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Commissioner

Niagara Landfill Gas Extraction System

Fourth Quarterly Sampling

and

Evaluation of Radon Releases

July 7 - 8, 1997

February 23, 1998

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Niagara Landfill Gas Extraction System
Fourth Quarterly Sampling and Evaluation of Radon Releases
July 1997

Summary

Division of Solid & Hazardous Materials' Bureau of Pesticides & Radiation staff collected six samples of landfill gas from the Niagara Landfill on July 7-8, 1997. These samples of landfill gas were collected from a sampling port located in the piping leading from the blower to the flare before the flame arrestor. Radon-222 concentrations measured in the samples were all less than 150 pCi/l and were similar to concentrations measured in previous sampling efforts. Annual average radon concentrations due to landfill gas emissions would be indistinguishable from background at ground level.

Background

History of Site

The Niagara Landfill is located in the Town of Tonawanda, Erie County (Figure 1). The site was an operating landfill in 1978 when Part 360 went into effect. Niagara Landfill, a subsidiary of Browning-Ferris Industries (BFI), operated the facility under NYSDEC Permit No. 9-1464-00147/00001-0. The land itself is owned by Seaway Industrial Development, Inc. The landfill ceased accepting waste in 1993 and is now closed. As part of closure operations, 6 NYCRR Part 360 requires a landfill gas venting system to be installed. At present, the landfill gas is actively being pumped to a flare system authorized under NYSDEC permit No. 9-0464-00184/00001.

The Niagara Landfill is one of the four properties designated as the Tonawanda Site by the United States Department of Energy (DOE) under the federal government's Formerly Utilized Sites Remedial Action Program (FUSRAP). The Niagara Landfill Site comprises approximately 100 acres located in an industrialized area in northwestern Tonawanda, New York. In 1974, uranium ore residues processed during the Manhattan Engineering District (MED) project were excavated from the Ashland 1 Site, which is adjacent to the Niagara Landfill, and placed on the Niagara Landfill Site in three areas identified as Areas A, B, and C (see Figure 2). Area A is the largest, covering about 10 acres. A fourth area, Area D, also contains MED waste. It is continuous with an area of contamination on the Ashland 1 site. The DOE has estimated that there are 91,100 cubic yards of FUSRAP material in Areas A and D and another 25,900 cubic yards of FUSRAP material in Areas B and C. At some point in time, the 2 acres in Areas B and C were covered with about 20 - 40 feet of refuse. Areas A and D have not been covered with solid waste.

Gas Extraction System

The Niagara Landfill has 34 methane extraction wells (see Figure 3), which are connected and routed through a blower unit to a flare. Figure 4 shows the location of each of the 34 gas wells. BFI had originally designed the gas extraction system to cover the entire landfill. At DEC's recommendation, BFI deleted from the original plans four wells that would have been located near the areas where MED materials were deposited. Thus, none of the wells in the gas extraction system collect gas directly from the FUSRAP material.

Sampling Procedure

In order to measure the radon released from the landfill, a plan was developed for sampling the radon in the gas pipe line after (i.e., downstream of) the blower and prior to (i.e., upstream of) the flare. Figure 5 shows the relationship of the sampling port to the rest of the system.

To take a sample, first a fitting was installed into the sample port and tygon tubing was connected to the fitting. The sampling train then consisted of an inline membrane filter, a drierite cartridge, the Lucas cell and finally the 5 liter/minute air pump, all connected together using tygon tubing. Gas was pumped through the Lucas cell for five minutes to flush all of the high purity nitrogen out of the Lucas cell and replace it with landfill gas. (Note: high purity nitrogen is routinely used to flush out the cell after use.)

In the planning stages for this sampling event it was decided that a minimum of three samples would be required to make a determination of the radon concentration. In addition to our sampling, BFI arranged to have Wilkes University analyze three samples as well. On the afternoon of July 7, 1997, Bureau staff collected three landfill gas samples in our Lucas cells and three landfill gas samples in Lucas cells owned by Wilkes University. Wilkes University samples were collected alternately with ours. After the sampling was completed, DEC staff packaged the Wilkes University Lucas cells. The package was given to Federal Express for shipment to Wilkes University the next morning.

On the morning of July 8, 1997, DEC staff filled three more Lucas cells to see if there was any variation of radon concentration with time of day. After sampling, staff returned to Albany with all six Lucas cells for analysis. A minimum of four hours between sampling and analysis is required to allow for equilibration. Since the travel time from Buffalo to Albany is about 6 hours, this was not a problem. Staff analyzed the samples for radon on July 9, 1997.

Results of Analysis

The samples were analyzed by the Bureau on DEC instrumentation, which consists of a Ludlum Model 182 Radon Flask Counter connected to a Ludlum 2000 Portable Scaler. The following table gives the analysis results (decay corrected to the time the gasses were extracted from the sampling port).

Lucas Cell No.	Sampling Date	Radon Concentration (pCi/l)
1194	07/07/97	149 +/- 3.3
1193	07/07/97	146 +/- 3.2
1199	07/07/97	148 +/- 3.3
1203	07/08/97	117 +/- 2.7
1197	07/08/97	121 +/- 2.8
1198	07/08/97	114 +/- 2.6

The average radon concentration of the samples collected on the afternoon of July 7, 1997 and the morning of July 8, 1997 was 148 pCi/l and 117 pCi/l respectively. The gas flow rate, as measured by BFI for July 7, 1997 and July 8, 1997 was 852 cubic feet per minute (cfm), and 860 cfm, respectively.

Comparison to Previous Results

In February 1996, before the flare was operating, DEC sampled the gas in six of the gas wells, which were then venting directly to the atmosphere, under natural pressure. DEC's March 1996 report (ref.1) of those results acknowledged that the operation of the flare could change the concentration of radon in the landfill gas, but also stated that the effect could be determined only by analyzing the gas once the flare was in operation. One purpose of the sampling during the first year of flare operation was to begin to answer that question.

The concentration of radon in the six wells sampled in February 1996 ranged from 87 to 193 pCi/l (ref. 1). The range in the samples collected in October 1996 was 175 to 194 pCi/l (ref. 2), the range in the samples collected in January 1997 was 160 to 175 pCi/l (ref. 3), and the range of samples collected in April 1997 was 84 to 157 pCi/l(ref. 4). These most recent samples (July 1997) range from 114 to 149 pCi/l. The collective range of radon concentrations measured since the flare began operating is from 84 to 194 pCi/l. The October 1996,

January 1997, April 1997 and July 1997 samples were in effect drawn from all 34 wells, so statistically valid comparisons between these four data sets and the pre-flare February 1996 data (when only 6 wells were sampled) cannot be made. However, it is apparent that the operation of the flare has not substantially increased the concentration of radon in the landfill gas. The data from this most recent sampling effort also indicate that the concentration of radon in the landfill gas has not increased since the flare went into operation.

Applicability of Previous Computer Model Studies

Our November 1996 report (ref. 2) of the October 1996 sampling results included the results of computer modeling studies performed to estimate the radiological impacts of the radon emissions from the flare. Three models were used to assess dispersion of the emitted radon, ground level concentrations, and the radiation dose to the maximally exposed individual in the general public: US Environmental Protection Agency's SCREEN3 model, DEC's Air Guide 1 model, and the US Environmental Protection Agency's CAP88.

Since that time, two parameters have changed: (1) the radon concentrations measured in July 1997 were slightly lower than those measured in October 1996, and (2) the landfill gas flow rate in July 1997 was about 72% of the gas flow rate during the October 1996 sampling.

The reduction in the concentration of radon is small. In the modeling studies, it was assumed that the concentration of radon in the landfill gas was 200 pCi/l, which is greater than the concentrations measured in July 1997. Therefore, the concentration assumed for the modeling performed in 1996 is conservative, but valid, for modeling the results of the July 1997 samples.

The gas flow rate affects the model results in two ways: (1) it reduces the heat output of the flare, and (2) it reduces the calculated total activity of radon released. Heat output is a parameter in only one of the models we used to analyze the October 1996 sampling results, SCREEN3. That model was used only to project the dispersion of the radon under a variety of meteorological conditions (stability classes 1 through 6). In the 1996 studies, the model predicted that the concentration of radon in the plume would fall below 0.5 pCi/l within 20 meters of the stack, and below 0.1 pCi/l within 40 meters. Under the more favorable meteorological conditions, the model calculated a radon concentration less than 0.5 pCi/l within 10 meters of the stack and less than 0.1 pCi/l within 20 meters.

We repeated those SCREEN3 model runs using a reduced heat output when we analyzed the January 1997 data (ref. 3). The modeling results did not change, except that in three cases, the radon concentration was projected to decrease below 0.5 pCi/l or 0.1 pCi/l closer to the flare stack than had been predicted in the 1996 modeling studies.

With a lower gas flow rate, the rate of release and the calculated total activity of radon released per year would decrease. The effect of this, in all three models, is to reduce the resulting projected concentration of radon in air. Thus, the following 1996 results from the Air Guide 1 model and the CAP88 model are also conservative, but valid, for estimating the impacts of the releases measured in July 1997.

1. In 1996, DEC's Air Guide 1 model was used to predict the maximum annual average concentration of radon at ground level due to emissions from the flare. The result was 0.0001 pCi/l, which is less than 0.1% of natural radon concentrations. This concentration would be indistinguishable from background concentrations of radon.

2. CAP88 was used to assess the radiation dose a member of the general public could receive due to the radon emissions from the flare. CAP88 calculates the maximum radiation dose to a member of the general public using historical meteorological data. The predicted maximum ground level concentration of radon was 0.0005 pCi/l (less than 0.1% of natural radon concentrations). This corresponds to a worst-case annual radiation dose of 0.01 millirem per year. This projected dose is less than 0.0001 of the dose due to background radiation

Impacts of the Radon Concentrations Measured in July 1997

The radon emissions measured in July 1997 are within the range previously measured. The following conclusions, first presented in DEC's November 1996 report (ref. 2) of the October 1996 sample results, are also valid for the July 1997 sample results.

1. The radon released through the flare disperses to a concentration indistinguishable from background radon concentrations within 40 meters of the stack.

2. The projected maximum radiation dose due to the radon emissions is less than 0.01 mrem/year and less than 0.0001 of the dose due to natural background radiation.

3. There is no adverse effect on the environment or the public health and safety from the emission of radon from the landfill.

Summary and Discussion of Data from All Quarterly Sampling Events

The results reported here are the last in a set of four quarterly sampling events performed between October 1996 and July 1997 by Department staff at the Niagara Landfill. All data are presented in Table 1.

The radon concentration in the landfill gas samples collected ranged from 84 pCi/l to 194 pCi/l. The mean was 146 pCi/l. Figure 6 is a scatter plot of radon concentration versus date of sampling. There is a general trend of decreasing radon concentration over time.

Figure 7 is a scatter plot of gas flow versus date of sampling. There was a downward trend in gas flow, with the greatest decline (235 cfm or 20 percent) occurring in the first quarter of the sampling period. Over the next three quarters, the total decrease in gas flow was 113 cfm, or 9 percent of the original flow of 1200 cfm.

Figure 8 is a scatter plot of radon concentration versus gas flow. Any relationship that may exist between radon concentration and gas flow rate is not linear. The rate at which radon is produced is a constant, determined solely by the rate of decay of radium-226. The rate at which radon enters the landfill gas collection system is determined by a variety of factors. One of those may be the movement of the other landfill gases, which could push some radon into the system that would otherwise have remained in the waste and decayed to a solid there. Figure 8 suggests that in the Niagara Landfill, the flow of methane and other landfill gases is not the only factor determining the concentration of radon in the landfill gas. Although the highest concentration of radon occurred at the time of highest gas flow, the concentration of radon did not decrease proportionately when the gas flow decreased.

Sixteen of the samples were collected in the morning, between the hours of 7:45 am and 9:30 am. Twelve samples were collected in the afternoon, between 2:15 pm and 4:00 pm. This was done to detect any diurnal variation in the radon concentration. There is very little difference between the two sets of data. The morning samples ranged from 84 to 192 pCi/l, with a mean of 144 pCi/l. The afternoon samples ranged from 110 to 194 pCi/l, with a mean of 149 pCi/l. Figure 9 is a scatter plot of radon concentration versus time of day. There does not appear to be a marked change in radon concentration with time of day.

Conclusions and Recommendations for Future Sampling

The data show that the concentration of radon in the landfill gas has not increased since the flare went into operation. The concentration of radon released through the flare does not pose a significant hazard to the environment or the public health and safety. Because of the public interest in the landfill, we recommend occasional sampling of the gas and analysis for radon, to confirm that no significant changes have occurred. The gas should be sampled twice during the next year and annually thereafter. This sampling is required as part of BFI's operation and maintenance plan. More frequent sampling is not warranted, given the fact that the measured concentrations are not a significant hazard and the quarterly sample results reported here show that the radon concentration is not increasing.

References

1. Interim Report on the Radon Investigation at the Niagara Landfill. New York State Department of Environmental Conservation. March 1996.

2. Niagara Landfill Gas Extraction System First Quarterly Sampling and Evaluation of Radon Releases, October 15-16, 1996. New York State Department of Environmental Conservation. November 1996.

3. Niagara Landfill Gas Extraction System Second Quarterly Sampling and Evaluation of Radon Releases, January 22, 1997. New York State Department of Environmental Conservation. May 1997.

4. Niagara Landfill Gas Extraction System Third Quarterly Sampling and Evaluation of Radon Releases, April 1997. New York State Department of Environmental Conservation. May 1997.

Table 1: Niagara Landfill Gas Sampling Results
Oct 96 - Jul 97

Date Sampled	Time Sampled	Radon Concentration (pCi/l)	+/- (pCi/l)	Gas Flow (cfm)
15-Oct-96	03:00 PM	194	3.5	1200
15-Oct-96	03:10 PM	190	3.4	1200
15-Oct-96	03:20 PM	193	3.5	1200
16-Oct-96	07:45 AM	175	3.2	1200
16-Oct-96	07:55 AM	192	3.5	1200
16-Oct-96	08:05 AM	184	3.5	1200
22-Jan-97	07:56 AM	172	3.3	960
22-Jan-97	08:12 AM	166	3.3	960
22-Jan-97	08:06 AM	160	3.1	960
22-Jan-97	08:01 AM	175	3.4	960
08-Apr-97	08:17 AM	87	2.4	870
08-Apr-97	08:07 AM	91	2.4	870
07-Apr-97	02:15 PM	139	3.0	870
07-Apr-97	02:35 PM	110	2.7	870
07-Apr-97	02:25 PM	119	2.7	870
08-Apr-97	08:12 AM	84	2.3	870
15-Apr-97	02:16 PM	141	3.2	905
16-Apr-97	09:18 AM	157	3.2	910
15-Apr-97	02:11 PM	137	3.2	905
15-Apr-97	02:22 PM	126	2.9	905
16-Apr-97	09:13 AM	157	3.2	910
16-Apr-97	09:24 AM	155	3.1	910
07-Jul-97	03:38 PM	146	3.2	852
07-Jul-97	03:26 PM	149	3.2	852
08-Jul-97	08:16 AM	121	2.8	860
08-Jul-97	08:22 AM	114	2.6	860
07-Jul-97	03:50 PM	148	3.3	852
08-Jul-97	08:11 AM	117	2.7	860

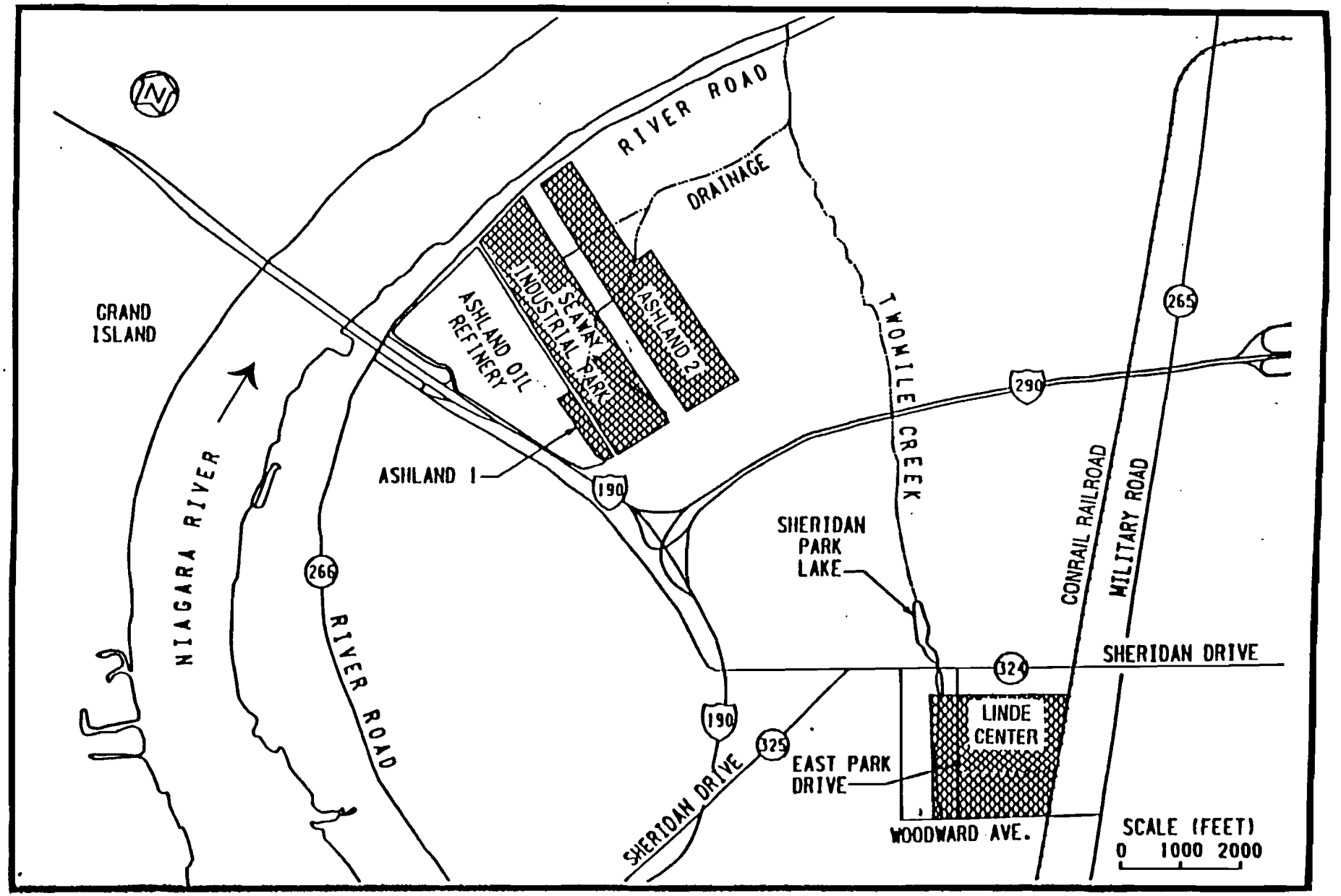


FIGURE 1 - LOCATION OF SEAWAY INDUSTRIAL PARK, SITE OF NIAGARA LANDFILL

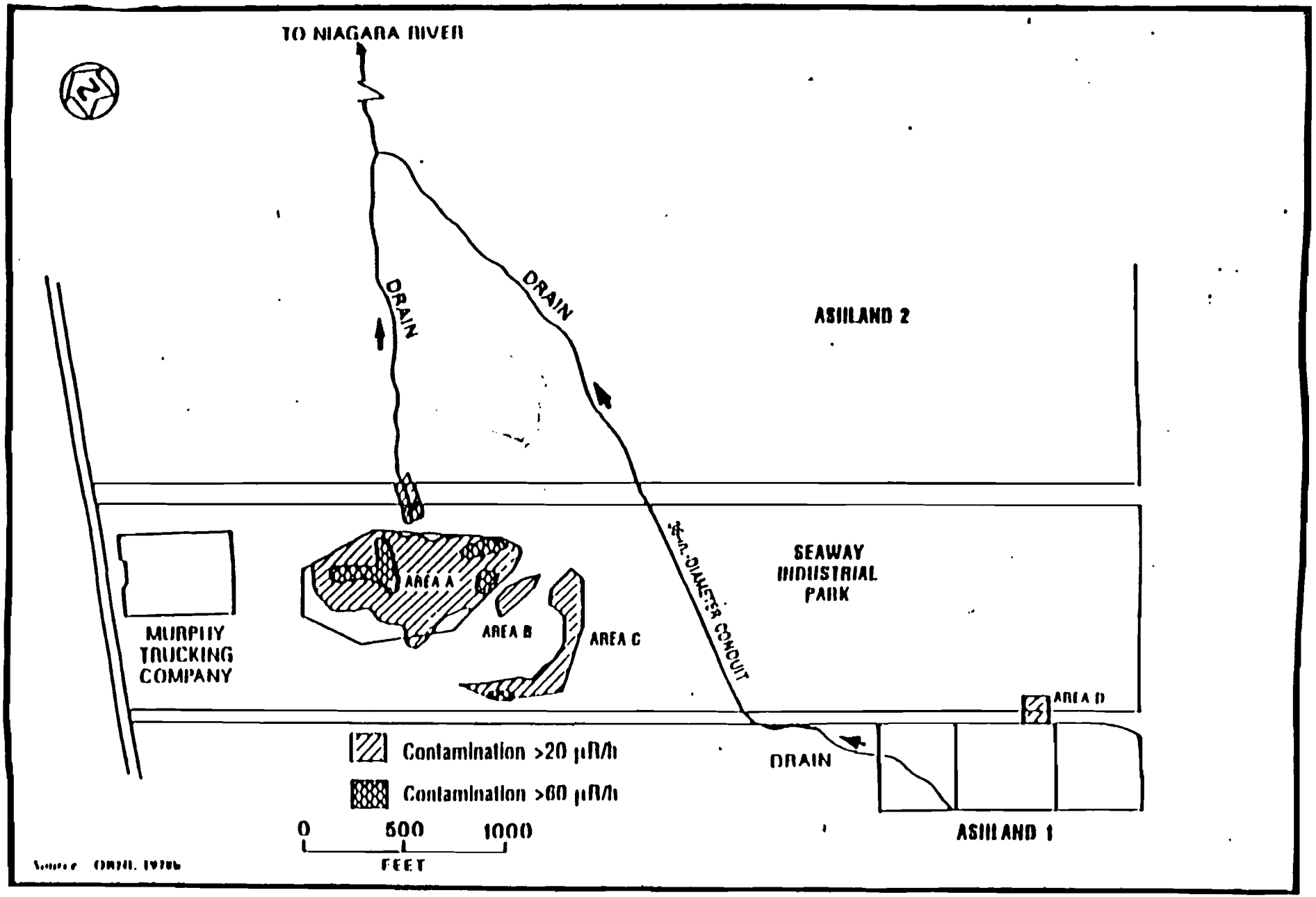
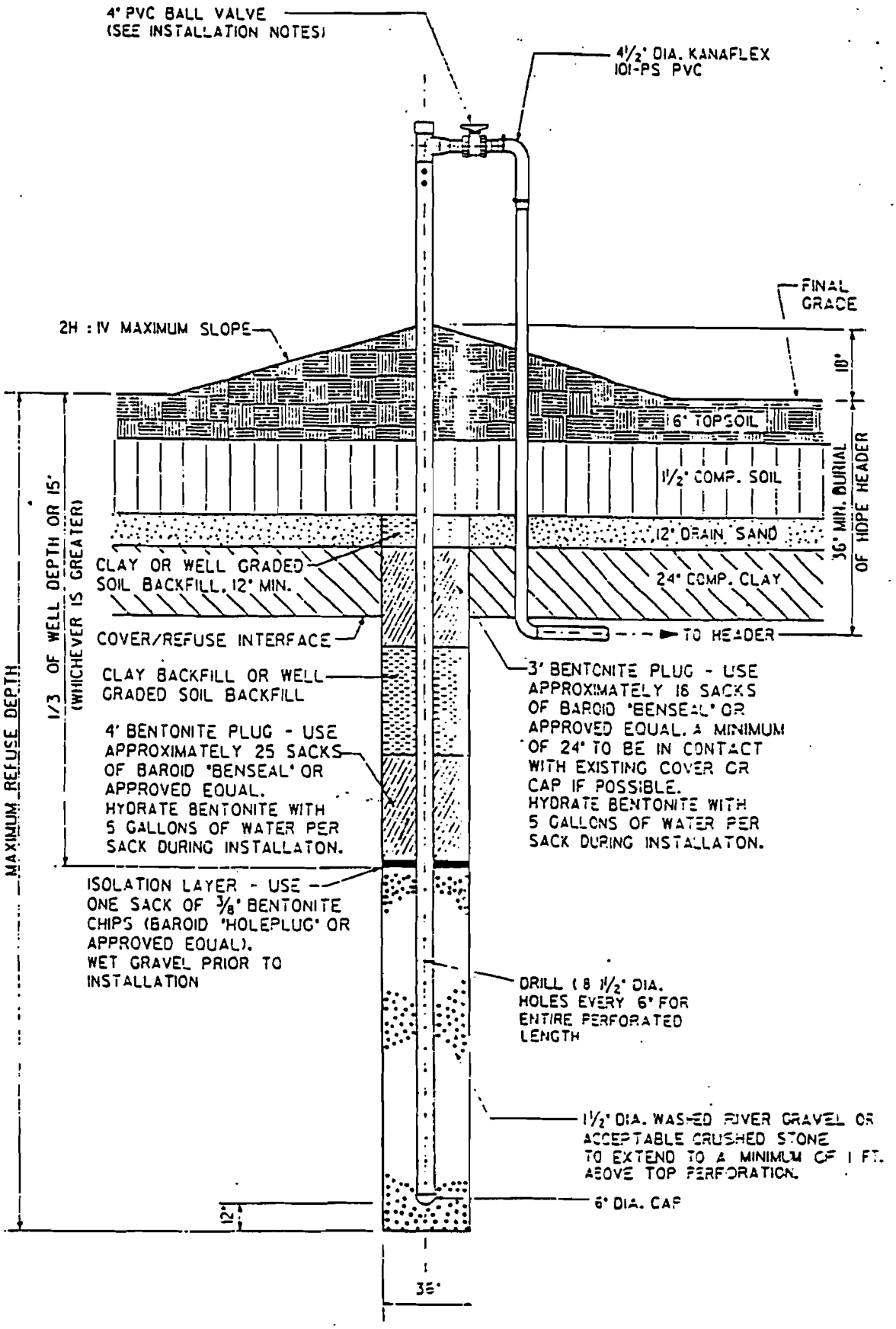


FIGURE 2 AREAS OF RADIOACTIVE CONTAMINATION AT NIAGARA LANDFILL (SEAWAY INDUSTRIAL PARK)



TYPICAL LANDFILL GAS EXTRACTION WELL DETAILS

NOTE 1: ADJUST PLUG AND BEDDING HEIGHTS AS NECESSARY TO MEET ACTUAL FEILD CONDITIONS

FIGURE 3

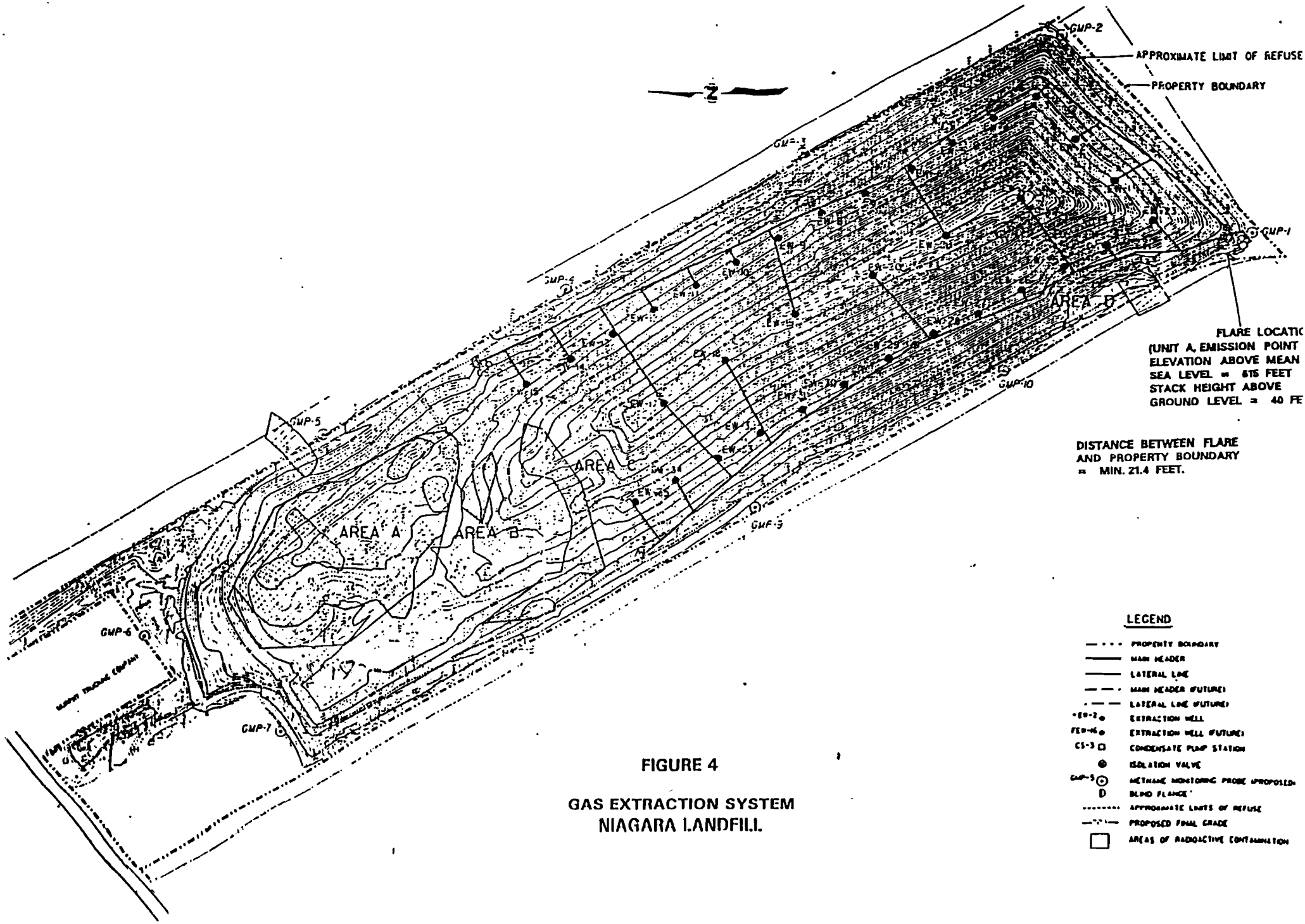


FIGURE 4

GAS EXTRACTION SYSTEM
NIAGARA LANDFILL

FIGURE 5

GAS EXTRACTION AND ENCLOSED FLARE SYSTEM

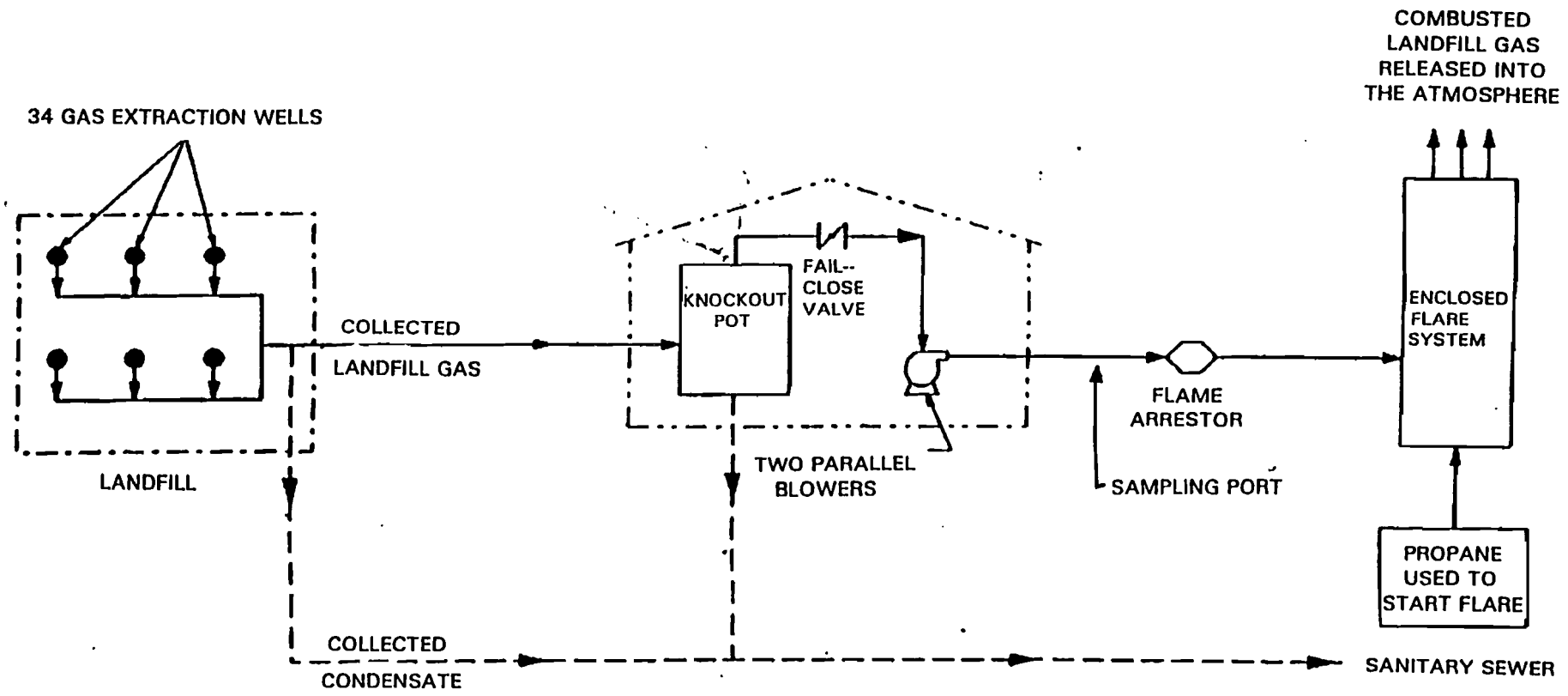


Figure 6: Niagara Landfill Gas- Radon vs Date of Sampling

Oct 96 -July 97

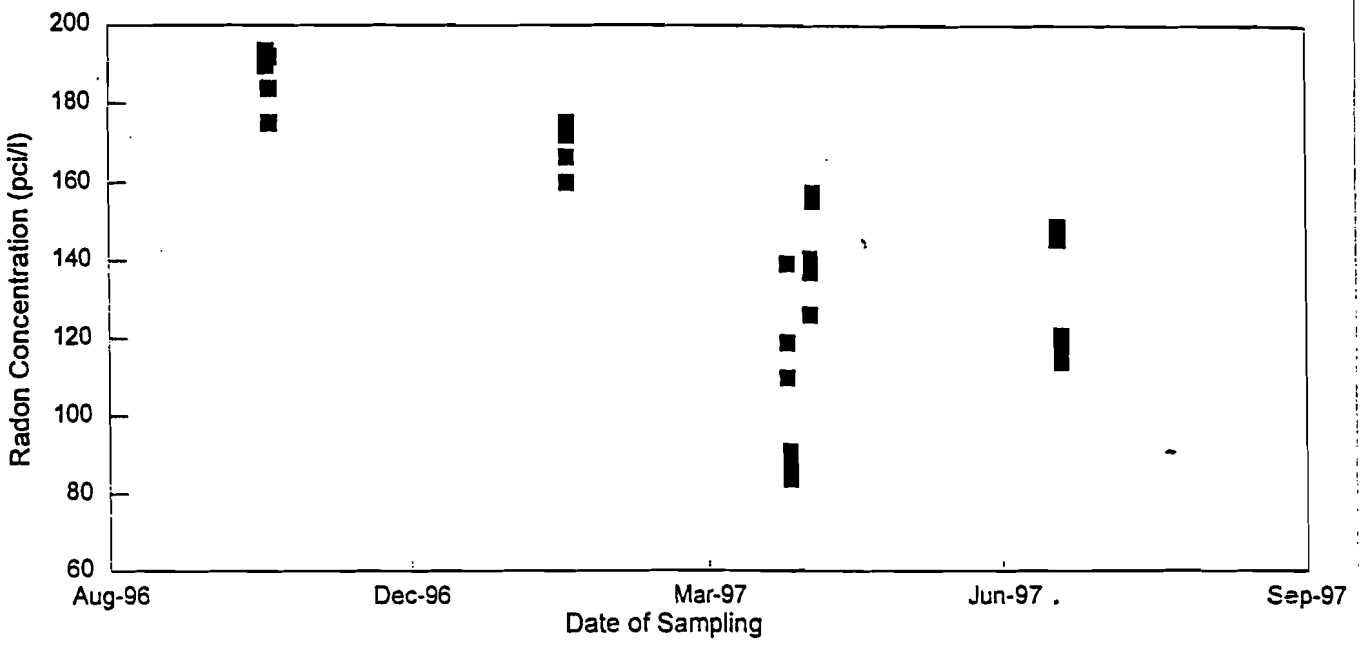


Figure 7 : Niagara Landfill - Gas Flow vs. Date of Sampling

Oct 96- July 97

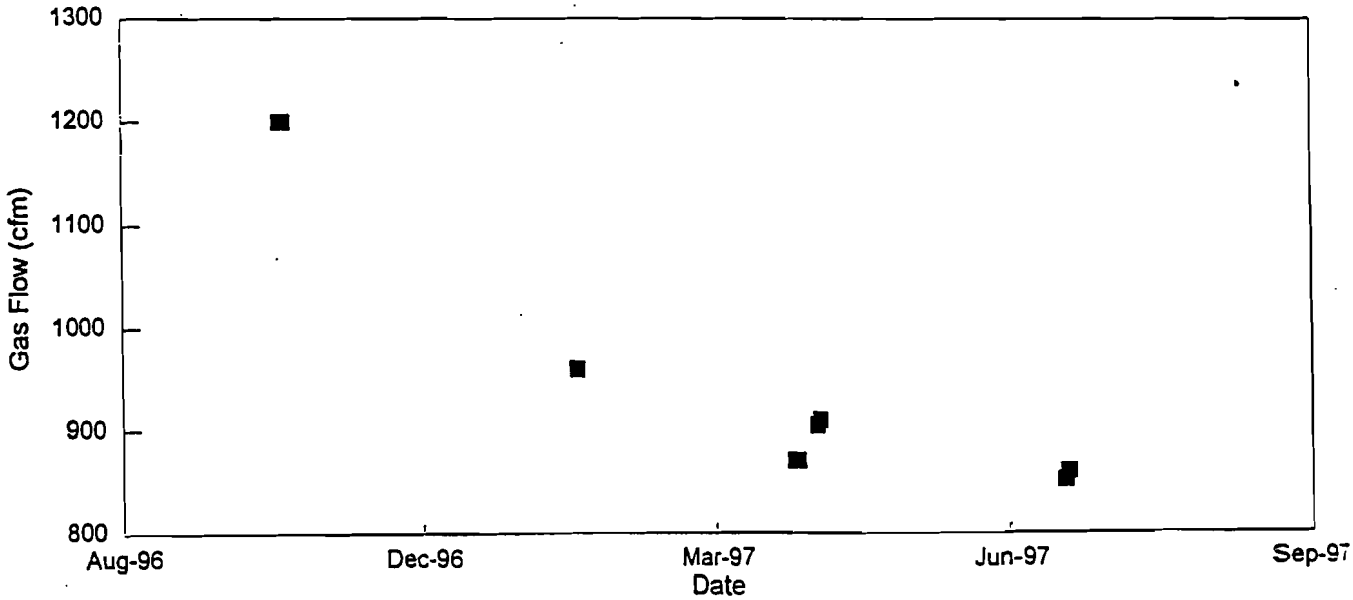


Figure 8: Niagara Landfill Gas- Radon vs Gas Flow

Oct 96 -July 97

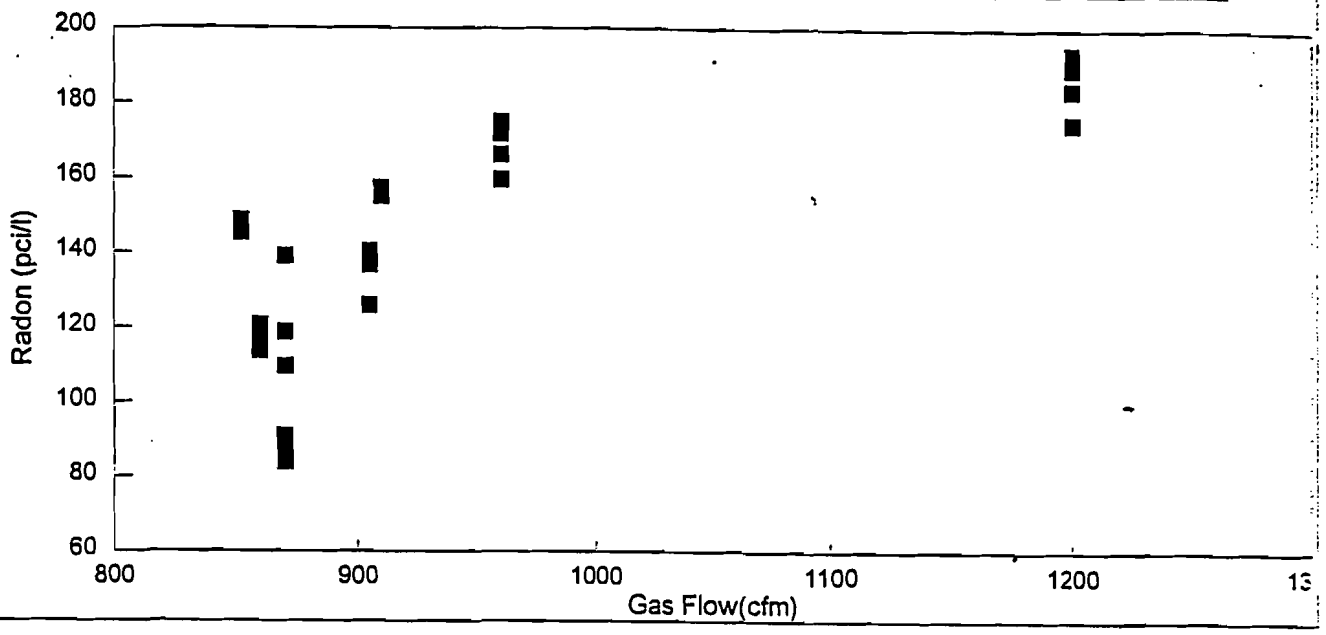
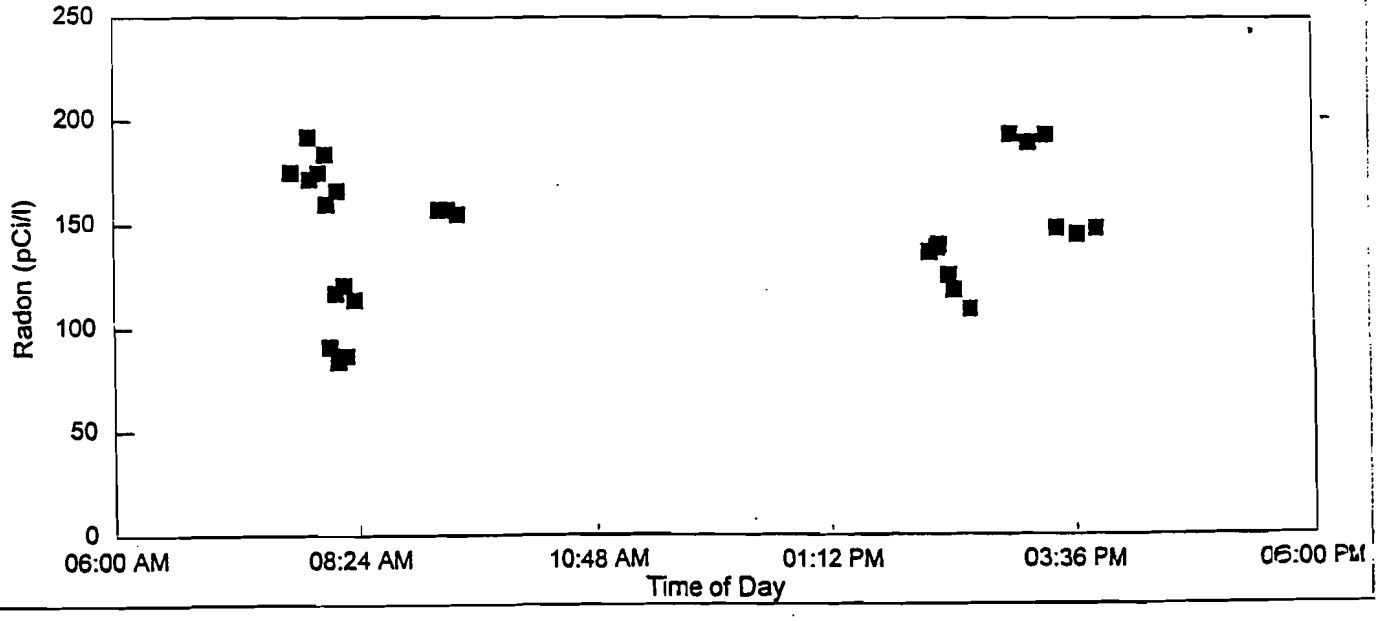


Figure 9: Niagara Landfill - Radon vs. Time of Day

Oct 96- July 97



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Prepare[redacted] Date: 2/23/98

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[redacted] in the sample collection and analysis of the results. He was no longer employed by the Department when this report was written.

Reviewed by[redacted] Date: 2/27/98

Chief
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