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ENGINEERING GLOBAL SOLUTIONS

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Project: WX-04010

Centra Gas Manitoba Inc.
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ATTENTION: Mr. Bob Gill

Dear Sir:

**RE: SUMMARY OF ACTIVITIES AND FINDINGS
INVESTIGATION OF THE SOURCE OF COAL TAR RESIDUES
CENTRA GAS SUTHERLAND AVENUE OPERATIONS SITE
WINNIPEG, MANITOBA**

1.0 INTRODUCTION

On February 17, 1998, AGRA Earth & Environmental Limited (AEE), Centra Gas Manitoba Inc. (Centra), Agassiz North Consultants (Agassiz) and Manitoba Environment (ME) met to discuss possible remedial requirements of the Sutherland Avenue site. At the meeting, concerns were expressed by ME regarding an apparent increase in the size of a coal tar residue plume which had been identified in the sediments of the Red River, immediately adjacent to the Centra site. The coal tar residue in the Red River was first discovered during sediment sampling conducted by Agassiz North in 1994. Subsequent monitoring in 1997 indicated a growth in plume size. The coal tar is believed to have originated from the former manufactured gas plant (MGP) which operated at the Centra site from about 1885 to 1958, however the manner in which the coal tar residue entered the river was not known. ME stated that delisting of the site from the Provincial Contaminated Sites list was contingent on identifying the source(s) of the coal tar residues and showing that the plume size was not increasing. ME also advised that dissolved PAH's were not of particular concern at this time and that the presence of the significant dissolved phase within the site groundwater would not keep the property on the Contaminated Sites listing.

The subject site is located between Sutherland Avenue and Rover Avenue, which lies on the west bank of the Red River. Annabella Street (formerly called Rachel Street) bounds the site to the east. The west property line originally extended to Gladstone Street along the full length of the site, however during the construction of the Disraeli Bridge in 1958, the northwest corner of the site was expropriated and Gladstone Street rerouted. The site is shown in Figure 1.

2.0 OBJECTIVES

The purpose of this review was to address concerns expressed by ME regarding an apparent increase in a coal tar residue plume size which was identified in the sediments of the Red River adjacent to the Centra site in 1997. This was to be accomplished by attempting to ascertain whether the plume was the result of on-going subsurface migration or whether the coal tar was deposited during the MGP's operation.

3.0 SCOPE OF WORK

AEE was to conduct a detailed information review of current and historical conditions at the site in an effort to identify potential migration pathways of coal tar residues between the Centra site and the Red River. As a minimum, the information sources to be reviewed included existing environmental reports, existing Centra files and plans, available case histories of similar coal tar sites, City of Winnipeg water and sewer file records, City of Winnipeg Bridge Department records, a review of taped conversations with past plant employees, and a site reconnaissance. The taped conversations of past employees could not be located by Centra during AEE's information review.

The assessment was to be a non-intrusive investigation. Additional test hole drilling was not considered to be required at this time, in view of the belief that the site conditions have been well documented and the findings would not likely aid in definitive determination of the source of the river bottom sediment contamination given the numerous potential sources.

Between 1994 and 1998, inclusive, Agassiz conducted sediment sampling to monitor the plume size of the coal tar residue within the Red River. Agassiz has also completed an assessment of the physical features of the riverbank, including the location of any existing outfalls, pipes, *etc.* AEE reviewed only the estimated impacted sediment plume sizes determined by Agassiz and the 1998 sediment sample descriptions.

At the completion of the information review, a report summarizing the findings, providing an assessment of potential migration pathways which may have resulted in the river bottom sediment contamination and addressing the issues related to the potential for on-going deposition of coal tar residue was to be provided to Centra.

4.0 BACKGROUND

4.1 HISTORY OF THE SITE

Historical information (CH2M, 1994) indicates that a retort gas plant operated at the site between 1885 and 1924 after which a water gas and a coke oven plant operated at the site until about 1958. The north end of the site was primarily used for the storage of coal and coke (carbonized coal). The coke oven plant was located at the south end of the site and the building locations and functions have been determined from historical plans.

In general, water gas (also known as blue gas) was produced by reacting coal or coke with steam to yield a gas rich in hydrogen and carbon monoxide. The water gas was usually enriched in heating value by adding petroleum oils to the hot gas. Oil was then thermally cracked to gaseous constituents in a practice known as carburetion with the resulting product called carburetted water gas (AES, 1996). The major by-product of water gas production was the uncracked portion of the liquid hydrocarbons fed to the carburetor.

Coal gas (also known as coke oven gas) was produced by the carbonization (coking) of bituminous coal in the absence of air. By-products and wastes of this operation included coke, coal tar, sludges, tar liquors, and ammonia liquor (AES, 1996). Coke was marketed for domestic heating and coal tar was recovered for distillation into valuable products or was sold for use as fuel. The sale of tar and coke at the Winnipeg Electric Street Railway Company was documented in Brown's Directory of North American and International Gas Companies between 1910 and 1948 (AES, 1996).

The MGP operated under several names including the Winnipeg Gas Company, the Manitoba Electric and Gas Light Company, the Winnipeg Electric Street Railway Company and the Winnipeg Electric Company. The MGP ceased production of manufactured gas in about 1958 (CH2M, 1994). After this time, many of the original buildings were demolished. However, some of the original building foundations and utility lines may remain buried at the site.

4.2 WORK COMPLETED BY OTHERS

The following is a description of the reports which were prepared by others and reviewed by AEE as part of the scope of work for this project.

In April 1994, CH2M Hill Engineering Limited (CH2M) completed for Centra Gas Manitoba Inc. a report entitled *Environmental, Health, and Safety Assessment of the Sutherland Avenue Operations Facility in Winnipeg, Manitoba, Phase I: Preliminary Site Investigation*. In brief, the report summarized CH2M's Preliminary Site Characterization and concluded that residues from the former manufactured gas plant were present in the soils in all areas of the site, however appeared to be most significant in the north portion of the site adjacent to the River. CH2M (1994) indicates that the residues or by-products were found in a deposit of glaciofluvial sands, silt and clay which border the River. These glaciofluvial soils represent an area with a higher soil

permeability than the underlying till and the high plastic clay which dominates the southern end of the site. Groundwater within the glaciofluvial soils was present at about 2 m below grade, with a northerly flow direction to the River. Groundwater quality beneath the site was found to be impacted by chemicals derived from the MGP residues. The degree of impact appeared higher towards the River, however the lateral extent was not determined (CH2M, 1994).

In January 1995, CH2M completed for Centra a report entitled *Environmental, Health and Safety Assessment of the Sutherland Avenue Operations Facility in Winnipeg, Manitoba, Phase II: Detailed Site Characterization*. Based on additional subsurface investigations, this report concluded that coal tar residues were found in the off-site soil and groundwater at the north end of the site, along the river bank, in concentrations exceeding the applicable guidelines. The highest concentrations were encountered in the northwest part of the area investigated and the residues appeared to be contained by a till zone of low permeability encountered at a depth of approximately 15 metres. As well, visual, olfactory and chemical characterization identified river sediments containing coal tar residues. The most significant residue concentrations were restricted to the upper 0.8 to 1.5 m of river-bottom sediment (CH2M, 1995) and were concentrated between piers 6 and 7 of the Disraeli Bridge.

5.0 SUMMARY OF FINDINGS

The following Section summarizes the findings of the review of available current and historical information which AEE performed under the scope of this project.

Figure 1 is a compilation of the information obtained during the information review and illustrates the sewer, water and natural gas pipelines which are discussed in the following Sections. Figure 1 also shows the Disraeli Bridge piers as well as some of the more relevant historical buildings in order to show the relative distances between the potential sources of coal tar (*ie.* the buildings) and the potential migration pathways (*ie.* the pipelines). The 1998 sediment sampling results provided by Agassiz have also been shown in Figure 1 so that the relationship between the coal tar residue plume and the potential migration pathways could be assessed.

5.1 Industry Related Newsletters

The document entitled *MGP Process and Historical Data, Brandon, Manitoba Site* was prepared for Manitoba Hydro by Atlantic Environmental Services, Inc. in 1996 and was provided to AEE by Manitoba Hydro as a professional courtesy. The document includes excerpts from a handbook on manufactured gas plant sites, an assessment of past disposal practices, and selected entries from *Brown's Directory of North American and International Gas Companies* (1910-1948). This document was valuable in gaining an understanding of typical processes and operating practices which would have occurred during the operation of the former MGP at the Centra site. This document also describes typical waste and by-products which were produced during the operation of a typical MGP.

Atlantic Environmental Services produces a newsletter called *Atlantic Siteline* which provides information regarding brownfields in the United States. AEE reviewed the newsletters published between January 1996 and March 1998 in search of information on former MGPs. The intent was to find another MGP with conditions similar to Centra's site and in which the presence of coal tar residue in an adjacent river was explained. The newsletter *Atlantic_Compendium*, consists of abstracts of reports produced by GEI Consultants Inc., Atlantic Environmental Division. This newsletter provides information to utility companies, since many former MGP are still owned by utility companies, and often deals with issues relating to the rehabilitation of these impacted sites. AEE reviewed issues of the *Atlantic Compendium* produced between February 1996 and May 1998. A third newsletter, also produced by GEI Consultants Inc., called *The Atlantic MGP Reporter*, is devoted to the discussion of manufactured gas plants and related issues. AEE reviewed newsletters produced between March 1996 and June 1998. The June, 1998 issue (Appendix C) describes a project involving the removal of sediment from the Susquehanna River in Columbia, PA. The remediation involved the removal of sediment contaminated with low levels of PAHs. The deposit was believed to have formed during the operation of the nearby gas plant as a result of co-deposition of river sediment with tar-water overflows from the plant. Originally, it was felt that there might be an ongoing subsurface discharge of tar from the site to the river however, later studies proved this to be incorrect. This example provides a case history where coal tar residues were apparently transported with overflow water. Former employees of the MGP at Centra's site indicated that on occasion, overflow water was released to the sewer or Red River (CH2M, 1994). This is considered to be a potential source of the coal tar residue in the River sediment. The remaining newsletters and reports did not provide any comparable case studies.

5.2 Provincial Archives

An Insurers' Advisory Organization Plan (Sheet 232, Volume 2, Series 2, December 1917) was reviewed for the subject site and adjacent properties at the Provincial Archives Building. The plan showed the storage of tar in underground concrete tanks located along the east property line (near the centre of the site), a 60,000 gallon oil tank and the building layouts for the former MGP located at the Centra site. The plan indicated that the site was owned by the Winnipeg Electric Railway Company. Underground piping was not shown on the plan. The site was operated by the Greater Winnipeg Gas Company in about 1964 according to an Insurers' Advisory Organization (IAO plan) dated 1964 (Sheet 232, Volume II, Series 4).

In addition to IAO Plans, AEE conducted a historical document search for the site. Keywords relating to manufactured gas plants, the site's former occupants, and adjacent streets did not identify any information which was relevant to determining the source of coal tar residue in the Red River. However, it was determined that the sewer and water mains were installed under Rover Avenue, between Annabella Street and Disraeli Avenue, in June 1925 (City of Winnipeg, Sewer and Water Mains, 1910-1928). This information is relevant considering that sewer and water lines could provide a potential migration pathway between the site and the River.

5.3 Centra Gas Manitoba Plans

AEE reviewed the available plans provided by Mr. Bob Gill, of Centra, for the former MGP located at the Centra site. Centra's Plan 421, dated 1924, shows the layout of the water gas plant, the coke oven gas manufacturing process and the location of numerous underground pipelines. On Plan 421, two abandoned sewer lines are shown on the west side of the water gas plant and the lines reportedly ran down the west side of Gladstone street and exited at the river. These sewer lines are labelled as line ⑥ in Figure 1.

Plan 421 also shows a twelve inch sewer line which was connected to sewer piping and manholes located throughout the site. This sewer reportedly exited at an invert outlet at the river's edge. On Figure 1, the sewer pipe is labelled as line ③ and the river outlet is labelled as point ⑦. The same twelve inch sewer line was shown on Plan number 4502-14 (dated 1953) which AEE obtained from the City of Winnipeg. It appears that liquid entering the sewer at the south end of the site could flow north to exit at the river bank. Plan 421 indicates that most of the buildings at the site had sewer connections and the sewer connections lead in general to the surrounding streets (Sutherland, Annabella or Gladstone). Based on the recollections of former employees of the MGP, it appears that the sewers were occasionally used to dispose of overflow water and the sewers along Gladstone were infrequently cleaned due to an accumulation of coke fines (CH2M, 1994).

Another pipeline described as an old overflow sewer which serviced the tar well at the east side of the site was also shown on Plan 421. The tar well and overflow sewer (labelled as line ⑤) are shown on Figure 1. The overflow sewer line was described in some locations as a broken twelve inch pipe and it ran parallel to the twelve inch sewer line (labelled as line ③ in Figure 1) which exited at a river outlet. Based on information reviewed regarding the operations of both Centra's former MGP and other similar operations, it is likely that water which separated from the tar in the tar well was released to this overflow sewer line. The overflow sewer or the backfill around the sewer could have acted as a conduit for the migration of coal tar.

A small booster pump house, connected to a four inch water intake line, was identified on Centra's Plan R-2-A dated April 29, 1940. The pump house was located on the river bank, north of the Centra site. River water was apparently drawn up to a pump house located at the northwest corner of the manufactured gas plant site. Centra's Plan 421, also shows the river water intake pipe and indicates that river water was supplied to the coke oven plant at the south end of the site. The approximate location of the pump houses and water intake line (labelled as line ①) are shown in Figure 1.

5.4 City of Winnipeg, Underground Structures and Microfilm Department

The Underground Structures Department supplied AEE with plans which were a compilation of all documented functional and abandoned underground structures in the area of the subject site which the City had on record. Plan NW-31-503, dated 1994, shows a 300 mm storm relief

sewer which is located below Gladstone Street, west of bridge pier number 4, and runs east towards the bridge and the Red River. This sewer is labelled as ④ in Figure 1. The location of this sewer line corresponds with the location of a sewer line shown on Plan 4502-14, dated 1953 (obtained from the Bridge Inspection Department and discussed in Section 5.6).

An un-numbered plan obtained from the Underground Structures Department shows the location of Centra's 400 mm high pressure natural gas line that crosses below the Red River. Also shown on the un-numbered plan, is a 356 mm steel pipe water main which runs from the south side of Rover Ave, west of Gladstone St, then travels north below the river. It appears that this water line is still active. Both the natural gas line (labelled as ②)and the water main are shown on Figure 1. The un-numbered plan also shows a 300 mm abandoned water line which originates at the east side of Annabella Street, then travels north under the Red River. It is believed that this pipe is connected to the water main under Rover Avenue which was installed in 1925. The location of the abandoned water line and the 1925 water main have also been shown on Figure 1.

5.5 City of Winnipeg, Bridge Maintenance Department

Mr. Gord Smith of the Bridge Maintenance Department indicated that to his knowledge there are no records which describe soil conditions encountered during bridge construction or problems which may have been encountered during the bridge construction (eg. evidence of contamination). Reportedly, the piers and abutments do not have special drainage systems (such as weeping tiles), but likely have a gravel base around them. At the present time, the drains on the bridge deck are plugged and are not routinely cleaned. The deck drains at the west bridge abutment are connected to collection pipes which run down pier number 5 and into a catch basin which has an outfall along the river bank. The location of the drains, catch basin and outfall were confirmed by the site reconnaissance conducted by AEE on November 16, 1998.

5.6 City of Winnipeg, Bridge Inspection Department

Mr. Ken Galvraes of the Bridge Inspection Department provided AEE with an historical photograph account of the Disraeli Bridge and Disraeli Expressway construction. Photographs dated June 17-18, 1958 show a "wooden gastank and tar in the excavation" for pier number 4 (Plate 1, Appendix B). Information sources reviewed by AEE and others did not indicate the presence of a storage tank in the location of pier number 4 (northwest corner of the original property boundary). Based on the location of pier number 4, the tank must have been located north of the former water gas plant. Tar can be seen seeping from the walls of the excavation in the photographs. Photographs dated October 17, 1958 show the demolition of the "coke yard building" (Plate 2, Appendix B). The newly constructed bridge piers are evident to the left of the building. Based on the photograph, it appears that the "coke yard building" owned by the Greater Winnipeg Electric Co., was the former water gas plant building located at the north end of the site along the west property line. Photographs from the excavation of bridge pier 5 (*ie*. closest to the River) do not indicate visible tar.

In addition to the photographic record, Mr. Galvraes provided AEE with Plan 4502-14 dated March 4, 1953 (with some revisions in 1958). The plan shows the underground and overhead utilities which were known to be present at the intersection of Gladstone Street and Rover Avenue prior to construction of the Disraeli Bridge. Two sewer lines are deemed to be particularly relevant to this investigation since they appear to remove waste water from the former MGP site. One of the sewer lines was a 24 inch sewer line associated with the Winnipeg Electric Company and it ran along Gladstone Street at the west side of the subject site (shown in Figure 1 as line ④). At the intersection of Gladstone Street and Rover Avenue, the sewer line turns east at a manhole to terminate at the river outlet labelled as point ⑦ in Figure 1. Interviews of former employees conducted during the Preliminary Site Characterization (CH2M, 1994) identified that effluent waters from the plant were occasionally discharged to the sewer on Gladstone Avenue. It is possible that the employees were referring to this 24 inch sewer line.

The second sewer line shown on Plan 4502-14, was a twelve inch tile pipe, which exited the Centra site at the north side and terminated at the same river outlet as the 24 inch sewer line described above. The twelve inch tile pipe (labelled as line ③ in Figure 1) appears to be the same sewer line which serviced the entire MGP shown on Centra's Plan 421. The twelve inch and 24 inch sewer lines terminated at an outlet on the west bank of the Red River at a recorded elevation of 8.08 feet, shown as point ⑦ on Figure 1. The reference elevation for this outlet is not known.

Additional plans provided by the Bridge Inspection Department document borehole logs which were advanced in the vicinity of the bridge piers prior to the Disraeli Bridge construction. The boreholes appear to have been completed in 1949 and 1955 and do not mention the presence of any contaminants (Sheet 1, Appendix B). The winter ice level is shown to have an elevation of 0.0 feet. A second drawing (Sheet 2, Appendix B) shows the bridge piers and logs for boreholes advanced adjacent to the piers. This drawing is undated but indicates that the River's summer water elevation was 7.0 feet and the ice level as 0.0 feet. In general the river sediment consisted of clay, silt, sand and gravel overlying gravel, limestone boulders and broken limestone.

Personal communication with Mr. Galvraes indicated that pier numbers 2,3 and 4 on the west bank were likely supported on driven creosote soaked timber piles and were backfilled with granular material.

5.7 Aerial Photographs

An aerial photograph from 1928 shows the site was developed with the MGP and that the structures appear similar to those shown on available IAO plans. The Disraeli Bridge has not yet been constructed. No structures can be seen along the river bank immediately north of the subject site, however a dock appears to be located upstream from the site, immediately north of the adjacent Winnipeg Hydro sub-station to the east of the site.

An aerial photograph from 1948 shows the site is developed as it was in 1928. No structures can be seen along the river bank immediately north of the Centra Gas property and the dock structure to the east appears to have been removed.

In an aerial photograph from 1950, a small structure immediately north of the Centra site is evident along the river bank. The structure appears to be a small pumping station and this is supported by Centra records (Plan R-2-A, discussed in Section 5.3.). A smaller structure of unknown purpose appears to the left of the pump house and may be the outlet for the two sewers which serviced the MGP site according to City of Winnipeg Plan 4502-14 (discussed in Section 5.6).

5.8 City of Winnipeg Archives

Ms. Evelyn West of the City of Winnipeg Archives indicated that they maintain records for the other City of Winnipeg departments which AEE had contacted and that the Archives do not have any additional information regarding the construction of the Disraeli Bridge, current and existing sewer and water plans for Gladstone Street, Rover Avenue or Annabella Street, or any information regarding outfalls into the Red River.

5.9 Province of Manitoba Water Resources Branch

Mr. Alf Warkentin indicated that the Water Resources Branch does not have any records regarding historical discharge permits to the Red River or records regarding former outfalls or abandoned pipes.

Mr. Frank Render, of the Water Resources Branch, indicated that to his knowledge there were no known wells at the Centra site during the operation of the former MGP. Water to this area of Winnipeg was provided by underground mains in about 1919. Mr. Render indicated that prior to 1919 the City of Winnipeg typically used well water or water from the Assiniboine River.

5.10 Site Reconnaissance

On November 16, 1998, Mr. Harley Pankratz, P.Eng. and Ms. Allyson Desgroseilliers, EIT of AEE visited the site with the intent of locating existing outfalls along the west bank of the Red River adjacent to the Centra site, confirming information obtained from previous sources and determining if coal tar residue was visible along the river's edge. Photographs taken during the site visit are included in Appendix B. East of the Disraeli Bridge, a former pump house structure was found to remain along the bank although it appeared that all piping has since been disconnected (Plate 3, Photo 1). This pump house was identified on Centra's plan R-2-A and was discussed in Section 5.3. There was no evidence of coal tar or hydrocarbon residues in the vicinity of the pump house. The location of the buried natural gas line which crosses the river east of the Disraeli Bridge was identified by signage. The pipe itself was not evident above the surface and no coal tar residue was observed on the river bank in this area. West of the Disraeli Bridge, AEE identified an outfall from the bridge's deck drainage system which was

consistent with the description by the Bridge Maintenance Department. The bridge outfall invert (Plate 3, Photo 2) was covered by a gate and had stone rip rap. Approximately 3 m west of the drainage outfall, AEE identified water with a hydrocarbon sheen seeping from the midpoint of the river bank (Plate 4, Photo 3 and shown in Figure 1). The seepage could be associated with a buried pipe although this could not be verified.

At the time of the site reconnaissance, there was no evidence of the former sewer outlet or sewer lines that were located along the river's edge as shown in Plan 4502-14 and discussed in Section 5.6.

Coal tar residue was not observed along the river bank (Plate 4, Photo 4) immediately adjacent to the water's edge at any locations.

6.0 DISCUSSION

There are several possible explanations for the presence of coal tar residue in the sediment of the Red River and these can be generalized into two categories: subsurface migration and deposition during operations, either as an ongoing operational procedure or as the result of discrete events. Each category is discussed below.

6.1 Subsurface Migration

One possible source of the coal tar residue which is present in the river sediment is subsurface migration of coal tar from the Centra site through permeable zones directly into the river bed material. If the impacted river sediment is the result of subsurface migration, it is likely that the impacted sediment plume size will continue to expand until an equilibrium condition is reached, if it has not already been reached.

Based on the borehole log information provided (CH2M, 1994 and 1995), it appears that evidence of hydrocarbon impacted soil below the Centra site was limited to a zone of glaciofluvial sands, silt and clay deposits which are present at the north end of the site. The glaciofluvial soils were suspected of having a higher permeability than the underlying till deposit. In 1995, CH2M concluded that the residues in soil were most likely the source of the coal tar residues in the river sediment. This was based on the observations that the residues in soil extended off-site to the north towards the river and that concentrations were highest in the area adjacent to where they were found at their highest level in sediments (CH2M, 1995). CH2M (1995) stated "the residues were found to exist at their highest concentration at a depth of 6 to 8 m which corresponds to the bottom of the river where affected sediments were encountered". However, AEE's review of CH2M borehole logs and cross sections indicates that the highest concentrations correspond more closely to the River's normal summer water level and not the river bottom elevation. The coal tar residues were found at low to negligible levels below 11 m in depth (CH2M, 1995), the depth at which the contaminated sediments occur.

Excavation trenches of the numerous pipelines at the Centra site, which may have been backfilled with granular material, represent other permeable zones in which subsurface migration could occur. Although it is likely that many of the original pipelines were removed as the site was redeveloped, it is possible that some piping remains buried at the site and could provide a preferential subsurface migration pathway.

If on-going subsurface migration was occurring through permeable soils located along the entire north end of the site, coal tar residue would be expected to be seeping out of the river bank or impacted sediments would be expected to be found immediately adjacent to the river bank along the majority of the Centra site. Instead, river sediment sampling has indicated very little evidence of coal tar impacts in the sediments along the bank immediately adjacent to the Centra site. The lack of coal tar present along the river bank and in the sediment immediately adjacent to the river bank does not support the on-going subsurface migration hypothesis. Also, coal tar residue did not collect within the monitoring wells and liquid coal tar deposits of

significant size were not encountered during borehole drilling. If substantial coal tar or coal tar by-products had been found in the monitoring wells or during borehole drilling, there would be greater reason to suspect on-going subsurface migration to the river. There is a possibility that the contamination has spread along the riverbank for the entire length of the plume and then has migrated into the River all along the river's edge. However, there is no evidence to suggest that this has occurred and this migration path appears unlikely.

On-going subsurface migration could have occurred at a point(s) along the river bank at one time (*ie*. during or immediately after operation of the MGP), when contaminant levels were potentially much higher. This type of subsurface migration would be expected to result in the plume which has been observed. However, on-going subsurface migration at a point source(s) is unlikely because there has been no evidence of substantial seepage from the river bank and coal tar has not been observed along the river's edge or near the shore.

Disturbances such as construction of the Disraeli Bridge (commencing in 1958), construction of the earthen dyke along the river bank (in the 1950s), and redevelopment of the site may have resulted in new or altered migration pathways. This could have resulted in the redeposition of existing contaminants.

6.2 Deposition of Coal Tar Residue during Plant Operations

One other potential explanation of the coal tar residue in the river sediment is that the coal tar was deposited during operation of the MGP. Although there is no evidence to suggest that coal tar from either the water gas plant or coke oven plant was directly disposed of in the river, there is evidence that sewers which ran throughout the site flowed to the river bank. Therefore, coal tar residue present in river sediment may have been deposited indirectly. For example, it is known that there was a sewer line which took overflow away from the tar well. The tar was usually separated from the condensates by gravity in tar separators (or wells). The tar/condensate mixture flowed into the separator and separated into three distinct layers by gravity. An oil layer of lighter hydrocarbons floated to the top of the liquid and could be collected by oil skimmers. The tar sunk to the bottom of the tank and was removed and the water, in the middle layer, flowed through and exited. It is known that the by-product tar at this site was sold (AES, 1996). Typically the oil could be recovered and mixed with light oil, mixed with carburetion stocks, or disposed of with the condensate water. The condensate at most MGP was typically disposed of into a river or stream, treated for recovery of phenols and ammonia (coal gas only), flowed through coke beds prior to disposal, used as coke quench water, or recycled to cooler scrubbers. Reportedly, if insufficient time was allowed for settling, an emulsion of tar and condensate could form causing tar and condensate to exit the separator (AES, 1996). CH2M determined through interviewing personnel that the water used to cool the coke in the quenching tower was reused. When surplus water exceeded the holding capacity of the sump, it was likely directed to the Red River and/or the sewer. It was also believed that effluent waters from the plant were discharged on occasion to the sewer on Gladstone Avenue. This overflow was likely primarily water however, there could have been dissolved hydrocarbon components in the water, and on occasions coal tar may have flowed through this pipe. It may

also be that the coal tar residue present in the Red River was deposited by a single event or multiple cumulative events and was not part of the regular operational procedure, but was instead a rare or infrequent occurrence conducted under a unique set of circumstances. For example, an accidental release of coal tar due to a pipe break or an accidental spill from a holding tank resulting in the direct discharge of coal tar to the river may have occurred.

The plume which has been shown in Figure 1 would be consistent with an accumulation of coal tar residue at point ⑦ between bridge piers 6 and 7 and then dispersed downstream by the River. The lack of coal tar residue near bridge pier 6 could be the result of scouring by the River's flow or by ice during breakup. The Agassiz sediment sampling data indicated that coal tar was evident in the vicinity of point ⑦, supporting the conclusion that the sewer lines were the main source of tar residues.

If the coal tar present in the river sediment was deposited during the operation of the MGP it would be expected that the overall volume of coal tar residue would not be significantly increasing, but rather dispersing since the source has been removed. Sediment monitoring conducted by Agassiz between 1994 and 1998 showed that the plume size decreased from 1994 to 1996. However, in the autumn of 1997 the plume size appeared to have increased, particularly in the downstream direction. It should be appreciated that in the spring of 1997 the Red River experienced a major flood event which may have resulted in significant scouring of the River sediment. This seems to be consistent with the 1998 sediment monitoring conducted by Agassiz which shows an apparent reduction in the plume size. The reduction in plume size could possibly be attributed to the deposition of new sediment, the difficulties involved in obtaining reproducible sampling results due to the heterogeneous nature of the sediments, or inconsistencies in sampling procedure.

Another possibility is that the coal tar residue in the River was a result of a combination of discharges during the MGP operation and subsurface migration at point(s) along the river bank. As noted in section 6.1, it does not appear that subsurface migration of coal tar is on-going.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The historical information review identified several possible explanations for the presence of coal tar residue in the sediment of the Red River adjacent the Centra site. These have been grouped into two broad categories: subsurface migration and deposition during operation of the MGP.

Research conducted for the preparation of this report determined that several sewer pipes were present on site which likely disposed of process wastewater to the River. During the operation of the MGP, coal tar may have been carried with the overflow water regularly produced as part of the MGP process through the sewer pipes which exited at the river. Coal tar may also have been deposited during events which were not part of the regular operation of the MGP (*eg.* accidental release).

Subsurface migration of coal tar could have occurred through permeable soil zones along the river bank, or through granular backfill around pipelines. Considering the current distribution of coal tar in the river sediment and lack of coal tar along the river's edge, it is AEE's opinion that migration of coal tar through permeable zones along the river bank likely did not occur. Although, on-going subsurface migration is possible, it is unlikely since large accumulations of coal tar have not been observed in the sediment along the river's edge.

Seepage of water with a hydrocarbon sheen from the river bank west of the Disraeli Bridge was noted. This not considered to be a likely source of on-going migration, as no substantial ground staining was observed however, considering that the seepage point is in close proximity to the contamination plume, it may have acted as a contributing source at one time.

It was observed that the estimated extent of the residual coal tar in the river sediments recorded in 1997 seemed to have significantly increased although it could not be determined if there was an actual increase in the total volume of coal tar (ie. a larger area that was less concentrated). However, the plume size appears to have decreased slightly during the 1998 sampling season (November and December). A likely explanation for the variation is the Red River Flood which occurred in the spring of 1997. The Flood may have caused a scouring effect which disturbed the overlying uncontaminated sediment and exposed the coal tar impacted sediment below. It is expected that once exposed, additional dispersion of the coal tar could occur due to the dissolution, scouring during high water flow and scouring by near shore ice floes. After the flood event, uncontaminated sediment would be expected to gradually settle over the exposed coal tar residue.

Although the data reviewed has not been conclusive, it is AEE's opinion that the plume of coal tar residue present in the Red River adjacent to the Centra Gas Manitoba Inc. facility is not the result of on-going subsurface migration. Instead, it appears that the majority of the coal tar was likely deposited during operation of the former MGP or was the result of a combination of subsurface migration and deposition during or shortly after operation, when potentially higher concentrations of contaminants were present. There is direct evidence of effluent water being

discharged to sewers located on Gladstone Avenue (accounts of former employees) and a historical review of underground utilities at the former MGP has indicated other potential piping which could have transported coal tar residue from the site to the Red River. In addition, the plume size, location and shape appears to be consistent with a point source(s) release of contaminant with subsequent dispersion downstream.

If further evidence that on-going migration is not occurring is required, a trench could be excavated along the river's edge to identify the presence or absence of migration pathways. A test pit should also be advanced in the vicinity of the oily water seepage which was observed along the river bank to the west of the Disraeli Bridge. If no significant pathways are found, it could be confirmed that significant on-going migration is not occurring.

8.0 CLOSURE

This report has been prepared for the exclusive use of Centra Gas Manitoba Inc. for specific application to the subject site. The environmental investigation was conducted in accordance with the work plan prepared for this site and generally accepted assessment practices. No other warranty, expressed or implied, is made.

Respectfully submitted,

AGRA Earth & Environmental Limited

Allyson Desgroseilliers, B.Sc.(C.E.), B.Sc.(Bio)

Reviewed by:

Harley Pankratz, P. Eng.
Manager, Winnipeg Operations

Distribution (3): Mr. Bob Gill, Centra Gas Manitoba Inc.

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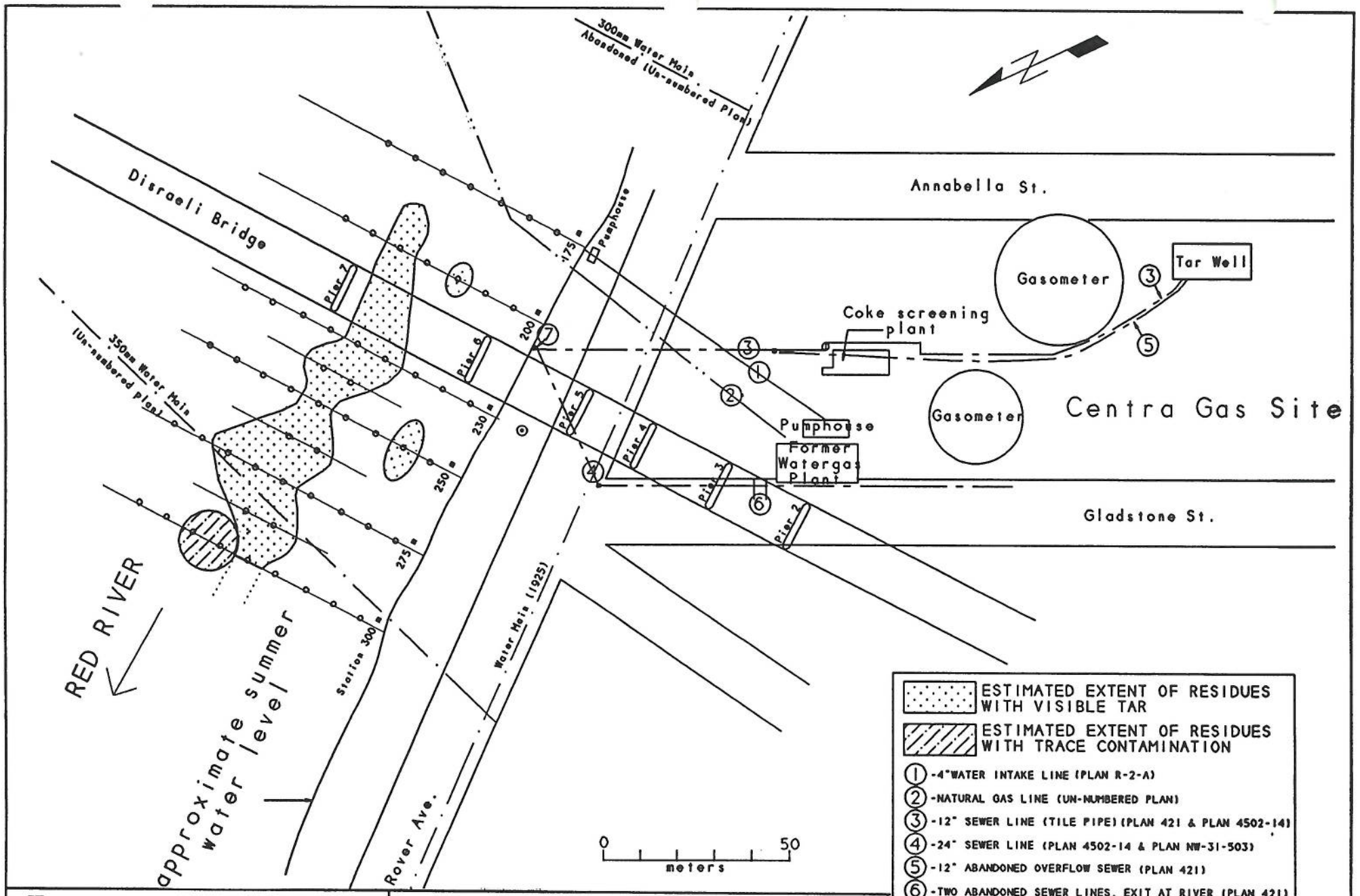

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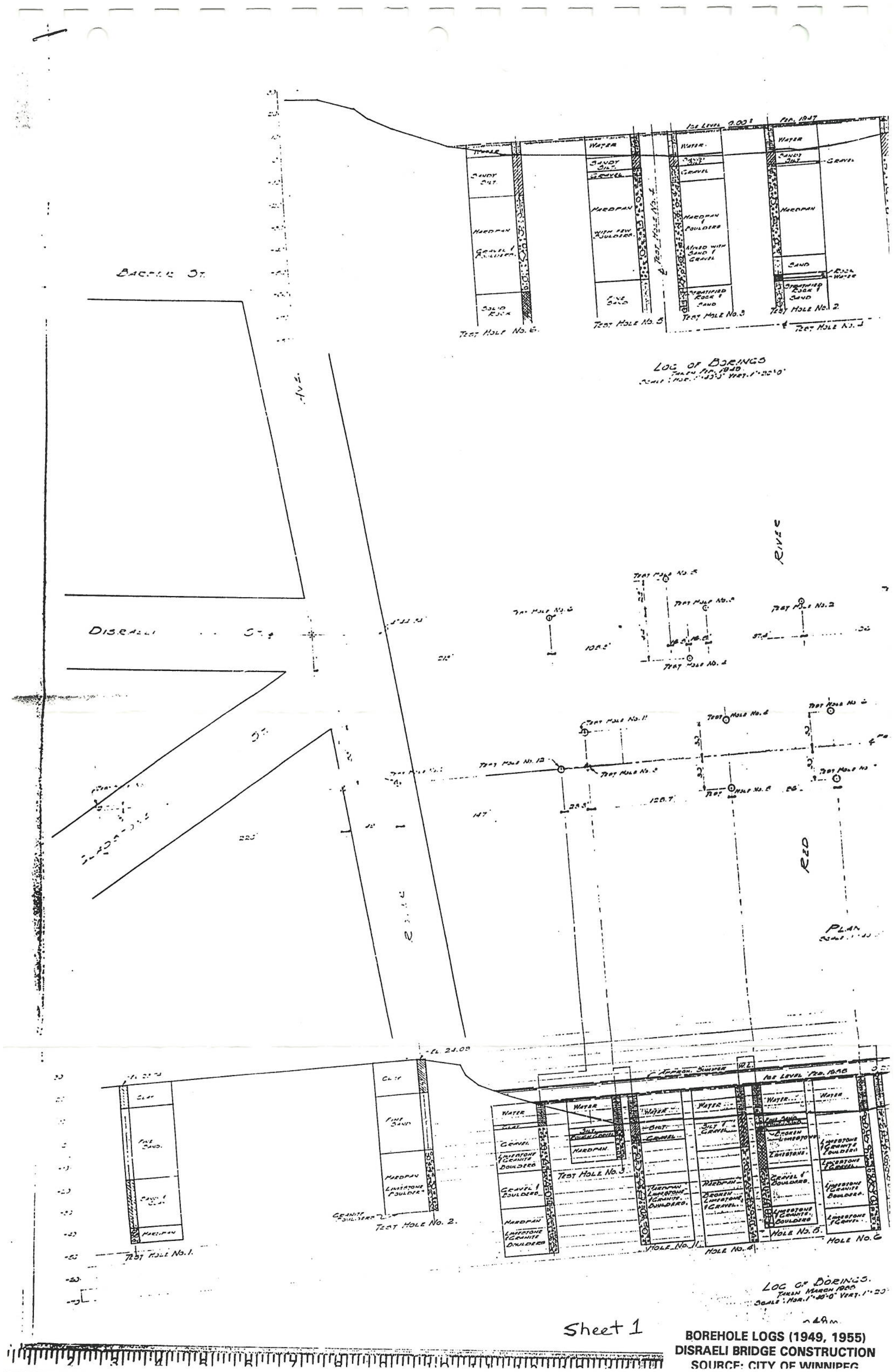
Earth & Environmental Limited

CENTRA GAS MANITOBA INC.
LOCATION OF PIPELINES AND CONTAMINANT PLUME

Drawn: ASD	Scale: AS SHOWN	Date: JAN/99	Project No: WX-04010	Figure: 1

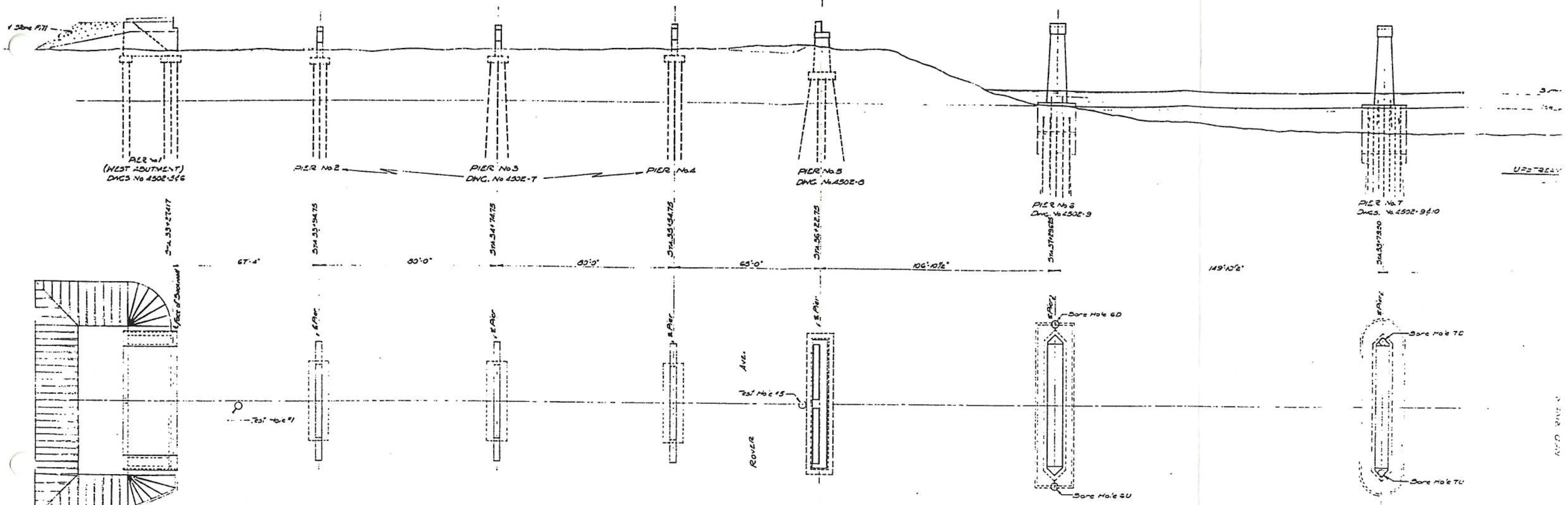
APPENDIX A

HISTORICAL BOREHOLE LOGS



Sheet 1

BOREHOLE LOGS (1949, 1955)
DISRAELI BRIDGE CONSTRUCTION
SOURCE: CITY OF WINNIPEG



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BOREHOLE LOGS (UNDATED)
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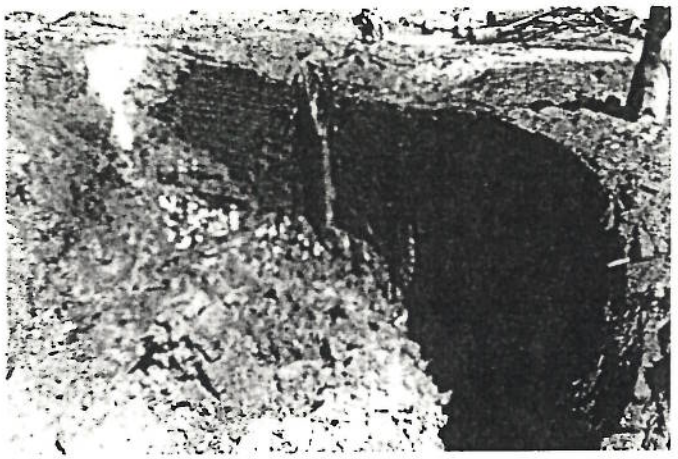
SOURCE: CITY OF WINNIPEG

APPENDIX B

PHOTOGRAPHS



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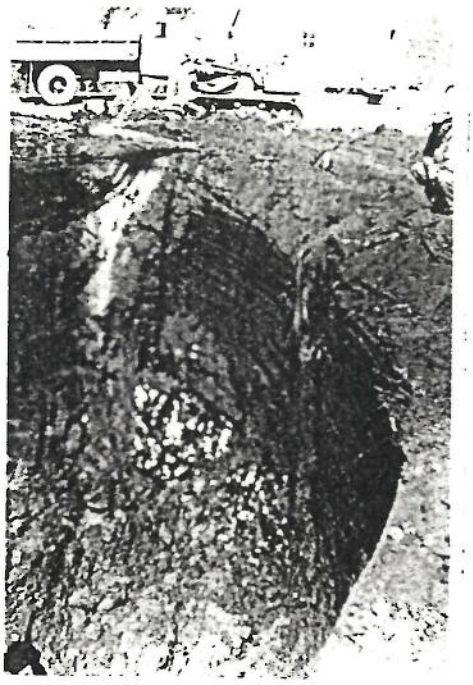

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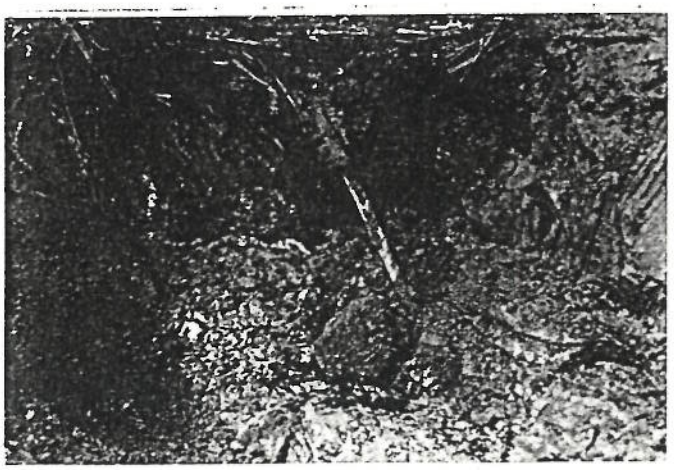
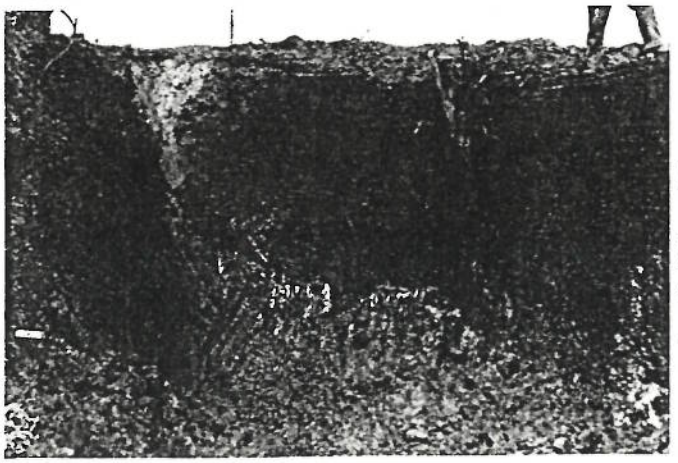


44-3

GOLDEN EASTWIND
AND F 3
IN EXCAVATION FOR PIPE No. 4

JUNE 4, 1953



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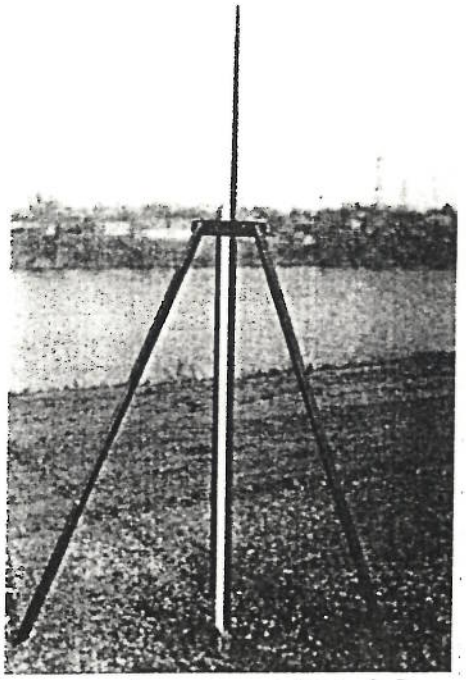
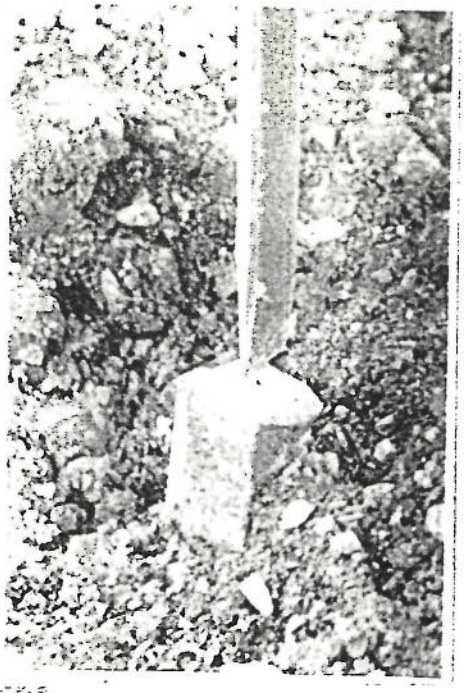
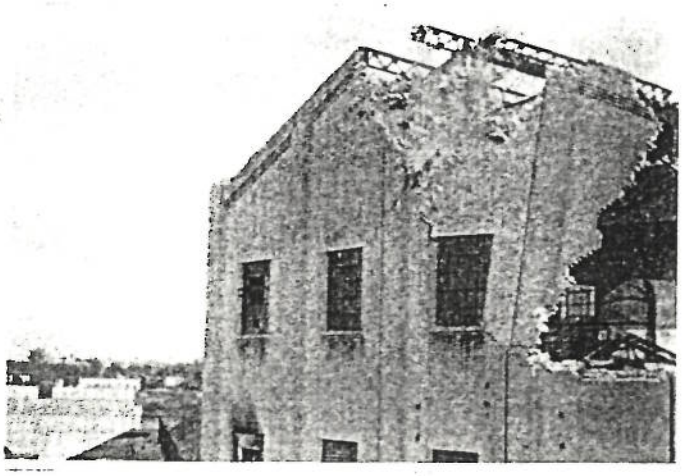
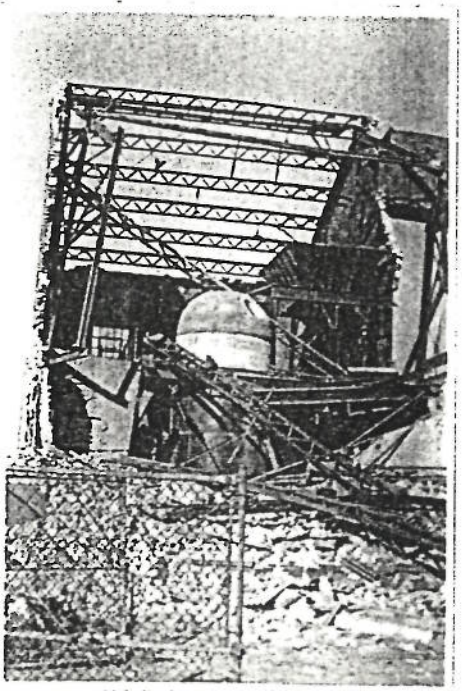
AGRA Earth & Environmental Ltd		PHOTOGRAPHS CENTRA GAS SUTHERLAND AVENUE OPERATIONS WINNIPEG, MANITOBA		
CENTRA GAS MANITOBA INC				
Drawn: N/A	Scale: N/A	Date: JAN/99	Project No.: WX-04010	Plate 1

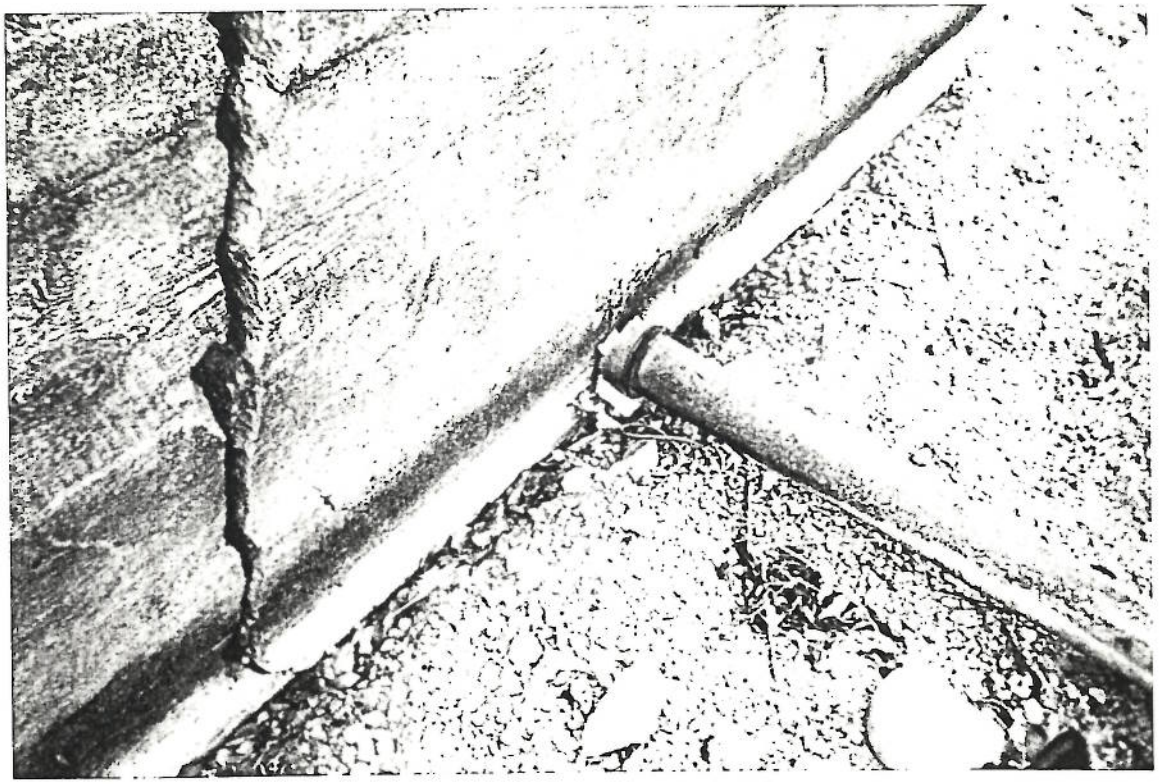








AGRA Earth & Environmental Ltd	PHOTOGRAPHS CENTRA GAS SUTHERLAND AVENUE OPERATIONS WINNIPEG, MANITOBA			
CENTRA GAS MANITOBA INC				
Drawn: N/A	Scale: N/A	Date: JAN/99	Project No.: WX-04010	Plate 2



PHOTOGRAPH 1: Small abandoned pump house on west bank of Red River, north of Centra site.

PHOTOGRAPH 2: Outfall from deck drains, west of the Disraeli Bridge abutment.

AGRA Earth & Environmental Ltd		**PHOTOGRAPHS CENTRA GAS SUTHERLAND AVENUE OPERATIONS WINNIPEG, MANITOBA**		
CENTRA GAS MANITOBA INC				
Drawn: N/A	Scale: N/A	Date: JAN/99	Project No.: WX-04010	Plate 3

PHOTOGRAPH 3: Water with a hydrocarbon sheen observed to be seeping from the west bank of the Red River, west of the Disraeli Bridge abutment.

PHOTOGRAPH 4: West bank of Red River, west of the Disraeli Bridge.

AGRA Earth & Environmental Ltd		**PHOTOGRAPHS**		
CENTRA GAS MANITOBA INC		**CENTRA GAS SUTHERLAND AVENUE OPERATIONS WINNIPEG, MANITOBA**		
Drawn: N/A	Scale: N/A	Date: JAN/99	Project No.: WX-04010	Plate 4

APPENDIX C

EXCERPTS FROM MGP REPORTER

Removal of Sediment from MGP Superfund Site

by James F. Villaume, P.G., PP&L, Inc.

As utilities and the regulatory community become more experienced in dealing with on-site issues at MGPs, the natural tendency is to start looking off site at other environmental issues. One source of exposure that has so far been largely overlooked, but which is now receiving closer scrutiny, is sediments. Recently, PP&L completed one of the first, full-scale remediations of coal tar impacted sediments at its MGP site along the lower Susquehanna River in Columbia, PA. The site was placed on the Superfund National Priorities List (NPL) in June 1994.

The remediation, which was conducted during the December and January, involved approximately 500 cubic yards of sediment contaminated by low levels of polycyclic aromatic hydrocarbons (PAHs). The deposit is believed to have formed during the operation of the nearby gas plant as a result of co-deposition of river sediment with tar-water overflows from the plant. The affected sediment was located just slightly downstream of the drinking water intake for the City of Lancaster, and originally it was felt that there might be an ongoing subsurface discharge of tar from the site to the river. This is the primary reason the site was placed on the NPL. While later studies proved this to be wrong, the contaminated sediments were still considered a source of exposure to recreational water users and aquatic life in the area and were therefore ordered to be removed.

The remedy selected for the non-time-critical removal action was dredging of the impacted sediments and installation of a sheetpile wall along the bank of the river to contain contaminated landside sediments that had become buried over the years by over 15 feet of random fill. The sediment deposit, which was only about 5 feet thick at its deepest point, occupied an approximately 50-foot-wide by 125-foot-long area along the shore of the river in water that was only about 4 to 5 feet deep under normal flow conditions. Flow velocities under these conditions are typically low due to the presence of a dam about 3 miles downstream. Early winter was chosen for conducting the work because it is one of the two times during the year when the probability of flooding is lowest (and fish are spawning at the other time).

Rather than dredging, which would have required the use of a barge and specialized equipment, it was decided to dewater the area first and then remove the sediments with standard excavation equipment. Treatability testing performed before the start of work indicated that the excavated sediments would dewater sufficiently through normal gravity drainage. This was later borne out during the actual performance of the work.

In order to dewater the area to be excavated, a portable dam, consisting of flexible geo-membrane panels draped over a bolted steel frame structure, was first installed about 10 feet out from the excavation boundaries using a 90-ton crane. This activity was completed in five days. The water inside the dam was then pumped over the dam back into the river through a 15- by 15-foot filter "sock" using a 6-inch dry-prime pump. In order to segregate clean river water infiltrating through the dam from water that came into contact with the contaminated sediments, a short sandbag wall was constructed within the dam immediately around the area to be excavated. All excavation activity, including sediment dewatering, was then confined to this "dirty" bermed area.

Water treatment consisted of filtration down to 10 microns followed by carbon adsorption. Initially, the untreated and treated water was to be stored in two large, double-lined "pools," but the first attempt to use them resulted in a liner failure due to excessive stretching of the liner material. The pools were then replaced with six 20,000-gallon portable "frac" tanks. Two separate treatment trains, each capable of a 90-gallon-per-minute throughput, were operated continuously throughout the project along with the

(Continued on page 6)

New EPA Report to be Published This Year

by Jim Cummings

The EPA, in collaboration with the Edison Electric Institute (EEI), American Gas Association (AGA), state regulators, and utilities, is preparing a document capturing innovative administrative and technical approaches to addressing MGP sites. This report is a successor to EPA's original presumptive remedies effort. A major objective of this report is to provide information useful for expediting remediation of Brownfields MGP sites.

Numerous states and utilities have provided information on case studies at MGP sites. Examples include multi-site agreements and multi-site bundling; innovative site characterization tools such as cone penetrometer/laser-induced fluorescence, immunoassay kits, and geophysical techniques; and remediation approaches ranging from co-burning to cold-mix asphalt batching.

An additional component of this collaboration involves field demonstration of promising site characterization tools. New York State Electric and Gas (NYSEG), in cooperation with the Electric Power Research Institute (EPRI) and EPA, distributed a request for proposal for this demonstration work.

A draft report was the focus of a meeting with selected states and trade association representatives (see page 5), and is undergoing an additional round of revisions. The target date for publication is September 1998. Utilities, regulatory personnel, consultants, and others who have information they would like considered for inclusion can contact:

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Removal of Sediment from MGP Superfund Site (Continued)

excavation dewatering system. The only parameters assigned discharge limits were benzene, naphthalene, and total suspended solids, and these limits were consistently met. To further minimize the amount of water that had to be treated, a PVC well-point header system was installed just outside the bermed area to intercept clean groundwater before it could enter the excavation. This system worked extremely well and was relatively simple to install.

After dewatering, which generally took fewer than 12 hours, the sediment was transported by a separate front-end loader to a triple-lined staging area near the excavation, where it was temporarily stored until arrangements could be made for transfer off site to a commercial thermal desorption unit. Water that collected in the staging area was processed through the same treatment system as the rest of the contaminated site water.

The entire excavation took 15 days to complete and ultimately produced about 750 tons of material. Post-excavation sampling was performed to demonstrate that the 4 ppm total PAH cleanup standard established for the project had been met. Following sampling, the excavation was to be backfilled with clean quarry sand; but, before the backfilling could be completed, the river flooded and the dam was overtopped. The dam itself was largely unaffected, except for a few torn panels. Once the floodwater subsided, the dam was removed, which took only two days.

A 110-foot-long steel sheetpile wall was installed along the bank in the area of the excavation to a depth of about 7 feet using an excavator bucket to push the sheets into place. Riprap was then placed over the exposed slopes to protect against future flooding.

From mobilization to demobilization, the project took 35 days to complete and cost approximately $500,000, including the cost of an independent oversight contractor. Initially, the sheetpile wall was to have been installed prior to the start of excavation but a field decision was made to wait because it was believed the excavation would commence immediately; however, problems with the initial dewatering of the excavation caused excessive delays. Had the wall been installed as planned, the ongoing excavation dewatering probably would have been a more manageable task. Cost increases, though, were avoided by making the contractor entirely responsible for dewatering, as it was realized early on that this was the one area of the project that had the greatest uncertainty.

The Columbia MGP site itself is currently at the feasibility study stage in the Superfund process. Other work completed to date includes grouting of the two on-site gas holder pits following the removal of the contained tar using steam and hot-water injection enhanced recovery technology■

J. F. Villaume is Superfund issue manager at PP&L, Inc.

UPCOMING CONFERENCES OF NOTE

• ***LDR Phase IV Workshop,*** July 31, 1998, at the Hyatt Regency O'Hare, Chicago, IL. Sponsored by USWAG and EEI. Co-sponsored by GEI Consultants, Inc., Atlantic Environmental Division. The workshop will be open to electric and gas utility employees, remediation consultants and regulators. For information on registration, contact Jim Rower. USWAG program manager (202-508-5645); jamesree@eei.org.

• ***Optimizing MGP and Brownfield Liability Recovery through Insurance Settlement Strategies and Asset Management,*** September 15-16, 1998, at the Westin City Center Hotel, Washington, D.C. This hands-on program includes detailed modules on the latest strategies including real estate asset management, remediation management, insurance recovery appraisal and insurance settlement tactics. For more information contact, IBC USA Conferences Inc., by telephone at (508) 481-6400, by facsimile at (508) 481-7911, by E-mail at reg@ibcusa.com, or visit its Web site at:

www.ibcusa.com/conf/mgp.

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