HARTCROWSER

Earth and Environmental Technologies

Site Assessment
Arness Disposal Site
Kenai Peninsula

A-8136

PREPARED FOR

STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SOUTHCENTRAL REGION
ANCHORAGE, ALASKA

OCTOBER 1988

REVISED JANUARY, 1989

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INTRODUCTION

This report presents the results of the limited soil boring, monitoring well installation and combined electrical conductivity and magnetometer survey of the approximate 2-acre Arness Disposal Site, North Kenai, Alaska. The field program was conducted from September 12, through 16, 1988, after development, submittal and ADEC acceptance of the site-specific QA/QC and health and safety plans. At the request of ADEC, a second magnetometer survey was performed on October 21, 1988.

This work was authorized by the Alaska Department of Environmental Conservation (ADEC) upon general acceptance of our proposal of August 18, 1988, as modified by the ADEC during contract negotiations. At this time, the Task 7, Scout Lake Road Site geophysical survey task was deleted from the project work scope. The notice to proceed (NTP #880296-002) was issued on September 7, 1988. This report was prepared for the exclusive use of the ADEC, for specific application to the project site using generally accepted professional practices at the time and location in which the work was completed. No other warranty, express or implied, is made.

DATA PRESENTATION

The following sections describe the task activities and present the data obtained during those tasks.

Task 1: QA/QC Plan

A section of the site-specific QA/QC plan was prepared with regard to soil sampling activities for the Arness Disposal Site Project. This section was incorporated into the ADEC QA/QC Plan. The plan was transmitted on 9/6/88 to the ADEC.

A site reconnaissance visit was conducted on 9/7/88 to stake the monitoring well and soil boring locations and to confirm the areas for the combined geophysical survey. The site reconnaissance party consisted of Mr. Al Kegler, ADEC Project Manager and Steve Rog, Hart Crowser Project Manager.

Task 2: Health and Safety Plan

Hart Crowser, Inc. reviewed geochemical data provided by the ADEC regarding the existing condition at the Arness Disposal Site. A site-specific health and safety plan was prepared and submitted to the ADEC on 9/8/88.

Tasks 3 and 4: Geophysical Survey and Interpretation

Data Acquisition and Reduction

Field data acquisition included two site geophysical surveys which were performed on September 16, 1988. The surveys were performed using a Geonics Model EM-31 Non-contacting Terrain Conductivity Meter, and EG&G Geometrics Magnetometers. Field surveys were performed using a grid staked by Hart Crowser, Inc. The grid was generally 25 feet x 50 feet extending along a base line from a point on the access road near the west end of the site, oriented northeasterly and extending through BH-3. Grid lines extended left (west) and right (east) off the base line (0+00) on 50-foot centers. Staking along the base line was at 25-foot centers. Readings were taken along each east-west grid line at all stakes and intermediate points. In areas where small differences in instrument signal were anticipated between grid stakes, intermediate readings were taken at 25-foot intervals. Where larger data variations were anticipated, the reading interval was decreased to 12.5 feet. Intermediate data points were located by pacing from staked points.

The EM-31 Non-contacting Terrain Conductivity Meter is comprised of a transmitter, receiver, and readout. The transmitter induces a circular eddy current into the soil, a portion of which is intercepted by the receiver. The terrain conductivity is a function of the difference between output signal strength at the transmitter and input signal strength at the receiver. Flow of electrical current through soil is dependent on the mineralogy of the soil particles and the quantity, ion content, and thermal state of the water in the soil matrix. Other factors which influence data output are the presence of buried conduits or debris, surficial metallic debris, or nearby sources of strong electrical signals. With the distance between the transmitter and receiver fixed in the EM-31 configuration, the instrument output is most reflective of conditions between 0.5 and 6.0 meters (1.5 and 18 feet) below grade. Prior to mobilization to the project site, the instrument calibration was verified at a test site of known relative conductivity.

The EG&G Geometrics Magnetometers are proton precession portable magnetometers which measure the intensity of the earth's magnetic field at a given location and time. The instruments consist of a directional coil, power source and readout equipment. Magnetic field intensity is a function of the magnetite content of the soil, or the presence of other magnetic materials. Influencing the field intensity are the size and quantity of the magnetic source, its distance from the recorder, the susceptibility of the magnetic source to absorb magnetism from other sources, and variations in the Earth's overall magnetic field. Output signal strength for these instruments is also influenced by the orientation of the receiver coil, with optimum signal strength when the coil is oriented toward magnetic north. For this survey, the coils were mounted on an

8-foot staff and manually oriented at each reading location prior to taking the reading. Prior to survey, magnetic north was established by compass with bearing referenced to the grid stake pattern. Orientation was then made visually by siting along grid stakes. Prior to commencement of the survey, the magnetometer operator was "demagnetized" by removing all ferromatic items from his person.

All geophysical field survey data were checked and cataloged into computer files upon completion of the survey. Conductivity and magnetic field intensity contours were generated using an AT-class computer driven with DPMS SDS Release 1.20 Contour Plotting software. For this application, the first derivative plotting option was used, as this produces smooth contours of natural data (of the function $z(i)=f(x_i,y_i)$). The program creates a lattice of "n" points in which the first partial derivatives dz/dx and dz/dy are continuous throughout the domain of the lattice grid. This algorithm tends to produce smooth continuous contours, however "peaks" and "valleys" are introduced in areas of sparse data and at the edges of the data field.

The data grid stake locations are is shown on the Site Plan (Figure 1) with existing physical features on the site also indicated. The data plots of Apparent Conductivity (Figure 2) and Magnetic Field Intensity (Figure 3) were compared to identify areas where sharp data gradients were observed by both survey methods. Survey data were correlated with borehole data previously gathered at the site.

Data Interpretation

Conductivity data across the site indicated relatively uniform subsurface materials. Readings at most data points were taken with instrument orientation both parallel and perpendicular to the grid lines to maximize the potential of detecting any oriented anomalies. Readings were averaged at each grid point for data presentation, however, no significant data variations were observed due to changes in instrument orientation. Values recorded were in the range typical of dry to slightly moist gravels, consistent with materials observed in the boreholes on the site.

Conductivities at the south end of the site were slightly lower than the remainder of the site. Soils in this area may be slightly drier than the remainder of the site, possibly because less subsurface disturbance was incurred in this area during removal of the leach field system. No anomalous areas which may be indicative of buried structures or other metallic debris were observed with this survey technique.

The magnetometer data obtained using a Model G-856 magnetometer were highly erratic during the site survey. Data were typically in 2 ranges; one at 55,500 gamma and on in the 7,000 to 11,000 gamma range. Upon observation of the high intensity variations, the instrument was taken to a remote, relatively undisturbed portion of the site and all field accessible diagnostic procedures were performed. No indication of internal circuitry problems could be detected from these procedures. Technical service representatives for the instrument manufacturer were contacted for input in analyzing the large data variation. Assuming the instrument is operational, according the the representatives, another possible source of this magnitude variation would be a solar storm or significant magnetic storm in the atmosphere. The Alaska Geophysical Institute indicated that high sunspot activity had been occurring in weeks prior to the surveys, however, Institute data did not indicate a major magnetic disturbance occurred on the date of the survey. The magnetometer data from this survey was therefore considered inconclusive.

Magnetometer Re-survey

At the request of ADEC, a second magnetomer survey was performed on October 21, 1988. Prior to this survey, portions of the grid had to be reestablished due to excavations by ADEC at the site after the original survey. Care was taken to set the reestablished grid stakes as close as possible to their original locations to allow comparison between the different survey periods. For the second survey, a Model G-816 was then used for collecting survey data. The G-816 was tuned at the site and had an optimum signal at 55,000 gamma.

The site survey was performed as previously described with the addition that the time of reading was also recorded. To evaluate the sensitivity of the G-816 to metallic objects, an additional loop was added to the survey grid extending westerly off grid lines 2+75 and 3+00 North to the area of MW-1. All locations in this loop were determined by pacing only, using the stakes in the gridded area for alignment. The monitoring well influence (6" OD steel casing, 40 feet deep) can be inferred by the increase in field intensity observed. The field intensity variation with distance from the well casing are presented in Figure 9. An additional verification test was performed by resurveying points at various times during the survey period to check reproducibility of the data. All resurvey readings were within 2 gamma at each check point.

The grid survey data were correlated on a time history plot, presented on Figure 10. As can be seen from the raw data in this figure, no significant data fluctuations are present, except while surveying the loop around MW-1. Based on the consistent nature of the data, and repeatability of field resurvey points, data from the second survey is considered representative of the subsurface conditions.

A map of magnetic field contours across the site is presented on Figure 11. A summary of survey data, including flux and survey annotations, is presented in Appendix A. The base magnetic field intensity at the site appears to be approximately 55,550 gamma. In the area west of the line 0+00 and north of line 1+50, the field intensity drops off to approximately 55,530 gamma except along the perimeter of the site. This area is interpreted as disturbance associated with previous excavation of the site during removal of the leach field system. It is assumed from the data that original surficial gravels on the site produced a slightly greater magnetic field intensity than present conditions. Readings between 55,550 and 55,570 gamma were observed in the southern undisturbed portions of the site. The anomalous conditions indicated in the area between lines 2+50 and 3+00 North and east of line 0+25 East can be directly correlated to spoil piles of this gravel material from the pit still present at the site in this area. Readings taken on the spoil piles were typically 55,570 gamma. The short clearing along line 0+75 East, north of line 3+50, is believed to be underlain by gravel fill from the pit or of similar material.

One magnetic anomaly which has no apparent surficial expression is in the vicinity of 1+50 North of 0+25 West (-25.00). A 10 gamma increase was noted in a small area near this grid point. Using linear interpolation techniques, the center of this anomaly is estimated to be slightly north and east (by grid coordinates) from this grid location. No similar anomalous condition could be correlated from the resistivity data. No other unexplainable anomalies are apparent at the site.

The exact nature of the anomaly previously noted cannot be directly determined from geophysical data. The anomaly may be related to fill materials used during the site restoration, remnant metal, or other unknown causes. All data in this area was reproducible to within 1 gamma. Because the anomaly was not identified by the conductivity survey, the data may indicate that the source of the magnetic signature is small in comparison to the signal path of the EM-31, or that the source lacks significant size or orientation to alter the instrument signal. Included in Appendix A are two figures. Figure A-1 is a reproduction of a table of typical signatures observed at various distances from a known magnetic source. Figure A-2 is a figure drawn from a research project in which magnetometer traverses were run at varying distances from a single barrel and a cluster of barrels. By comparing the data presented in these figures with data recorded in this location of the site, it is possible that the anomaly is the signature of a buried metalic object. Direct visual observation with test pits in this area is suggested.

It should be noted that all geophysical data is indirect in nature and influenced by an infinite combination of envrionmental parameters including survey methods. The geophysical survey methods used for this project were developed to provide a relatively high resolution of data for identifying a single steel barrel at a depth of 15 feet in an economical manner. It is possible that single barrels or smaller metallic objects might not be identified by interpretation of the geophysical data due to a low signal signature of the objects, masking of the signature by other envrionmental variations or random positioning of the objects so as to produce a minimal signal at all surrounding data points.

Task 5: Monitoring Well Installation

This task included completion of one 4-inch monitoring well within a 6-inch air rotary boring. The results of our exploration program are presented on the exploration log, Figure 4. The exploration log is a representation of our interpretation of the drilling or excavation, sampling, and testing information. The depth where the soils or characteristics of the soils changed is noted. The change may be gradual. Soil samples recovered in the explorations were visually classified in the field in general accordance with the method presented on Figure B-1. A legend for the field exploration logs defining symbols and abbreviations utilized is also presented on Figure B-1.

The location of the monitoring well was staked by ADEC prior to mobilization of equipment to the site. The approximate location of the well is indicated on the Site Plan, Figure 1. The surface elevation at the well site is unknown.

The 6-inch air rotary boring designated MW-1 was drilled from 9/12/88 to 9/15/88. The boring was completed to 138 feet below the ground surface. The boring was advanced with a truck-mounted Koehring SS-15TTH drill rig under subcontract to Hart Crowser, Inc. using air rotary drill and drive techniques to advance the 6-inch ID casing. The drilling was accomplished under the continuous observation a geologist from our firm. Detailed field logs were prepared during drilling. Samples were obtained at depths of 2, 10, 20, and 98 feet, as directed by on-site ADEC personnel using a 2.5-inch ID split-spoon driven by either a 150-pound downhole hammer, a 300-pound drop hammer, or the compressed air actuated casing hammer.

Prior to mobilization to the site, all drilling and sampling tools were thoroughly decontaminated with a high pressure hot water wash. Cleaned, decontaminated drill rods were used for all drilling. Sampling tools, including logging equipment were decontaminated between each sampling attempt by washing in Alconox solution, followed by multiple rinses with potable water.

Samples were logged by Hart Crowser, Inc. personnel and then transferred to ADEC custody for appropriate packaging, handling, and testing. Operational characteristics were recorded by the geologist, including descriptions of drill action, effectiveness of air circulation, cuttings observations, and water production in cuttings. The boring log for this well is presented on Figure 4. The driller's log, prepared by Kraxberger Drilling is presented as Figure 4A.

Drilling was halted at 119 feet on 9/13/88 when apparently saturated drill cuttings were observed. After an equilibration period of approximately 1/2 hour, water at this depth proved insufficient for a well completion. On 9/14/88, drilling was resumed to a depth of 138 feet. The water table was encountered at 125 feet at the time of drilling, with wet sandy gravels observed through the depth drilled. A 4-inch diameter PVC well was constructed to this depth. The well included 20 feet of 0.010-inch factory-slotted well screen embedded in a filter pack of #16 silica sand. During placement of the filter pack, the casing was withdrawn and sand depth continuously sounded to verify the integrity of the filter pack. Above the filter pack, a hydrated bentonite pellet seal was placed and the annulus adjacent to the 4-inch well pipe was backfilled with Volclay grout to within 10 feet of the ground surface. Because of the difficulty in removing the well casing, it was agreed by ADEC, Hart Crowser, and Kraxberger Drilling to abandon the last 40 feet of casing in the boring. The boring backfill was completed with a concrete surface seal. A locking security cap was provided by the drilling contractor.

After completion of the monitoring well, the water level was measured at approximately 125 feet. A decontaminated 3-inch electric submersible pump (Fairbanks-Morse) was temporarily installed in the well for development purposes. The monitoring well was developed by pumping approximately 5 to 7.5

gpm for 1 hour. Initially, moderately turbid groundwater was pumped and discharged to the ground surface. Within approximately 15 minutes, turbidity was reduced to clear water and sustained flows of 5 to 7.5 gpm were maintained for the 1 hour development period. Approximately 1 foot of drawdown was observed during well development.

Groundwater sampling was conducted by the ADEC on 9/16/88.

Task 6: Soil Boring Installation

The program of subsurface explorations for this task included completion of 4 soil borings. The results of our exploration program are presented on the exploration logs, Figures 5 through 8. The exploration logs are a representation of our interpretation of the drilling or excavation, sampling, and testing information. The depth where the soils or characteristics of the soils changed is noted. The change may be gradual. Soil samples recovered in the explorations were visually classified in the field in general accordance with the method presented on Figure B-1. A legend for field exploration logs defining symbols and abbreviations utilized is also presented on Figure B-1.

The exploration locations are presented on Figure 1. The explorations were drilled at locations staked by ADEC prior to mobilization to the site. The actual locations of the explorations, as given in this report, were established during the geophysical surveys performed as Task 3 and 4. The ground surface elevations at the boring locations were not determined.

A total of 4 hollow-stem auger borings, designated BH-1 through BH-4, were drilled on September 13, 1988. The borings were completed to depths ranging from 30 to 34 feet below the ground surface. The borings were advanced with a truck-mounted CME-55 drill rig under subcontract to Hart Crowser, Inc. using 4 1/4-inch inside diameter hollow-stem auger. The drilling was accomplished under the continuous observation of a geotechnical engineer from Hart Crowser, Inc. Detailed field logs were prepared of each boring (Figures 5 through 8). Samples were obtained at depth of 5, 15, and 30 feet, as directed by ADEC using a 2.5-inch ID split-spoon driven with a 300-pound drop hammer.

Prior to mobilization to the site, all drilling and sampling tools were thoroughly decontaminated with a high pressure hot water wash. Cleaned, decontaminated augers were used for all drilling. Sampling tools, including logging equipment were decontaminated between each sampling attempt by washing in Alconox solution, followed by multiple rinses with potable water.

Samples were logged by Hart Crowser, Inc. personnel and then transferred to ADEC custody for appropriate packaging, handling, and testing. Operational characteristics were recorded by the field engineer, including descriptions of drill action and cuttings observations. Upon completion of each boring, the boring was backfilled with drill cuttings.

In Boring BH-4, soils with strong petroleum odor were encountered between the 5- and 15-foot sample interval. A sample of the cuttings from this zone was collected in a lab-clean jar with teflon-lined lid and provided to ADEC in addition to the requested drive samples.

CONCLUSIONS

The data obtained from the monitoring well and boreholes in this investigation are representative of that well/borehole only. Absence of petroleum product/septage-contaminated soils or water does not preclude the presence of contamination of other locations on the property. Similarly, the presence of contaminated soils and water in the vicinity of a borehole does not indicate the extent, both laterally and vertically, of that contamination.

This report is intended to transmit the results of our explorations and document the procedures used to gather these data. The foregoing and attached are intended to be comprehensive within the scope of the effort authorized by the acceptance of our proposal dated August 18, 1988, but may not be exhaustive of the possibilities. Please call if there are any questions, or if we can be of further service.

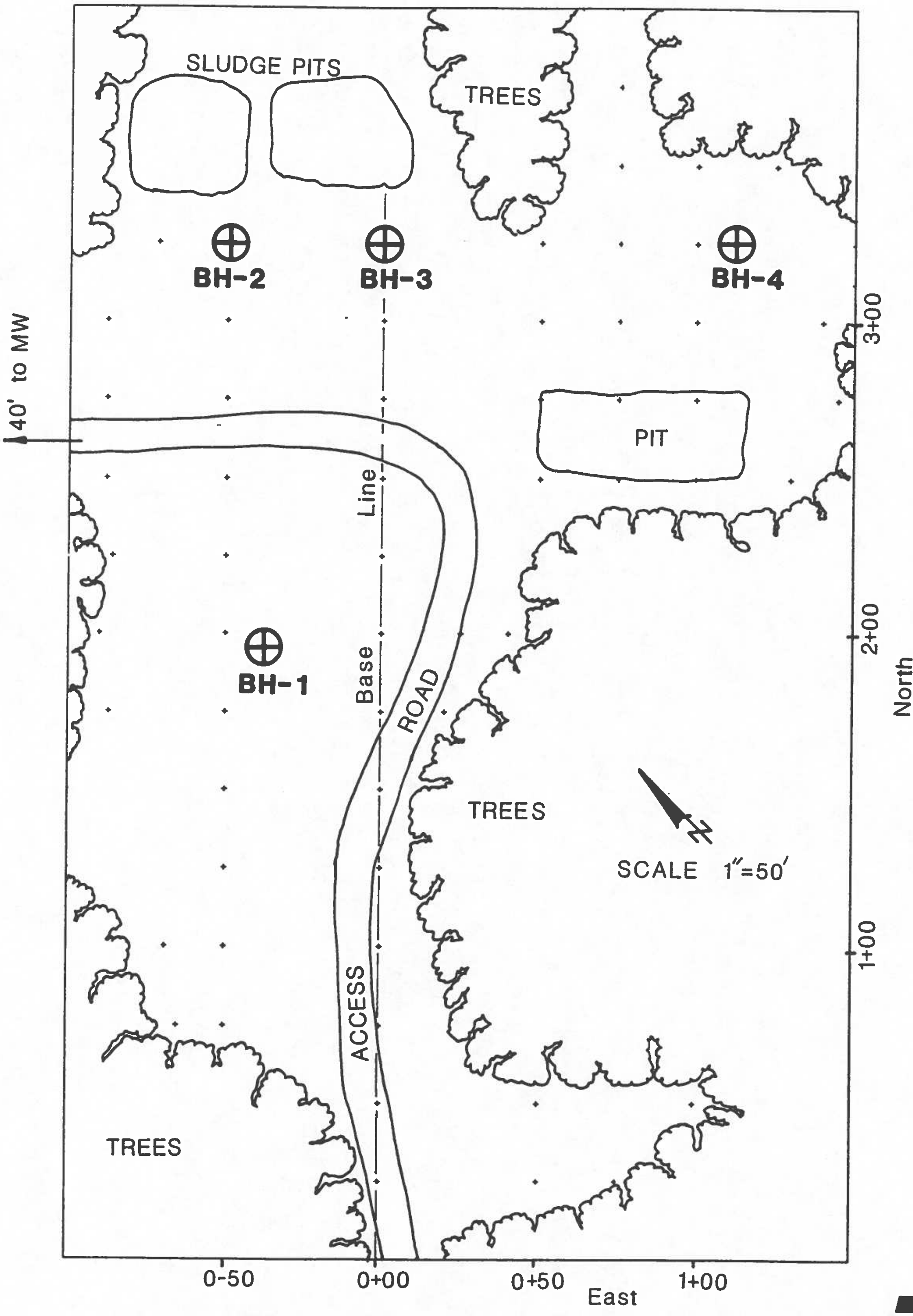
Respectfully submitted,

HART CROWSER, INC.

Stephen R. Rog, CPG
Sr. Project Geologist

James D. Gill, P.E.
Alaska Manager

SITE PLAN



+ Geophysical Survey Grid Stake

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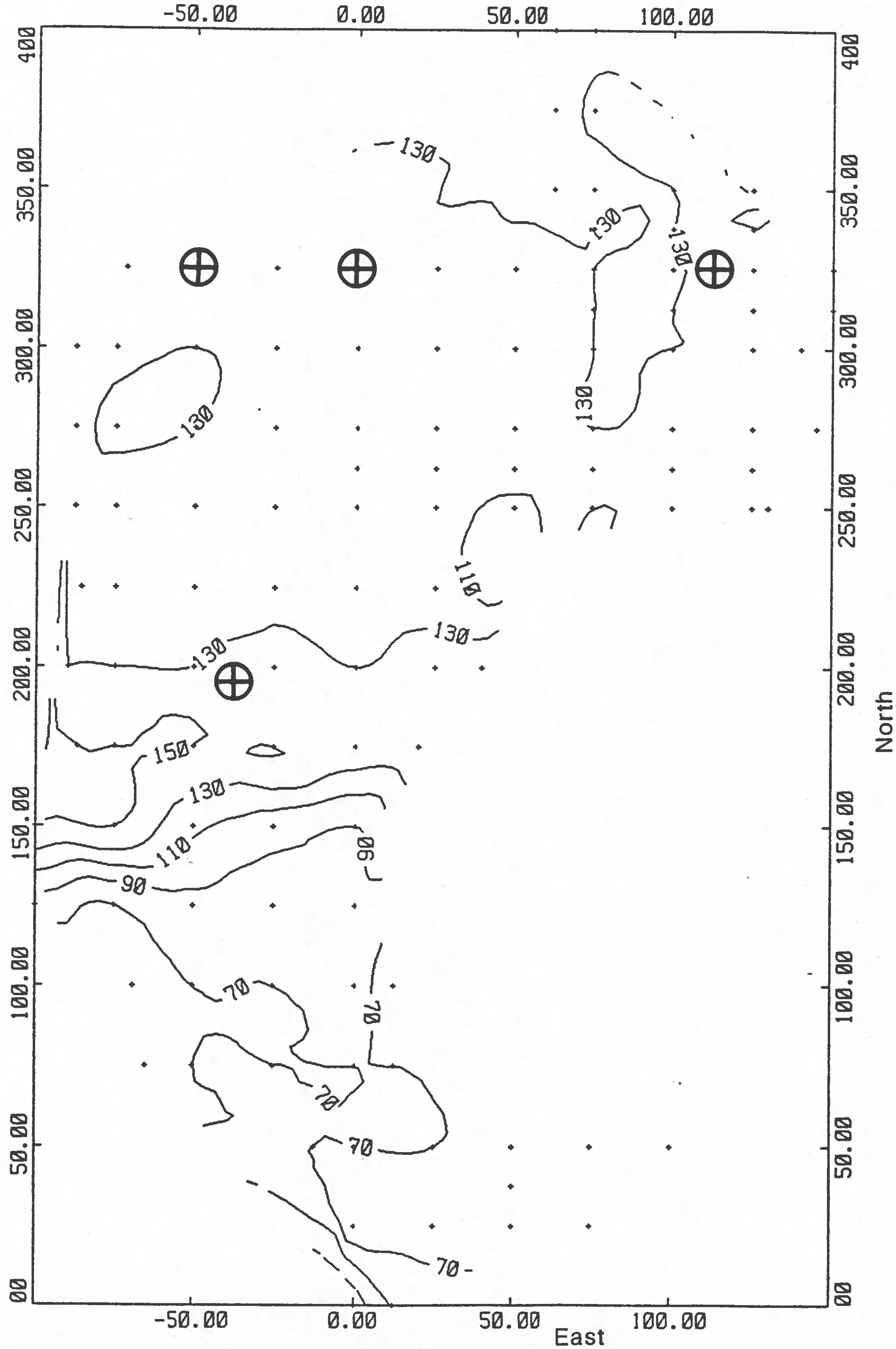
Figure 1

APPARENT CONDUCTIVITY



+ Data Reading Point

Conductivity Contours at 0.02 mmhos/m

Contour Values in .001 mmhos/m

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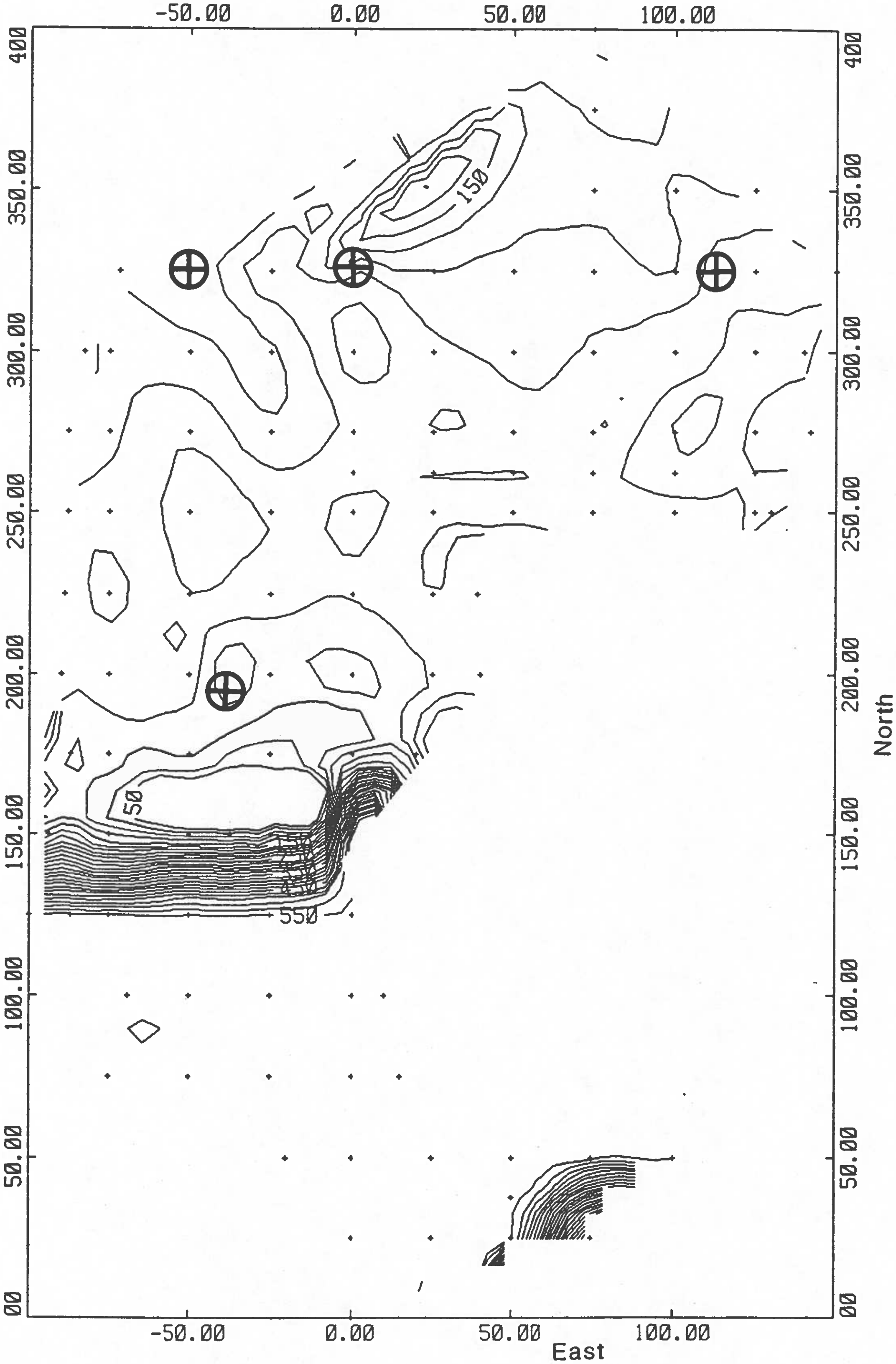
Figure 2

MAGNETIC FIELD INTENSITY



+ Data Reading Point

Magnetic Contours at 1000 gamma intervals

Contour Values in 100 gammas

Survey performed 9-16-88

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Figure 3

Key to Boring and Test Pit Logs

Sample Descriptions

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following: Color, textural soil classification, USC, frost classification, density/consistency, moisture, and additional remarks.

Density/Consistency

Soil density/consistency in borings is estimated based on the Standard Penetration Resistance (SPT) or from tests on undisturbed samples. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs. Correlation between SPT and Shear Strength is to be considered approximate only, and not to be used for design.

SAND or GRAVEL Density	Standard Penetration Resistance in Blows/Foot
Very loose	0 - 4
Loose	4 - 10
Medium dense	10 - 30
Dense	30 - 50
Very dense	>50

SILT or CLAY Consistency	Standard Penetration Resistance in Blows/Foot	Approximate Shear Strength in TSF
Very Soft	0 - 2	> 0.125
Soft	2 - 4	0.125 - 0.25
Medium stiff	4 - 8	0.25 - 0.5
Stiff	8 - 15	0.5 - 1.0
Very stiff	15 - 30	1.0 - 2.0
Hard	> 30	> 2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Sampling

BORING SAMPLES

- ⊠ Split Spoon — SPT-1.4" I.D., SS -2.5" I.D.
- Shelby Tube
- Cuttings
- Core Run
- * No Sample Recovery
- P Tube pushed, Not Driven

TEST PIT SAMPLES

- ⊠ Grab (Jar)
- Bag
- Shelby Tube

Ground Water Observations

Surface Seal

Ground Water Level on Date (ATD At Time of Drilling)

Observation Well Tip or Slotted Section

Ground Water Seepage (Test Pits)

Test Symbols

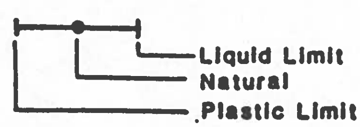
AL	Atterberg Limits
CBR	California Bearing Ratio
CN	Consolidation
DS	Direct Shear
FPD	Freezing Point Depression (°C)
GS	Grain Size Classification
K	Permeability
LOI	Loss on Ignition (% by weight)
MD	Moisture Density Curve
PP	Pocket Penetrometer (Approximate Compressive Strength in TSF)
QU	Unconfined Compression
TCD	Triaxial Consolidated Drained
TCU	Triaxial Consolidated Undrained
TUU	Triaxial Unconsolidated Undrained
TV	Torvane (Approximate Shear Strength in TSF)

THERMAL STATE

Frozen

Unfrozen

WATER CONTENT IN PERCENT



POL Petroleum Oil Liquids (fuel products)

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FIGURE B-1

Boring Log and Construction Data for Well MW-1

Geologic Log

Depth in Feet

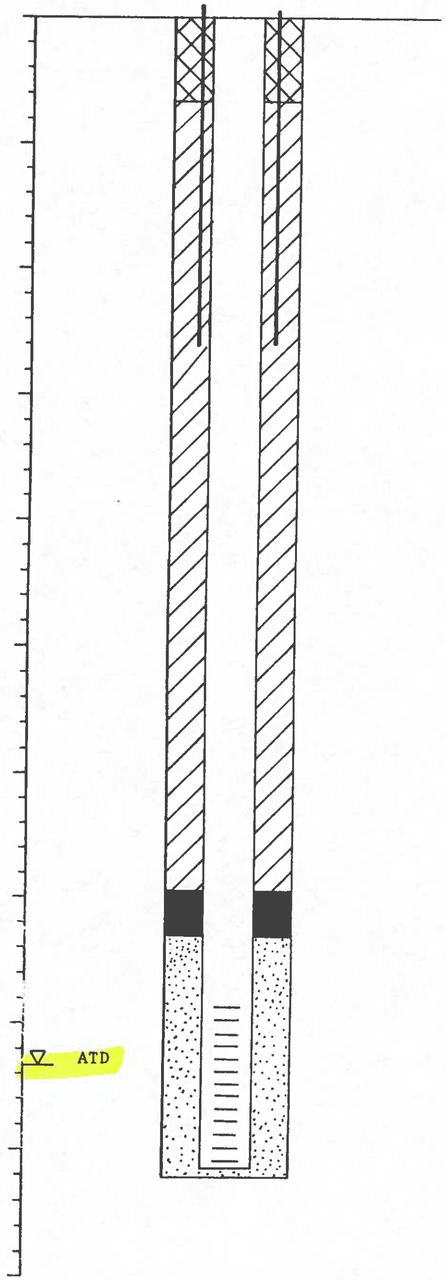
Approximate Ground Surface Elevation in Feet

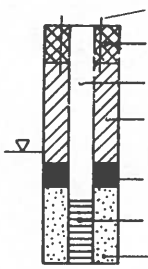
Depth	Description	Sample
0	Brown Sandy Gravelly Silt, ML, loose, dry, no odor	
	Brown Sandy Gravel, GP, dense, dry to moist, with cobbles. No odor	SSHD-1
	Brown Gravelly Sand, SP, very dense, moist, no odor. Sampler refusal in 10 foot sample, redrove at 12 feet.	SSHD-2 SSHD-2A
	Grey-brown Gravelly Sand, SP, dense, moist, no odor.	SSHD-3
	Boulders and cobbles at 24 feet.	
30	Slight loss of circulation at 30 feet. No odor in cuttings.	
	Sandy Gravelly drill action	
	Some air loss at 45 feet	
	Cobbles at 50 feet	
	Cobbles at 56 feet	
60	Sandier drilling at 64 feet with air loss	
	Sandy drilling at 76 feet	
90	Silt layer 91 to 95 feet	
	Loss of air circulation at 95 feet.	
	Grey-brown Gravelly Sand, SP, dense moist, no odor.	SSHD-4
	Siltier layer 105 to 107 feet	
120	Dark grey Sand, SP, wet. Let stand at 119 to observe free water.	
	Dark grey Sandy Silt, ML dry to moist, no free water.	
	Dark grey Sandy Gravel, wet at 125 feet	
	Gravelly drilling to 138 feet	
	Bottom of Boring - 138 feet Completed 9-18-88 Free water at 125 feet ATD	
150		

Well Design

Top Casing Elevation in Feet 3.8 Ft.

Casing Stickup in Feet





6-inch ID Cased Borehole

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
3. Refer to Figure A-1 for explaination of symbols.

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FIGURE 4

Kraxberger Drilling Co. Well Drilling Log

Well owner: Hart-Crowser   Driller: ARK   Completion: 9/15/88

Builder: Arness Disposal Site   City: Nth Kenai

Road/Area: Behind Baker /North Rd

Legal 1: ____________   Legal2: ____________

Depth: 138   Casing length: 48   Diameter: 6   Rig type: AR

Static level: 120 → 125' 7.   Yield/GPM   Finish of well: PVC 4" .010 scr 117-137

113' ← 10/92

0-14 gravel,sand & rocks	14-21 sand & gravel
21-55 loose gravel,sand & rocks	55-56 rock
56-91 loose grave,sand & rock	91-95 tight silt,sand & gravel
95-105 loose gravel sand & rock	105-107 clay,sand & gravel
107-119 damp sand & gravel	119-123 wet silt & sand
123-124 clay	124-134 wet silt,sand & gravel
134-138 water sand & gravel	
47'6" steel casing (3'6" above gr	20' screen & 120'PVC casing

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FIGURE 4A

Boring Log BH-1

Geologic Log

Depth in Feet | Thermal State | Approximate Ground Surface Elevation in Feet | Sample

5 — Brown Sandy Gravel, GP, loose, wet to saturated, slight septage odor. Very small recovery, redrive at 6.5 feet. — S-1, S-1A

Strong septage odor in cuttings at 9.0 feet.

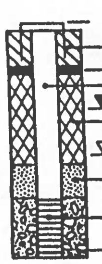
15 — Brown to grey Sandy Gravel, GP, wet, loose, mild septage odor. — S-2

20 — Very tough drilling, 22.0 to 24.0 feet.

30 — Grey-brown Sandy Gravel, GP, moist to wet, medium dense, no unusual odor. — S-3

35 — Bottom of Boring - 30.5 feet
Completed 9-13-88
No free water observed ATD
Backfilled with drill cuttings.

0 5 10 15 20 25 30 35 40 45 50



Nominal 8-Inch Borehole

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 Drill
3. Refer to Figure A-1 for explaination of symbo

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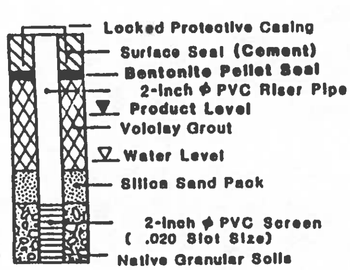
FIGURE 5

Boring Log BH-2

Geologic Log

Depth in Feet	Approximate Ground Surface Elevation in Feet	Sample
5	Brown Gravelly Sand, SP, moist, loose no unusual odor.	S-1
10	Cuttings change to grey sand at 8 feet with slight to moderate petroleum odor.	
15	Grey Sandy Gravel, GP, moist, medium dense, mild sweet odor.	S-2
25	Very gravelly drilling at 27 feet.	
30	Grey Sandy Gravel, GP, moist, very dense with cobbles. Very small recovery. Redrive at 32.5 feet. Recovery contained large broken rock fragments, no unusual odor.	S-3, S-3A
35	Bottom of Boring - 33.5 feet Completed 9-13-88 No free water observed ATD Backfilled with drill cuttings.	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50. Column headings: Depth in Feet; Thermal State.



Nominal 8-inch Borehole

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and ma vary with time of year. ATD:At Time of Dril
3. Refer to Figure A-1 for explaination of symbc

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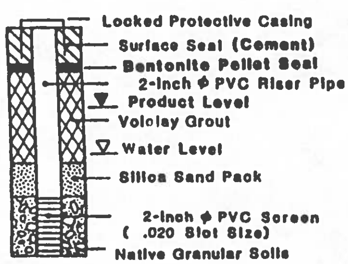
FIGURE 6

Boring Log BH-3

Geologic Log

Depth in Feet	Thermal State	Approximate Ground Surface Elevation in Feet	Sample
5		Brown Gravelly Sand, SP, damp to moist, loose to medium dense, no unusual odor	S-1
10		Grey sandier cutting with some gravel between 7 and 10 feet.	
15		Brown Sandy Gravel, GP, damp, medium dense, no unusual odor.	S-2
23		Very slow cobbly drilling 23 to 30 feet.	
30		Brown-grey Sandy Gravel, GP, moist, medium dense with no unusual odor.	S-3
35		Bottom of Boring - 31.0 feet Completed 9-13-88 No free water observed ATD Backfilled with drill cuttings.	



Nominal 8-inch Borehole

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 Drilli
3. Refer to Figure A-1 for explaination of symbol

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FIGURE 7

Boring Log BH-4

Geologic Log

Depth in Feet | Thermal State | Approximate Ground Surface Elevation in Feet | Sample

0

Brown Sandy Silt, ML, dry to moist

Brown Gravelly Sand, SP, with cobbles.

5

Brown Sandy Gravel, GP, moist, medium dense, no unusual odor.

S-1

10

Grey sandier cuttings 6 to 13 feet.

Slight to moderate petroleum odor in cuttings at 11 feet.

15

Brown Sandy Gravel, GP, moist, medium dense, no unusual odor.

S-2

20

Tough cobbly drilling 22 to 26 feet.

25

30

Brown Sandy Gravel, GP, moist to wet, medium dense well rounded 1/4 inch to 3/8 inch pea gravel. No unusual odor.

S-3

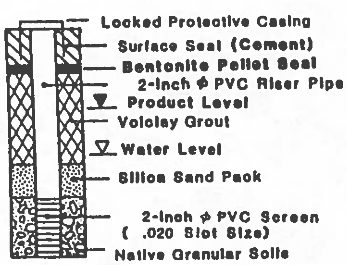
35

Bottom of Boring - 30.5 feet
Completed 9-13-88
No free water ATD
Backfilled with drill cuttings.

40

45

50



Nominal 8-inch Borehole

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 Drilli
3. Refer to Figure A-1 for explaination of symbol

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FIGURE 8

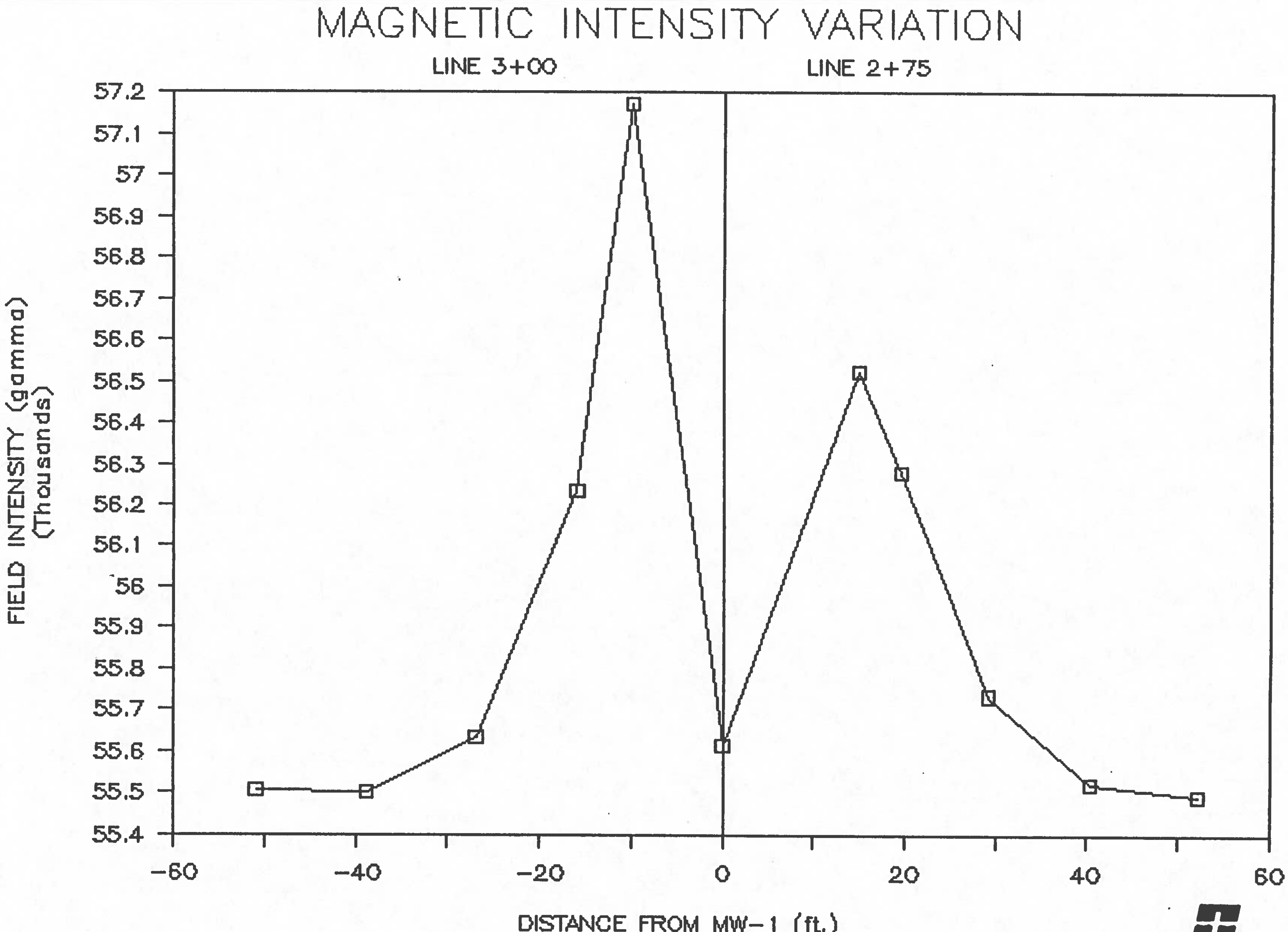

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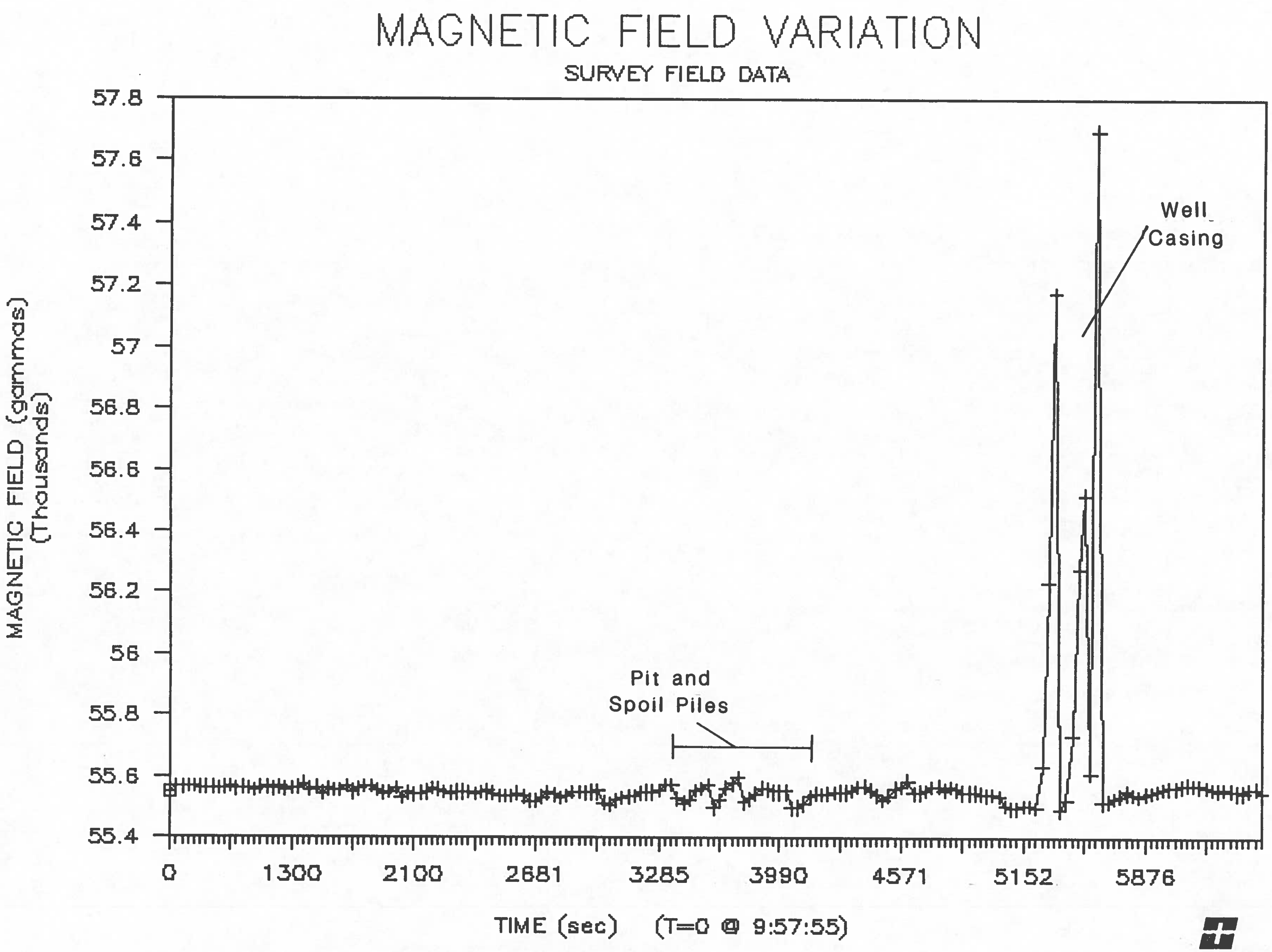
Figure 9



Field data recorded on October 21, 1988 using
EG&G Model G-816 Magnetometer.

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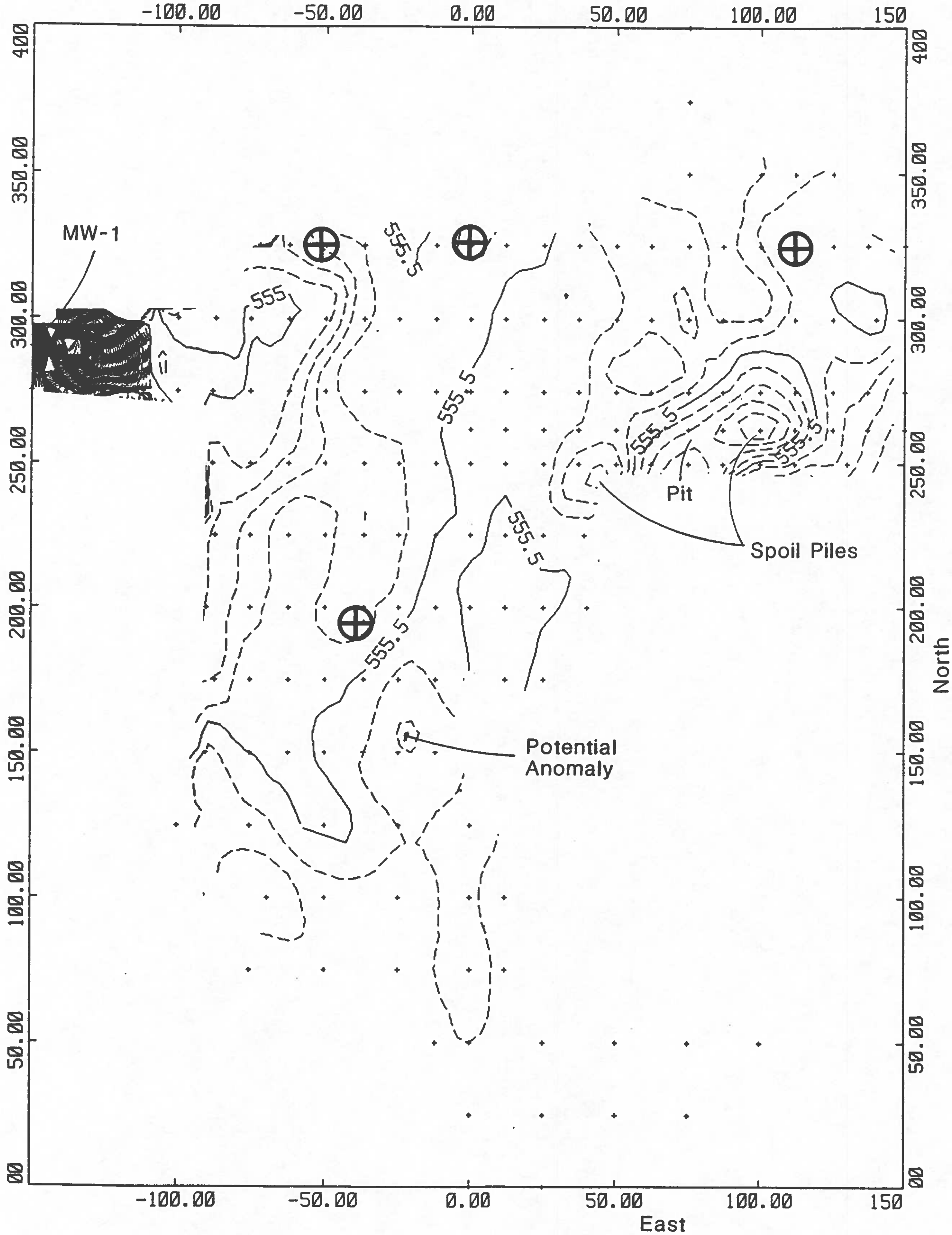
Figure 10

MAGNETIC FIELD INTENSITY



+ Data Reading Point
Magnetic Contours at 10 gamma intervals
Contour Values in 100 gammas
Survey Performed 10-21-88

HARTCROWSER
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Figure 11

Table of Anomalies of Common Objects

Typical Maximum Anomaly

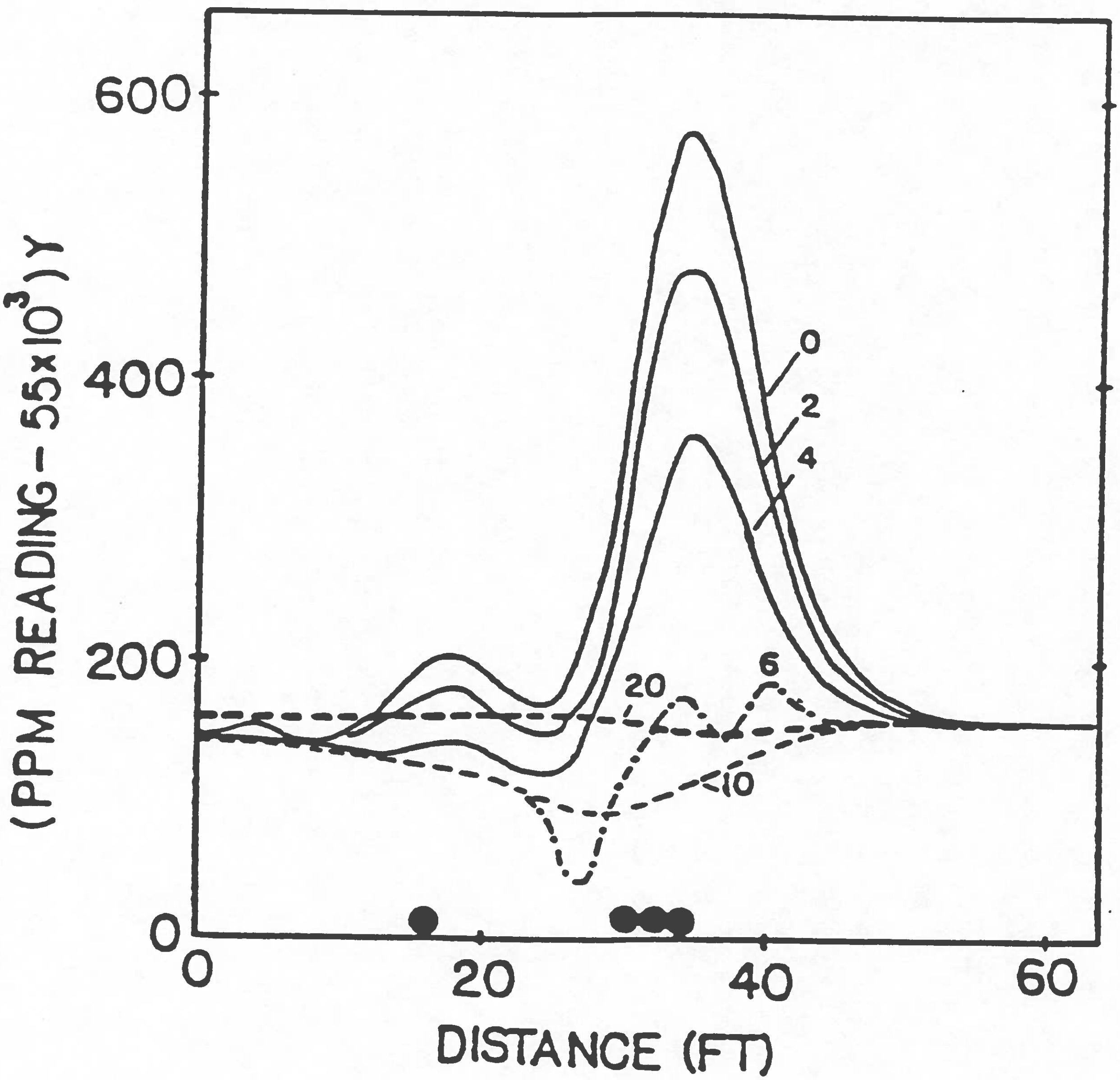
Object	Near Distance	Far Distance
Automobile (1 ton)	30 feet 40 gammas	100 feet 1 gamma
Ship (1000 tons)	100 feet 300 to 700 gammas	1000 feet 0.3 to 0.7 gammas
Light Aircraft	20 feet 10 to 30 gammas	50 feet 0.5 to 2 gammas
File (10 inch)	5 feet 50 to 100 gammas	10 feet 5 to 10 gammas
Screwdriver (5 inch)	5 feet 5 to 10 gammas	10 feet 0.5 to 1 gamma
Revolver (38 special or 45 automatic) (induced approximately equal to permanent, see text)	5 feet 10 to 20 gammas	10 feet 1 to 2 gammas
Rifle	5 feet 10 to 50 gammas	10 feet 2 to 10 gammas
Ball Bearing (2mm)	3 inches 4 gammas	6 inches (0.5 feet) 0.5 gamma
Fenceline	10 feet 15 gammas	25 feet 1 to 2 gammas
Pipeline (12 inch diameter)	25 feet 50 to 200 gammas	50 feet 12 to 50 gammas
DC Train	500 feet 5 to 200 gammas	1000 feet 1 to 50 gammas
'Cow' magnet (½" W, 3" L)	10 feet 20 gammas	20 feet 2 gammas
Well casing and wellhead	50 feet 200 to 500 gammas	500 feet 2 to 5 gammas

(Note: anomalies are only representative and may vary by a factor of 5 or even 10 depending upon the many factors described herein)

Source: "Applications Manual for Portable Magnetometers", by S. Briener (GeoMetrics, 1973)

HARTCROWSER

Figure A-1



Influence of distance between sensor and magnetic source. Dark circles indicate position of and number of barrels along base line. Distance of traverse from base line as indicated in figure. Barrels are 30 gallon containers buried at a depth of 3.5 feet below grade in uniform sand backfill. (Source: Tyagi, S. and Koerner, R., "Use of Proton Precession Magnetometer to Detect Buried Drums in Sand Soil", Journal of Hazardous Materials, No. 8, 1983, pp. 11-23.)

HARTCROWSER

Figure A-2

STATION NORTH	STATION EAST	SURVEY FIELD	FLUX	BASE FIELD	FLUX	TIME	
				55549		95755	
				55550	0	95855	
				55550	0	95955	
				55552	2	100055	
				55551	-1	100155	
				55550	-0	100255	
				55550	-0	100355	
				55550	0	100455	
				55520	-30	100555	
				55550	30	100655	
0	0	55569				100710	
0	25	55566	-3			100746	
				57196	1646	100755	
25	0	55569	3			100843	
				55551	-1645	100855	
25	25	55568	-1			100900	
25	50	55565	-3			100931	
				55551	0	100955	
25	75	55565				101012	
				55536	-15	101055	
50	100	55565				101110	
50	75	55563	-2			101140	
				55550	14	101155	
50	50	55565	2			101208	
50	25	55568	3			101235	
				55550	-0	101255	
50	0	55560	-8			101304	
50	-12	55564	4			101337	
				55550	0	101354	
				58791	3241	101454	
75	12	55562	-2			101533	
				58835	44	101554	
75	0	55557	-5			101616	
75	-25	55564	7			101642	
				58824	-10	101654	
75	-50	55566	2			101714	
75	-75	55561	-5			101741	
				58826	2	101754	
100	12	55566	5			101840	
				58807	-19	101854	
100	0	55559	-7			101906	
100	-25	55563	4			101935	
				58800	-7	101954	
100	-50	55565	2			102010	
100	-69	55577	12			102044	Edge of Clearing
				58816	16	102054	
				58808	-7	102154	
125	-100	55558	-19			102202	New Line
				58787	-21	102254	
125	-75	55564	6			102320	
				58815	28	102354	
125	-50	55547	-17			102358	
125	-25	55560	13			102425	

STATION NORTH	STATION EAST	SURVEY FIELD	FLUX	BASE FIELD	FLUX	TIME	
125	0	55556	-4			102450	
				58835	20	102454	
150	0	55555	-1			102525	
				58814	-21	102554	
150	-25	55568	13			102607	Peak - No surface expression
				57468	-1346	102654	
150	-50	55552	-16			102702	
150	-37	55560	8			102740	
				58806	1338	102754	
150	-25	55569	9			102815	Peak (repeat)
150	-12	55568	-1			102833	
150	0	55555	-13			102850	
				58790	-16	102854	
				58806	15	102954	
150	-62	55546	-9			102958	Data discontinuity
150	-75	55550	4			103025	
				58805	-0	103054	
150	-90	55562	12			103100	Edge of Clearing
175	-87	55531	-31			103135	New Line
				57386	-1420	103154	
175	-75	55548	17			103230	Edge of Clearing
				58776	1390	103254	
175	-62	55541	-7			103255	
175	-50	55545	4			103324	
175	-37	55552	7			103349	
				58776	1	103354	
175	-25	55562	10			103414	Peak (continuation of 150, -25 ?)
175	-12	55559	-3			103435	
				57636	-1141	103454	
175	0	55550	-9			103502	
175	12	55546	-4			103533	
				57448	-188	103554	
175	25	55553	7			103616	
				56991	-457	103654	
200	40	55552	-1			103720	
200	25	55549	-3			103743	
				57761	770	103754	
200	12	55544	-5			103810	
200		55549	5			103841	
				57412	-349	103854	
200	-12	55554	5			103902	
200	-25	55545	-9			103929	
				57930	519	103954	
200	-37	55538	-7			103956	
195	-37	55538				104033	TH #1
				56552	-1379	104054	
200	-50	55539	1			104057	
200	-62	55547	8			104122	
200	-75	55536	-11			104144	Edge of Clearing
				57753	1201	104154	
200	-90	55521	-15			104203	Edge of Clearing
225	-87	55522	1			104236	
				55542	-2211	104254	

STATION NORTH	STATION EAST	SURVEY FIELD	FLUX	BASE FIELD	FLUX	TIME	
225	-75	55533	11			104317	Boundary of Disturbed Area
225	-62	55548	15			104342	Boundary of Disturbed Area
				55545	3	104354	
225	-50	55542	-6			104406	
225	-37	55531	-11			104427	
225	-25	55538	7			104452	
				57869	2324	104454	
225	-12	55550	12			104535	Edge of Cleanup Exc
				58848	979	104554	
225		55551	1			104603	
225	12	55548	-3			104626	
225	25	55553	5			104648	
				58824	-24	104654	
225	39	55554	1			104710	
				58773	-51	104754	
250	-88	55514	-40			104850	Line Change
				58790	18	104854	
250	-75	55509	-5			104924	
				58783	-7	104954	
250	-62	55523	14			104955	Boundary of Disturbed Area
250	-50	55532	9			105024	
250	-37	55535	3			105043	
				58822	39	105054	
250	-25	55539	4			105105	
250	-12	55548	9			105129	
250		55553	5			105150	
				58822	-0	105154	
250	12	55552	-1			105215	
250	25	55555	3			105240	
				58846	24	105254	
250	37	55575	20			105310	Gravel Pile Adj to Pit
250	50	55575				105350	" " " " "
				58798	-48	105354	┐
250	62	55530	-45			105420	│
				58788	-10	105454	│
250	75	55514	-16			105504	│ Line Along S. Edge of Pit
250	87	55528	14			105537	│
				58829	41	105554	│
250	100	55555	27			105638	┘
				58812	-16	105654	
250	112	55563	8			105702	
250	130	55575	12			105731	
				58851	39	105754	
262	100	55502	-73			105834	
				58841	-10	105854	
262	112	55525	23			105858	┐
262	125	55564	39			105921	│ Spoil Pile @ E. End of Pit
262	137	55580	16	58921	80	105954	│
262	150	55597	17			110024	┘
				58860	-60	110054	
262	87	55517	-80			110116	┐ Data Discontinuity
262	75	55530	13			110151	│
				58944	84	110154	↓ ℄ of Pit

STATION NORTH	STATION EAST	SURVEY FIELD	FLUX
262	62	55545	15
262	50	55565	20
262	37	55561	-4
262	25	55554	-7
262	12	55554	
262		55554	
275	-88	55499	-55
275	-75	55502	3
275	-62	55510	8
275	-50	55535	25
275	-37	55547	12
275	-25	55543	-4
275	-12	55546	3
275	0	55551	5
275	12	55553	2
275	25	55553	
275	37	55557	4
275	50	55568	11
275	62	55571	3
275	75	55558	-13
275	87	55541	-17
275	100	55526	-15
275	112	55538	12
275	125	55564	26
275	137	55570	6
275	150	55590	20
300	140	55548	-42
300	125	55552	4
300	112	55556	4
300	100	55569	13
300	87	55571	2
300	75	55559	-12
300	62	55569	10
300	50	55560	-9
300	37	55552	-8

BASE FIELD	FLUX	TIME	Notes
		110253	℄ of Pit (110253–110316)
58894	-51	110254	
		110316	
		110341	
58879	-15	110354	
		110402	
		110425	
		110447	
58843	-37	110454	
		110553	Line Change
58836	-6	110554	
		110625	
		110651	
55547	-3289	110654	
		110717	Gravel Pile @ N. Corner of Pit (110717–110759)
55548	0	110754	
		110759	
		110823	
		110846	
55547	-0	110854	
		110912	
		110937	
55547	-0	110954	
		111000	
		111022	Area excavated by ADEC after September 16, 1988 survey (111022–111332)
		111048	
55547	-0	111054	
		111124	
		111150	
55546	-1	111154	
		111219	
		111241	
57631	2085	111254	
		111309	
		111332	
55524	-2106	111354	
		111406	
55519	-6	111454	
		111516	
		111552	Line Change
58910	3391	111554	
		111628	
		111651	
58953	44	111654	
		111713	Area affected by ADEC excavation after 9-16-88 survey (111713–111938)
		111741	
58877	-76	111754	
		111807	
		111840	
58889	12	111854	
		111913	
		111938	
55548	-3341	111954	

MAGNETOMETER DATA

STATION NORTH	STATION EAST	SURVEY FIELD	FLUX	BASE FIELD	FLUX	TIME	
300	25	55553	1			112009	
300	12	55552	-1			112032	
				58942	3394	112054	
300		55547	-5			112056	
300	-12	55541	-6			112117	
300	-25	55544	3			112131	
				58849	-93	112154	
300	-37	55538	-6			112201	
300	-50	55507	-31			112223	Boundary of Disturbed Area
300	-62	55499	-8			112253	
				58914	65	112254	
300	-75	55499				112321	
300	-87	55507	8			112347	Edge of Cleared Area
				58863	-51	112354	
300	-100	55506	-1			112416	
				58890	27	112454	
300	-112	55500	-6			112500	
300	-125	55636	136			112517	
				57026	-1864	112554	
300	-137	56234	598			112638	Approaching well casing
				55522	-1504	112654	
300	-150	57174	940			112707	along Lines 275 and 300
				55547	26	112754	
				55548	1	112854	
275	-100	55492	-1682			112856	
275	-112	55523	31			112930	
				55547	-1	112954	
275	-125	55734	211			112958	
275	-137	56280	546			113024	
275	-150	56521	241	55546	-1	113054	
290	-150	55613	-908			113124	Directly over Well Casing
				55546	0	113154	
290	-140	57698	2085			113156	10' E of well casing
				55546	0	113254	
325	-72	55517	-2181			113301	New Line - Data Discontinuity
325	-62	55522	5			113328	
325	-50	55532	10			113351	
				55546	-0	113354	Along edge of Sludge
325	-37	55540	8			113417	
325	-25	55554	14			113442	pits (includes BH-2 & BH-3)
				55546	-1	113454	
325	-12	55543	-11			113506	
325	0	55538	-5			113526	
325	12	55547	9			113551	
				55546	0	113554	
325	25	55549	2			113617	
325	37	55557	8			113640	
				55547	1	113654	
325	50	55562	5			113702	
325	62	55567	5			113728	
325	75	55566	-1	55548	1	113754	
				55548	-0	113854	
350	75	55573	7			113859	On small fill area

STATION NORTH	STATION EAST	SURVEY FIELD	FLUX	BASE FIELD	FLUX	TIME	
375	75	55576	3			113931	
				55546	-2	113954	On Small Fill Area
400	75	55575	-1			114001	
325	87	55573	-2	55545	-1	114054	
				55546	1	114154	
350	100	55570	-3			114203	
				55545	-0	114254	
350	112	55562	-8			114306	
350	125	55559	-3			114337	
				55546	1	114354	
325	150	55562	3			114428	
325	137	55558	-4			114446	
				55546	0	114454	
325	125	55554	-4			114517	
325	112	55553	-1			114552	
				55546	-1	114554	
325	100	55560	7			114606	
325	75	55564	4			114624	
				55545	-1	114654	
				55546	1	114754	
				55546	-1	114854	
				55545	-0	114954	
				55546	0	115054	
				55546	0	115154	
				55545	-1	115254	
				55544	-1	115354	
				55545	1	115454	
				55540	-5	115554	