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JAN 2 2 1982

# Report

Prepared For

U.S. Environmental Protection Agency
Hazardous Waste Site Investigation
Sample Mgmt. Office, 112 N. Columbus Street
Alexandria, VA 22313
Attenton: Marian Bernd

Date: January 21, 1982

Date Received: October 24, 1981 PO No: VIAR 51 HQ Job No: 22413/jlg

Description of Samples

FINAL REPORT

Four (4) water samples labeled B0677, B0777, B0780, and B0781.

Five (5) soil samples labeled B0749, B0750, B0776, B0778, and B0779.

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The samples were analyzed by gas chromatography equipped with an electron capture detector for dichlorobenzenes, trichlorobenzenes, tetrachlorobenzenes, pentachlorobenzene, hexachlorobenzene, polychlorinated biphenyls (PCBs), Mirex, dioxin, 2,4,6-trichlorophenol, and benzenehexachlorides (BHCs).

None of these compounds were found in the water samples with the exception of B0677. Sample B0677 was found to contain a trace of 2,4,6-trichlorophenol, however a second column could not be found on which to confirm this result. Table I shows the detection limits for these compounds in the water samles. Table III shows acceptable recoveries from the matrix for most compounds except for the BHC's. This is discussed below.

The soil samples contained chlorinated benzenes and PCBs; results are listed in Table II for the soils. Positive results were confirmed on a second column (chromatographic conditions are given on the following page).

We would appreciate a telephone call if you have any questions regarding this report.



I certify that this report fully represents the findings of work performed by me, or under my direct supervision.

Joe Bramblett
Staff Chemist

Reviewed and Approved.

D.J. Northington, Ph.D.
Technical Director

The analytical results of the samples investigated and does not necessarily apply to other apparently identical or similar materials. This report is submitted for the exclusive use of the client to whom it is addressed. Any reproduction of this report or use of this report's name for advertising or publicity purposes without written authorization is prohibited.

JAN 22 1982

Duplicate and spike sample analysis showed fair to poor precision (Table IV) and fair recoveries (Table III).

No appreciable interferences were encountered for PCB's, chlorobenzenes, or trichlorophenol. However, coeluting PCB peaks interfered with dioxin and Mirex. Mirex was shown not to be recovered from the soil but showed quantitative recovery from the water. The loss of Mirex from the soil sample may be attributable to matrix effects.

The BHC's had no interferences in the water samples, but there were coeluting interferences in the soil samples. Recovery of these compounds from the water and soil was erratic. For example, in the water 20781 spike, gamma-BHC showed 165% recovery and beta-30% recovery. Both alpha and delta showed quantitative recovery ( 98%). A similar situation occurs in the soil sample spike. The beta isomer shows a recovery of 319%. The others show a very poor recovery. A distilled water spike of delta-BHC (Table III of original report) showed 99% recovery. So apparently, the sample matrix causes anomalous results. The problem is academic since no BHCs were detected in either sample.

Due to the characteristic elution patterns, identification of PCB's was very easy and reliable. The BHC's, dioxin and Mirex were readily identifiable in the water samples but not so in the soils. The chlorinated benzenes were readily identified in both samples. However, the dichlorobenzenes are too volatile for accurate quantitation using this method. Poor recovery of tetrachlorobenzene from the soil samples may be attributable to matrix effects.

Most chromatograms accompanied earlier reports. Chromatograms for pentachlorobenzene are enclosed.

Extraction of Samples

One liter (1.0L) of water samples and 100g of soil samples were extracted with 3 x 60mL methylene chloride, the extracts dried over anhydrous sodium sulfate, then concentrated and exchanged into hexane using a K-D concentrator.

The extracts were analyzed by gas chromatography equipped with an electron capture detector. The columns used for a particular analysis are listed on the following page.

JAN 22 1982

Chromatographic Conditions

Column A: 6' x 2mm I.D. glass column packed with 3% SP 2250 DB on 100/120 mesh Supelcoport; high purity nitrogen flow rate, 25mL/min; column temperature programmed from 120°C to 180°C at 10°C/min; injection port temperature, 240°C, detector temperature, 280°C.

Column B: 6' x 2mm ID glass column packed with 1.5% SP2250/1.95% SP2401 on 100/120 mesh Supelcoport; high purity nitrogen flow rate 25mL/min.; column temperature, 200°C isothermal; injection port temperature, 240°C; detector temperature, 280°C.

Column C: 6' x 2mm ID glass column packed with 1% SP1240 DA on 100/120 mesh Supelcoport; high purity nitrogen flow rate, 25ml/min; column temperature, 130°C isothermal; injector temperature, 240°C; detector temperature, 280°C.

Table I Water Samples

Parts per Trillion (Nanograms/Liter)

| Compound | Distilled Water Method Blank | B0677 | B0777 | B0780 | B0781 | Column |
|---|---|---|---|---|---|---|
| o-,m-,p-dichlorobenzene | ND<30 | ND<30 | ND<30 | ND<30 | ND<30 | A |
| 1,2,4-trichlorobenzene | ND<10 | ND<10 | ND<10 | ND<10 | ND<10 | A |
| 1,2,4,5-tetrachlorobenzene | ND<5.0 | ND<5.0 | ND<5.0 | ND<5.0 | ND<5.0 | A |
| Pentachlorobenzene | ND<5.0 | ND<5.0 | ND<5.0 | ND<5.0 | ND<5.0 | A |
| Hexachlorobenzene | ND<1.0 | ND<1.0 | ND<1.0 | ND<1.0 | ND<1.0 | A |
| PCB 1260 | ND<50 | ND<50 | ND<50 | ND<50 | ND<50 | A |
| Mirex | ND<5.0 | ND<5.0 | ND<5.0 | ND<5.0 | ND<5.0 | B |
| Dioxin | ND<1.0 | ND<1.0 | ND<1.0 | ND<1.0 | ND<1.0 | B |
| 2,4,6-trichlorophenol | ND<1.5 | 20 | ND<1.5 | ND<1.5 | ND<1.5 | C |
| $\alpha$, $\beta$, $\gamma$, $\delta$-BHC | ND<1.0 | ND<1.0 | ND<1.0 | ND<1.0 | ND<1.0 | B |

ND - Ths compound was not detected; the limit of detection for this analysis is less than the amount stated in the table above.

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## Table II Soil Samples

### Parts per Trillion (Nanograms/Kilograms)

| Compound | B0749 | B0750 | B0776 | B0778 | B0779 | Column |
|---|---|---|---|---|---|---|
| o-,m-,p-dichlorobenzene | 91,500 | ND<1500 | ND<1500 | 21,500 | 46,400 | A,B |
| 1,2,4-trichlorobenzene | 2,070 | 2,140 | 1,430 | 860 | 9,930 | A,B |
| 1,2,4,5-tetrachlorobenzene | 1,600 | 1,620 | 756 | 650 | 2,440 | A,B |
| Pentachlorobenzene | 540 | 1,400 | 510 | 740 | 2,420 | A,B |
| Hexachlorobenzene | 70 | 2,680 | ND<50 | 120 | 720 | A,B |
| PCB 1260 | 178,000 | 123,000 | 132,000 | ND<2500 | 278,000 | B |
| Mirex | ND<250 | ND<250 | ND<250 | ND<250 | ND<250 | B |
| Dioxin | ND<50 | ND<50 | ND<50 | ND<50 | ND<50 | B |
| 2,4,6-trichlorophenol | ND<75 | ND<75 | ND<75 | ND<75 | ND<75 | C |
| $\alpha$-,$\beta$-,$\gamma$-,$\delta$-BHC | ND<50 | ND<50 | ND<50 | ND<50 | ND<50 | A |

ND - This compound was not detected the limit of detection for this analysis is less than the amount stated in the table above.

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TABLE III

Q.C. Recovery Study

| | Soil B0749 | | | Water B0781 | | |
|---|---|---|---|---|---|---|
| | Amount Spiked ng/kg | Amount Recovered ng/kg | Percent Recovery | Amount Spiked ng/L | Amount Recovered ng/Lg | Percent Percent. Recovery |
| m-,p-Dichloro-benzene | 7000 | 28000 | 40% | 1400 | 80 | 6% |
| o-Dichloro-benzene | 30000 | 9000 | 30% | 600 | 90 | 15% |
| 1,2,4-Trichloro-benzene | 9000 | 6000 | 67% | 180 | 130 | 72% |
| 1,2,4,5-Tetra-chlorobenzene | 3600 | 1900 | 53% | 72 | 50 | 69% |
| Hexachlorobenzene | 470 | 400 | 85% | 9.4 | 8.1 | 86% |
| PCB 1254 | 10,000 | 10,500 | 105% | 200 | 206 | 103% |
| Mirex | 2100 | ND<250 | 0% | 42 | 41 | 98% |
| Alpha-BHC | 530 | 135 | 25% | 10.6 | 10.5 | 99% |
| Beta-BHC | 550 | 85 | 15% | 11.0 | 17.8 | 165% |
| Gama-BHC | 540 | 1720 | 319% | 10.8 | 3.3 | 30% |
| Delta-BHC | 540 | 270 | 50% | 10.8 | 10.7 | 98% |
| 2,4,6-Trichloro-phenol | 470 | 470 | 100% | 9.4 | 6.8 | 72% |

ND - This compound was not detected; the limit of detection for this analysis is less than the amount stated in the table above.

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TABLE IV

Duplicate Results-Soil Sample B0749

ng/kg (Parts Per Trillion)

| | Original Result | Duplicate Result | % Relative Difference * |
|---|---|---|---|
| o,m,p-dichlorobenzene | 91,500 | 144,000 | 44% |
| 1,2,4-Trichlorobenzene | 2,070 | 1,500 | 32% |
| 1,2,4,5-Tetrachlorobenzene | 1,600 | 1,150 | 33% |
| Hexachlorobenzene | 70 | 35 | 67% |
| PCB 1260 | 178,000 | 28,000 | 145% |
| Pentachlorobenzene | 540 | 470 | 14% |

* % Relative Difference = difference/mean

# United States Depart ient of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION - SOUTHEASTERN REGION
Richard B. Russell Federal Building
75 Spring Street, S.W., Suite 772
Atlanta, Georgia 30303

January 18, 1982

Mr. Charles Morgan
Office of Waste Programs Enforcement
U.S. Environmental Protection Agency
499 South Capitol Street
Washington, D.C. 20460

Dear Chuck:

At the request of Bill Walsh I am summarizing for the record the circumstances surrounding the preparation of the report, "Simulation of ground-water flow in the vicinity of Hyde Park landfill, Niagara Falls, New York" by Morris Maslia and myself. Preparation and review of the report can be summarized as follows:

1. The report resulted from our discussion in early September (at the time of the Buffalo court hearings) about the use of computer models to simulate ground-water flow at Hyde Park landfill. Later you advised me that EPA would pay all costs as specified in the memo of understanding covering EPA-USGS cooperation in hazardous waste site studies.

2. Computer runs were begun in late September and a calibrated model was achieved by November 18, 1981.

3. Preparation of the report was begun in early November and completed by early December. The report presents ground-water flow directions, estimated velocities, and probable points of discharge based on simulation. The computer simulation, in turn, is based on the hydrogeologic framework described in my 1964 Niagara Falls report plus the recent site specific data on geology, ground-water levels, and hydraulic properties provided by Conestoga-Rovers Associates.

4. Following usual USGS practice, report review consisted of these steps:

   a. Colleague technical review by wo experienced USGS hydrologists and by Professor M. Aral of Georgia Tech (who has done research in ground-water modeling).

   b. Editorial and overall review by the USGS reports specialist for the southeastern United States.

   c. Final technical review, USGS policy review, and approval (pending at this time) at USGS headquarters in Reston, Virginia.

5. No one at EPA or EPA's consultants or any of the parties involved in the Hyde Park landfill enforcement action was involved in the preparation or review of the report. As you know, the USGS is an impartial fact-finding agency. Therefore, the report is not intended to support the position of any party involved in the Hyde Park case.

Dick Johnston

Richard H. Johnston

cc: Ren Jen Sun, GW Branch, Reston, Virginia MS 411

SIMPLIFIED EXPLANATION OF THE GROUND-WATER SIMULATION DESCRIBED IN THE MASLIA/JOHNSTON 1982 REPORT ON HYDE PARK LANDFILL

1. What is the model?

The model is a computer program to solve mathematical equations describing ground-water flow for which no analytical method of solution exists (i.e., the equations cannot be solved by hand calculations). These equations consider the complex hydrologic boundary conditions existing at the Hyde Park site--i.e., variations in recharge rates, differences in hydraulic properties of the geologic units, directional differences of hydraulic properties within each unit, and the differing discharge conditions at the Niagara Gorge versus the buried power conduits. The alternative to using a computer model for obtaining ground-water velocities is to apply an analytical method such as the Darcy equation. This is a simple calculation; however, the use of this equation ignores complex recharge and boundary conditions as well as the unsaturated zone and thus is suspect.

2. How do we know that the model is simulating ground-water flow as it exists in the "real world"?

The only way to check the validity and accuracy of the model is to "calibrate" it. "Calibration" consists of using the model to compute hydraulic heads for specified conditions (recharge rates, hydraulic properties, etc.) and comparing the computed heads to field measurements of water levels (or contours derived from them). If the field and computer-generated values disagree, we adjust the hydraulic properties (within acceptable limits) until agreement is reached. Very little adjustment was needed for the Hyde Park model suggesting that our original hydrologic concepts were correct. However, in the bedrock units, we had to make the horizontal conductivity

100 to 1,000 times the vertical conductivity to achieve calibration. This indicates that the ability of the bedrock to transmit water vertically was even less than originally thought.

It should be noted that computer solutions obtained in the Rochester Shale cannot be verified because there are no field measurements to compare with the model-generated values.

3. Discharge of ground water at the Niagara Gorge

The model results indicate that all ground water moving from the landfill or beneath it will discharge at the Niagara River Gorge. The approximate percentage of ground-water flow reaching the gorge from each of the geologic units is as follows:

15% - glacial till

30% - Lockport Dolomite (upper 15 feet)

50% - Lockport Dolomite (lower part)

5% - Rochester Shale

However, it is important to understand that the discharging water may not actually reach the gorge face because of the extensive vertical joints there. We simulated these joints by specifying that the vertical hydraulic conductivity of the bedrock is 10 times the horizontal conductivity for a distance of 200 feet back from the gorge. Even so, our simulation is only a rough approximation in this area.

The lack of seepage or springs at the gorge face (as mentioned in testimony) is due to vertical movement of water via "open" joints or within slope rubble. The computer simulation is therefore valid only to the point where the ground water intercepts either "open" vertical joints or rubble.

4. Vertical versus horizontal flow in the bedrock units underlying Hyde Park

The model results indicate that horizontal ground-water flow rates greatly exceed vertical flow rates in the Lockport Dolomite and Rochester shale. The reason we know that movement is predominantly horizontal is because calibration required a much greater horizontal than vertical hydraulic conductivity. As a result, the velocity vectors computed by the model have large horizontal components but small vertical components. Although the arrows shown in the velocity diagram (figure 6 of our report) appear to be horizontal, they are generally 1-5 degrees below horizontal--indicating a slight vertical (downward) component of flow. The model results are in agreement with Johnston's 1960 observations in the conduit excavation; namely that flow is predominantly horizontal along bedding joints.

5. Time of travel of ground water

Times of travel for ground water presented in the report are from the center of the landfill to the gorge (or that point where the ground water intercepts "open" joints or rubble). The travel times shown for the Lockport Dolomite include time to move vertically through about 10 feet of till to the top of rock. We did not calculate travel times for the Rochester Shale because, as noted previously, computer solutions obtained for the Rochester shale cannot be verified.