

**Preliminary Nitric Acid Spill
Residual Impact Evaluation**

Poligen Site

Port of Tacoma, Washington

**Prepared for
Solidus Corporation**

**March 19, 1986
J-1615-03**



**HART
CROWSER &
associates inc.**

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J-1615

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PRELIMINARY NITRIC ACID SPILL RESIDUAL IMPACT EVALUATION
POLIGEN SITE
PORT OF TACOMA, WASHINGTON

INTRODUCTION

This report presents our preliminary evaluation of possible residual impacts of a nitric acid spill on the soil and groundwater at the Poligen site in the Port of Tacoma. The purpose of our work was to ascertain whether residual impacts could be identified. Our evaluation is based on the drilling, installation, and sampling of four monitoring wells installed in the area of the Poligen property and around the area of the spill.

The nitric acid spill occurred in October of 1985 when a Chemical Processor's tank ruptured. Our work was performed during February, 1986. The acid was a 10 to 11 percent solution with an approximate 0.8 percent concentration of hexavalent chromium. Clean-up work consisting of berming, adding lime and bisulfide to the acid, and removal of contaminated surface soils, was performed following the spill. The location of the spill is shown on Figure 1. Lori Herman, a hydrogeologist with Hart-Crowser, performed much of the field work and analyses.

Our scope of work included:

- o Logging and collecting soil samples during the drilling of four borings;
- o Installing 2-inch PVC monitoring wells within the borings;
- o Visual description of soil type and laboratory analyses of soil pH;

- o Water level measurements, well development, and groundwater sampling from the monitoring wells;
- o Analyzing groundwater samples for pH, specific conductance, temperature, and nitrate, and dissolved zinc, lead, cadmium, and chromium (total and hexavalent).

Work was authorized by Mr. Glen Tegen on February 14, 1986. This report is prepared for the exclusive use of Mr. Tegen and the Solidus Corporation for specific application to the referenced project at the Poligen site using generally accepted hydrogeologic practices. This is in lieu of other warranties.

SUMMARY OF FINDINGS

- o Groundwater flow directions in the spill area are from the north to the south, towards the Blair waterway, and the water table was within a few feet of ground surface during our work.
- o Nitrate concentration in downgradient well MW-2 (26 mg/l as N) was substantially above all other measurements. Metals concentrations were not elevated in any well. It is possible that the elevated nitrate is a residual effect of the nitric acid spill.
- o Soil pH measurements, made in our laboratory on soil samples collected in the field, are neutral to slightly alkaline.
- o Groundwater pH measurements made in the field are neutral to slightly acid.

SUBSURFACE CONDITIONS

Three principal soil units were encountered during drilling at the monitoring well locations. From the ground surface down, these included:

- o FILL which occurred to an approximate depth of 2 to 3 feet in MW-1, MW-2, and MW-3 and generally consisted of a silty, gravelly SAND. The FILL occurred to approximately 8 feet in depth at the MW-4 location and consisted primarily of refuse material mixed with silt and sand.
- o Slightly silty to clean, fine to medium SAND, with occasional sea shell fragments which occurred below the FILL to the bottom of MW-1, and to depths of approximately 8.5, 11.5, and 10.5 in MW-2, MW-3, and MW-4, respectively. The SAND is typical of the hydraulic fill material used throughout the Port of Tacoma area.
- o SILT and ORGANIC MATTER which was found to occur beneath the SAND in MW-2, MW-3, and MW-4. This soil unit is thought to constitute the uppermost original tide flat sediments.

Boring logs showing the soils encountered, intervals sampled, well construction details, and other pertinent data are presented on Figures 2 and 3.

Two sets of static water level measurements were obtained in the monitoring wells after allowing two days for the levels to stabilize. The depth to water in the wells ranged from 1.1 to 3.3 feet below ground surface. The water level data are presented in Table 1. A slight variation between the two sets of readings may be caused by tidal influences.

Water level elevations were evaluated to assess the groundwater flow directions by subtracting depth to water measurements from surveyed measuring point elevations. An arbitrary elevation of 10 feet was assumed for the measuring point of MW-1 and the measuring points of the other observation wells were then determined relative to this point. As groundwater flows from areas of high groundwater head (elevation) to areas of lower groundwater head, the data indicate groundwater flow from north to south with a slight southwest component (Figure 1). In a more regional sense, it is likely groundwater flows toward the Blair waterway. Both sets

of water level measurements indicate a consistent groundwater flow direction.

Groundwater flow directions indicate monitoring wells MW-3 and MW-4 are up-gradient from the spill region and monitoring wells MW-1 and MW-2 are in the downgradient flow direction. Dissolved contaminants within the groundwater system would be expected to move with the groundwater flow from the north site area to the south site area. Impact from the nitric acid spill would most likely be seen in the downgradient wells MW-1 and MW-2.

SOIL QUALITY

The relative pH of the soil samples was measured in the Hart-Crowser soil laboratory. A soil slurry consisting of 50 percent soil and 50 percent distilled water by mass was tested for pH by immersing the pH electrode into the water after settling. The pH values were neutral to slightly alkaline, ranging from a low of 6.68 in monitoring well MW-1 to a high of 8.5 in MW-4. The high pH in MW-4 may have been caused by lime-waste material within the refuse encountered in this boring. The results of the soil slurry testing are presented in Table 1.

Additional soil analyses were not performed. Groundwater analyses were considered more appropriate for evaluation of the spill impact because the soil samples were obtained below or at the water table.

GROUNDWATER QUALITY

Well water samples were analyzed for pH, electrical conductivity, nitrates, and metals (including dissolved cadmium, zinc, lead, chromium, and hexavalent chromium). Field measurements of pH and electrical conductivity are presented in Table 1. The results of the laboratory analyses are presented in Appendix A on Figures A-1 and A-2.

The nitrate concentration in downgradient well MW-2 appears to be elevated above what is expected for natural groundwater in general, and also above

site conditions in other wells including upgradient wells. A nitrate level of 26 mg/l expressed as nitrogen was determined for MW-2 while concentration levels generally below 0.3 mg/l were determined from the samples obtained in the other site wells. The nitrate concentration level in MW-2 is also above the drinking water standard of 10 mg/l (as N). This elevated concentration may be a residual effect of the nitric acid spill. As MW-2 is located in the groundwater flow direction downgradient from the majority of the spill area, the water in this location is most likely to show the effect of the spill.

Well MW-1 is also downgradient of the site yet did not show elevated nitrate concentrations. If the nitric acid spill is the cause of the elevated concentration in MW-2, the lack of such elevated concentration in MW-1 may be the result of small scale differences in flow direction coupled with uneven source distribution (non-uniform cleanup - remaining source material around telephone poles and foundations?). Another possible explanation is denitrification by microbial activity fed by the oil-like material encountered in MW-1.

The results of the water pH analyses indicate pH values that are slightly acid to neutral (range 6.2 in MW-3 measured in the field to 7.0 in MW-4 measured in the field). The relatively neutral pH's may be the result of buffering the acid by addition of lime following the spill, removal of the acid contaminated soil, buffering of the acid by carbonates as it traveled through the soil, and/or dilution of the acid by the flow of upgradient groundwater through the affected area.

The metal concentrations were generally low and did not show increase from upgradient to downgradient positions. Metals are relatively immobile compared to nitrate under neutral pH conditions. Metals in the soil that were dissolved by the acid would generally precipitate or adsorb as the acid was neutralized. If metals were mobilized by the acid, then immobilized by an increase in the pH, a concentration of metals may be observed in the soil profile. It is most likely this occurred within the top few feet of the soil, much of which was removed during the cleanup

operation. Selected areas of remaining metals contamination in soil may exist.

FIELD METHODS

The borings were drilled using a CME drilling rig with 3.75-inch inside diameter hollow-stem auger on February 18, 1986. Samples were obtained at 2.5 foot intervals by driving a 2-inch split spoon sampler over a 1.5 foot length beyond the bottom of the auger. The number of blows required to drive the sampler the last foot using a 140 pound hammer falling 30 inches were used to determine the relative density of the soil.

Water levels were noted during drilling to determine the depth of well screen installation. Two-inch-diameter PVC riser pipes with 5-foot sections of 2-inch-diameter PVC well screen were then installed to a depth approximately 5 feet below the observed water level. The pipe and screen assembly were placed in the hole through the auger to the desired depth. Sand backfill material was placed around the screen section as the auger was removed. A cement and bentonite (Aqua Gel) surface seal was installed from the top of the sand pack to ground surface to limit surface water infiltration and provide a setting for the protective casing.

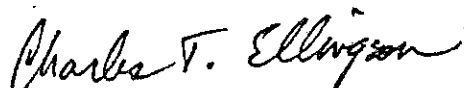
Water levels were measured on February 20, 1986 using a steel tape. One set of measurements was obtained prior to well development and water sampling and a second set was obtained following the site work. The relative elevations of the measuring points of the wells were determined by survey using a level and rod. The survey and water level data are presented in Table 1.

Well development and water quality sampling were accomplished on February 20, 1986. The well development consisted of pumping the well at roughly 2 gallons per minute using a suction lift centrifugal pump. A suction pipe was placed in the screened section of the well, the well was pumped until the fine-grained material that had settled in the bottom of the well was removed, and the discharge water was generally clear. Monitoring wells MW-

2 and MW-3 were pumped for about 5 minutes and MW-1 and MW-4 were pumped for about 15 minutes.

Water quality samples were obtained following well development using a peristaltic pump. Three samples were obtained from each well. The samples obtained for metals analysis (cadmium, zinc, lead, chromium) were filtered in the field using a 0.45 micron filter. Samples for nitrate analysis, and samples for pH and hexavalent chrome, were collected directly from the pump discharge line. The water was also tested in the field for pH and electrical conductivity. A field blank was obtained using the peristaltic pump by pumping from a plastic gallon container of distilled water. Field methods similar to those used for sampling from the monitoring wells were used to obtain the field blank sample. The field blank sample is referred to as MW-5 in the laboratory report. All samples were submitted to Lauck's Laboratory within 20 hours.

HART-CROWSER & ASSOCIATES, INC.



CHARLES T. ELLINGSON

Senior Project Hydrogeologist



MATTHEW G. DALTON

Senior Associate Hydrogeologist

CTE/MGD:sea

Table 1 Water Level and Field Water Quality Data

| WELL NUMBER | MEASURING POINT LOCATION | ELEVATION IN FEET ① | WATER LEVEL - 2/20/86 | | | | pH ④ | ELECTRICAL CONDUCTIVITY IN μ -MHOS/CM ⑤ |
|-------------|--------------------------|---------------------|-----------------------|-------------------|----------------|-------------------|------|---|
| | | | 10:30-11:30 AM ② | | 6:10-6:35 PM ③ | | | |
| | | | DEPTH IN FEET | ELEVATION IN FEET | DEPTH IN FEET | ELEVATION IN FEET | | |
| MW-1 | Top 6-inch Monument | 10.0 | 1.25 | 8.75 | 1.2 | 8.8 | 6.25 | 625 |
| MW-2 | Top 2-inch PVC | 10.0 | 1.1 | 8.9 | - | - | 6.45 | 600 |
| | Top 6-inch Monument | 10.3 | - | - | 1.35 | 8.95 | | |
| MW-3 | Top 6-inch Monument | 12.55 | 3.25 | 9.3 | 3.3 | 9.25 | 6.2 | 650 |
| MW-4 | Top 6-inch Monument | 12.3 | 2.7 | 9.6 | 2.85 | 9.45 | 7.0 | 1450 |

① Elevations measured relative to an assumed elevation of 10.0 feet at top of 6-inch monument in MW-1.

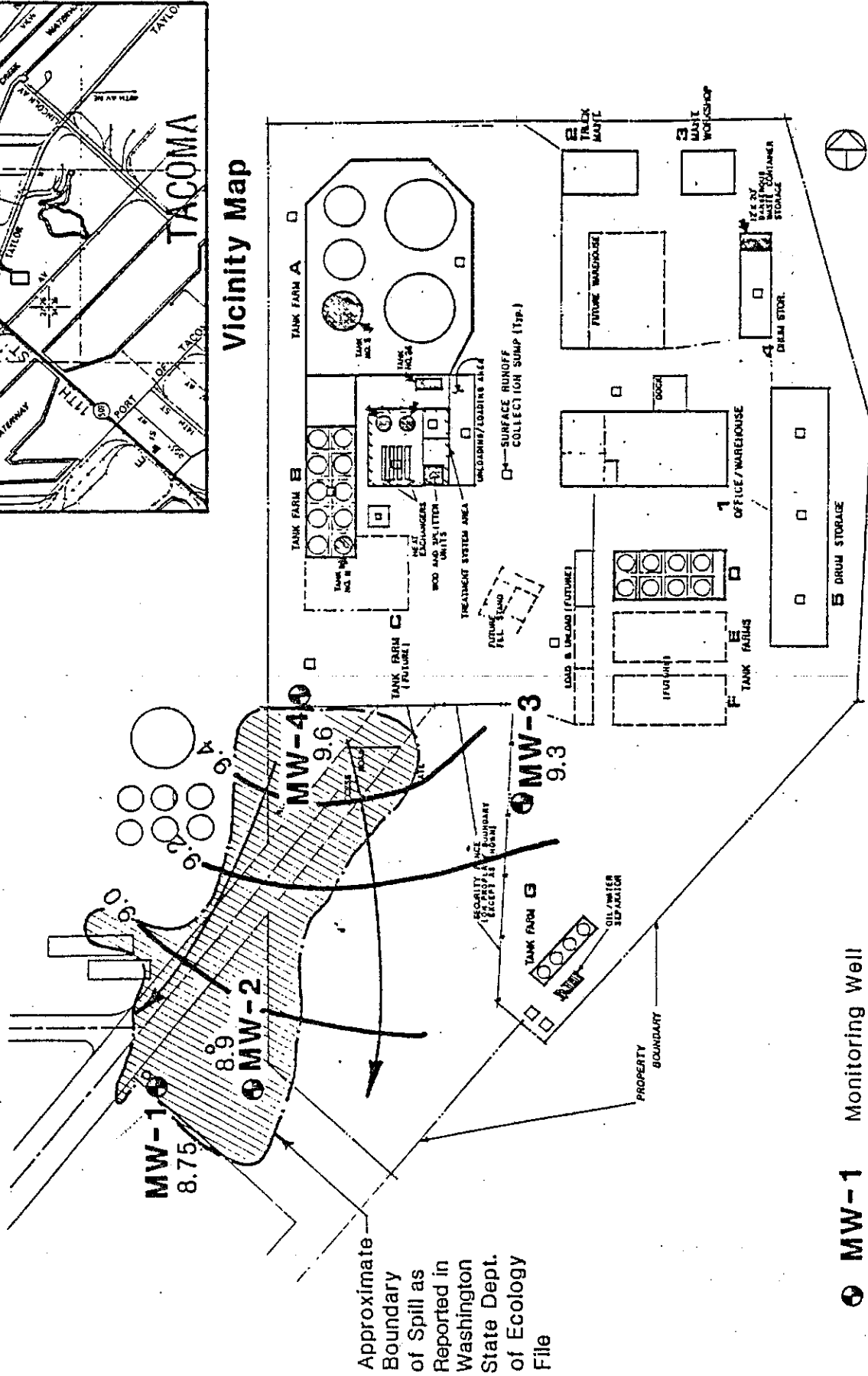
② Measurement taken prior to well development and sampling

③ Measurement taken following well development and sampling

④ pH measured in field using SSE 209B pH meter

⑤ Electrical Conductivity measured in field using YSI Model 33 S-C-T meter

Site and Exploration Plan



● MW-1

Monitoring Well Location and Number

9.3

Water Level Spot Elevation in Feet Measured 2/20/86

—

Contour in Feet of Equal Water Level Elevation

→

Groundwater Flow Direction

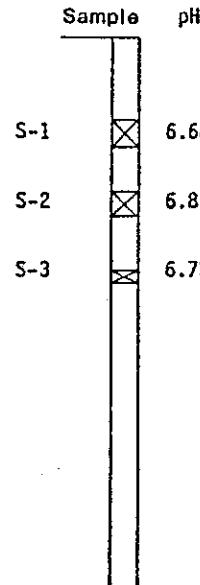
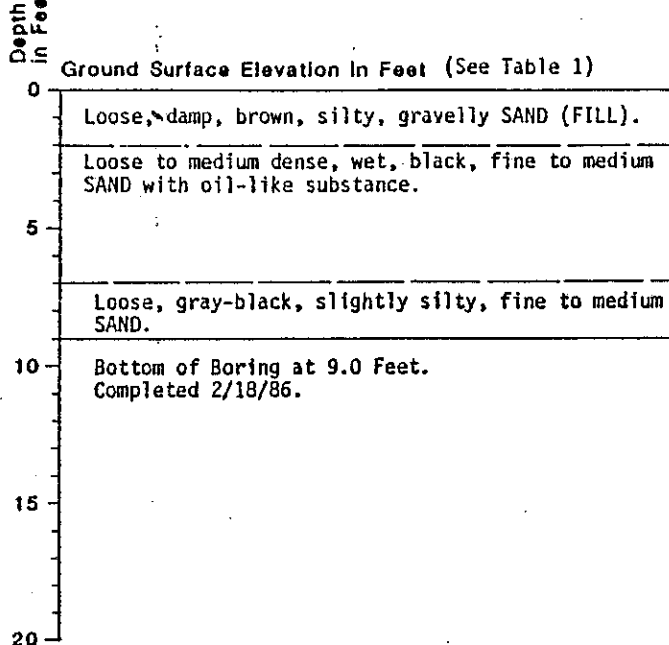
□ REMOTE AREAS OF DANGEROUS WASTE STORAGE OR TREATMENT



Figure 1

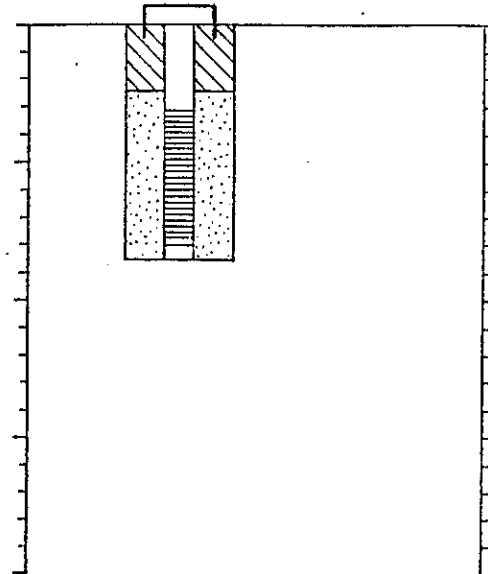
Boring Log and Construction Data for Well MW-1

Geologic Log



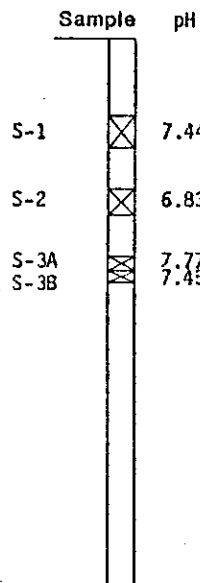
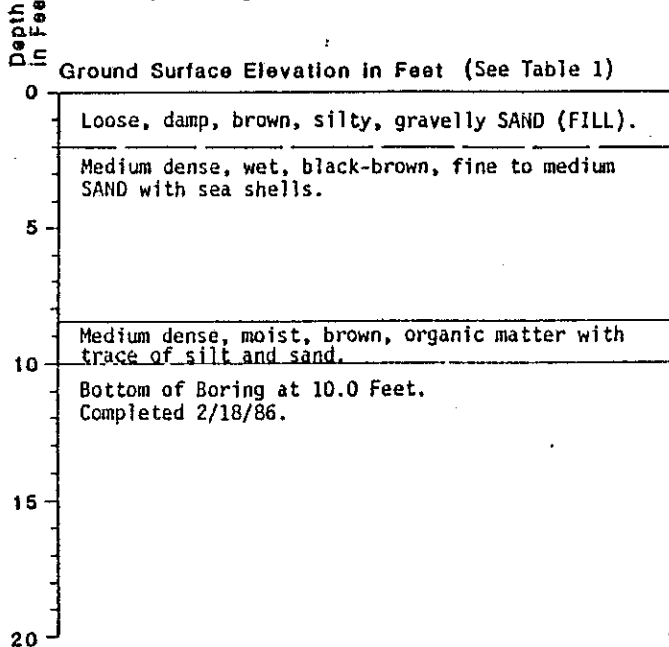
Well Design

Top Casing Elevation in Feet
Casing Stickup in Feet



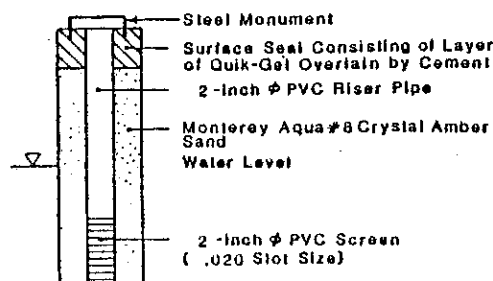
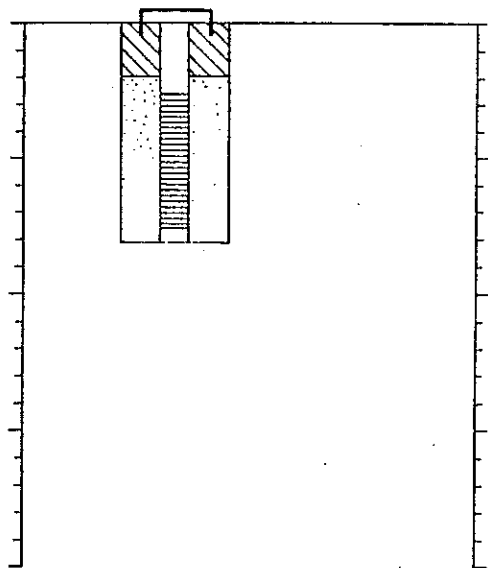
Boring Log and Construction Data for Well MW-2

Geologic Log



Well Design

Top Casing Elevation in Feet
Casing Stickup in Feet



- 2-inch O.D. Split Spoon Sample
- * No Sample Recovery
- N Standard Penetration Resistance, Blows per foot
- GS Grain Size Analysis
- K Permeability Test
- pH Test for pH of Soil Slurry Consisting of 50% Soil and 50% Distilled Water

NOTES:

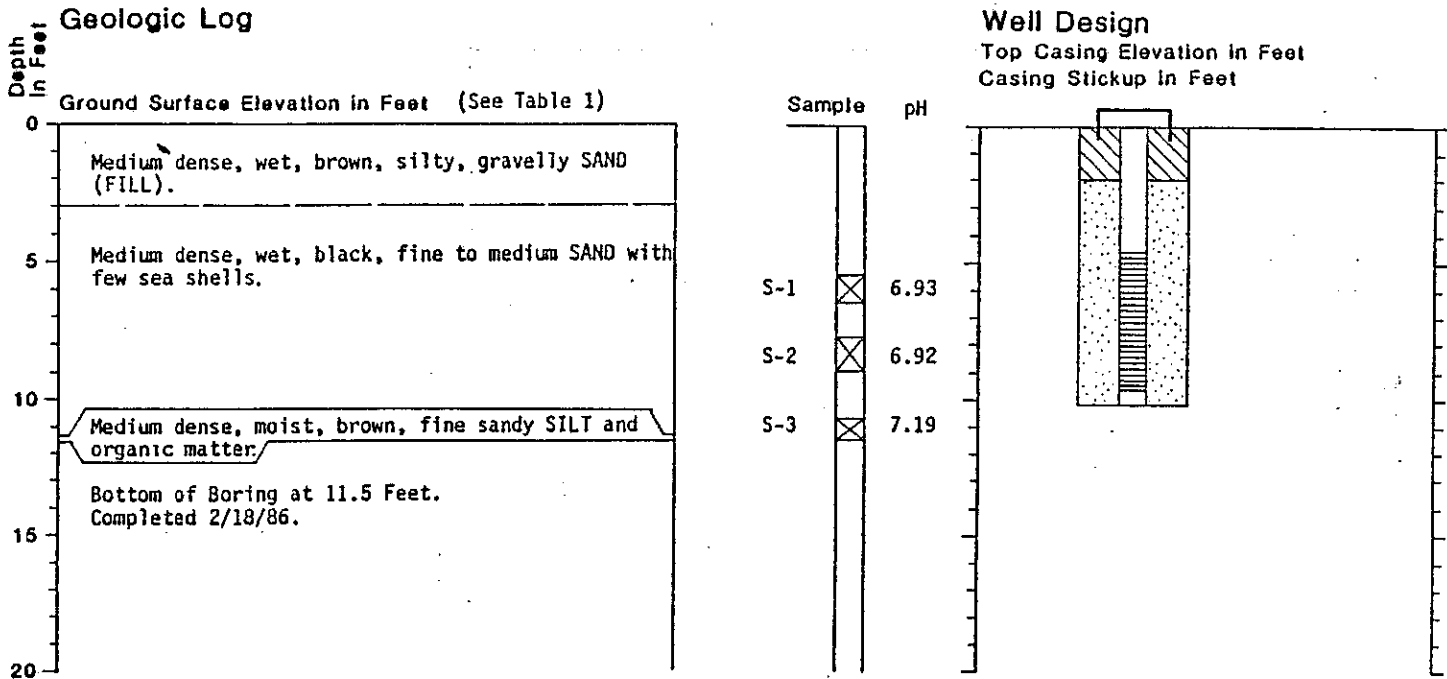
1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

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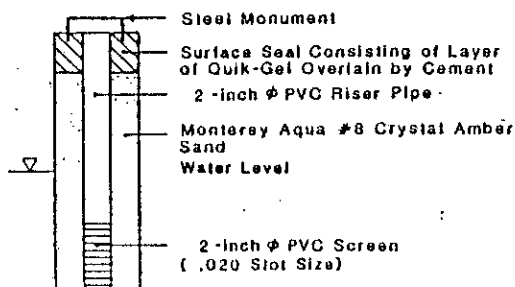
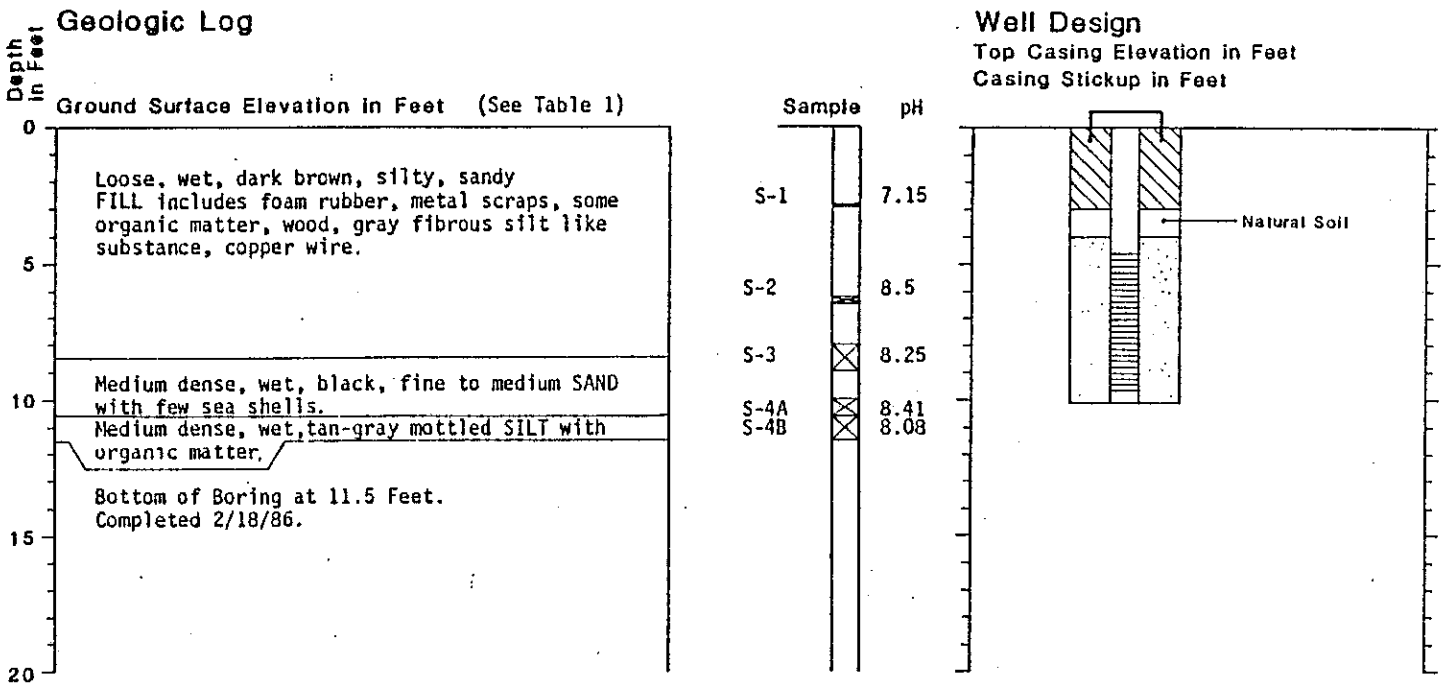
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Figure 2

Boring Log and Construction Data for Well MW-3



Boring Log and Construction Data for Well MW-4



- ☒ 2-inch O.D. Split Spoon Sample
- * No Sample Recovery
- N Standard Penetration Resistance, Blows per foot
- GS Grain Size Analysis
- K Permeability Test
- pH Test for pH of Soil Slurry Consisting of 50% Soil and 50% Distilled Water

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

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Figure 3

APPENDIX A

LAUCKS TESTING LABORATORIES DATA

Results of the laboratory testing accomplished by Laucks Laboratory of Seattle, Washington are attached as Figures A-1 and A-2. All of the samples were obtained on February 20, 1986. Note that the date on samples 1 (MW-2) and 2 (MW-3) should be February 20, 1986, not February 19, as indicated. Also note that sample 2 (MW-2) was obtained at approximately 2:35 p.m.

Sample 5 (MW-5) was a field blank submitted for comparison of sampling and analysis procedures. The sample consisted of distilled water pumped from a plastic gallon container purchased at a store. The pH value of the sample is abnormally low as the pH of distilled water is generally around 5. Possible explanations for the low pH recorded include: 1) acid contamination of the sample bottle, possibly due to acid rinsing, 2) acid contamination of the distilled water source, or 3) bad pH electrode during the testing.

Laucks

Testing Laboratories, Inc.



940 South Harney St., Seattle, Washington 98108 (206)767-5060

Certificate

Chemistry, Microbiology, and Technical Services

CLIENT Hart Crowser & Associates
1910 Fairview Ave. East
Seattle, WA 98102-3699
ATTN: Lori Herman

LABORATORY NO. 95346

DATE March 6, 1986

REPORT ON WATER

SAMPLE IDENTIFICATION Submitted 2/21/86 and identified as shown below:

TESTS PERFORMED AND RESULTS:

- 1) MW-2 LJH 2/19/86* 1:26 pm KMR
- 2) MW-1 LJH 2/20/86 KMR
- 3) MW-3 LJH 2/19/86* 12:45 pm KMR
- 4) MW-4 LJH 2/20/86 4:40 pm KMR
- 5) MW-5 LJH 2/20/86 5:00 pm KMR

| | <u>1</u> | <u>2</u> | <u>3</u> | <u>4</u> | <u>5</u> |
|----------------------------|---------------------------------|----------|----------|----------|----------|
| pH, glass electrode @ 25°C | 8.1 | 6.8 | 6.9 | 7.3 | 3.4 |
| | <u>parts per million (mg/L)</u> | | | | |
| Hexavalent Chromium | L/0.005 | L/0.005 | L/0.005 | L/0.005 | L/0.005 |
| Cadmium | L/0.002 | L/0.002 | L/0.002 | L/0.002 | L/0.002 |
| Zinc | 0.016 | 0.071 | 0.019 | 0.24 | 0.034 |
| Lead | L/0.01 | 0.02 | 0.01 | 0.02 | L/0.01 |
| Chromium | L/0.005 | L/0.005 | L/0.005 | L/0.005 | L/0.005 |
| Nitrate as N | 26. | 0.10 | 0.29 | L/0.05 | L/0.05 |

Key

L/ = less than

* Water samples were obtained on 2/20/86 in all wells.

LJH

Respectfully submitted,

Laucks Testing Laboratories, Inc.

J. M. Owens

J. M. Owens

JMO:veg



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Figure A-1



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Certificate

Chemistry, Microbiology, and Technical Services

PAGE NO. 2

Hart Crowser

LABORATORY NO. 95346

APPENDIX

Matrix Spike/Matrix Spike Duplicate Report

Inorganics/Metals Analyses

| Sample | Analyte | Spike | Sample | MS | % | MSD | % | RPD |
|--------|----------|-------|---------|--------|------|--------|-----|-----|
| | | Added | Result | Result | Rec | Result | Rec | |
| | | | mg/L | | | mg/L | | |
| 2 | Nitrate | 0.1 | 0.10 | 0.20 | 100. | 0.19 | 90. | 10. |
| 1 | Cadmium | 0.050 | L/0.002 | 0.048 | 96. | 0.048 | 96. | 0. |
| 1 | Chromium | 0.050 | L/0.005 | 0.044 | 88. | 0.045 | 90. | -2. |
| 1 | Lead | 0.10 | L/0.01 | 0.10 | 100. | 0.09 | 95. | 5. |
| 1 | Zinc | 0.05 | 0.016 | 0.058 | 84. | 0.060 | 88. | -5. |



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EXHIBIT "9"