DUNN
GEOSCIENCE CORP

12 METRO PARK RD. •
ALBANY, NEW YORK 12205
518/458-1313
FAX 518/458-2472

HYDROGEOLOGIC CONDITIONS AT THE BUCKEYE PROPERTY

PROPOSED CAROUSEL CENTER MALL, SYRACUSE, NEW YORK

Prepared for:

SHANLEY, SWEENEY & REILLY
Albany, New York

Prepared by:

DUNN GEOSCIENCE CORPORATION
Albany, New York

Date:

August, 1988

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
1.1	Project Initiation	1
1.2	Site Description	1
1.3	Site History	4
1.4	Project Objectives	5
1.5	Project Scope	5
2.0	PREVIOUS INVESTIGATIONS	6
2.1	Engineering Investigations	6
2.2	Environmental Investigations	6
3.0	METHODS AND RESULTS	9
3.1	Historical Aerial Photographs	9
3.2	Site Survey	10
3.3	Water Level Measurements	10
3.4	Environmental Sampling and Analysis	10
3.4.1	Surface Soils	10
3.4.2	Groundwater	13
4.0	GEOLOGIC CONDITIONS	20
4.1	Regional Geology	20
4.2	Site Geology	20
5.0	HYDROGEOLOGIC CONDITIONS	24
5.1	Regional Hydrogeology	24
5.2	Site Hydrogeology	24
5.2.1	General	24
5.2.2	Groundwater Flow System	25
6.0	ENVIRONMENTAL QUALITY	32
6.1	Surface Soil	32
6.2	Groundwater	33
6.3	Discussion of Findings	34

TABLE OF CONTENTS
(cont'd)

Page

LIST OF TABLES

Tables		Page
2.1	Summary of Monitoring Well Construction Details for the Buckeye Property	8
3.1	Monitoring Well Elevation Measurements for the Buckeye Property	11
3.2	Water Level Measurements for the Buckeye Property	12
3.3	Surface Soil PCB Analytical Data for the Buckeye Property	15
3.4	Field Measurements of Selected Groundwater Properties for the Buckeye Property, March 21-23, 1988	17
3.5	Volatile Organic Groundwater Analytical Data for the Buckeye Property, March 21-23, 1988	18
3.6	Petroleum Hydrocarbon Groundwater Analytical Data for the Buckeye Property, March 21-23, 1988	19
5.1	Results of Three Point Calculations for the Buckeye Property	31

LIST OF FIGURES

Figure		Page
1.1	Location map of the Carousel Center Mall site in Syracuse, New York	2
1.2	Area of current investigations	3
2.1	Monitoring well locations for the Buckeye property	7
3.1	Soil sampling locations for the Buckeye property	14
4.1	Isopach map showing thickness of fill soils on the Buckeye property	22
4.2	Isopach map showing thickness of Solvay fill on the Buckeye property	23
5.1	Water level contour map for the Buckeye property, March 12, 1988	26

LIST OF FIGURES
(cont'd)

		Page
5.2	Water level contour map for the Buckeye property, March 21, 1988	27
5.3	Water level contour map for the Buckeye property, March 18, 1988	28
5.4	Three point calculations for the Buckeye property	30

LIST OF APPENDICES

Appendix A Surface Soil Analytical Data

Appendix B Groundwater Analytical Data

1.0 INTRODUCTION

1.1 Project Initiation

Dunn Geoscience Corporation (DUNN), in response to a request from the law firm of Shanley, Sweeney, and Reilly, P.C., has continued subsurface investigations of the proposed site of the Carousel Center Mall. DUNN's investigative studies are a continuation of work begun by others in 1987. The proposed mall site presently includes the Marley property and a portion of the Buckeye property. This report summarizes investigative results from the Buckeye property.

1.2 Site Description

The proposed site of the Carousel Center Mall is located within the City of Syracuse, New York just south of Onondaga Lake (Figure 1.1). The proposed mall site is located generally between Interstate 81 to the northeast, Hiawatha Boulevard to the southeast, the New York State Barge Canal to the southwest, and Onondaga Lake to the northwest.

The proposed mall site includes two parcels of land referred to herein as the Marley and Buckeye properties (Figure 1.2). This report is prepared for the Buckeye property. An adjacent piece of property (Clark) may be incorporated into the final plans for the mall as well as an additional parcel owned by Buckeye.

The Buckeye property covers approximately 3.5 acres. It is currently an undeveloped piece of land with dense phreatophytic vegetation.

The Buckeye property is relatively flat. Elevations range from approximately 369 feet above mean sea level at the western corner near the Clark property to 375 feet above sea level near the eastern corner adjacent to Hiawatha Boulevard. This topographic range is approximately equivalent to 9 to 15 feet above the City of Syracuse datum. The topography is subtle but a depression generally runs from east to west across the Buckeye property. A low area also exists along the western portion of the Buckeye-Hess boundary line.

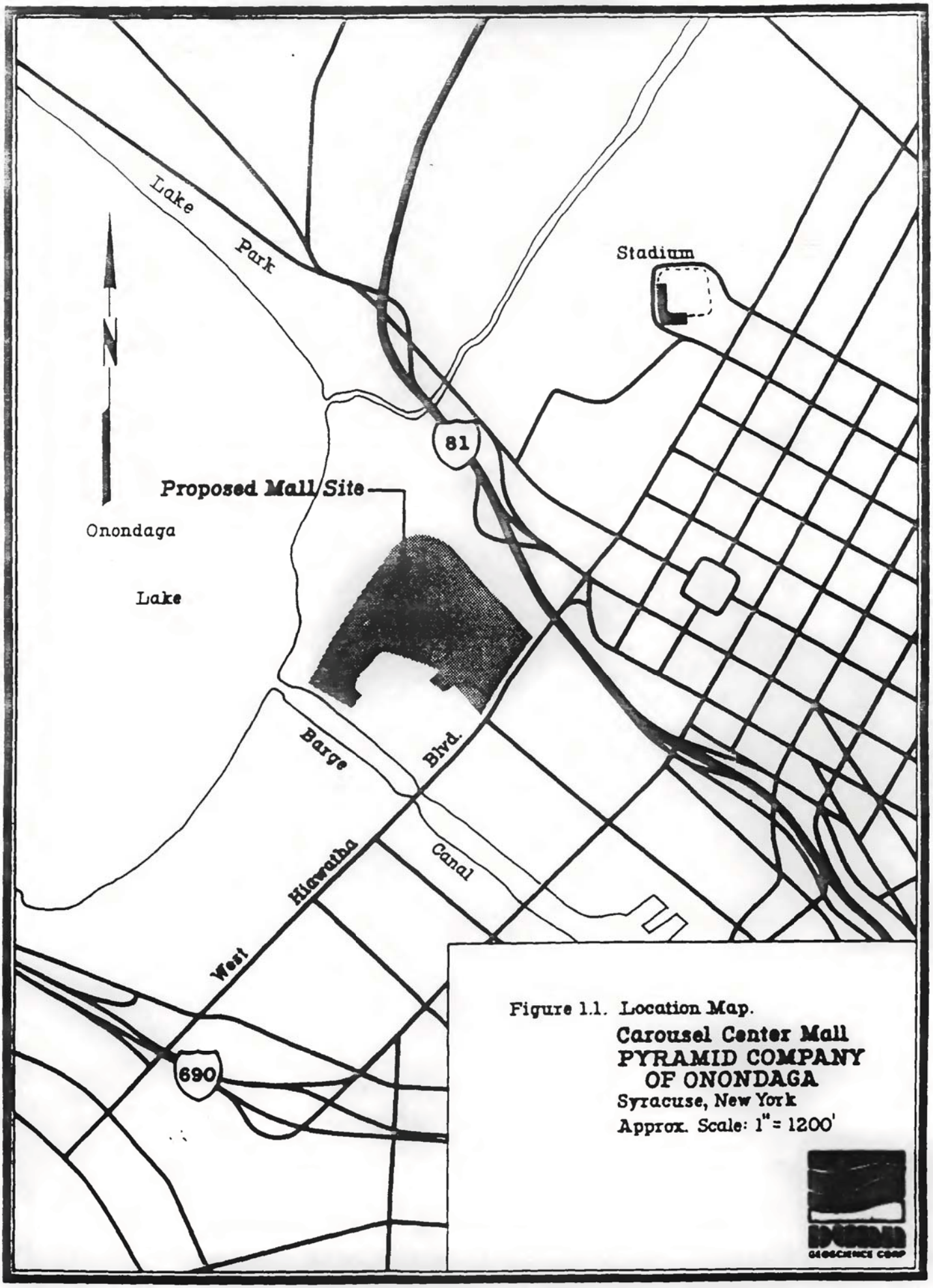
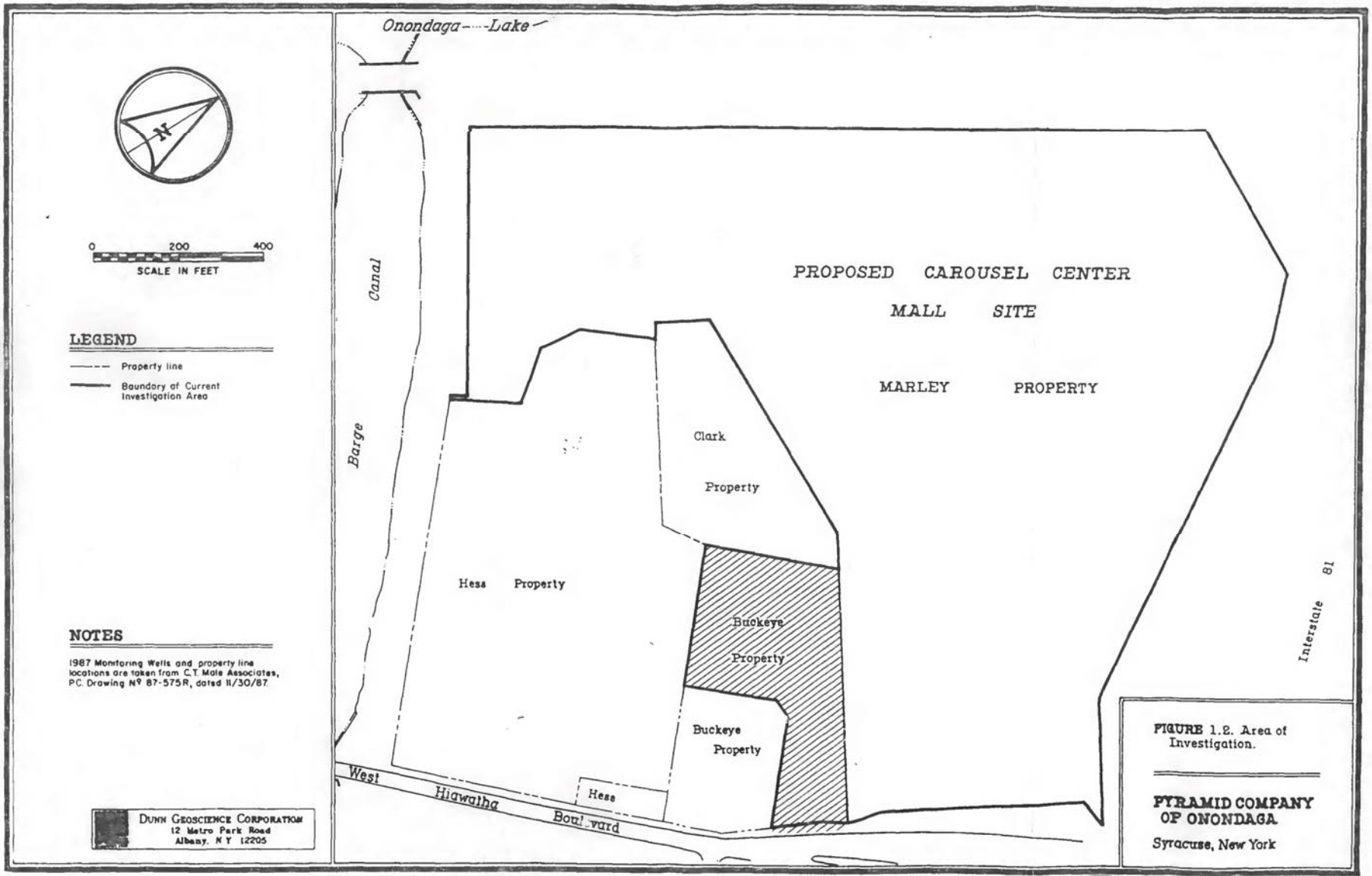


Figure 1.1. Location Map.

Carousel Center Mall
PYRAMID COMPANY OF ONONDAGA
Syracuse, New York
Approx. Scale: 1" = 1200'


Onondaga Lake
N
0 200 400
SCALE IN FEET
LEGEND
Property line
Boundary of Current Investigation Area
NOTES
1987 Monitoring Wells and property line locations are taken from C.T. Male Associates, P.C. Drawing Nº 87-575R, dated 11/30/87
Barge Canal
PROPOSED CAROUSEL CENTER MALL SITE
MARLEY PROPERTY
Clark Property
Hesa Property
Buckeye Property
Buckeye Property
Hesa
West Highwaha Boulvard
Interstate 81
DUNN GEOSCIENCE CORPORATION
12 Metro Park Road
Albany, N Y 12205
FIGURE 1.2. Area of Investigation.
PYRAMID COMPANY OF ONONDAGA
Syracuse, New York

1.3 Site History

The broad, low area immediately southeast of Onondaga Lake was originally a salt marsh. Saline groundwater reportedly discharged to the marshes and formed salt springs. This natural feature was exploited for salt production as early as the mid 1600's. Salt production became Syracuse's largest industry in the early 1800's. However, salt production had declined dramatically by the end of the century.

Salt was produced by two methods: one involving boiling of the saline water via burning wood and the other involving solar evaporation of the saline water in large plots. Maps dated 1892 and 1908 show that the Buckeye property was being used as evaporation plots for salt production. Salt production in the Syracuse area was discontinued in the mid 1920's though production at the mall site was evidently discontinued by 1910 as discussed below.

A number of changes occurred during the period when the Buckeye property was used as salt plots. Most significant, the original channel of Onondaga Creek which flowed across the southern portion of the Buckeye property was straightened and relocated. The straightened channel was later used as part of the New York State Barge Canal system which opened in 1917.

The level of Onondaga Lake reportedly changed on two occasions during the 1800's. The lake level was intentionally lowered in 1822 by as much as 11 feet. This resulted in exposure of a wider portion of salt marsh for exploitation by the salt producers. The lake level was raised following the alteration of Onondaga Creek but reportedly did not return to its previous levels. The lake level rise enabled barges to navigate into the new channel via Onondaga Lake.

Use of the Buckeye property as salt plots apparently ended prior to 1910 when filling activities began. Annotations on a map from 1910 indicates fill emplacement with Solvay Process Company wastes on the Buckeye property. Solvay wastes are a mixture of calcium carbonate ($CaCO_3$), calcium chloride

($CaCl_2$), and calcium oxide (CaO). Records reportedly indicate that Solvay wastes were disposed on the Buckeye property during the periods from 1907 to 1910 and 1924 to 1930.

The Buckeye property has remained undeveloped. The placement of fill is the only activity known to have occurred on the Buckeye property.

1.4 Project Objectives

The purpose of the investigation was to characterize environmental conditions on the Buckeye property, specifically including:

- o definition of the subsurface geologic conditions;
- o definition of the subsurface hydrologic conditions;
- o determination of the presence or absence of chemical constituents in surface soil and groundwater; and,
- o if present, definition of the nature and extent of constituents in surface soil and groundwater.

1.5 Project Scope

The scope of work for DUNN included both analysis of available data and further investigation of the Buckeye property. Additional data collection activities were designed to complement and verify or refute results of previous studies and included the following:

1. site surveying;
2. water level monitoring;
3. sampling and analysis of surface soil; and,
4. sampling and analysis of groundwater.

Previous available data and land use history did not justify additional soil borings or monitoring wells.

This report details the methodologies employed and results of our investigation of the Buckeye property and incorporates the results of previous investigations where appropriate.

2.0 PREVIOUS INVESTIGATIONS

Information is available on the Buckeye property as a result of previous investigations. Some of the previous investigations have been oriented toward engineering applications (e.g., foundation and piling design) while others have dealt with environmental assessments. These previous investigations are summarized briefly below.

2.1 Engineering Investigations

Soil borings related to engineering design of the Carousel Center Mall were performed by Parrott-Wolff, Inc. under the direction of John P. Stopen Engineering Partnership in late 1987. These activities resulted in drilling seventeen test borings, two of which were drilled on the Buckeye property. Some of these borings were advanced to depths in excess of 200 feet below grade. Logs from these test borings are used to provide information on the regional geology in Section 4.1, Regional Geology.

2.2 Environmental Investigations

JEB Consultants performed an environmental investigation of the Buckeye property in late 1987. The focus of this investigation was to evaluate groundwater conditions. Four soil borings were performed on the Buckeye property with subsequent installation of monitoring wells (P-16 through P-19). The locations of these monitoring wells are shown in Figure 2.1. Table 2.1 summarizes well construction details. Additionally, JEB Consultants collected groundwater samples from these wells for subsequent laboratory analysis.

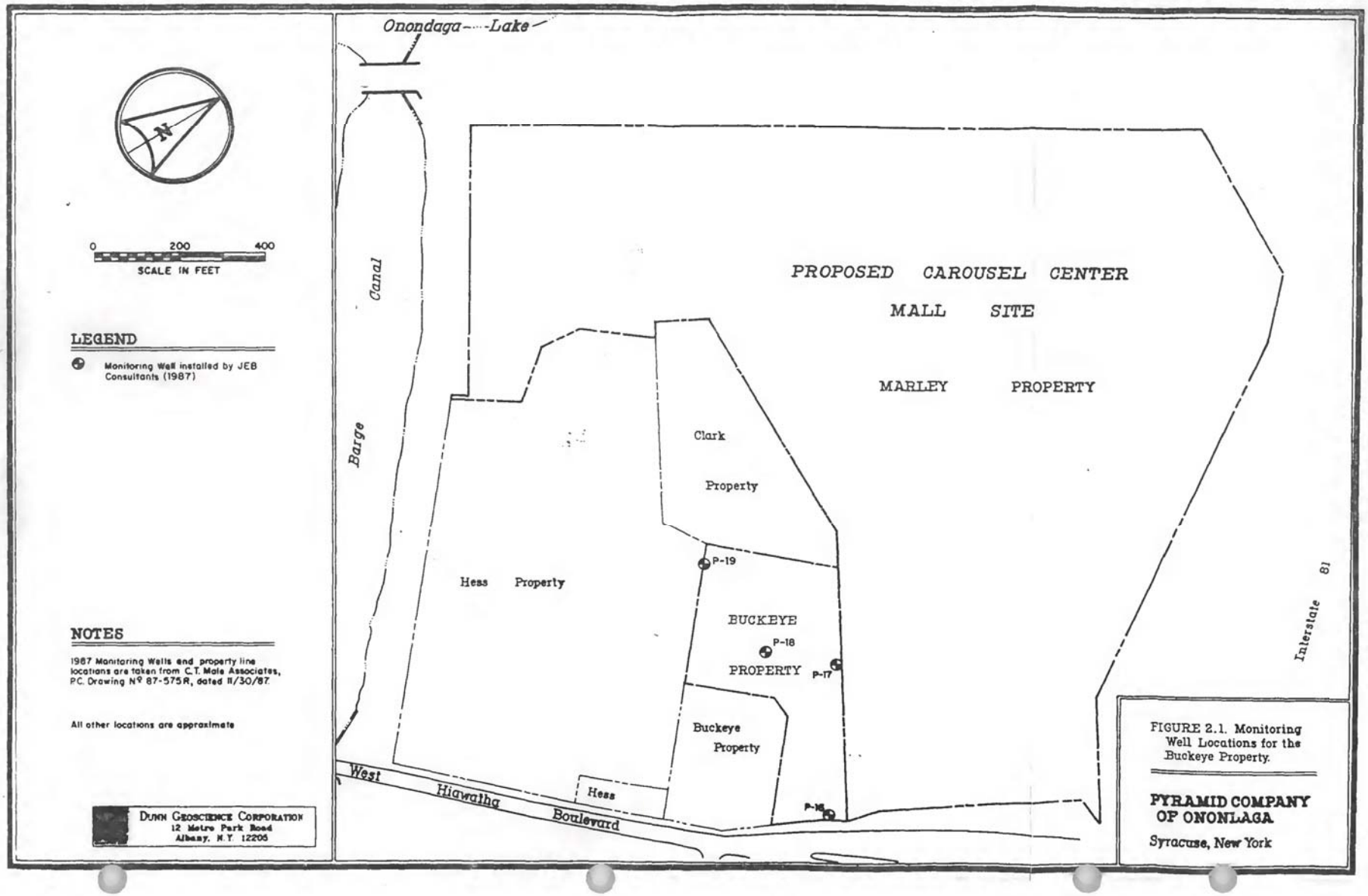

Onondaga Lake
Barge Canal
PROPOSED CAROUSEL CENTER MALL SITE
MARLEY PROPERTY
Clark Property
Hess Property
P-19
BUCKEYE PROPERTY
P-18
P-17
Buckeye Property
Hess
P-16
West Hiawatha Boulevard
Interstate 81
0 200 400
SCALE IN FEET
LEGEND
Monitoring Well installed by JEB Consultants (1987)
NOTES
1987 Monitoring Wells and property line locations are taken from C.T. Male Associates, P.C. Drawing N° 87-575R, dated 11/30/87.
All other locations are approximate
DUNN GEOSCIENCE CORPORATION
12 Metro Park Road
Albany, N.Y. 12205
FIGURE 2.1. Monitoring Well Locations for the Buckeye Property.
PYRAMID COMPANY OF ONONDAGA
Syracuse, New York

Table 2.1
Summary of Monitoring Well Construction *
Buckeye Property

Well No.	Date Completed	Boring Depth (ft)	Screened Interval Depth(ft)	Screened Interval Elevation(ft)	Stratigraphic Unit Screened
P-16	12-04-87	15.7	5.0 to 10.0	9.5 to 4.5	Mixed Fill/Natural
P-17	12-04-87	13.0	6.2 to 11.2	5.6 to 0.6	Natural
P-18	12-04-87	12.3	6.0 to 11.0	5.9 to 0.9	Mixed Fill/Solvay/Natural
P-19	12-05-87	12.5 **	7.3 to 12.3	2.2 to -2.8	Solvay/Natural

Notes

* All wells drilled and completed under the supervision of JEB Consultants.
** Split spoon sample obtained from 12.5 to 14.5 feet depth.

Target Environmental Services, Inc. conducted a soil gas survey of the Buckeye property in early November, 1987 for JEB Consultants, Inc. Soil gas samples were obtained at 31 locations for subsequent laboratory analysis. Results indicated no significant levels of volatile organics over most of the Buckeye property; a small area was noted in the westernmost corner of the Buckeye property immediately adjacent to the Clark property was identified as containing slightly elevated levels of volatile organics.

DUNN prepared an Environmental Site Assessment (ESA) in January, 1988 utilizing available data. Soil sampling was also performed at two selected locations.

3.0 METHODS AND RESULTS

3.1 Historical Aerial Photographs

DUNN performed a search for available aerial photography of the Buckeye property. Black-and-white, stereographic coverage was obtained for several dates including: October 15, 1951; October 6, 1958; June 15, 1959; July 1, 1966; April 28, 1967; April 29, 1972; and March 28, 1981. In addition, non-stereographic, black-and-white coverage was obtained for February 11, 1957.

Review of the aerial photographs supports available site history information for the Buckeye property (Section 1.3, Site History). The earliest photos available (October 15, 1951) indicate that filling to present grade had been completed by this time including filling of the abandoned Onondaga Creek channel. The position of the old channel is marked by vegetation patterns, especially noticeable on the April 29, 1972 photos.

Aerial photographs confirm that the Buckeye property has remained undeveloped. However, air photos obtained on several dates (i.e., July 1, 1966; April 28, 1967; and April 29, 1972) seemingly indicate use of the extreme northeastern edge of the Buckeye property for parking. Some minor filling or regrading seems associated with this use based on photo review, especially near the northeastern corner of the property.

3.2 Site Survey

The measuring point elevations were determined for all wells located on the Buckeye property. These wells had been installed previously by JEB Consultants. All elevations were referenced to the City of Syracuse datum.

As part of the survey DUNN also established two reference points over the Barge Canal on the Hiawatha Boulevard and Conrail bridges (SP-1 and SP-2, respectively). These reference points are used to measure Onondaga Lake and the Barge Canal water level elevations.

Monitoring well and surface water measuring point elevations are listed in Table 3.1. Existing site maps were updated using the survey data.

3.3 Water Level Measurements

Water level measurements were obtained from monitoring wells on the Buckeye property on six dates during the period of investigations. Measurements were generally obtained using electronic water level probes. The depth to water was recorded for each measurement. This information was converted to water level elevations with respect to the City of Syracuse datum using the surveyed elevations of the measuring points (either top of PVC or steel casing). Water level elevations and measuring point elevations for the Buckeye property are presented in Table 3.2. Water level information for the Barge Canal and Onondaga Lake are also presented in Table 3.2.

3.4 Environmental Sampling and Analysis

3.4.1 Surface Soil Sampling

Previous investigations conducted during November and December, 1987 included surface soil sampling at two locations on the Buckeye property (Figure 3.1). Those samples were analyzed for the following: pesticides and PCBs (EPA Method 8080); metals (EPA Method 7000 series); volatile organics (EPA Method 624); and

Table 3.1

Monitoring Well Elevation Measurements
for the Buckeye property
(in feet above the City of Syracuse Datum)

Well or Water Elevation Reference Point	Well Elevations			Reference Point Elevation
	Top of Steel Casing	Top of PVC Riser	Ground Surface	
P-16	16.87	16.77	14.5	
P-17	13.93	13.81	11.8	
P-18 *	14.34	14.24	11.9	
P-19 *	12.30	12.18	9.5	
SP-1 Hiawatha Blvd. canal bridge				23.14
SP-2 Conrail canal bridge				19.92

Notes

* Top of steel and ground surface elevations supplied by C.T. Male Associates, P.C.; top of PVC elevations calculated from top of steel elevations and measured separation between top of steel and PVC.

Table 3.2
Water Level Measurements
Buckeye Property

Well	Steel	PVC	Ground	Date of Measurement 10-Mar-88	11-Mar-88	12-Mar-88	14-Mar-88	15-Mar-88	21-Mar-88	18-May-88	06-Jul-88	07-Jul-88	23-Jul-88
P-16	16.87	16.77	14.5	NA	8.41	8.53	NA	NA	8.09	7.93	NA	7.59	8.47
P-17	13.93	13.81	11.8	NA	8.71	8.76	NA	NA	8.26	7.99	NA	7.37	8.66
P-18	14.34	14.24	11.9	NA	9.09	9.07	NA	NA	8.64	8.24	NA	7.29	8.73
P-19	12.30	12.18	9.5	NA	8.98	9.11	NA	NA	8.47	8.29	NA	7.68	8.99
SP-1	23.14	NA	NA	NA	NA	NA	NA	NA	NA	1.64	NA	1.49	NA
SP-2	19.92	NA	NA	NA	NA	NA	NA	NA	1.32	1.60	NA	1.37	1.78

semi-volatile organics (EPA Method 625). Results were presented in the Environmental Site Assessment (Section 2.2, Environmental Investigations).

The above samples indicated no detectable levels of pesticides or PCBs. Methylene chloride, a volatile organic, was detected in one sample via EPA Method 624 at an extremely low level for soil (41 ppb). It was actually only detected in the test sample at 4.1 ppb with a multiplier factor of 10 to account for extraction into the aqueous analytical medium. Such a level is a commonly reported laboratory contamination level and is not environmentally significant. No other volatile organics were detected in the surface soil samples. Thus, environmental conditions are not deemed significant on the undeveloped Buckeye property.

During this present investigation, one additional grab sample was collected from the Buckeye property to provide better areal coverage. The location of this sample (M) is shown in Figure 3.1. The surface soil sample was collected on March 4, 1988 using a hand trowel. All sampling equipment was decontaminated with pesticide-grade hexane and distilled water. This sample was analyzed for PCBs using EPA Method 8080 by RECRA Environmental, Inc. of Tonawanda, New York.

Results of the PCB analysis of surface soil sample M are summarized in Table 3.3; Appendix A contains the laboratory reporting forms and quality assurance/quality control information.

3.4.2 Groundwater Sampling

Monitoring wells P-17 and P-19 on the Buckeye property were sampled on March 21 through March 23, 1988. A minimum of three well volumes were evacuated from each well prior to sampling, using a Fuji pump and dedicated 0.5-inch I.D. polyethylene tubing. Samples were obtained using clean, dedicated bottom filling, check-valved, PVC bailers. Samples were placed in sample containers supplied by the laboratory, labeled and placed on ice for transport. Chain of custody records were maintained.

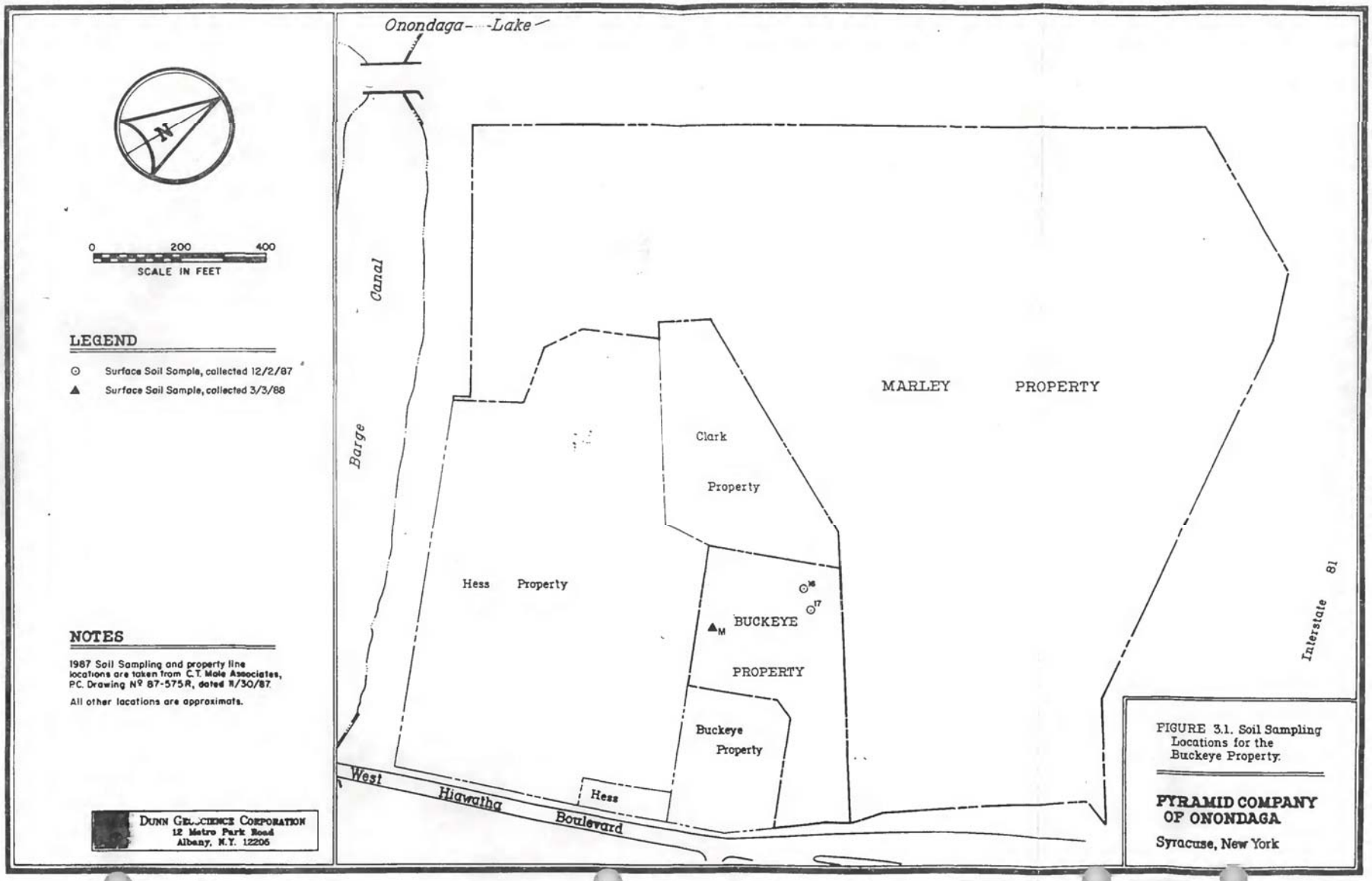

Onondaga Lake
Barge Canal
MARLEY PROPERTY
Clark Property
Hess Property
BUCKEYE PROPERTY
Buckeye Property
Hess
West Highwatha Boulevard
Interstate 81
0 200 400
SCALE IN FEET
LEGEND
Surface Soil Sample, collected 12/2/87
Surface Soil Sample, collected 3/3/88
NOTES
1987 Soil Sampling and property line locations are taken from C.T. Male Associates, P.C. Drawing Nº 87-575R, dated 11/30/87.
All other locations are approximate.
DUNN GEOSCIENCE CORPORATION
12 Metro Park Road
Albany, N.Y. 12205
FIGURE 3.1. Soil Sampling Locations for the Buckeye Property.
PYRAMID COMPANY OF ONONDAGA
Syracuse, New York

Table 3.3
Surface Soil PCB Analytical Data
Buckeye Property
Syracuse, New York

Date Collected: March 3,1988

	Arochlor Compound						
Sample Point	1016	1221	1232	1242	1248	1254	1260
M	<0.05	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05

All results in ug/g on a dry weight basis

Groundwater samples obtained from wells on the Buckeye property were measured in the field for pH, temperature, specific conductance and turbidity. Results are summarized in Table 3.4.

Erco Laboratory (Enseco, Inc.) of Cambridge, Massachusetts performed the chemical analyses for groundwater samples obtained in March, 1988. The analytical program for this sampling event is discussed below.

Groundwater samples were analyzed for volatile organics via EPA Method 624. Quality assurance/quality control included analysis of two field blanks and one trip blank. Results for the groundwater samples are presented in Table 3.5.

The groundwater samples from the Buckeye property were also analyzed for petroleum hydrocarbons. The analytical procedure used by Erco was the U.S. Coast Guard Hydrocarbon Fingerprinting Spill Identification System. Results are summarized in Table 3.6.

The laboratory reporting forms for all groundwater analyses for the Buckeye property, including quality assurance/quality control information, are included in Appendix B.

Table 3.4
Field Measurements of Selected Groundwater Properties
Buckeye Property
March 23, 1988

Monitoring Well Number	pH (Standard Units)	Temp (C)	Specific Conductance (umhos)	Turbidity (NTU)
P-17	6.7	10.0	700	>200
P-19	12.8	8.0	7000	>200

Table 3.5
Volatile Organic Groundwater Analytical Data
Buckeye Property
March 23, 1988

Hazardous Substance List (HSL) - Volatile Organics
EPA Method 624

Compound	RL	P-17	RL	P-19
Chloromethane	5	ND	5	ND
Bromomethane	5	ND	5	ND
Vinyl Chloride	5	ND	5	83
Chloroethane	5	ND	5	42
Methylene Chloride	5	ND	5	ND
Acetone	25	ND	25	ND
Carbon Disulfide	2	ND	2	ND
1,1-Dichloroethylene	2	ND	2	ND
1,1-Dichloroethane	2	ND	2	24
1,2-Trans-Dichloroethylene	2	ND	2	110
Chloroform	2	ND	2	ND
1,2-Dichloroethane	2	ND	2	ND
2-Butanone	10	ND	10	ND
1,1,1-Trichloroethane	2	ND	2	ND
Carbon Tetrachloride	2	ND	2	ND
Vinyl Acetate	10	ND	10	ND
Bromodichloromethane	2	ND	2	ND
1,2-Dichloropropane	2	ND	2	ND
1,3-Trans-Dichloropropene	2	ND	2	ND
Trichloroethylene	2	ND	2	ND
Dibromochloromethane	2	ND	2	ND
1,1,2 Trichloroethane	2	ND	2	ND
Benzene	2	ND	2	ND
1,3-Cis-Dichloropropene	2	ND	2	ND
2-Chloroethyl vinyl ether	10	ND	10	ND
Bromoform	2	ND	2	ND
4-Methyl-2-Pentanone	10	ND	10	ND
2-Hexanone	10	ND	10	ND
1,1,2,2-Tetrachloroethane	2	ND	2	ND
Tetrachloroethylene	2	ND	2	ND
Toluene	2	ND	2	21
Chlorobenzene	2	ND	2	ND
Ethyl Benzene	2	ND	2	ND
Styrene	2	ND	2	ND
Total Xylenes	2	ND	2	ND

All values expressed in ug/l (ppb).

ND = Not Detected
RL = Reporting Limit

Table 3.6
Petroleum Hydrocarbon Groundwater Analytical Data
Buckeye Property
March 23, 1988

Monitoring Well Number	Total Petroleum Hydrocarbon(mg/L)	Qualitative Identification *
P-17	4.4	LO
P-19	2.4	LO

LO = Lubricating Oil
PAH = Polynuclear Aromatic Hydrocarbons
FO = Fuel Oil
G = Gasoline

* The sample has GC/FID characteristics that are similar to one of the above materials.

4.0 GEOLOGIC CONDITIONS

4.1 Regional Geology

The proposed Carousel Center Mall site, including the Buckeye property, is located in the Erie-Ontario Lowland physiographic province. Landforms in this province are primarily the result of erosion of flat lying sedimentary rocks and subsequent Wisconsin glaciation. Onondaga Lake and the Buckeye property are located within a glacially-scoured trough-shaped bedrock valley which trends northwest-southeast.

The bedrock underlying the Buckeye property is the Vernon Formation of Late Silurian age. The Vernon Formation is a thick unit consisting predominantly of green and red silty shales and minor salt beds. Bedrock at the proposed mall site occurs at considerable depth. Two previous engineering soil borings on the Buckeye property (Section 2.1, Engineering Investigations) sampled to 162 and 196 feet, respectively, have failed to determine the depth to bedrock.

The unconsolidated materials overlying bedrock at the Buckeye property are predominantly lacustrine in origin. These materials are generally silt and clay. Logs from deep borings indicate progressive fining from silt to clay with increasing depth. At depths of approximately 120 to 150 feet, however, sands and gravels (possibly glacial till or compact outwash) are encountered beneath the clays and, presumably, overlie bedrock.

4.2 Site Geology

Four shallow borings (P-16 through P-19) drilled on the Buckeye property were logged by JEB Consultants primarily by visual examination of auger cuttings, rather than split-spoon soil samples. For this reason, exact details of the subsurface soil stratigraphy are not available; however, a general description can be prepared from information presented in JEB Consultants' boring logs which is geologically reasonable and consistent with stratigraphies for adjacent parcels.

The general soil stratigraphy at the Buckeye property consists of man-emplaced fill materials overlying a naturally-occurring sequence of glacial lake (glaciolacustrine) and post glacial lake and marsh deposits. Fill materials form the uppermost soil unit and cover the entire property. Fill can be classified as mixed fill and Solvay waste. The mixed fill was found throughout the Buckeye property. The Solvay waste was found only in borings P-18 and P-19 and was encountered at the base of the fill section. Figure 4.1 is an isopach map of total thickness of fill materials, including both the mixed fill and the Solvay waste where present. Fill thickness is generally 5 to 10 feet at the Buckeye property.

The mixed fill consists primarily of gray silty, clayey or sandy soil with admixed gravel and man-made rubble such as wood, brick and ceramic materials.

The white to gray clay, silty clay, and clayey silt referred to as "Solvay waste" was encountered beneath the mixed fill in two borings on the the Buckeye property. Solvay waste is a white, chalky-textured, alkaline material composed of clay-sized and silt-sized particles that is a by-product of sodium carbonate production using the Solvay process. The waste is primarily composed of mineral salts, particularly calcium chloride and calcium carbonate. The term "Solvay waste" is used herein to refer to the white and white-gray fill material having the characteristics listed above. This terminology is used to be consistent with earlier reports and subsurface investigations. Figure 4.2 is an isopach map of Solvay waste thickness.

The various fill materials overlay glaciolacustrine and post-glaciolacustrine sediments. The top of the glaciolacustrine sediments typically contains roots, or shells. Lacustrine sediments are predominantly gray in color, with textures ranging from medium to fine sand to clayey sand or sandy clay.

The deeper engineering borings from previous investigations (Section 2.1, Engineering Investigations) indicate that most of the glaciolacustrine sequence below the sandier, upper section, consists of varved silt and clay.

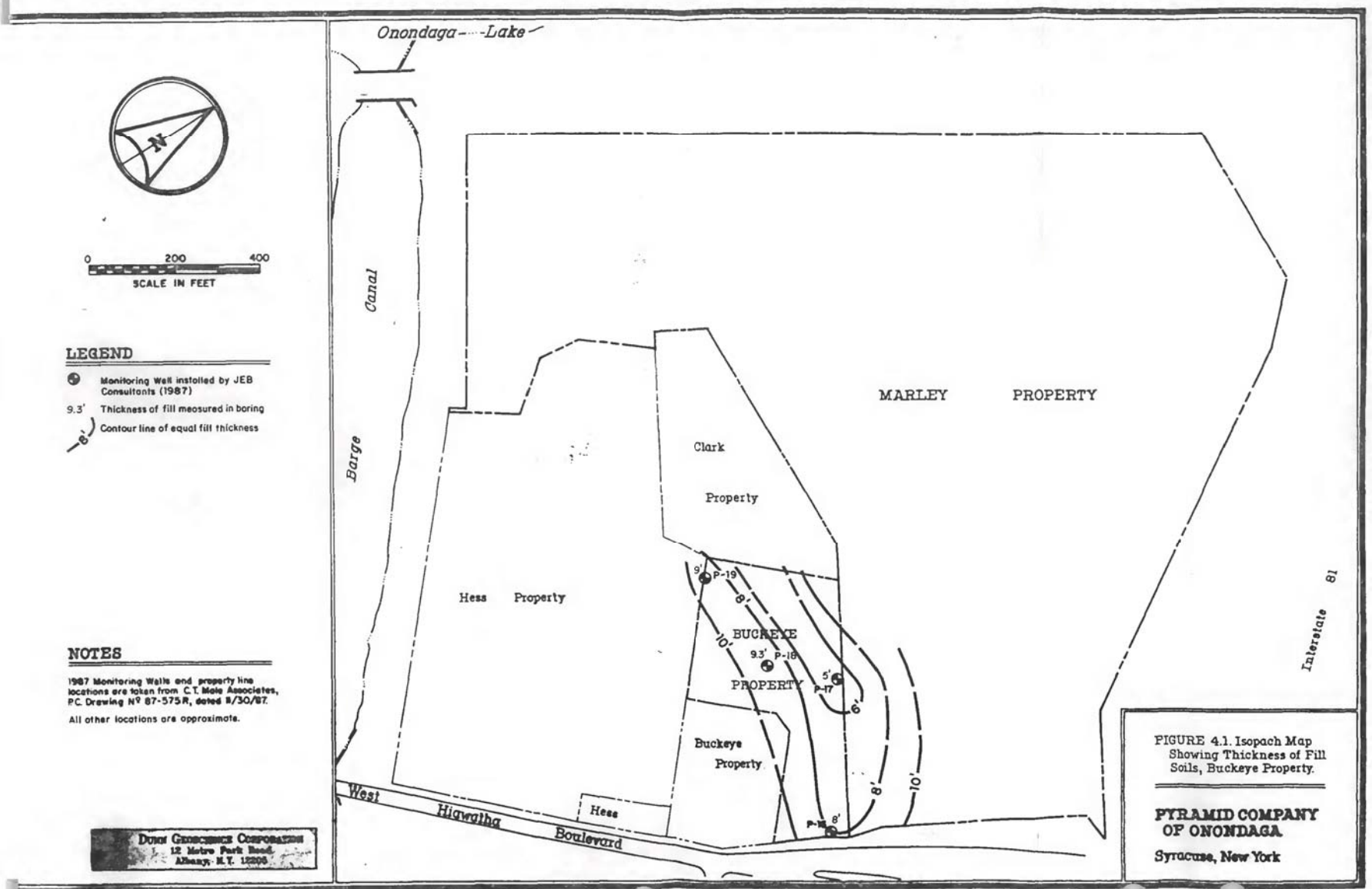


FIGURE 4.1. Isopach Map Showing Thickness of Fill Soils, Buckeye Property.

PYRAMID COMPANY OF ONONDAGA

Syracuse, New York

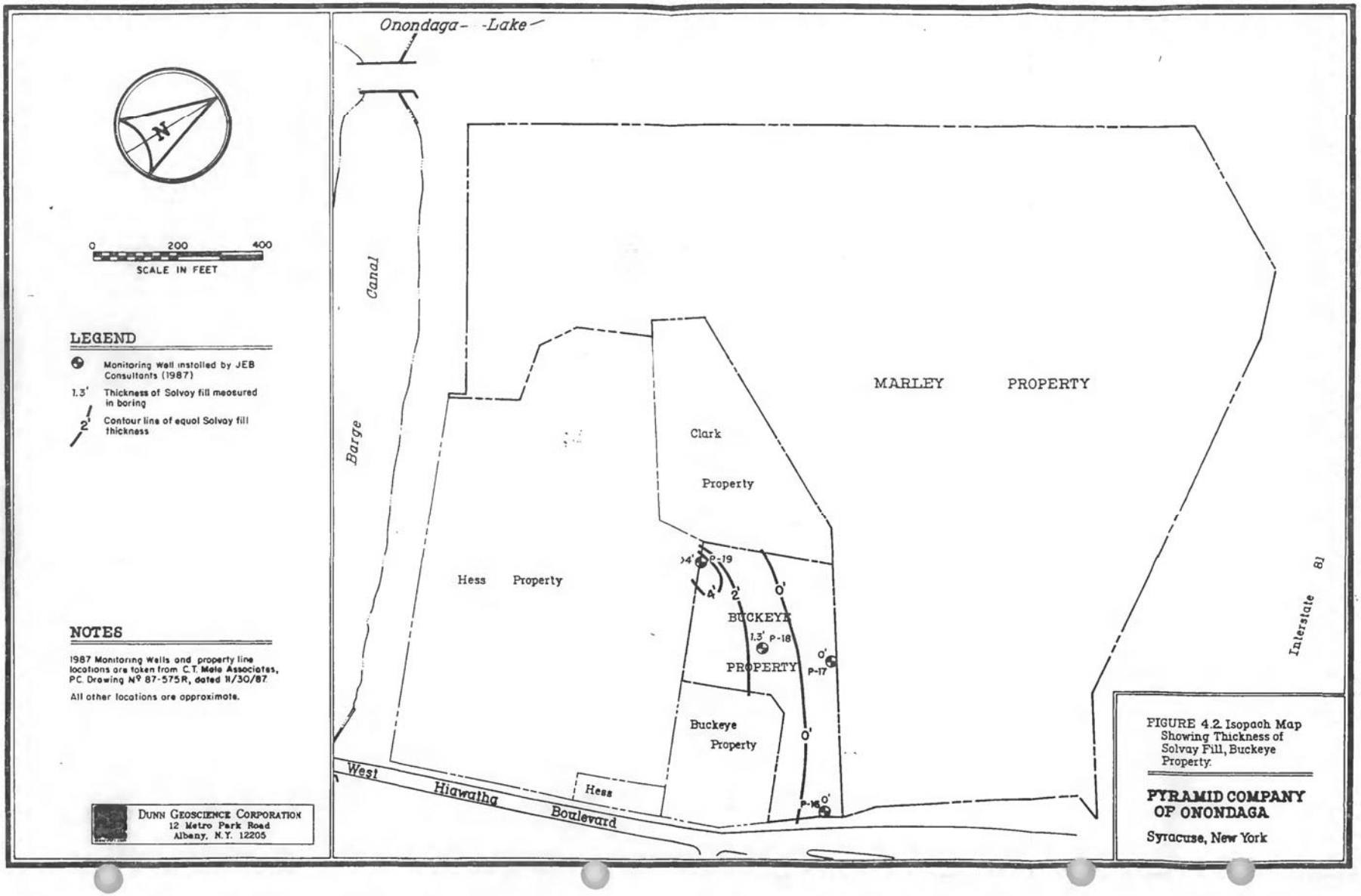


FIGURE 4.2 Isopach Map Showing Thickness of Solvay Fill, Buckeye Property.

PYRAMID COMPANY OF ONONDAGA

Syracuse, New York

5.0 HYDROGEOLOGIC CONDITIONS

5.1 Regional Hydrogeology

The proposed mall site is located in a large groundwater discharge area. Local and regional groundwater flow is toward Onondaga Lake and its major tributaries. The salt marsh and salt springs which existed at the mall site prior to filling activities are indicative of upward flow of groundwater through the lacustrine sediments toward the discharge zone.

The thick sequence of lacustrine silts and clays beneath the Buckeye property form an effective aquitard. The lower permeabilities of these sediments and upward hydraulic gradients preclude deep groundwater contamination problems resulting from surface activities and, therefore, limit the depth of required investigative efforts.

The sands and gravels which occur deep beneath the proposed mall site (i.e., in excess of 150 feet below grade) form a buried aquifer of unknown areal extent. Wells tapping this horizon reportedly flow indicating upward gradients and artesian conditions as expected. Groundwater from this permeable zone is reportedly saline.

Groundwater in the area is, from both unconsolidated materials and bedrock and is not used as water supply due to high salinity. The City of Syracuse uses Skaneateles Lake and Lake Ontario for its water supply.

5.2 Site Hydrogeology

5.2.1 General

As discussed in Section 4.2, Site Geology, the surficial materials at the site consist of mixed fill with Solvay wastes overlying lacustrine sands, silts, and clays. The fill in the Buckeye property ranges up to 10 feet in thickness based on available data. The underlying lacustrine deposit becomes

progressively finer with depth.

Groundwater occurs at shallow depths on the Buckeye property. Depth to groundwater is greatest in the western corner of the Buckeye site but is typically less than five feet. After significant rainfall events, the water table surface is coincident with the ground surface over large portions of the Buckeye property.

Groundwater occurs under unconfined conditions with the water table surface occurring within the fill materials. Groundwater flow generally occurs within the fill and uppermost portion of the lacustrine deposit. The deeper portions of the lacustrine deposit are much less permeable and form an aquitard.

Recharge to the shallow flow system is by precipitation, augmented in areas by surface water drainage pathways. The groundwater discharges to Onondaga Lake and the Barge Canal. Groundwater losses to evapotranspiration may be significant given the shallow water table and thick phreatophytic vegetative cover.

5.2.2 Groundwater Flow System

Water level elevation data were collected on several dates as presented in Table 3.2. Data were collected for the period from March to July, 1988.

Water level data collected from wells on March 12, March 21, and May 18, 1988 were used to construct water table contour maps. These maps are presented in Figures 5.1, 5.2 and 5.3, respectively. As shown, the configuration of the water table on the Buckeye property is relatively consistent during the period of observation.

Assuming an isotropic medium (i.e., hydraulic properties such as hydraulic conductivity are independent of direction at any given location), groundwater flow is perpendicular to the water table contours in the direction of decreasing head (i.e., water level elevation). Thus, based on Figures 5.1 to

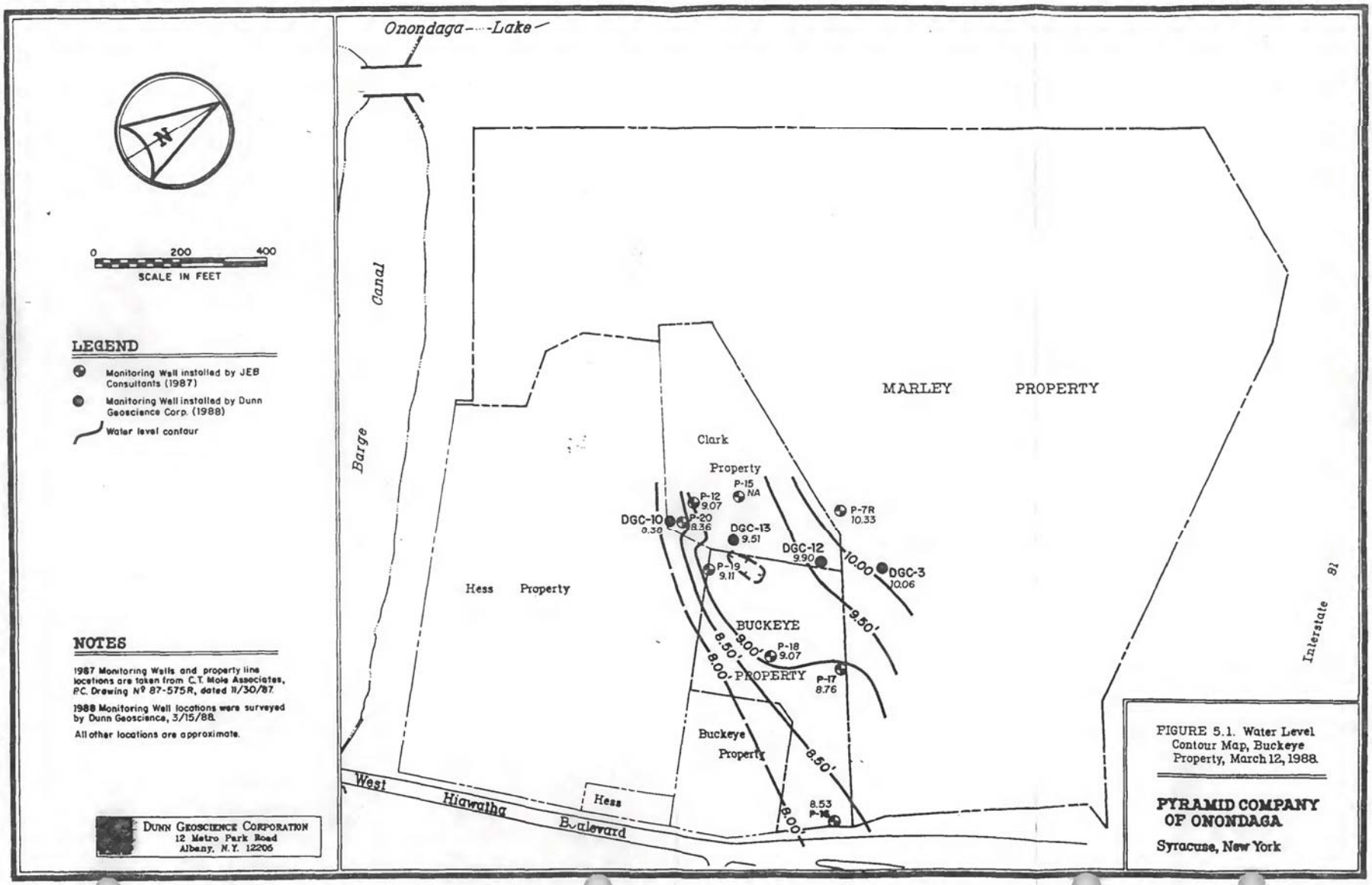


FIGURE 5.1. Water Level Contour Map, Buckeye Property, March 12, 1988.

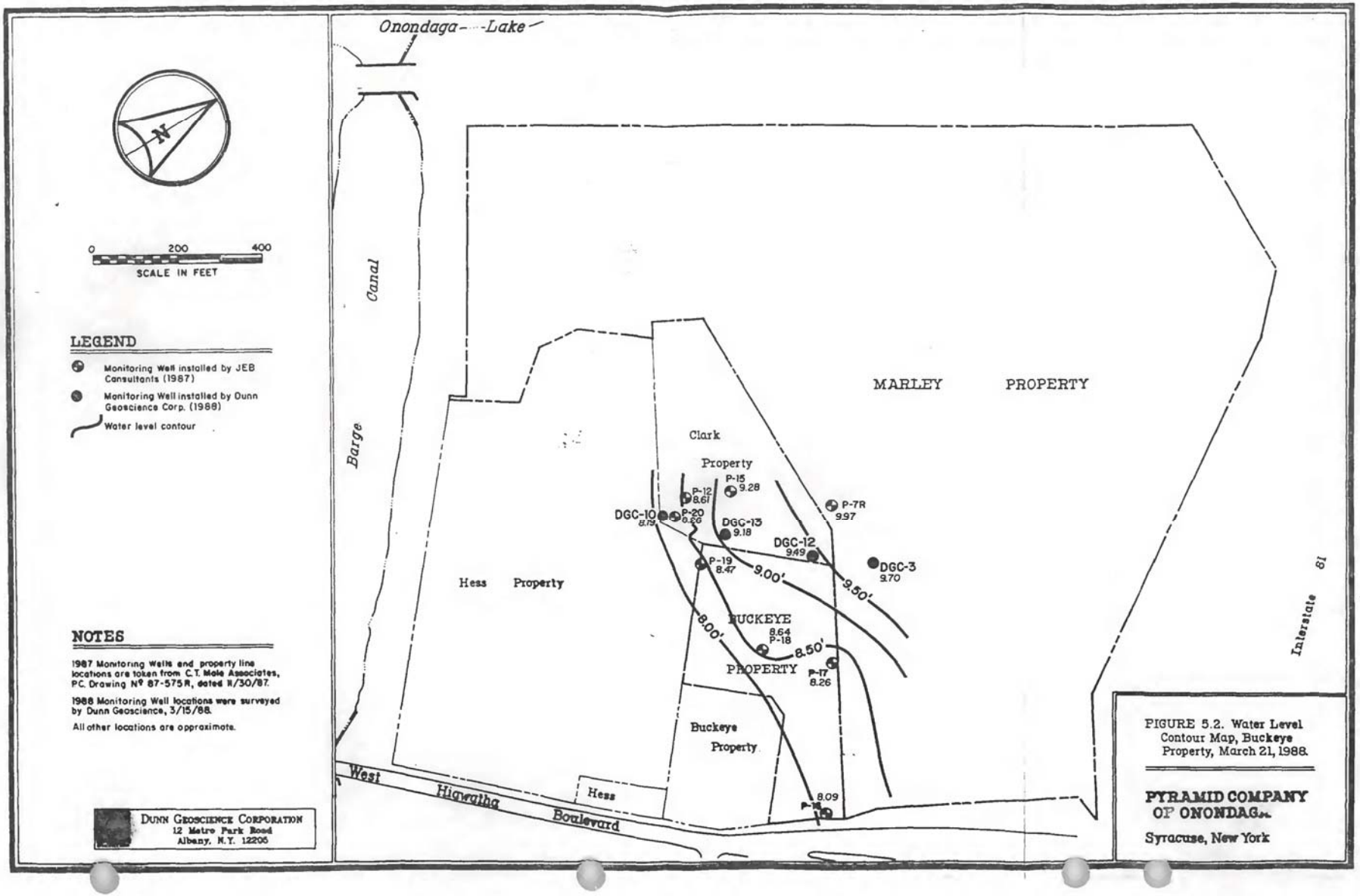


FIGURE 5.2. Water Level Contour Map, Buckeye Property, March 21, 1988.

PYRAMID COMPANY OF ONONDAGA

Syracuse, New York

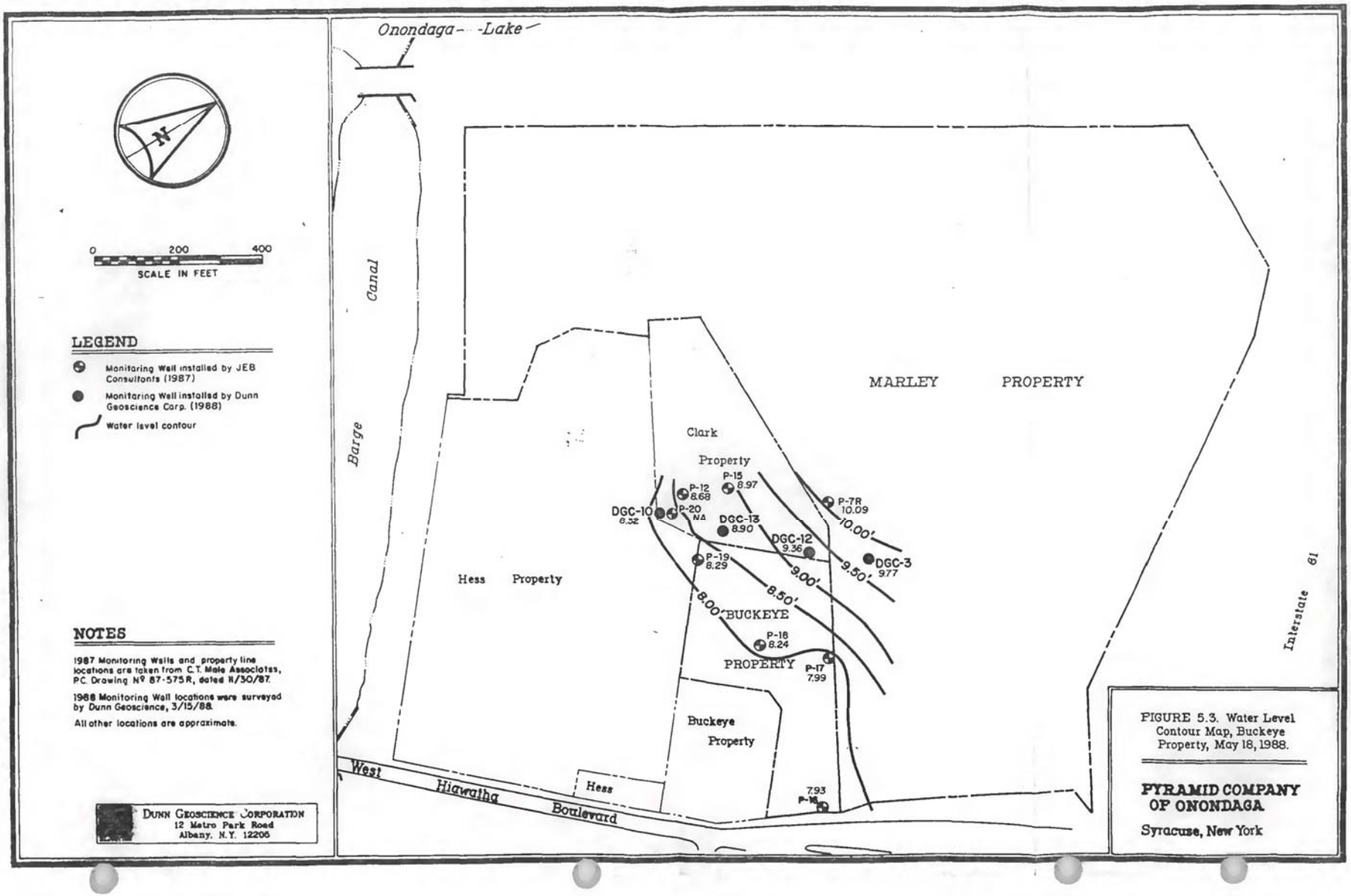


FIGURE 5.3. Water Level Contour Map, Buckeye Property, May 18, 1988.

PYRAMID COMPANY OF ONONDAGA

Syracuse, New York

5.3, groundwater flow is generally directed to the south toward areas of discharge. The Barge Canal to the south forms the primary discharge area to which most of the groundwater at the Buckeye property eventually flows. Some shallow groundwater in the extreme western part of the Buckeye property discharges to the surface water drainage ditch/swale. This ditch continues in a westward direction along the Clark-Hess property boundary.

Three point methods were employed to quantify hydraulic gradients at the Buckeye property and support the water table mapping efforts. This method, whether graphical or numerical, is based on the water level elevation at three wells located in a triangular pattern and the x, y grid location of each well. The method assumed a planar water table between the three wells. Therefore, the three wells used should not be so far apart that they straddle a groundwater divide or discharge zone.

Figure 5.4 shows the wells utilized for three point calculations. Some of the wells used are on adjacent parcels and associated information is contained in other reports. Results are presented in Table 5.1.

Results of three point calculations support water table maps presented in Figures 5.1 to 5.3. Groundwater flow is generally to the south toward the Barge Canal. Both the magnitude and direction of the gradient are relatively consistent through time with one exception as discussed below.

Calculated flow directions support the swing in the water table contours in the vicinity of P-17 and P-18. Flow directions for the three point problems involving P-17 are generally more to the southeast. Further, the three point problems involving P-16, P-17 and P-18 shows significant variability in both the magnitude and direction of gradient. The cause of variability is probably similar to that of the shift in water table contours.

Darcy's Law can be utilized to estimate the rate of groundwater flow at the Buckeye property. Modifying to account for the porosity of the materials, Darcy's Law is stated as:

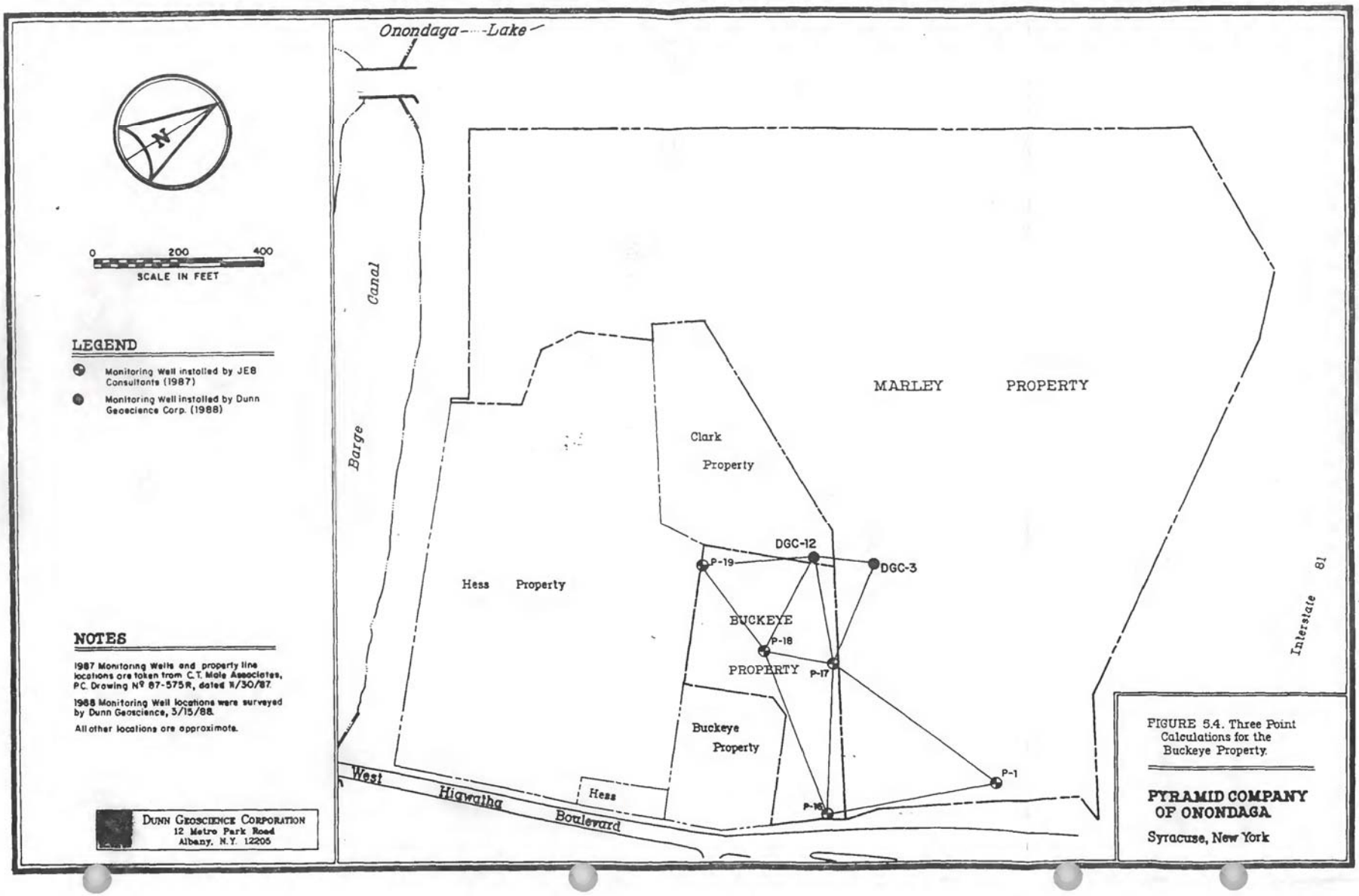


FIGURE 5.4. Three Point Calculations for the Buckeye Property.

PYRAMID COMPANY OF ONONDAGA

Syracuse, New York

Table 5.1
Results of Three Point Calculations (1,2)
Buckeye Property

Three Point Calculation	Dates of Measurement									
	03/12/1988		03/21/1988		05/18/1988		07/06/1988		07/23/1988	
	Mag	Dir	Mag	Dir	Mag	Dir	Mag	Dir	Mag	Dir
P-1,P-17,P-16	0.00365	207.4	0.00366	210.0	0.00390	215.0	0.00417	225.9	0.00355	208.9
P-16,P-17,P-18	0.00186	57.5	0.00224	49.6	0.00147	43.9	0.00072	275.2	0.00063	94.8
P-17,DGC-3,DGC-12	0.00494	138.7	0.00545	141.2	0.00677	150.5	NA	NA	0.00488	137.2
P-17,DGC-12,P-18	0.00441	111.5	0.00478	108.0	0.00535	120.0	0.00572	140.7	0.00466	130.9
P-18,DGC-12,P-19	0.00368	174.8	0.00422	186.4	0.00497	175.0	0.00571	161.7	0.00446	164.1

Notes
---

1. Magnitude measured in feet/feet.
2. Direction measured in degrees relative to north.

$$v = Ki/n$$

where v is the linear velocity of groundwater flow (feet/day), K is the hydraulic conductivity (feet/day), i is the hydraulic gradient (feet/feet), and n is the effective porosity.

A representative hydraulic conductivity for the fill materials, exclusive of the Solvay wastes, is 15 feet/day as determined by slug test results on the Marley property. The hydraulic gradient averages approximately 0.0047 feet/feet as determined by three point methods (Table 5.1). An effective porosity of 0.20 (20%) is assumed. Thus, the groundwater flow velocity is calculated as approximately 0.35 feet/day.

6.0 ENVIRONMENTAL QUALITY

6.1 Surface Soils

Laboratory results from the soil sampling performed in late 1987 at points 16 and 17 (Figure 3.1) on the Buckeye property indicated no detectable levels of any PCBs. The surface soil sample obtained at point M (Figure 3.1) on the Buckeye property during this present study also showed no detectable levels of PCB isomers (Table 3.3). Thus, surface soil samples obtained on the Buckeye property show no detectable levels of PCBs. It is concluded that PCBs are not of environmental concern on the Buckeye property.

As stated previously (Section 2.2, Environmental Investigations), soil samples from points 16 and 17 (Figure 3.1) on the Buckeye property each exhibited total lead concentrations of 110 ppm during a previous study. EP Toxicity values, which represent extractable concentrations which might be leachable into the groundwater, were not obtained. However, EP Toxicity lead values from the adjacent Marley property were very low for the few samples which exhibited elevated total lead concentrations. Therefore, it was concluded to be unnecessary to run the EP Toxicity test for this property because there does not appear to be a toxic lead problem in the local soils.

6.2 Groundwater

Monitoring wells P-16 and P-18 (Figure 2.1) on the Buckeye property showed no detectable levels of volatile organic compounds, including the fuel-related compounds (i.e., benzene, toluene, and xylene), in samples reported by JEB Consultants. For this reason, these wells were not resampled during this investigation. Only wells P-17 (which showed only very low concentrations of methylene chloride, a common lab contaminant) and P-19 were sampled.

Results of field measurements of groundwater quality (Table 3.4) indicated high pH and specific conductance in monitoring well P-19. These elevated values are likely due to the presence of alkaline materials in the fill such as Solvay waste, ashes, concrete, or lime. The soil boring for P-19 encountered more than 5 feet of Solvay waste. Further, the well screen of P-19 is situated partly in Solvay waste. The soil boring at P-17 did not encounter Solvay waste and groundwater from this well exhibited much lower pH and specific conductance as compared to well P-19.

High turbidity was measured in both wells P-17 and P-19. These values probably reflect the silt and clay content of the screened materials.

Volatile organic compounds were not detected in monitoring well P-17 (Figure 3.5). Evidence supports the conclusion that the methylene chloride detected during previous sampling at 8 ppb was indeed due to common laboratory background contamination rather than groundwater quality conditions.

Based on the above, P-19 is the only monitoring well on the Buckeye property which has exhibited the presence of volatile organic compounds and only at low levels. Compounds detected in P-19 were: trans-1,2-dichloroethylene (110 ppb), vinyl chloride (83 ppb), chloroethane (42 ppb), 1,1-dichloroethane (24 ppb), and toluene (21 ppb). These compounds are typically associated with organic solvents; some of these species such as vinyl chloride and trans-1,2-dichloroethylene are known degradation products of trichloroethylene (TCE).

Monitoring well P-19 is located in the western corner of the Buckeye property adjacent to the Clark property. The volatile organic species detected at low levels in this well are also detected at higher concentrations in several wells on Clark property. Other volatile organic species such as TCE were also detected in groundwater from some of the Clark property wells. There is no evidence that any of these materials have been disposed on the Buckeye property.

Groundwater samples from P-17 and P-19 were also analyzed for petroleum hydrocarbons (Table 3.6). Low levels were detected in both wells (4.4 ppm and 2.4 ppm, respectively). The petroleum hydrocarbons were tentatively identified as lubricating oils. The very low levels detected do not pose any environmental hazards.

6.3 Discussion of Findings

The surface soil investigation for the Buckeye property establishes that there is no cause for concern. The accompanying groundwater investigation establishes that there is no cause for concern, except for evidence of low level volatile organic chemicals in a small portion of the property located in the western corner. The species found and the concentrations detected in such area support the conclusion that the source of these organic chemicals is occurring, not on Buckeye, but on the adjacent Clark property.

lar

APPENDIX A

SURFACE SOIL ANALYTICAL DATA

Analytical Results for Surface Soil Sample M
Obtained on March 3, 1988

ANALYTICAL RESULTS

Prepared For

Dunn Geoscience Corporation
12 Metro Park Road
Albany, NY 12205

Prepared By

Recra Environmental, Inc.
10 Hazelwood Drive, Suite 106
Amherst, New York 14150

METHODOLOGIES

The specific methodologies employed in obtaining the enclosed analytical results are indicated on the specific data table. The method numbers presented refer to the following U.S. Environmental Protection Agency reference.

- U.S. Environmental Protection Agency "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods". Office of Solid Waste and Emergency Response. July 1982, SW-846, Second Edition.

COMMENTS

Comments pertain to data on one or all pages of this report.

The values reported as "less than" (<) indicate the working detection limit for the particular sample and/or parameter.

The value reported as "less than or equal to" ($\leq$) indicates the compound may be present at trace levels relative to the detection limit but not subject to accurate quantification.

Results of analyses for Method 8080 (PCB's) are corrected for moisture content and reported on a dry weight basis.

SOIL MATRIX
METHOD 8080 - PCB'S

COMPOUND (Units of Measure = µg/g dry)	SAMPLE IDENTIFICATION	
	M	
Aroclor 1016	<0.05	
Aroclor 1221	<0.1	
Aroclor 1232	<0.1	
Aroclor 1242	<0.05	
Aroclor 1248	<0.05	
Aroclor 1254	<0.05	
Aroclor 1260	<0.05	
Extraction Date	3/8/88	
Analysis Date	3/10/88	

QUALITY CONTROL INFORMATION - ACCURACY
SOIL MATRIX
METHOD 8080 - PCB'S

SAMPLE IDENTIFICATION Method Blank Spike

COMPOUND	NANOGRAMS OF SPIKE	PERCENT RECOVERY
Aroclor 1016	1.0	108
Aroclor 1260	1.0	115
Extraction Date	3/8/88	
Analysis Date	3/12/88	

APPENDIX B

GROUNDWATER ANALYTICAL DATA

B1: Volatile Organics for Groundwater Samples Obtained on March 23, 1988

Enseco

HAZARDOUS SUBSTANCE LIST (HSL) VOLATILE ORGANICS

EPA Method 624/HSL List

Client Name: Dunn Geoscience Corporation

Client ID: P-17

Laboratory ID: 7180-33

Matrix: Aqueous Sampled: 03/23/88 Received: 03/24/88

Authorized: 03/24/88 Prepared: 03/30/88 Analyzed: 03/30/88

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	µg/L	5.0
Bromomethane	ND	µg/L	5.0
Vinyl chloride	ND	µg/L	5.0
Chloroethane	ND	µg/L	5.0
Methylene chloride	ND	µg/L	5.0
Acetone	ND	µg/L	25
Carbon disulfide	ND	µg/L	2.0
1,1-Dichloroethene	ND	µg/L	2.0
1,1-Dichloroethane	ND	µg/L	2.0
trans-1,2-Dichloroethene	ND	µg/L	2.0
Chloroform	ND	µg/L	2.0
1,2-Dichloroethane	ND	µg/L	2.0
2-Butanone	ND	µg/L	10
1,1,1-Trichloroethane	ND	µg/L	2.0
Carbon tetrachloride	ND	µg/L	2.0
Vinyl acetate	ND	µg/L	10
Bromodichloromethane	ND	µg/L	2.0
1,2-Dichloropropane	ND	µg/L	2.0
trans-1,3-Dichloropropene	ND	µg/L	2.0
Trichloroethene	ND	µg/L	2.0
Dibromochloromethane	ND	µg/L	2.0
1,1,2-Trichloroethane	ND	µg/L	2.0
Benzene	ND	µg/L	2.0
cis-1,3-Dichloropropene	ND	µg/L	2.0
2-Chloroethyl vinyl ether	ND	µg/L	10
Bromoform	ND	µg/L	2.0
4-Methyl-2-pentanone	ND	µg/L	10
2-Hexanone	ND	µg/L	10
1,1,2,2-Tetrachloroethane	ND	µg/L	2.0
Tetrachloroethene	ND	µg/L	2.0
Toluene	ND	µg/L	2.0
Chlorobenzene	ND	µg/L	2.0
Ethylbenzene	ND	µg/L	2.0
Styrene	ND	µg/L	2.0
Total xylenes	ND	µg/L	2.0

ND = Not detected.

Reported by LS Approved by CB

Ensecc

HAZARDOUS SUBSTANCE LIST (HSL) VOLATILE ORGANICS

EPA Method 624/HSL List

Client Name: Dunn Geoscience Corporation

Client ID: P-19

Laboratory ID: 7180-37

Matrix: Aqueous Sampled: 03/23/88 Received: 03/24/88

Authorized: 03/24/88 Prepared: 03/30/88 Analyzed: 03/30/88

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	µg/L	5.0
Bromomethane	ND	µg/L	5.0
Vinyl chloride	83	µg/L	5.0
Chloroethane	42	µg/L	5.0
Methylene chloride	ND	µg/L	5.0
Acetone	ND	µg/L	25
Carbon disulfide	ND	µg/L	2.0
1,1-Dichloroethene	ND	µg/L	2.0
1,1-Dichloroethane	24	µg/L	2.0
trans-1,2-Dichloroethene	110	µg/L	2.0
Chloroform	ND	µg/L	2.0
1,2-Dichloroethane	ND	µg/L	2.0
2-Butanone	ND	µg/L	10
1,1,1-Trichloroethane	ND	µg/L	2.0
Carbon tetrachloride	ND	µg/L	2.0
Vinyl acetate	ND	µg/L	10
Bromodichloromethane	ND	µg/L	2.0
1,2-Dichloropropane	ND	µg/L	2.0
trans-1,3-Dichloropropene	ND	µg/L	2.0
Trichloroethene	ND	µg/L	2.0
Dibromochloromethane	ND	µg/L	2.0
1,1,2-Trichloroethane	ND	µg/L	2.0
Benzene	ND	µg/L	2.0
cis-1,3-Dichloropropene	ND	µg/L	2.0
2-Chloroethyl vinyl ether	ND	µg/L	10
Bromoform	ND	µg/L	2.0
4-Methyl-2-pentanone	ND	µg/L	10
2-Hexanone	ND	µg/L	10
1,1,2,2-Tetrachloroethane	ND	µg/L	2.0
Tetrachloroethene	ND	µg/L	2.0
Toluene	21	µg/L	2.0
Chlorobenzene	ND	µg/L	2.0
Ethylbenzene	ND	µg/L	2.0
Styrene	ND	µg/L	2.0
Total xylenes	ND	µg/L	2.0

ND = Not detected.

Reported by LS Approved by CB

Enseco

HAZARDOUS SUBSTANCE LIST (HSL) VOLATILE ORGANICS

EPA Method 624/HSL List

Client Name: Dunn Geoscience Corporation

Client ID: FB-1

Laboratory ID: 7180-27

Matrix: Aqueous Sampled: 03/23/88 Received: 03/24/88

Authorized: 03/24/88 Prepared: 03/30/88 Analyzed: 03/30/88

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	µg/L	5.0
Bromomethane	ND	µg/L	5.0
Vinyl chloride	ND	µg/L	5.0
Chloroethane	ND	µg/L	5.0
Methylene chloride	ND	µg/L	5.0
Acetone	ND	µg/L	25
Carbon disulfide	ND	µg/L	2.0
1,1-Dichloroethene	ND	µg/L	2.0
1,1-Dichloroethane	ND	µg/L	2.0
trans-1,2-Dichloroethene	ND	µg/L	2.0
Chloroform	ND	µg/L	2.0
1,2-Dichloroethane	ND	µg/L	2.0
2-Butanone	ND	µg/L	10
1,1,1-Trichloroethane	ND	µg/L	2.0
Carbon tetrachloride	ND	µg/L	2.0
Vinyl acetate	ND	µg/L	10
Bromodichloromethane	ND	µg/L	2.0
1,2-Dichloropropane	ND	µg/L	2.0
trans-1,3-Dichloropropene	ND	µg/L	2.0
Trichloroethene	ND	µg/L	2.0
Dibromochloromethane	ND	µg/L	2.0
1,1,2-Trichloroethane	ND	µg/L	2.0
Benzene	ND	µg/L	2.0
cis-1,3-Dichloropropene	ND	µg/L	2.0
2-Chloroethyl vinyl ether	ND	µg/L	10
Bromoform	ND	µg/L	2.0
4-Methyl-2-pentanone	ND	µg/L	10
2-Hexanone	ND	µg/L	10
1,1,2,2-Tetrachloroethane	ND	µg/L	2.0
Tetrachloroethene	ND	µg/L	2.0
Toluene	ND	µg/L	2.0
Chlorobenzene	ND	µg/L	2.0
Ethylbenzene	ND	µg/L	2.0
Styrene	ND	µg/L	2.0
Total xylenes	ND	µg/L	2.0

ND = Not detected.

Reported by LS Approved by CB

Enseco

HAZARDOUS SUBSTANCE LIST (HSL) VOLATILE ORGANICS

EPA Method 624/HSL List

Client Name: Dunn Geoscience Corporation

Client ID: FB-2

Laboratory ID: 7180-28

Matrix: Aqueous Sampled: 03/23/88 Received: 03/24/88

Authorized: 03/24/88 Prepared: 03/30/88 Analyzed: 03/30/88

Parameter	Result	Units	Reporting Limit
Chloromethane	39	µg/L	5.0
Bromomethane	ND	µg/L	5.0
Vinyl chloride	ND	µg/L	5.0
Chloroethane	ND	µg/L	5.0
Methylene chloride	480	µg/L	5.0
Acetone	ND	µg/L	25
Carbon disulfide	ND	µg/L	2.0
1,1-Dichloroethene	ND	µg/L	2.0
1,1-Dichloroethane	ND	µg/L	2.0
trans-1,2-Dichloroethene	ND	µg/L	2.0
Chloroform	ND	µg/L	2.0
1,2-Dichloroethane	ND	µg/L	2.0
2-Butanone	ND	µg/L	10
1,1,1-Trichloroethane	ND	µg/L	2.0
Carbon tetrachloride	ND	µg/L	2.0
Vinyl acetate	ND	µg/L	10
Bromodichloromethane	ND	µg/L	2.0
1,2-Dichloropropane	ND	µg/L	2.0
trans-1,3-Dichloropropene	ND	µg/L	2.0
Trichloroethene	ND	µg/L	2.0
Dibromochloromethane	ND	µg/L	2.0
1,1,2-Trichloroethane	ND	µg/L	2.0
Benzene	ND	µg/L	2.0
cis-1,3-Dichloropropene	ND	µg/L	2.0
2-Chloroethyl vinyl ether	ND	µg/L	10
Bromoform	ND	µg/L	2.0
4-Methyl-2-pentanone	ND	µg/L	10
2-Hexanone	ND	µg/L	10
1,1,2,2-Tetrachloroethane	ND	µg/L	2.0
Tetrachloroethene	ND	µg/L	2.0
Toluene	ND	µg/L	2.0
Chlorobenzene	ND	µg/L	2.0
Ethylbenzene	ND	µg/L	2.0
Styrene	ND	µg/L	2.0
Total xylenes	ND	µg/L	2.0

ND = Not detected.

Reported by LS Approved by CB

Enseco

HAZARDOUS SUBSTANCE LIST (HSL) VOLATILE ORGANICS

EPA Method 624/HSL List

Client Name: Dunn Geoscience Corporation

Client ID: TB

Laboratory ID: 7180-29

Matrix: Aqueous Sampled: 03/23/88 Received: 03/24/88

Authorized: 03/24/88 Prepared: 03/30/88 Analyzed: 03/30/88

Parameter	Result	Units	Reporting Limit
Chloromethane	ND	µg/L	5.0
Bromomethane	ND	µg/L	5.0
Vinyl chloride	ND	µg/L	5.0
Chloroethane	ND	µg/L	5.0
Methylene chloride	ND	µg/L	10
Acetone	ND	µg/L	25
Carbon disulfide	ND	µg/L	2.0
1,1-Dichloroethene	ND	µg/L	2.0
1,1-Dichloroethane	ND	µg/L	2.0
trans-1,2-Dichloroethene	ND	µg/L	2.0
Chloroform	ND	µg/L	2.0
1,2-Dichloroethane	ND	µg/L	2.0
2-Butanone	ND	µg/L	10
1,1,1-Trichloroethane	ND	µg/L	2.0
Carbon tetrachloride	ND	µg/L	2.0
Vinyl acetate	ND	µg/L	10
Bromodichloromethane	ND	µg/L	2.0
1,2-Dichloropropane	ND	µg/L	2.0
trans-1,3-Dichloropropene	ND	µg/L	2.0
Trichloroethene	ND	µg/L	2.0
Dibromochloromethane	ND	µg/L	2.0
1,1,2-Trichloroethane	ND	µg/L	2.0
Benzene	ND	µg/L	2.0
cis-1,3-Dichloropropene	ND	µg/L	2.0
2-Chloroethyl vinyl ether	ND	µg/L	10
Bromoform	ND	µg/L	2.0
4-Methyl-2-pentanone	ND	µg/L	10
2-Hexanone	ND	µg/L	10
1,1,2,2-Tetrachloroethane	ND	µg/L	2.0
Tetrachloroethene	ND	µg/L	2.0
Toluene	ND	µg/L	2.0
Chlorobenzene	ND	µg/L	2.0
Ethylbenzene	ND	µg/L	2.0
Styrene	ND	µg/L	2.0
Total xylenes	ND	µg/L	2.0

ND = Not detected.

Reported by LS Approved by CB

Enseco

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA Method 624 + 624/HSL List

QUALITY CONTROL

Client Name: Dunn Geoscience Corporation

Client ID: Laboratory Control Spike

Laboratory ID: P454LCS

Matrix: Aqueous Prepared: 03/30/88 Analyzed: 03/30/88

Parameter	% Recovery	QC Advisory Limits
1,1-Dichloroethene	88	61 - 145%
Trichloroethene	75	71 - 120%
Benzene	85	76 - 127%
Toluene	87	76 - 125%
Chlorobenzene	88	75 - 130%

Reported by LS Approved by CB

Enseco

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA Method 624 + 624/HSL List

QUALITY CONTROL

Client Name: Dunn Geoscience Corporation

Client ID: Laboratory Control Spike Dup.

Laboratory ID: P465LCSD

Matrix: Aqueous Prepared: 03/30/88 Analyzed: 03/30/88

Parameter	% Recovery	QC Advisory Limits
1,1-Dichloroethene	92	61 - 145%
Trichloroethene	80	71 - 120%
Benzene	90	76 - 127%
Toluene	93	76 - 125%
Chlorobenzene	91	75 - 130%

Reported by LS Approved by CB

Enseco

VOLATILE ORGANICS (CONT.)

Surrogate Recovery Summary

Client Name: Dunn Geoscience Corporation

Matrix: Aqueous

Authorized: 03/24/88 Received: 03/24/88

		Surrogate Compound (%)		
Erco ID	Client ID	d_4-1,2,-Dichloro-ethane	d_8-Toluene	p-Bromofluoro-benzene
7180-33	P-17	102	97	98
7180-37	P-19	104	101	97
QC Advisory Limits:		76-114%	61-110%	74-115%

Reported by LS Approved by

B2: Petroleum Hydrocarbons for Groundwater Samples Obtained on March 23, 1988

Enseco

HYDROCARBON FINGERPRINTING
U.S. COAST GUARD OIL SPILL IDENTIFICATION SYSTEM
MARINE ORGANICS LABORATORY

Client Name: Dunn Geoscience Corporation
Matrix: Aqueous
Authorized: 03/25/88 Sampled: 03/23/88 Received: 03/24/88
Concentration Units: mg/L (ppm) Prepared: 03/28/88 Analyzed: 03/30/88

Enseco ID	Client ID	Total Petroleum Hydro-carbons	Reporting Limits for Individual Hydrocarbons	Reporting Limits for Total Product	% Solids
7180-33	P-17	4.4	0.01	0.25	NA

Qualitative Identification: This sample has GC/FID characteristics that are similar to lubricating oil.

NA = Not applicable.
All samples are corrected for Method Blank.
Minimum reporting limit for individual hydrocarbons = 0.01 mg/L.
Minimum reporting limit for total products = 0.25 mg/L.
Internal standard recovery = 75%.

Reported by AH Approved by GD

Enseco

HYDROCARBON FINGERPRINTING
U.S. COAST GUARD OIL SPILL IDENTIFICATION SYSTEM
MARINE ORGANICS LABORATORY

Client Name: Dunn Geoscience Corporation
Matrix: Aqueous
Authorized: 03/25/88 Sampled: 03/23/88 Received: 03/24/88
Concentration Units: mg/L (ppm) Prepared: 03/28/88 Analyzed: 03/30/88

Enseco ID	Client ID	Total Petroleum Hydro-carbons	Reporting Limits for Individual Hydrocarbons	Reporting Limits for Total Product	% Solids
7180-37	P-19	2.4	0.01	0.25	NA

Qualitative Identification: This sample has GC/FID characteristics that are similar to lubricating oil.

NA = Not applicable.
All samples are corrected for Method Blank.
Minimum reporting limit for individual hydrocarbons = 0.01 mg/L.
Minimum reporting limit for total products = 0.25 mg/L.
Internal standard recovery = 91%.

Reported by AH Approved by GD

Enseco

HYDROCARBON FINGERPRINTING
U.S. COAST GUARD OIL SPILL IDENTIFICATION SYSTEM
MARINE ORGANICS LABORATORY

Client Name: Dunn Geoscience Corporation
Matrix: Aqueous
Authorized: 03/25/88 Sampled: 03/23/88 Received: 03/24/88
Concentration Units: mg/L (ppm) Prepared: 03/28/88 Analyzed: 03/30/88

Enseco ID	Client ID	Total Petroleum Hydro-carbons	Reporting Limits for Individual Hydrocarbons	Reporting Limits for Total Product	% Solids
7180-27	FB-1	0.10	0.01	0.25	NA

Qualitative Identification: NA

NA = Not applicable.
All samples are corrected for Method Blank.
Minimum reporting limit for individual hydrocarbons = 0.01 mg/L.
Minimum reporting limit for total products = 0.25 mg/L.
Internal standard recovery = 87%.

Reported by AH Approved by GD

Enseco

HYDROCARBON FINGERPRINTING
U.S. COAST GUARD OIL SPILL IDENTIFICATION SYSTEM
MARINE ORGANICS LABORATORY

Client Name: Dunn Geoscience Corporation
Matrix: Aqueous
Authorized: 03/25/88 Sampled: 03/23/88 Received: 03/24/88
Concentration Units: mg/L (ppm) Prepared: 03/28/88 Analyzed: 03/30/88

Enseco ID	Client ID	Total Petroleum Hydro-carbons	Reporting Limits for Individual Hydrocarbons	Reporting Limits for Total Product	% Solids
7180-28	FB-2	0.09	0.01	0.25	NA

Qualitative Identification: NA

NA = Not applicable.
All samples are corrected for Method Blank.
Minimum reporting limit for individual hydrocarbons = 0.01 mg/L.
Minimum reporting limit for total products = 0.25 mg/L.
Internal standard recovery = 88%.

Reported by AH Approved by GD

Enseco

HYDROCARBON FINGERPRINTING
U.S. COAST GUARD OIL SPILL IDENTIFICATION SYSTEM
MARINE ORGANICS LABORATORY

Client Name: Dunn Geoscience Corporation
Matrix: Aqueous
Authorized: NA Sampled: NA Received: NA
Concentration Units: mg/L (ppm) Prepared: 03/25/88 Analyzed: 03/26/88

Enseco ID	Client ID	Total Petroleum Hydro-carbons	Reporting Limits for Individual Hydrocarbons	Reporting Limits for Total Product	% Solids
7180-11B	Erco Blank	ND	0.01	0.25	NA

Qualitative Identification: NA

NA = Not applicable.
ND = Not detected.
All samples are corrected for Method Blank.
Minimum reporting limit for individual hydrocarbons = 0.01 mg/L.
Minimum reporting limit for total products = 0.25 mg/L.
Internal standard recovery = 53%.

Reported by AH Approved by GD

Enseco

HYDROCARBON FINGERPRINTING
U.S. COAST GUARD OIL SPILL IDENTIFICATION SYSTEM
MARINE ORGANICS LABORATORY

Client Name: Dunn Geoscience Corporation
Matrix: Aqueous
Authorized: NA Sampled: NA Received: NA
Concentration Units: mg/L (ppm) Prepared: 03/28/88 Analyzed: 03/28/88

Enseco ID	Client ID	Total Petroleum Hydro-carbons	Reporting Limits for Individual Hydrocarbons	Reporting Limits for Total Product	% Solids
7180-26B	Erco Blank	ND	0.01	0.25	NA

Qualitative Identification: NA

ND = Not detected.
NA = Not applicable.
All samples are corrected for Method Blank.
Minimum reporting limit for individual hydrocarbons = 0.01 mg/L.
Minimum reporting limit for total products = 0.25 mg/L.
Internal standard recovery = 92%.

Reported by AH Approved by GD

Enseco

HYDROCARBON FINGERPRINTING
U.S. COAST GUARD OIL SPILL IDENTIFICATION SYSTEM
MARINE ORGANICS LABORATORY

Client Name: Dunn Geoscience Corporation
Matrix: Solid
Authorized: NA Sampled: NA Received: NA
Concentration Units: µg/g (dry wt) Prepared: 03/29/88 Analyzed: 03/31/88

Enseco ID	Client ID	Total Petroleum Hydro-carbons	Reporting Limits for Individual Hydrocarbons	Reporting Limits for Total Product	% Solids
7180-30B	Erco Blank	0.22	0.2	5.0	NA

Qualitative Identification: NA

NA = Not applicable.
All samples are corrected for Method Blank.
Minimum reporting limit for individual hydrocarbons = 0.2 µg/g (dry wt).
Minimum reporting limit for total products = 5.0 µg/g (dry wt).
Internal standard recovery = 96%.

Reported by AH Approved by SD

Enseco

HYDROCARBON FINGERPRINTING
U.S. COAST GUARD OIL SPILL IDENTIFICATION SYSTEM
MARINE ORGANICS LABORATORY

Client Name: Dunn Geoscience Corporation
Matrix: Aqueous
Authorized: NA Sampled: NA Received: NA
Concentration Units: mg/L (ppm) Prepared: 03/28/88 Analyzed: 03/30/88

Enseco ID	Client ID	Total Petroleum Hydro-carbons	Reporting Limits for Individual Hydrocarbons	Reporting Limits for Total Product	% Solids
7154-01B	Erco Blank	ND	0.01	0.25	NA

Qualitative Identification: NA

NA = Not applicable.
All samples are corrected for Method Blank.
Minimum reporting limit for individual hydrocarbons = 0.01 mg/L.
Minimum reporting limit for total products = 0.25 mg/L.
Internal standard recovery = 89%.

Reported by AH Approved by 6D