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ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES

PHASE I INVESTIGATION

DIAMOND SHAMROCK, SITE NUMBER 932071
CITY OF LOCKPORT, NIAGARA COUNTY

September 1987

Prepared for:

New York State Department of Environmental Conservation

50 Wolf Road, Albany, New York 12233
Thomas C. Jorling, Commissioner

Division of Solid and Hazardous Waste
Norman H. Nosenchuck, P.E., Director

Prepared by:

Ecology and Environment, Inc.

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1. EXECUTIVE SUMMARY

1.1 SITE BACKGROUND

The Diamond Shamrock grounds have been used by Diamond Shamrock and its former owner Standard Silicate to dispose of fly ash and cinders from coal gasification processes. The area where this has occurred has been overgrown with vegetation and covered by nearby construction. It is not presently used for any disposal.

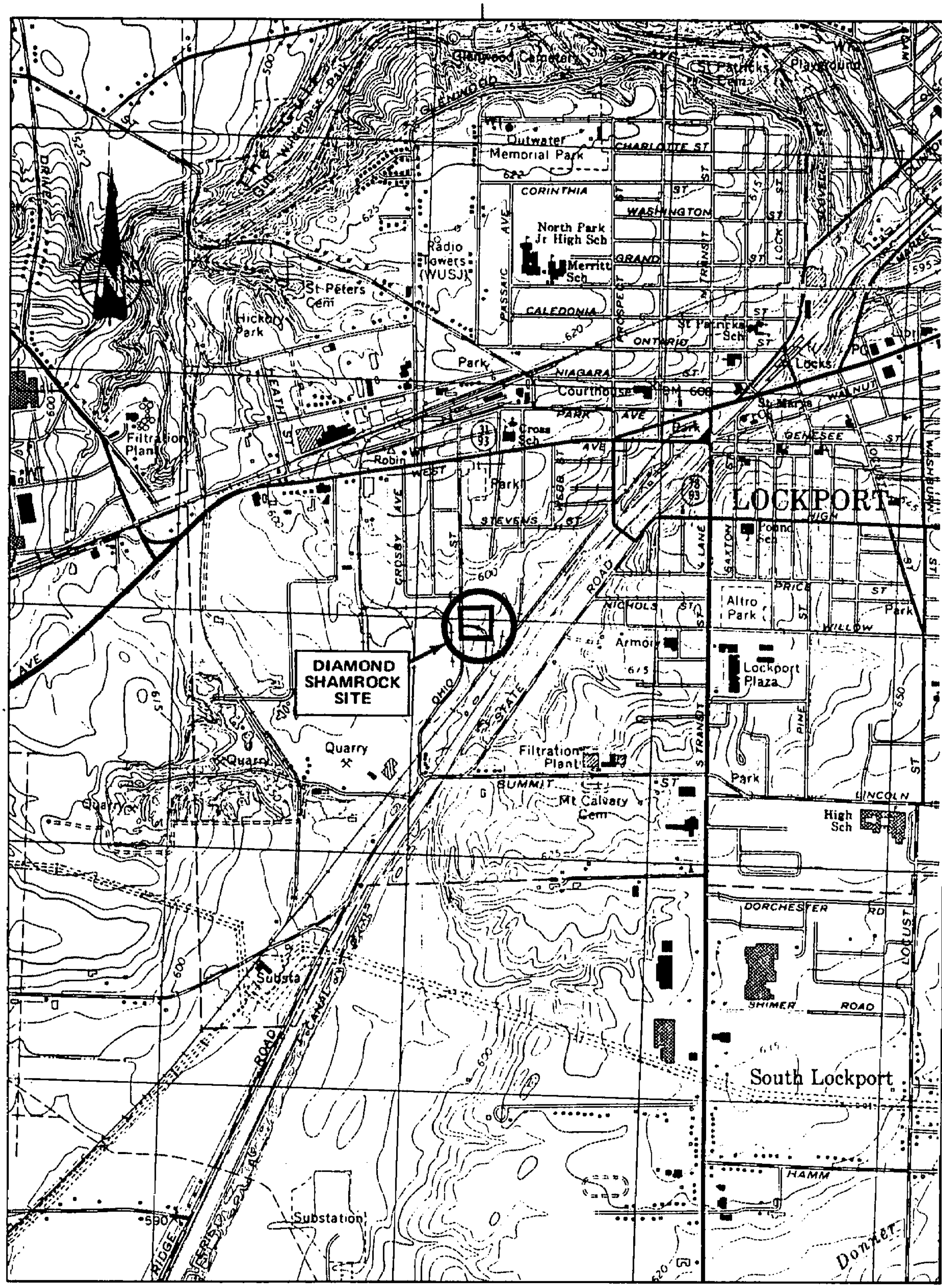
The site comprises approximately 5 acres and consists of office and production buildings, adjacent rail spurs, and gravel parking and loading areas (see Figures 1-1 and 1-2). The suspected disposal area is located in the northern half of the facility grounds. Although the site is fairly level, no standing water was noted. An open City of Lockport storm drain is located in the southeast quadrant of the plant grounds.

1.2 PHASE I EFFORTS

The site was visited on June 12, 1987, by Ecology and Environment, Inc., (E & E) personnel to conduct a physical inspection of the site in support of this investigation. Prior to the inspection, available state, federal, and municipal files were reviewed, and individuals having knowledge of the site were contacted. The site inspection consisted of a walk-over survey around the perimeter and into adjacent areas of the site. Of interest to the inspection were:

- Overall site conditions; and
- Determination of former waste disposal areas.

78°42'35"



43°9'54"

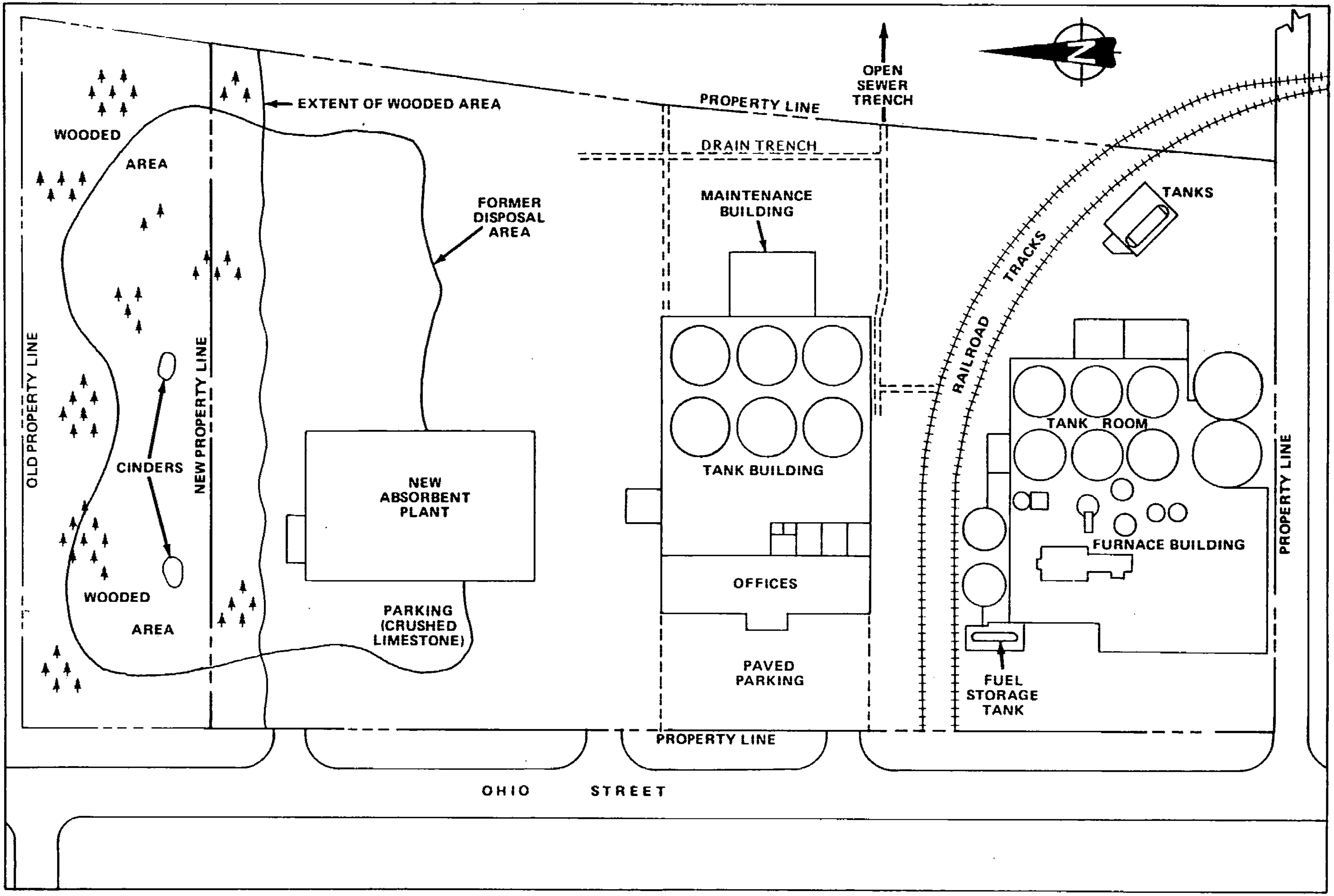
SOURCE: U.S.G.S. 7.5 Minute Series (Topograhic) Quadrangle, Lockport, N.Y., 1980.

SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

Figure 1—1 LOCATION MAP



NOT TO SCALE

Figure 1–2 SITE MAP - DIAMOND SHAMROCK

1.3 ASSESSMENT

In general, the site appeared to be maintained and was in good condition. Scrap waste was placed in a roll-off dumpster, and no waste of any type was observed being stored or landfilled on the site. A few small patches of cinders and boiler slag were noted and photographed at the northern end of the site, which is overgrown with vegetation.

1.4 HAZARD RANKING SYSTEM SCORE

A preliminary application of the Hazard Ranking System (HRS) has been made to quantify the risk associated with this site. As the Phase I investigation is limited in scope, not all the information needed to fully evaluate the site is available. An HRS score was completed on the basis of the available data. Absence of necessary data may result in an unrealistically low HRS score.

Under the HRS, three numerical scores are computed to express the site's relative risk or damage to the population and the environment. The three scores are:

- S_M reflects the potential for harm to humans or the environment from migration of a hazardous substance away from the facility by routes involving groundwater, surface water, or air. It is a composite of separate scores for each of the three routes (S_{GW} = groundwater route score, S_{SW} = surface water route score, and S_A = air route score).

- S_{FE} reflects the potential for harm from substances that can explode or cause fires.

- S_{DC} reflects the potential for harm from direct contact with hazardous substances at the facility (i.e., no migration need be involved).

The preliminary HRS score was:

$S_M = 0$ ($S_{GW} = 0$; $S_{SW} = 0$; $S_A = 0$)
$S_{FE} = 0$
$S_{DC} = 0$

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2. PURPOSE

This Phase I investigation was conducted under contract to the New York State Department of Environmental Conservation (NYSDEC) Superfund Program. The purpose of this investigation was to provide a preliminary evaluation of the potential environmental or public health hazards associated with past disposal activities at the Diamond Shamrock disposal site. This initial investigation consisted of a detailed file review of available information and a site inspection. This evaluation includes both a narrative description and preliminary HRS score. The investigation at this site focused on the section of the site where cinders and fly ash were reported buried during the 1920s through 1940s. Based on this initial evaluation, a Phase II investigation is proposed to better assess the potential hazards posed by the industrial wastes disposed of on the site.

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3. SCOPE OF WORK

The Phase I effort involved:

- The review of available information from state, municipal, and private files;

- Interviews with individuals knowledgeable of the site; and

- A physical inspection of the site.

State files reviewed were maintained by the NYSDEC Region 9 in Buffalo, New York. County files reviewed were maintained by Niagara County Department of Health. Private files reviewed were maintained by Occidental Chemical Corporation at the Ohio Street, Lockport, facility. Items reviewed were:

- Facility inspection reports (NYSDEC); and
- Niagara County Health Department profile report.

Mr. Michael Hopkins of the Niagara County Health Department was contacted in person on May 1, 1987, to discuss information maintained in the county files. The county file on the facility contained a profile and inspection report prepared in 1983. Mr. Gary Ernst of Occidental Chemical Corporation was contacted in person on June 12, 1987, to furnish background information and to accompany E & E personnel on a site inspection. He was able to furnish E & E personnel with a site map, a copy of a New York State Industrial Hazardous Waste Management Inspection Form, and background information on the history and ongoing processes on site.

No samples were collected by E & E although monitoring of air quality was performed using a HNu photoionizing organic vapor detector. Photographs were taken and are included in Appendix A. A physical inspection of the site and review of pertinent USGS 7.5-minute topographic maps were completed. A summary of agencies contacted, along with contact persons and addresses, is presented in Table 3-1.

Table 3-1

SOURCES CONTACTED FOR THE NYSDEC PHASE I
INVESTIGATION AT DIAMOND SHAMROCK

New York State Department of Environmental Conservation,
Region 9
600 Delaware Avenue, Buffalo, New York 14202
Telephone Number: (716) 847-4585

- Division of Solid Hazardous Waste
  Contact: Lawrence Clare, Ahmed Tayyebi
  Date Contacted: May 8, 1987
  Information: Referred to Niagara County Health Department for further information.

- Division of Regulatory Affairs
  Contact: Paul Eismann
  Date Contacted: May 8, 1987, and June 2, 1987
  Information: Permits; wetlands information.

- Division of Environmental Enforcement
  Contact: Joann Gould
  Date Contacted: May 6, 1987
  Information: Enforcement actions.

- Division of Water
  Contact: Rebecca Anderson
  Date Contacted: June 2, 1987
  Information: Floodplain locations.

- Bureau of Wildlife
  Contact: James R. Snider
  Date Contacted: June 2, 1987
  Information: Critical habitat locations.

Niagara County Health Department
10th and East Falls Street, Niagara Falls, New York, 14302
Telephone Number: (716) 284-3128
Contact: Michael Hopkins, Paul Dicky
Dates Contacted: May 1, 1987, and May 5, 1987
Information: Inspection and profile reports.

Occidental Chemical Corporation
Ohio Street, Lockport, New York, 14094
Telephone Number: (716) 434-4077
Contact: Gary Ernst, Barry Christensen
Date Contacted: June 12, 1987
Information: Site history, background information, New York State Industrial Hazardous Waste Management Inspection Form.

Lockport Water Department
Lockport Municipal Building, Lockport, New York 14094
Telephone Number: (716) 439-6678
Contact: James McCann
Date Contacted: June 10, 1987
Information: Details of the drinking water supply in the City and Town of Lockport.

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4. SITE ASSESSMENT

4.1 SITE HISTORY

The Diamond Shamrock disposal area was used as a refuse site for coal ash and cinders from a coal gasification plant from the 1920s to the late 1940s. This facility, which generated coal gas for use in Diamond Shamrock's production furnaces, is no longer in existence; the plant on site now uses electricity and natural gas as sources of power and no longer produces this waste.

An inspection by E & E personnel in June 1987 concluded that no hazardous wastes are currently generated or stored on site. No positive evidence of previous disposal was found, although traces of ash and cinders were found in the area north of the plant buildings. This area is partially covered by a new building and an overgrown orchard, and part of it has been sold to another corporation. No samples were taken from this area.

The Diamond Shamrock facility was formerly owned by Standard Silicate, which produced liquid sodium silicate from 1923 until Diamond Shamrock bought the facility in 1928. Diamond Shamrock produced liquid sodium silicate up to 1986 and sodium silicate insulation from 1980 until 1986. Occidental Chemical Corporation purchased Diamond Shamrock in 1986 and continued to produce sodium silicate and sodium silicate insulation. During the time of E & E's site inspection, the silicate production facility was not operating. A product called Hazorb was being produced, which is used as an absorbant in the chemical industry.

Waste such as paper, wood, and metal is placed into roll-off containers and removed by Modern Disposal Services, Inc.

4.2 SITE TOPOGRAPHY

This site is located on the Ontario Plain approximately 1 mile south of the Niagara Escarpment in the City of Lockport, New York. The escarpment presents the most topographic relief in the area, running in an east to west direction and rising approximately 175 feet. The area south of the escarpment is characterized by very low relief, except in its eastern part where small knobby hills and long low ridges rise above the former lake plain. The area to the north of the escarpment is generally flat with little relief and slopes gently toward Lake Ontario, approximately 12 miles to the north.

The Erie Canal is approximately 1,000 feet to the southeast of the site and flows to the east through the City of Lockport. The Niagara River is approximately 17 miles to the west. Site elevation is approximately 600 feet above sea level. The site is not in a floodplain, and the nearest wetland is approximately 4,000 feet to the south. The site is located in the highly industrialized areas southwest of the City of Lockport. It is bounded on the west by Ohio Street and on the south by other industries.

4.3 SITE HYDROLOGY

4.3.1 Regional Geology and Hydrology

The geology of the Lockport area is well understood because of its simplicity and because of the excellent exposures of bedrock along the Niagara River gorge and the Niagara escarpment.

The overburden in the Lockport area is relatively thin. Three types of unconsolidated deposits are present. The lowermost is glacial till and regolith, an unsorted mixture of boulders, clay, and sand deposited by glaciers, which directly overlies the bedrock. This is covered by clays, silts, and fine sands of lacustrine origin. These are the surface soils throughout most of the region. In isolated spots, sand and gravel deposits are found above the lacustrine soils. These were deposited by glacial melt streams and by wave action of the larger ancestors of the Great Lakes.

The bedrock in the Lockport area consists of nearly flat-lying sedimentary rocks, including dolomite, shale, limestone, and sandstone units. The several beds of bedrock slope southward approximately 30 feet per mile.

The entire region south of the Niagara escarpment, and extending almost to Erie County, is directly underlain by the Lockport Dolomite. The Clinton and Albion groups underlie the Lockport but crop out only along the escarpment and in the gorge of the Niagara River. These units are underlain by the Queenston shale. This unit is the uppermost bedrock unit under the plain north of the escarpment.

Groundwater in the Lockport area occurs in both the unconsolidated deposits and in the bedrock. The bedrock, specifically the Lockport Dolomite, is, however, the principal source of groundwater in the Lockport area. Three types of bedrock openings contain groundwater: bedding joints, vertical joints, and solution cavities.

The bedding joints, which transmit most of the water in the Lockport, are fractures along prominent bedding planes which have been widened up to 1/8 inch by solution of the rocks. These joints extend several miles thus constituting effective water conduits.

The vertical joints are generally too short and sparse to account for significant groundwater storage and transmission, except in the top 10-25 feet of bedrock. Solution cavities, formed when gypsum is dissolved, are also not important components of the aquifer. Although they increase the storage capacity of the aquifer, they are isolated and do not contribute to groundwater transmission.

Two distinct sets of groundwater conditions exist in the Lockport Dolomite. The first is the upper 10 to 25 feet of the bedrock. This region is highly fractured resulting in moderate permeabilities. In some areas in the region, a confining layer of clay above this zone can produce artesian groundwater conditions. The second class of groundwater conditions is found deeper in the bedrock, where at least seven different permeable zones have been identified. These zones are surrounded by impermeable bedrock, and it is not likely that they are hydraulically connected (Johnston 1964).

4.3.2 Site Hydrogeology

The soils at the site are of the Hilton-Ovid-Ontario association. These soils consist of deep well-drained to somewhat poorly drained soils having a medium-textured or moderately fine-textured subsoil. Natural drainage is a limitation in the wetter areas. Slope and erosion are concerns, mainly near the Niagara escarpment. The site is located in an elevated area and is expected to be somewhat better drained than other areas having the same association. Soil permeability ranges from 0.20 to 6.3 inches per hour (Higgins et al. 1972).

Little specific information on hydrology is available for this site. There are no wells on site and no known wells in the immediate vicinity. The presence of glacial deposits may impede downward flow of groundwater but there is insufficient data to adequately assess the hydraulic gradients and dominant flow patterns at this site.

The Lockport Dolomite is expected to be encountered between 5 and 10 feet below the land surface. Groundwater is likely to occur within the first encountered fracture or solutioning zone. Flow is expected to be in a southerly direction, toward the Erie Canal, approximately 500 feet to the south. This shallow water is probably hydraulically connected to the canal water.

The permeability of Lockport Dolomite depends on fracturing, weathering, and solutioning of the rock beneath the site.

To determine more accurately the site hydrogeology, extensive subsurface investigating would have to be performed, including installation of monitoring wells and up- and downstream sampling of the Erie Canal. This is not recommended until it is determined whether any hazardous waste has been present on site.

For purposes of HRS scoring the Lockport Dolomite is considered the aquifer of concern. This aquifer is expected to be encountered from 5 to 10 feet below land surface.

4.3.3 Hydraulic Connections

The Lockport can be divided into two zones on the basis of water-transmitting properties. The upper 10 to 25 feet of rock is a moderately permeable zone that contains relatively abundant bedding planes and vertical joints enlarged by dissolution of dolomite and abundant solution cavities left by dissolution of gypsum. These zones are more than likely hydraulically connected. The remainder of the formation contains low to moderately permeable bedding planes of which as many as seven may be major water-bearing zones that are surrounded by fine-grained crystalline dolomite. These zones are probably not hydraulically connected and are recharged by precipitation.

4.4 SITE CONTAMINATION

As far as it can be determined, no sampling of any kind has been conducted at this site. No known hazardous waste has been stored or disposed of on site. Cinders and fly ash from a coal gasification plant have been placed on site from the 1920s through the 1940s. Air monitoring with a photoionization detector was performed while on site; no readings above background were noted.

In summary, sampling and analysis of soil, fly ash, and cinders should be conducted to determine overall site contamination, if any, with further investigation of groundwater parameters if warranted based on the results of the above sampling.

FIGURE 1

HRS COVER SHEET

Facility Name: Occidental Chemical (formerly Diamond Shamrock)

Location: Ohio Street, Lockport, New York

EPA Region: II

Person(s) in Charge of Facility: Gary Ernst, Barry Christensen

360 Rainbow Blvd.

Niagara Falls, New York

Name of Reviewer: Dennis Sutton Date: July 1, 1987

General Description of the Facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action; etc.)

This approximately 5-acre site encompasses a 1-acre area where fly ash and boiler cinders have been disposed. These wastes have been generated by coal gasification processes that were used on site from the 1920s to the 1940s. These processes were used to generate coal gas for use in facility production furnaces. No sampling of the site has been performed and little is known about groundwater or soil contamination if any. The HRS is a preliminary score.

Scores: S_M = 0 (S_{gw} = 0 S_{sw} = 0 S_a = 0)

S_{FE} = 0

S_{DC} = 4.17

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Ground Water Route Work Sheet					
Rating Factor	**Assigned Value (Circle One)**	**Multi-plier**	**Score**	**Max. Score**	**Ref. (Section)**
[1] Observed Release	0 45	1	0	45	3.1
If observed release is given a score of 45, proceed to line [4]. If observed release is given a score of 0, proceed to line [2].					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 (3)	2	6	6	
Net Precipitation	0 (1) 2 3	1	1	3	
Permeability of the Unsaturated Zone	0 (1) 2 3	1	1	3	
Physical State	0 (1) 2 3	1	1	3	
	Total Route Characteristics Score		9	15	
[3] Containment	0 1 2 (3)	1	3	3	3.3
[4] Waste Characteristics					3.4
Toxicity/Persistence	(0) 3 6 9 12 15 18	1	0	18	
Hazardous Waste Quantity	(0) 1 2 3 4 5 6 7 8	1	0	8	
	Total Waste Characteristics Score		0	26	
[5] Targets					3.5
Ground Water Use	0 (1) 2 3	3	3	9	
Distance to Nearest Well/Population Served	(0) 4 6 8 10 12 16 18 20 24 30 32 35 40	1	0	40	
	Total Targets Score		3	49	
[6] If line [1] is 45, multiply [1] x [4] x [5] If line [1] is 0, multiply [2] x [3] x [4] x [5]			0	57,330	
[7] Divide line [6] by 57,330 and multiply by 100		S_{gw} =	0		

FIGURE 2
GROUND WATER ROUTE WORK SHEET

Surface Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	4.1
If observed release is given a value of 45, proceed to line 4. If observed release is given a value of 0, proceed to line 2.					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	(0) 1 2 3	1	0	3	
1-yr. 24-hr. Rainfall	0 1 (2) 3	1	2	3	
Distance to Nearest Surface Water	0 1 2 (3)	2	6	6	
Physical State	0 (1) 2 3	1	1	3	
	Total Route Characteristics Score		9	15	
3 Containment	0 (1) 2 3	1	1	3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	(0) 3 6 9 12 15 18	1	0	18	
Hazardous Waste Quantity	(0) 1 2 3 4 5 6 7 8	1	0	8	
	Total Waste Characteristics Score		0	26	
5 Targets					4.5
Surface Water Use	0 1 (2) 3	3	6	9	
Distance to a Sensitive Environment	0 (1) (2) 3	2	2	6	
Population Served/Distance to Water Intake Downstream	(0) 4 6 8 10 / 12 16 18 20 / 24 30 32 35 40	1	0	40	
	Total Targets Score		8	55	
6 If line 1 is 45, multiply 1 x 4 x 5; If line 1 is 0, multiply 2 x 3 x 4 x 5			0	64,350	
7 Divide line 6 by 64,350 and multiply by 100		S_{sw} =	0		

FIGURE 7
SURFACE WATER ROUTE WORK SHEET

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5. PRELIMINARY APPLICATION OF THE HAZARD RANKING SYSTEM

5.1 NARRATIVE SUMMARY

The Diamond Shamrock site covers approximately 5 acres in the City of Lockport, Niagara County, New York (see Figure 5-1). Standard Silicate produced liquid sodium silicate on this site starting in 1923. Diamond Shamrock purchased the facility in 1928 and continued liquid sodium silicate production and introduced sodium silicate insulation production in 1980. Occidental Chemical Corporation purchased the facility in 1986 and has continued these operations.

It was reported that boiler fly ash and cinders were disposed on the site from 1923 to the late 1940s. Little else is known about disposal practices or amounts of wastes disposed.

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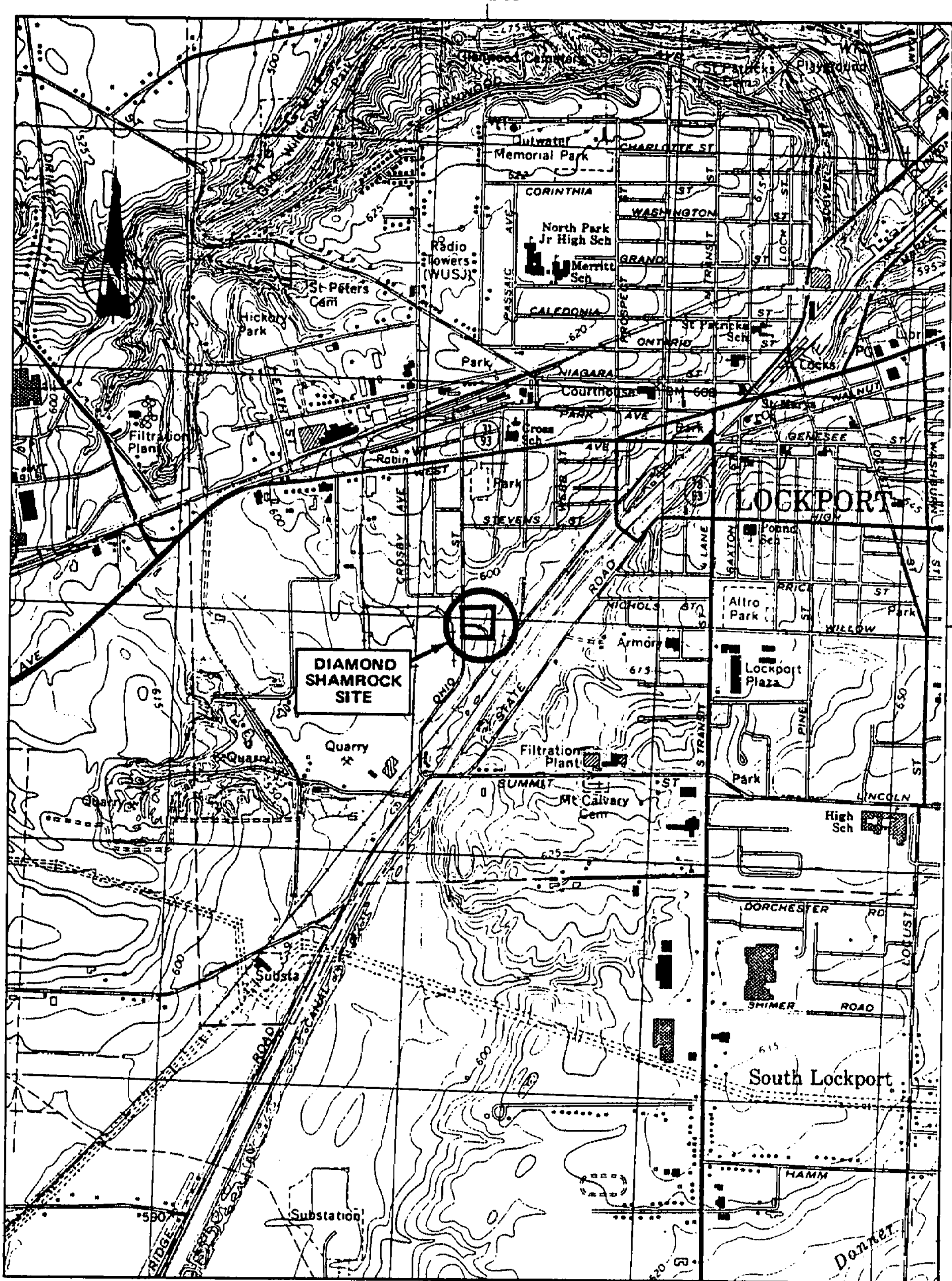

SOURCE: U.S.G.S. 7.5 Minute Series (Topograhic) Quadrangle, Lockport, N.Y., 1980.

SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

Figure 5—1 LOCATION MAP

Air Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	(0) 45	1	0	45	5.1
Date and Location:					
Sampling Protocol:					
If line [1] is 0, the S_a = 0. Enter on line [5]. If line [1] is 45, then proceed to line [2].					
[2] Waste Characteristics					5.2
Reactivity and Incompatibility	0 1 2 3	1		3	
Toxicity	0 1 2 3	3		9	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1		8	
	Total Waste Characteristics Score			20	
[3] Targets					5.3
Population Within 4-Mile Radius	0 9 12 15 18 21 24 27 30	1		30	
Distance to Sensitive Environment	0 1 2 3	2		6	
Land Use	0 1 2 3	1		3	
	Total Targets Score			39	
[4] Multiply [1] x [2] x [3]				35,100	
[5] Divide line [4] by 35,100 and multiply by 100	S_a = 0				

FIGURE 9
AIR ROUTE WORK SHEET

	S	S^2
Groundwater Route Score (S_{gw})	0	
Surface Water Route Score (S_{sw})	0	0
Air Route Score (S_a)	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		0

FIGURE 10
WORKSHEET FOR COMPUTING S_M

Fire and Explosion Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
[1] Containment	(1) 3	1	1	3	7.1
[2] Waste Characteristics					7.2
Direct Evidence	(0) 3	1	0	3	
Ignitability	(0) 1 2 3	1	0	3	
Reactivity	(0) 1 2 3	1	0	3	
Incompatibility	(0) 1 2 3	1	0	3	
Hazardous Waste Quantity	(0) 1 2 3 4 5 6 7 8	1	0	8	
	Total Waste Characteristics Score		0	20	
[3] Targets					7.3
Distance to Nearest Population	0 1 2 3 4 (5)	1	5	5	
Distance to Nearest Building	0 1 2 (3)	1	3	3	
Distance to Sensitive Environment	0 (1) 2 3	1	1	3	
Land Use	0 1 2 (3)	1	3	3	
Population Within 2-Mile Radius	0 1 2 3 4 (5)	1	5	5	
Buildings Within 2-Mile Radius	0 1 2 3 4 (5)	1	5	5	
	Total Targets Score		22	24	
[4] Multiply [1] x [2] x [3]			0	1,440	
[5] Divide line [4] by 1,440 and multiply by 100		S_{FE} =	0		

FIGURE 11
FIRE AND EXPLOSION WORK SHEET

Direct Contact Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
[1] Observed Incident	(0) 45	1	0	45	8.1
If line [1] is 45, proceed to line [4] If line [1] is 0, proceed to line [2]					
[2] Accessibility	0 1 2 (3)	1	3	3	8.2
[3] Containment	0 (15)	1	15	15	8.3
[4] Waste Characteristics Toxicity	0 (1) 2 3	5	1	15	8.4
[5] Targets					8.5
Population Within a 1-Mile Radius	0 1 2 3 (4) 5	4	16	20	
Distance to a Critical Habitat	0 (1) 2 3.	4	4	12	
Total Targets Score			·20	32	
[6] If line [1] is 45, multiply [1] x [4] x [5] If line [1] is 0, multiply [2] x [3] x [4] x [5]			900	21,600	
[7] Divide line [6] by 21,600 and multiply by 100	S_{DC} = 4.17				

FIGURE 12
DIRECT CONTACT WORK SHEET

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DOCUMENTATION RECORDS FOR HAZARD RANKING SYSTEM

Instructions: As briefly as possible summarize the information you used to assign the score for each factor (e.g., "Waste quantity = 4,230 drums plus 800 cubic yards of sludges"). The source of information should be provided for each entry and should be a bibliographic-type reference. Include the location of the document.

Facility Name: Occidental Chemical (formerly Diamond Shamrock)

Location: Ohio Street, Lockport, New York

Date Scored: July 1, 1987

Person Scoring: Dennis Sutton

Primary Source(s) of Information (e.g., EPA region, state, FIT, etc.):

NYSDEC Region 9 files, Buffalo, New York
Niagara County Health Department files, Niagara Falls, New York
Occidental Chemical Corp files, Lockport Facility, Lockport, New York

Factors Not Scored Due to Insufficient Information:

Insufficient information is available to score this site.
This report provides a preliminary score based on available information.

Comments or Qualifications:

D1619

GROUNDWATER ROUTE

1. OBSERVED RELEASE

Contaminants detected (3 maximum):

None reported

Rationale for attributing the contaminants to the facility:

NA

* * *

2. ROUTE CHARACTERISTICS

Depth to Aquifer of Concern

Name/description of aquifer(s) of concern:

Lockport Dolomite - depth unknown
Suspected to be from 5 - 10 ft below ground surface
Ref. No. 2, 12

Depth(s) from the ground surface to the highest seasonal level of the saturated zone [water table(s)] of the aquifer of concern:

Unknown

Depth from the ground surface to the lowest point of waste disposal/storage:

Unknown

Net Precipitation

Mean annual or seasonal precipitation (list months for seasonal):

31 in/yr
Ref. No. 5

Mean annual lake or seasonal evaporation (list months for seasonal):

27 in/yr
Ref. No. 5

Net precipitation (subtract the above figures):

4 in/yr

Permeability of Unsaturated Zone

Soil type in unsaturated zone:

Silt, loams, clay
Ref. No. 3

Permeability associated with soil type:

10^{-5} to 10^{-7} cm/sec
Ref. No. 5

Physical State

Physical state of substances at time of disposal (or at present time for generated gases):

Solid, unconsolidated or unstabilized
Ref. Nos. 5 and 7

* * *

3. CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

None in place
Ref. Nos. 6 and 7

Method with highest score:

Waste unstabilized, no liner
Waste not covered
Ref. No. 5

4. WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated:

Unable to score
No information available - no sample analysis

Compound with highest score:

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (give a reasonable estimate even if quantity is above maximum):

Unknown

Basis of estimating and/or computing waste quantity:

* * *

5. TARGETS

Groundwater Use

Use(s) of aquifer(s) of concern within a 3-mile radius of the facility:

0
Ref. No. 11, 4

Distance to Nearest Well

Location of nearest well drawing from aquifer of concern or occupied building not served by a public water supply:

NA
Ref. No. 11

Distance to above well or building:

NA

Population Served by Groundwater Wells Within a 3-Mile Radius

Identified water-supply well(s) drawing from aquifer(s) of concern within a 3-mile radius and populations served by each:

0
Ref. No. 11, 4

Computation of land area irrigated by supply well(s) drawing from aquifer(s) of concern within a 3-mile radius, and conversion to population (1.5 people per acre):

0
Ref. No. 11

Total population served by groundwater within a 3-mile radius:

0
Ref. No. 11

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SURFACE WATER ROUTE

1. OBSERVED RELEASE

Contaminants detected in surface water at the facility or downhill from it (5 maximum):

None reported

Rationale for attributing the contaminants to the facility:

NA

* * *

2. ROUTE CHARACTERISTICS

<u>Facility Slope and Intervening Terrain</u>

Average slope of facility in percent:

<3%
Ref. No. 1

Name/description of nearest downslope surface water:

Erie Canal
Ref. No. 1

Average slope of terrain between facility and above-cited surface water body in percent:

<3%
Ref. No. 1

Is the facility located either totally or partially in surface water?

No
Ref. No. 1

Is the facility completely surrounded by areas of higher elevation?

No
Ref. No. 1

<u>1-Year 24-Hour Rainfall in Inches</u>

2.5 in
Ref. No. 5

<u>Distance to Nearest Downslope Surface Water</u>

1,000 ft
Ref. No. 1

Physical State of Waste

Solid, unconsolidated, unstabilized
Ref. No. 5

* * *

3. CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

None in place
Ref. Nos. 6 and 7

Method with highest score:

Piles uncovered, no liner, waste not covered
Ref. No. 5

4. WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated:

None evaluated

Compound with highest score:

NA

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (give a reasonable estimate even if quantity is above maximum):

Unknown

Basis of estimating and/or computing waste quantity:

* * *

5. TARGETS

Surface Water Use

Use(s) of surface water within 3 miles downstream of the hazardous substance:

Recreation
Ref. No. 11

Is there tidal influence?

No
Ref. No. 1

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less:

NA
Ref. No. 1, 9

Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less:

4,000 ft
Ref. No. 9

Distance to critical habitat of an endangered species or national wildlife refuge, if 1 mile or less:

NA
Ref. No. 13

Population Served by Surface Water

Location(s) of water-supply intake(s) within 3 miles (free-flowing bodies) or 1 mile (static water bodies) downstream of the hazardous substance and population served by each intake:

NA
Ref. No. 11

Computation of land area irrigated by above-cited intake(s) and conversion to population (1.5 people per acre):

NA
Ref. No. 11

Total population served:

NA
Ref. No. 11

Name/description of nearest of above water bodies:

NA

Distance to above-cited intakes, measured in stream miles:

NA

3. TARGETS

Population Within 4-Mile Radius

Circle radius used, give population, and indicate how determined:

0 to 4 mi   (0 to 1 mi)   0 to 1/2 mi   0 to 1/4 mi

8,308
Ref. No. 8

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less:

NA
Ref. No. 9

Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less:

4,000 ft
Ref. No. 9

Distance to critical habitat of an endangered species, if 1 mile or less:

NA
Ref. No. 13

Land Use

Distance to commercial/industrial area, if 1 mile or less:

100 ft
Ref. No. 1

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less:

NA
Ref. No. 1

Distance to residential area, if 2 miles or less:

500 ft
Ref. No. 1

Distance to agricultural land in production within past 5 years, if 1 mile or less:

3,500 ft
Ref. No. 3

Distance to prime agricultural land in production within past 5 years, if 2 miles or less:

3,500 ft
Ref. No. 3

Is a historic or landmark site (National Register of Historic Places and National Natural Landmarks) within the view of the site?

NA
Ref. No. 10

AIR ROUTE

1. OBSERVED RELEASE

Contaminants detected:

None

Date and location of detection of contaminants:

NA

Methods used to detect the contaminants:

NA

Rationale for attributing the contaminants to the site:

NA

* * *

2. WASTE CHARACTERISTICS

Reactivity and Incompatibility

Most reactive compound:

NA

Most incompatible pair of compounds:

NA

Toxicity

Most toxic compound:

NA

Hazardous Waste Quantity

Total quantity of hazardous waste:

NA

Basis of estimating and/or computing waste quantity:

NA

* * *

F I R E   A N D   E X P L O S I O N

1. CONTAINMENT

Hazardous substances present:

Unknown

Type of containment, if applicable

None in place
Ref. Nos. 6 and 7

* * *

2. WASTE CHARACTERISTICS

Direct Evidence

Type of instrument and measurements:

No measurements

Ignitability

Compound used:

Not determined

Reactivity

Most reactive compound:

Not determined

Incompatibility

Most incompatible pair of compounds:

Not determined

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility:

Unknown

Basis of estimating and/or computing waste quantity:

* * *

3. TARGETS

Distance to Nearest Population

50 ft
Ref. Nos. 6 and 7

Distance to Nearest Building

50 ft
Ref. Nos. 6 and 7

Distance to a Sensitive Environment

Distance to wetlands:

3,500 ft
Ref. No. 9

Distance to critical habitat:

NA
Ref. No. 13

Land Use

Distance to commercial/industrial area, if 1 mile or less:

0
Ref. Nos. 6 and 7

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less:

NA
Ref. No. 1

Distance to residential area, if 2 miles or less:

500 ft
Ref. No. 1

Distance to agricultural land in production within past 5 years, if 1 mile or less:

3,500 ft
Ref. No. 3

Distance to prime agricultural land in production within past 5 years, if 2 miles or less:

3,500 ft
Ref. No. 3

Is a historic or landmark site (National Register of Historic Places and National Natural Landmarks) within the view of the site?

No
Ref. No. 10

Population Within 2-Mile Radius

16,055
Ref. No. 8

Buildings Within 2-Mile Radius

11,201
Ref. No. 8

DIRECT CONTACT

1. OBSERVED INCIDENT

Date, location, and pertinent details of incident:

None observed

* * *

2. ACCESSIBILITY

Describe type of barrier(s):

No barriers in place
Ref. No. 7

* * *

3. CONTAINMENT

Type of containment, if applicable:

None in place
Ref. Nos. 6 and 7

* * *

4. WASTE CHARACTERISTICS

Toxicity

Compounds evaluated:

Unknown

Compound with highest score:

* * *

5. TARGETS

Population within one-mile radius

8,308
Ref. No. 8

Distance to critical habitat (of endangered species)

NA
Ref. No. 13

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REFERENCES

If the entire reference is not available for public review in the EPA regional files on this site, indicate where the reference may be found:

Reference Number	Description of the Reference
1	USGS 7.5 minute topographical map, 1980, Lockport, NY quad. Document location: E & E, Buffalo, N.Y.
2	Johnson, Richard H., 1964, Groundwater in the Niagara Falls Area, New York, State of New York Conservation Department, Water Resource Commission, Bulletin GW-53. Document location: E & E, Buffalo, N.Y.
3	Higgins, B.A., P.S. Puglia, R.P. Leonard, T.D. Yoakum, W.A. Wirtz, 1972; Soil Survey of Niagara County, New York, USDA Soil Conservation Service. Document location: E & E, Buffalo, N.Y.
4	Hopkins, Michael, June 1987, personal communication, Niagara County Health Department, Niagara Falls, New York. Document location: E & E, Buffalo, N.Y.
5	Barrett, K.W., S.S. Chang, S.A. Hans, A.M. Platt, 1982, Uncontrolled Hazardous Waste Site Ranking System Users Manual, MITRE Corporation. Document location: E & E, Buffalo, N.Y.
6	Ernst, Gary, plant manager, Chicago Plant, and B.H. Christensen, environmental services manager, Occidental Chemical Corporation, June 1987, personal communication.
7	Ecology and Environment, Inc., June 12, 1987, Site inspection logbook and photo log. Document location: E & E, Buffalo, N.Y.
8	Graphical Exposure Modeling System, June 1987, Environmental Protection Agency, Office of Pesticides and Toxic Substances, Federal Plaza, New York, New York. Information location: E & E, Buffalo, N.Y.
9	New York State Department of Environmental Conservation (NYSDEC), wetlands maps, Region 9 NYSDEC offices, Buffalo, New York. Document location: Region 9 offices.
10	Murtaugh, William, 1976, The National Register of Historic Places, U.S. Department of the Interior, National Park Service, Washington, D.C. Document location: Ecology and Environment, Inc., Buffalo, New York.
11	McCann, James, June 1987, personal communication, Lockport Water Department, Lockport, New York. Document location: E & E, Buffalo, N.Y.
12	Miller, T.S., W.M. Koppel, 1987, The Effect of Niagara Power Project on Groundwater Flow in the Upper Part of the Lockport Dolomite, Niagara Falls Area, USGS, Survey Report 86-4130. Document location: E & E, Buffalo, N.Y.
13	Snider, James, wildlife biologist, personal communication, June 1987, NYSDEC Region 9, Buffalo, New York. Document location: E & E, Buffalo, N.Y.

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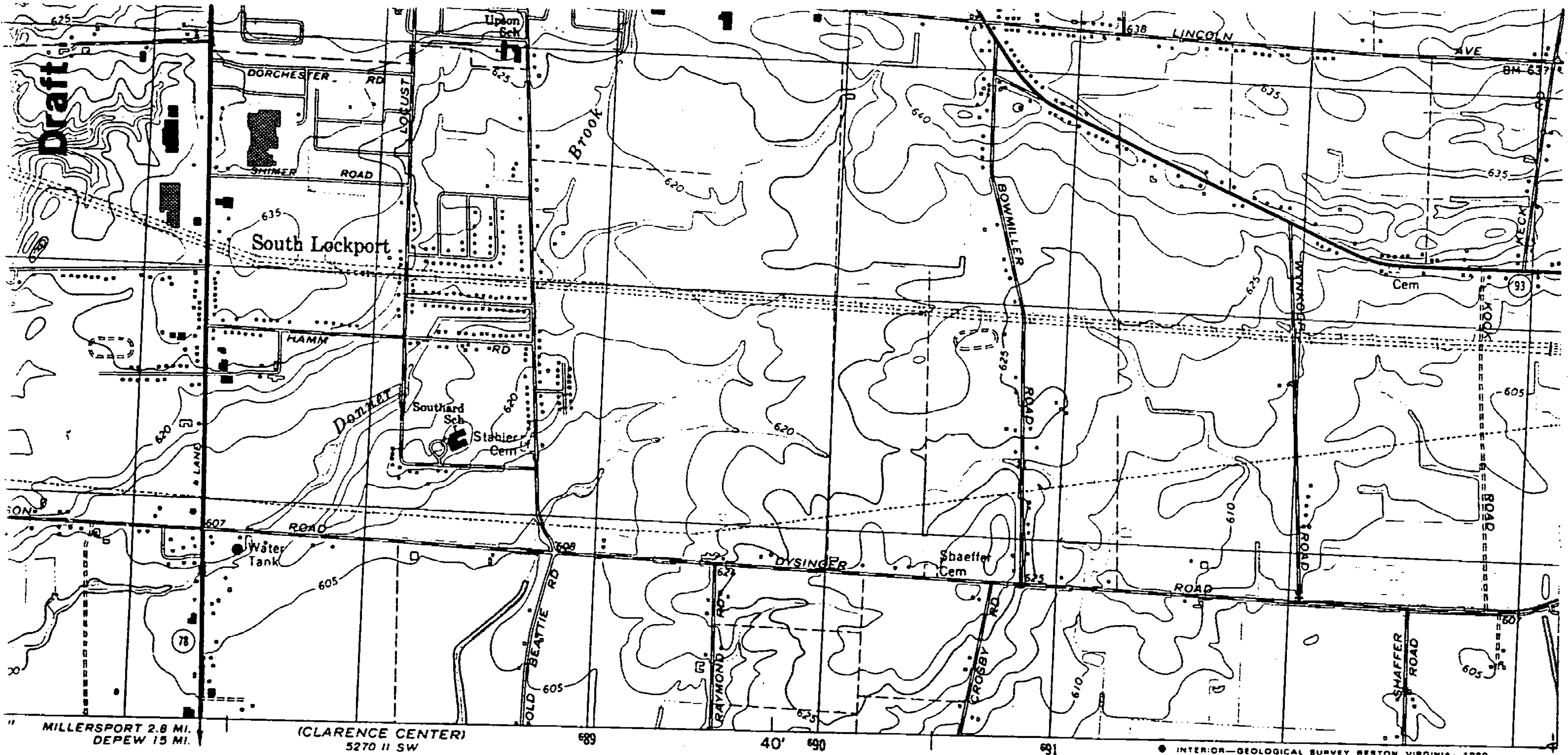
REFERENCE NO. 1



SCALE 1:25 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

ROAD CLASSIFICATION

Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route
U. S. Route
State Route

QUADRANGLE LOCATION

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

LOCKPORT, N. Y.
NW/4 LOCKPORT 15' QUADRANGLE
N4307.5—W7837.5/7.5

1980

DMA 5270 II NW—SERIES V821

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REFERENCE NO. 2

Draft

GROUND WATER IN THE NIAGARA FALLS AREA, NEW YORK

With Emphasis on the Water-Bearing Characteristics of the Bedrock

BY

RICHARD H. JOHNSTON

GEOLOGIST

U.S. GEOLOGICAL SURVEY

STATE OF NEW YORK

CONSERVATION DEPARTMENT

WATER RESOURCES COMMISSION

BULLETIN GW-53

1964

because studies made on the Lockport may contribute to a better understanding of the occurrence of ground water in bedrock generally. The Queenston Shale and Clinton and Albion Groups are poor aquifers in comparison to the Lockport Dolomite, and less is known of their water-bearing characteristics.

LOCKPORT DOLOMITE

Character and extent

The Lockport Dolomite is the uppermost bedrock formation in about one-third of the Niagara Falls area. Its outcrop area extends from the Niagara escarpment on the north to the southern boundary of the area covered by this report except in two small areas that may be underlain by the Salina Group. (See plate 3.) One of these areas is in the vicinity of the hamlet of Nashville and the other is in the extreme southeast corner. Because of a lack of rock outcrops in these areas the position of the contact between the Lockport and the Salina cannot be accurately determined. However, the Salina Group is not discussed as a separate water-bearing unit in this report because at most only a few feet of it occurs in the area. Continuous exposures of the Lockport are found along the gorge of the Niagara River and along the Niagara escarpment. The formation is about 150 feet thick in the southern part of the area but has been eroded to a thickness of only about 20 feet along the escarpment (pl. 2). The excellent exposures at Niagara Falls (fig. 5), where the Lockport forms the lip of the Falls, are shown in many geology textbooks as a classic example of flat-lying sedimentary rocks. Throughout most of the remainder of the area, which is relatively flat, the Lockport is concealed by a thin cover of glacial deposits.

As its name implies, the Lockport Dolomite consists mainly of dolomite; however, the formation also includes thin beds of limestone and shaly dolomite near the base. The Lockport consists of five lithologic types which, from top to bottom, are:

(a) brownish-gray, coarse- to medium-grained dolomite, locally saccharoidal with thin intervals of curved bedding (algal structures).

(b) gray to dark-gray, fine-grained dolomite, containing abundant carbonaceous partings.

(c) tannish-gray, fine-grained dolomite.

(d) light-gray, coarse-grained limestone containing abundant crinoid fragments (Gasport Limestone Member).

(e) light-gray shaly dolomite, laminated in part (DeCew Limestone Member of Williams, 1919).

Fisher (1960) divides the Lockport Dolomite into six units based on fossils as well as rock types. An excellent discussion of the stratigraphy of the

Lockport, including measured sections in the Niagara Falls area, is given in the recent thesis by Zenger 1/.

The detailed breakdowns by Fisher and Zenger, although helpful for geologic mapping and correlating the Lockport with rocks of similar age elsewhere, are not necessary in descriptions of the water-bearing properties of the formation. For this purpose the Lockport is subdivided as follows (figure 5 and table 1): (1) upper and middle parts of the Lockport, and (2) lower part of the Lockport, including the Gasport Limestone Member and DeCew Limestone Member of Williams (1919).

Most of the beds in the Lockport are described as either "thick" (1 foot to 3 feet) or "thin" (1 inch to 1 foot). However, massive beds up to eight feet thick and very thin beds (1/4 to 1 inch) occur within the formation. The bedding is generally straight, but curved bedding occurs in some places in the upper part of the formation. The curved bedding is caused by dome-shaped algal structures called "stromatolites" (Zenger, p. 140). These reefs (bioherms), which occur as lens-like masses up to 50 feet across and 10 to 20 feet thick, contain no bedding.

Gypsum (calcium sulfate) is common in the Lockport, occurring chiefly as small irregularly shaped masses (commonly 1/2 to 5 inches in diameter) and as selenite. Sulfide minerals, particularly sphalerite (zinc sulfide), galena (lead sulfide), and pyrite (iron sulfide) occur as particles disseminated throughout the formation.

Water-bearing openings

Types.--Ground-water occurs in the Lockport Dolomite in three types of openings: (1) bedding joints which constitute at least seven important water-bearing zones, (2) vertical joints, and (3) small cavities from which gypsum has been dissolved. Of these, the bedding joints are the most important and transmit nearly all the water moving through the formation. The three types of openings were observed in the dewatered excavations for the conduits of the Niagara Power Project. (See the description of the power project in the introduction and the location of the conduits in figure 3.) The rock faces along the four-mile length of the conduits provided an unequaled opportunity to study water-bearing openings in the entire stratigraphic thickness of the Lockport and to observe the lateral extent of these openings for a few thousand feet. At the time the observations were made (July - August 1960), approximately one-third of the length of the conduits was available for inspection by the writer.

1/ Zenger, D. H., 1962, Stratigraphy of the Lockport Formation (Silurian) in New York State: Unpublished doctoral thesis, Cornell University.

The bedding joints, which transmit most of the water in the Lockport, are fractures along prominent bedding planes which have been widened very slightly by solution of the rock. These planar openings persist laterally for distances of at least 3 to 4 miles. The separation along individual bedding joints is small (less than 1/8 inch). However, their continuity makes them effective "conduits" for movement of ground water. The large water-transmitting capacity of the bedding joints was shown by the fact that they supplied nearly all the ground-water seepage entering the conduit excavations. The almost continuous lines of seepage from bedding joints was strikingly apparent in the conduits. Figure 7 shows seepage from two bedding joints.

The bedding joints transmitting ground water comprise at least seven distinct water-bearing zones within the Lockport. These water-bearing zones could be traced laterally for distances of 1 to 4 miles. Figure 8 shows the stratigraphic position and part of the lateral extent of the seven zones. The water-bearing zones have been numbered from 1 to 7 from bottom to top. The three sections shown in figure 8 were surveyed by transit and then correlated on the following basis: (1) lithologic similarities, (2) laterally tracing seepage from individual water-bearing zones, and (3) in the case of section A, the distance above the Rochester Shale as shown by core holes. The correlation of water-bearing zone 6 between sections A and B has been changed slightly from an earlier published version (Johnston, 1962, fig. 110.2).

A water-bearing zone may consist of a single open bedding joint (for example zone 4, section C, fig. 8) or it may consist of an interval of rock measuring up to one foot in thickness containing several open bedding joints (zone 7, section A, fig. 8). Where the water-bearing zone consists of several joints, the open joint transmitting most of the water at one locality may "pinch out" laterally and be replaced by another open joint within the same zone elsewhere. For example, at section B (fig. 8) most seepage from water-bearing zone 6 came from a joint at the top of a thin-bedded interval; however, at section A all seepage came from a joint at the bottom of the interval. The opening along one bedding joint thus becomes closed while a parallel opening along an adjacent bedding joint becomes open.

The water-bearing zones occur most commonly within intervals of the Lockport containing thin beds from 1/4 to about 4 inches thick which are directly overlain by thick or massive beds. The thin beds generally contain open vertical joints, and at the intersection of such vertical joints with open bedding joints ground-water seepage is greatest. At a few such points water was observed to squirt from the openings into the conduit excavations in much the same manner as it would from a broken water pipe. It seems likely that open joints occur most commonly in thin-bedded intervals because the greater structural rigidity of the overlying thick or massive beds permits the joints to remain open.

Water-bearing zones occur less commonly within thick-bedded intervals. In such cases all seepage occurs from one distinct bedding joint rather than from several joints. Seepage from zone 4 at section C (fig. 8) came from one prominent bedding joint within an interval of beds averaging one foot in thickness. This bedding joint is open about 1/16 to 1/8 inch locally and appears to transmit as much ground water as any water-bearing zone in the Lockport.

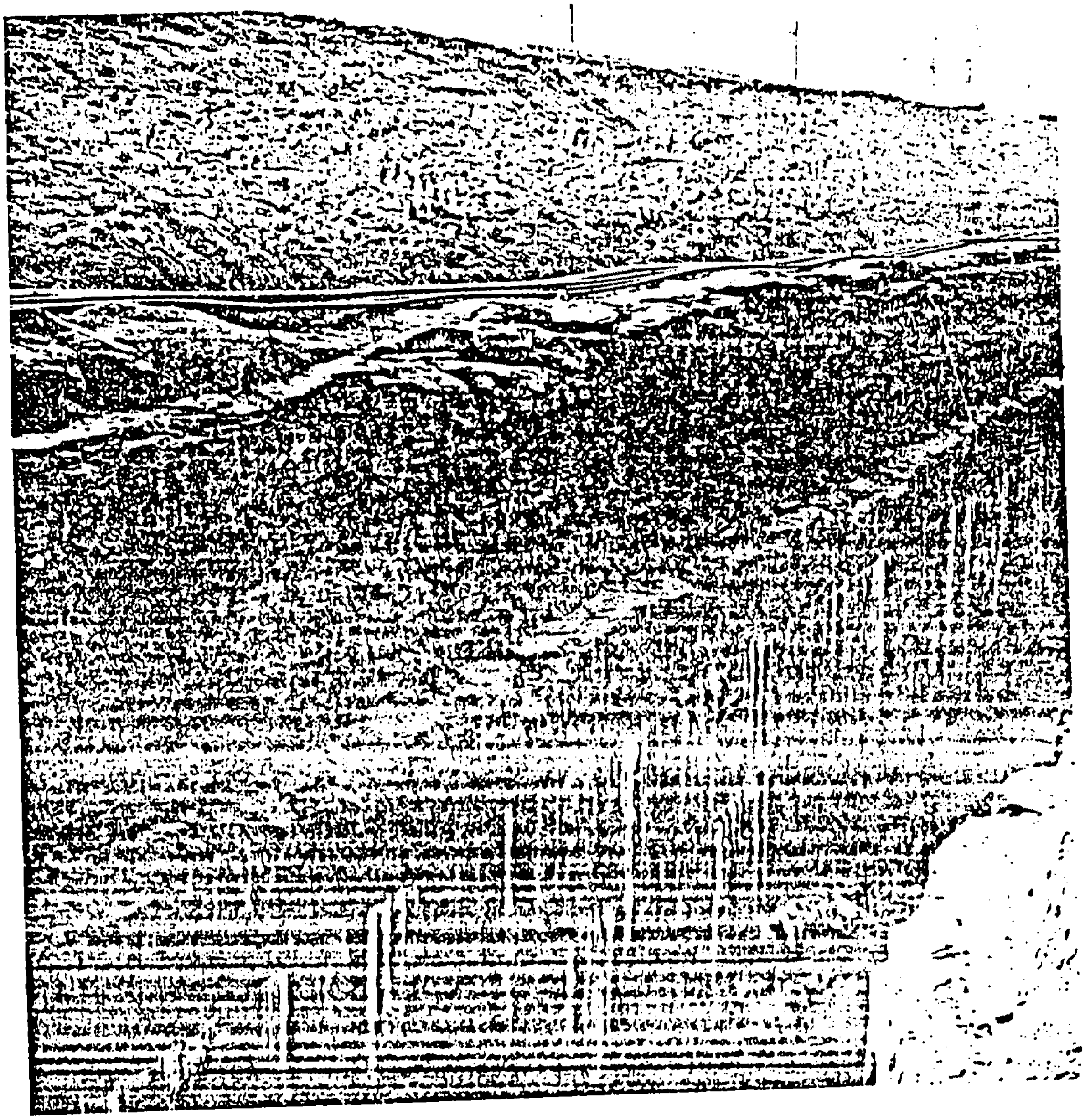

Figure 7.--Seepage from bedding joints in the Lockport Dolomite. View is of east wall of conduit number 1, looking south from Porter Rd. bridge. (Photograph by the Power Authority of the State of New York.)

Vertical joints, excluding those mentioned above which are associated with open bedding joints in thin-bedded intervals, are not important water-bearing openings in the Lockport, except within the top few feet of rock. Two prominent sets of vertical joints exist in the Niagara Falls area; one set oriented N. 65° E. and the other N. 30° W. These joints are fractures in the rock which must be widened by solution before they can become effective water-bearing openings. Such widening is apparent in outcrops of the Lockport. For example, open vertical joints are particularly

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prominent in the rock cliffs of the Niagara River Gorge and the Niagara escarpment. The width of these joints in many areas exceeds several inches. However, in fresh exposures of the Lockport, such as the conduit excavations, vertical joints are tight and often not apparent to the eye except in the upper few feet of the rock.

Cavities formed by solution of gypsum occur in the Lockport Dolomite. These cavities range in size from 1/16 inch or less to 5 inches but are generally less than one inch in size. The cavities are formed by the dissolving of gypsum by percolating ground water, and there is a complete range in the development of cavities from voids containing no gypsum to pin-point openings in gypsum nodules. The cavities are most abundant in the top 10 to 15 feet of rock but they also occur along water-bearing zones in the lower part of the rock (for example, water-bearing zone 3, section C, fig. 8). In the upper part of the rock, the abundance of cavities locally gives a vuggy appearance to the dolomite.

The cavities in the Lockport resulting from solution of gypsum increase the ability of the Lockport to store water (porosity) but probably have little effect on the water-transmitting ability of the formation. This is because the water-transmitting ability (or permeability) is dependent upon the size of the continuous openings rather than the size of isolated openings. Thus, the relatively thin but continuous bedding joints determine the permeability of the Lockport rather than the larger but isolated cavities resulting from solution of gypsum.

The character and interrelationships of the three types of water-bearing openings described above result in two distinct sets of ground-water conditions in the Lockport Dolomite: (1) a moderately permeable zone at the top of rock, generally 10 to 15 feet thick, characterized by both vertical and bedding joints that have been widened by solution and by gypsum cavities, and (2) the remainder of the formation consisting of seven permeable zones (composed of bedding joints) surrounded by essentially impermeable rock.

<u>Areal extent</u>.--Relatively little is known about the areal extent of the seven water-bearing zones in the Lockport Dolomite, except as observed in the conduits (fig. 8). Many of the individual bedding joints tend to "pinch out" laterally, and be replaced by adjacent joints in the same zone. Such "pinching out" of joints transmitting water was observed in the conduits. Observations in the conduits and data from wells suggest that a few of the zones may persist for tens of miles. The water-bearing zones of greatest areal extent are those which occur at distinct lithologic breaks in the formation. Zone 1, occurring at the base of the Lockport (fig. 8), is frequently reported to be a water-bearing zone by drillers throughout the area. Zone 2, which occurs at the contact between coarse-grained limestone (Gasport Member) and shaly dolomite (DeCew Limestone Member of Williams, 1919) is the source of most of the springs along the Niagara escarpment. Other water-bearing zones, not located at contacts between distinct lithologic units, probably tend to pinch out within a few miles. In summary, at any point in the area, a number of water-bearing zones parallel to bedding exist in the Lockport. All such zones, however, are not necessarily equivalent to the seven water-bearing zones observed in the conduit excavations at Niagara Falls.

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It was also noted in the conduit excavations that there were places, even along the most prominent water-bearing zones, where no seepage was occurring. Many such places doubtless represent natural supports for the overlying rock because no extensive horizontal opening below the earth's surface can exist for any great distance. Little is known either about the nature or the size of these support areas or the distance between them. The available data suggest, however, that they encompass an area of at least a few square feet and are separated by a few tens of feet. It may be expected that with depth the size of the supports increases and the distance between them decreases.

The occurrence of ground water principally in zones parallel to bedding is probably characteristic of flat-lying Paleozoic carbonate rocks in many other places. This type of occurrence was reported by Trainer and Salvas (1962, p. 42) in the Beekmantown Dolomite near Massena, N. Y. They observed that "... The openings which are horizontal or gently dipping, and most of which are probably joints or other fractures parallel to the bedding of the rocks, are wider and more numerous than the steeply dipping openings." Although the Beekmantown Dolomite is of an older geologic age than the Lockport, certain similarities exist between the two formations: (1) both units consist of indurated Paleozoic dolomite and limestone; (2) both units are gently dipping, neither having been subjected to extensive folding and faulting which would result in the development of more prominent vertical joints or fractures associated with faulting; (3) both units were subjected to scouring by ice during glaciation within the last 10,000 to 15,000 years and thus, the extensive solution features common to limestones and dolomites in unglaciated areas have not had time to develop. It seems probable that any flat-lying carbonate rock, possessing the characteristics just stated, will contain ground water principally within joints parallel to bedding.

Origin of water-bearing openings.--The origin and the sequence of development of both the vertical joints and bedding joints are of considerable importance in developing an understanding of the occurrence of water in bedrock. Although it was not possible to investigate the origin or the development during this study, speculations based on fundamental principles of geology, especially regarding the origin of the bedding joints, may be worthwhile.

It is widely recognized that joints are formed by forces which tend to pull the rock apart (tension joints) or slide one part of the rock past an adjacent part (shear joints); see, for example, the discussion by Billings (1954, p. 115). The vertical joints were probably formed by a combination of tension and shear forces during or following the folding of the Appalachian Mountains about 200 million years ago. The bedding joints represent tension fractures that formed as a result of expansion of the rock in a vertical direction during more recent geologic time. The Lockport as recently as 200 million years ago was doubtless buried under thousands of feet of other rocks in the Niagara Falls area just as it is at the present time in the southern part of New York State. During the erosion of the overlying rocks the Lockport expanded vertically. The expansion caused fracturing to occur along bedding planes which are natural planes of weakness in the rock and which are approximately parallel to the land surface. Vertical joints, being at right angles to the land surface were little affected by the removal of the overlying rock.

Draft

The bedding joints may have been further expanded by stresses produced in the rock during the recession of the glaciers 10 to 15 thousand years ago. The melting of several thousand feet of ice was doubtless accompanied by an expansion of the rock. This expansion either resulted in an enlargement of existing bedding-plane openings or the formation of new openings along other bedding planes.

In recent geologic times, chemical solution of the rock has widened both the vertical and bedding joints. In the already well-developed openings along bedding joints, slight widening by solution has occurred to depths of 100 feet or more. Enlargement of vertical joints, in contrast, is generally restricted to the upper 10 to 15 feet of rock. Cavities formed by solution of gypsum exist where water moving along joints in the Lockport came into contact with gypsum. Gypsum is much more soluble than dolomite; thus, openings formed by the solution of gypsum are wider than other openings along joints. Water moving down vertical joints has dissolved the gypsum to a depth of about 15 feet leaving irregularly-shaped cavities, and water moving along bedding joints has dissolved gypsum to depths of at least 70 feet.

Water-bearing characteristics

Ground water exists in the Lockport Dolomite under artesian, semi-artesian, and unconfined conditions. Unconfined conditions occur where the water table is the upper surface of the zone of saturation within an aquifer. The water table in an unconfined aquifer moves freely upward as water is added to storage, or downward as water is taken from storage. In contrast, an artesian aquifer contains water which is confined by an overlying impermeable bed and which is under sufficient pressure to rise above the top of the aquifer. The level to which water in an artesian aquifer will rise forms an imaginary surface which is called a piezometric surface. Water levels in artesian aquifers change in response to pressure changes on the aquifer rather than to changes in the amount of water stored in the aquifer.

Both artesian and water-table conditions exist in the Lockport. However, artesian conditions predominate. Figure 9 illustrates the occurrence of both artesian and water-table conditions in the Lockport. The wells shown in the diagram are cased through the clay and silt, but are open holes in the bedrock. A packer is installed in each well which tapped water at two or more distinct levels. The packers make possible the measurement of two distinct water levels in each well; a water level above the packer reflecting conditions in the upper part of the rock and a water level below the packer reflecting conditions in the lower part of the rock.

In the upper part of the rock, either artesian or water-table conditions may exist locally. The clay and silt overlying the Lockport are less permeable than the rock and thus act as a confining bed. Artesian conditions exist where the water in the Lockport has sufficient head to rise above the bottom of the overlying clay and silt. In contrast, unconfined (or water-table) conditions exist where the water level occurs within the fractured upper part of the rock, as at well 309-901-5 in figure 9. Locally a "washed till" or dirty gravel zone occurs just above the top of rock. In these localities good connection probably exists between the bedrock and the overlying till or gravel, and the upper part of the rock and washed till zone together form a continuous semi-confined aquifer.

In the lower part of the rock, artesian conditions occur exclusively. The seven water-bearing zones in the Lockport are surrounded by essentially impermeable rock and therefore act as separate and distinct artesian aquifers. The hydraulic nature of the water-bearing zones was observed during the drilling of observation wells in the vicinity of the Niagara Power Project. These wells, whose locations are shown in plate 1, were drilled to observe the effects of the reservoir on ground-water levels in the area. The piezometric level for each successively lower water-bearing zone is lower than for the zone just above it in most of the wells. The reasons for this will be discussed in the section entitled "Ground-Water Movement and Discharge." During construction, the water level in the wells progressively declined in a steplike sequence as the wells were drilled deeper--that is, when a well had been drilled through the uppermost water-bearing zone, the water level in the well remained approximately at a constant level until the next lower zone was penetrated, at which time the water level abruptly declined to the piezometric level of the next lower zone. The difference between the piezometric levels of any two water-bearing zones is large, and in some places is comparable to the distance between zones. If no packer is installed in a well tapping two water-bearing zones, the upper zone will continue to drain into the well indefinitely. This condition exists in a few of the power project observation wells. In these wells the sides of the well remain wet from the level of the upper zone down to the water level in the well. The nature of the water-bearing zones as described above substantiates the reports by drillers and others of "finding water and losing it" in a well, or of wells with "water running in the top and out the bottom." These phenomena occur in some wells tapping two or more water-bearing zones in the Lockport Dolomite.

A well drilled into the Lockport may penetrate several water-bearing zones, but only one of the zones may be hydraulically effective at the site of the well. This is the case for wells 309-901-1, 3, and 5 shown in figure 9. These wells are open below the packers to zones 1, 2, and 3. However, because the water levels observed below the packers in these three wells apparently represents the piezometric surface of zone 3, zones 1 and 2 are not believed to contain effective openings at the sites of the wells. A well also may be drilled through the section occupied by several zones and not be open to any of them. For example, well 309-901-7 shown in figure 9, is apparently open only to the weathered zone at the top of rock.

Yield and specific capacity of wells

The yield of a well in the Lockport Dolomite depends mainly upon which water-bearing zone or zones are penetrated and the degree to which the bedding joints comprising the zones are open to the well. Near the top of rock, the number of open vertical joints and gypsum cavities penetrated may also be important. The average yield of 56 wells tapping the upper and middle parts of the Lockport (which includes water-bearing zones 4 through 7) is 31 gpm (gallons per minute). In contrast, 15 wells penetrating only the lower 40 feet of the Lockport (which includes water-bearing zones 1, 2, and 3) have an average yield of 7 gpm. The yields of individual wells range from less than 1 gpm to 110 gpm. (These figures do not include a few exceptionally high yield wells which obtain water by induced infiltration from the Niagara River and which are discussed in a following paragraph.) Wells tapping the same water-bearing zone may have different yields. For example, wells 309-901-3 and 309-901-5, which are 500 feet apart and tap water-bearing zones 1 through 4 (fig. 9) yielded 7 gpm and 39 gpm, respectively, before the packers were installed. The bedding joints comprising the water-bearing zones are thus more open at well -5 than at well -3.

Increases in yield during drilling in the Lockport Dolomite occur abruptly rather than gradually. As drilling proceeds through the rock, relatively little increase in the yield of a well will be observed until a water-bearing zone is tapped. At that time a marked increase in yield usually occurs. For example, during the drilling of well 308-901-7, the bailing rate abruptly increased from 12 to 50 gpm when water-bearing zone 5 was tapped. During the drilling of well 308-900-21, three distinct increases in yield were observed. The yield, which was 3 gpm at 17 feet (water-bearing zone 7), increased to 9 gpm at 22 feet (an open vertical? joint or solution cavity?) and abruptly increased to 30 gpm at 34 feet (water-bearing zone 6).

Wells in an area about a half mile wide adjacent to the Niagara River above the falls have substantially higher yields than wells elsewhere in the area. The higher yields in this area are caused by two conditions: (1) the Lockport Dolomite is thickest in the area, and (2) more importantly, conditions are favorable for the infiltration of water from the Niagara River. The greater thickness of the Lockport provides the maximum number of water-bearing zones to supply water to the wells. The Niagara River provides an unlimited source of recharge to the water-bearing zones.

Evidence that a substantial part of the water pumped is supplied by induced infiltration from the Niagara River is indicated by the high yields, which exceed 2,000 gpm at some wells, and the chemical character of the water. The chemical composition of the water in well 304-901-6 (which has been pumped at 2,100 gpm) is more similar to Niagara River water than "typical" ground water in the Lockport. (See the following discussion of the chemical character of water and figure 11.) Similar infiltration of Niagara River water into the bedrock at Tonawanda, N. Y., a few miles south of Niagara Falls, was described by Reck and Simmons (1952, p. 19-20).

Infiltration from the river can occur where pumping has lowered ground-water levels below river level to such an extent that a hydraulic gradient is created between the river and the wells. The amount of the infiltration depends on the gradient and the nature of the hydraulic connection between the river and Lockport. The hydraulic connection is controlled by the character of the river bottom. Throughout most of its length in the Niagara Falls area the bottom of the river is covered by a layer of unconsolidated deposits including both till and clay and silt. This layer was found to be from 10 to 20 feet thick in the vicinity of the Niagara Falls water-system intake. (See logs 304-900-1 and -J in figure 19.) In the section of the river occupied by rapids, extending a half mile or more above the falls, the bottom has been scoured clean by the river. Where the layer of unconsolidated deposits is present its low permeability greatly retards infiltration. Where the layer is thin or absent infiltration can readily occur.

One of the most striking features in plate 2 is that all wells yielding more than 1,000 gpm are located in a narrow band that intercepts the river about two miles east of the falls. This band trends in a northeasterly direction roughly parallel to one of the two major directions of vertical jointing. Thus, the very high yields may be caused by a greater abundance of vertical joints within the band of high-yielding wells. Vertical joints provide avenues through which water could readily move from the river downward to the bedding joints comprising the water-bearing zones in the Lockport Dolomite.

Wells in the Lockport Dolomite are almost always adequate for domestic needs of a few gallons per minute. Supplies of 50 to 100 gpm, which are adequate for commercial uses and small public supplies, can be obtained in much of the area underlain by the upper part of the Lockport (pl. 2). Large supplies (over 1,000 gpm), as previously noted, are available only in a small area adjacent to the Niagara River.

Wells inadequate for domestic needs are occasionally reported. All wells that are perennially inadequate are located near the Niagara escarpment and therefore tap only the lowest and least permeable water-bearing zones (1, 2, and 3) in the Lockport. Throughout the area a few shallow wells that derive nearly all their water from a single water-bearing zone become inadequate during the summer and autumn of some dry years. Such is the case with well 308-853-1. This well is 27 feet deep and reportedly obtained over 50 gpm from a water-bearing zone 17 feet below land surface. During the drought in 1960, this zone was dewatered as the water table declined in the fall of the year, and the yield of the well quickly declined to less than 1 gpm. The inadequacy of some wells in the Lockport Dolomite can normally be overcome by deepening the well until it penetrates one or more lower water-bearing zones.

Information on the specific capacity of a well is more meaningful than a simple statement of yield. The specific capacity is the yield per unit drawdown, generally expressed as gallons per minute per foot of drawdown. For example, well 307-903-1 was pumped at 20 gpm with 54 feet of drawdown which indicates a specific capacity of 0.37 gpm per foot. The yield and the drawdown for a number of wells in the Lockport are shown in plates 2 and 3. These data must be used with care as they apply only so long as no part of the formation is dewatered.

As water-bearing zones in the Lockport are dewatered, the specific capacity declines. The decline in specific capacity caused by dewatering a water-bearing zone is shown by the data obtained during a pumping test on well 309-859-1. This well was pumped at 2.2 gpm with 5.0 feet of drawdown for 70 minutes--specific capacity of 0.44 gpm per foot. After 70 minutes, water-bearing zone 3 was partially dewatered and a drawdown of 8.2 feet was required to maintain the pumping rate of 2.2 gpm. This indicates a specific capacity of 0.27 gpm per foot. At the time the well was drilled, it was bailed at 3 gpm with a drawdown of about 60 feet. Thus, during the bailing the entire 42 feet of Lockport penetrated by the well was dewatered. The specific capacity of the well with the Lockport dewatered is 0.07 gpm per foot (3 gpm with 42 feet of drawdown) compared to 0.44 gpm per foot with no dewatering.

water from the Queenston are usually found in two areas--(1) in a band about two miles wide immediately north of the Niagara escarpment, and (2) in areas immediately adjacent to streams. Both these areas are believed to be places of ground-water discharge--that is, areas where ground water is moving upward from the Queenston to discharge naturally.

The origin of the salty water in the Queenston is unknown. In commenting on a similar occurrence of salty water in the bedrock in northern St. Lawrence County, N. Y., Trainer and Salvas (1962, p. 103) suggest three causes for the salty water in that area: (1) connate water, (2) the Champlain Sea, and (3) evaporite deposits. They conclude that the Champlain Sea, which covered the area about 10 or 20 thousand years ago, is the most likely source. This source is not applicable to the Niagara area, however, because the Champlain Sea did not extend into the area. Furthermore, it is unlikely that the salty water in the Niagara area is derived from evaporite beds because no such deposits are known to exist in the Queenston. Nor do any salt beds occur in the bedrock formations overlying the Queenston Shale (fig. 5) in the Niagara Falls area. The nearest salt beds occur about 40 miles to the southeast in the Salina Group which overlies the Lockport Dolomite. However, it is very improbable that salty water from the Salina beds has entered the Queenston Shale because (1) the salt beds themselves act as impermeable barriers to water moving downward from the Salina to the Queenston, and (2) it is more likely that salty water from the Salina would be discharged at points between the outcrop areas of the two formations.

Although direct evidence is lacking, the writer believes that the salty water in the Queenston Shale is most likely derived from connate water. The discharge of connate water begins as soon as a deeply buried bed is brought up into the zone of circulating ground water. The Queenston rocks were deposited as a sea-bottom clay about 350 million years ago, and have been deeply buried throughout most of the intervening time. During some thousands of years of Recent geologic time, connate water has been flushed from the upper several hundred feet of the Queenston. However, it is probable that flushing of the deeper part of the formation is continuing at present.

OCCURRENCE OF WATER IN UNCONSOLIDATED DEPOSITS

The unconsolidated deposits in the Niagara Falls area are not important sources of water. These deposits may be classified into two types based on their water-bearing properties: (1) coarse-grained materials of high permeability (sand and gravel), and (2) fine-grained materials of very low permeability (glacial till and lake deposits). The unconsolidated deposits in the Niagara Falls area are predominantly of the fine-grained type. However, the lack of sand and gravel deposits in the Niagara Falls area, other than a few deposits of very limited thickness and extent, has severely limited the development of large ground-water supplies in the area. Most large ground-water supplies in New York State are derived from sand and gravel deposits.

Table 2 shows selected chemical constituents from wells tapping unconsolidated deposits. Water from the different types of unconsolidated deposits is not easy to differentiate on the basis of quality because many wells tap more than one type of deposit. Thus, water samples from such wells are mixtures of water from two or more deposits. In general, water from the unconsolidated deposits is very hard, but not so highly mineralized as water from the bedrock. A complete analysis of water from well 312-859-1, which taps both till and lake deposits, is listed in table 9. This is a calcium bicarbonate water, very hard (568 ppm of total hardness) containing a moderately high chloride content (105 ppm). Water from the unconsolidated deposits generally has a wide range in chloride content. Those wells which yield water with a high chloride content are probably affected either by (1) local pollution, or by (2) upward discharge of saline water from the underlying bedrock.

SAND AND GRAVEL

Sand and gravel is found in small isolated hills and in a narrow "beach ridge" which crosses the area along an east-west line (pl. 3). The sand and gravel deposits are of limited areal extent, generally thin, and occur as topographic highs. The deposits commonly consist of two lithologic types: (1) fine-grained reddish-brown sand, and (2) coarse sand and pebbles with a matrix of fine to medium sand. The origin of both the beach ridge and small hills of sand and gravel is associated with glaciation in the Niagara Falls area. The small hills are kames, i.e. hills of sand and gravel formed originally against an ice front by deposition from sediment-laden melt-water streams. The long, narrow beach ridge is believed to represent a former shore line of glacial Lake Iroquois. This large lake, the predecessor of the present Lake Ontario, existed in the Niagara Falls area near the end of the Ice Age. The sand and gravel composing the beach ridge apparently was produced from pre-existing material by wave action at the shore which winnowed out most of the silt and clay originally contained in the glacial deposit.

Although the sand and gravel deposits in the Niagara Falls area are much more permeable than the other unconsolidated deposits or the bedrock, their occurrence as small topographic highs permits them to drain rapidly. As a result, ground water generally occurs only within a thin zone at the base of the sand and gravel. This is shown in the cross section of the beach ridge in figure 12. It can be seen that the water table is only a few feet above the base of the sand and gravel. Extensive pumping of any of the wells shown would quickly dewater the sand and gravel. In general, wells in the beach ridge and kames will yield only the small amounts of water required for domestic and small-farm needs.

Moderate supplies of ground water can be obtained from a sand and gravel deposit (probably a kame) just east of Lockport, N. Y. (pl. 3). This is the largest sand and gravel deposit in the area, measuring 1 1/2 by 3/4 miles in size. The thickness of the deposit is highly variable because of the hummocky nature of the land surface, but probably averages 60-70 feet. Some notion of the ability of this deposit to yield water is shown by the yield of 165 gpm pumped from a sand pit during excavation. One large-diameter supply well has been constructed in this deposit. This well (311-838-3) was reportedly pumped at a rate of 200 gpm for 24 hours in 1956.

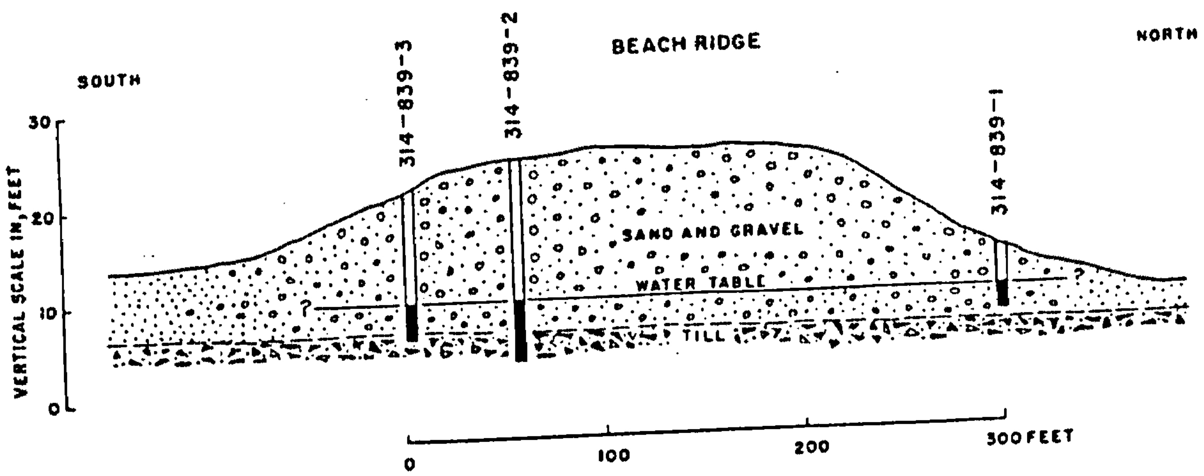

Figure 12.--Cross section of sand and gravel "beach ridge" through wells 314-839-1, -2, and -3.

LAKE DEPOSITS

Lake deposits consisting of silt, clay, and fine sand occur throughout the Niagara Falls area. These deposits are predominantly composed of laminated silt and clay which is characteristically dense and compact. Thin beds of fine sand (locally called quicksand) occur in the lake deposits. The clay, silt, and sand were deposited in lakes which existed in the area at the close of the Pleistocene Epoch (10,000 to 15,000 years ago). The lakes, which formed in the wake of the melting ice sheet, provided large bodies of quiet water for the slow accumulation of fine-grained deposits. Thus, the lake deposits are found at the surface nearly everywhere in the Niagara Falls area. The deposits are thinnest in the area south of the Niagara escarpment where they rarely exceed 20 feet in thickness. On the lake plain north of the escarpment the deposits average 30 to 40 feet in thickness; however, locally they vary from 0 to 90 feet in thickness. The greater thickness on the lake plain results from the persistence of a lake in this area (glacial Lake Iroquois) after the area south of the escarpment was above water.

The silt and clay have extremely low permeability and yield little water to wells. The thin beds of fine sand have comparatively greater permeability. Wells which tap only clay and silt will yield less than 100 gpd; those wells tapping sand beds yield more water and are usually adequate for domestic or very small agricultural needs. The lake deposits are utilized for water supplies only in the lake plain (north of the Niagara escarpment); to the south of the escarpment the deposits are too thin and are underlain by the much more permeable Lockport Dolomite.

The impermeable nature of the silt and clay was shown by a recovery test conducted on well 315-859-1. This well is believed to penetrate only clay and silt. After being pumped dry, the well required 4 1/2 months for

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the water level to rise to its static level 13 feet above the bottom. The permeability of the clay and silt, as calculated from the recovery data, was 0.04 gallons per day per square foot. The well was originally intended to provide water for a domestic supply, but was inadequate. In contrast, well 315-859-2, which is located about 500 feet to the south, provides an adequate domestic supply. This well undoubtedly penetrates a thin bed of sand.

GLACIAL TILL

A thin veneer of glacial till lies between the lake deposits described above and the bedrock throughout nearly all of the Niagara Falls area. The till is a mixture containing mostly sandy silt with boulders, pebbles, and some clay. The till was deposited directly by the ice sheet and is composed of rock which was quarried by the advancing ice, then ground up, and "plastered down" beneath the ice. The till cover in the Niagara Falls area is generally less than 10 feet thick. The greatest thickness of till (30 to 40 feet) is found in the moraines in the eastern part of the area. These features are the low ridges which trend approximately east-west located in the area southeast of Lockport and south of Medina (pl. 3). The moraines are composed of debris which was piled up in front of the advancing ice front. The moraines in the Niagara Falls area are believed to represent four minor readvances of the ice sheet during its retreat from the area (Kindle and Taylor, 1913, p. 10).

The poorly sorted nature of the till causes it to have very low permeability. An indication of the low permeability was obtained from a "slug" test on well 309-900-8. This well penetrates 7.5 feet of lake clay and silt and 1.5 feet of glacial till, and is cased through the lake deposits. The permeability of the till at this well was determined to be 23 gallons per day per square foot. This value for permeability may be too high because the well bottomed at the top of the Lockport Dolomite. Thus an open joint in the rock could have contributed to the yield of the well. However, the value for permeability may be representative of the "washed till-top of rock" aquifer tapped by many dug wells in the Niagara Falls area.

Yields adequate for domestic needs are obtained from till wells which tap: (1) sand lenses within the till, (2) the relatively permeable ("washed") zone at the top of rock, or (3) the sandy till making up the moraines. Wells which do not tap these more permeable horizons in the till are often inadequate to supply even domestic needs. Such inadequate wells yield less than 100 gpd.

separating Lake Erie from Lake Ontario. The winds are thus less moisture-laden than if they had passed over the lakes. Even those winds which may be moisture-laden (from evaporated lake water) may retain most of their moisture until they reach the more hilly areas east of Lake Ontario. The Niagara escarpment appears to have a local effect on the amount of precipitation also. As can be seen from the precipitation data given in table 5, Lewiston (elevation 320 feet), which is located below the escarpment, receives less precipitation than Lockport (elevation 520 feet), which is at the escarpment. Table 5 also shows that precipitation is fairly evenly distributed throughout the year. Within a given year, however, large variations from the average figures listed may occur. Note that the minimum monthly precipitation for each month during the 25-year period is between 1/2 and 1/20 the average precipitation for that month. However, the minimum annual precipitation (1941) is more than 1/2 the average annual precipitation. Average annual temperature is 48°F at Lewiston. The length of the growing season averages 160 days.

GROUND WATER

A part of the rain and snow falling on the Niagara Falls area seeps into the ground and continues downward to the water table to become ground water. The ground water is in constant, but generally very slow, movement from points of recharge to points of discharge. Ultimately all ground water in the area is discharged into Lake Ontario or the Niagara River either directly or via small tributary streams. The Niagara Falls area is, in effect, a peninsula-shaped catchment area in which the ground-water reservoir is being repeatedly replenished by precipitation, and constantly discharging to the surrounding surface-water bodies. This section of the report describes: (1) recharge to the unconsolidated deposits and the bedrock, (2) movement and discharge of ground water in the area, and (3) changes in storage in the ground-water reservoir as shown by water-level fluctuations.

RECHARGE

The source of nearly all the ground-water recharge in the Niagara Falls area is precipitation; however, a small amount of recharge also occurs in the area beneath and immediately adjacent to the Niagara Power Project reservoir by infiltration from the reservoir. Recharge of ground water means simply the addition of water (or quantity added) to the zone of saturation (Meinzer, 1923, p. 46). The rate and amount of recharge depends mainly upon the permeability of the soil, the amount of precipitation, and the soil-moisture condition at the time of precipitation. The rate of infiltration of water into the soil increases with increase of permeability. In the relatively small part of the Niagara Falls area underlain by sand and gravel, infiltration rates are greatest. However, throughout most of the area underlain by glacial till and lake clays and silts infiltration rates are low and surface runoff is high.

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Table 5.--Monthly precipitation at Lewiston and Lockport, N. Y., 1936-60 (Data from reports of U.S. Weather Bureau)

Month	Lewiston (1 mile north of; elevation 320 feet)		Lockport (2 miles northeast of; elevation 520 feet)	
	Average (inches)	Minimum (inches)	Average (inches)	Minimum (inches)
January	1.98	0.59 (1946)	2.38	0.67 (1946)
February	2.35	.54 (1947)	2.52	.85 (1947)
March	2.49	.63 (1958)	2.56	.71 (1958)
April	2.66	.83 (1946)	2.80	.91 (1946)
May	3.08	.71 (1941)	3.26	.94 (1936)
June	2.18	.66 (1953)	2.41	.33 (1953)
July	2.44	1.15 (1955)	2.70	.90 (1954)
August	2.57	.21 (1948)	2.97	.36 (1948)
September	2.97	.46 (1941)	2.92	.14 (1941)
October	2.55	.47 (1947)	2.85	.60 (1938)
November	2.33	.75 (1939)	2.62	.64 (1939)
December	2.02	.39 (1958)	2.39	.71 (1943)
Annual	29.62	17.64 (1941)	32.38	19.75 (1941)

The mechanism of recharge to the Lockport Dolomite is of primary concern in this report because this bedrock unit is by far the most important aquifer in the Niagara Falls area. As discussed previously, most ground water occurs in the Lockport within seven relatively permeable zones parallel to bedding which are separated by essentially impermeable rock. Recharge to these water-bearing zones occurs by one of two mechanisms: (1) downward movement of water through vertical joints or (2) recharge directly to the water-bearing zones at the outcrop of the bedding joints composing the zones.

Several lines of evidence suggest that recharge to the Lockport Dolomite occurs predominantly at the outcrop of the water-bearing zones. The lack of persistent open vertical joints in the Lockport as observed in the conduit

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excavations, suggests that vertical joints are not important avenues for downward movement of water. However, this is not conclusive evidence in itself because on an areal basis, many vertical joints, although apparently tight, might be able to transmit appreciable quantities of water when considered as a whole even though each joint singly might transmit a very small quantity of water. More conclusive evidence of a negligible movement of water along vertical joints is the occurrence of "dry" open bedding joints below the "wet" bedding joints comprising the water-bearing zones in the Lockport (fig. 8). This phenomenon could not occur if permeable vertical joints connected the "dry" and "wet" bedding joints. It seems probable that the "dry" bedding joints exist because they receive little or no recharge in their outcrop area. This lack of recharge would be particularly applicable to those bedding joints cropping out along the Niagara escarpment where there is very little opportunity for recharge.

The most important indication that recharge to the water-bearing zones of the Lockport Dolomite occurs at the outcrop of the zones, is the alignment of water levels approximately parallel to the dip of the zones themselves. This alignment of water level is shown for water-bearing zone 3 in figure 9.

The wells shown in the cross section are adjacent to the reservoir of the Niagara Power Project; however, the water levels shown were measured prior to flooding of the reservoir. If recharge to the water-bearing zones did occur throughout the area by downward movement through vertical joints, the gradient along the zones would steepen in the downdip direction rather than continue roughly parallel to the dip of the zones--that is, if it is assumed that there is no increase in transmissibility downdip. This steepening of the hydraulic gradient would be required in order to transmit the ever-increasing amounts of water supplied to the zone by the vertical joints. No such steepening of the gradient was observed.

In summary, it appears that recharge occurs principally at the outcrop of the water-bearing zones in the Lockport Dolomite and that water then moves down the dip of the zone with a relatively constant loss of head. Recharge is probably not limited to the actual line of outcrop of a zone, however, but occurs throughout the area where the zone is reached by the enlarged vertical joints that occur in the upper few feet of the rock.

Little is known about the recharge to the other bedrock formations underlying the Niagara Falls area. It is probable that a very small amount of water moves downward from the Lockport Dolomite into the Rochester Shale and the underlying bedrock units. As was pointed out in the preceding discussion, however, vertical openings even in the Lockport Dolomite appear to transmit relatively little water except in the upper few feet of the rock. Therefore, movement of water from the Lockport into the underlying formations probably occurs only along widely spaced major vertical joints. Some of the water in the deeper bedrock units in the Niagara Falls area may also be derived from recharge to these beds in the area to the south. Such water would move through the Niagara area toward the Niagara gorge and Lake Ontario, both of which are regional discharge areas.

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GROUND-WATER MOVEMENT AND DISCHARGE

Ground water moves from points of high head to points of low head (or potential), in other words from points where the water table or piezometric surfaces are highest to points where they are lowest. The direction of ground-water movement in the upper few feet of bedrock and in the unconsolidated deposits (where water-table conditions exist) is shown by the configuration of the water table. The direction of movement in the remainder of the bedrock is shown by the configuration of the piezometric surfaces associated with each of the artesian water-bearing zones in the different bedrock formations.

As discussed previously, each of the seven water-bearing zones in the Lockport is a distinct artesian aquifer with an associated piezometric surface. To show in detail the ground-water movement in the Niagara Falls area, it would be necessary to construct a water-table map, and piezometric maps for each of the water-bearing zones. Such maps are not included in this report because water levels could be measured in relatively few wells and because of the difficulty of differentiating between water levels which represent the water table and water levels which represent the piezometric surfaces associated with each of the several water-bearing zones. In a few wells constructed with packers, such as shown in figure 9, it was possible to measure separate water levels associated with the water table and with distinct water-bearing zones. In wells not equipped with packers, which includes all domestic and industrial wells in the area, a measured water level is an average of the heads of the different water-bearing openings penetrated by the well. Such an average water level represents neither the water table nor the piezometric surface of a single water-bearing zone.

Nearly all water-level data that could be used in determining direction of ground-water movement were obtained from wells in the vicinity of the pumped-storage reservoir. These data show that in general the configuration of the water table follows the surface of the land, being highest under hills and in interstream tracts and lowest in stream valleys. The configuration of the piezometric surfaces associated with each water-bearing zone in the Lockport has little relationship to the land surface. The piezometric surfaces are approximately parallel to the slope of the water-bearing zones. The disparity in the configuration of the water table and the piezometric surfaces is shown in figure 9, which was previously referred to in the discussion of artesian and water-table conditions in the Lockport. As shown in the figure, the water table slopes from all directions toward Fish Creek, whereas the piezometric surface for water-bearing zone 3 slopes to the south away from the creek. Thus, ground-water movement in the upper fractured part of rock and in the overlying unconsolidated deposits is toward the creek, but movement along water-bearing zone 3 and, presumable in the other water-bearing zones, is to the south toward the upper Niagara River.

Figure 14 shows the inferred direction of ground-water movement in the upper water-bearing zones of the Lockport Dolomite. This figure is based on adequate data only in the vicinity of the reservoir. Because only a few scattered water-level observations are available for the area south of the reservoir, the flow lines in that area are based largely on the fundamental principles governing ground-water movement.

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It may be observed in figure 14 that ground water in the Lockport Dolomite moves north toward the Niagara escarpment in a narrow area parallel to the escarpment. This northerly direction of ground-water movement is shown by (1) the location of springs near the base of the Lockport along the escarpment (pl. 1), and (2) the decline of water levels in wells in the direction of the escarpment. A divide in the water table and in the upper fractured part of the rock apparently exists at a distance of 1,000 to 2,000 feet south of the escarpment. The existence of this divide is shown by the reversal of hydraulic gradient in the area. The gradient is toward the escarpment in the area less than 1,000 feet south of the escarpment. However, a hydraulic gradient to the southeast (approximately parallel to the dip of the beds in the Lockport) was observed in wells located over 2,500 feet south of the escarpment.

Prior to the start of the investigation it was assumed that water in the Lockport Dolomite in the western part of the Niagara Falls area moved west to the gorge to discharge. It was observed very early in the study, however, that there was practically no evidence of seepage on the sides of the gorge. The lack of seepage could be explained by (1) assuming that the water moving toward the gorge was intercepted by enlarged vertical joints parallel to the gorge, or (2) assuming that there was little or no movement of water toward the gorge.

Because the city of Niagara Falls and the area along the gorge north of the city is supplied by the Niagara Falls municipal water system, very few wells suitable for water-level observations were found in the area. The only wells readily accessible for water-level measurements were in the vicinity of the power station and canal. The data from these wells indicate that water moves toward the gorge. The width of the area supplying water to the gorge, however, could not be determined. Indirect information relative to this problem was derived from the water-level measurements in the vicinity of the reservoir. It was found that if the slope of the piezometric surface for a specific water-bearing zone (for example, zone 3 in figure 9) was extended to the south, the pressure reached the level of the upper Niagara River a short distance south of the reservoir. This does not prove but certainly strongly suggests that under natural (pre-power project) conditions the water in the Lockport Dolomite turned west to discharge into the Niagara River gorge, roughly midway between the escarpment and the upper Niagara River (fig. 14). The absence of seepage on the sides of the gorge, therefore, is believed to be attributable to enlarged vertical joints parallel to the gorge.

Ground-water movement as it probably existed in 1962 may be summarized as follows: (1) water moves northward in a narrow area parallel to the Niagara escarpment, (2) water moves southward (downdip) in the area around the reservoir (which acts as a recharge mound and tends to deflect the water moving from the north), (3) water moves into the canal, conduits, and area of industrial pumping to discharge, and (4) water moves toward the gorge in the southwestern part of the area.

On the lake plain, north of the Niagara escarpment, ground water moves in a generally northward direction toward Lake Ontario. The water table is located within the lake deposits about 3 to 10 feet below the surface. The water table very nearly parallels the land surface and slopes regionally toward Lake Ontario with a gradient of 5 to 20 feet per mile. It also slopes toward the streams crossing the lake plain in a narrow area adjoining each stream. The direction of ground-water movement in the Lockport Dolomite in the eastern part of the Niagara Falls area is not known.

WATER-LEVEL FLUCTUATIONS

Fluctuations of ground-water levels reflect changes in the amount of water stored in an aquifer. A decline in water level shows a decrease in storage in the aquifer, and means simply that discharge from the aquifer is exceeding recharge. A rise in water level indicates the reverse situation--recharge is greater than discharge. In wells tapping unconfined aquifers, water-level fluctuations show changes in the position of the water table. In wells tapping artesian aquifers, water-level fluctuations show changes in artesian pressure.

Natural fluctuations

Water-level fluctuations of natural origin can be broadly classified as either short- or long-term fluctuations. The short-term fluctuations are produced mainly by changes in atmospheric pressure, ocean tides, and earth tides. Fluctuations due to atmospheric pressure and earth tides occur in the Niagara Falls area but are of relatively little importance in the description of the ground water. Such short-term fluctuations are observed only in wells tapping artesian aquifers. Long-term fluctuations are largely a product of climate, particularly precipitation and temperature. The long-term fluctuations in water levels show changes in the natural rate of recharge to an aquifer compared to its rate of discharge to springs and stream beds.

The most noticeable fluctuation of ground-water levels in the Niagara Falls area are seasonal fluctuations. In general, water levels in the area reach their peak during the spring of the year (March and April) because of the large amount of recharge provided by snow melt and precipitation. Water levels generally decline throughout the summer because most of the precipitation is lost by evaporation and the transpiration of plants. Such water loss is characteristic of the summer growing season. During other seasons substantial amounts of water pass through the soil zone and continue downward to the water table. Water levels generally reach their yearly lows near the end of the growing season during September or October. Thereafter, water levels begin to rise and this rise is more or less continuous through March or April. Because the amount of precipitation is normally evenly spaced throughout the year in the Niagara Falls area (table 4), seasonal fluctuations are more a product of air temperature than of precipitation. The air temperature controls whether precipitation falls as snow or rain, whether the ground is frozen at the time of precipitation, and the length of the growing season; all of these are factors that affect water levels.

SPRINGS

Springs are not widely utilized as ground-water supplies in the Niagara Falls area. Springs are common along the Niagara escarpment but rarely occur elsewhere in the area. (See plates 1 and 3.)

Most of the springs along the escarpment originate near the base of the Lockport Dolomite. The source is nearly always seepage from bedding joints at the contact between the DeCew Limestone Member of Williams (1919) and the Gasport Limestone Member of the Lockport (water-bearing zone 2 in fig. 8). The springs occur where vertical joints intersect the water-bearing zone. Enlargement of both vertical and bedding joints is common at the springs, and in some cases has proceeded to the point where small caves have developed.

Springs are uncommon along the cliffs of the Niagara River Gorge. This lack of springs probably results from the development of extensive open vertical joints parallel to the face of the gorge. These joints drain water readily from the Lockport Dolomite through the underlying rocks and talus to the river. (See figure 6.)

Notable exceptions to the lack of springs along the gorge are springs 309-902-2Sp and -3Sp which are located just south of the Niagara escarpment (pl. 1). These springs are located in caves developed by solution of the shaly dolomite of the DeCew Member of Williams (1919) of the Lockport. The source of the springs, like the source of most springs along the escarpment, are bedding joints at the contact between the DeCew and Gasport Members (water-bearing zone 2 in fig. 8). Extensive solution features, such as sink holes, exist in the area drained by these two springs. Fish Creek, which crosses the area, loses water as it flows across the bedrock, and apparently contributes a major part of the water discharging from the springs. Dye introduced into Fish Creek reappeared at the springs, 1,000 feet away, 38 minutes after introduction (personal communication from C. P. Benziger of Uhl, Hall & Rich). The yield of these springs is therefore highly variable; the yields varying from about 15 gpm during dry periods to reportedly thousands of gallons per minute following heavy rains or periods of melting snow. The water from springs 309-902-2Sp and -3Sp is polluted by nearby septic tanks as shown by the strong odor of sewage and the sudsy character of the water.

The yield of single springs in the Niagara Falls area ranges from about 2 to 30 gpm during the dry parts of the year. The yields of most springs increase following rains but not nearly so much as the increase noted for springs 309-902-2Sp and -3Sp in the discussion above. Spring 310-859-6Sp is the only spring in the area utilized as a water supply on a year-round basis. This spring provides an adequate domestic supply for a trailer court with eight families.

PRESENT UTILIZATION

An estimated 10 mgd (million gallons per day) of ground water was obtained from wells in the Niagara Falls area during 1961-62. This figure contrasts with an estimated 60 mgd of water obtained from surface sources

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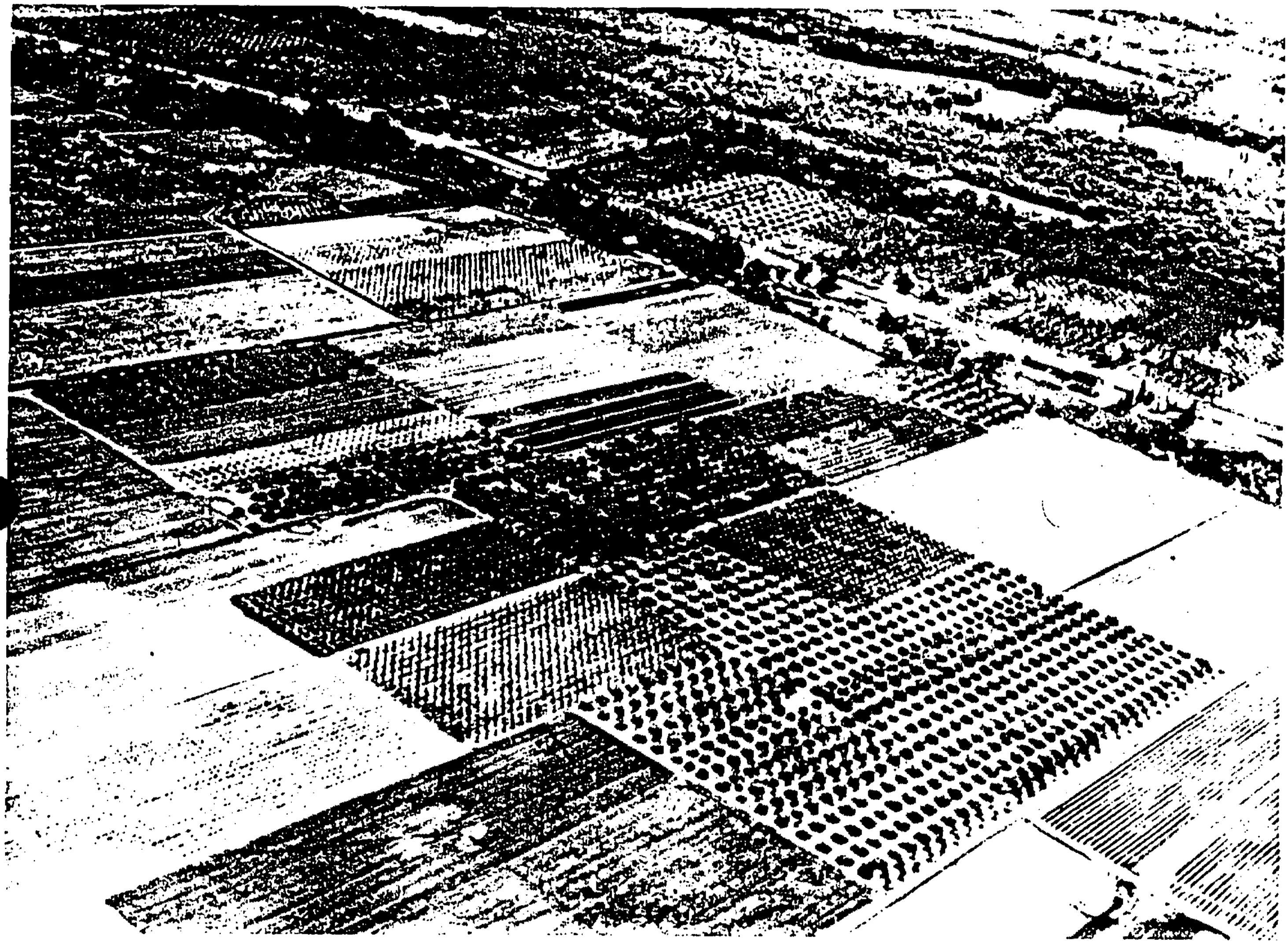
REFERENCE NO. 3

Draft

SOIL SURVEY OF

Niagara County, New York



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Cornell University Agricultural Experiment Station

Issued October 1972

Natural drainage and slow permeability are the two most limiting factors for community development. Sanitary sewers and an adequate drainage system are needed. Because the soils in most of this association are underlain by firm glacial till, bearing strength and soil stability are generally favorable for foundations.

About 75 percent of the association is open land. The remaining 25 percent is scattered farm woodlots or idle land that is reverting to forest. Openland wildlife is plentiful in many areas. Pheasants and rabbits are the most commonly hunted wildlife species. The potential for wetland wildlife is good. Many dug-out ponds are in this association. Marsh occurs in the northern part of Hartland. Recreation consists mostly of hunting and fishing. Scenic areas are few.

2. Hilton-Ovid-Ontario association

Deep, well-drained to somewhat poorly drained soils having a medium-textured or moderately fine textured subsoil

This association occurs in nearly level to strongly sloping areas in which till deposits are dominant (fig. 3). One continuous area occupies the central part of the county. The association crosses the county in a general east-west direction. A limestone escarpment is prominent, and there is a sandy delta in an area that begins near the city of Lockport and extends eastward to the village of Gasport.

The Hilton-Ovid-Ontario association occupies about 15 percent of the county. About 24 percent of this association is Hilton soils, 14 percent is Ovid soils, 7 percent is Ontario soils, and the remaining 55 percent is soils of minor extent.

The Hilton soils are deep, moderately well drained, and medium textured. They have a gravelly loam or silt loam surface layer, have a heavy loam or silt loam subsoil, and are underlain by calcareous loamy glacial till. In some areas limestone bedrock is at a depth of 3 1/2 to 6 feet. These areas have large stones above the bedrock in many places. Hilton soils are nearly level or gently sloping. They commonly are at intermediate elevations on the glacial till plain. In a few places, they are on fairly large lateral moraines or small drumlins.

The Ovid soils are deep and somewhat poorly drained, and they have a moderately fine textured subsoil. Typically, they have a silt loam surface layer, have a silty clay loam subsoil, and are underlain by heavy loam glacial till. They are nearly level to gently sloping and occur at a slightly lower elevation than the Hilton soils. In some places Ovid soils are along drainageways. Some areas of Ovid soils are underlain by limestone bedrock at a depth of 3 1/2 to 6 feet.

The Ontario soils are deep, well drained, and medium textured. Typically, they have a loam surface layer, have a heavy loam subsoil, and are underlain by calcareous loamy glacial till. Ontario soils are nearly level to strongly sloping. They occupy the higher elevations, such as the tops and sides of drumlins or lateral moraines. In places the Ontario soils have limestone bedrock at a depth of 3 1/2 to 6 feet. In these areas they are nearly level or gently sloping and contain some large stones.

The minor soils are mainly of the Appleton, Cazenovia, Cayuga, Churchville, Sun, and Arkport series. The Appleton and Cazenovia soils are intermingled with the major soils on the till plain. The Cayuga and Churchville soils are along the fringes of the till plain where lacustrine sediments cap the till. Sun soils are in depressions, and Arkport soils are mainly on the sandy delta between the city of Lockport and the village of Gasport. Also, Rock land occurs in small areas.

This association has a medium value for farming. In much of the area, farming competes with nonfarm uses. Most of the city of Lockport and the villages of Sanborn, Gasport, and Middleport are in this association. Many estate-type homes are near the limestone escarpment.

Dairying is the major farm use. In the sandy area along the escarpment between Lockport and Gasport, fruit growing is fairly intensive. The 1958 Conservation Needs Inventory indicates that about 50 percent of the association is cropland, 15 percent is forest or woodland, 10 percent is urbanized, and the remaining 25 percent is pasture and miscellaneous open land.

In places stones and bedrock are limitations for farming and urban development. Natural drainage is a limitation in the wetter areas. Slope and erosion are concerns, mainly near the escarpment. In many places installing artificial drainage is difficult because of stones and underlying bedrock.

This association has a high potential for dairying, raising livestock, and part-time farming. Stones and depth to bedrock are limitations to use locally. Lime needs generally are low. Vegetable growing is mostly restricted to the relatively stone-free, level or nearly level soils. Fruit is more susceptible to frost damage than in areas closer to Lake Ontario.

Wet areas, stones, and bedrock near the surface are the most limiting factors for urban development. Sanitary sewers are needed for concentrated housing developments. In many places underground installations are costly. Most soils in this association have adequate strength for building foundations. The association contains some of the most scenic sites for homes in the county.

This association contains five county parks and most of the Tuscarora Indian Reservation. Also, there are several municipal parks and playgrounds. Some of the most scenic views in the county are in this association. Especially near the scenic escarpment, there is a potential for more hiking, nature, and horseback-riding trails.

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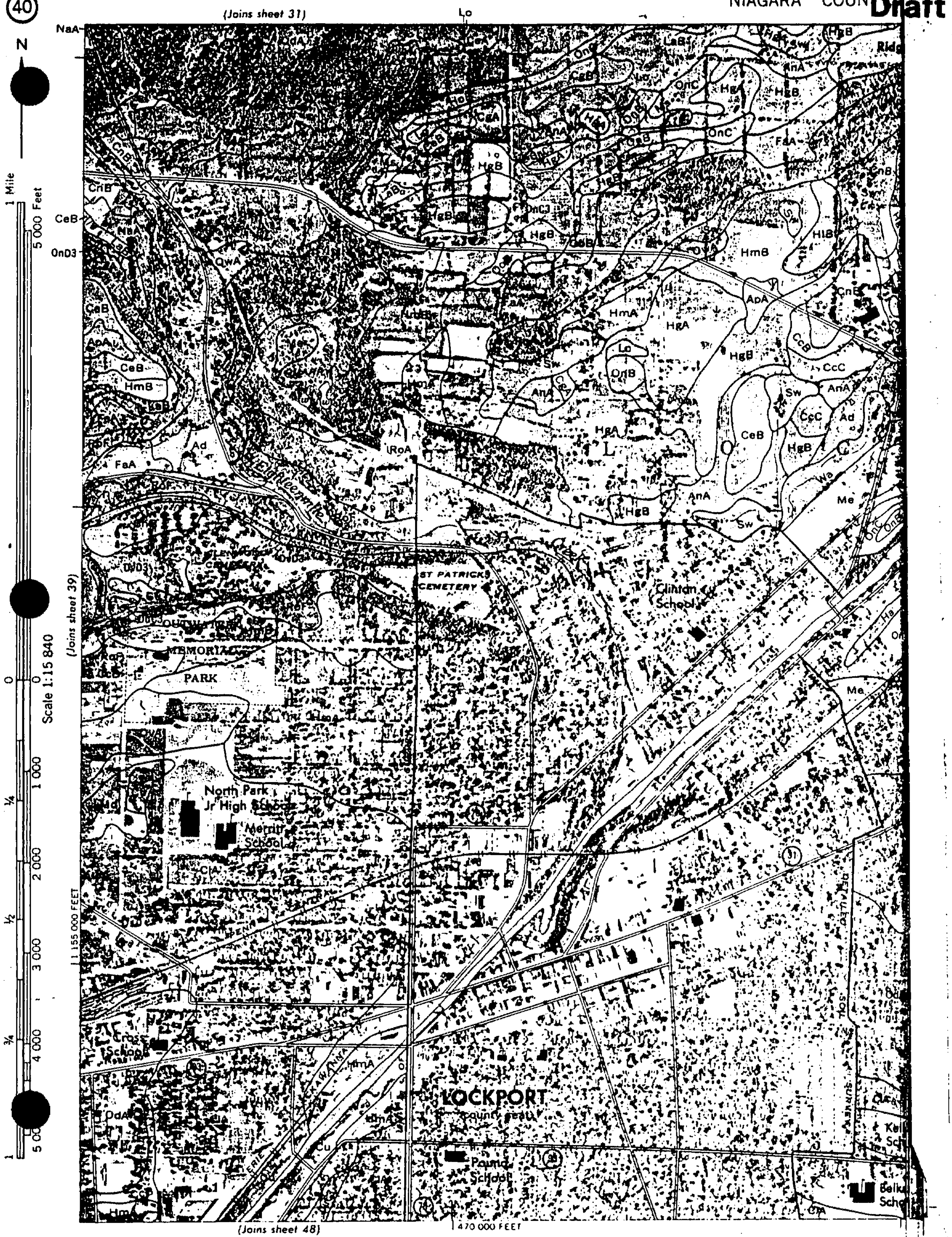
(Joins sheet 31)
(Joins sheet 39)
(Joins sheet 48)
N
1 Mile
5 000 Feet
Scale 1:15 840
470 000 FEET
1 155 000 FEET
ST PATRICKS CEMETERY
MEMORIAL
PARK
Clinton St School
North Park Jr High School
Merritt School
LOCKPORT
(county seat)
Pound School

REFERENCE NO. 4

Draft

ecology and environment, inc.

195 SUGG ROAD, P.O. BOX D, BUFFALO, NEW YORK 14225, TEL. 716-632-4491, TELEX 91-9183

International Specialists in the Environment

October 2, 1987

Mr. Michael Hopkins
Niagara County Department
of Health
10th and East Falls Street
Niagara Falls, New York 14302

Dear Mr. Hopkins:

On several occasions during the course of the Phase 1 investigations, E & E has contacted the Niagara County Department of Health to obtain information in regard to various characteristics of the sites under investigation. The DEC requires that all information contained in Phase 1 reports be fully documented. We ask you to review the information your department has provided, as presented in this letter, and sign this document to acknowledge that you have provided this information and that it (with any corrections or qualifications) is correct to the best of your knowledge.

Ross Steel

1) No hazardous waste is expected to be on site.
2) Groundwater is not used for irrigation within a 3-mile radius of the site.
3) Surface water within 3 miles of this site is used for commercial, industrial, and recreational purposes.
4) The drinking water intakes are upstream of site.

Dussault Foundry

1) There is no use of groundwater within 3 miles of site.
2) The surface water within 3 miles downstream of site is used for recreation (Erie Canal).

Town of Lockport Landfill

1) There is no use of groundwater within 3 miles of site.
2) The Erie Canal (surface water) is used for recreation near this site.
3) The drinking water intakes are located in the Niagara River located upstream of this site.

Draft

SKW Landfill

1) The drinking water surface intakes are located upstream of this site.
2) Groundwater is used within a 3 mile radius of this site for drinking water.
3) The surface water downstream (Niagara River) is used for recreation (Maid of Mist, fishing).

Diamond Shamrock

1) There is no groundwater used within a 3 mile radius of this site.

Roblin Street

1) There is no use of groundwater within a 3 mile radius of this site, drinking or irrigation.

Electro Minerals U. S. (formerly Carborundum Bldg. 82)

1) The water supply intakes are located upstream of this site.

Frontier Bronze

1) There is no suspected hazardous waste disposal present at this site.
2) Groundwater for drinking purposes is used by a neighborhood approximately 2.5 miles to the NW, at the intersection of Pennsylvania and Witmer Road. Two families, roughly 8 people, use groundwater for drinking purposes.

Walmore Road

1) The well on site is used for irrigation.
2) Approximately 1 acre of area is irrigated by this groundwater well.
3) There is no use of surface water 3 miles downstream of this site.

New York Power Authority Road Site

1) Hazardous waste is not suspected to be disposed of on site.
2) There is no land irrigated with groundwater within 3 miles of site.

I would also like you to confirm the fact that no fire official has declared any of the following sites a fire or explosion hazard:

- SKW Alloys Landfill - Witmer Road, Town of Niagara.
- Dussault Foundry - Washburn Street, Lockport.
- Frontier Bronze - New Road, City of Niagara Falls.
- Staufer Chemical, North Love Canal - Town of Lewiston.

Draft

- o Electro Minerals, U.S., Inc., (formerly Carobrundum Bldg. #82), Buffalo Avenue, City of Niagara Falls.
- o Ross Steel Co. - Pine Avenue, Niagara Falls (now the site of the New York Power Authority water intake conduit right-of-way).
- o Roblin Steel Company - Oliver Street, North Tonawanda.
- o LaSalle Expressway - specifically near Love Canal.
- o Diamond Shamrock, now Occidental Petroleum Corp., Ohio Street, Lockport, New York.
- o Town of Lockport Landfill - East Canal Street, Lockport, New York.
- o Power Authority Road Site - New Road, Lewiston, New York (across from Hyde Park Landfill).
- o 64 Street South (owned by Russo Chevrolet) - 64th and Niagara Falls Blvd., Niagara Falls.
- o Walmore Road, 6373 Walmore Road, Town of Wheatfield, New York.

I certify that I provided the above information to Ecology and Environment, Inc., and It is correct to the best of my knowledge.

________________________ ____________________
Signature Date

Please find maps enclosed to assist you in locating these sites. If you have any questions regarding the above, please contact me at 633-9881.

Thank you very much for your time and assistance in our ongoing investigations.

Sincerely,

Dennis Sutton

oio

REFERENCE NO. 5

Draft

Uncontrolled Hazardous Waste Site Ranking System

A Users Manual

Kris W. Barrett
S. Steven Chang
Stuart A. Haus
Andrew M. Platt

August 1982

MTR-82W111

SPONSOR:
U.S. Environmental Protection Agency
CONTRACT NO.:
68-01-6278

The MITRE Corporation
Metrek Division
1820 Dolley Madison Boulevard
McLean, Virginia 22102

S 202 - .36

REFERENCE NO. 6

Draft

JUN 2 ...

ecology and environment, inc.

195 SUGG ROAD, P.O. BOX D, BUFFALO, NEW YORK 14225, TEL. 716-632-4491, TELEX 91-9183

International Specialists in the Environment

June 23, 1987

Barry H. Christensen
Manager Environmental Services
Occidental Chemical Corporation
Occidental Chemical Center
360 Rainbow Blvd., South
Niagara Falls, NY 14302

Dear Mr. Christensen:

On June 12, 1987, Mark Cotter and I attended a meeting with you and Mr. Gary Ernst concerning possible hazardous waste disposal at the Lockport, New York, sodium silicate plant. During that meeting, the following was discussed:

- The facility has produced sodium silicate, which is used in the foundry industry and as a raw material for soap production, from 1923 to September 1986; at which time, the sodium silicate production was shut down.

- From 1923 until 1925, the plant was operated by Standard Silicate. In 1925, the plant was operated by Diamond Shamrock, who operated the facility until Occidental Chemical Corp. bought it in 1986.

- The plant now produces nothing but Hazsorb, a glass absorbant manufactured for the chemical industry. ? (CAN BE used BY OTHER INDUSTRIES)

- No organic chemicals or acids are used in production and no hazardous waste is generated on site.

- Water used on site is supplied by the City of Lockport.

- Cinders generated by coal gasification in the 1920s through 1940s have been buried on the northern portion of the site; part of which has been sold to Diversified in December 1986.

- This cinder disposal area is partially covered by the glass mill building, the L.W.A. plant, and heavy vegetation.

I would like to request that you review the above information and make any changes necessary. Please sign your name to indicate that you are in agreement with the above and return the original to me as soon as possible.

Barry Christensen
7/2/87

Draft

I will be using this material as part of the New York State Department of Environmental Conservation Phase 1 Report that is being compiled on the Lockport plant. I appreciate the help you have given me on this matter and look forward to hearing from you soon.

Sincerely,

Dennis Sutton

Dennis Sutton

oio

Draft

REFERENCE NO. 7

Desmond Shomrock
6/12/87

overcast 60's

6/12/87

6/12/87

Questions To ask

(1) How much ~~soda~~ caustic soda is used, where is it stored ?

- check NE corner of property - ash & cinder

- underground storage Tanks

-

0930 arrived at site

- Personnel Present:

Barry H. Christensen: Manager Environmental Services

Paul R. Dieby Assistant Public Health Engineer

Gary Ernst. Chicago Plant Manager Oxy

Draft

Dennis is asking questions &
I'm taking notes.

Raw Materials Used:

- sand

- soda ash

- liquid caustic soda

started 1923 - 5/86.

Owners History:

Standard Silicate - 1928

Diamond Shamrock 1928-1986

Oxy 1986 - present

Other Raw Material

Hi-Sil - pottery glass
refined sugar -

"no organic chemicals
on property" - G.E.

- liquid Caustic Soda - 10,000
(1) above ground Tank.

- presently use electric + natural
gas

1920 - late 1940's -
cinder ash. covered over
with gravel, new building

(2) 10,000 gal #2 oil Tank
removed 1986

Draft

Sodium Silicate come
from Tank car

- 90% of waste generated is office Trash. Hauled by Water Disposal

[other 10% of Trash is office products

→

- at one Time a TSD permit was pursued. no longer pursued due To lengthy paper work
- only hazy waste - on site boiler acid washing - HCl trucked to Cecos 1982

- boiler wash on site 12 (55 gall drums per smonthly. - Nalco

Draft

Mr Ernst
answered all questions

~~Permits~~ #

Permits

#	
3	air permits for stacks for sodium silicate

- discharge to city sewer systems

(Silicate production not running

Hayosb material is manufactured here

- no pending permits,
- particulate emissions on site

6 oil tank is on site (20,000 gal) below grade

→ 9/85 - 5/86 period of performance for sewer discharge permit expired

- no wells on property city of Lockport supplied

- Photos

-

① above grd Tanks 1025
② Modern Disposal Services 1027
③ sodium silicate tank 1023 cars

④ open Drainage leav. site - brownish colored. Open Storm Sewer 1026

⑤ former UST loc. 1027

⑥ soda ash silos - no longer used. 1029

⑦ FRP - 20,000 gal #6 fuel oil registered - below grade 1030

Draft

(8) - Toured inside the building holding the caustic soda Tanks

- drums of lubricating oil

sodium silicate used in foundry industry as binder & as a soap raw material.

no readings above background on HNU

Toured inside the HAZORB building

{ no - boric acid
- solid ~~sodium~~ ~~sodium~~ $NaSiO_2$
- lime

boric acid quantity on site less than one ton
= 300 lbs used per week

Draft

The contents of of
HAZORB is proprietary data.

(8) - Orchard North of site 1050
old $NaSiO_2$ slag

(9) same as (8) 1052

1110 - left site

Draft

Draft

REFERENCE NO. 8

Draft

GSC-TR8705

DRAFT

GRAPHICAL EXPOSURE MODELING SYSTEM

(GEMS)

USER'S GUIDE

VOLUME 1. CORE MANUAL

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PESTICIDES AND TOXIC SUBSTANCES
EXPOSURE EVALUATION DIVISION
Task No. 3-2
Contract No. 68023970
Project Officer: Russell Kinerson
Task Manager: Loren Hall

Prepared by:

GENERAL SCIENCES CORPORATION
6100 Chevy Chase Drive, Suite 200
Laurel, Maryland 20707

Submitted: February, 1987

1. INTRODUCTION

The Graphical Exposure Modeling System (GEMS) is an interactive computer system developed by General Sciences Corporation under the auspices of the Modeling Section in the Exposure Evaluation Division (EED), Office of Toxic Substances (OTS) of the Environmental Protection Agency (EPA). It provides a simple interface to environmental modeling, physiochemical property estimation, statistical analysis, and graphic display capabilities, with data manipulation which supports all of these functions. An overview of the basic GEMS components is shown in Figure 1-1. The system is installed on the OTS VAX 11/780 computer in Research Triangle Park, North Carolina, and is accessible through dial-up lines.

GEMS is being developed to support integrated exposure analyses at OTS. Its purpose is to provide environmental researchers and analysts with a set of sophisticated tools to perform exposure assessments of toxic substances without requiring them to become familiar with most aspects of computer science or programming.

GEMS is designed under a unique concept which integrates the computerized tools of graphics, mapping, statistics, file management, and special functions such as modeling and physiochemical property estimation, under a user-oriented and simple-to-learn interface. GEMS prompts the user or provides a menu for each action to be performed. The following features provide users with great flexibility during the GEMS execution:

- HELP commands - When you are using the GEMS system, you may not always have a user's manual readily available and/or you may need to see the format and type of a command or an answer before you enter it. Various HELP commands are available in GEMS which provide such information.

- Recovering from errors - If you enter a command or a response incorrectly, the system issues an error message and reprompts you for the correct information.

- Built-in defaults for model execution - GEMS is designed to guide inexperienced users through the execution of selected models. Default responses are usually available when you cannot specify a choice or supply an input to a prompt during model execution.

- Data management of modeling results - Data generated from execution of the SESOIL, ISC, SWIP, or AT123D models may be stored automatically in GEMS. These data may be accessed or analyzed via GEMS' file management, graphics, and statistics operations.

The purpose of this document is to describe GEMS from the user's point of view. It is intended as a comprehensive guide to the use of GEMS for personnel who have no specialized knowledge of computer programming. However, a working knowledge of environmental modeling is necessary for complete and accurate use of the system.

Draft

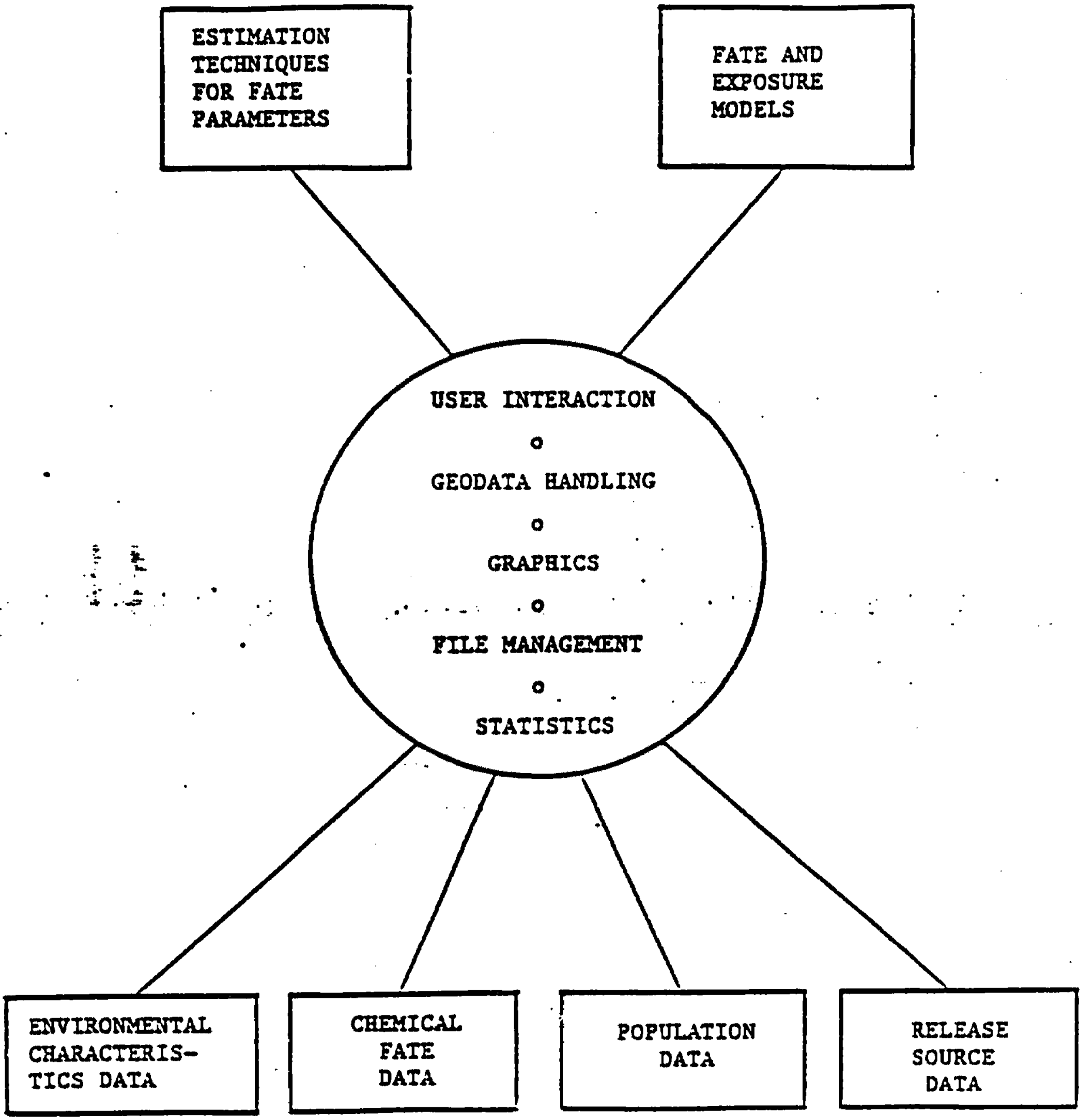

FIGURE 1-1. Components of the Graphical Exposure Modeling System (GEMS)

Since the last draft of the GEMS User's Guide, completed in June, 1984, the GEMS system has gone through a number of modifications and enhancements. It is no longer feasible to hold all sections in one single volume. This revised user's guide is designed in a modular fashion of six separate volumes described briefly below. In addition, GEMS has been adapted to function on an IBM PC/XT or AT. This prototype called PCGEMS has many of the same capabilities of the mainframe GEMS. These include environmental modeling procedures such as ENPART and AT123D as well as property estimation procedures such as CLOGP and AUTOCHEM. The prototype PCGEMS works in large part through interface with the OTS VAX 11/780 on which GEMS resides, a user's guide for PCGEMS will be available in the near future.

Volume 1: Core-Manual

This volume is a reference manual and introduction for first-time users. In addition to Section 1 - Introduction, a functional description of GEMS is presented in Section 2, a detailed guide to the use of the system is presented in Section 3, and summaries of the VAX operating environment and system and frequently used utilities are presented in Section 4. Two sample runs are given in the attachment to provide users with information in order to interact with the GEMS system, to generate a dataset, and subsequently, produce a map from the dataset.

Volume 2: Modeling

This volume consists of all GSC prepared user's manuals to GEMS models, grouped according to media. User's manuals are available for the following models: SESOIL, AT123D, SWIP, ENPART, TOX-SCREEN, INPUFF, and ISC/GAMS. A user's manual for EXAMS II model will be available later this year. Refer to Section 2.2 for further information.

Volume 3: Graphics and Geodata Handling

This volume contains two GEMS operations, Graphics and Geodata Handling. The Graphics operation contains a variety of graphics procedures which may be used to display results from modeling runs or from datasets. The Geodata Handling operation contains procedures that perform geographic data manipulation and generate maps of U.S. states or counties. Refer to Section 2.3 for further information.

Volume 4: Data Manipulation

This volume contains descriptions of GEMS system-installed datasets and two GEMS operations - File Management, and Utilities. Refer to Section 2.4 for further information.

Volume 5: Estimation

This volume consists of user's manuals for SFILES, FAP, CLOGP, and AUTOCHEM. These estimation programs may be used to provide estimated physiochemical properties for model input or for other environmental fate analyses. Refer to Section 2.5 for further information.

Volume 6: Statistics

This volume contains information on the GEMS Statistics operation which includes the Descriptive Statistics procedure and procedures to produce simple or multiple regression and contingency tables. Refer to Section 2.6 for further information.

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REFERENCE NO. 9

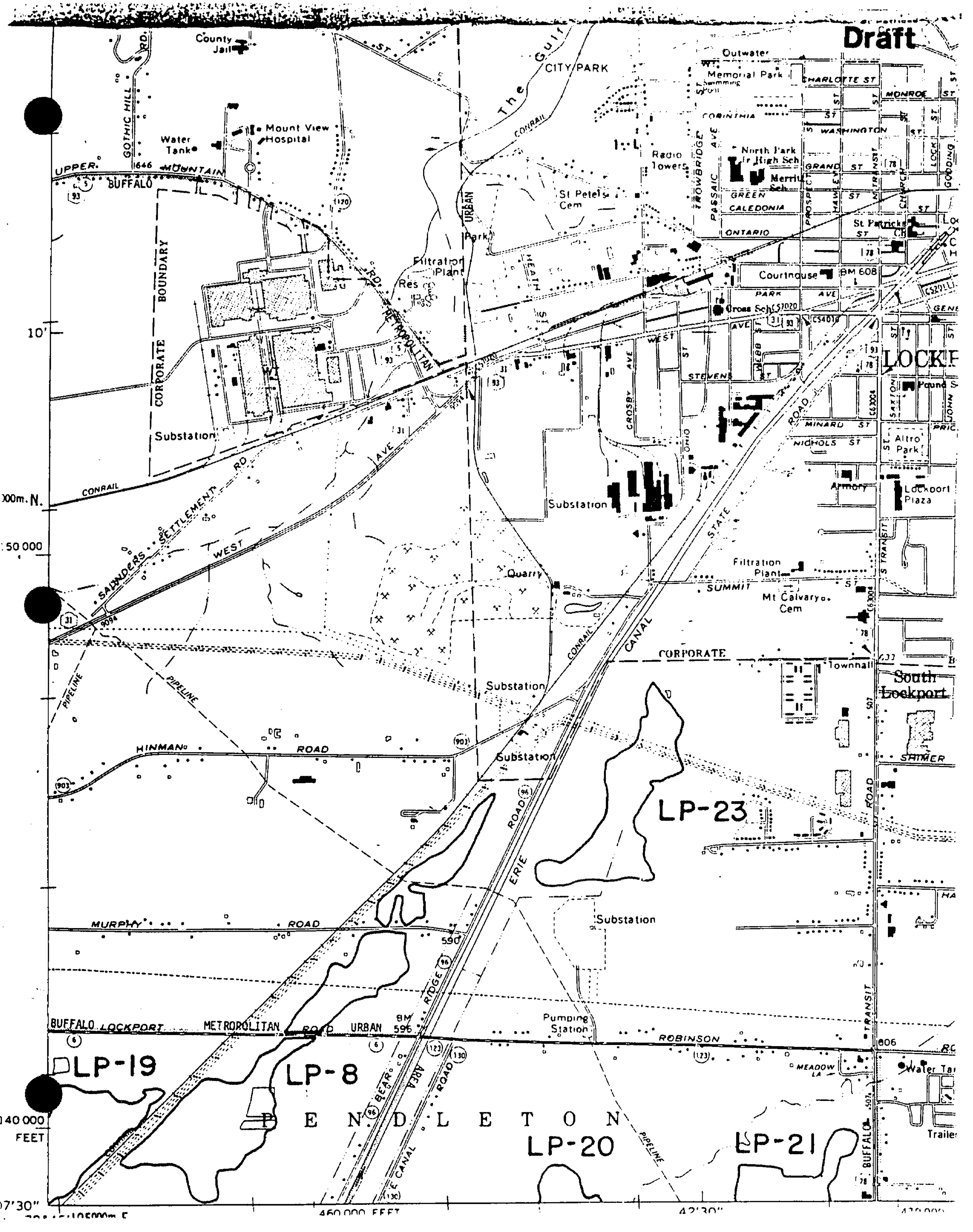
Draft

Freshwater Wetlands Classification Sheet

December 5, 1984

Niagara County
Map 10 of 18
Lockport Quadrangle

Wetlands Identification Code	Municipality	Classification
LP-1	Newfane	II
LP-2	Newfane	II
LP-3	Newfane	III
LP-4	Newfane, Lockport Town	II
LP-5	Lockport Town, City of Lockport	I
LP-7	Lockport Town	II
LP-8	Pendleton, Lockport Town	II
LP-9	Lockport Town, City of Lockport	II
LP-10	Lockport Town, City of Lockport	I
LP-12	Lockport Town	II
LP-13	Lockport Town	II
LP-14	Lockport Town	II
LP-15	Lockport Town	II
LP-16 (formerly LP, GA-16)	Lockport Town	III
LP-17 (formerly LP, NW-17)	Newfane	III
LP-18 (formerly LP, NW-18)	Newfane	III
LP-19 (formerly LP, CB-19)	Pendleton	II
LP-20 (formerly LP, CC-20)	Pendleton	II
LP-21 (formerly LP, CC-21)	Pendleton	II
LP-22 (formerly LP, GA-22)	Royalton, Lockport Town	III
LP-23	Lockport Town	II
LP-24	Lockport Town	II
LP-26	Newfane	III
LP-27	Newfane	III
LP-29	Newfane	II
LP-30	Lockport Town	II
LP-31	Newfane	III
LP-32	Lockport Town	III
LP-33 (formerly LP, CC-33)	Lockport Town	II
LP-34	Lockport Town	II
LP-35	Lockport Town	II
LP-36	Lockport Town	II
LP-37	Lockport Town	II
NW-24 (formerly NW, LP-24)	Newfane	III


Draft
County Jail
GOTHIC HILL RD.
Water Tank
Mount View Hospital
UPPER MOUNTAIN
BUFFALO
1646
The Gulf
CITY PARK
CONRAIL
Outwater Memorial Park
Swimming Pool
CHARLOTTE ST
MONROE
CORINTHIA ST
WASHINGTON
Radio Towers
TROWBRIDGE
PASSAIC AVE
North Park Jr High Sch
Merritt Sch
GRAND ST
GREEN
CALEDONIA
ONTARIO
PROSPECT
HAWLEY
TRANSIT
CHURCH
LOCK
GOODING
St Peters Cem
St Patricks Ch
URBAN
Park
Filtration Plant
Res
METROPOLITAN RD
HEATH ST
Courthouse
BM 608
PARK AVE
Cross Sch
WEST AVE
CORPORATE BOUNDARY
STEVENS
WEBB
CROSBY AVE
ORIO
ROAD
LOCKP
Pound
SAXTON
JOHN
MINARD ST
NICHOLS ST
PRICE
Altro Park
Armory
Lockport Plaza
Substation
CONRAIL
SAUNDERS SETTLEMENT RD
WEST AVE
STATE ROAD
Quarry
Filtration Plant
SUMMIT ST
Mt Calvary Cem
CANAL
CORPORATE
Townhall
South Lockport
PIPELINE
HINMAN ROAD
SHIMER
LP-23
ERIE ROAD
MURPHY ROAD
590
BUFFALO LOCKPORT METROPOLITAN ROAD URBAN
BM 596
Pumping Station
ROBINSON
RIDGE
BEAR RIDGE
AREA ROAD
MEADOW LA
Water Tank
Trailer
606
LP-19
LP-8
P E N D L E T O N
LP-20
LP-21
CANAL
BUFFALO
10'
50 000
140 000 FEET
7'30"
460 000 FEET
42'30"

REFERENCE NO. 10

The National Register of Historic Places

1976

e Lewishon to carry forward their work in drama and dance with local children. *Multiple public/private:* NHL.

NIAGARA COUNTY

Lewiston. **FRONTIER HOUSE,** 460 Center St., 1824–1826. Stone, 3 1/2 stories, rectangular; gabled roof with stepped gables, paired chimneys, and balustrade; off-center and center entrances, full-width front porch with hipped roof, regular fenestration, oval windows in gables; N kitchen wings. Federal elements. Built as a tavern for Joshua Fairbanks and Benjamin and Samuel Barton, local prominent businessmen. *Private.*

Lewiston. **LEWISTON MOUND,** Lewiston State Park, Hopewellian affinities (c. 160). Oval burial mound. Partially investigated. *County.*

Lewiston vicinity. **LEWISTON PORTAGE LANDING SITE,** Prehistoric–19th C.. Gently sloping ravine leading from river remains of path used by travelers to avoid Niagara Falls. Archeological explorations yielded artifacts from Indian to British occupation, indicating this was a heavily used access point to a vital overland route. *State.*

Lockport. **LOWERTOWN HISTORIC DISTRICT,** Roughly bounded by Erie Canal and New York Central RR., 19th–20th C.. Primarily residential district, with some religious and commercial buildings and warehouses; facing the canal are 2 1/2-story brick and stone residences with Greek Revival and Italianate elements built in the 1830's; off the canal are 1–2-story frame structures with additions and modern siding built mid-19th C. and some stone structures: notable are the Gothic Revival former Christ Episcopal Church (1854) and the Italianate Vine Street School (1864). Systematic development of the village began after canal opened; district was Lockport's social, commercial, and industrial center, 1830's–1860's. *Multiple public/private:* HABS.

Lockport. **MOORE, BENJAMIN C., MILL (LOCKPORT CITY HALL; HOLLY WATER WORKS)** , Pine St. on the Erie Canal, 1864. Coursed rubble, 2 1/2 stories over basement on sloping site, trapezoidal shape, hipped roof sections with cross gables, interior chimney; front center entrance with transom and pediment on pilasters, triple round arched windows in gables, rock-faced stone lintels and sills, ashlar quoins; interior altered; rear 2-story addition 1893. Built as a flour mill, converted c. 1885 to a water pumping plant; adapted as city hall 1893; one of few survivors of 25 industrial buildings once clustered along this section of Erie Canal. *Municipal.*

Niagara Falls. **DEVEAUX SCHOOL COMPLEX,** 2900 Lewiston Rd., 1855–1888. Educational complex; contains 3 connected structures–Van Rensselaer Hall (1855–1857), Patton Hall (1866), and Munro Hall (1888); and outbuildings–barn, shed, and gymnasium. Gothic Revival elements. Founded by Judge Samuel DeVeaux as an Episcopal school for poor and orphaned boys; later became a prominent preparatory school; closed, 1971. *Private.*

Niagara Falls. **NIAGARA FALLS PUBLIC LIBRARY,** 1022 Main St., 1902–1904, E. E. Joralemon, architect. Stone, yellow brick; 1 story, rectangular with semielliptical rear bow, flat roof with parapet, slightly projecting center entrance bay with pedimented double doorway, pedimented windows, string courses; fine interior detail intact. Neo-Classical Revival elements. One of many public libraries endowed by Andrew Carnegie. *Public.*

Niagara Falls. **NIAGARA RESERVATION,** 1885. Includes the falls, Goat Island and other islets, paths, and an observation tower. In establishing a reservation of over 400 acres, New York became the first state to use eminent domain powers to acquire land for aesthetic purposes. *State:* NHL.

Niagara Falls. **SHREDDED WHEAT OFFICE BUILDING,** 430 Buffalo Ave., 1900. Steel frame, brick; 5 stories, rectangular, flat roof, center entrance, 5 paired window bays, segmental arched basement windows, wide parapet; interior featured 4th-floor auditorium and 5th-floor cafeteria; doubled glazed windows. Commercial style. Administrative office building of original Shredded Wheat factory complex, developed by Henry D. Perky. *Private.*

Niagara Falls. **U.S. CUSTOMHOUSE,** 2245 Whirlpool St., 1863. Stone, 2 1/2 stories, square, hipped roof, arched window and door openings on W facade; built into railroad embankment, S side opens onto railroad tracks; renovated, 1928. Continues to serve as customs office for trains from Canada. *Private:* HABS.

Niagara Falls. **WHITNEY MANSION,** 335 Buffalo Ave., 1849–1851. Limestone, 2 1/2 stories, L-shaped, intersecting gabled roof sections; original section has off-center entrance with full-width Ionic portico; 19th C. side addition has front bay window and gabled dormer with 3 round arched windows. Greek Revival. Built according to 1830's design by Solon Whitney, son of Gen. Parkhurst Whitney, village founder and prominent hotel and tavern owner. *Private.*

Youngstown vicinity. **OLD FORT NIAGARA,** N of Youngstown on NY 18, 1678. Complex of stone buildings bounded by stone walls, earthworks, and a moat; restored. Original fort built in 1678; altered 1725–1726 and 1750–1759. Held alternately by French, British, and Americans in struggle for control of continent; strategically located in commanding the Great Lakes from Lake Erie to Ontario and in covering approaches to western NY. *State:* NHL.

ONEIDA COUNTY

Boonville. **ERWIN LIBRARY AND PRATT HOUSE,** 104 and 106 Schuyler St., 1890, C. L. Vivian (Erwin Library); 1875, J. B. Lathrop (Pratt House). Erwin Library: limestone, 1 story, gabled and hipped roofs; square tower with pyramidal roof contains recessed arched entrance. Romanesque. Pratt House: brick, 3 stories, mansard roof with dormers and central tower crowned with iron cresting and spire, ornate bracketed cornices and metal lintels; original interior wall coverings, fixtures, and woodwork. Second Empire. *Private.*

Boonville. **FIVE LOCK COMBINE AND LOCKS 37 AND 38, BLACK RIVER CANAL (BOONVILLE GORGE PARK)** , NY 46, 19th–20th C.. Section of the abandoned Black River Canal (built mid-19th C.) running through rugged terrain of Boonville Gorge; contains locks 37 and 38 and a 5-lock combine (locks 39–43); canal was 42' deep; locks, 90' by 15', which accommodate 70-ton boats, were built 1895–early 1900's. Canal built to connect Black River Valley to Erie Canal provided water supply for Erie Canal, allowed expansion of valley's lumbering industry, and fostered growth of towns. *State/county:* HAER.

Clinton. **HAMILTON COLLEGE CHAPEL,** Hamilton College campus, 1827, Philip Hooker, architect. Coursed rubble, 3 stories, rectangular, low pitched roof, interior chimney, modillion cornice, front and rear parapet; front slightly projecting 4-story clock tower with 3-stage frame belfry–2 stories, each with columns and entablature, surmounted by octagonal cupola; front center double-door entrance with round arched window above, flanked by tall round arched windows, blind decorative frame panels; limestone ashlar quoins, lintels, and sills; side elevations with 3 tiers of windows; apse added 1897; interior altered. Federal. Multipurpose classroom and chapel building designed by Philip Hooker; unusual 3-story interior plan attributed to John H. Lothrop, a trustee. *Private.*

Clinton. **ROOT, ELIHU, HOUSE,** 101 College Hill Rd., 1817. Frame, clapboarding; 2 stories, irregular shape, gabled roof, interior chimneys, pedimented arched portico, off-center entrance with semielliptical fanlight and side lights, 2-story pilasters dividing bays in flush-sided main facade, pedimented rear porch; side additions; restored, 1900's. Federal. Home of Elihu Root, U.S. Secretary of War largely credited with conceptual foundation for 20th C. development of American Army, Secretary of State, U.S. senator, and winner of 1912 Nobel Peace Prize. *Private; not accessible to the public:* NHL.

Rome. **ARSENAL HOUSE,** 514 W. Dominick St., c. 1813–1814. Brick, 2 1/2 stories, rectangular, gabled roof, pairs of bridged interior end chimneys above single gable steps, central pedimented gable with elliptical window, 2 vertical elliptical windows in gabled ends between chimneys, stone sills and lintels; later front porch with large modillion blocks, chamfered

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REFERENCE NO. 11

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ecology and environment, inc.

195 SUGG ROAD, P.O. BOX D, BUFFALO, NEW YORK 14225, TEL. 716-632-4491, TELEX 91-9183

International Specialists in the Environment

June 23, 1987

Mr. James McCann
Lockport Water Dept.
Lockport Municipal Bldg.
Lockport, New York 14094

Dear Mr. McCann:

On 6/10/87, I spoke with you via telephone concerning water supply for the City of Lockport. The following points were made during that conversation:

- o The City of Lockport obtains its water supply from a pumping station in the Niagara River in North Tonawanda, New York.
- o A back-up pumping station is located in the Erie Canal near Summit and Ohio Streets in the City of Lockport.
- o There are no known groundwater wells in use in the city or town of Lockport.

I would like to request that you review the above points and make any changes necessary. Please sign your name in agreement with the material, and return the original to me as soon as possible.

I will be using this information as part of the New York State Department of Environmental Conservation Phase 1 reports that are being compiled on several sites in the Lockport area. I appreciate the help you have given me on this matter, and look forward to hearing from you soon.

Sincerely,

Dennis Sutton

Dennis Sutton

DS/db

Dear Mr. Sutton:

Items 1 & 2 are correct in your letter above. I cannot verify Item 3 concerning the Town of Lockport.

Sincerely,

James P. McCann

James P. McCann
Sr. Building Inspector

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REFERENCE NO. 12

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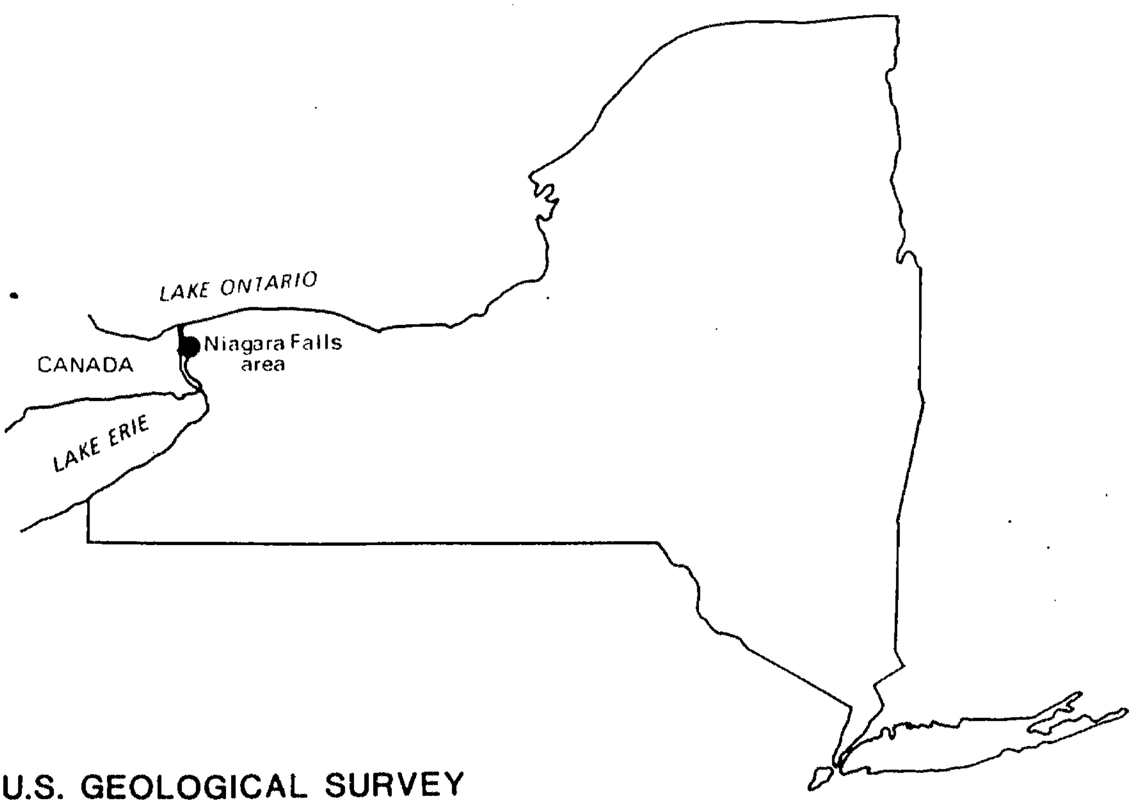
Effect of Niagara Power Project on Ground-Water Flow in the Upper Part of the Lockport Dolomite, Niagara Falls Area, New York



U.S. GEOLOGICAL SURVEY
Water-Resources Investigations
Report 86-4130

Prepared in cooperation with the
U.S. ENVIRONMENTAL PROTECTION AGENCY
NEW YORK STATE DEPARTMENT OF
ENVIRONMENTAL CONSERVATION

Draft

of studies by the New York State Department of Environmental Conservation, private consultants, and by the U.S. Geological Survey to describe ground-water conditions at many waste-disposal sites in the Niagara Falls area.

Acknowledgments

The New York Power Authority provided construction details of the power-project facilities, water-level data from the forebay canal and pumped-storage reservoir, and assistance in measuring water levels in NYPA wells in the vicinity of the pumped-storage reservoir. The New York State Department of Environmental Conservation coordinated the water-level measurements at industrial sites. Several industries, including Occidental Petroleum and E.I. Dupont De Nemours and Company, provided water-level data. The City of Niagara Falls provided construction details on many sewer and building projects and assisted in obtaining permits and permission to drill observation wells within the city.

GEOHYDROLOGY OF THE LOCKPORT DOLOMITE

Stratigraphy and Lithology

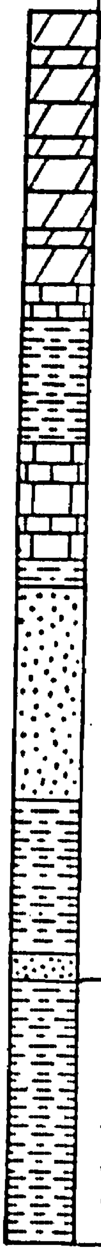
Unconsolidated glacial deposits of till and lacustrine silt and clay, generally 5 to 15 ft thick but ranging to 48 ft thick, overlie the 80- to 158-ft-thick Lockport Dolomite of Middle Silurian age within the Niagara Falls area (Tesmer, 1981). The thickest unconsolidated deposits (up to 48 ft) are in a shallow buried valley in the western part of the city (pl. 1B).

Underlying the Lockport Dolomite is a 27-ft-thick sequence of Middle Silurian shale, limestone, and dolomite in the lower part of the Clinton Group, which is underlain by a 113-ft-thick sequence of Lower Silurian sandstone and shale that is in turn underlain by 1,200-ft-thick Upper Ordovician shale. These rocks are exposed only in the Niagara River gorge and are shown in the stratigraphic column in figure 2. The strata are gently folded and dip slightly to the south-southwest at about 30 ft/mi (Fisher and Brett, 1981).

The Lockport Dolomite is a fine to coarse crystalline, thin to massive bedded dolomite, limestone, and shaly dolomite, with vugs containing gypsum (calcium sulfate) and calcite (calcium carbonate). Other minor minerals disseminated throughout the formation are sphalerite (zinc sulfide), pyrite (iron sulfide), and galena (lead sulfide) (Tesmer, 1981).

Hydraulic Conductivity

The Lockport can be divided into two zones on the basis of water-transmitting properties. The upper 10 to 25 ft of rock is a moderately permeable zone that contains relatively abundant bedding planes and vertical joints enlarged by dissolution of dolomite and abundant solution cavities left by dissolution of gypsum; the remainder of the formation contains low to moderately permeable bedding planes of which as many as seven may be major water-bearing zones that are surrounded by fine-grained crystalline dolomite of low permeability. Hydraulic-conductivity values obtained from model simulations and limited aquifer-test data (Maslia and Johnston, 1982) range from 5 to 15 ft/d in the upper part and from 1 to 2 ft/d in the lower part. Well yields commonly range from 10 to 100 gal/min.



System and series		Group	Formation	Thickness (feet)	Description
Silurian	Middle	Lockport	Lockport Dolomite	158	Dark-gray to brown, massive to thin-bedded dolomite locally containing algal reefs and small, irregularly shaped masses of gypsum. Near the base are light-gray coarse-grained limestone (Gasport Limestone Member, dark-gray shaley dolomite)
Silurian	Middle	Clinton	Rochester Shale	60	Dark-gray calcareous shale weathering light-gray to olive.
Silurian	Middle	Clinton	Irondequoit Limestone	12	Light-gray to pinkish-white coarse-grained limestone.
Silurian	Middle	Clinton	Reynales Limestone	10	White to yellowish-gray shaly limestone and dolomite.
Silurian	Middle	Clinton	Neahga Shale	5	Greenish-gray soft fissile shale.
Silurian	Lower	Medina	Thorold Sandstone	8	Greenish-gray shaly sandstone.
Silurian	Lower	Medina	Grimsby Sandstone	45	Reddish-brown to greenish-gray cross-bedded sandstone interbedded with red to greenish-gray shale.
Silurian	Lower	Medina	Power Glen Shale	40	Gray to greenish-gray shale interbedded with light-gray sandstone.
Silurian	Lower	Medina	Whirlpool Sandstone	20	White, quartzitic sandstone
Ordovician	Upper	Richmond	Queenston Shale	1,200	Brick-red sandy to argillaceous shale.

Figure 2.--Stratigraphy of the Niagara Falls area. (Modified from Fisher, 1959.)

Draft

Ground Water

Occurrence

The Lockport Dolomite is the principal source of ground water in the Niagara Falls area. Although the effective primary porosity is negligible, significant ground-water movement occurs through secondary openings such as bedding joints (planes), vertical joints (fractures), and solution cavities, described below. The upper 25 ft of the Lockport has a greater potential for movement of ground water (and contaminants) than the deeper parts because it has more interconnected vertical and horizontal joints that have been widened by solutioning, which allows direct entry of contaminants from surface sources.

Bedding planes.--The bedding planes, which transmit most of the water in the Lockport (Johnston, 1964), are relatively continuous fracture planes parallel to the natural layering of the rock. These openings were caused by crustal movements and the expansion of the rock during removal of weight by erosion of overlying rock units and by retreat of the glaciers. Johnston (1964) identified seven water-bearing zones, which consist either of a single open-bedding plane or an interval of rock layers containing several open planes. The top 10 to 25 ft of rock may contain one or two significant bedding planes; these are probably connected by vertical joints, which are abundant in the upper part of the formation.

The lower part of the Lockport Dolomite contains fewer water-bearing bedding planes that are interconnected by vertical joints. These deeper water-bearing zones are underlain and overlain by essentially impermeable rock. Each water-bearing bedding plane can be considered a separate and distinct artesian aquifer (Johnston, 1964). The hydraulic head within each water-bearing zone is lower than that in the zone above it; this indicates a downward component of ground-water flow.

Vertical joints.--Vertical joints in the Lockport Dolomite are not significant water-bearing openings except (1) in the upper 10 to 25 ft of rock, (2) within about 200 ft of the Niagara River Gorge, and (3) in the vicinity of the buried conduits. Physical and chemical weathering have increased the number, continuity, and size of vertical fractures in the upper part of the Lockport. The major joints, oriented N 70°E to N 80°E, are generally straight, spaced 10 to 80 ft apart, and penetrate 10 to 25 ft (American Falls International Board, 1974). Intersecting the major joint set are less extensive high-angle joints that are confined to particular beds. Vertical joints become narrower, less numerous, and less connected with depth.

In addition to the major regional fractures, extensive tension-release fractures were formed near the gorge wall by the erosion and removal of the supporting rock mass in the gorge; openings up to 0.3 ft wide have been observed (American Falls International Board, 1974). Less developed tension-release joints and blasting-originated joints are common along the twin conduits. These fractures probably extend less than 100 ft from the trench walls.

Solution cavities.--Solution cavities are formed by the dissolution of gypsum pockets and stringers by percolating ground water. These cavities range in diameter from 1/16 in to 5 in; they are most abundant in the upper 10 to 15 ft of rock but occur also along water-bearing bedding zones throughout the Lockport. The solution cavities become less continuous with depth and therefore have little effect on the water-transmitting ability of the lower parts of the formation.

Recharge

Most of the recharge to the Lockport Dolomite results from infiltration of rainfall and snowmelt through the soil to the water table. Precipitation in the Niagara Falls area averages 30 in/yr and is fairly evenly distributed throughout the year (Dethier, 1966). Snow usually accumulates from mid-December to mid-March, during which time several thaws may reduce or entirely melt the snow pack. Seven 14-month hydrographs of U.S. Geological Survey wells installed in the upper part of the Lockport (fig. 3) and a 10-year hydrograph of a long-term observation well, Ni-69 (fig. 4) indicate that most recharge occurs from late fall through winter (November to April), when evapotranspiration is low. Generally, water levels fluctuate less than 6 ft annually.

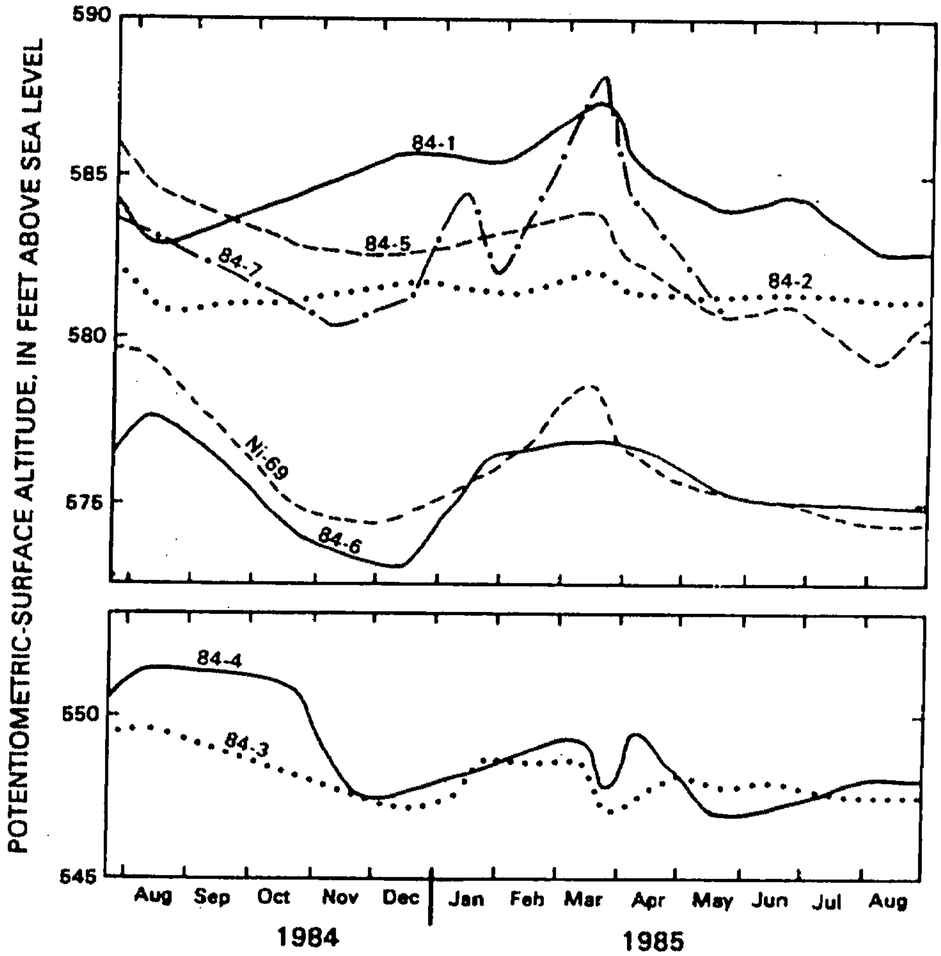


Figure 3.--Hydrographs of wells 84-1 through 84-7 in and near the City of Niagara Falls.

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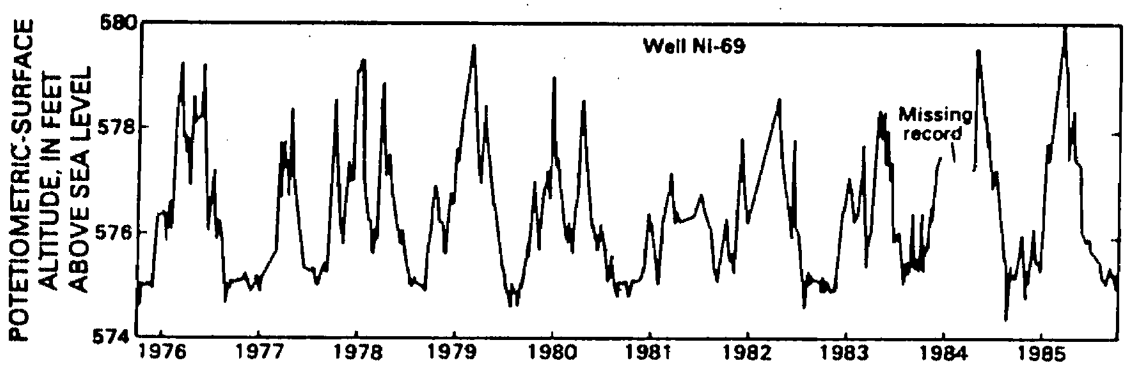

Figure 4.--Hydrograph of well Ni-69 in northern part of the city of Niagara Falls.

The rate and amount of recharge to a formation from precipitation depends on the permeability of the overlying lacustrine fine sand, silt, clay, and till, which in the Niagara Falls area is relatively low, with hydraulic conductivity ranging from 0.0014 to 0.27 ft/d. The average annual recharge from precipitation is estimated to be 5 to 6 in/yr (LaSala, 1967) but is probably greater in several small areas where the Lockport, whose hydraulic conductivity ranges from 5 to 15 ft/d, crops out at land surface.

Movement and Discharge

Before construction of Niagara Power project and Falls Street tunnel.--Little information is available on ground-water levels in the Niagara Falls area before 1960; therefore, interpretation of ground-water movement in the upper part of the Lockport Dolomite before that time is based largely on fundamental assumptions governing ground-water flow. These assumptions are that (1) ground-water divides coincide with topographic highs; thus the major divides in the region were at the Niagara Escarpment, north of the study area (fig. 1), and in the central part of the City of Niagara Falls (pl. 1A); (2) regional flow of ground water followed the south-southwestward slope of the land surface and the southwestward dip of major bedding planes, (3) local ground-water movement followed the configuration of the buried bedrock surface; and (4) ground water in the central and southern parts of the city discharged to the upper Niagara River, while water in the western part discharged to the lower Niagara River in the gorge. The general inferred directions of ground-water movement in the upper part of the Lockport Dolomite before any major construction or industrial pumping is shown in figure 5.

Effect of Falls Street tunnel.--In the early 1900's, the Falls Street tunnel was excavated through the upper part of the Lockport Dolomite from 56th Street to the Niagara gorge (fig. 6). This 3.5-mi-long unlined tunnel trends east-west and slopes 20 ft/mi beneath the southern part of the city approximately 0.65 mi north of the upper Niagara River (fig. 1). Runoff and ground water that drained into the tunnel flowed west with sewage to a treatment plant in the Niagara River gorge below the Falls.

The bottom of the Falls Street tunnel slopes westward from 549 ft above sea level at 56th Street to 533 ft at 27th Street (fig. 6), which places the tunnel at or above the altitude of the lowest part of the Niagara River channel in this reach. Thus, in the reach from 56th Street to 27th Street, water from the Niagara River (surface altitude about 560 ft) probably moves through the upper part of the Lockport northward toward the tunnel through the relatively permeable upper 15 to 20 ft of the Lockport. A shallow bedrock valley in this area (pl. 1B) may be a major zone of infiltration to the tunnel because the depth of weathering would be deepest under this channel. Ground water north and south of the tunnel probably drains into the tunnel also, but the size of the area affected by the tunnel is unknown.

The Falls Street tunnel from 24th Street west to the Niagara gorge is 25 ft or more below the relatively permeable upper zone of the Lockport. Thus, the tunnel in this area is overlain by less fractured, less permeable beds that limit downward flow. A study of ground-water infiltration into the tunnel (Camp, Dresser and McKee, 1982) found only minimal seepage to the Falls Street tunnel between 24th Street and the gorge. Although the amount of water that drained into the tunnel before construction of the conduits is unknown, the Falls Street tunnel east of 27th Street probably altered ground-water movement by creating a local ground-water low as water drained into the tunnel from the upper 25 ft of bedrock and possibly from the Niagara River.

During the 1930's and 1940's, several companies drilled and pumped water from an industrialized area within 2,000 ft of the Niagara River near Gill Creek (fig. 1); yields from these wells were as high as 1,800 gal/min. Johnston 1964) and Woodward-Clyde Consultants (1983) reported that most of the pumped water was induced recharge from the Niagara River that moves predominantly through the upper part of the Lockport Dolomite. The induced recharge from the Niagara River by industrial pumping and possibly some infiltration to the Falls Street tunnel are the only known changes in natural ground-water flow patterns in this part of the city before the construction of the Niagara Power Project.

HYDROLOGIC EFFECTS OF NIAGARA POWER PROJECT

The Niagara Power Project, constructed by New York Power Authority during 1958-62, has an electrical production capacity of 1,950,000 kw. Part of the flow of the upper Niagara River 2.5 mi above the Falls is diverted 4 mi north through the twin buried conduits to the L-shaped forebay canal, which is between the Robert Moses powerplant and the Lewiston powerplant (fig. 1). The conduits can divert 50,000 to 75,000 ft^3/s of water, which is at least 25 percent of the river's flow.

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Table 1.--Flow of Niagara River over Horseshoe and American Falls.[1]

Season	Dates		Hours	Minimum flow over falls (ft³/s)
Tourist season	Apr. 1 to Sept. 15	Day:	8:00 am to 10:00 pm	100,000
		Night:	10:00 pm to 8:00 am	50,000
	Sept. 1 to Oct. 31	Day:	8:00 am to 8:00 pm	100,000
		Night:	8:00 pm to 8:00 am	50,000
Non-tourist season	Nov. 1 to Mar. 30		12:00 am to 12:00 am	50,000

[1] The diverted water (average total flow of river, 204,000 ft^3/s, minus flow over falls) is divided between Canada and United States.

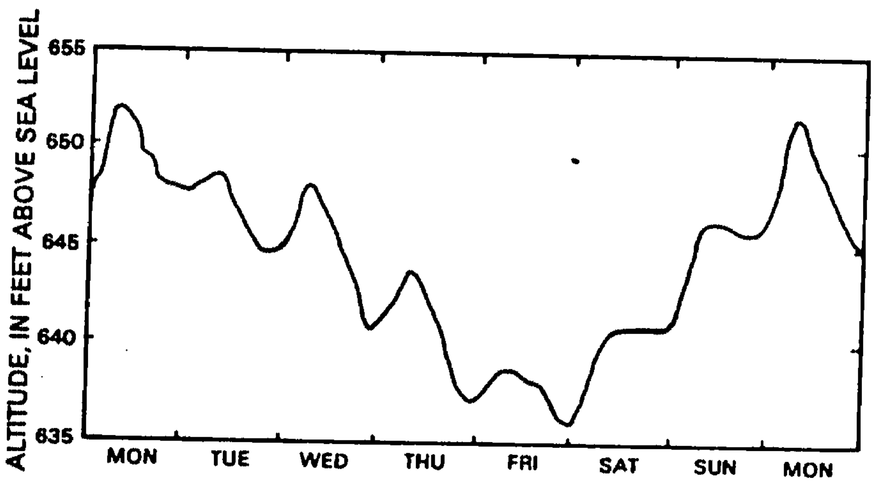

Figure 8.

Typical Lewiston Reservoir water levels during a weekly pumped-storage/release cycle.

Ground-Water Flow and Water Levels

Construction of the twin buried conduits, the forebay canal, and the pumped-storage reservoir has modified hydrologic conditions within the Niagara Falls area. The daily and seasonal regulation of water levels in the reservoir and forebay canal have changed the natural flow patterns and water levels in the upper part of the Lockport Dolomite. To determine the effect of the power project on ground-water movement, water levels in the upper part of the Lockport Dolomite were measured at 104 wells on October 23-24, 1984 and on March 26-27, 1985 (values are given in table 2, at end of report). The difference between water levels in October and those in March were relatively small (generally within 3 to 5 ft); therefore, only the water levels measured in March were used to construct a potentiometric-surface map (pl. 1A), which includes arrows showing the directions of ground-water flow.

Effect of Twin Buried Conduits

The twin buried conduits were constructed in two separate parallel bedrock trenches approximately 4 mi long. Each trench is 52 ft wide and penetrates 100 to 160 ft into the Lockport Dolomite; at the north end they penetrate the Lockport and upper part of the underlying Rochester Shale (fig. 9). The top of the conduits averages more than 40 ft below land surface. General construction details for the conduits are shown in figure 10.

Along the conduits are two dewatering stations--one at the intersection of the Falls Street tunnel at Royal Avenue, the other just south of the forebay canal (fig. 1). Each pumping station has direct access to water in both conduits and to water in the drain system that surrounds the conduits, which is in hydraulic contact with the surrounding bedrock. The pumping stations were designed to drain water from the bedrock surrounding each conduit through the drain system to reduce hydrostatic pressure, which could collapse the conduits should they need to be dewatered.

The drain system surrounding the conduits consists of formed, vertical 6-in-diameter drains placed every 10 ft along both sides of each conduit (fig. 11A), and two semicircular (2-ft radius) floor drains beneath the full length of the conduits at the bottom of each trench. The wall and floor drains are connected to continuous concrete-formed side drains in the lower corners of each bedrock trench (fig. 11A). All drains were formed into the concrete-conduit structure and are open to the bedrock walls and floor of conduit trenches but are not open directly to the river or forebay canal.

The only locations where water in the drain system can mix with water inside the conduits is at the two pumping stations. Each station has three sumps (fig. 11B)--a central sump connected to the conduit drain system that surrounds both conduits, and the two outer sumps, each of which is connected to the adjacent conduit. Both pumping stations have a pair of balancing weirs; one is near the Falls Street tunnel and operates at an altitude of 560 ft; the other is at the conduit outlet on the forebay canal and operates at an altitude of 550 ft. When the water level in the drain system exceeds the altitude of the balancing weir, water from the drains flows through the weir to the outer sumps and into the conduits, which discharge into the forebay canal.

Ground-water discharge into the backfill.--Backfill on top of the conduits was found to be relatively permeable where the Falls Street tunnel and conduits intersect (Koszalka and others, 1985, p. 56); however, no description of the backfill materials elsewhere along the conduits could be found. To determine whether the backfill is permeable elsewhere and forms a major pathway for ground-water movement, four wells were drilled during this study, three over the east conduit (wells 84-9, 84-10, and 84-11) and one over the west conduit (84-8, fig. 1). Drill cuttings indicated that the backfill consists of 2 to 5 ft of topsoil overlying 30 to 75 ft of shotrock (cobble- to boulder-size clasts of Lockport Dolomite that was blasted and removed during trench excavation), which overlies 5 to 15 ft of sandy, clayey silt fill of low permeability that overlies the conduits. The shotrock is permeable but unsaturated; only the lower part of the sandy, clayey silt was saturated. Water-level recorders installed on two wells in the sandy clayey silt (84-9 and 84-11, location shown in fig. 1) indicated that the water levels took several months to recover to a static level after the wells were pumped dry (fig. 12), which indicates that the sandy, clayey silt backfill has very low permeability and therefore transmits little ground water. Well 84-9 did not respond to fluctuations of water levels in the forebay canal, and water levels in well 84-11 fluctuated only when water levels in the forebay rose to altitudes greater than 560 ft, which occurred at the end of January and beginning of February 1985, when NYPA raised the water level in the forebay canal to clear a large accumulation of pack ice from the conduit intakes along the upper Niagara River. When this occurred, the water level in well 84-11 rose 10 ft to an altitude of 556.11 ft, then began a slow, steady decline (fig. 12). Water-level altitudes greater than 560 ft at well 84-11 would have caused the lower zone of the permeable shotrock fill to become saturated. Water probably entered the well relatively rapidly by leakage down the side of the casing, which could explain the rapid rise of the water level in the well; normally this should not have occurred because the well was installed in relatively impermeable sediment. Well 84-11 does not respond to water-level fluctuations in the bedrock or forebay canal below this altitude.

The relatively impermeable, sandy, clayey silt in the saturated part of the backfill prevents significant ground-water movement in the backfill. An exception may be at the intersection of the Falls Street tunnel and the conduits, where more permeable backfill was found. The method of backfilling there may have been different from that used elsewhere along the conduits because the conduits dip where they pass under the Falls Street sewer (fig. 9).

<u>Ground-water discharge into drains surrounding the conduits</u>.--The drain system that surrounds the conduits has lowered ground-water levels near the conduit trenches, which causes ground water in the Lockport Dolomite to flow toward the conduits (pl. 1A). Ground water within 0.5 mi of the conduits that previously flowed southward now flows toward the conduits and discharges into the drain system. To determine the direction of flow in the drains, water levels were measured in the central chamber in the pumping stations and in several NYPA open-hole wells installed in the bedrock 5 to 10 ft from the vertical wall drains. Because the drain system is in direct hydraulic contact

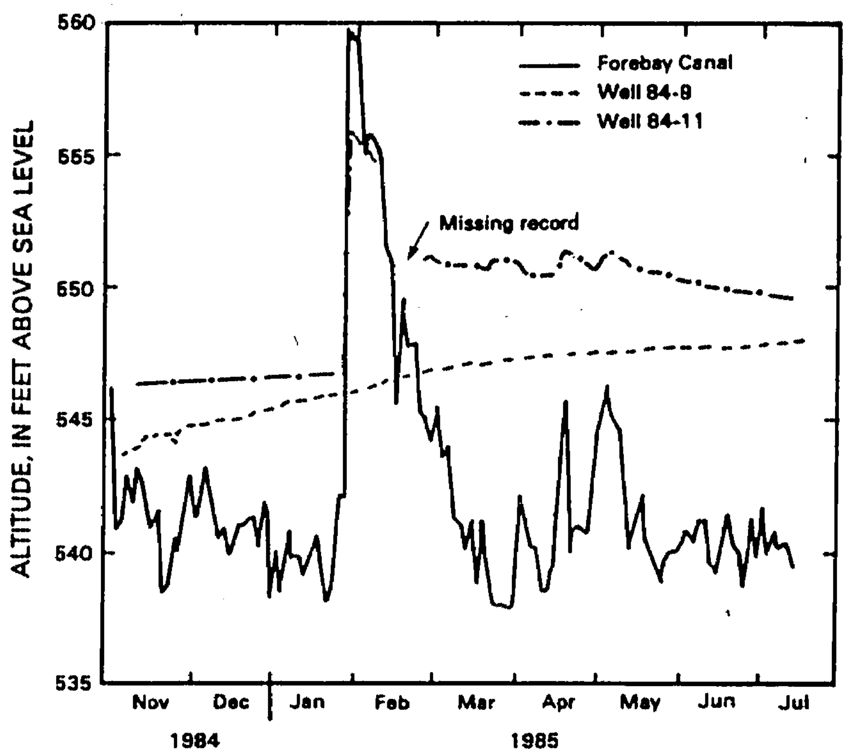

Figure 12.

Average daily water-level fluctuations in the forebay canal and recovery of water levels in wells 84-9 and 84-11 (installed in backfill atop conduits) after evacuation of water from the casing, November 1984 through July 1986.

with ground water in the Lockport Dolomite, the hydraulic heads measured in the NYPA wells are the same or nearly the same as water levels in the drains that surround the conduits (fig. 10). Water levels in wells adjacent to the conduits indicate that, most of the time, water from the vicinity of the forebay canal that enters the drains flows southward to where the Falls Street tunnel crosses the conduits (pl. 1A), whereas water from the upper Niagara River that enters the drains flows northward to the tunnel. The drain system acts as the path of least resistance to ground-water flow in and near the conduit trenches.

The major discharge point for water in the conduit drains is the Falls Street tunnel where it crosses the conduits (fig. 9). The method of construction at the conduit/tunnel intersection probably created this discharge zone. During construction of the conduit trenches, a 400-ft section of the Falls Street tunnel was rebuilt with precast concrete pipe sections, and the conduit trenches were then excavated beneath the Falls Street pipeline. After backfill was placed over the conduits and around the Falls Street tunnel pipe section, ground-water levels in the backfill fluctuated at or above the top of the rebuilt section of the Falls Street tunnel (fig. 13). Apparently the seals between the concrete pipe sections failed, and water from the drains began to leak into the Falls Street tunnel.

In 1982, the Falls Street tunnel was inspected for ground-water infiltration, and a large amount of inflow, estimated at approximately 6 Mgal/d, was found to leak into the Falls Street tunnel through joints in the concrete pipe where the tunnel passes over the conduits (Camp, Dresser and McKee, 1982). Most of this leakage is probably water from the conduit drain system, which drains ground water from 0.5 mi on both sides of the 4-mi-long trenches. The Lockport Dolomite is too impermeable to supply the quantity of water that

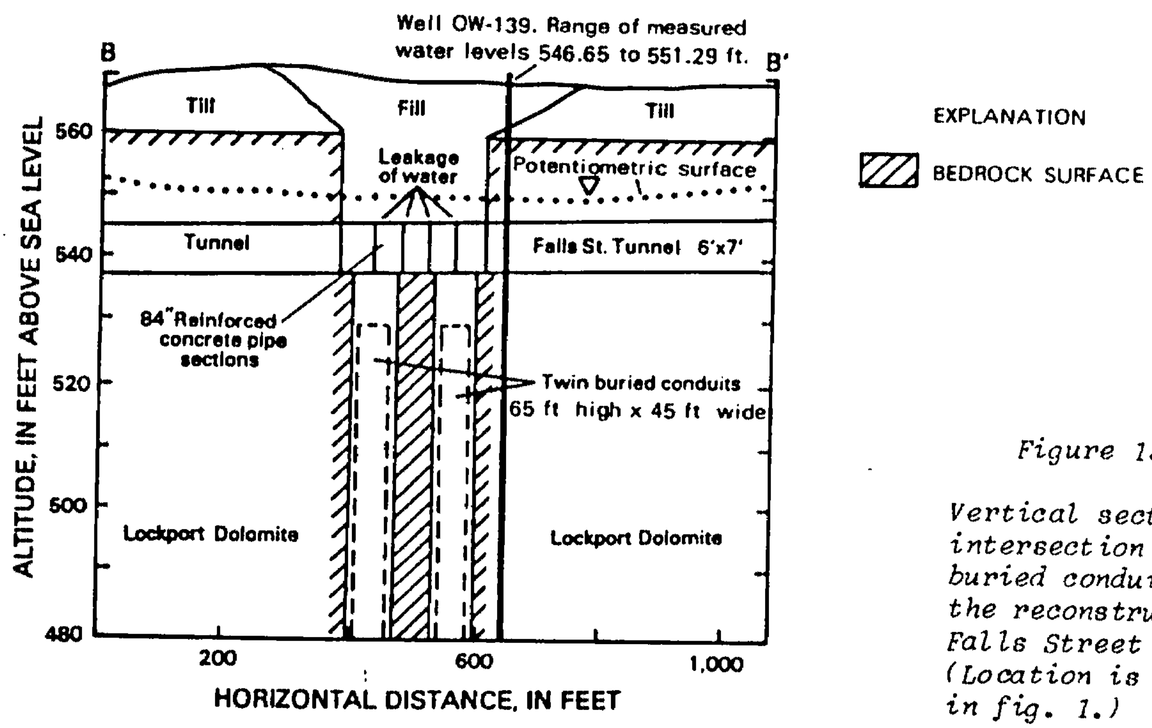

Figure 13.

Vertical section of intersection of twin buried conduits and the reconstructed Falls Street tunnel. (Location is shown in fig. 1.)

leaks into the tunnel. Estimation of how much water enters the Falls Street tunnel from either the north (powerplant) or south (river) side of the tunnel was beyond the scope of this project, however.

Effect of Forebay Canal

The forebay canal is an L-shaped excavation that penetrates the Lockport Dolomite and upper part of the Rochester Shale at the north end (outlet) of the twin conduits (fig. 1). It is 4,000 ft long, 500 ft wide, and 110 ft deep. The walls and floor are unlined. Water that enters the forebay canal from the conduits is routed to the Robert Moses powerplant, and some is pumped up to the Lewiston Reservoir, depending on the daily power-demand schedule.

The daily range of water-level fluctuations in the canal is dependent on the seasonal diversion schedule, the demand for power generation, and the flow of the Niagara River. During the summer and early fall, when the flow in the Niagara River is generally lower, daily fluctuations in the canal are greatest, as much as 25 ft. The water level in the forebay canal is increased by the release of water from the Lewiston Reservoir, which supplements the flow entering from the conduits. This combined flow into the forebay canal increases the hydraulic head in the canal to drive the Robert Moses powerplant turbines more efficiently. During high-flow periods (generally during spring) or when allowable diversions from the Niagara River are higher (table 1), daily water-level fluctuations in the forebay are less, usually ranging from 5 to 10 ft even during peak power-demand periods (fig. 7).

<u>Ground-water discharge into the forebay canal</u>.--The walls and floor of the forebay canal consist of bedrock. Observations of ground-water seepage from bedding planes in the forebay canal walls to the forebay canal (Lockport Dolomite) and higher water levels in nearby wells than in the forebay (pl. 1A and table 2) indicate that ground water generally discharges into the forebay canal. Little, if any, water enters the forebay canal from the underlying Rochester Shale, which has low permeability.

<u>Effects of water-level fluctuations in the forebay canal</u>.--The daily water-level fluctuations in the forebay canal, which can range to as much as 25 ft (fig. 7), cause instantaneous water-level fluctuations in wells along the conduits to as least 3.4 mi south of the forebay canal. The water-level fluctuations in the forebay canal also cause hydraulic-pressure changes in the drain system that surrounds the conduits. Instantaneous head responses in wells adjacent to the twin conduits to water-level fluctuations in the forebay canal suggest a direct hydraulic connection between the forebay canal and the drains. Water probably moves from the canal to the drains through gently southward dipping water-bearing bedding planes that are exposed in the walls of the forebay canal and is intercepted by the drain system that surrounds the conduits.

Water levels were recorded at four NYPA observation wells adjacent to the conduits at various distances south of the forebay canal; well OW-167 is at the outlet of the conduits, and wells OW-162, OW-152, and OW-139 are 0.8, 2.2,

REFERENCE NO. 13

Draft

CONTACT REPORT

AGENCY : New York State Department of Environmental Conservation, Region 9

ADDRESS : 600 Delaware Ave., Buffalo, NY 14202

PHONE : (716)847-4550

PERSON CONTACTED : James Snider, Senior Wildlife Biologist

TO : Jon Sundquist

DATE : June 2, 1987

SUBJECT : Critical Wildlife habitats near potential hazardous waste sites in Niagara County

In preparation of Phase 1 reports on potential hazardous waste sites in New York for the NYSDEC, information about nearby critical wildlife habitats is necessary. The following information is provided by Mr. James Snider of the Bureau of Wildlife, NYSDEC Region 9.

Except for the seasonal appearance of migratory birds, including, possibly the bald eagle, there are no critical habitats of endangered species within 2 miles of the suspected waste sites listed below:

- SKW Alloys
  Witmer Road at Maryland Ave.
  Niagara Falls, NY
- Dussault Foundries
  2 Washburn Street
  Lockport, NY
- North Love Canal
  Near Cleghorn Drive
  Lewiston, NY
- Carborundum Building 82
  Buffalo Ave.
  Niagara Falls, NY
- Ross Steel Company
  4237 Pine Ave.
  Niagara Falls, NY
- Frontier Bronze
  4870 Packard Rd.
  Niagara Falls, NY
- Roblin Steel
  101 East Ave.
  N. Tonawanda, NY

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- LaSalle Expressway
  Niagara Falls, NY
- Diamond Shamrock
  Ohio Ave.
  Lockport, NY
- Town of Lockport Landfill
  Canal Road
  Lockport, NY
- Power Authority Road
  Lewiston, NY
- 64th Street South
  Chevy Place
  Niagara Falls, NY
- Walmore Road
  Walmore Rd., 0.5 miles south of Lockport Road
  Wheatfield, NY

James R. Pinder
Signature

July 27, 1987
Date

Draft

POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT

EPA

PART 1 - SITE LOCATION AND INSPECTION INFORMATION

I. IDENTIFICATION	
01 State NY	02 Site Number 932071

II. SITE NAME AND LOCATION

01 Site Name (Legal, common, or descriptive name of site) Diamond Shamrock	02 Street, Route No., or Specific Location Identifier Ohio Street

03 City	04 State	05 Zip Code	06 County	07 County Code	08 Cong. Dist.
Lockport	NY	14094	Niagara	063	

09 Coordinates — Latitude: 43 09 54.N — Longitude: 78 42 35.W

10 Type of Ownership (Check one)
[X] A. Private [ ] B. Federal ______ [ ] C. State [ ] D. County
[ ] E. Municipal [ ] F. Other ______ [ ] G. Unknown

III. INSPECTION INFORMATION

01 Date of Inspection	02 Site Status	03 Years of Operation
6 / 12 / 87 (Month Day Year)	[ ] Active [X] Inactive	1923 (Beginning Year) — 1940s (Ending Year) [ ] Unknown

04 Agency Performing Inspection (Check all that apply)
[ ] A. EPA [ ] B. EPA Contractor ______ (Name of Firm) [ ] C. Municipal [ ] D. Municipal Contractor ______ (Name of Firm)
[ ] E. State [X] F. State Contractor E & E* (Name of Firm) [ ] G. Other ______ (Specify)

05 Chief Inspector	06 Title	07 Organization	08 Telephone No.
Dennis Sutton	Geologist	E & E	(716) 633-9881

09 Other Inspectors	10 Title	11 Organization	12 Telephone No.
Mark Cotter	Geologist	E & E	(716) 633-9881
			( )
			( )
			( )
			( )

13 Site Representatives Interviewed	14 Title	15 Address	16 Telephone No.
Gary Ernst	Plant Manager	Ohio Street, Lockport, NY	(716) 434-4077
Barry Christensen	Environmental Manager	360 Rainbow Blvd., Niagara Falls, NY	(716) 286-3368
			( )
			( )
			( )

17 Access Gained By (Check one)	18 Time of Inspection	19 Weather Conditions
[X] Permission [ ] Warrant	9:30 a.m.	Overcast, temp. 65°F, winds 5-10 mph

IV. INFORMATION AVAILABLE FROM

01 Contact	02 Of (Agency/Organization)	03 Telephone No.
Walter E. Demick	NYSDEC	(518) 457-9538

04 Person Responsible for Site Inspection Form	05 Agency	06 Organization	07 Telephone No.	08 Date
Mike Hanchak		E & E	(716)633-9881	6 / 25 / 87 (Month Day Year)

EPA Form 2070-13 (7-81) D1619

*Ecology and Environment, Inc.

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POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT

PART 2 - WASTE INFORMATION

I. IDENTIFICATION	
01 State NY	02 Site Number 932071

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 Physical States (Check all that apply)

- [X] A. Solid
- [ ] B. Powder, Fines
- [ ] C. Sludge
- [ ] D. Other fly ash, cinders (Specify)
- [ ] E. Slurry
- [ ] F. Liquid
- [ ] G. Gas

02 Waste Quantity at Site (Measure of waste quantities must be independent)

Tons NA
Cubic Yards ______
No. of Drums ______

03 Waste Characteristics (Check all that apply)

- [ ] A. Toxic
- [ ] B. Corrosive
- [ ] C. Radioactive
- [ ] D. Persistent
- [ ] E. Soluble
- [ ] F. Infectious
- [ ] G. Flammable
- [ ] H. Ignitable
- [ ] I. Highly volatile
- [ ] J. Explosive
- [ ] K. Reactive
- [ ] L. Incompatible
- [X] M. Not applicable

III. WASTE TYPE

Category	Substance Name	01 Gross Amount	02 Unit of Measure	03 Comments
SLU	Sludge			This site generates or stores no
OLW	Oily waste			hazardous waste. Coal cinders and
SOL	Solvents			fly ash were disposed of on-site
PSD	Pesticides			between 1923 and late 1940s.
OCC	Other organic chemicals			
IOC	Inorganic chemicals			
ACD	Acids			
BAS	Bases			
MES	Heavy Metals			

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 Category	02 Substance Name	03 CAS Number	04 Storage/Disposal Method	05 Concentration	06 Measure of Concentration
	No. 6 Fuel oil				
	Boric acid				
	Boiler acid		Used cleaning boilers and removed		
	Soda ash				

V. FEEDSTOCKS (See Appendix for CAS Numbers)

Category	01 Feedstock Name	02 CAS Number	Category	01 Feedstock Name	02 CAS Number
FDS			FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

NYSDEC compliance inspection report dated 4/14/87
NCHD inspection report dated 2/3/83
On-site interview - E & E, 6/12/87

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POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	Draft
01 State	02 Site Number
NY	932071

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 [ ] A. Groundwater Contamination — 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Population Potentially Affected: Unknown — 04 Narrative Description:

Potential unknown - characteristics of waste not determined.

01 [ ] B. Surface Water Contamination — 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Population Potentially Affected: Unknown — 04 Narrative Description:

Potential unknown - characteristics of waste not determined.

01 [ ] C. Contamination of Air — 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Population Potentially Affected: Unknown — 04 Narrative Description:

Little potential exists - no hazardous waste generated or stored on-site.

01 [ ] D. Fire/Explosive Conditions — 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Population Potentially Affected: Unknown — 04 Narrative Description:

Potential unknown - characteristics of waste not determined.

01 [ ] E. Direct Contact — 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Population Potentially Affected: Unknown — 04 Narrative Description:

Potential exists - site is not fenced or secure.

01 [ ] F. Contamination of Soil — 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Area Potentially Affected: Unknown (Acres) — 04 Narrative Description:

Potential exists - waste placed on ground surface without liner.

01 [ ] G. Drinking Water Contamination — 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Population Potentially Affected: Unknown — 04 Narrative Description:

Potential exists - water intake is in Niagara River.

01 [ ] H. Worker Exposure/Injury — 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Workers Potentially Affected: Unknown — 04 Narrative Description:

Potential exists - waste area is not secured.

01 [ ] I. Population Exposure/Injury — 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Population Potentially Affected: Unknown — 04 Narrative Description:

Little known potential exists.

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POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION **Draft**

01 State	02 Site Number
NY	932071

II. HAZARDOUS CONDITIONS AND INCIDENTS (Cont.)

01 [ ] J. Damage to Flora 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
04 Narrative Description:

Potential exists - waste is placed directly on ground surface.

01 [ ] K. Damage to Fauna 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
04 Narrative Description:

Little known potential exists.

01 [ ] L. Contamination of Food Chain 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
04 Narrative Description:

Potential exists - waste is placed directly on ground surface.

01 [ ] M. Unstable Containment of Wastes (Spills/Runoff/Standing liquids, Leaking drums) 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
03 Population Potentially Affected Unknown 04 Narrative Description:

Little potential exists - waste disposal area is overgrown with vegetation.

01 [ ] N. Damage to Offsite Property 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
04 Narrative Description:

Little known potential exists.

01 [ ] O. Contamination of Sewers, Storm Drains, WWTPs 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
04 Narrative Description:

Open storm sewer is located on-site.

01 [ ] P. Illegal/Unauthorized Dumping 02 [ ] Observed (Date ________) [X] Potential [ ] Alleged
04 Narrative Description:

Little potential exists.

05 Description of Any Other Known, Potential, or Alleged Hazards

III. TOTAL POPULATION POTENTIALLY AFFECTED Unknown

IV. COMMENTS

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

NYSDEC compliance inspection report dated 4/14/87. E & E site inspection - 6/12/87.
NCHD inspection report dated 2/3/83.

D1619

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 4 - PERMIT AND DESCRIPTIVE INFORMATION

I. IDENTIFICATION	
01 State	02 Site Number
NY	932071

Draft

II. PERMIT INFORMATION

01 Type of Permit Issued (Check all that apply)	02 Permit Number	03 Date Issued	04 Expiration Date	05 Comments
[ ] A. NPDES				
[ ] B. UIC				
[ ] C. AIR				
[X] D. RCRA				Underground storage tanks
[ ] E. RCRA Interim Status				
[X] F. SPCC Plan				
[ ] G. State (Specify)				
[ ] H. Local (Specify)				
[ ] I. Other (Specify)				
[ ] J. None				

III. SITE DESCRIPTION

01 Storage Disposal (Check all that apply)	02 Amount	03 Unit of Measure	04 Treatment (Check all that apply)
[ ] A. Surface Impoundment			[ ] A. Incineration
[X] B. Piles	Unknown		[ ] B. Underground Injection
[ ] C. Drums, Above Ground			[ ] C. Chemical/Physical
[X] D. Tank, Above Ground			[ ] D. Biological
[X] E. Tank, Below Ground	20,000	gallon	[ ] E. Waste Oil Processing
[ ] F. Landfill			[ ] F. Solvent Recovery
[ ] G. Landfarm			[ ] G. Other Recycling Recovery
[ ] H. Open Dump			[ ] H. Other ____ (Specify)
[ ] I. Other ____ (Specify)			

05 Other

[X] A. Buildings On Site

06 Area of Site

5 Acres

07 Comments

IV. CONTAINMENT

01 Containment of Wastes (Check one)

[ ] A. Adequate, Secure [ ] B. Moderate [X] C. Inadequate, Poor [ ] D. Insecure, Unsound, Dangerous

02 Description of Drums, Diking, Liners, Barriers, etc.

Fly ash and boiler cinders disposed of on ground surface - no liner used.

V. ACCESSIBILITY

01 Waste Easily Accessible: [X] Yes [ ] No
02 Comments:

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

NYSDEC compliance inspection report dated 4/14/87
NCHD inspection report dated 2/3/83
E & E site inspection - 6/12/87

D1619

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 5 - WATER, DEMOGRAPHIC, AND ENVIRONMENTAL DATA

I. IDENTIFICATION Draft	
01 State	02 Site Number
NY	932071

II. DRINKING WATER SUPPLY

01 Type of Drinking Supply (Check as applicable)	Surface	Well	02 Status: Endangered	Affected	Monitored	03 Distance to Site
Community	A. [X]	B. [ ]	A. [ ]	B. [ ]	C. [X]	A 15 (mi)
Non-community	D. [ ]	D. [ ]	D. [ ]	E. [ ]	F. [ ]	B NA (mi)

III. GROUNDWATER

01 Groundwater Use in Vicinity (Check one)

[ ] A. Only Source for Drinking

[ ] B. Drinking (Other sources available) Commercial, Industrial, Irrigation (No other water sources available)

[ ] C. Commercial, Industrial, Irrigation (Limited other sources available)

[X] D. Not Used, Unuseable

02 Population Served by Groundwater 0

03 Distance to Nearest Drinking Water Well NA (mi)

04 Depth to Groundwater	05 Direction of Groundwater Flow	06 Depth to Aquifer of Concern	07 Potential Yield of Aquifer	08 Sole Source Aquifer
5-10 (ft)	Unknown	5-10 (ft)	NA (gpd)	[ ] Yes [X] No

09 Description of Wells (Including usage, depth, and location relative to population and buildings)

No known wells in the area.

10 Recharge Area

[ ] Yes [ ] No Comments: NA

11 Discharge Area

[ ] Yes [ ] No Comments: NA

IV. SURFACE WATER

01 Surface Water (Check one)

[X] A. Reservoir Recreation Drinking Water Source

[ ] B. Irrigation Economically Important Resources

[ ] C. Commercial, Industrial

[ ] D. Not Currently Used

02 Affected/Potentially Affected Bodies of Water

Name:	Affected	Distance to Site
Erie Canal	[ ]	500 ft
Eighteen Mile Creek	[ ]	1,600 ft
	[ ]	(mi)

V. DEMOGRAPHIC AND PROPERTY INFORMATION

01 Total Population Within

One (1) Mile of Site	Two (2) Miles of Site	Three (3) Miles of Site
A. 8,308 No. of Persons	B. 16,055 No. of Persons	C. 19,723 No. of Persons

02 Distance to Nearest Population 1,000 ft

03 Number of Buildings Within Two (2) Miles of Site 11,201

04 Distance to Nearest Off-Site Building 100 ft.

05 Population Within Vicinity of Site (Provide narrative description of nature of population within vicinity of site, e.g., rural, village, densely populated urban area)

Densely populated urban/industrial area.

D1619

POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT PART 5 - WATER, DEMOGRAPHIC, AND ENVIRONMENTAL DATA	I. IDENTIFICATION **Draft** 01 State: NY 02 Site Number: 932071

VI. ENVIRONMENTAL INFORMATION

01 Permeability of Unsaturated Zone (Check one)

[ ] A. 10^{-6} - 10^{-8} cm/sec [X] B. 10^{-4} - 10^{-6} cm/sec [ ] C. 10^{-4} - 10^{-3} cm/sec [ ] D. Greater Than 10^{-3} cm/sec

02 Permeability of Bedrock (Check one)

[ ] A. Impermeable (Less than 10^{-6} cm/sec) [ ] B. Relatively Impermeable (10^{-4} - 10^{-6} cm/sec) [X] C. Relatively Permeable (10^{-2} - 10^{-4} cm/sec) [ ] D. Very Permeable (Greater than 10^{-2} cm/sec)

03 Depth to Bedrock	04 Depth of Contaminated Soil Zone	05 Soil pH
5-10 (ft)	NA (ft)	5.6 - 7.3

06 Net Precipitation	07 One Year 24-Hour Rainfall	08 Slope: Site Slope	Direction of Site Slope	Terrain Average Slope
4 (in)	2.5 (in)	1 %	SE	1 %

09 Flood Potential

Site is in NA Year Floodplain

10

[ ] Site is on Barrier Island, Coastal High Hazard Area, Riverine Floodway

11 Distance to Wetlands (5 acre minimum)

ESTUARINE	OTHER
A. NA (mi)	B. <1 (mi)

12 Distance to Critical Habitat (of Endangered Species)

NA (mi)

Endangered Species:

13 Land Use in Vicinity

Distance to:

COMMERCIAL/INDUSTRIAL	RESIDENTIAL AREAS, NATIONAL/STATE PARKS, FORESTS, OR WILDLIFE RESERVES	AGRICULTURAL LANDS: PRIME AG LAND	AGRICULTURAL LANDS: AG LAND
A. 0 (mi)	B. <1 (mi)	C. <1 (mi)	D. <1 (mi)

14 Description of Site in Relation to Surrounding Topography

This site is located 1 mile south of the Niagara Escarpment and 1,000 feet southeast of the Erie Canal in the City of Lockport, New York. The site is essentially flat and in an industrialized section of the City of Lockport.

VII. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

Graphical Exposure Modeling System, June 1987, Environmental Protection Agency, Office of Pesticides and Toxic Substances, Federal Plaza, New York, New York

USGS Topographic Map, 7.5 minute Lockport, New York quadrangle

NYSDEC Region 9 files, Buffalo, New York

Johnson, Richard H., 1964, Groundwater in the Niagara Falls Area, New York, State of New York Conservation Department, Water Resource Commission, Bulletin GW-53

Barrett, K.W., S.S. Chang, S.A. Hans, A.M. Platt, 1982, Uncontrolled Hazardous Waste Site Ranking System Users Manual, MITRE Corporation

Higgins, B.A., P.S. Puglia, R.P. Leonard, T.D. Yoakum, W.A. Wirtz, 1972, Soil Survey of Niagara County, New York, USDA Soil Conservation Service

D1619

POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT	I. IDENTIFICATION	
PART 6 - SAMPLE AND FIELD INFORMATION	01 State NY	02 Site Number 932071

Draft

II. SAMPLES TAKEN

Sample Type	01 Number of Samples Taken	02 Samples Sent to	03 Estimated Date Results Available
Groundwater	NA		
Surface Water			
Waste			
Air			
Runoff			
Spill			
Soil			
Vegetation			
Other			

III. FIELD MEASUREMENTS TAKEN

01 Type	02 Comments
Air	Photoionization Detector - no readings noted above background.

IV. PHOTOGRAPHS AND MAPS

01 Type [X] Ground [ ] Aerial

02 In Custody of Mike Hanchak, Ecology and Environment
(Name of organization or individual)

03 Maps
[X] Yes
[ ] No

04 Location of Maps
NYSDEC Region 9, Buffalo, New York

V. OTHER FIELD DATA COLLECTED (Provide narrative description of sampling activities)

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

E & E site inspection logbook

01619

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 7 - OWNER INFORMATION

I. IDENTIFICATION **Draft**

01 State	02 Site Number
NY	932071

II. CURRENT OWNER(S)				PARENT COMPANY (If applicable)			
01 Name: Occidental Chemical Corp.	02 D+B Number:			08 Name: Occidental Petroleum Corp.	09 D+B Number:		
03 Street Address (P.O. Box, RFD #, etc.): Ohio Street	04 SIC Code:			10 Street Address (P.O. Box, RFD #, etc.): Occidental Tower, P.O. Box 809050	11 SIC Code:		
05 City: Lockport	06 State: NY	07 Zip Code: 14094		12 City: Dallas	13 State: TX	14 Zip Code: 75380	
01 Name:	02 D+B Number:			08 Name:	09 D+B Number:		
03 Street Address (P.O. Box, RFD #, etc.):	04 SIC Code:			10 Street Address (P.O. Box, RFD #, etc.):	11 SIC Code:		
05 City:	06 State:	07 Zip Code:		12 City:	13 State:	14 Zip Code:	
01 Name:	02 D+B Number:			08 Name:	09 D+B Number:		
03 Street Address (P.O. Box, RFD #, etc.):	04 SIC Code:			10 Street Address (P.O. Box, RFD #, etc.):	11 SIC Code:		
05 City:	06 State:	07 Zip Code:		12 City:	13 State:	14 Zip Code:	
01 Name:	02 D+B Number:			08 Name:	09 D+B Number:		
03 Street Address (P.O. Box, RFD #, etc.):	04 SIC Code:			10 Street Address (P.O. Box, RFD #, etc.):	11 SIC Code:		
05 City:	06 State:	07 Zip Code:		12 City:	13 State:	14 Zip Code:	

III. PREVIOUS OWNER(S) (List most recent first)			IV. REALTY OWNER(S) (If applicable, list most recent first)		
01 Name: Diamond Shamrock	02 D+B Number:		01 Name:	02 D+B Number:	
03 Street Address (P.O. Box, RFD #, etc.): Ohio Street	04 SIC Code:		03 Street Address (P.O. Box, RFD #, etc.):	04 SIC Code:	
05 City: Lockport	06 State: NY	07 Zip Code: 14094	05 City:	06 State:	07 Zip Code:
01 Name:	02 D+B Number:		01 Name:	02 D+B Number:	
03 Street Address (P.O. Box, RFD #, etc.):	04 SIC Code:		03 Street Address (P.O. Box, RFD #, etc.):	04 SIC Code:	
05 City:	06 State:	07 Zip Code:	05 City:	06 State:	07 Zip Code:
01 Name:	02 D+B Number:		01 Name:	02 D+B Number:	
03 Street Address (P.O. Box, RFD #, etc.):	04 SIC Code:		03 Street Address (P.O. Box, RFD #, etc.):	04 SIC Code:	
05 City:	06 State:	07 Zip Code:	05 City:	06 State:	07 Zip Code:

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

Niagara County Health Department Inspection Report, 7/3/83, Niagara Falls, New York
New York State DEC Compliance Inspection Report, 4/14/87
Ecology & Environment, Inc. Site Inspection, 6/12/87

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 8 - OPERATOR INFORMATION

I. IDENTIFICATION	
01 State	02 Site Number
NY	932071

Draft

II. CURRENT OPERATOR (Provide if different from owner) / OPERATOR'S PARENT COMPANY (if applicable)

01 Name	02 D+B Number	10 Name	11 D+B Number
Occidental Chemical Corp.		Occidental Petroleum Corp.	

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	12 Street Address (P.O. Box, RFD #, etc.)	13 SIC Code
Ohio Street		Occidental Tower, P.O. Box 809050	

05 City	06 State	07 Zip Code	14 City	15 State	16 Zip Code
Lockport	NY	14094	Dallas	TX	75380

08 Years of Operation	09 Name of Owner
1	

III. PREVIOUS OPERATOR(s) (List most recent first; provide only if different from owner) / PREVIOUS OPERATORS' PARENT COMPANIES (if applicable)

01 Name	02 D+B Number	10 Name	11 D+B Number
Diamond Shamrock		Diamond Shamrock	

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	12 Street Address (P.O. Box, RFD #, etc.)	13 SIC Code
Ohio Street			

05 City	06 State	07 Zip Code	14 City	15 State	16 Zip Code
Lockport	NY	14094			

08 Years of Operation	09 Name of Owner During This Period
46	

01 Name	02 D+B Number	10 Name	11 D+B Number
Standard Silicate			

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	12 Street Address (P.O. Box, RFD #, etc.)	13 SIC Code
Ohio Street			

05 City	06 State	07 Zip Code	14 City	15 State	16 Zip Code
Lockport	NY	14094			

08 Years of Operation	09 Name of Owner During This Period
5	

01 Name	02 D+B Number	10 Name	11 D+B Number

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	12 Street Address (P.O. Box, RFD #, etc.)	13 SIC Code

05 City	06 State	07 Zip Code	14 City	15 State	16 Zip Code

08 Years of Operation	09 Name of Owner During This Period

IV. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

Ecology & Environment, Inc. Site Inspection, 6/12/87
NYSDEC Compliance Inspection Report, 4/14/87
Niagara County Health Department Inspection Report, 2/3/83, Niagara Falls, New York

D1619

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 9 - GENERATOR/TRANSPORTER INFORMATION

I. IDENTIFICATION Draft	
01 State	02 Site Number
NY	932071

II. ON-SITE GENERATOR

01 Name	02 D+B Number	03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	05 City	06 State	07 Zip Code
Diamond Shamrock		Ohio Street		Lockport	NY	14094

III. OFF-SITE GENERATOR(S)

01 Name	02 D+B Number	03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	05 City	06 State	07 Zip Code
NA						

IV. TRANSPORTER(S)

01 Name	02 D+B Number	03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	05 City	06 State	07 Zip Code
Modern Disposal		Model City Rd.		Lewiston	NY	14092

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

Niagara County Health Department files, Niagara Falls, New York

D1619

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 10 - PAST RESPONSE ACTIVITIES

I. IDENTIFICATION **Draft**

01 State	02 Site Number
NY	932071

II. PAST RESPONSE ACTIVITIES NA

01 [ ] A. Water Supply Closed 02 Date ______ 03 Agency ______
04 Description:

01 [ ] B. Temporary Water Supply Provided 02 Date ______ 03 Agency ______
04 Description:

01 [ ] C. Permanent Water Supply Provided 02 Date ______ 03 Agency ______
04 Description:

01 [ ] D. Spilled Material Removed 02 Date ______ 03 Agency ______
04 Description:

01 [ ] E. Contaminated Soil Removed 02 Date ______ 03 Agency ______
04 Description:

01 [ ] F. Waste Repackaged 02 Date ______ 03 Agency ______
04 Description:

01 [ ] G. Waste Disposed Elsewhere 02 Date ______ 03 Agency ______
04 Description:

01 [ ] H. On-Site Burial 02 Date ______ 03 Agency ______
04 Description:

01 [ ] I. In Situ Chemical Treatment 02 Date ______ 03 Agency ______
04 Description:

01 [ ] J. In Situ Biological Treatment 02 Date ______ 03 Agency ______
04 Description:

01 [ ] K. In Situ Physical Treatment 02 Date ______ 03 Agency ______
04 Description:

01 [ ] L. Encapsulation 02 Date ______ 03 Agency ______
04 Description:

01 [ ] M. Emergency Waste Treatment 02 Date ______ 03 Agency ______
04 Description:

01 [ ] N. Cutoff Walls 02 Date ______ 03 Agency ______
04 Description:

01 [ ] O. Emergency Diking/Surface Water Diversion 02 Date ______ 03 Agency ______
04 Description:

01 [ ] P. Cutoff Trenches/Sump 02 Date ______ 03 Agency ______
04 Description:

01 [ ] Q. Subsurface Cutoff Wall 02 Date ______ 03 Agency ______
04 Description:

D1619

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 10 - PAST RESPONSE ACTIVITIES

I. IDENTIFICATION	
01 State	02 Site Number
NY	932071

Draft

II. PAST RESPONSE ACTIVITIES (Cont.)

01 [ ] R. Barrier Walls Constructed 02 Date ________ 03 Agency ________
04 Description:

01 [ ] S. Capping/Covering 02 Date ________ 03 Agency ________
04 Description:

01 [ ] T. Bulk Tankage Repaired 02 Date ________ 03 Agency ________
04 Description:

01 [ ] U. Grout Curtain Constructed 02 Date ________ 03 Agency ________
04 Description:

01 [ ] V. Bottom Sealed 02 Date ________ 03 Agency ________
04 Description:

01 [ ] W. Gas Control 02 Date ________ 03 Agency ________
04 Description:

01 [ ] X. Fire Control 02 Date ________ 03 Agency ________
04 Description:

01 [ ] Y. Leachate Treatment 02 Date ________ 03 Agency ________
04 Description:

01 [ ] Z. Area Evacuated 02 Date ________ 03 Agency ________
04 Description:

01 [ ] 1. Access to Site Restricted 02 Date ________ 03 Agency ________
04 Description:

01 [ ] 2. Population Relocated 02 Date ________ 03 Agency ________
04 Description:

01 [ ] 3. Other Remedial Activities 02 Date ________ 03 Agency ________
04 Description:

III. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

D1619

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 11 - ENFORCEMENT INFORMATION

I. IDENTIFICATION	
01 State	02 Site Number
NY	932071

Draft

II. ENFORCEMENT INFORMATION

01 Past Regulatory/Enforcement Action [ ] Yes [X] No

02 Description of Federal, State, Local Regulatory/Enforcement Action

NA

III. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

NYSDEC files, Region 9, Buffalo, New York
Niagara County Health Department files, Niagara Falls, New York
Occidental plant files, Lockport Facility, Lockport, New York

D1619

Draft

6. ASSESSMENT OF DATA ADEQUACY AND RECOMMENDATIONS

After assessing the information gathered for this site and applying it to an HRS worksheet, it was determined that the existing information is not adequate to accurately score the site, and that further investigations are necessary to determine a proper HRS score.

Since no sampling of any kind from the disposal area is known to have taken place, E & E recommends a screening program consisting of several soil and groundwater samples collected at a depth of at least 2 feet from the disposal area and analyzed for priority pollutants and hazardous waste characteristics of ignitability, reactivity, corrosivity, and EP Toxicity. A more comprehensive sampling program could be undertaken if hazardous wastes are found. These data can be used to generate a more accurate HRS score.

7. REFERENCES

Barrett, K.W., S.S. Chang, S.A. Hans, A.M. Platt, 1982, Uncontrolled Hazardous Waste Site Ranking System Users Manual, MITRE Corporation. Document location: Ecology & Environment, Inc., Buffalo, New York.

Christensen, B.H., Environmental Services Manager, Occidental Petroleum Corporation, June 1987, personal communication.

Ecology and Environment, Inc. Site Inspection and Photo Log Book. Document location: Ecology & Environment, Inc., Buffalo, New York.

Higgins, B.A., P.S. Puglia, R.P. Leonard, T.D. Yoakum, W.A. Wirtz (1972), Soil Survey of Niagara County, New York, USDA Soil Conservation Service. Document location: Ecology & Environment, Inc., Buffalo, New York.

Johnston, R.H. (1964), Groundwater in the Niagara Falls Area, New York, State of New York Conservation Department, Water Resources Commission, Bulletin GW-53. Document location: Ecology & Environment, Inc., Buffalo, New York.

New York State Department of Environmental Conservation, Division of Solid and Hazardous Waste, Inactive Hazardous Waste Disposal Report. Document location: NYSDEC, Region 9, Buffalo, New York.

Niagara County Health Department Profile Report, Niagara Falls, New York. Document location: Niagara County Health Department, Niagara Falls, New York.

USGS 7.5 minute topographical map, 1980, Lockport, New York quadrangle.

Draft

APPENDIX A

PHOTOGRAPHIC RECORD

Draft

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: New York State DEC | E & E Job No.: ND2031

Camera: Make Ansco 35 mm | SN:

Photographer: D. Sutton

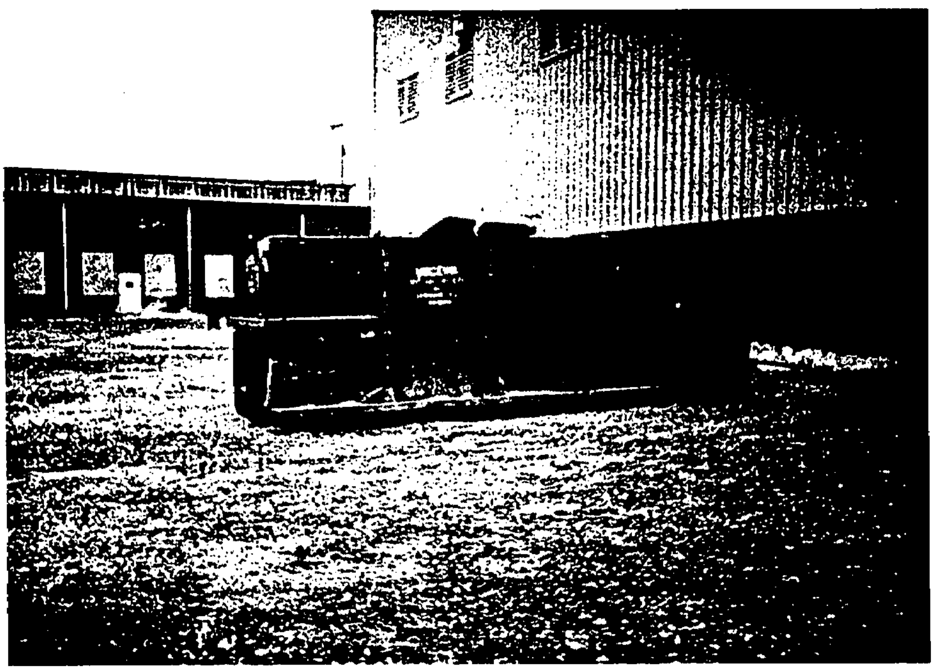
Date/Time: 6/12/87 10:13

Lens: Type:

SN:

Frame No.: 1

Comments*: parking area, aboveground tanks located near the east side of the maintenance building



Photographer: D. Sutton

Date/Time: 6/12/87 1017

Lens: Type:

SN:

Frame No.: 2

Comments*: Modern Disposal dumpster for disposal of scrap pallets, paper, pipe, and steel

*Comments to include location

339023

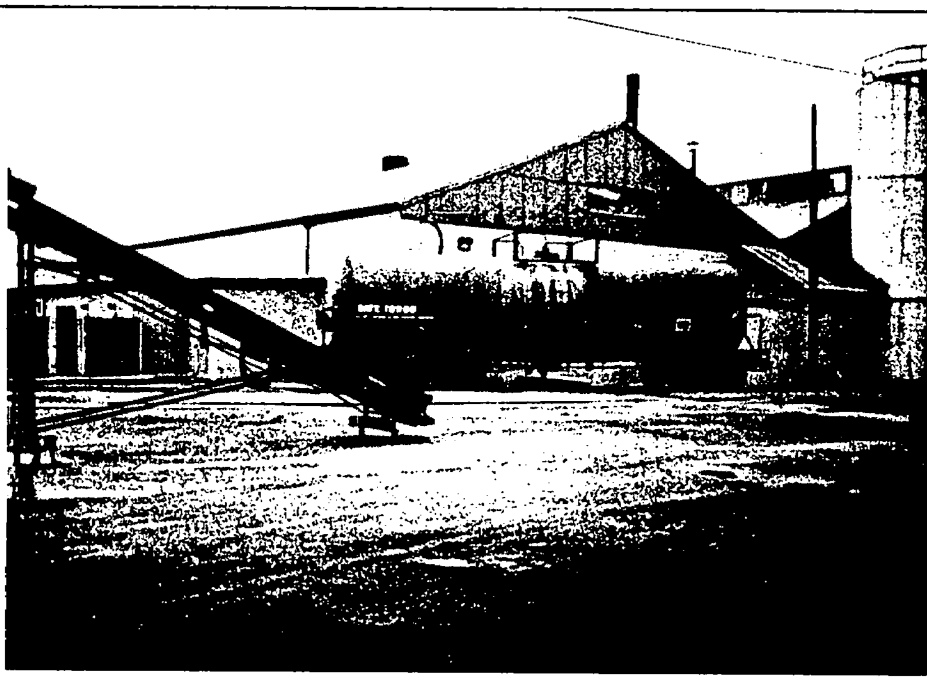
Draft

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: New York State DEC | E & E Job No.: ND2031

Camera: Make Ansco 35 mm | SN:



Photographer: D. Sutton

Date/Time: 6/12/87 10:23

Lens: Type:

SN:

Frame No.: 3

Comments*: Sodium silicate tank car located south of the tank building and north of the furnace building on site

Photographer: D. Sutton

Date/Time: 6/12/87 10:26

Lens: Type:

SN:

Frame No.: 4

Comments*: Open drainage, storm sewer located behind the maintenance building in the southeast portion of the site

*Comments to include location

339023

Draft

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: New York State DEC E & E Job No.: ND2031

Camera: Make Ansco 35 mm SN:

Photographer: D. Sutton

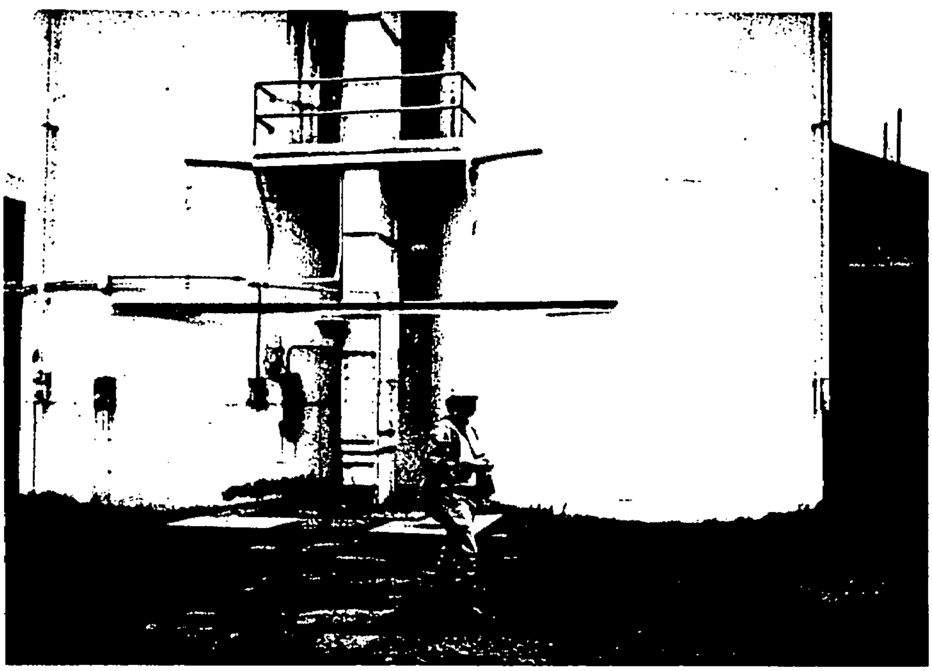
Date/Time: 6/12/87 10:27

Lens: Type:

SN:

Frame No.: 5

Comments*: Former underground storage tank located behind the furnace building, adjacent to the RR tracks on site



Photographer: D. Sutton

Date/Time: 6/12/87 10:29

Lens: Type:

SN:

Frame No.: 6

Comments*: Soda ash and sand bins located on the north side of the furnace building and south of the RR tracks on site

*Comments to include location

339023

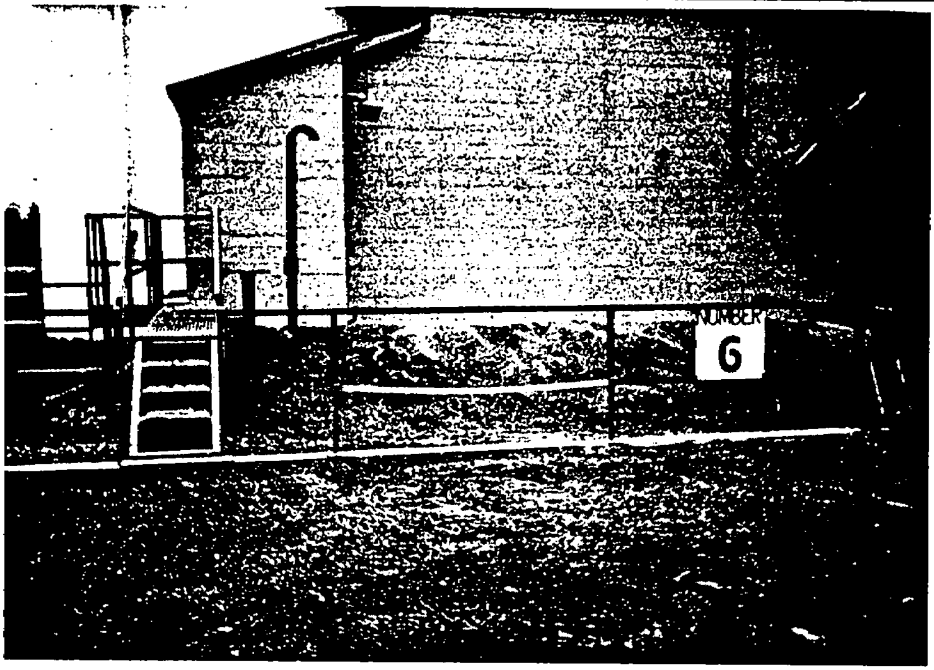
Draft

ecology and environment, inc.

P H O T O G R A P H I C   R E C O R D

Client: New York State DEC E & E Job No.: ND2031

Camera: Make Ansco 35 mm SN:



Photographer: D. Sutton

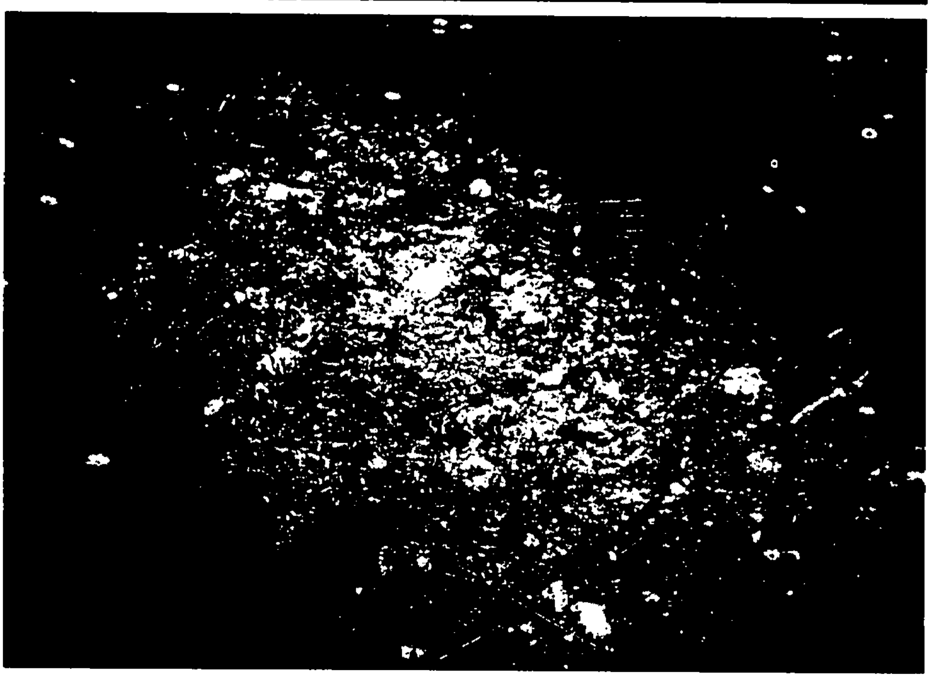
Date/Time: 6/12/87 10:30

Lens: Type:

SN:

Frame No.: 7

Comments*: 20,000 gal No. 6 fuel oil tank, below grade, located west of sand bin near northwest corner of the furnace building



Photographer: D. Sutton

Date/Time: 6/12/87 10:50

Lens: Type:

SN:

Frame No.: 8

Comments*: Cinders and slag located in the northern portion of the site, overgrown with vegetation, former cinder disposal area

*Comments to include location

339023

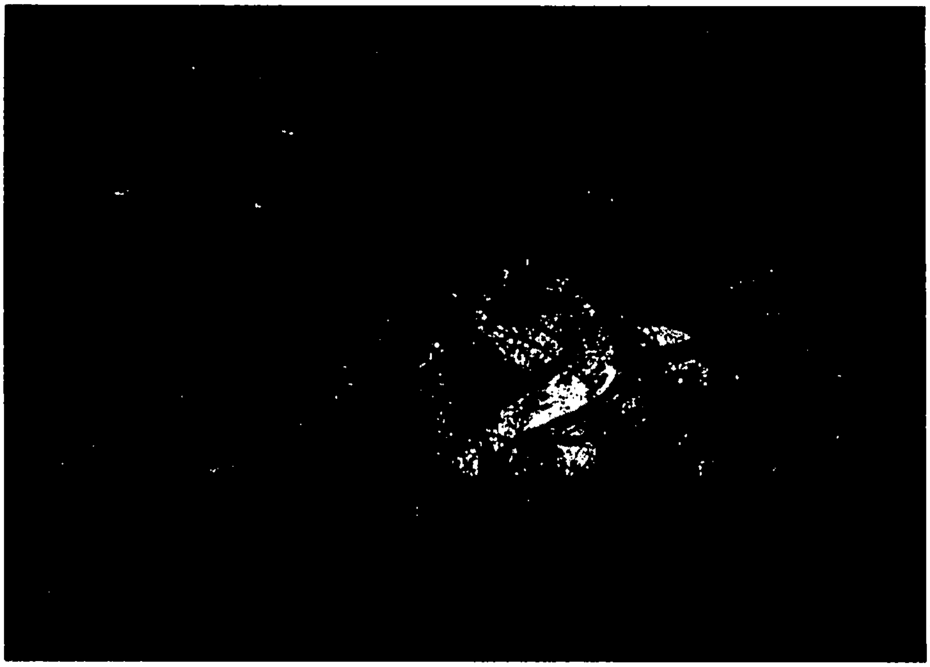
Draft

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: New York State DEC   E & E Job No.: ND2031

Camera: Make Ansco 35mm   SN:



Photographer: D. Sutton

Date/Time: 6/12/87 10:52

Lens: Type:

SN:

Frame No.: 9

Comments*: Cinders and slag located in the northern section of the site, former cinder disposal area

Photographer:

Date/Time:

Lens: Type:

SN:

Frame No.:

Comments*:

*Comments to include location

339023

APPENDIX B

UPDATED NYSDEC HAZARDOUS WASTE DISPOSAL SITE REGISTRY FORM

47-15-11 (10/83)

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF SOLID AND HAZARDOUS WASTE

INACTIVE HAZARDOUS WASTE DISPOSAL SITE REPORT

Priority Code: ______ Site Code: D002123388

Name of Site: Diamond Shamrock Region: 9

Street Address: Ohio Street

Town/City: Lockport County: Niagara

Name of Current Owner of Site: Occidental Petroleum Corporation

Address of Current Owner of Site: Ohio Street, Lockport, NY

Type of Site: [ ] Open Dump [ ] Structure [ ] Lagoon
[X] Landfill [ ] Treatment Pond

Estimated Size: 1 acre(s)

Site Description:

Hazardous Waste Disposed: [ ] Confirmed [X] Suspected

Type and Quantity of Hazardous Wastes Disposed:

Type	Quantity (Pounds, Drums, Tons, Gallons)
Fly ash, cinders associated with coal gassification processes	Unknown

D1619

Draft

Time Period Site was Used for Hazardous Waste Disposal:

__________, 1920's To __________, 1940's

Owner(s) During Period of Use: Diamond Shamrock Corp.

Site Operator During Period of Use: Diamond Shamrock Corp.

Address of Site Operator: Ohio Street, Lockport, New York

Analytical Data Available: [ ] Air [ ] Surface Water [ ] Groundwater
[ ] Soil [ ] Sediment [X] None

Contravention of Standards: [ ] Groundwater [ ] Drinking Water
[ ] Surface Water [ ] Air

Soil Type: Loams, clay, silt

Depth to Groundwater Table: Unknown

Legal Action: Type: None [ ] State [•] Federal

Status: [ ] In Progress [ ] Completed

Remedial Action: [ ] Proposed [ ] Under Design
[ ] In Progress [ ] Completed

Nature of Action: __________

Assessment of Environmental Problems:

Assessment of Health Problems:

Person(s) Completing This Form:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION		NEW YORK STATE DEPARTMENT OF HEALTH	
Name:		Name:	
Title:		Title:	
Name:		Name:	
Title:		Title:	
Date:		Date:	

D1619
Page 2 of 2

APPENDIX C

PHOTOCOPIED REFERENCES

Draft

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SOLID AND HAZARDOUS WASTE
INACTIVE HAZARDOUS WASTE DISPOSAL REPORT

CLASSIFICATION CODE: 2a   REGION: 9   SITE CODE: 932071
EPA ID: NYD002135807

NAME OF SITE : Diamond Shamrock
STREET ADDRESS: Ohio Street
TOWN/CITY: Lockport   COUNTY: Niagara   ZIP:

SITE TYPE: Open Dump-X Structure- Lagoon- Landfill- Treatment Pond-
ESTIMATED SIZE: Acres

SITE OWNER/OPERATOR INFORMATION:
CURRENT OWNER NAME....: Diamond Shamrock
CURRENT OWNER ADDRESS.: Ohio Street, Lockport, NY
OWNER(S) DURING USE...: not known
OPERATOR DURING USE...: now known
OPERATOR ADDRESS......: not known
PERIOD ASSOCIATED WITH HAZARDOUS WASTE: From unknown To unknown

SITE DESCRIPTION:
The site was listed in the Eckhardt report. No information is presently available about this site.

HAZARDOUS WASTE DISPOSED: Confirmed- Suspected-X

TYPE	QUANTITY (units)
unknown	

SITE CODE: 932071 **Draft**

ANALYTICAL DATA AVAILABLE:
Air- Surface Water- Groundwater- Soil- Sediment- None-X

CONTRAVENTION OF STANDARDS:
Groundwater- Drinking Water- Surface Water- Air-

LEGAL ACTION:

TYPE..: none State- Federal-
STATUS: Negotiation in Progress- Order Signed-

REMEDIAL ACTION:

Proposed- Under design- In Progress- Completed-
NATURE OF ACTION: none

GEOTECHNICAL INFORMATION:
SOIL TYPE: not known
GROUNDWATER DEPTH: not known

ASSESSMENT OF ENVIRONMENTAL PROBLEMS:

As no data is currently available, no assessment of any environmental problem can be made at this stage.

ASSESSMENT OF HEALTH PROBLEMS:

Medium	Contaminants Available	Migration Potential	Potentially Exposed Population	Need for Investigation
Air				
Surface Soil				
Groundwater				
Surface Water				

Health Department Site Inspection Date :

MUNICIPAL WASTE ID:

47-15-18 (1/87)—7e

Draft

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SOLID AND HAZARDOUS WASTE
BUREAU OF HAZARDOUS WASTE OPERATIONS
COMPLIANCE INSPECTION SECTION
50 WOLF ROAD, ALBANY, NEW YORK 12233-4017

Name: Gary C. Ernst

Title: Plant Manager

Business Name: Oxy Chem. - Occidental Chemical

Address: 500 Ohio St.
Lockport, NY 14094

RE: Hazardous Waste Inspection Date: April 14, 1987 Inspected By: Nelson Schnabel

Location of Business: As Above

EPA Identification Number: NYD002123388

Dear

In order to determine compliance with the New York State Hazardous Waste Regulations, the New York State Department of Environmental Conservation conducted an inspection of your facility on the above referenced date.

As a result of that inspection, you were found to be operating as follows:

☐ Small Quantity Generator—Generates less than 100 kg/month and stores less than 100 kg.

☐ Small Quantity Generator—Generates less than 100 kg/month and stores more than 100 kg., but less than 1,000 kg.

☐ Small Quantity Generator—Generates more than 100 kg/month but less than 1,000 kg/month and stores less than 1,000 kg.

☐ Generator—Generates 1,000 kg or more per month and/or stores more than 1,000 kg.

☐ Other— ______________________________

____

☐ The Department's Inspector found no violations of the New York State Hazardous Waste Regulations on the inspection date referenced above. A copy of the Inspection Form is enclosed for your records.

☒ Your facility was not subject to the New York State Hazardous Waste Regulations on the inspection date referenced above. A copy of the Inspection Form is enclosed for your records.

If you have any questions, please contact the Inspector at the location circled on the back.

Thank you for your cooperation.

Sincerely,

Nelson Schnabel

ENCLOSURE:
Inspection Form

47-15-14(9/86)

Draft

REGION:	9
Major:	
Major TSDF:	
Non-Major:	✓
Substitution:	✓

INSPECTION FORM

NEW YORK STATE INDUSTRIAL HAZARDOUS WASTE MANAGEMENT ACT

Chapter 639, Laws of 1978

Prepared for:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Henry G. Williams, Commissioner

Division of Solid and Hazardous Waste
Norman H. Nosenchuck, Director

Send to: Compliance Inspection Section
50 Wolf Road - Room 209/415
Albany, New York 12233-0001

EPA I.D. NUMBER: N Y D 0 0 2 1 2 3 3 8 8

*HANDLER'S NAME (Corporate): OCCIDENTAL CHEMICAL CORPORATION *

(Division): OXY CHEM

*HANDLER'S MAILING ADDRESS: 500 OHIO ST

City, State & Zip Code: LOCKPORT NY 14094

*HANDLER'S LOCATION ADDRESS: (if different than mailing)

City, State & Zip Code:

*HANDLER'S TELEPHONE NUMBER: (716) 434-4077 Extension:

*FULL NAME OF HANDLER'S CONTACT: (Mr.) (Ms.) GARY C ERNST

*SIGNATURE OF HANDLER'S CONTACT:
(This signature is not an admittance to any violations cited herein. It merely acknowledges that an inspection took place.)

*TITLE OF HANDLER'S CONTACT: PLANT MANAGER

INSPECTION DATE: 4 / 14 / 1987 TIME OF INSPECTION: 10:00 (a.m.) (p.m.)

INSPECTOR'S SIGNATURE: Nelson Schnabel

COUNTY: NIAGARA E/A NUMBER:

INSPECTOR'S NAME: NELSON SCHNABEL

TITLE: SANITARY ENGINEER

NAME:

TITLE:

CHECK ONE: Copy of THIS report (___ has) (✓ has not) been given to the Handler.

REPORT PREPARED BY: Nelson Schnabel DATE: 4/15/87

REPORT APPROVED BY: James P. Heehan DATE: 4/16/87

* site previously owned by Diamond Shamrock – Occidental purchased facility Sept 86

Draft

New York State Department of Environmental Conservation
Division of Solid and Hazardous Waste
50 Wolf Road, Albany, New York 12233

PART I

General Information and Classification of Facility

1. Identification of Hazardous Waste - 371 — Yes / No

A. Is there reason to believe the facility has hazardous waste on-site? If yes, what leads you to believe it is hazardous waste? Check appropriate box/boxes and attach any applicable correspondence with DEC or EPA: Yes ___ No ✓

(1) ____ Company recognizes that its waste is hazardous during the inspection.

(2) ____ Company admitted the waste is hazardous in its RCRA notification and/or Part A permit application.

(3) ____ Testing has shown characteristics of:
( ) ignitability - 371.3(b);
( ) corrosivity - 371.3(c);
( ) reactivity - 371.3(d);
( ) EP toxicity - 371.3(e)

____ Has revealed hazardous constituents (please attach analysis report) 371.4(a)(2), Appendix 22, Appendix 23

(4) ____ The material is listed in the regulations as a hazardous waste from non-specific sources 371.4(b).

(5) ____ The waste material is listed in the regulations as a hazardous waste from specific sources. 371.4(c).

(6) ____ The material or product is listed in the regulations as discarded commercial chemical products, off-specification species, container residues and spill residues thereof. 371.4(d).

(7) ____ Company is unsure, but they have reason to believe that waste materials are hazardous. (Explain) ____________________

Draft

B. Is there reason, other than those above, for you to believe that there is hazardous waste on site? (Explain) ____________________

No
____

C. What other environmental permits are held by the company, relative to hazardous waste management?

____ SPDES Permit Number ____ Air Permit Number

____ Part 364 Industrial Waste Transporter Permit (indicate this company's permit number if any)

Please describe other relavent (if any) permits and give the name, address, Part 364 Permit Number and EPA I.D. Number of transporter(s) used by company.

____

____

____

D. If the facility is a treatment, storage or disposal facility, have they:

____ Submitted a Part A application. ____ Have changes been made that are not reflected in the Part A application? Should the Part A be modified by the Company? ____ If so, explain.

____

____

____

____

____

____ Submitted a Part B application.

____ Been granted a Part 373 permit.

If so, when does it expire: ____________
Please attach or explain any special conditions or variances - 373-1.1(e) ____________________

____

____

____

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____ Been granted a hazardous waste Part B permit.

If so, also complete Appendix M.

E. Describe the activities that result in the generation of hazardous waste. Include the company's manufacturing processes.

No waste of a hazardous nature is generated at the facility. A sodium silicate (glass) is warehoused at the facility.

An absorbant material (Hazsorb) is still manufactured at the facility, but no hazardous waste is generated in this process.

F. Identify the hazardous wastes that are on-site and the quantity of each (use the identification numbers referred to in Part 371).

No hazardous waste on site

G. The handler notified EPA as a:

Generator

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Has EPA or DEC officially modified the handlers status? If so, attach correspondence. ______________________

_______________ NO ______________________

2. Status Identification:

This handler should be inspected as a (check each appropriate category after considering exemptions)

A. ____ Transporter - complete Appendix B

B. Generator Status Identification 372.1 Does not generate hazardous waste.

1. ____ Category 1 generator - small quantity generator - generates less than 100 kg/mo and stores less than 100 kg. - 372.1(e)(1)(vii)(a) Complete Part II, 1A.

2. ____ Category 2 generator - small quantity generator - generates less than 100 kg/mo and stores more than 100 kg but less than 1,000 kg. - 372.1(e)(1)(vii)(b) - Complete Part II, 1B.

3. ____ Category 3 generator - small quantity generator - generates more than 100 kg/mo but less than 1,000 kg/mo and stores less than 1,000 kg. - 372.1(e)(1)(viii) - Complete Part II, 1B and 1C.

4. ____ Category 5 generator - generated 1,000 kilograms or more per month or generated acute hazardous waste in quantities greater than those specified in Part 372.1(e)(1)(v). Complete Part II. Generators over sole source aquifers also complete Appendix A.

5. ____ Category 6 generator - stores 1,000 kilograms or more or stores acute hazardous waste in quantities greater than those specified in Part 372.1(e)(1)(v). Complete Part II. Generators over sole source aquifers also complete Appendix A.

C. Treatment, Storage or Disposal Facility Status

If yes, complete Appendix A and other appropriate Appendices.

1. Is hazardous waste generated and stored on-site? If so:

(a) ____ Has hazardous waste been stored on-site longer than 90 days? 373-1.1(d)(1)(iii)

(b) ____ Has more than 8,800 gallons of hazardous waste been stored in containers? 373-1.1(d)(iii)(a)

(c) ____ Has more than 20,000 gallons of hazardous waste been stored in tanks? 373-1.1(d)(iii)(b)

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NOT FOR RELEASE TO COMPANY, PROTECTED INFORMATION

PART III

Comments, Conclusions and Recommendations Section

Facility Name OXY CHEM

EPA I.D. No. N Y D 0 0 2 1 2 3 3 8 8

Date of Inspection April 14, 1987

General Comments and Conclusions (cite appropriate State regulations in violation and attach additional sheets and other information as required)

This site was previously owned by Diamond Shamrock who ceased operation in '86. No hazardous waste was generated in '86. Occidental Chemical purchased the facility in Sept '86 and has since ceased production of sodium silicate. An absorbant material (Hazsorb) is still manufactured but hazardous waste is not generated in this process.

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Recommendations EPA I.D. No. N Y D 0 0 2 1 2 3 3 8 8

____ Formal confidentiality is being requested.

✓ No follow-up necessary.

____ Do you recommend that the central office wait a maximum of two weeks for you to review supplemental documents prior to determining if a warning letter should be issued?

____ A soft warning letter should be issued.

____ A strong warning letter should be issued.

____ A complaint letter should be issued and a fine levied.

____ DO NOT PROCESS, THIS COMPANY HAS BEEN REFERRED TO THE BUREAU OF ENVIRONMENTAL CONSERVATION INVESTIGATION (BECI) ON ____________ (Date).

____ Facility representative would like a copy of report (inspector submit two copies to C.O. and C.O. will send with reply)

____ Façility representative has been given a copy of report on ________ (Date) (inspector submit one copy to C.O.)

____ Other (please explain)

____ Sample(s) have been taken.

Comments on sample results: ____________

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NIAGARA COUNTY HEALTH DEPARTMENT

MEMORANDUM

DATE: December 20, 1983

TO: Mr. Ronald Tramantano

FROM: Mr. J. A. Kehoe, P.E.

SUBJECT: DISPOSAL SITE INFORMATION

This writing is a response to your memorandum of October 26, 1983, which requested information regarding the involvement and concerns of this department for all hazardous waste sites in Niagara County. Attached are statements outlining our involvement and concerns for 116 sites in Niagara County. Copies of profile reports for sixty of these sites are also attached.

The requested information is presented in individual statements for each site. Each of these statements contains two sections. The first section of each statement is a summary of this department's involvement with that site since the writing of the 1980 registry. Only major areas of involvement are included. The second section of each statement outlines this department's most significant concerns regarding that site. These concerns are based on potential health impacts only. Environmental concerns are not addressed.

The attached profile reports are provided for your information. These reports summarize information obtained from site investigations conducted by this department from 1981 to 1983. Please note that some information contained in the 1981 and 1982 reports may already be outdated.

The department has expended a considerable amount of manpower over the last three years to investigate and monitor activities at waste disposal sites. We intend to continue this involvement. We feel that we are now in a position to provide information and judgement which would be necessary in the assessment and evaluation of potential risks and exposures at these sites. We request that we be kept informed of all actions taken by your office which are related to sites in Niagara County and would be happy to provide you with assistance whenever possible.

Please feel free to contact us with any questions.

MEH/JAK:cs
Attachments..

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DIAMOND SHAMROCK

DEC No. 932071

The Niagara County Health Department has been involved with this site as follows:

1. Performed preliminary investigation and wrote profile report (1983).

The Niagara County Health Department has the following concerns regarding this site:

1. There is no evidence of dumping of any material other than coal cinders and boiler ash at this site. None of Diamond Shamrock's process wastes are hazardous. This department does not suspect any health impacts from this site.

NOTE: A profile report is attached.

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NAME:

Diamond Shamrock (DEC #932071)

LOCATION:

Diamond Shamrock operates a plant on Ohio Street in Lockport, NY. The plant occupies about one half of a six acre parcel. The extent and exact location of any disposal site on this property is unknown, but if present, it would most likely be in the northeast corner of the property. A site sketch is attached.

OWNERSHIP:

The property is owned by the Diamond Shamrock Corporation, 1149 Ellsworth Drive, Pasadena, Texas 77501. The local plant address is Ohio Street, Lockport. The contact person at the plant is Mr. Gary Ernst (434-4077).

HISTORY:

Diamond Shamrock began operations in Lockport in the 1920's. Liquid sodium silicate was the only product until 1980 when production of sodium silicate insulation was added. The processes consist of blast furnace processing of soda ash and silica sand to produce sodium silicate, dissolving sodium silicate in water and production of sodium silicate based insulation (since 1980).

The only hazardous material used in the process is 50% caustic soda. None of the wastes generated including paper, wood, waste sand, waste soda ash and occasionally bi-product absorbant (usually recycled on-site) are hazardous. All furnaces, boilers, etc. are now gas, oil or electric fired. Originally (1920's), a coal fired boiler was used. Ash from this source may have been placed in the field north of the plant. It was not determined when this boiler was removed.

An inspection by NCHD personnel in February 1982 concluded that currently no hazardous wastes are generated or stored on site. No positive evidence of previous disposal was found. Traces of ash and cinders were found in the area north of the plant. Solid waste is placed into rolloff containers and removed by Modern Disposal. At one time, Diamond Shamrock operated vehicles with 364 permits to remove wastes but this practice has been discontinued. Mr. Ernst of Diamond Shamrock said that he was unaware of any former on-site disposal activities, except the possible dumping of coal ash and cinders when the coal burners were in use (1920's & 1930's).

SOILS/GEOLOGY:

According to the Soil Conservation Service Soil Survey for Niagara County, soils in this area are of the Odessa-Lakemont-Ovid association. The site is reportedly located in an area of elevated glacial till and is expected to be somewhat better drained than other areas of this association. Soil types include Odessa, Hilton/Cayuga and Cayuga/Cazenovia. Natural drainage is poor, however, in portions of these areas. Surficial soils are expected to be underlain with calcareous loamy glacial till.

Bedrock is Lockport Dolomite to unknown depths.

GROUNDWATER:

Little information on groundwater is available. The direction of groundwater flow is assumed to be southerly to the Barge Canal. Both shallow and bedrock aquifers are expected to be present.

There are no known wells in this area. All surrounding areas are served by public water.

The potential for groundwater contamination is considered small since no significant quantities of toxic materials are suspected to be present.

SURFACE WATER:

The nearest surface water is the Erie Barge Canal, located 1000 feet southeast. The Canal serves as an emergency water source for the City of Lockport. The Canal is partially drained in the winter.

The site is not in a flood plain or near designated wetlands.

As with groundwater, the potential for surface water contamination is considered to be small.

AIR/FIRE/EXPLOSION:

The potential for fire, explosion or air emissions is considered to be very small due to the suspected small quantity (possibly none) and types of wastes believed to be present (boilerash). The nearest residence is 1200 feet away and nearly all the surrounding area is industrial.

DIRECT CONTACT:

Access to the plant area is regulated by plant personnel. The area is surrounded by fence on three sides. The field north of the plant is physically accessible but is apparently seldom if ever entered. No exposed wastes except for small amounts of cinders were found. No problems with direct contact are anticipated.

CONCLUSIONS/RECOMMENDATIONS:

If a disposal site exists on this property, it is likely that only non-hazardous materials would be present. No further action is recommended.