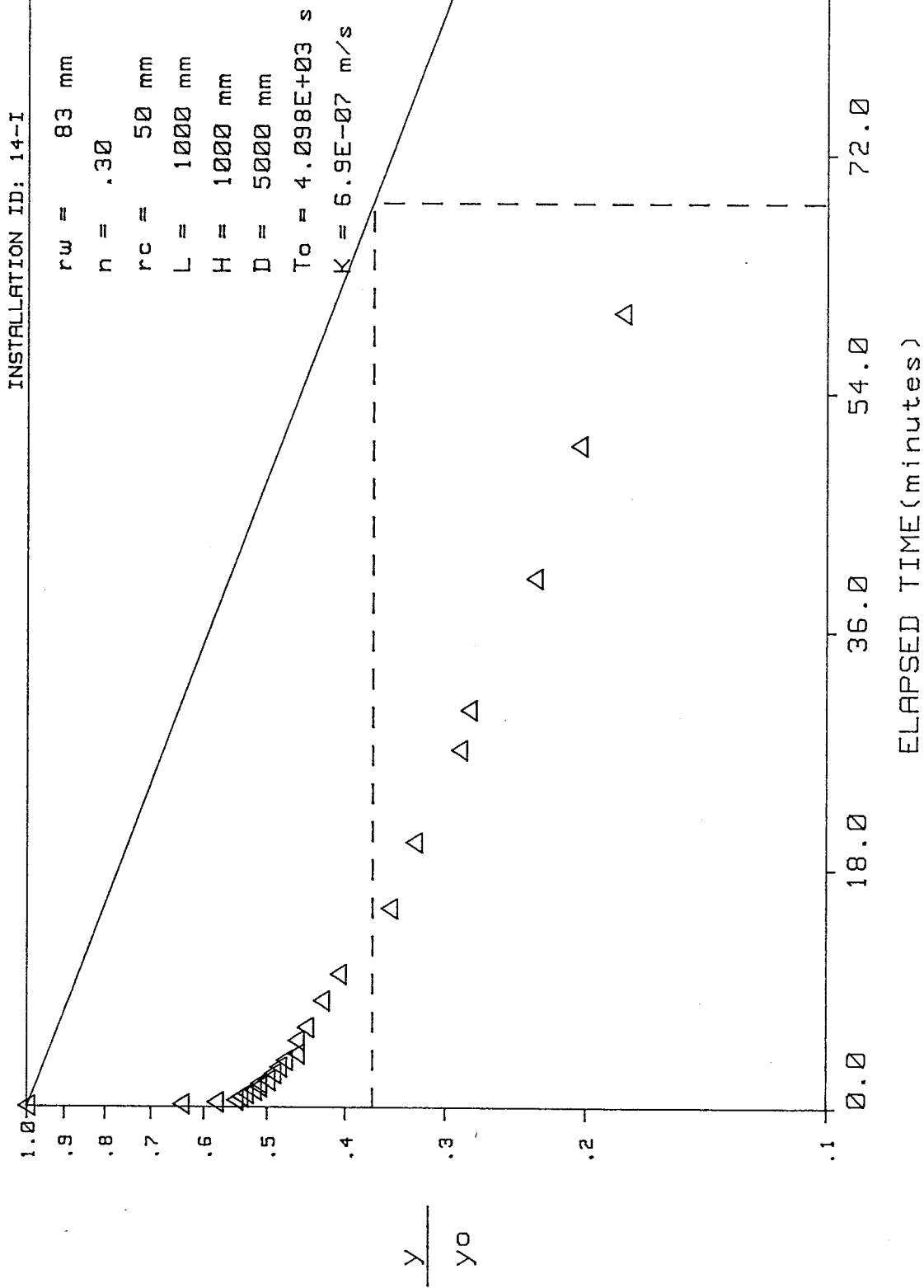
DATE	ACTUAL TIME	CUMULATIVE TIME (minutes)	WATER LEVEL (mbRP)	$\frac{y}{y_0}$
19 JAN 1988	09:58:00	0.00	1.15	1.00
19 JAN 1988	09:58:10	.17	1.24	.64
19 JAN 1988	09:58:20	.33	1.25	.58
19 JAN 1988	09:58:30	.50	1.26	.55
19 JAN 1988	09:58:45	.75	1.26	.54
19 JAN 1988	09:59:00	1.00	1.26	.53
19 JAN 1988	09:59:15	1.25	1.27	.52
19 JAN 1988	09:59:30	1.50	1.27	.51
19 JAN 1988	09:59:45	1.75	1.27	.51
19 JAN 1988	10:00:00	2.00	1.27	.50
19 JAN 1988	10:00:30	2.50	1.27	.49
19 JAN 1988	10:01:00	3.00	1.27	.48
19 JAN 1988	10:01:30	3.50	1.28	.48
19 JAN 1988	10:02:00	4.00	1.28	.46
19 JAN 1988	10:03:00	5.00	1.28	.46
19 JAN 1988	10:04:00	6.00	1.28	.45
19 JAN 1988	10:06:00	8.00	1.29	.43
19 JAN 1988	10:08:00	10.00	1.29	.41
19 JAN 1988	10:13:00	15.00	1.31	.35
19 JAN 1988	10:18:00	20.00	1.31	.33
19 JAN 1988	10:25:00	27.00	1.32	.29
19 JAN 1988	10:28:00	30.00	1.33	.28
19 JAN 1988	10:38:00	40.00	1.34	.23
19 JAN 1988	10:48:00	50.00	1.34	.20
19 JAN 1988	10:58:00	60.00	1.35	.18

NOTE - mbRP is metres below Reference Point elevation



# SLUG TEST ANALYSIS

BOUWER AND RICE, WATER RESOURCES RESEARCH, 1976



PROJECT NAME: GUELPH COAL TAR PROJECT NUMBER: 87-907

**APPENDIX E**

**RESULTS FROM CHEMICAL ANALYSES OF  
GROUND WATER, SEWER WATER,  
SURFACE WATER AND SEDIMENT  
SAMPLES**

## GROUND WATER MONITOR SAMPLING

## SAMPLE NUMBERING CORRELATION TABLE

## SAMPLE LOCATION - SAMPLE NUMBER

PROJECT NAME: GUELPH GAS WORKS STUDY

PROJECT NUMBER: 87-907

PARAMETER ANALYZED (sample volume)	S= (1000 ml)	NH4 (100 ml)	ICP METAL (100 ml)	CN (500 ml)	PHENOL (100 ml)	PAH (1000 ml)
BOREHOLE MONITOR	F I E L D / L A B      S A M P L E      N U M B E R S					
5-I					5-1	
6-I					6-1	
6-II					6-2	
7-I	7-1	7-2	7-3	7-4	7-5	7-6
Dup		19-3		19-1		
Blank	19-2			19-4	19-4	23-1
8-I					8-1	
12-I	12-1	12-2	12-3	12-4	12-5	12-6
Dup	16-1				22-1	
Blank		16-2				
13-I					13-1	
14-I	14-1	14-2	14-3	14-4	14-5	14-6
Dup			17-1			
Blank			17-2			
15-I					15-1	15-2
S-I					S-2	S-1
(Surrey Street Storm Sewer)						
REMARKS:	Dup = Field Duplicate Sample					
	Blank = Field Distilled Water Sample Blank					

304 CARLINGVIEW DRIVE  
REXDALE, ONTARIO  
M9W 5G2  
(416) 675-3870

**BARRINGER MAGENTA**

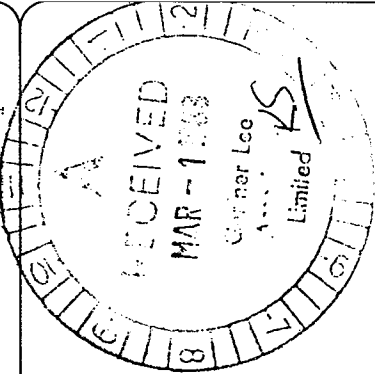
FILE: T8-4023  
DATE: 08/02/88  
MATRIX: WATER

GANTNER-LEE ASSOCIATES (KURT STAUFFERT) PROJECT #87-907 WATERS

WD NO: 88-4023

PAGE: 1

SAMPLE	AG	AL	B	BA	BE	CA	CD	CO	CR	CU
ID	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
<b>KHS</b>										
5-1-PHENOL	--	--	--	--	--	--	--	--	--	--
5-18-2-PHENOL + PAH	--	--	--	--	--	--	--	--	--	--
6-1-6-1-PHENOL	--	--	--	--	--	--	--	--	--	--
6-1-6-2-PHENOL	--	--	--	--	--	--	--	--	--	--
7-1-S-	--	--	--	--	--	--	--	--	--	--
8-1-7-2-NH <sub>3</sub>	--	--	--	--	--	--	--	--	--	--
11-1-7-3-ICP METAL	.007	.01	.097	.019	<.0005	15.6	<.01	<.05	.02	<.008
7-4-CN-	--	--	--	--	--	--	--	--	--	--
7-5-PHENOL	--	--	--	--	--	--	--	--	--	--
8-1-8-1-PHENOL	--	--	--	--	--	--	--	--	--	--
12-1-S-	--	--	--	--	--	--	--	--	--	--
12-2-NH <sub>3</sub>	--	--	--	--	--	--	--	--	--	--
12-3-ICP METAL	.011	<.01	.136	.110	.0005	165	<.01	<.05	.03	<.008
12-4-CN-	--	--	--	--	--	--	--	--	--	--
12-5-PHENOL	--	--	--	--	--	--	--	--	--	--
13-1-13-1-PHENOL	--	--	--	--	--	--	--	--	--	--
14-1-S-	--	--	--	--	--	--	--	--	--	--
14-2-NH <sub>3</sub>	--	--	--	--	--	--	--	--	--	--
14-3-ICP METAL	.007	<.01	.188	.098	.0005	111	<.01	<.05	.03	.022
14-4-CN-	--	--	--	--	--	--	--	--	--	--
14-5-PHENOL	--	--	--	--	--	--	--	--	--	--
15-115-1-PHENOL	--	--	--	--	--	--	--	--	--	--
12-116-1-S-(Dup)	--	--	--	--	--	--	--	--	--	--
16-2-NH <sub>3</sub> (BLANK)	--	--	--	--	--	--	--	--	--	--
16-3	--	--	--	--	--	--	--	--	--	--
16-4	--	--	--	--	--	--	--	--	--	--
17-1-ICP METAL (Dup), 013	--	--	--	--	--	--	--	--	--	--
17-2-ICP METAL (Blank), 009	--	--	--	--	--	--	--	--	--	--
17-19-1-CN (Dup)	--	--	--	--	--	--	--	--	--	--
17-2-S- (BLANK)	--	--	--	--	--	--	--	--	--	--
17-19-3-NH <sub>3</sub> (Dup)	--	--	--	--	--	--	--	--	--	--
19-4-CN+PHENOL (Blank)	--	--	--	--	--	--	--	--	--	--
12-122-1-PHENOL (Dup)	--	--	--	--	--	--	--	--	--	--
CONTROL DATA	--	--	--	--	--	--	--	--	--	--
BLANK	<.005	.02	<.004	<.005	<.0005	.19	<.01	.06	<.01	<.008
5-15-1-PHENOL	--	--	--	--	--	--	--	--	--	--
5-1-R-PHENOL-REPLICATE	--	--	--	--	--	--	--	--	--	--
6-2-PHENOL	--	--	--	--	--	--	--	--	--	--
6-2-R-PHENOL-REPLICATE	--	--	--	--	--	--	--	--	--	--
7-2-NH <sub>3</sub>	--	--	--	--	--	--	--	--	--	--
7-2-R-NH <sub>3</sub> -REPLICATE	--	--	--	--	--	--	--	--	--	--
7-3-ICP Metal	.007	.01	.097	.019	<.0005	15.6	<.01	<.05	.02	<.008
7-3-R-ICP Metal-Rep, 005	--	--	.097	.019	<.0005	15.5	<.01	<.05	.01	<.008
7-4-CN-	--	--	--	--	--	--	--	--	--	--
7-4-R-CN-REPLICATE	--	--	--	--	--	--	--	--	--	--



## GARTNER-LEE ASSOCIATES (KURT STAUFFERT) PROJECT #87-907 WATERS

WG NO: 88-4023

SAMPLE ID	AG MG/L	AL MG/L	B MG/L	BA MG/L	BE MG/L	CA MG/L	CD MG/L	CO MG/L	CR MG/L	CU MG/L
13-1 - PHENOL	---	---	---	---	---	---	---	---	---	---
13-1-R-PHENOL-REPLICATE	---	---	---	---	---	---	---	---	---	---
CONTROL STD	<.005	.94	.193	.965	.0182	<.01	.19	.18	.18	.188
CONTROL EST.	---	1.00	.200	---	.0200	---	.20	.20	.20	.200
EPA STD	<.005	<.01	.100	<.005	<.0005	38.8	<.01	<.05	<.01	<.008
EPA STD (CRT)	---	---	---	---	---	40.0	---	---	---	---

FILE: T8\_4023  
DATE: 08/02/88  
MATRIX: WATER

GARTNER-LEE ASSOCIATES (KURT STAUFFERT) PROJECT #87-907 WATERS

07-10-09 10N DFH

115

[illegible]

304 CARLINGVIEW DRIVE  
REXDALE, ONTARIO  
M9W 5G2  
(416) 875-3870

**BARRINGER MAGENTA**

FILE: T8\_4023  
DATE: 08/02/88  
MATRIX: WATER

GARTNER-LEE ASSOCIATES (KURT STAUFFERT) PROJECT #87-907 WATERS

PAGE: 4

WO NO: 88-4023

SAMPLE ID	FE MG/L	K MG/L	MG MG/L	MN MG/L	MO MG/L	NA MG/L	NI MG/L	P MG/L	PB MG/L	SI MG/L
13-1	--	--	--	--	--	--	--	--	--	--
13-1-R	--	--	--	--	--	--	--	--	--	--
CONTROL STD	.87	<.5	<.01	.19	<.2	<.5	.19	<.5	.97	<.05
EPA STD	1.00	--	--	.20	--	--	.20	--	1.00	--
EPA STD (CRT)	.02	9.8	10.1	<.01	<.2	39.7	<.05	<.5	--	.55
	--	10.0	10.0	--	--	40.0	--	--	--	--

SAMPLE ID	SR	TH	TI	V	ZN	ZR	CN-TOT	NH3-N	PHENOLS	S=
MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	MG/L	UG/L	UG/L
5-1	---	---	---	---	---	---	---	---	<1	---
<del>5-2</del> S-1 KHS	---	---	---	---	---	---	---	---	16	---
6-1	---	---	---	---	---	---	---	---	<1	---
6-2	---	---	---	---	---	---	---	---	<1	---
7-1	---	---	---	---	---	---	---	---	---	<1
7-2	---	---	---	---	---	---	---	26.1	---	---
7-3	.138	<.05	.071	.034	<.01	<.05	---	---	---	---
7-4	---	---	---	---	---	---	2680	---	---	---
7-5	---	---	---	---	---	---	---	---	254	---
8-1	---	---	---	---	---	---	---	---	27600	---
12-1	---	---	---	---	---	---	---	---	---	<1
12-2	---	---	---	---	---	---	---	.73	---	---
12-3	.548	<.05	<.005	.012	.03	<.05	---	---	---	---
12-4	---	---	---	---	---	---	110	---	---	---
12-5	---	---	---	---	---	---	---	---	3	---
13-1	---	---	---	---	---	---	---	---	<1	---
14-1	---	---	---	---	---	---	---	.77	---	<1
14-2	---	---	---	---	---	---	---	---	---	---
14-3	.519	<.05	<.005	.012	.04	<.05	14	---	---	---
14-4	---	---	---	---	---	---	---	---	---	---
14-5	---	---	---	---	---	---	---	---	<1	---
15-1	---	---	---	---	---	---	---	---	30	<1
16-1	---	---	---	---	---	---	---	---	---	---
16-2	---	---	---	---	---	---	---	.09	---	---
16-3	---	---	---	---	---	---	---	---	---	---
16-4	---	---	---	---	---	---	---	---	---	---
17-1	.518	<.05	<.005	.012	.04	<.05	---	---	---	---
17-2	<.001	.08	<.005	.007	<.01	<.05	---	---	---	---
19-1	---	---	---	---	---	---	2950	---	---	<1
19-2	---	---	---	---	---	---	---	---	---	---
19-3	---	---	---	---	---	---	---	26.1	---	---
19-4	---	---	---	---	---	---	5	---	<1	---
22-1	---	---	---	---	---	---	---	---	3	---
CONTROL DATA	---	---	---	---	---	---	---	---	---	---
BLANK	.005	<.05	<.005	.010	<.01	<.05	2	<.02	<1	<1
5-1	---	---	---	---	---	---	---	---	<1	---
5-1-R	---	---	---	---	---	---	---	---	<1	---
6-2	---	---	---	---	---	---	---	---	<1	---
6-2-R	---	---	---	---	---	---	---	---	<1	---
7-2	---	---	---	---	---	---	---	26.1	---	---
7-2-R	---	---	---	---	---	---	---	28.2	---	---
7-3	.138	<.05	.071	.034	<.01	<.05	---	---	---	---
7-3-R	.129	<.05	.069	.027	<.01	<.05	---	---	---	---
7-4	---	---	---	---	---	---	2680	---	---	---
7-4-R	---	---	---	---	---	---	2500	---	---	---

*KHS*

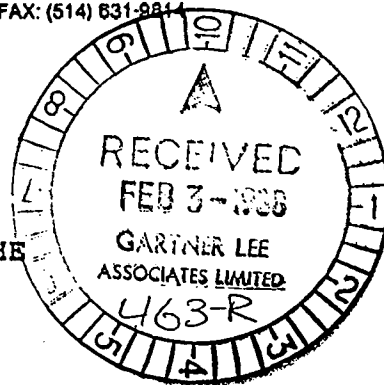


[illegible]



9420 CÔTE DE LIESSE, LACHINE, QUÉ. H8T 1A1

TÉL.: (514) 636-6218, 631-1838  
TÉLEX: 05-822787 • (LYNJO)  
FAX: (514) 631-9811



LETTRE COUVERTURE POUR BELINOGRAPHE  
FAX COVERING LETTER

DATE FEB. 3/88

HEURE/TIME 3:00 p.m.

VEUILLEZ LIVRER A:  
PLEASE DELIVER TO:

NOM/  
NAME: MR. T. KENEN.

COMPAGNIE/  
COMPANY: GARTNER - LEE & ASSOC.

FAX #: 1-416-477-1456

PAGES: 2 (LETTRE COUVERTURE INCLUSE/  
INCLUDING COVERING LETTER)

DE/FROM: B. Clowley

MESSAGE:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CONCENTRATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN WATER**  
ug/L

COMPOUND	15-2	MDL	Sewer	Mr	Mr	Mr	DISTILLED WATER	Lab Blank	MDL
			5-1	7-1	12-1	14-1			
			<del>5-1</del>	7-6	12-6	14-6	23-1		
ACENAPHTHENE	120	0.5	-	15	11	-	-	-	0.05
ACENAPHTHYLENE	270	0.5	-	290	-	-	-	-	0.05
ANTHRACENE	55	0.5	-	7.8	-	-	-	-	0.05
BENZ(A)ANTHRACENE	38	0.5	-	0.1	-	-	-	-	0.05
BENZO(B) + BENZO(K)FLUORANTHENE	28	0.5	-	-	-	-	-	-	0.05
BENZO(A)PYRENE	29	0.5	-	-	-	-	-	-	0.05
BENZO(GHI)PERYLENE	19	1	-	-	-	-	-	-	0.1
CHRYSENE	25	0.5	-	0.06	-	-	-	-	0.05
DIBENZ(A,H)ANTHRACENE	3	1	-	-	-	-	-	-	0.1
FLUORANTHENE	120	0.5	-	3.3	-	-	-	-	0.05
FLUORENE	100	0.5	-	56	1	-	-	-	0.05
INDENO(1,2,3-CD)PYRENE	13	1	-	-	-	-	-	-	0.1
NAPHTHALENE	-	0.5	-	270	1.4	-	-	-	0.05
PHENANTHRENE	340	0.5	-	55	-	-	-	-	0.05
PYRENE	130	0.5	-	2.5	-	-	-	-	0.05

MDL = METHOD DETECTION LIMIT

**RECOVERY OF SURROGATE STANDARDS  
(%)**

COMPOUND	15-2	5-1	7-6	12-6	14-6	23-1	Lab
							Blank
D8-NAPHTHALENE	28.8	52.4	*	68.7	48.1	59	60.3
D10-ANTHRACENE	54.5	86.9	55.9	95.6	88.2	80.2	85.5
D10-FLUORANTHENE	36.2	67.2	64.9	67.6	67.1	62.8	68.2
D12-PERYLENE	18.6	60.9	32	55.6	55.7	58.1	61.4

\* = Recovery not determined due to the high concentration of native naphthalene

FILE: T7-4697  
DATE: 08/02/88  
MATRIX: WATERS

GARTNER LEE (T. KEWEN) ANALYSIS OF 2 WATERS (PROJECT #87-907)

40 NO: 87-4697

PAGE: 1

[illegible][illegible]

304 CARLINGVIEW DRIVE  
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(416) 675-3870

**BARRINGER MAGENTA**

FILE: T7-4697  
DATE: 08/02/88  
MATRIX: WATERS

GARTNER LEE (T. KEMEN) ANALYSIS OF 2 WATERS (PROJECT #87-907)

PAGE: 2

SAMPLE ID	TR	SR	TH	TI	V	ZN	ZR	CN-TOT	NH3-N	PHENOLS	S=
		MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L	MG/L	UG/L	MG/L
SPEED RIVER	1	.155	.18	<.005	.005	.02	<.05	10	.01	<1	<.001
<del>ERAMOSA RIVER</del>	2	.160	.15	<.005	.005	.02	<.05	1	.01	<1	<.001
CONTROL DATA		--	--	--	--	--	--	--	--	--	--
BLANK		<.001	<.05	<.005	<.005	<.01	<.05	<1	<.01	<1	<.001
SPEED RIVER	1	.155	.18	<.005	.005	.02	<.05	10	.01	<1	<.001
SPEED RIVER	1	.155	.18	<.005	.008	.01	<.05	6	.01	<1	--
CONTROL STD		.198	<.05	.193	.195	.19	.19	38	.50	10	--
CONTROL EST.		.200	--	.200	.200	.20	.20	40	.50	10	--
EPA STD		.022	.13	<.005	<.005	.01	<.05	--	--	--	--
EPA STD (CRT)		--	--	--	--	--	--	--	--	--	--
BLANK		--	--	--	--	--	--	<1	<.01	<1	--

FILE: L7.46978  
DATE: 07/02/88  
MATRIX: WATER

BASE-NEUTRAL EXTRACTABLES: ND = NOT DETECTED; \* = DETECTED BELOW M.D.L.

WU NO: 67-46978

PAGE: 1

SAMPLE NUMBER	COMPOUND	M.D.L. UG/L	SPEED RIVER	SPEED RIVER REPEAT	ERAMOSA RIVER	REAGENT BLANK
1	BIS(2-CHLOROETHYL)ETHER	.5	ND	ND	ND	ND
2	1,3-DICHLOROBENZENE	.5	ND	ND	ND	ND
3	1,4-DICHLOROBENZENE	.5	ND	ND	ND	ND
4	1,2-DICHLOROBENZENE	.5	ND	ND	ND	ND
5	BIS(2-CHLOROISOPROPYL)ETHER	2.0	ND	ND	ND	ND
6	HEXACHLOROETHANE	2.0	ND	ND	ND	ND
7	N-NITROSODI-N-PROPYLAMINE	5.0	ND	ND	ND	ND
8	NITROBENZENE	.5	ND	ND	ND	ND
9	ISOPHORONE	.5	ND	ND	ND	ND
10	BIS(2-CHLOROETHOXY)METHANE	.5	ND	ND	ND	ND
11	1,2,4-TRICHLOROBENZENE	1.0	ND	ND	ND	ND
12	NAPHTHALENE	.5	ND	ND	ND	ND
13	HEXACHLOROBUTADIENE	2.0	ND	ND	ND	ND
14	2-METHYLNAPHTHALENE	.5	ND	ND	ND	ND
15	1-METHYLNAPHTHALENE	.5	ND	ND	ND	ND
16	HEXACHLOROCYCLOPENTADIENE	2.0	ND	ND	ND	ND
17	2-CHLORONAPHTHALENE	.5	ND	ND	ND	ND
18	ACENAPHTHYLENE	.5	ND	ND	ND	ND
19	DIMETHYL PHTHALATE	.5	ND	ND	ND	ND
20	2,6-DINITROTOLUENE	2.0	ND	ND	ND	ND
21	ACENAPHTHENE	.5	ND	ND	ND	ND
22	2,4-DINITROTOLUENE	2.0	ND	ND	ND	ND
23	FLUORENE	.5	ND	ND	ND	ND
24	4-CHLOROPHENYL PHENYL ETHER	1.0	ND	ND	ND	ND
25	DIETHYL PHTHALATE	.5	ND	ND	ND	ND
26	N-NITROSODIPHENYLAMINE	.5	ND	ND	ND	ND
27	AZOBENZENE	.5	ND	ND	ND	ND
28	4-BROMOPHENYL PHENYL ETHER	2.0	ND	ND	ND	ND
29	HEXACHLOROBENZENE	2.0	ND	ND	ND	ND
30	PHENANTHRENE	.5	ND	ND	ND	ND
31	ANTHRACENE	.5	ND	ND	ND	ND
32	DI-N-BUTYL PHTHALATE	.5	31.1	34.0	13.7	33.6
33	FLUORANTHENE	.5	ND	ND	ND	ND
34	BENZIDINE	15.0	ND	ND	ND	ND
35	PYRENE	.5	ND	ND	ND	ND
36	BENZYL BUTYL PHTHALATE	2.0	ND	ND	ND	ND
37	BENZO(A)ANTHRACENE	1.0	ND	ND	ND	ND
38	CHRYSENE	1.0	ND	ND	ND	ND
39	3,3'-DICHLOROBENZIDINE	5.0	ND	ND	ND	ND
40	BIS(2-ETHYLHEXYL)PHTHALATE	1.0	ND	ND	ND	ND
41	DI-N-OCTYL PHTHALATE	1.0	ND	ND	ND	ND
42	BENZO(B)FLUORANTHENE	1.0	ND	ND	ND	ND
43	BENZO(K)FLUORANTHENE	1.0	ND	ND	ND	ND
44	BENZO(A)PYRENE	2.0	ND	ND	ND	ND
45	INDENO(1,2,3-CD)PYRENE	2.0	ND	ND	ND	ND

304 CARLINGVIEW DRIVE  
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**BARRINGER MAGENTA**

FILE: L7,46978  
DATE: 07/02/88  
MATRIX: WATER

BASE-NEUTRAL EXTRACTABLES: ND = NOT DETECTED; \* = DETECTED BELOW M.D.L.

WD NO: 87-46978 PAGE: 2

SAMPLE NUMBER	COMPOUND	M.D.L. UG/L	SPEED RIVER	SPEED, R. REPEAT	SRAMBSA RIVER	REAGENT
46	DIBENZO(A,H)ANTHRACENE	2.0	ND	ND	ND	ND
47	BENZO(GH)PERYLENE	2.0	ND	ND	ND	ND

304 CARLINGVIEW DRIVE  
REXDALE, ONTARIO  
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**BARRINGER MAGENTA**

FILE: L7.4697C  
DATE: 07/02/87  
MATRIX: WATER

BASE-NEUTRAL SURROGATE STANDARD PERCENT RECOVERIES

WD NO: 87-4697C PAGE: 1

SAMPLE NUMBER	COMPOUND	AMOUNT UG/L	SPEED RIVER	SPEED RIVER	REPEAT REPEAT	ERAMOSA RIVER	REAGENT BLANK
1	NITROBENZENE-D5	50	51	81	1	49	87
2	2-FLUOROBIPHENYL	50	64	106	106	64	91
3	4-TERPHENYL-D14	50	70	152	152	58	117



SPIKED BASE-NEUTRAL SAMPLES - PERCENT RECOVERY

WD NO: 87-4697D

SAMPLE NUMBER	COMPOUND	AMOUNT UG/L	REAGENT BLANK
1	BIS(2-CHLOROETHYL)ETHER	50	102
2	1,3-DICHLOROBENZENE	50	84
3	1,4-DICHLOROBENZENE	50	83
4	1,2-DICHLOROBENZENE	50	86
5	BIS(2-CHLOROISOPROPYL)ETHER	50	91
6	HEXACHLOROETHANE	50	72
7	N-NITROSODI-N-PROPYLAMINE	50	99
8	NITROBENZENE	50	99
9	ISOPHORONE	50	123
10	BIS(2-CHLOROETHOXY)METHANE	50	102
11	1,2,4-TRICHLOROBENZENE	50	91
12	NAPHTHALENE	50	100
13	HEXACHLOROBUTADIENE	50	81
14	2-METHYLNAPHTHALENE	50	106
15	1-METHYLNAPHTHALENE	50	102
16	HEXACHLOROCYCLOPENTADIENE	50	89
17	2-CHLORONAPHTHALENE	50	103
18	ACENAPHTHYLENE	50	111
19	DIMETHYL PHTHALATE	50	57
20	2,6-DINITROTOLUENE	50	122
21	ACENAPHTHENE	50	112
22	2,4-DINITROTOLUENE	50	115
23	FLUORENE	50	113
24	4-CHLOROPHENYL PHENYL ETHER	50	113
25	DIETHYL PHTHALATE	50	94
26	N-NITROSODIPHENYLAMINE	50	111
27	AZOBENZENE	50	122
28	4-BROMOPHENYL PHENYL ETHER	50	116
29	HEXACHLOROBENZENE	50	107
30	PHENANTHRENE	50	110
31	ANTHRACENE	50	108
32	DI-N-BUTYL PHTHALATE	50	104
33	FLUORANTHENE	50	60
34	BENZIDINE	50	64
35	PYRENE	50	64
36	BENZYL BUTYL PHTHALATE	50	70
37	BENZO(A)ANTHRACENE	50	104
38	CHRYSENE	50	104
39	3,3'-DICHLOROBENZIDINE	50	81
40	BIS(2-ETHYLHEXYL)PHTHALATE	50	81
41	DI-N-OCTYL PHTHALATE	50	80
42	BENZO(B)FLUORANTHENE	50	100
43	BENZO(K)FLUORANTHENE	50	100
44	BENZO(A)PYRENE	50	105
45	INDENO(1,2,3-CD)PYRENE	50	72

FILE: L7-46970  
DATE: 07/02/87  
MATRIX: WATER

PAGE: 2

WO NO: 87-46970

## SPIKED BASE-NEUTRAL SAMPLES - PERCENT RECOVERY

SAMPLE NUMBER	COMPOUND	AMOUNT UG/L	REAGENT BLANK
46	DIRENZO(A,H)ANTHRACENE	50	73
47	BENZO(G,H,I)PERYLENE	50	68
48	NITROBENZENE-D5(S,ST)	50	92
49	2-FLUOROBIPHENYL(S,ST)	50	107
50	4-TERPHENYL-D14(S,ST)	50	73

FILE: T7-4697  
DATE: 08/02/88  
MATRIX: SEDIMENT

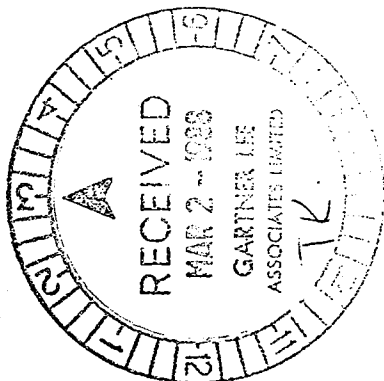
## GARTNER LEE (T. KEWEN) ANALYSIS OF 4 SEDIMENTS (PROJECT #87-907)

WD NO: 87-4697 PAGE: 2

SAMPLE ID	SR PPM	TH PPM	TI PPM	V PPM	ZN PPM	ZR PPM	OIL&GRS PPM
A-SPEED RIVER	185	24	4960	67	209	97	3280
B-SPEED RIVER	201	24	2100	43	448	60	6000
<del>A-ERAMOSA</del>	245	23	1280	38	877	48	6000
<del>B-ERAMOSA</del>	213	28	2530	42	403	59	3540
CONTROL DATA	--	--	--	--	--	--	--
A-SPEED RIVER	185	24	4960	67	209	97	3280
A-SPEED-R	205	27	4380	64	261	90	3180
BLANK	<1	4	2	<1	3	<5	<200
SY-2	250	362	747	49	251	272	--
SY-2(CERT)	265	375	795	50.0	250	--	--
NRS-1645	--	--	--	--	--	--	19500
1645 (CERT.)	--	--	--	--	--	--	17900

~~GARTNER LEE (T. KEWEN) ANALYSIS OF 4 SEDIMENTS (PROJECT #87-907)~~

PAGE 4

[illegible]

FILE: L7.4697G  
DATE: 07/02/88  
MATRIX: SEDIMENT

BASE-NEUTRAL EXTRACTABLES: ND = NOT DETECTED; % = DETECTED BELOW M.D.L.

MO. NO.: 87-4697G

PAGE: 1

SAMPLE NUMBER	COMPOUND	M.D.L. UG/G	SPEED, R A	SPEED, R B	SPEED, R B-REPEAT	ERAMBSA	ERAMBSA	REAGENT
						TK	TK	BLANK
1	BIS(2-CHLOROETHYL)ETHER	.2	ND	ND	ND	ND	ND	ND
2	1,3-DICHLOROBENZENE	.2	ND	ND	ND	ND	ND	ND
3	1,4-DICHLOROBENZENE	.2	ND	ND	ND	ND	ND	ND
4	1,2-DICHLOROBENZENE	.2	ND	ND	ND	ND	ND	ND
5	BIS(2-CHLOROISOPROPYL)ETHER	.8	ND	ND	ND	ND	ND	ND
6	HEXACHLOROETHANE	.8	ND	ND	ND	ND	ND	ND
7	N-NITROSODI-N-PROPYLAMINE	2.0	ND	ND	ND	ND	ND	ND
8	NITROBENZENE	.2	ND	ND	ND	ND	ND	ND
9	ISOPHORONE	.2	ND	ND	ND	ND	ND	ND
10	BIS(2-CHLOROETHOXY)METHANE	.2	ND	ND	ND	ND	ND	ND
11	1,2,4-TRICHLOROBENZENE	.4	ND	ND	ND	ND	ND	ND
12	NAPHTHALENE	.2	ND	ND	ND	ND	ND	ND
13	HEXACHLOROBUTADIENE	.8	ND	ND	ND	ND	ND	ND
14	2-METHYLNAPHTHALENE	.2	ND	ND	ND	ND	ND	ND
15	1-METHYLNAPHTHALENE	.2	ND	ND	ND	ND	ND	ND
16	HEXACHLOROCYCLOPENTADIENE	.8	ND	ND	ND	ND	ND	ND
17	2-CHLORONAPHTHALENE	.2	ND	ND	ND	ND	ND	ND
18	ACENAPHTHYLENE	.2	ND	ND	ND	ND	ND	ND
19	DIMETHYL PHTHALATE	.2	ND	ND	ND	ND	ND	ND
20	2,6-DINITROTOLUENE	.8	ND	ND	ND	ND	ND	ND
21	ACENAPHTHENE	.2	ND	ND	ND	ND	ND	ND
22	2,4-DINITROTOLUENE	.8	ND	ND	ND	ND	ND	ND
23	FLUORENE	.2	ND	ND	ND	ND	ND	ND
24	4-CHLOROPHENYL PHENYL ETHER	.4	ND	ND	ND	ND	ND	ND
25	DIETHYL PHTHALATE	.2	ND	ND	ND	ND	ND	ND
26	N-NITROSODIPHENYLAMINE	.2	ND	ND	ND	ND	ND	ND
27	AZOBENZENE	.2	ND	ND	ND	ND	ND	ND
28	4-BROMOPHENYL PHENYL ETHER	2.0	.8	ND	ND	ND	ND	ND
29	HEXACHLOROBENZENE	2.0	.8	ND	ND	ND	ND	ND
30	PHENANTHRENE	.2	.9	2.8	1.6	.4	2.2	ND
31	ANTHRACENE	.2	.2	.5	.4	ND	.4	ND
32	DI-N-BUTYL PHTHALATE	.2	ND	.6	.3	.9	.6	ND
33	FLUORANTHENE	.2	.6	6.9	2.6	.8	2.4	ND
34	BENZIDINE	6.0	ND	ND	ND	ND	ND	ND
35	PYRENE	.2	.5	4.8	2.0	.6	1.7	ND
36	BENZYL BUTYL PHTHALATE	.8	ND	ND	ND	ND	ND	ND
37	BENZO(A)ANTHRACENE	.4	ND	ND	ND	.3	1.4	ND
38	CHRYSENE	.4	ND	ND	ND	.4	1.3	ND
39	3,3'-DICHLOROBENZIDINE	2.0	ND	ND	ND	ND	ND	ND
40	BIS(2-ETHYLHEXYL)PHTHALATE	.4	ND	ND	ND	1.8	2.3	ND
41	DI-N-OCTYL PHTHALATE	.4	ND	ND	ND	ND	ND	ND
42	BENZO(B)FLUORANTHENE	.4	ND	ND	ND	.5	1.4	ND
43	BENZO(K)FLUORANTHENE	.4	ND	ND	ND	ND	ND	ND
44	BENZO(A)PYRENE	.8	ND	ND	ND	ND	ND	ND
45	INDENO(1,2,3-CD)PYRENE	.8	ND	ND	ND	ND	ND	ND

304 CARLINGVIEW DRIVE  
 REXDALE, ONTARIO  
 M9W 5G2  
 (416) 675-3870

**BARRINGER MAGENTA**

FILE: L7.4697G  
 DATE: 07/02/88  
 MATRIX: SEDIMENT

*Handwritten signature*

BASE-NEUTRAL EXTRACTABLES: ND = NOT DETECTED; % = DETECTED BELOW M.D.L.

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WO NO: 87-4697G

SAMPLE NUMBER	COMPOUND	M.D.L. UG/G	SPEED,R A	SPEED,R B	SPEEDR B-REPEAT	EPA808A TK	EPA808A TK-C	EPA808A TK-D	REAGENT BLANK
46	DIBENZO(A,H)ANTHRACENE	.8	ND	ND	ND	ND	ND	ND	ND
47	BENZO(GHI)PERYLENE	.8	ND	ND	ND	ND	ND	ND	ND

SPIKED BASE-NEUTRAL SAMPLES - PERCENT RECOVERY

SAMPLE NUMBER	COMPOUND	AMOUNT UG/G	SPEED, R. A
1	BIS(2-CHLOROETHYL)ETHER	3	87
2	1,3-DICHLOROBENZENE	3	72
3	1,4-DICHLOROBENZENE	3	74
4	1,2-DICHLOROBENZENE	3	78
5	BIS(2-CHLOROISOPROPYL)ETHER	3	77
6	HEXACHLOROETHANE	3	67
7	N-NITROSODI-N-PROPYLAMINE	3	66
8	NITROBENZENE	3	89
9	ISOPHORONE	3	90
10	BIS(2-CHLOROETHOXY)METHANE	3	85
11	1,2,4-TRICHLOROBENZENE	3	76
12	NAPHTHALENE	3	79
13	HEXACHLOROCYCLOPENTADIENE	3	78
14	2-METHYLNAPHTHALENE	3	62
15	1-METHYLNAPHTHALENE	3	64
16	HEXACHLOROCYCLOPENTADIENE	3	28
17	2-CHLORONAPHTHALENE	3	81
18	ACENAPHTHYLENE	3	80
19	DIMETHYL PHTHALATE	3	79
20	2,6-DINITROTOLUENE	3	65
21	ACENAPHTHENE	3	79
22	2,4-DINITROTOLUENE	3	73
23	FLUORENE	3	82
24	4-CHLOROPHENYL PHENYL ETHER	3	84
25	DIETHYL PHTHALATE	3	78
26	N-NITROSODIPHENYLAMINE	3	78
27	AZOBENZENE	3	90
28	4-BROMOPHENYL PHENYL ETHER	3	81
29	HEXACHLOROBENZENE	3	85
30	PHENANTHRENE	3	57
31	ANTHRACENE	3	95
32	DI-N-BUTYL PHTHALATE	3	94
33	FLUORANTHENE	3	92
34	BENZIDINE	3	105
35	PYRENE	3	105
36	BENZYL BUTYL PHTHALATE	3	121
37	BENZO(A)ANTHRACENE	3	114
38	CHRYSENE	3	107
39	3,3'-DICHLOROBENZIDINE	3	132
40	BIS(2-ETHYLHEXYL)PHTHALATE	3	132
41	DI-N-OCTYL PHTHALATE	3	87
42	BENZO(B)FLUORANTHENE	3	51
43	BENZO(K)FLUORANTHENE	3	51
44	BENZO(A)PYRENE	3	49
45	INDENO(1,2,3-CD)PYRENE	3	30

304 CARLINGVIEW DRIVE  
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 BARRINGER MAGENTA

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DATE: 07/02/87  
MATRIX: SEDIMENT

WU NU: 87-46971 PAGE: 2

SPINEX BASE-NEUTRAL SAMPLES - PERCENT RECOVERY

SAMPLE NUMBER	COMPOUND	AMOUNT UG/G	SPEED, R. A
46	DIBENZO(A,H)ANTHRACENE	3	25
47	BENZO(GH)PERYLENE	3	29
48	NITROBENZENE-05(S,ST)	3	81
49	2-FLUORORIPHENYL(S,ST)	3	78
3	4-TERPHENYL-D14(S,ST)	3	111



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**BARRINGER MAGENTA**

FILE: L7.4697H  
DATE: 07/02/88  
MATRIX: SEDIMENT

BASE-NEUTRAL SURROGATE STANDARD PERCENT RECOVERIES

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WO NO: 87-4697H

SAMPLE NUMBER	COMPOUND	AMOUNT UG/G	SPEED, R		B	B-REPEAT	SPEED, R	SRAHOSA		REAGENT
			A	B				A, -C	A, -D	
1	NITROBENZENE-D5	3	161	92	89	TK	106	TK	86	95
2	2-FLUOROBIPHENYL	3	172	75	104		99		75	86
3	4-TERPHENYL-D14	3	24	83	29		99		61	87

**APPENDIX F**

**INSPECTION REPORT OF BASEMENT  
SURVEY SOUTH OF SURVEY STREET**

BASEMENT SURVEY  
SOUTH OF SURREY STREET

On July 6, 1988, the City and Environmental Strategies Ltd visited the residences south of Surrey Street across from the former Guelph Gas Works. The purpose of the visits was to inspect the basements for any evidence of coal tar odours or seepage.

45,47 and 49 Surrey Street

These addresses refer to three different portions of the same building. This building is one of the original residences in the area and is situated directly opposite the former gas works. The original portion of the building was constructed about 1913. A major addition was completed to the rear of the building several years ago. The basement extends beneath the entire building. The basement is fully developed and contains two large apartments which each occupy about half the basement. The basement appears to be completed above the bedrock surface.

The superintendent of the building was interviewed during the basement inspection. He has lived in the building for ten years. He could not recall unusual odours or seepages in the basements during this time. He was also not aware of any flooding of the basement during the last ten years.

During the basement inspection, no unusual odours or seepages were noted. However, the sump in the central basement area was found to contain black hydrocarbon sediment. The superintendent was not previously aware of this sediment. The sump is located beside a water heater that was previously oil-fired. No sediment was found in any floor drains or outside drains.

The building used to be heated with fuel oil. One fuel storage tank was located in the southwest corner of the basement and was removed several years ago. A filling pipe for another tank was found on the northeast side of the building but the superintendent

could not recall the location of any second fuel storage tank. The superintendent did not know of any other hydrocarbon storage on-site.

#### 53 Surrey Street

This address is a small separate residence. It is one of the original houses in the area and is situated directly opposite the gas works. The basement of this house is not finished although a small raised floor has been constructed in the northwest corner of the basement. The basement is completed above the bedrock.

One of the tenants was interviewed during the basement inspection. He has lived in this house for three years. He could not recall any unusual odours or seepages in the basement and none was apparent during the inspection. The basement does not have any visible sump.

#### 41 Wyndham Street

This address is a small separate residence. It is one of the original houses in the area and is located opposite the east corner of the gas works. The basement of this house is not developed and appears to be completed above the bedrock.

One of the tenants was interviewed during the basement inspection. The tenant has lived in the house for only six months and was not aware of any unusual odours or seepage in the basement. None was apparent during the inspection. The basement does not have any sump.

#### 45 Wyndham Street

This address is a small separate residence. It is one of the original houses in the area and is located three houses southeast of the gas works.

The owner has lived in this house for over 50 years and was interviewed during this visit. The basement was not inspected but the owner has never observed any unusual odours or seepage in the basement.