T-1336-03

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Washington State
Department of Ecology

First Quarterly Groundwater Sampling Activities Tacoma, Washington

October 1992

Northwest Wire Rope and Equipment, Inc.
2301 Lincoln Avenue
Tacoma, WA 98401

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
400 N. 34th St. ▪ Suite 100
P.O. Box 300303
Seattle, Washington 98103
206 ▪ 632 ▪ 8020

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SEATTLE
EVERETT
KENNEWICK
FAIRBANKS
ANCHORAGE
SAINT LOUIS

October 19, 1992

Mr. Ron Kline, President
NORTHWEST Wire Rope and Equipment, Inc.
2301 Lincoln Avenue
P.O. Box 1806
Tacoma, Washington 98401

RE: TECHNICAL MEMORANDUM 03 : FIRST QUARTERLY GROUNDWATER SAMPLING ACTIVITIES FOR NORTHWEST WIRE ROPE AND EQUIPMENT, INC. LOCATED AT 2301 LINCOLN AVENUE, TACOMA, WASHINGTON

Dear Mr. Kline:

Shannon & Wilson, Inc.'s (S&W) report, Technical Memorandum 03, presents first quarterly groundwater monitoring activities performed on September 18, 1992 at the above referenced site.

As stated in S&W's August 5, 1992 letter, please submit a copy of this first quarterly report to the Tacoma-Pierce County Health Department as addressed below:

Tacoma-Pierce County Health Department
Attn: John Hildenbrand, R.S., EHS II
Water Resources Section
Environmental Health Division
3629 South D Street
Tacoma, Washington 98408-6897

If you have any questions or comments, please contact us at (206) 632-8020.

Respectfully,

SHANNON & WILSON, INC.

Kimberly A. L. Fenske
Geoenvironmental Engineer

Robert Colombo
Environmental Project Manager

KLF/RC/klf

10-19-92/T1336-03.RP2/T1336-lkd/dgw

T-1336-02

400 NORTH 34TH STREET • SUITE 100
P.O. BOX 300303
SEATTLE, WASHINGTON 98103
206 • 632 • 8020 FAX 206 • 633 • 6777

EXECUTIVE SUMMARY

Shannon & Wilson, Inc. has completed the first of four groundwater sampling activities for Northwest Wire Rope and Equipment, Inc. This work is being performed at the direction of Mr. John Hildenbrand of the Tacoma-Pierce County Health Department as stated in their department letter dated June 12, 1992.

Analytical results for BTE&X and WTPH-G concentrations in the three monitoring wells (MW001, MW002, and MW003) were below MTCA regulatory levels as presented in Table 1 entitled, First Quarterly Groundwater Results. Total lead concentrations in MW001 (22 ppb and duplicate sample, 41 ppb) exceeded the MTCA regulatory level of 5 ppb. MW002 and MW003 were below the regulatory level for total lead concentrations.

Concentrations of all the tested petroleum hydrocarbon constituents have significantly decreased in comparison to the concentrations quantified for the initial groundwater sampling event performed during May 1992.

This executive summary is a limited synopsis of our own study and should only be used in conjunction with the full report.

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TECHNICAL MEMORANDUM 03
FIRST QUARTERLY GROUNDWATER MONITORING
AT 2301 LINCOLN AVENUE, TACOMA, WASHINGTON

1.0 INTRODUCTION

Shannon & Wilson, Inc. has completed the first of four groundwater sampling activities for Northwest Wire Rope and Equipment, Inc. This work is being performed at the direction of Mr. John Hildenbrand of the Tacoma-Pierce County Health Department as stated in their department letter dated June 12, 1992.

2.0 AUTHORIZATION

Shannon & Wilson, Inc. performed this work in accordance with the contract dated August 5, 1992 and authorized by Mr. Ron Kline, owner of Northwest Wire Rope and Equipment, Inc. on August 6, 1992.

3.0 SITE LOCATION

The facility is located at 2301 Lincoln Avenue, Tacoma, Washington. The geographical location of the property is illustrated in Figure 1, Vicinity Map. A U.S. Oil Company storage facility borders this property to the east and other industrial businesses exist in the surrounding area.

4.0 GROUNDWATER SAMPLING ACTIVITIES

4.1 Groundwater Quality Assessment

The first of four groundwater sampling events occurred on September 18, 1992 to characterize groundwater samples for benzene, toluene, ethylbenzene, total xylenes (BTE&X), total petroleum hydrocarbons as gasoline (WTPH-G), and total lead concentrations in compliance with the state Model Toxics Control Act (MTCA) Method "A" regulatory levels.

Groundwater results quantified by Friedman and Bruya, Inc. of Seattle, Washington determined BTE&X and WTPH-G concentrations in the three monitoring wells (MW001, MW002, and MW003) below MTCA regulatory levels. Results are presented in Table 1 enclosed.

Total lead concentrations in MW001 (22 ppb) exceeded the MTCA regulatory level of 5 ppb. MW002 and MW003 were below the regulatory level for total lead concentrations.

4.2 Groundwater Elevations

In addition, a MCC oil/water interface detection probe was used to measure the depth to groundwater. All well casings were referenced to a previously established benchmark of 100.00 feet. Measurements were made from the north side of the well casing. Depth to the groundwater ranged from approximately eight and one-half to ten feet from the top of the well casing. Groundwater elevation contours are delineated in Figure 3.

4.3 Data Interpretation

Groundwater data and associated petroleum compounds reported in Table 1 have been geostatistically contoured utilizing the GOLDEN software package SURFER[R]. Concentrations of benzene, toluene, ethylbenzene, total xylenes, total petroleum hydrocarbons as gasoline, and total lead are contoured in Figures 4 through 9. Caution should be exercised when interpreting these figures due to the limited amount of data used in their construction.

Groundwater flow was inferred to be in a southeasterly direction. However, the flow is dependant on tidal mechanisms and therefore the limited data available may not be fully representative of the actual conditions throughout the year.

Contours of regulated compounds display decreasing concentrations with distance from the UST excavation area. Concentrations of all the tested petroleum hydrocarbon constituents have decreased in comparison to the concentrations quantified for the initial groundwater sampling event in May 1992.

5.0 SUMMARY

The first of four groundwater sample results were below MTCA regulatory concentrations for volatile organic compounds (BTE&X) and WTPH-G in the three monitoring wells located on site. Total lead concentrations were below regulatory levels in MW002 and MW003, but exceeded the MTCA regulatory level of 5 ppb in MW001. As stated in John Hildenbrand's letter dated June 12, 1992, a re-evaluation by the Tacoma-Pierce County Health Department of the conditions at the site will be made at the end of this monitoring period.

6.0 CLOSURE

The findings we have presented within this technical memorandum are based on limited research at the facility. They should not be construed as a definite statement regarding reported conditions. Shannon & Wilson, Inc. performed this work phase within our best judgement to adequately describe site conditions at the facility.

The data presented in this technical memorandum should be considered representative at the time of our observations. Changes in the conditions of the property can occur with time from both natural processes and human activities. In addition, changes in governmental codes, regulations, or law may occur. Due to such changes, our observations and recommendations applicable to this facility may need to be revised wholly or in part, due to changes beyond our control.

Shannon & Wilson, Inc. has prepared the attachment, "Important Information About Your Subsurface Waste Management (Remediation) Report", to assist you in understanding the use and limitations of our reports.

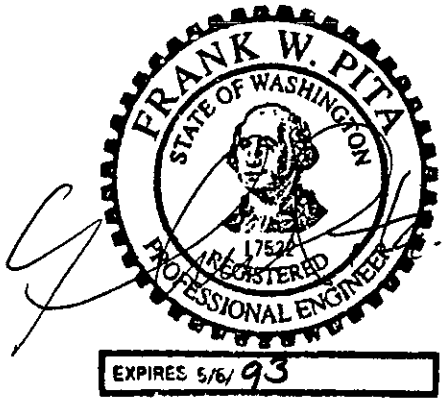
This technical memorandum was prepared for the exclusive use of Mr. Ron Kline in the study of their facility in Tacoma, Washington, and in no way guarantees that an agency or its staff will reach the same conclusions as Shannon & Wilson, Inc.

SHANNON & WILSON, INC.

Kimberly A. L. Fenske
Geoenvironmental Engineer

R. Colombo

Robert Colombo
Environmental Project Manager



10/20/92

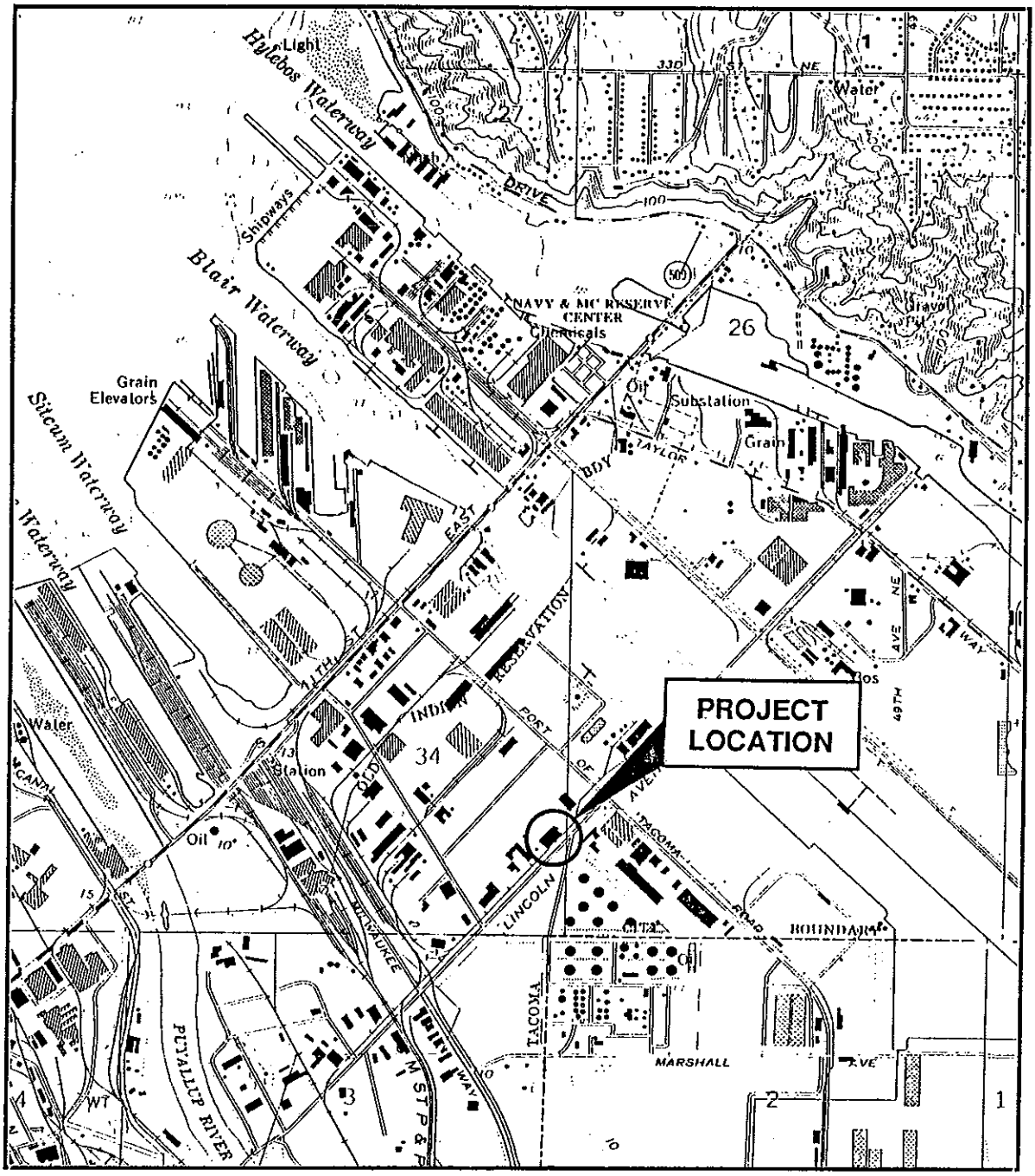
Frank W. Pita, P.E., P.G.
Vice President - Environmental Services

TABLE 1
NORTHWEST Wire Rope and Equipment, Inc.
FIRST QUARTERLY GROUNDWATER RESULTS, (1)
SAMPLED DURING SEPTEMBER 18, 1992

SAMPLE NUMBER	VOLATILE ORGANICS (ppb), (2), (3), (5)				TPH- AS GASOLINE	TOTAL LEAD
	BENZENE	TOLUENE	ETHYL-BENZENE	TOTAL XYLENES	(ppm) , (4), (5)	(ppb), (9)
NWR-MW001-021-GW-0, (7)	<1	<1	<1	<2	<0.1	22
NWR-MW001-022-GW-2, (8)	<2	<2	<2	<4	<0.2	41
NWR-MW002-019-GW-0, (7)	<1	<1	<1	<2	<0.1	<5
NWR-MW003-020-GW-0, (7)	1	<1	<1	3	0.4	<5
NWR-TB001-023-WA-4, (7), (10)	<1	<1	<1	<2	<0.1	
Cleanup Levels - Groundwater, (6)	5.0	40.0	30.0	20.0	1.0	5.0

NOTES

1) As reported by Friedman and Bruya, Inc., Seattle, Washington.
2) Parts Per Billion (ppb).
3) m-Xylene and p-Xylene cannot be separated and are reported here as a total of the the two isomers.
4) Parts Per Million (ppm).
5) TPH is the abbreviation for Total Petroleum Hydrocarbons as GASOLINE as determined by WTPH-G with BTE and X distinction.
6) Model Toxic Control Act, Method A, February 1991.
7) Original laboratory report and correspondence available at the Shannon and Wilson (S&W) Seattle office.
8) Field duplicate for QA/QC.
9) E.P.A. Method 6010.
10) Trip blank for QA/QC.



NOTE

Map adapted from USGS topographic map of Tacoma North, WA. quadrangle, dated 1981.

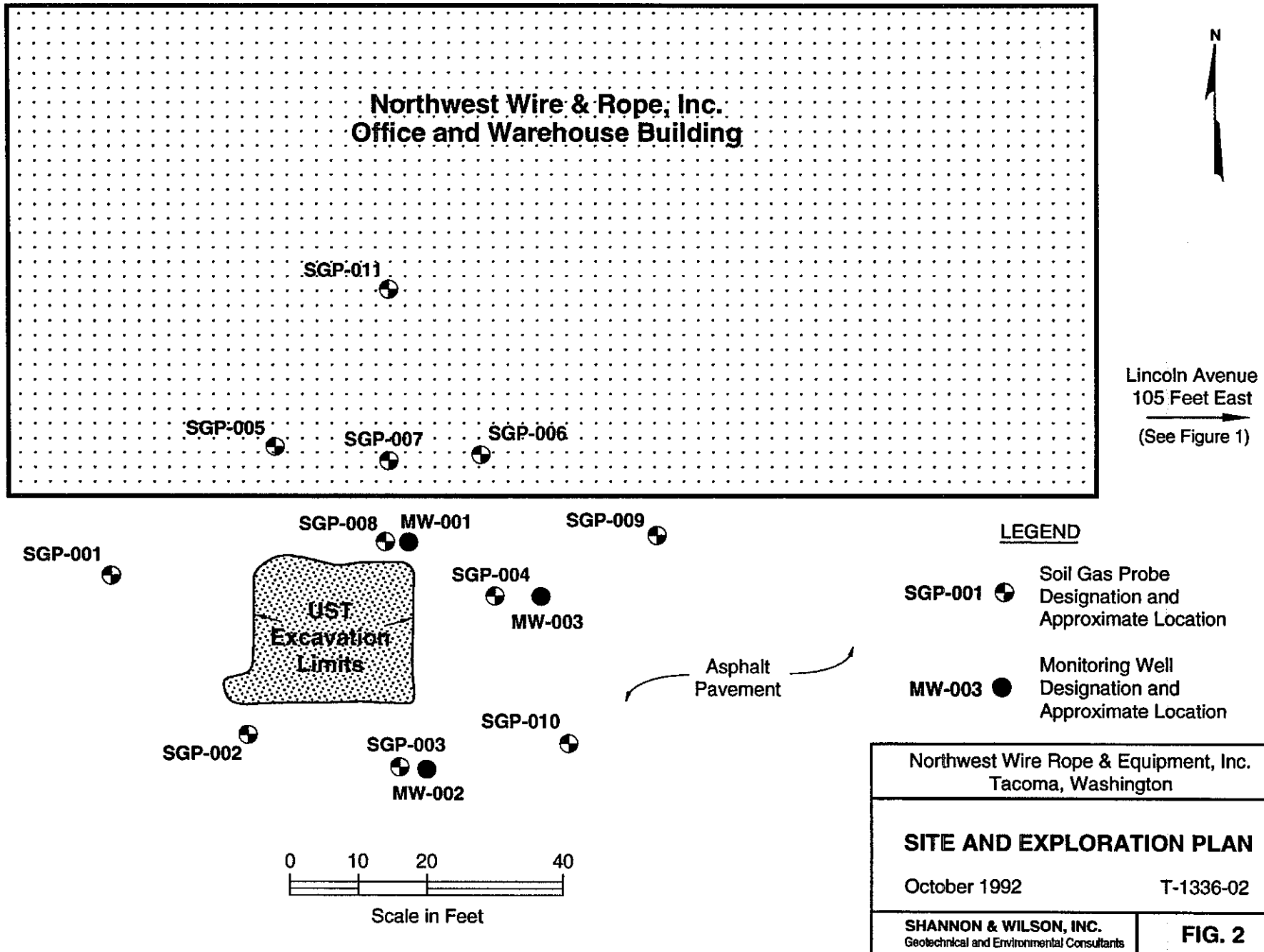
Northwest Wire Rope & Equipment, Inc.
Tacoma, Washington

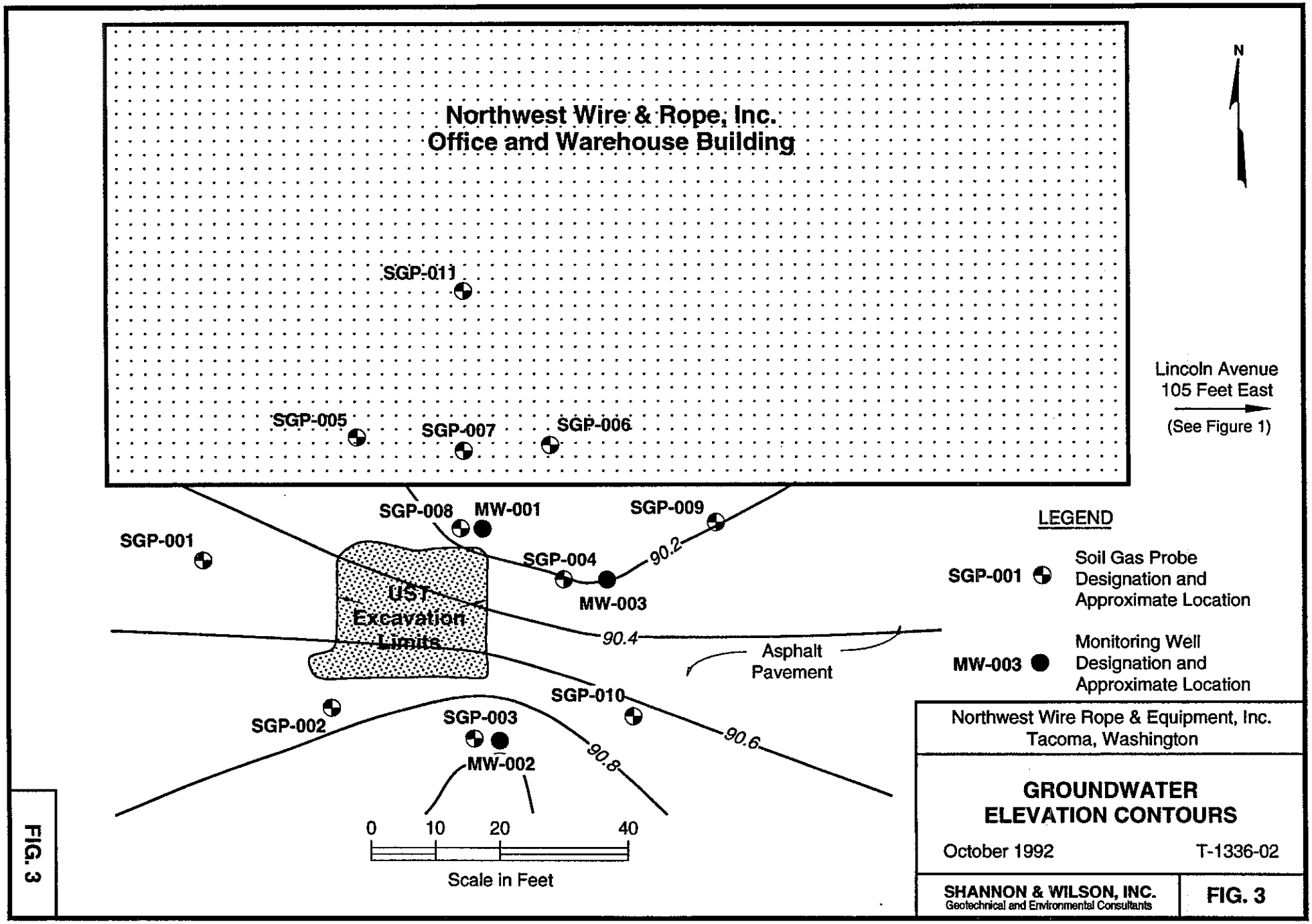
VICINITY MAP

October 1992 T-1336-02

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 1


Northwest Wire & Rope, Inc.
Office and Warehouse Building
N
SGP-011
SGP-005
SGP-007
SGP-006
Lincoln Avenue
105 Feet East
(See Figure 1)
SGP-008
MW-001
SGP-009
SGP-001
SGP-004
MW-003
UST
Excavation
Limits
Asphalt
Pavement
SGP-010
SGP-002
SGP-003
MW-002
LEGEND
SGP-001
Soil Gas Probe
Designation and
Approximate Location
MW-003
Monitoring Well
Designation and
Approximate Location
0
10
20
40
Scale in Feet
Northwest Wire Rope & Equipment, Inc.
Tacoma, Washington
SITE AND EXPLORATION PLAN
October 1992
T-1336-02
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants
FIG. 2
FIG. 2


Northwest Wire & Rope, Inc.
Office and Warehouse Building
N
SGP-011
SGP-005
SGP-007
SGP-006
Lincoln Avenue
105 Feet East
(See Figure 1)
SGP-008
MW-001
SGP-009
SGP-001
SGP-004
90.2
MW-003
UST
Excavation
Limits
90.4
Asphalt
Pavement
SGP-010
SGP-002
SGP-003
90.6
90.8
MW-002
0
10
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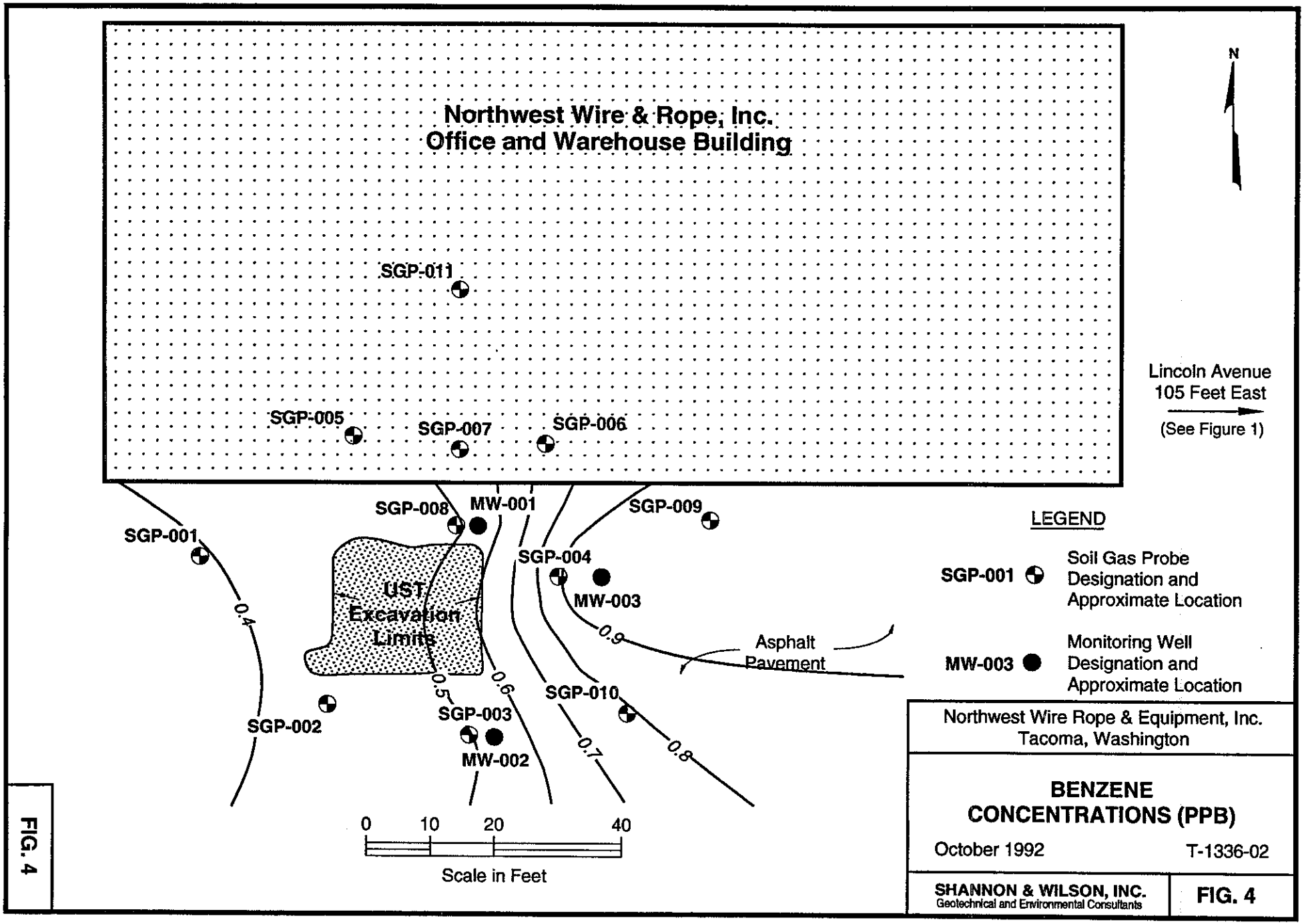
40
Scale in Feet
LEGEND
SGP-001
Soil Gas Probe
Designation and
Approximate Location
MW-003
Monitoring Well
Designation and
Approximate Location
Northwest Wire Rope & Equipment, Inc.
Tacoma, Washington
GROUNDWATER
ELEVATION CONTOURS
October 1992
T-1336-02
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants
FIG. 3
FIG. 3


Northwest Wire & Rope, Inc.
Office and Warehouse Building
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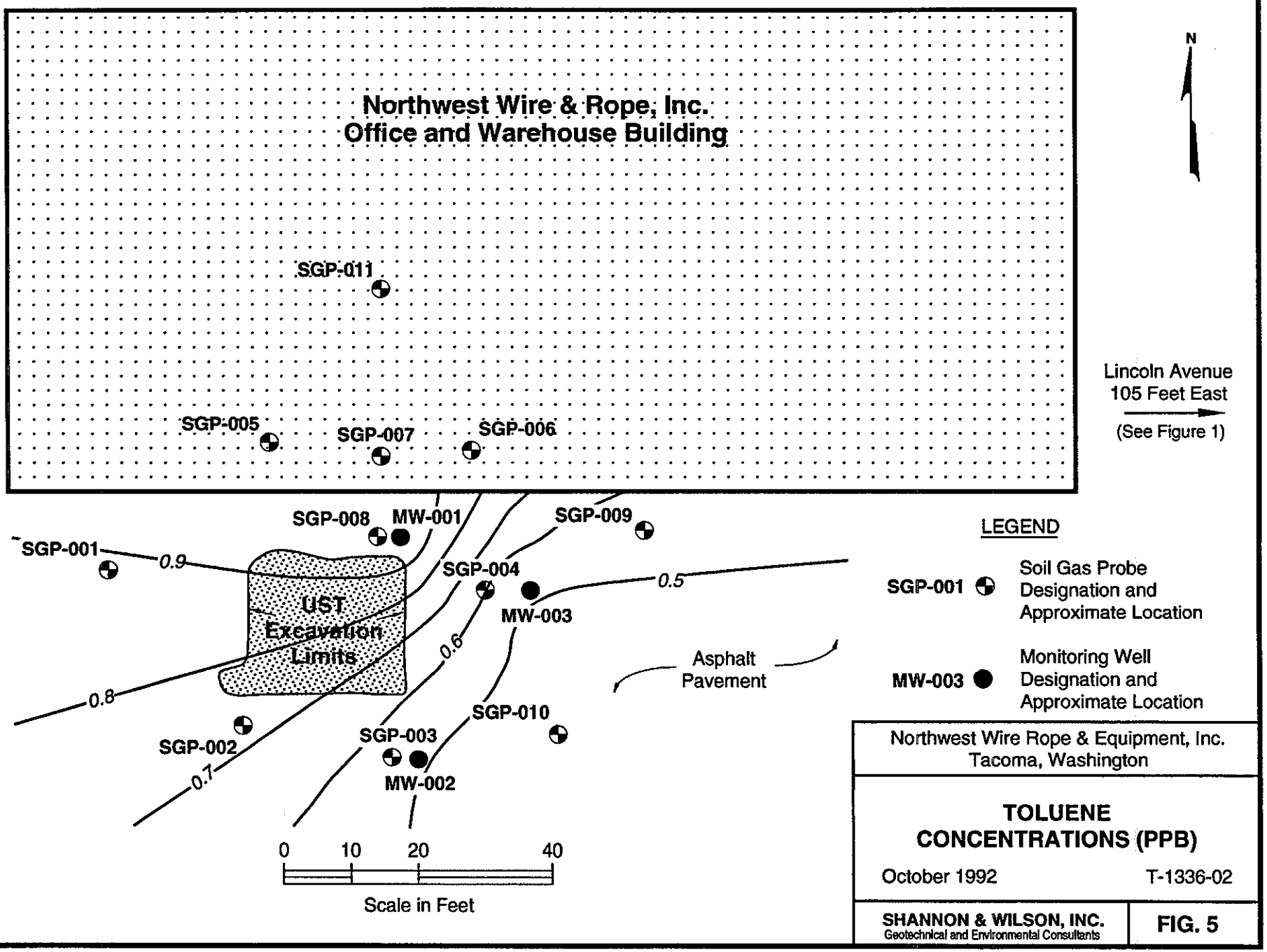
SGP-005
SGP-007
SGP-006
Lincoln Avenue
105 Feet East
(See Figure 1)
SGP-008
MW-001
SGP-009
SGP-001
SGP-004
MW-003
UST
Excavation
Limits
Asphalt
Pavement
0.4
0.5
0.6
0.7
0.8
0.9
SGP-002
SGP-003
MW-002
SGP-010
0
10
20
40
Scale in Feet
LEGEND
SGP-001
Soil Gas Probe
Designation and
Approximate Location
MW-003
Monitoring Well
Designation and
Approximate Location
Northwest Wire Rope & Equipment, Inc.
Tacoma, Washington
BENZENE
CONCENTRATIONS (PPB)
October 1992
T-1336-02
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants
FIG. 4
FIG. 4


Northwest Wire & Rope, Inc.
Office and Warehouse Building
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SGP-005
SGP-007
SGP-006
Lincoln Avenue
105 Feet East
(See Figure 1)
SGP-008
MW-001
SGP-009
SGP-001
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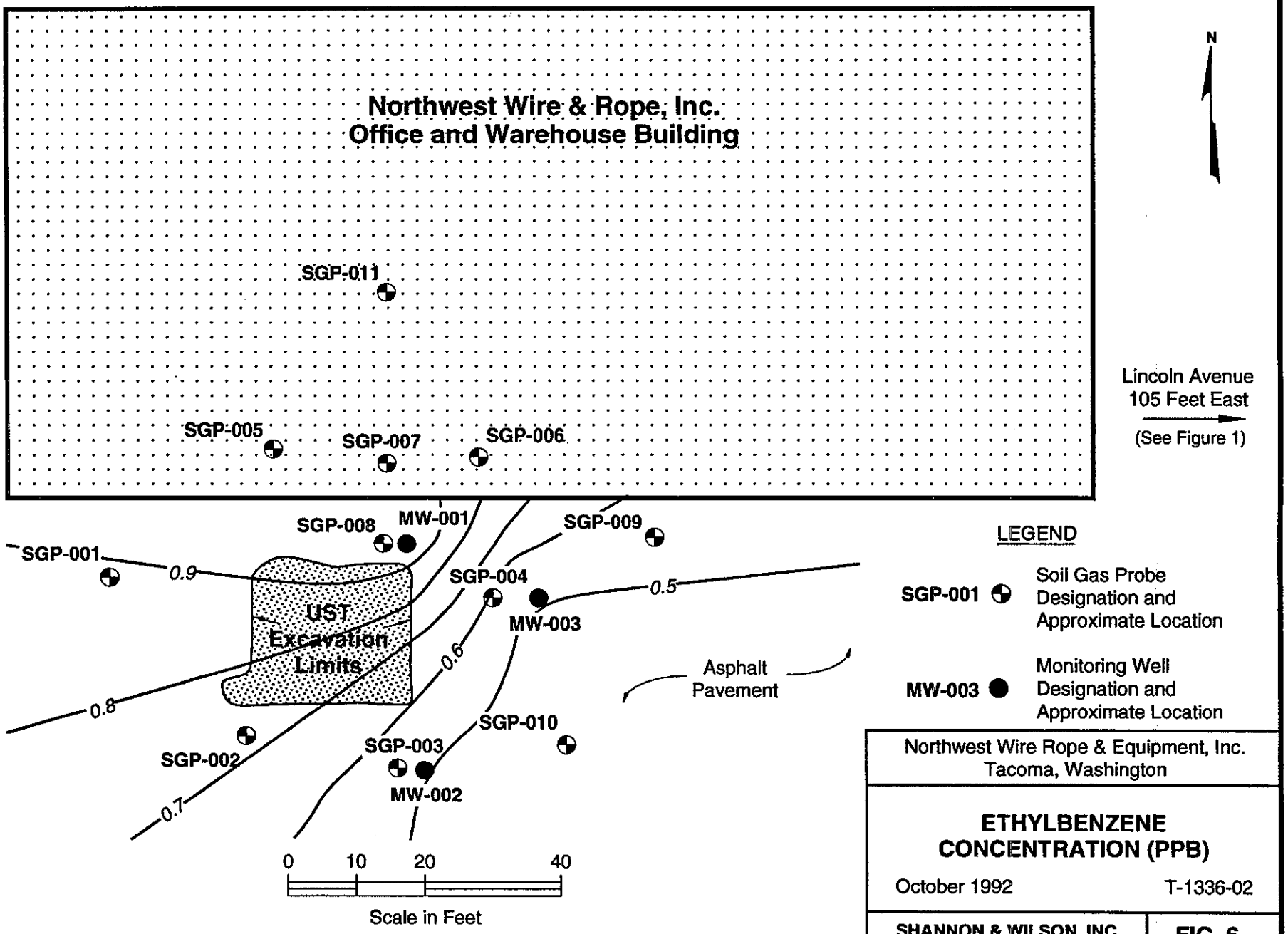
SGP-004
0.5
UST
Excavation
Limits
MW-003
0.6
0.8
Asphalt
Pavement
SGP-010
SGP-002
SGP-003
0.7
MW-002
0
10
20
40
Scale in Feet
LEGEND
SGP-001
Soil Gas Probe
Designation and
Approximate Location
MW-003
Monitoring Well
Designation and
Approximate Location
Northwest Wire Rope & Equipment, Inc.
Tacoma, Washington
TOLUENE
CONCENTRATIONS (PPB)
October 1992
T-1336-02
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants
FIG. 5
FIG. 5



Northwest Wire Rope & Equipment, Inc.
Tacoma, Washington

ETHYLBENZENE CONCENTRATION (PPB)

October 1992 T-1336-02

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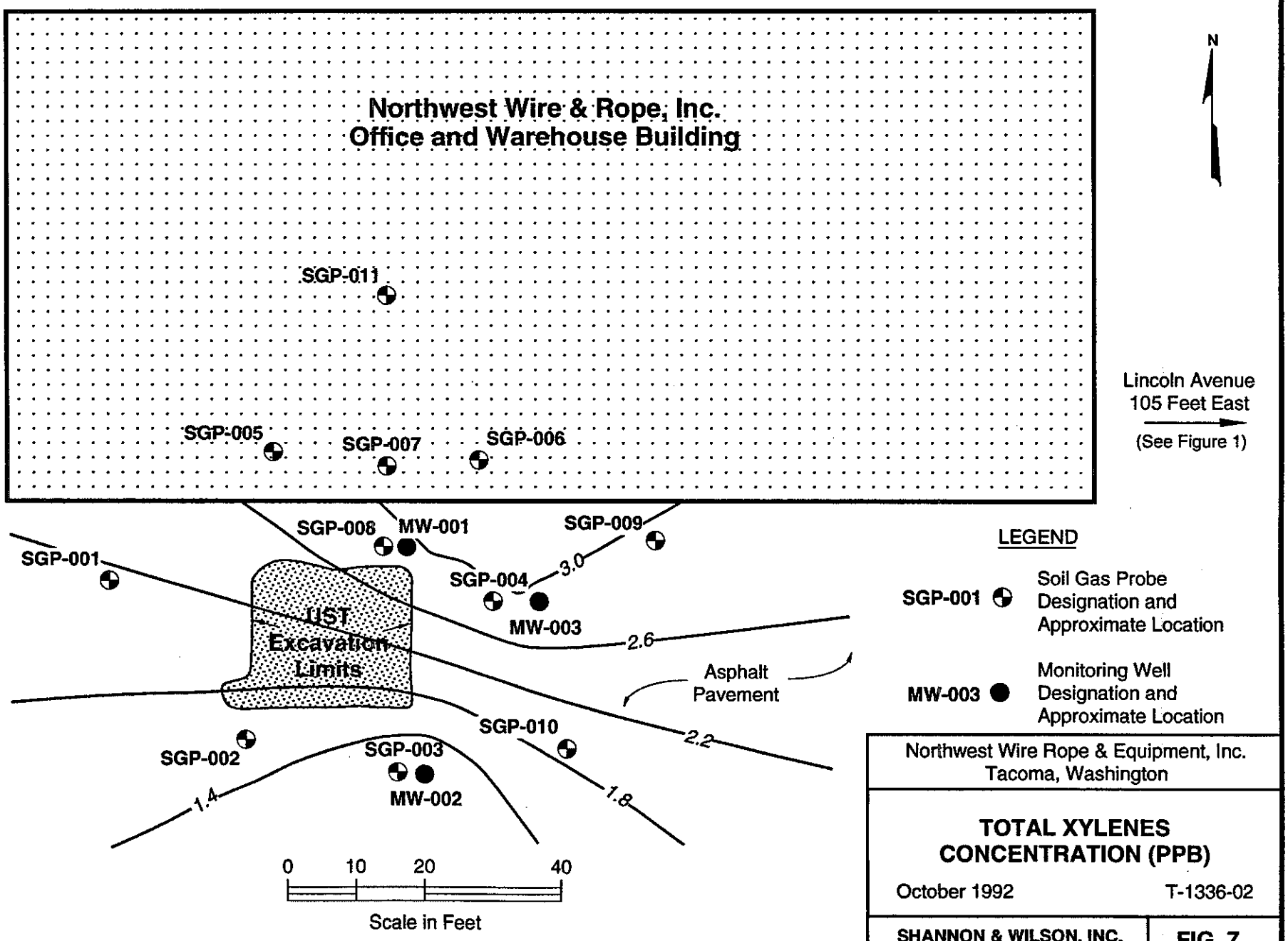
Geotechnical and Environmental Consultants

FIG. 6

FIG. 6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Lincoln Avenue
105 Feet East
(See Figure 1)
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MW-001
SGP-009
SGP-001
SGP-004
3.0
MW-003
2.6
UST
Excavation
Limits
Asphalt
Pavement
SGP-010
2.2
SGP-002
SGP-003
MW-002
1.4
1.8
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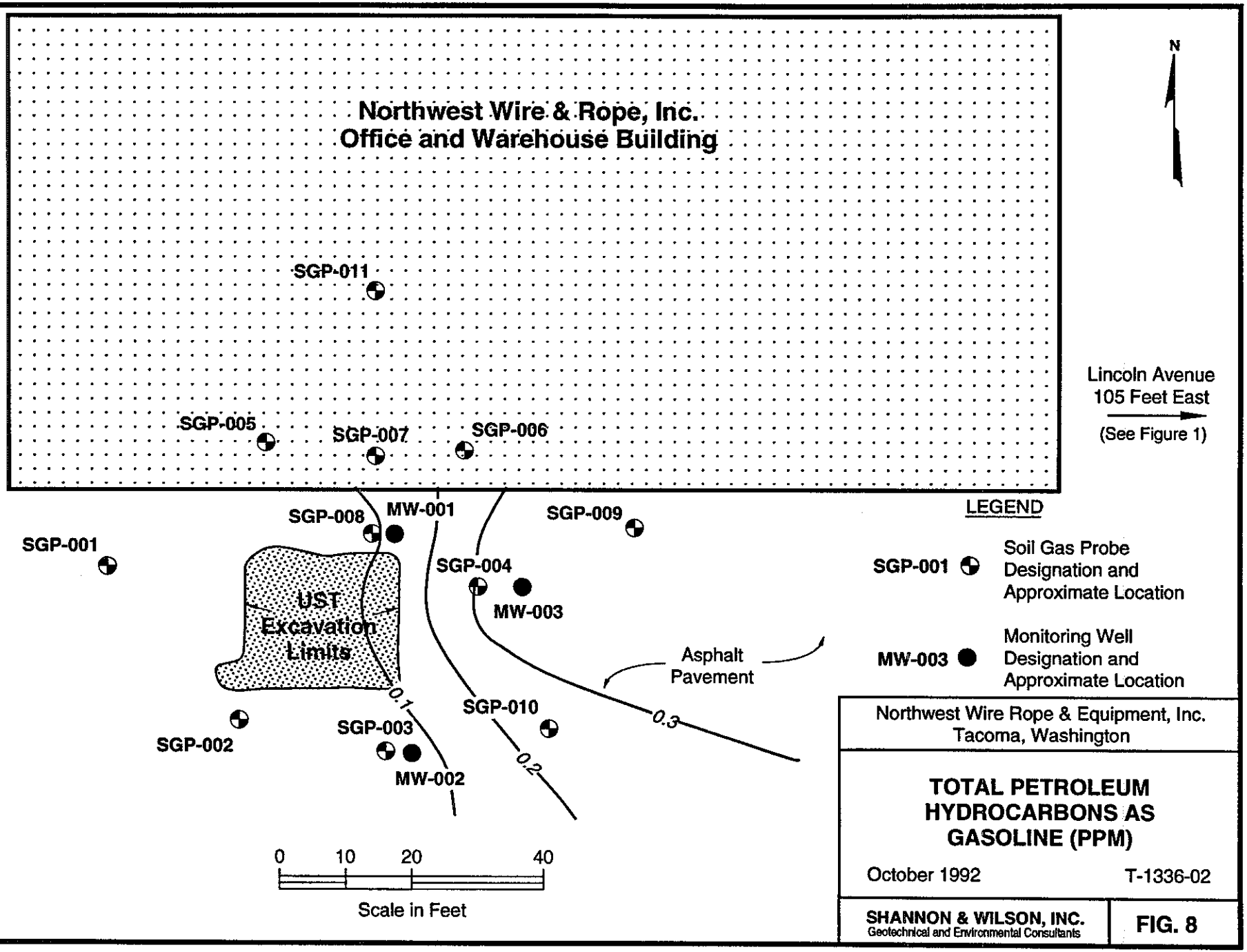
Scale in Feet
LEGEND
SGP-001
Soil Gas Probe
Designation and
Approximate Location
MW-003
Monitoring Well
Designation and
Approximate Location
Northwest Wire Rope & Equipment, Inc.
Tacoma, Washington
TOTAL XYLENES
CONCENTRATION (PPB)
October 1992
T-1336-02
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants
FIG. 7
FIG. 7



Northwest Wire Rope & Equipment, Inc.
Tacoma, Washington

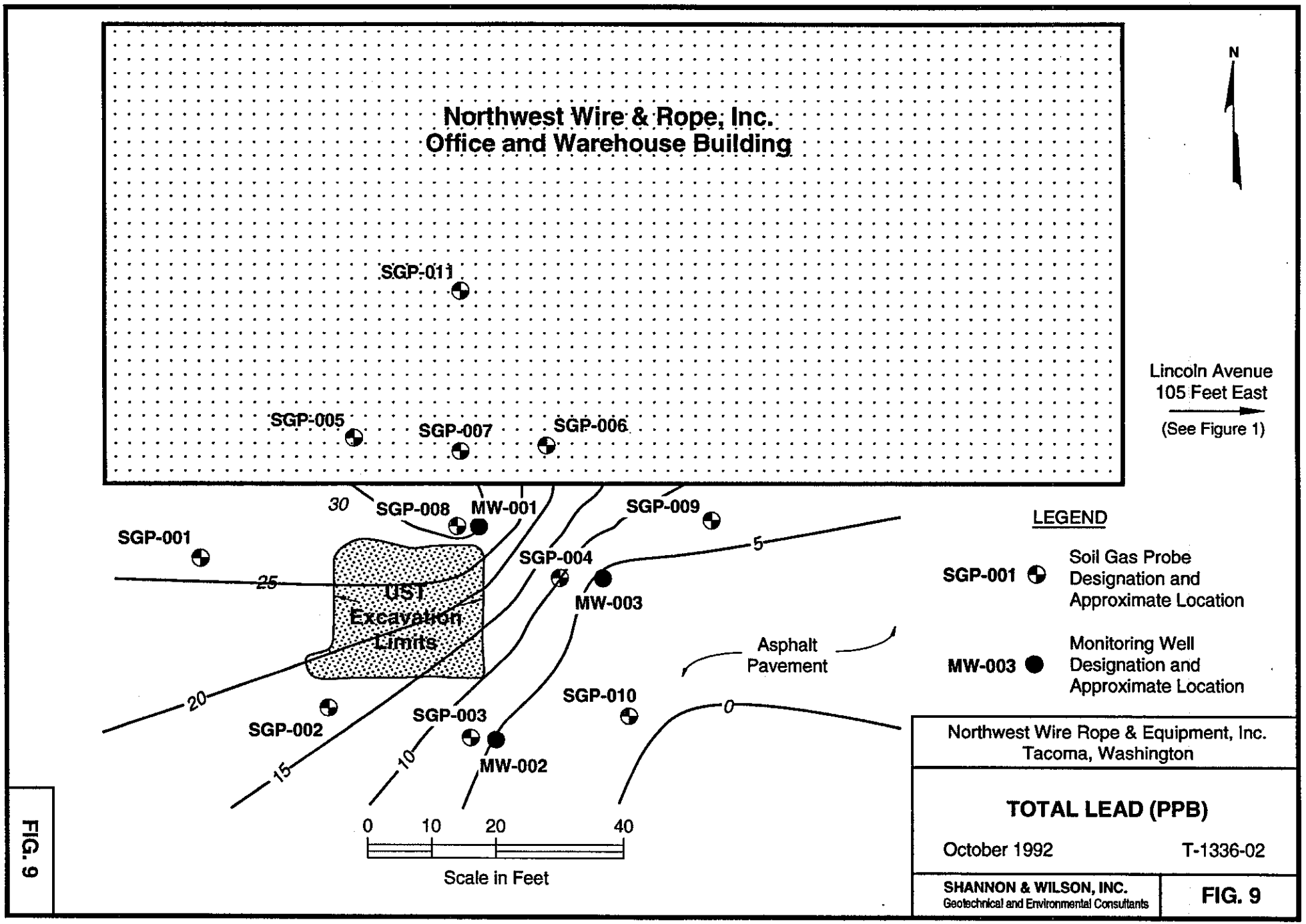
TOTAL PETROLEUM HYDROCARBONS AS GASOLINE (PPM)

October 1992 T-1336-02

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 8

FIG. 8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Lincoln Avenue
105 Feet East
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30
SGP-008
MW-001
SGP-009
SGP-001
5
SGP-004
25
MW-003
UST
Excavation
Limits
Asphalt
Pavement
20
SGP-010
SGP-002
SGP-003
0
15
10
MW-002
0
10
20
40
Scale in Feet
LEGEND
SGP-001
Soil Gas Probe
Designation and
Approximate Location
MW-003
Monitoring Well
Designation and
Approximate Location
Northwest Wire Rope & Equipment, Inc.
Tacoma, Washington
TOTAL LEAD (PPB)
October 1992
T-1336-02
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants
FIG. 9
FIG. 9

APPENDIX A

LABORATORY DOCUMENTATION

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Andrew John Friedman
James E. Bruya, Ph.D.
(206) 285-8282

3008-B 16th Avenue West
Seattle, WA 98119
FAX: (206) 283-5044

September 28, 1992

Kim Fenske, Project Leader
Shannon & Wilson, Inc.
P.O. Box C-30313
Seattle, WA 98103

Dear Ms Fenske:

Enclosed are the results of the analyses of the samples submitted on September 18, 1992 from Project T-1336~~-01~~ 02 KJ, NWR.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Kelly K. Greenhaw

Kelly K. Greenhaw
Chemist

KKG/dp

Enclosures

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: September 28, 1992
Date Submitted: September 18, 1992
Project: T-1336-01, NWR

RESULTS OF ANALYSES OF THE WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND GASOLINE USING EPA METHODS 5030 COUPLED TO 8020 and 8015
Results Reported as mg/L (ppm)

Sample #	NWR-TB001-023-WA-4	NWR-MW002-019-GW-0	NWR-MW003-020-GW-0
Analyte:			
Benzene	<0.001	<0.001	0.001
Toluene	<0.001	<0.001	<0.001
Ethylbenzene	<0.001	<0.001	<0.001
Total Xylenes	<0.002	<0.002	0.003
Gasoline	<0.1	<0.1	0.4

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: September 28, 1992
Date Submitted: September 18, 1992
Project: T-1336-01, NWR

RESULTS OF ANALYSES OF THE WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND GASOLINE USING EPA METHODS 5030 COUPLED TO 8020 and 8015
Results Reported as mg/L (ppm)

Sample #	NWR-MW001-021-GW-0	NWR-MW001-022-GW-2
Analyte:		
Benzene	<0.001	<0.002
Toluene	<0.001	<0.002
Ethylbenzene	<0.001	<0.002
Total Xylenes	<0.002	<0.004
Gasoline	<0.1	<0.2

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: September 28, 1992
Date Submitted: September 18, 1992
Project: T-1336-01, NWR

RESULTS OF ANALYSES OF THE WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND GASOLINE USING EPA METHODS 5030 COUPLED TO 8020 and 8015
Results Reported as mg/L (ppm)
Quality Assurance

Sample #	Method Blank	NWR-MW-002-019-GW-0 (Duplicate)
Analyte:		
Benzene	<0.001	<0.002
Toluene	<0.001	<0.002
Ethylbenzene	<0.001	<0.002
Total Xylenes	<0.002	<0.004
Gasoline	<2	<0.2

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: September 28, 1992
Date Submitted: September 18, 1992
Project: T-1336-01, NWR

RESULTS OF ANALYSES OF THE WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND GASOLINE USING EPA METHODS 5030 COUPLED TO 8020 and 8015
Results Reported as mg/L (ppm)
Quality Assurance

Sample #	NWR-MW-002-019-GW-0 Matrix Spike % Recovery	NWR-MW-002-019-GW-0 Matrix Spike Duplicate % Recovery	Spike Level
Analyte:			
Benzene	96%	98%	0.2
Toluene	97%	99%	0.2
Ethylbenzene	97%	96%	0.2
Total Xylenes	97%	98%	0.4
Gasoline	84%	86%	20

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: September 28, 1992
Date Submitted: September 18, 1992
Project: T-1336-01, NWR

RESULTS OF ANALYSES OF THE WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND GASOLINE USING EPA METHODS 5030 COUPLED TO 8020 and 8015
Results Reported as mg/L (ppm)
Quality Assurance

Sample #	Spike Blank % Recovery	Spike Level
Analyte:		
Benzene	98%	0.2
Toluene	97%	0.2
Ethylbenzene	98%	0.2
Total Xylenes	96%	0.4
Gasoline	96%	20

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: September 28, 1992
Date Submitted: September 18, 1992
Project: T-1336-01, NWR

RESULTS OF ANALYSES OF THE WATER SAMPLES FOR SELECTED METALS BY ICP (6010) Results Reported as mg/L (ppm)

Sample #	Lead
NWR-MW002-019-GW-0	<0.005
NWR-MW003-020-GW-0	<0.005
NWR-MW001-021-GW-0	0.022
NWR-MW001-022-GW-2	0.041
Quality Assurance	
Method Blank	<0.005
NWR-MW001-022-GW-2 (Duplicate)	0.036
NWR-MW001-022-GW-2 (Matrix Spike) Percent Recovery	89%
NWR-MW001-022-GW-2 (Matrix Spike Duplicate) Percent Recovery	98%
Spike Blank Percent Recovery	96%
Spike Level	1

Shannon & Wilson, Inc.

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

11500 Olive Blvd., Suite 276
St. Louis, MO 63141
(314) 872-8170

2055 Hill Road
Fairbanks, AK 99707
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

Chain of Custody Record

Page 1 of 1
Laboratory FBI
Attn:

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab	Lead	BTEX	WTPH-G				Total Number of Containers	Remarks/Matrix
NWR-MW002-023-GW-G	W-1	1525	9/13		X	X	X	X				6	WATER
NWR-MW003-020-GW-G	W-2	1555	"		X	X	X	X				6	
NWR-MW001-021-GW-G	W-3	1620	"		X	X	X	X				6	
NWR-MW001-022-GW-G	W-4	1620	"		X	X	X	X				6	
NWR-TB001-023-WA-G	W-5	1625	"		X		X					1	

Project Information		Sample Receipt	
Project Number:	T1336-01	Total Number of Containers	25
Project Name:	NWR	COC Seals/Intact? Y/N/NA	
Contact:	K F.	Received Good Cond./Cold	
Ongoing Project?	Yes ☒ No ☐	Delivery Method:	
Sampler:	T. L	(attach shipping bill, if any)	

Instructions

Requested Turn Around Time: Normal

Special Instructions:

cc Kim Fenske fax?

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F-19-91/UR

No. 11658

APPENDIX B

IMPORTANT INFORMATION ABOUT YOUR SUBSURFACE WASTE MANAGEMENT (REMEDIATION) REPORT

Important Information About Your Geotechnical Engineering/ Subsurface Waste Management (Remediation) Report

AN ENGINEERING REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical engineering/subsurface waste management (remediation) report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure and property involved, its size and configuration; historical use and practice; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities; and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, have the consulting engineer/ scientists determine how any factors (which change subsequent to the date of the report) may affect the recommendations.

Unless your consulting geotechnical/civil engineer and/or scientist indicates otherwise, your report should not be used:

- when the nature of the proposed project is changed; for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one; or chemicals are discovered on or near the site;
- when the size or configuration of the proposed project is altered;
- when the location or orientation of the proposed project is modified;
- when there is a change of ownership; or
- for application to an adjacent site.

Geotechnical/civil engineers and/or scientists cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their reports have changed.

MOST GEOTECHNICAL AND SUBSURFACE WASTE MANAGEMENT "FINDINGS" ARE PROFESSIONAL ESTIMATES.

Site exploration identifies subsurface conditions only at those points where samples are taken and when they are taken, but the physical means of obtaining subsurface data precludes the determination of precise conditions. Consequently, the information obtained is intended to be sufficiently accurate for design, but is subject to interpretation. Additionally, data derived through sampling and subsequent laboratory testing are extrapolated by the geotechnical/civil engineer and/or scientist who then renders an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and/or appropriate design. Even under optimal circumstances actual conditions may differ from those opined to exist, because no geotechnical/civil engineer and/or scientist, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. For example, the actual interface between materials and/or chemicals may be far more gradual or abrupt than the report indicates, and actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact. For this reason, most experienced owners retain their geotechnical/waste management consultant through the construction stage to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site. Prudent owners establish contingencies to account for such variations in subsurface conditions as exposed during construction.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural changes or human influence. Because a geotechnical/waste management engineering report is based on conditions which existed at the time of subsurface exploration, construction decisions should not be

based on an engineering report whose adequacy may have been affected by time. Speak with the geotechnical/waste management consultant to learn if additional tests are advisable before construction starts. For example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/waste management report. The geotechnical/civil engineer and/or scientist should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

THE GEOTECHNICAL ENGINEERING/SUBSURFACE WASTE MANAGEMENT (REMEDIATION) REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical engineering/subsurface management (remediation) report. To help avoid these problems, the geotechnical/civil engineer and/or scientist should be retained to work with other appropriate design professionals to explain relevant geotechnical, geological, hydrogeological and waste management findings and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING/WASTE MANAGEMENT REPORT.

Final boring logs are developed by the geotechnical/civil engineer and/or scientist based upon interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering/waste management reports. These logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, contractors should be given ready access to the complete geotechnical engineering/waste management report. Those who do not provide such access may proceed under the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical engineering/subsurface waste mangement (remediation) is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical/waste management consultants. To help prevent this problem, geotechnical/civil engineers and/or scientists have developed model clauses for use in written transmittals. These are not exculpatory clauses designed to foist the engineer's or scientist's liabilities onto someone else. Rather, they are definitive clauses which identify where the engineer's or scientist's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your engineer/scientist will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK.

Your consulting engineer/scientist will be pleased to discuss other techniques which can be employed to mitigate risk and to provide a variety of materials which may be beneficial.

Contact your engineer/scientist for further information.

The preceding paragraphs are based on information provided by the
Association of Soil and Foundation Engineers, Silver Spring, Maryland