915043

CDM

GEOPHYSICAL SURVEY
OF THE
PFOHL BROTHERS LANDFILL
Cheektowaga, New York

NYS DEC No. D-001894
CDM No. 897-12-RC-DPDC
Technos Project No. 88-152

Camp Dresser & McKee

GEOPHYSICAL SURVEY
OF THE
PFOHL BROTHERS LANDFILL
Cheektowaga, New York

NYS DEC No. D-001894
CDM No. 897-12-RC-DPDC
Technos Project No. 88-152

Submitted by:
Technos Inc., Consultants in Applied Earth Sciences,
Miami, Florida

TABLE OF CONTENTS

LIST OF FIGURES

All data is plotted on oversized basemaps at a scale of 1 inch equals 100 feet. Copies of these maps are included in the backpockets. Backpocket A is the magnetometer data and backpocket B is the electromagnetic data.

PURPOSE AND SCOPE

The Pfohl Brothers Landfill is located in Cheektowaga, New York, just outside of Buffalo, New York (Figure 1). This site is designated as three areas, referred to as A, B and C. These areas are 15, 95 and 55 acres in size, respectively (Figure 2). A geophysical investigation, as part of an RI/FS, was required for the New York State Department of Environmental Conservation. Camp Dresser & McKee (CDM) subcontracted Technos, Inc. through Larsen Engineers to carry out the geophysical survey work.

The objectives of the geophysical survey included:

- Locating and mapping the boundaries of the landfill material;
- Locating and mapping any trenches within areas B and C;
- Determining the nature of the fill material (ferrous vs. non-ferrous) within the trenches, and;
- Locating and mapping clusters of drums.

These objectives were to be met by using a combination of geophysical techniques, magnetometer and electromagnetics (EM). These continuous techniques were run on 50-foot line spacing in order to provide the most cost-effective coverage of the entire 165 acres. A total of approximately 26 line miles of magnetometer data and approximately 26 line miles of electromagnetic data were acquired.

A minor change in scope occurred due to the need for a second mobilization of the geophysical survey crew. This was caused by a scheduling problem of the brush clearing and surveying teams. A preliminary description and plot of the Site B magnetometer and EM data was provided to CDM after completion of the first mobilization and field work. See Appendix A for a copy of the preliminary description.

Due to the erratic nature of both the magnetometer and EM data, it was not feasible to carry out a detail interpretation for individual trenches, or individual clusters of buried drums. See Appendices B and C for examples of magnetometer and EM field data.

APPROACH

The recommended approach to this project included the use of magnetometer and electromagnetic techniques.

The magnetometer survey was used to detect the presence of ferrous metal (i.e. steel drums). This data provides the lateral extent of areas with ferrous metals, possibly trenches with drums.

The electromagnetic survey was used to measure both, quad-phase data (electrical conductivity) and in-phase data which is used for metal detection. It was anticipated that the landfill areas would be identified as high conductivity areas. The electromagnetic data may also identify areas of trenches due to contrasts in conductivity. The in-phase data is a response to both, ferrous and non-ferrous metals, and may indicate buried pipes, drums, tanks or scrap metal.

PROCEDURES

SURVEY GRID

The survey grid established by Larsen Engineers used Aero Drive as the baseline. Traverses spaced every 50 feet extended perpendicular to Aero Drive and were numbered 10+00 on the western edge to 43+50 on the eastern edge. CDM was responsible for clearing the traverse lines. They were then surveyed and staked by Larsen Engineers. Stakes were placed every 50 feet along each traverse line in order to place reference marks on the data.

Because the area was covered by dense vegetation, the traverse line clearance and surveying proceeded slower than anticipated. Therefore, in order to maintain our schedule during the Site B geophysical investigation, several traverse lines, in whole or in part, were paced at approximately 50-foot intervals for reference marks on the data. This introduces a potential 10 to 15% error in positioning of the data along the traverse line. This did not, however, significantly impact the Site B investigation.

MAGNETOMETER MEASUREMENTS

A magnetometer measures the intensity of the earth's magnetic field and detects changes (anomalies) in the magnitude and spatial distribution of this field caused by the presence of buried ferrous materials (such as drums, tanks, or scrap ferrous metals). Non-ferrous metals are not detected.

A vertical fluxgate gradiometer magnetometer was used for this survey. This instrument provides a vertical gradient measurement of the magnetic field. The gradiometer's response is proportional to the mass of the ferrous material and inversely proportional to the fourth power of the distance to the mass. The advantage of a gradiometer measurement, as opposed to a total field measurement, is that it eliminates all time variable natural magnetic noise and much of the time variable cultural noise. Use of a vertical gradient measurement also allows a magnetic survey to be carried out in close proximity to steel buildings, fences, etc. The net result is that the signal to noise ratio is significantly improved and a more reliable measurement and interpretation can be made. In addition, a gradient measurement tends to better define the lateral boundaries of magnetic anomalies.

The fluxgate gradiometer magnetometer has an adjustable range. For this survey, it was used with a full scale deflection of ±228 gammas per foot with a maximum sensitivity of 0.3 gammas per foot. This sensitivity allows the detection of a single 55 gallon drum buried at a depth of 6 to 8 feet.

The magnetometer was carried at a height of approximately 3 feet above the ground to minimize the response due to small near-surface targets. The data was recorded on a strip chart recorder. Reference points were staked every 50 feet along each traverse by the surveyor. As these points were passed along a traverse, a reference mark was made on the strip chart

recorder. The process of making station marks at specific intervals eliminates any cumulative positioning error that may occur along the survey line.

When interpreting the magnetic data, it is not possible to differentiate between the magnetic anomalies due to a drum and those associated with scrap ferrous metal. As a result, the observed magnetic anomalies may be due to drums or other pieces of steel.

ELECTROMAGNETIC MEASUREMENTS

The electromagnetic method measures the electrical conductivity of subsurface soil and rock. It can be used to map waste disposal areas which generally have elevated electrical conductivities. Lateral variations in electromagnetic conductivity are mapped by profiling measurements made with a Geonics EM31 instrument. This instrument measures the conductivity from the surface to depths of approximately 20 feet. The EM31 was used with a full scale deflection of 100 millimhos/meter and was carried at hip height with a vertical dipole orientation (horizontal coplanar coils).

Conductivity values are given in millimhos/meter. The values are not necessarily diagnostic in themselves; however, the spatial variations in conductivity are significant. Most areas of buried wastes or inorganic contaminants have specific conductance values which are considerably higher than natural soils or ground water. These elevated values can be

identified by electromagnetic conductivity measurements and provide the contrast necessary to map burial areas or an inorganic contaminant plume.

Both the in-phase component (which is an indication of metal), and the quad-phase component (which measures conductivity) were continuously recorded on an analog strip-chart recorder along each survey line. Reference points were staked every 50 feet along each traverse by the surveyor. As these points were passed along a traverse, a reference mark was made on the strip chart recorder. The process of making station marks at 50-foot intervals eliminates any cumulative position error that occur along the survey line.

EM conductivity measurements can be influenced by the presence of pipes, culverts, buildings, fences, scrap metal and drums. When the in-phase component on the EM31 responds to the presence of a significant amount of metal, the quad-phase component may also be affected. When this happens the quad-phase response will become erratic and not representative of conductivity data.

RESULTS AND INTERPRETATION

GENERAL INTERPRETATION CRITERIA

All data was plotted on oversized basemaps provided by Larsen Engineers at a scale of 1 inch equals 100 feet. A total of six maps covers the areas of Site A, B and C. Two sets of these maps are provided in the backpocket (one showing magnetometer data and the other showing electromagnetic data).

Magnetometer Data

The magnetometer survey was run using a full scale of ±228 gammas/foot. The amplitudes were characterized using the following criteria:

- o 1 = greater than ±152 gammas/foot
- o 2 = ±76 to 152 gammas/foot
- o 3 = less than ±76 gammas/foot

The typical response from a large mass of buried drums is a broad full scale response. The magnetic data at this site was extremely noisy, high frequency data. This is caused, in large part, by the significant amount of metal debris over the site. Therefore, no distinction can be made between surface or buried metal; nor between drums or scrap metal.

Electromagnetic Data

The electromagnetic data acquired indicated a high degree of variability. Much of the variability was due to the influence of surface and buried metals causing high frequency spikes in the data. Therefore, this data

was analyzed similar to the magnetometer data. This procedure looks at the amplitude of the signal(s) and their lateral extent only. Those areas which were strongly influence by metals are not representative of conductivity data and should therefore be ignored.

The EM survey was run on a 100 millimhos per meter (mm/m) full scale. Background conductivity values at all three sites (A, B and C) were determined to range from 20 to 25 mm/m.

Therefore, values above background were classified as follows:

- 1 = >75 to 100 mm/m
- 2 = >50 to 75 mm/m
- 3 = >25 to 50 mm/m
- 4 = ≤25 mm/m (background)

The natural background conductivity values were determined based upon the low and very consistent values seen immediately off of the western boundary of Site B. These low values are also seen at Site A and C at various locations around the perimeter of the sites.

SITE A

Site A is located north of Site B and covers the area just north of the toll plaza (see Figure 2). The survey grid at Site A is an extension from the baseline along Aero Drive. Electromagnetic and magnetometer data was acquired along traverse lines 33+50 to 39+50.

The data was collected around a building, a fuel pump and several parked trucks. These cultural features provided some level of interference in both data sets.

Magnetometer Data

The magnetometer data indicates a significant amount of ferrous metal present extending from the building north beyond the parking area. Construction debris was noted in the grassy areas around the northern half of Site A.

Closer toward the highway the level of magnetic response decreases. In the far southwest corner of the site, there is an area indicating no ferrous metal present.

Electromagnetic Data

The EM data generally indicates low conductivities over Site A. The eastern side of Site A is dominated by background values (less than 25 mm/m). These low conductivities in areas of high ferrous metal content possibly indicate a "clean" fill material that contains metal debris.

Two very small areas of high conductivity occur toward the western edge. In the northwest corner a very isolated area of high conductivity occurs in an area of high ferrous metal content. The second area of high conductivity occurs in the southwest corner in an area of no ferrous metal content.

SITE B

Site B is located north of Aero Drive and extends north beyond the creek to the New York State Highway. Electromagnetic and magnetometer data was acquired along traverse lines 10+00 to 43+50. Both sets of data were significantly influenced by the large amount of surface metal (drums and other metal debris).

Magnetometer Data

The magnetometer data has been plotted in order to show the lateral extent and general amplitude of the data. The magnetometer data at Site B indicates a significant amount of ferrous metal over the entire area. The magnetometer typically registered values of greater than ±228 gammas/foot.

Landfill Boundary: The boundary of the landfill was previously estimated prior to the geophysical investigation. Along the western edge of the surveyed area no magnetic response was obtained (i.e. 0 gammas/foot). This indicates that ferrous metals were not present in this area. Therefore, the magnetometer clearly identified and confirmed the western boundary of the landfill area.

Along the southern edge of Site B (along Aero Drive) the magnetometer response typically becomes very low (0 to ±76 gammas per foot). This indicates that the presence of ferrous metals toward Aero Drive becomes less, but there are still some targets present. This relative decline in

magnetic response indicates that the landfill probably extends as far south as Aero Drive.

The geophysical traverse lines for Site B were run up to the edge of the drop-off to the creek. This elevated area that runs along the creek visually appears to be the edge of the landfill. The magnetometer data indicates very strong magnetic responses on this elevated area almost along the entire length of the creek.

The only area where data crosses the creek was obtained in the northeast section of Site B. This data indicates little or no magnetic response in the creek area itself. This indicates that the creek maybe the northern boundary of Site B.

The area of Site B extended north of the creek up to the highway. A small area of magnetic response occurred in the northeast corner of Site B just north of the creek. After running several traverse lines further to the west (up to 36+50) it was apparent that no magnetic response was present. Two traverse lines were then run parallel to the creek and extended westward to Aero Lake. These lines confirmed that no ferrous metal was present in this area.

Magnetometer Anomalies: The entire area of Site B indicated some level of magnetic response. The area was however dominated by magnetic values of ±152 gammas/foot or greater.

These magnetic responses were very erratic and high frequency in character. See Appendix B for an example. Due to the character of the data, no individual areas (typical of buried drums or trenches) could be identified (i.e. broad full scale magnetic responses).

The general trend in the data shows that the area of large magnetic responses is concentrated toward the creek and become somewhat less concentrated toward Aero Drive. There is an area between lines 16+00 and 29+00 of lower and more random magnetic values. These lower values indicate a smaller amount of ferrous metals.

Electromagnetic Data

The EM data acquired at Site B indicated a high degree of variability. Due to the significant amount of metals at this site, much of the EM data is not representative of conductivity.

Landfill Boundary: Along the western edge of the surveyed, area conductivity values decreased to 20 to 30 mm/m. This decrease in conductivity correlates well with the lack of magnetic response in this area. This provides further confirmation of the western landfill boundary.

Along the southern edge of Site B (along Aero Drive) the EM data decreases to values between 25 and 50 mm/m. These conductivity values are above background probably due to surface runoff from Aero Drive. These values are, however, lower than those typically found over the landfill.

Most of the EM data running up to the edge of the creek shows a strong metal influence. This correlates well with the magnetometer data. As with the magnetic data, the only area where data crosses the creek was obtained in the northeast section of Site B. The EM data indicates very low background conductivity values in the creek. This also indicates that the creek may be the northern boundary of Site B.

The area of Site B extending north of the creek up to the highway indicated areas of only slightly elevated conductivity (typically 25-35 mm/m) in the low area by the creek and much higher values (up to 75 mm/m) on the elevated highway area. The higher values associated with the highway are likely due to surface runoff or fill material used in highway construction.

Two traverse lines were then run parallel to the creek and extended westward to Aero Lake. These lines confirmed consistent low conductivities in the area near the creek.

Inorganic Contaminant Migration: The clear western boundary, as defined by EM data also indicates that there is no detectable migration of any inorganic contaminants toward the west.

Conductivities values decrease to background values in the creek area on the northeast. This indicates a clear boundary with no detectable migration of any inorganic contaminants toward the northeast.

On the eastern and southern boundaries of the site, conductivity values decrease to just above background values. Although low levels of inorganic contaminants from the landfill may be the cause of these values above background, it is more likely due to surface runoff from the roads to the east and south. Therefore, inorganic contaminant migration to the east and south cannot be clearly assessed with the EM data.

Electromagnetic Anomalies: Due to the significant amount of metal over Site B, much of the EM data has a strong metal influence. Therefore, this data is not representative of conductivity and should not be used.

The areas of little or no metal influence indicate highly variable EM data. The EM conductivity values range from 30 to greater than 100 mm/m on the landfill. These values could represent natural conditions such as clay, or elevated specific conductance of the soils and/or pore fluids (possible inorganic contaminants).

The general trend in the EM data shows a major concentration of high conductivity values toward the center of the site (between lines 15+00 to 30+50). This generally coincides with an area of lower magnetic values. Although much of this data is characterized as being from 75 to 100 mm/m, it is often full scale responses indicating values above 100 mm/m. See Appendix C for an example of the field data. Along line 23+00 a test was run to determine the actual conductivity values in this area. Data collected on the 300 scale had values as high as 250 mm/m. Values this high are typically a strong indication of inorganic contaminants.

A smaller area of high conductivity occurs in the eastern area of the site (between lines 39+50 and 42+00). This area has values typically between 75 and 100 mm/m. These high conductivities coincide with an area of high ferrous metal content.

SITE C

Site C is located south of Aero Drive and extends to the railroad tracks and/or Pfohl Road. Magnetometer and electromagnetic data was acquired along traverse lines 16+50 to 42+00. Both sets of data were influenced by the large amount of surface metal (drums and other metal debris).

A small area between traverse lines 34+00 and 36+50, extending from Aero Drive about 350 feet for the magnetometer data and up to 500 feet for the EM data, was not surveyed. Valid data would not be possible in that area due to the number of old trucks and scrap metal.

Magnetometer Data

The magnetometer data has been plotted in order to show the lateral extent and general amplitude of the data. The magnetometer data at Site C indicates a significant amount of ferrous metal over most of the area. The area of ferrous metal appears smaller in lateral extent than Site B. In addition, the typical magnetic response was between ±152 and ±228 gammas/foot. The areas with values greater than ±228 gammas/foot were not as abundant as in Site B.

Landfill Boundary: Generally, the highest magnetic responses are concentrated in the center of the area surveyed. With only minor exceptions, the entire area surveyed had some magnetic response. However, the concentration of ferrous metals begins to decrease toward the west at about traverse line 24+50. This general decrease in magnetic response appears to roughly define a western boundary to the landfill area at Site C.

The area of high magnetic values extends as far north as Aero Drive at traverse line 28+50. These high values begin to decrease south of Aero Drive as you continue eastward. In the extreme northeast corner of the site, the magnetic values are very random and contain areas of no magnetic response. Therefore, the northern boundary of the landfill area appears to be Aero Drive and possibly south of Aero Drive toward the east.

The landfill appears to be bounded on the east by Transit Road, and on the south by the railroad berm and Pfohl Road. High magnetic values extend up to all of these features. Once on the railroad berm, however, magnetic values decrease and in some areas indicate no ferrous metal present. A few traverse lines extended beyond Pfohl Road (25+00 to 26+00) and also indicate no ferrous metal present.

Magnetic Anomalies: The entire area of Site C indicated some level of magnetic response. The center of the site, however, was dominated by high magnetic values between ±152 to ±228 gammas/foot. Outside of this central

area, there were a number of scattered targets with the typical magnetic values being less than ±76 gamma/foot.

Within the central magnetic anomaly the data was very erratic with high frequency spikes. See Appendix B for an example. Due to the character of the data, no individual areas (typical of buried drums or trenches) could be identified.

To the west, beyond traverse line 24+50, there are numerous scattered targets. An area of high magnetic values, outside the approximate landfill boundary, occurs around a "barn" in the southwest corner of the site. This area contained a number of surface metal targets and appears to be a "disposal" area separate from the landfill itself.

Electromagnetic Data

The EM data acquired at Site C indicated a high degree of variability. Due the significant amount of metals at this site, much of the EM data is not representative of conductivity.

Landfill Boundary: The western boundary of the landfill is difficult to determine based on the EM conductivity data. The EM conductivity data is highly variable and does not indicate a distinct central area of high values. However, by looking at the area of strong metal influence in the EM data a general boundary can be defined. At about traverse line 26+00, the area of strong metal influence decreases to very isolated random areas of metal influence.

The landfill area generally appears to be bounded on the north by Aero Drive. High conductivity values extend to Aero Drive between traverse lines 27+00 to 34+00. However, in the far northeast corner of the site there is an area of very low background conductivities. This area correlates with an area of variable, but generally lower, magnetic values.

Based on the areas of strong metal influence, the landfill appears to be bounded on the east by Transit Road and on the south by the railroad berm and Pfohl Road. In general, the conductivities in these areas are only slightly above background, except along Pfohl Road. The high conductivities along Pfohl Road are likely associated with surface runoff and fill material used in construction of the road.

Inorganic Contaminant Migration: The background conductivity values in the northeast corner clearly indicate no detectable migration of any inorganic contaminants in that area.

The north, east and southern boundaries of the landfill have typical conductivities of 25 to 50 mm/m. These values, which are typical of this site are relatively low, as compared to those at Site B. However, because there is a lack of background values in these areas, inorganic contaminant migration to the east and south cannot be clearly assessed with the EM data.

To the west, the EM values are highly variable. These conductivities appear to be somewhat random rather than continuous from the landfill

area. Therefore, these higher conductivities may be due to random isolated sources rather than the landfill.

Electromagnetic Anomalies: Due to the significant amount of metal over Site C, much of the EM data has a strong metal influence. Therefore, this data is not representative of conductivity and should not be used.

The central area of the landfill, as defined by the magnetic and EM data, does have a small area of conductivities as high as 100 mm/m. High conductivities outside of the central area of the landfill occur in the northwest and southwest corners of Site C. The northwest corner has an area of conductivities ranging from 50 to 100 mm/m. This area appears to be separate from the landfill and contains some isolated areas of metal. The high conductivity area in the southwest, appears to be associated with the "barn" area. This isolated "disposal" area has a high metal content and high conductivities.

area. Therefore, these higher conductivities may be due to random isolated sources rather than the landfill.

Electromagnetic Anomalies: Due to the significant amount of metal over Site C, much of the EM data has a strong metal influence. Therefore, this data is not representative of conductivity and should not be used.

The central area of the landfill, as defined by the magnetic and EM data, does have a small area of conductivities as high as 100 mm/m. High conductivities outside of the central area of the landfill occur in the northwest and southwest corners of Site C. The northwest corner has an area of conductivities ranging from 50 to 100 mm/m. This area appears to be separate from the landfill and contains some isolated areas of metal. The high conductivity area in the southwest, appears to be associated with the "barn" area. This isolated "disposal" area has a high metal content and high conductivities.

CONCLUSIONS AND RECOMMENDATIONS

SITE A

Site A generally has a high ferrous metal content and low conductivities. Two isolated minor anomalies of high conductivity occur; one in an area of ferrous metal and the other in an area of no metal. Therefore, the high ferrous metal content and low conductivity at Site A may be due to possibly "clean" fill material with construction debris.

SITE B

The magnetic data indicates that the landfill area of Site B is covered entirely with ferrous metal to some extent. The majority of the site registers magnetic responses of greater than ±228 gammas/foot indicating an extensive amount of ferrous metals.

The EM data over most of Site B was strongly influenced by the presence of metals and, therefore, not representative of conductivity data and not usable. The areas of little or no metal influence but high conductivity typically indicated values of greater than 100 mm/m. These very high values are likely due to inorganic contaminants.

The western and northeastern boundaries of Site B are well defined by the magnetometer and EM data. The north, east and southern boundaries appear less clearly defined by the geophysical data.

The sharp decrease to background conductivity values along the western and northeastern boundaries indicates that there is no detectable inorganic contaminant migration off the landfill in those areas.

SITE C

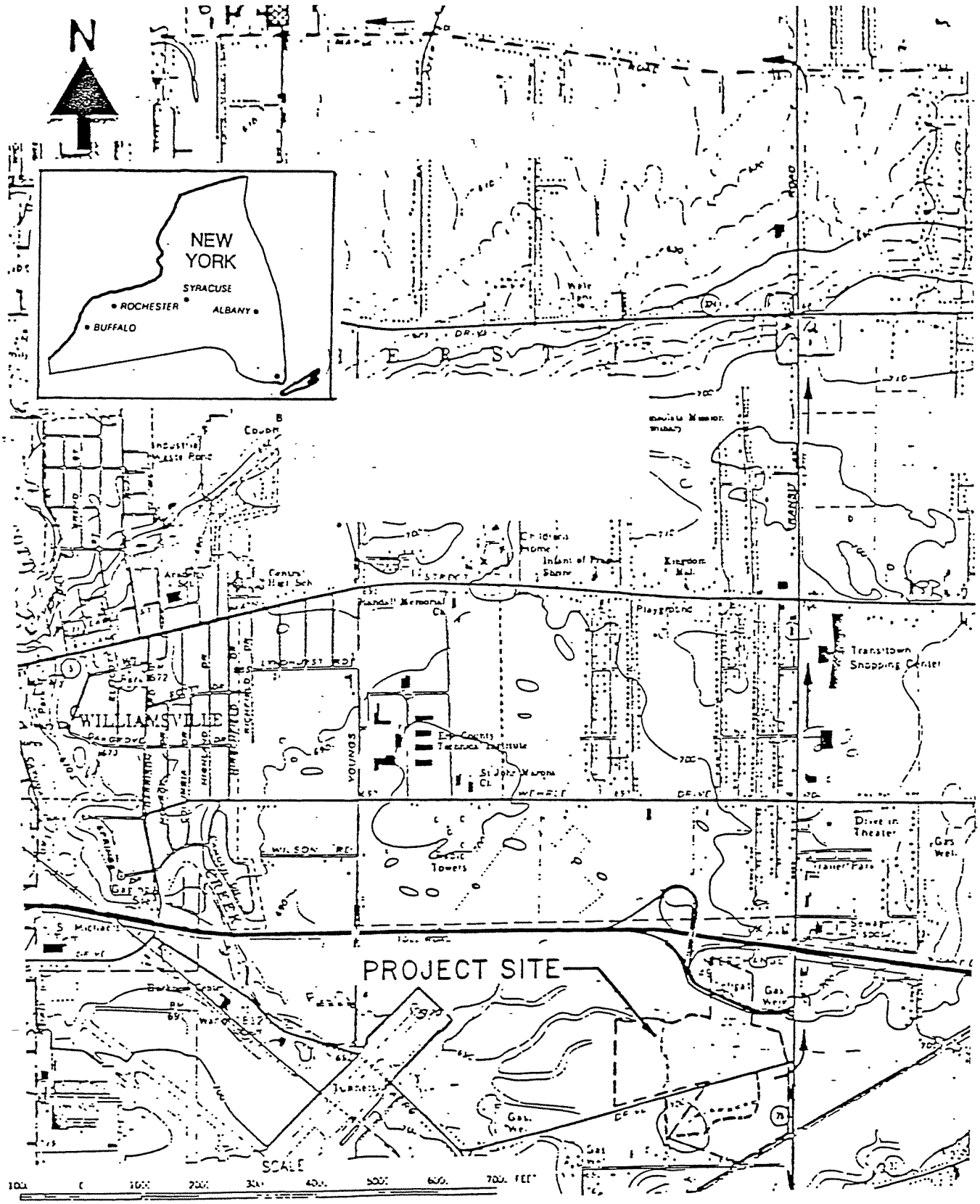
The magnetic data indicates that almost all of the Site C area is covered entirely with ferrous metals to some extent. The majority of the site registers magnetic responses between ±152 to ±228 gammas/foot. This area appears to have a less extensive amount of ferrous metal present, as compared to Site B.

The EM data over much of Site C was strongly influenced by the presence of metals and therefore not representative of conductivity data and not usable. The areas of little or no metal influence indicated EM values ranging from background (less than 25 mm/m) up to 100 mm/m. Conductivity values at Site C were typically, however, between 25 and 50 mm/m.

The boundaries of the landfill area at Site C were better defined by the magnetometer data than by the EM data. The western boundary is estimated to occur around traverse line 25+50. However, no clear boundaries were observed probably due to numerous random targets throughout the area.

The only area at Site C where inorganic contaminant migration can be clearly assessed is in the northeast corner of the site. In this area conductivity values decrease to background levels.

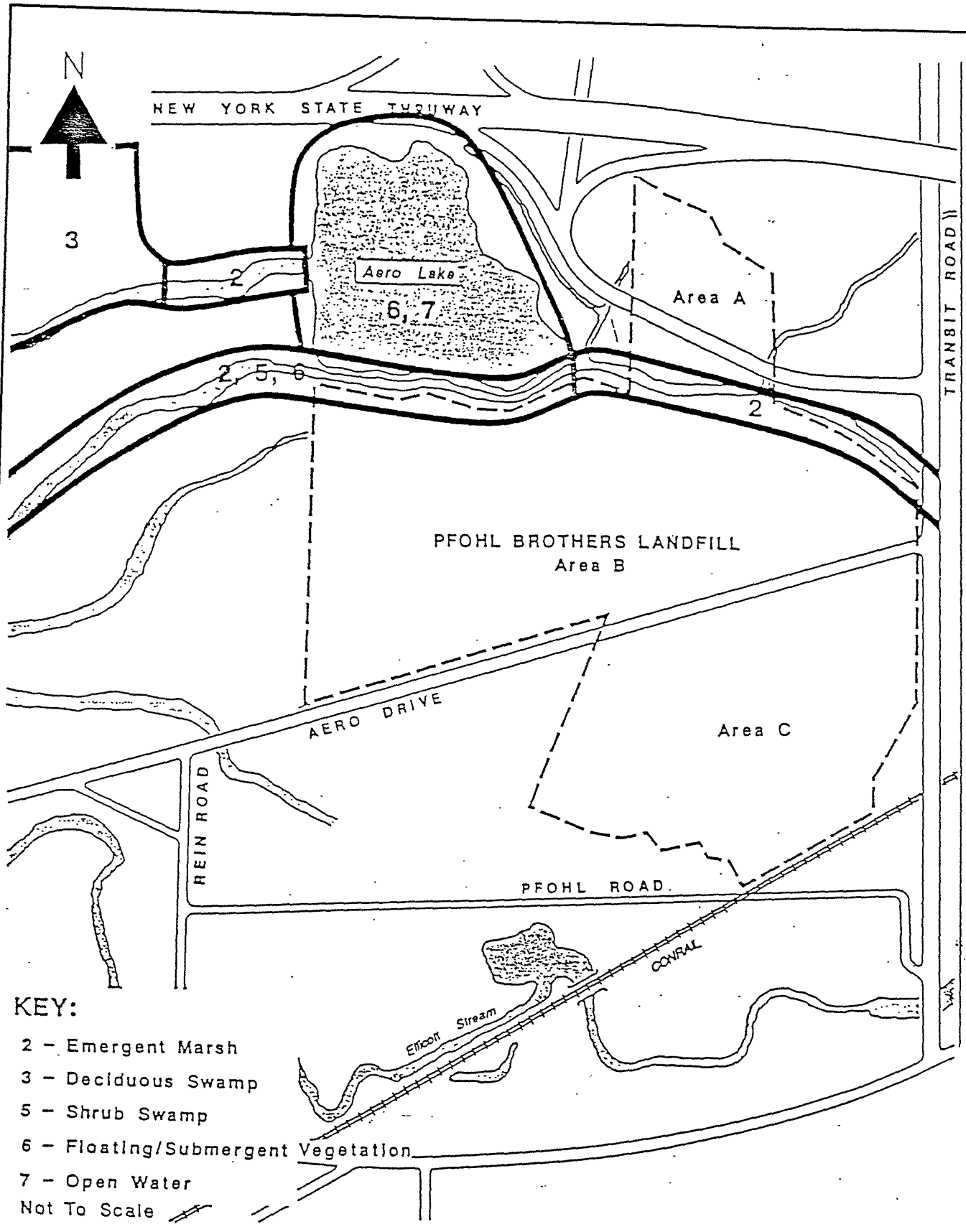
It should be noted: Due to the extensive amount of ferrous metals at all three sites, no areas can be recommended for purposes of drilling. It is recommended in order to minimize safety concerns, that any sampling is carried out using methods others than drilling.



Source: CDM

Figure 1. Location Map

TECHNOS



Source: CDM

Figure 2. Site Map

TECHNOS

TECHNOS

Technos Inc.
Consultants in Applied
Earth Sciences
3333 Northwest 21st Street
Miami, Florida 33142
Telephone (305) 634-4507

September 22, 1988

Lee Gutterman
Camp, Dresser & McKee
40 Rector Street
10th Floor
New York, NY 10006

Re: Pfohls Brothers Landfill - Preliminary Geophysical Data

Dear Lee:

We have completed the field work, data processing and preliminary interpretation for the Site B area of the landfill. Electromagnetic and magnetometer data was acquired along traverse lines 10 + 00 to 43 + 50. Both sets of data were significantly influenced by the large amount of surface metal (drums and other metal debris). These two data sets have been plotted on site maps (Figure 1 and 2).

Electromagnetic Data

The electromagnetic data acquired at Site B indicated a high degree of variability. Much of the variability was due to the influence of surface and buried metals causing high frequency spikes in the data. Therefore, this data will be analyzed similar to the magnetometer data. This procedure looks at the amplitude of the signal(s) and their lateral extent only.

The electromagnetic data is a measure of bulk conductivity of the soil, rock and pore fluids. This measurement can however be influenced by metal (both ferrous and nonferrous, buried or surface). Those areas which were strongly influence by metals are not representative of conductivity data and should therefore be ignored. These areas are shown on Figure 1.

Those areas moderately influenced by metal may or may not be representative data and therefore must be used with caution. These areas are shown on Figure 1.

The EM survey was run on a 100 mm/m full scale. Background conductivity values were determined to range from 20 to 30 millimhos/meter and were clearly picked up off the western edge of the landfill. Therefore, values above background were classified as follows:

- o 4 - ≤25 mm/m (background)
- o 3 - >25 to 50 mm/m
- o 2 - >50 to 75 mm/m
- o 1 - >75 to 100 mm/m

The EM data indicates values ranging from 30 to 100 mm/m on the landfill. These values could represent natural conditions such as clay, or elevated specific conductance of the soils and/or pore fluids (possible inorganic contaminants).

In many cases, the strip chart recorder was pegged to full scale. This indicates values greater than 100 mm/m. Along line 23 + 00 a test was run to see how high the EM values actually went. Data was collected at the 300 scale with values reaching 250 mm/m. Values this high (250mm/m) are typically a strong indication of inorganic contaminants. Therefore, areas on Figure 1 characterized as "1" should be considered anomalous and investigated further.

Magnetometer Data

The magnetometer data has been plotted on Figure 2 in order to show the lateral extent and general amplitude of the data. The magnetometer survey was run using a full scale of ± 228 gammas/foot. The amplitudes were characterized using the following criteria:

- o 1 = greater than ± 152 gammas/foot
- o 2 = ±76 to 152 gammas/foot
- o 3 = less than ±76 gammas/foot

The typical response from a large mass of buried drums is a broad full scale response. The magnetic data at this site was extremely noisy, high frequency data. This is caused in large part by the significant amount of metal debris over the site. Therefore, no distinction can be made between surface or buried metal; as well as drums or scrap metal.

The only few areas surveyed which did not indicate the presence of ferrous metal (i.e. 0 gammas/foot) were off of or at the boundary of the landfill Site B. The entire area of Site B (on the landfill) indicated some level of ferrous metals.

Therefore, due to the extensive amount of ferrous metals, no areas can be recommended for purposes of drilling. It is recommended in order to minimize safety concerns, that any sampling is carried out using hand augers.

Figure 1 and 2 represent the preliminary analysis of these data sets. Further review of the data will be carried out; therefore, these figures and preliminary analysis is subject to change.

If you have any questions, please phone.

Sincerely,

Lynn Yuhr
General Manager
Vice President

cc: Carol Yamarino, CDM Niagara Falls Office

Enclosures.-

APPENDIX B

This appendix includes examples of magnetometer field data obtained during this investigation. The examples are provided to illustrate the range of anomalies observed, their character and the linear method of classification used to characterize their magnitude.

The magnitude of the magnetic anomaly for a gradiometer is proportional to the mass of the target and inversely proportional to the depth to the target to the fourth power. Magnetic responses can be either negative or positive deflections (±228 gammas/foot) which are recorded on the strip chart recorder. As a rule of thumb, broad anomalies typically indicate large deep targets, and narrow anomalies typically indicate small shallow targets.

Interpretation of the magnetic data acquired at the Pfohl Brother's Landfill was limited to plotting the lateral extent of the magnetic anomaly along the traverse lines and a linear characterization of the magnitude in terms of gammas per foot, as follows:

- o 1 = greater than ±152 gammas/foot;
- o 2 = ±76 to 152 gammas/foot;
- o 3 = less than ±76 gammas/foot;
- o 4 = 0 gammas/foot.

Figure B1 is a magnetometer field record showing an example of three levels of magnetic anomalies. Note the low levels of magnetic noise in background areas.

Figure B2 is an example of a magnetometer field record illustrating a group of major anomalies characterized as 1. Major anomalies at Site B were typically greater than full scale ±228 gammas/foot, while anomalies characterized as 1 at Sites A and C were not as extreme.

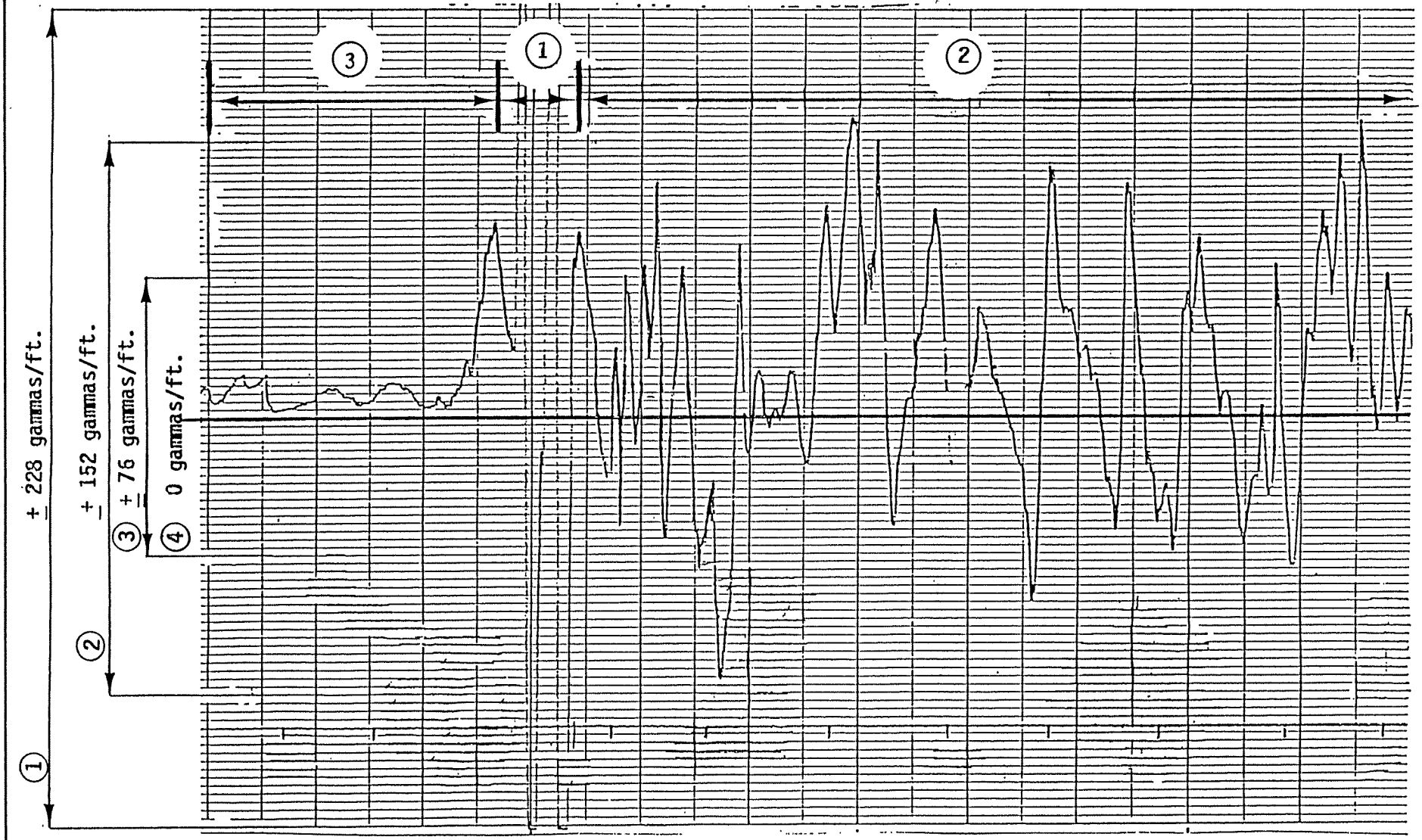


Figure B1. Example of Magnetic Anomalies

TECHNOS

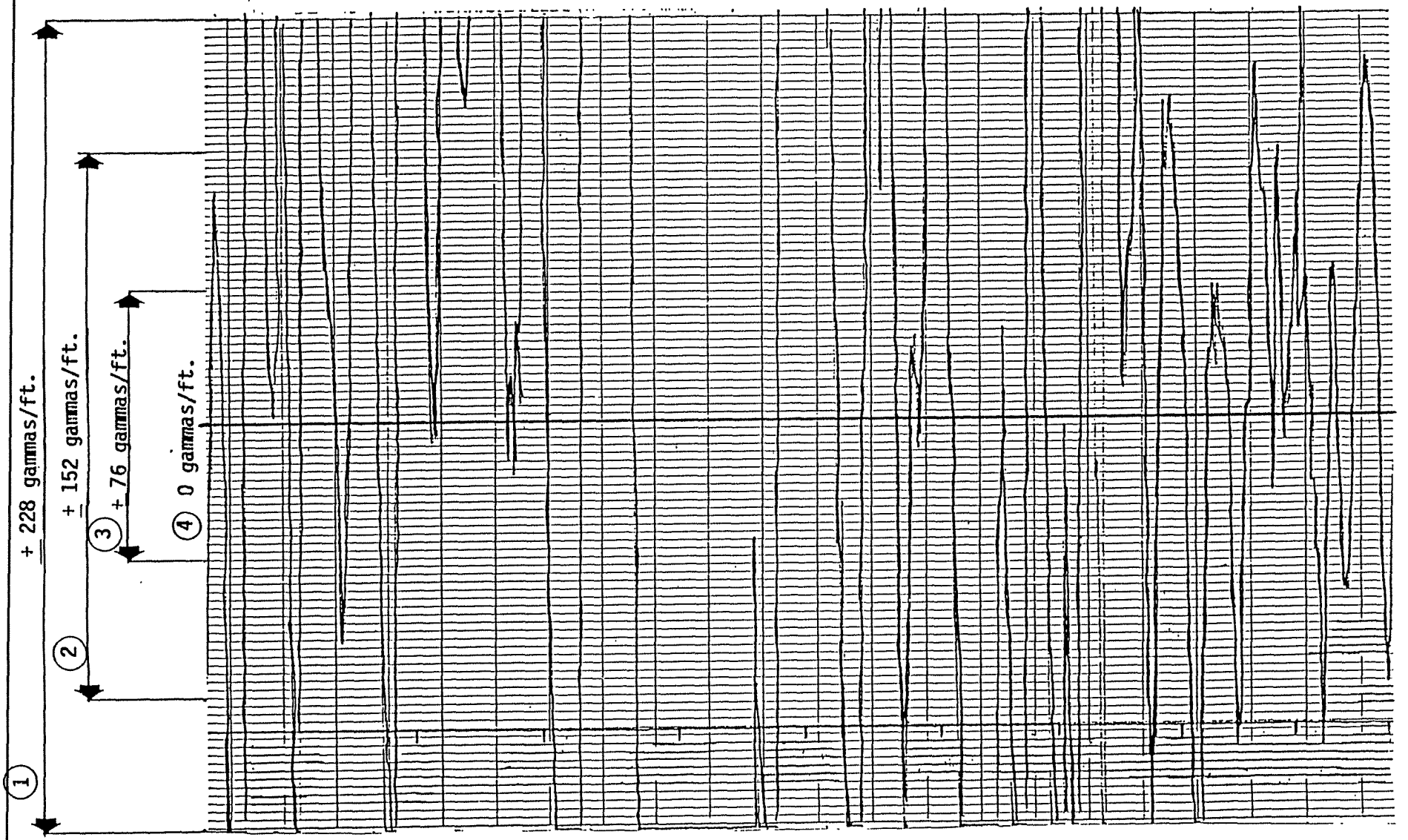


Figure B2. Example of Major Magnetic Anomaly

APPENDIX C

This appendix includes examples of electromagnetic field data obtained during this investigation. The examples are provided to illustrate the range of anomalies observed, their character and the linear method of classification used to characterize their magnitude.

The magnitude of the EM anomaly is based upon the bulk conductivity measurement of the soil, rock and the pore fluids to a depth of approximately 20 feet. Interpretation of the conductivity data required the characterization of the in-phase component, due to the influence of the metals present. When the in-phase component is significantly influenced by metals, the quad-phase component may also be affected. When this happens the quad-phase response will become erratic and not representative of conductivity data.

Interpretation of the EM data acquired at the Pfohl Brother's Landfill was limited to plotting the lateral extent of the magnetic anomaly along the traverse lines and a linear characterization of the magnitude in terms of millimhos per meter (mm/m), as follows:

- 1 = >75 to 100 mm/m
- 2 = >50 to 75 mm/m
- 3 = >25 to 50 mm/m
- 4 = $\leq$25 mm/m (background)

Figure C1 is an EM field record showing an example of three levels of EM anomalies. Note the contrast in the conductivity data with a strong metal influence with the conductivity data without a metal influence.

Figure C2 is an example of an EM field record illustrating a major anomalous area characterized a 1. Major anomalies at Site B were typically greater than full scale 100 mm/m, while anomalies characterized as 1 at Site A and C were typically 75 to 100 mm/m.

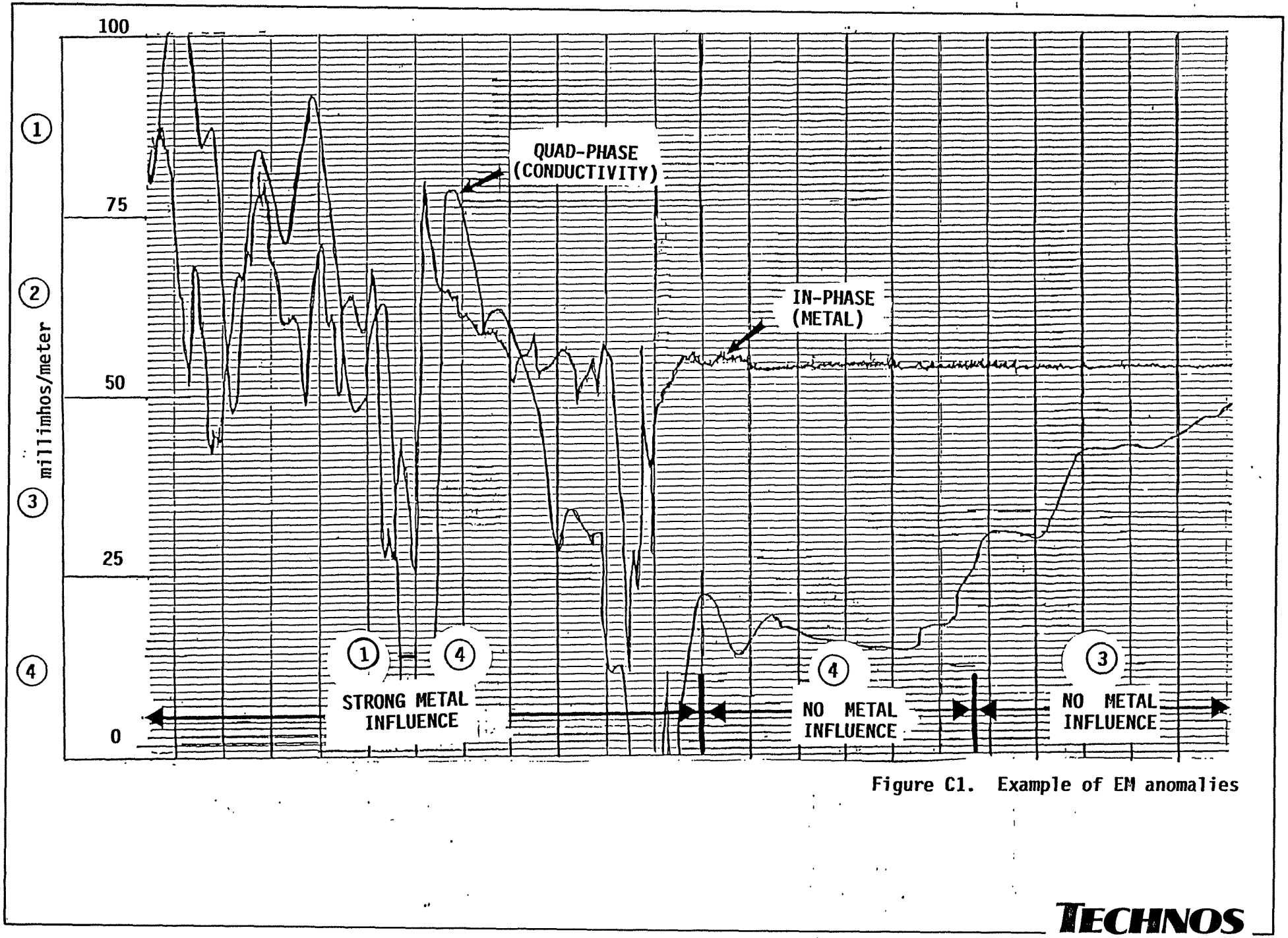


Figure C1. Example of EM anomalies

TECHNOS

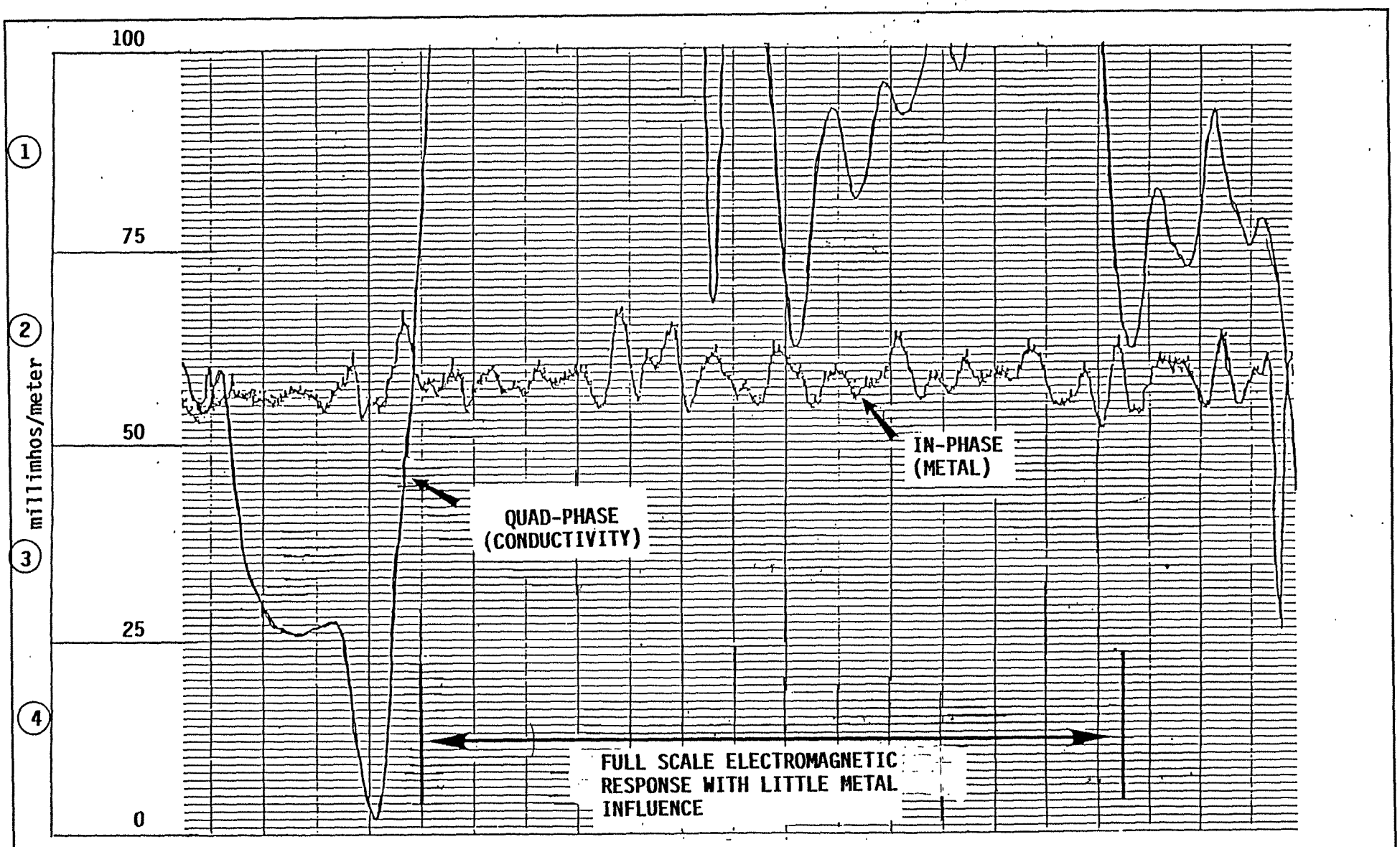
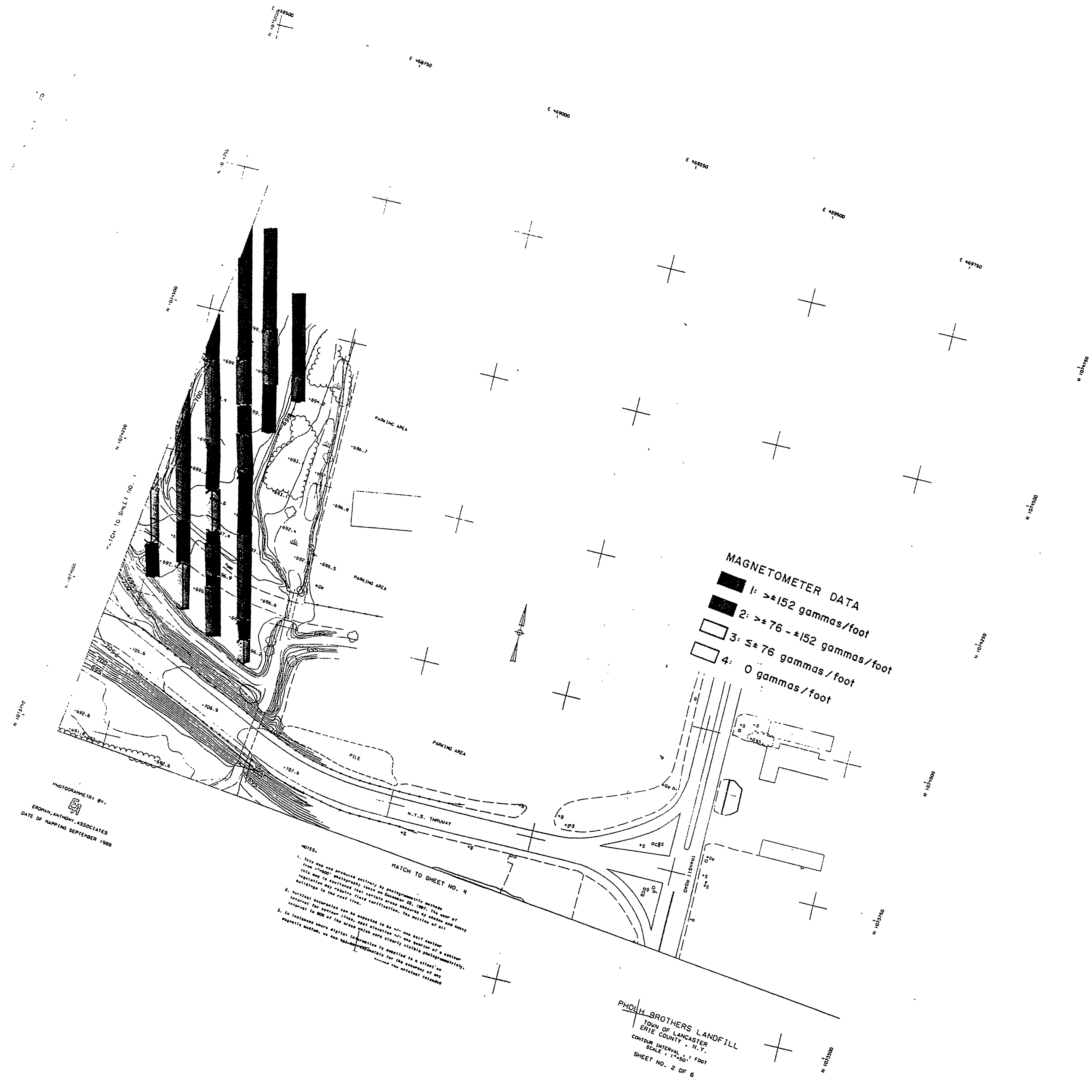


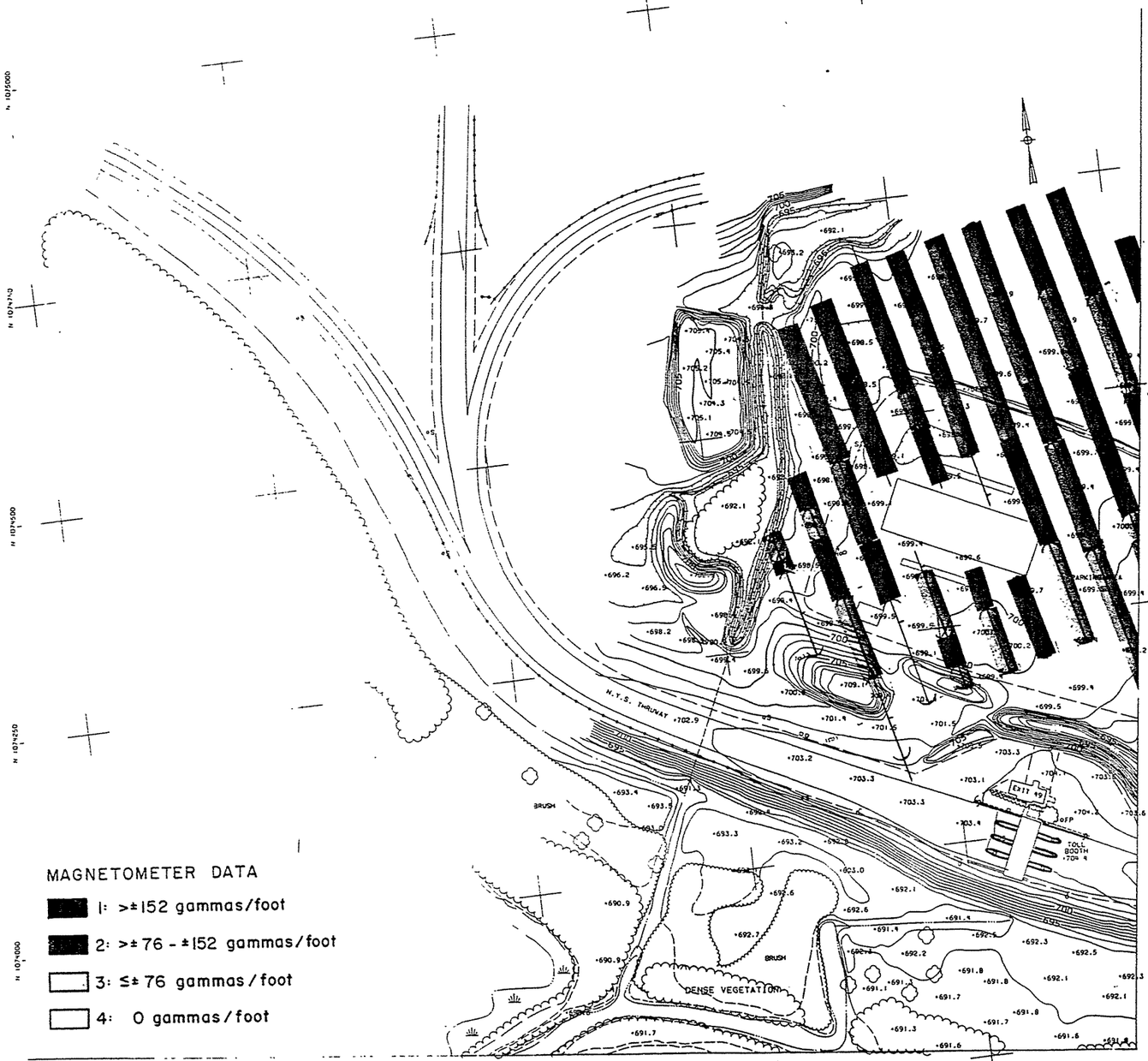
Figure C2. Examples of Major EM Anomaly

TECHNOS


MAGNETOMETER DATA
1: >±152 gammas/foot
2: >±76 - ±152 gammas/foot
3: ≤±76 gammas/foot
4: 0 gammas/foot
E 468500
E 468750
E 469000
E 469250
E 469500
E 469750
N 1074750
N 1074500
N 1074250
N 1074000
N 1073750
N 1073500
MATCH TO SHEET NO. 1
PARKING AREA
PARKING AREA
PARKING AREA
PILE
N.Y.S. THRUWAY
TRANSIT ROAD
MATCH TO SHEET NO. 4
NOTES:
PHOTOGRAMMETRY BY:
ERDMAN, ANTHONY, ASSOCIATES
DATE OF MAPPING SEPTEMBER 1988
PFOHL BROTHERS LANDFILL
TOWN OF LANCASTER
ERIE COUNTY, N.Y.
CONTOUR INTERVAL 1 FOOT
SCALE 1"=50'
SHEET NO. 2 OF 6

E 467500 E 467750 E 468000 E 468250 E 468500 E 468750

N 1075000 N 1074750 N 1074500 N 1074250 N 1074000 N 1073750 N 1073500



MAGNETOMETER DATA

1: >±152 gammas/foot

2: >±76 - ±152 gammas/foot

3: ≤±76 gammas/foot

4: 0 gammas/foot

NOTES:

1. This map was prepared entirely by photogrammetric methods from 1"=500' photography taken on December 22, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.

2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, spot elevation +/- one quarter of a contour interval in 90% of the areas which were clearly visible photogrammetrically.

3. In instances where digital information is supplied to a client on magnetic medium, we can not be responsible for the accuracy of any subsequent computer generated mapping, beyond the original intended map scale.

PHOTOGRAMMETRY BY:
EA
ERDMAN, ANTHONY, ASSOCIATES
DATE OF FLYING SEPTEMBER 1988

PHOLH BROTHERS LANDFILL

TOWN OF LANCASTER
ERIE COUNTY, N.Y.

CONTOUR INTERVAL = 1 FOOT
SCALE : 1"=50'

SHEET NO. 1 OF 6

MAGNETOMETER DATA

1: >±152 gammas/foot

2: >±76 - ±152 gammas/foot

3: ≤±76 gammas/foot

4: 0 gammas/foot

MATCH TO SHEET NO. 1

MATCH TO SHEET NO. 4

MATCH TO SHEET NO. 5

DENSE VEGETATION

BRUSH

NOTES.

1. This map was produced entirely by photogrammetric methods from 1"=600' photography taken on December 22, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.

2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, spot elevation +/- one quarter of a contour interval in 90% of the areas which were clearly visible photogrammetrically.

3. In fairness these digital information is supplied to a client on magnetic medium, we can not be responsible for the accuracy of any subsequent computer generated mapping, beyond the original intended map scale.

PHOTOGRAMMETRY BY:

ERDMAN, ANTHONY, ASSOCIATES

DATE OF MAPPING SEPTEMBER 1988

PHOLH BROTHERS LANDFILL

TOWN OF LANCASTER

ERIE COUNTY , N.Y.

CONTOUR INTERVAL = 1-FOOT

SCALE = 1"=50'

SHEET NO. 3 OF 6

NOTES:

1. This map was produced entirely by photogrammetric methods from 1"=500' photography taken on December 22, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.

2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, spot elevation +/- one quarter of a contour interval in 90% of the areas which were clearly visible photogrammetrically.

3. In instances where digital information is supplied to a client on magnetic medium, we can not be responsible for the accuracy of any subsequent computer generated mapping, beyond the original intended map scale.

PHOTOGRAMMETRY BY:

EA

ERDMAN, ANTHONY, ASSOCIATES

DATE OF MAPPING SEPTEMBER 1988

PHOLH BROTHERS LANDFILL

TOWN OF LANCASTER
ERIE COUNTY, N.Y.

CONTOUR INTERVAL = 1 FOOT
SCALE = 1"=50'

SHEET NO. 4 OF 6

E 466250 E 466500 E 466750 E 467000 E 467250 E 467500 E 467750 E 468000 E 468250

N 1072750 N 1072500 N 1072250 N 1072000 N 1071750 N 1071500 N 1071250

MATCH TO SHEET NO. 3

MATCH TO SHEET NO. 6

MAGNETOMETER DATA

- 1: >±152 gammas/foot
- 2: >±76 - ±152 gammas/foot
- 3: ≤±76 gammas/foot
- 4: 0 gammas/foot

PHOTOGRAMMETRY BY:

ERDMAN, ANTHONY, ASSOCIATES

DATE OF MAPPING SEPTEMBER 1988

NOTES:

1. This map was produced entirely by photogrammetric methods from 1"=500' photography taken on December 22, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.
2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, and elevations +/- one quarter of a contour interval in 90% of the areas which were clearly visible photogrammetrically.
3. In instances where digital information is supplied in a client on magnetic medium, we can not be responsible for the accuracy of any enhancement computer generated mapping, beyond the original intended use scale.

PHOLH BROTHERS LANDFILL

TOWN OF LANCASTER
ERIE COUNTY, N.Y.

CONTOUR INTERVAL = 1 FOOT
SCALE = 1"=50'

SHEET NO. 5 OF 6

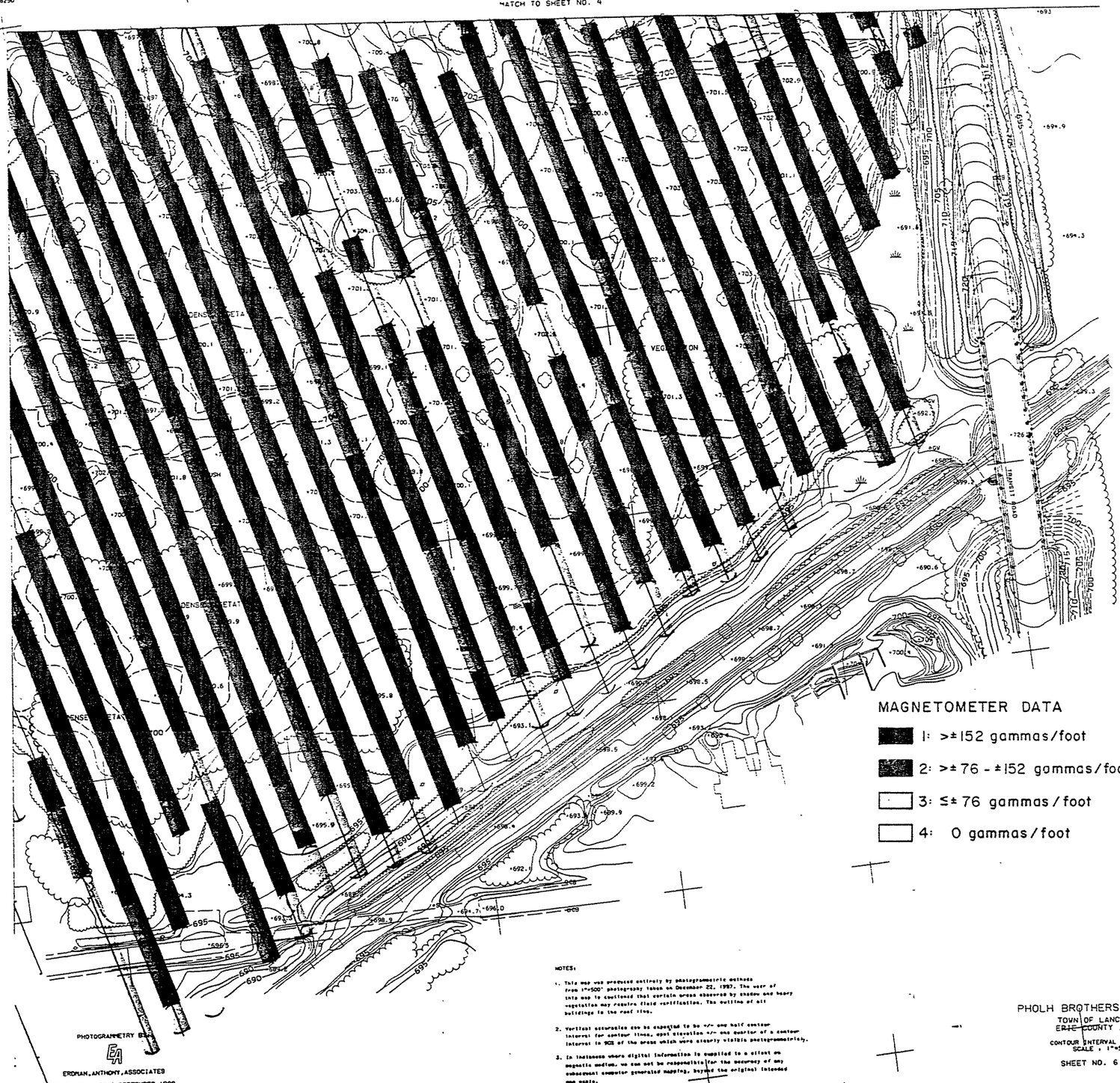
E 466000 E 466250 E 466500 E 466750 E 467000 E 467250 E 467500 E 467750 E 468000

E 468250 E 468500 E 468750 E 469000 E 469250 E 469500 E 469750

N 1072500 N 1072250 N 1072000 N 1071750 N 1071500 N 1071250 N 1071000

MATCH TO SHEET NO. 4

MATCH TO SHEET NO. 5



MAGNETOMETER DATA

1: >±152 gammas/foot

2: >±76 - ±152 gammas/foot

3: ≤±76 gammas/foot

4: 0 gammas/foot

NOTES:

1. This map was produced entirely by photogrammetric methods from 1"=500' photography taken on December 22, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.

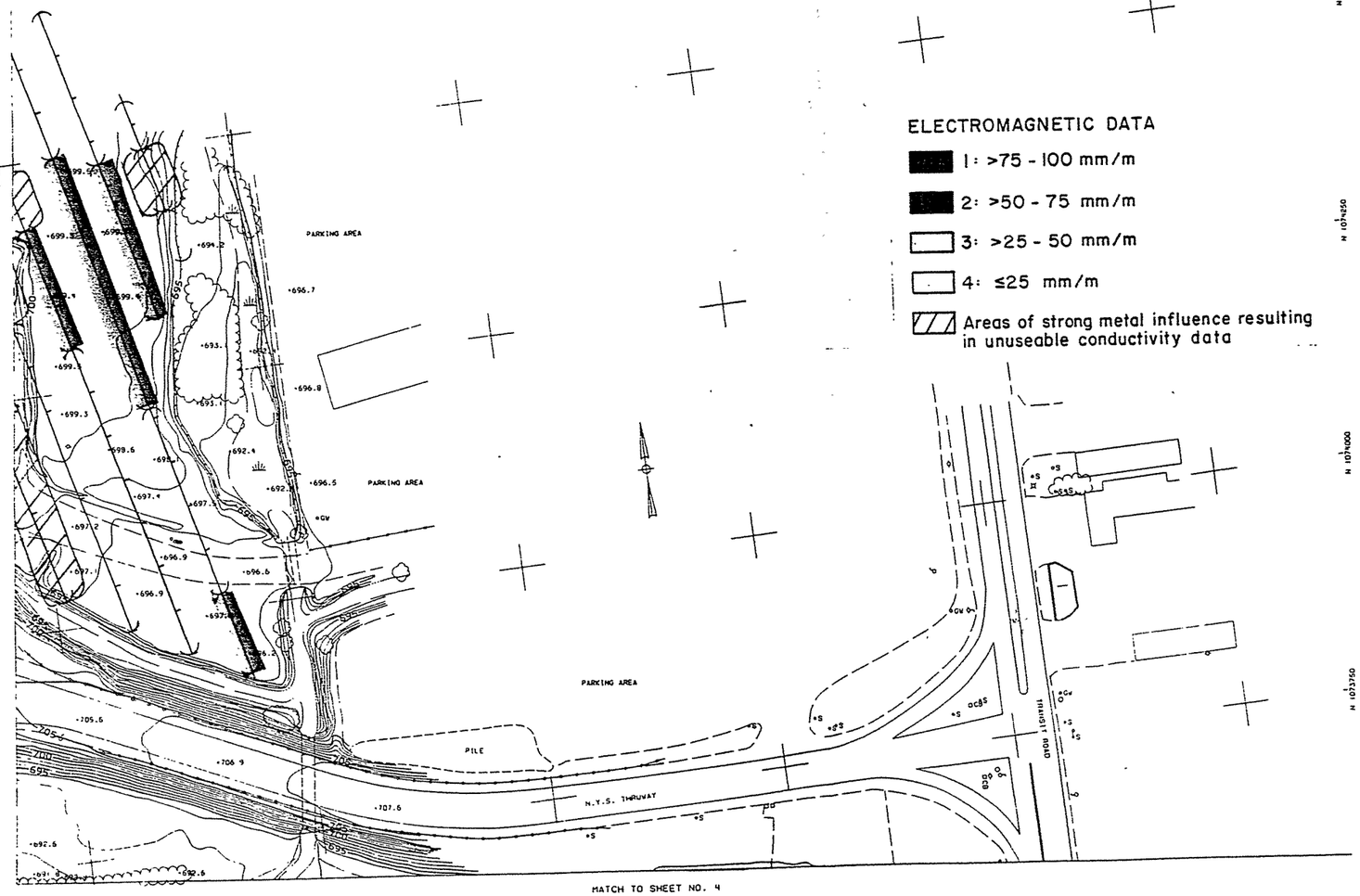
2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, spot elevation +/- one quarter of a contour interval in 90% of the areas which were clearly visible photogrammetrically.

3. In instances where digital information is supplied to a client on magnetic medium, we can not be responsible for the accuracy of any subsequent computer generated mapping, beyond the original intended map scale.

PHOLH BROTHERS LANDFILL
TOWN OF LANCASTER
ERIE COUNTY, N.Y.
CONTOUR INTERVAL = 1 FOOT
SCALE : 1"=50'

SHEET NO. 6 OF 6

E 468500
E 468750
E 469000
E 469250
E 469500
E 469750
N 1075000
N 1074750
N 1074500
N 1074250
N 1074000
N 1073750
N 1073500



ELECTROMAGNETIC DATA

1: >75 - 100 mm/m

2: >50 - 75 mm/m

3: >25 - 50 mm/m

4: ≤25 mm/m

Areas of strong metal influence resulting in unuseable conductivity data

NOTES:

1. This map was produced entirely by photogrammetric methods from 1"=500' photography taken on December 22, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.

2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, spot elevation +/- one quarter of a contour interval in 90% of the areas which were clearly visible photogrammetrically.

3. In instances where digital information is supplied to a client on

PHOTOGRAMMETRY BY:

ERDMAN, ANTHONY, ASSOCIATES

PHOUH BROTHERS LANDFILL

TOWN OF LANCASTER
ERIE COUNTY, N.Y.

CONTOUR INTERVAL = 1 FOOT
SCALE : 1"=50'

E 467500

E 467750

E 468000

E 468250

E 468500

E 468750

N 107500

N 107250

N 107000

N 106750

N 106500

N 106250

N 106000

N 105750

MATCH TO SHEET NO. 2

MATCH TO SHEET NO. 3

N.Y.S. THRUWAY

EXIT 49

TOLL BOOTH

OFF

PARKING AREA

BRUSH

DENSE VEGETATION

ELECTROMAGNETIC DATA

1: >75 - 100 mm/m

2: >50 - 75 mm/m

3: >25 - 50 mm/m

4: ≤25 mm/m

Areas of strong metal influence resulting in unuseable conductivity data

NOTES:

1. This map was prepared entirely by photogrammetric methods from 1"=200' photography taken on December 22, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.

2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, spot elevation +/- one quarter of a contour interval in 90% of the areas which were clearly visible photogrammetrically.

PHOTOGRAMMETRY BY

PHOLI BROTHERS LANDFILL

TOWN OF LANCASTER

ERIE COUNTY, N.Y.

CONTOUR INTERVAL = 1 FOOT

SCALE : 1"=50'

ELECTROMAGNETIC DATA

1: >75 - 100 mm/m

2: >50 - 75 mm/m

3: >25 - 50 mm/m

4: ≤25 mm/m

Areas of strong metal influence resulting in unuseable conductivity data

MATCH TO SHEET NO. 1

MATCH TO SHEET NO. 4

MATCH TO SHEET NO. 5

NOTES:

1. This map was produced entirely by photogrammetric methods from 1"=500' photography taken on December 21, 1987. The user of this map is cautioned that aerials areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.

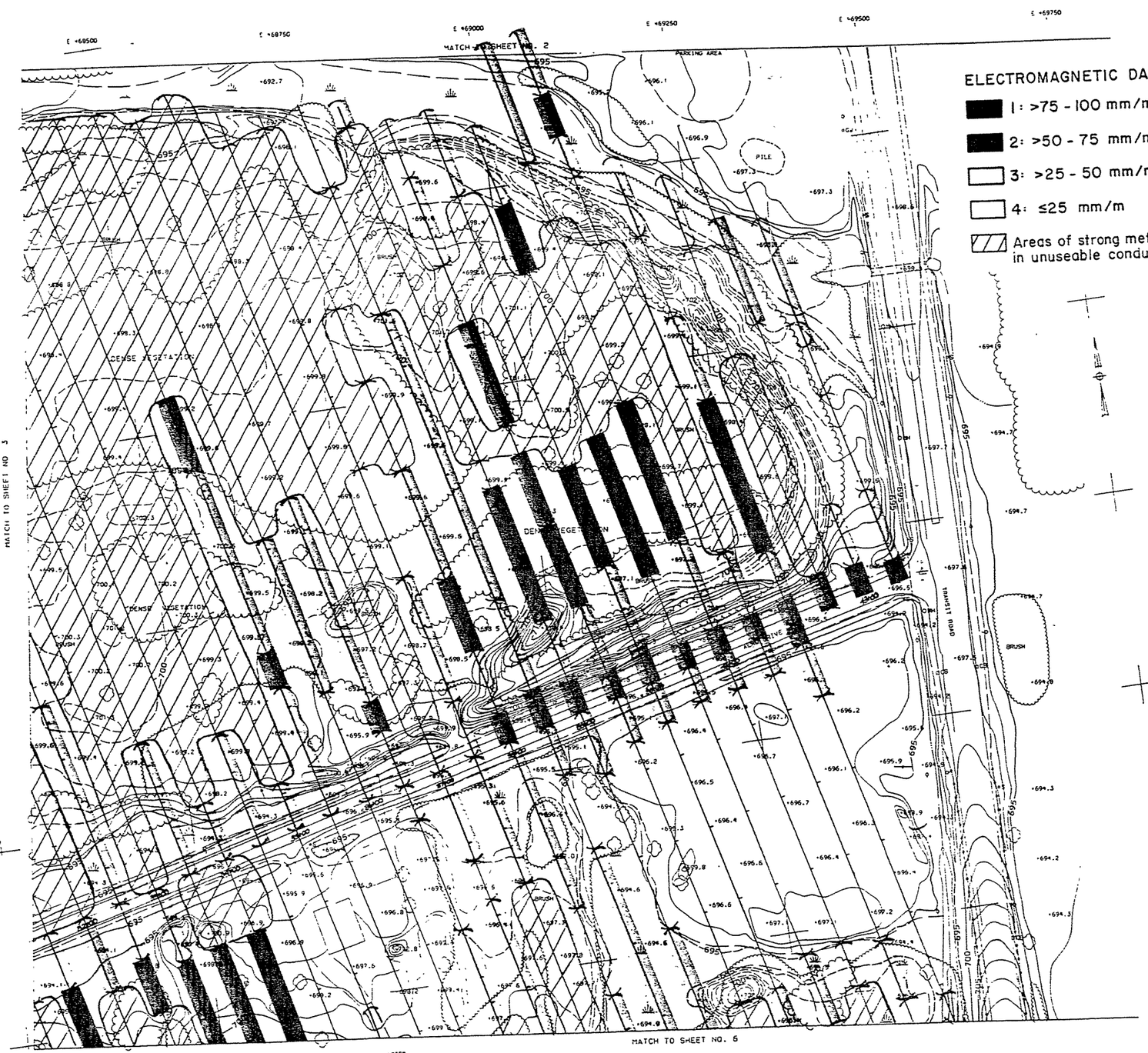
2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, spot elevation +/- one quarter of a contour

PHOTOGRAMMETRY BY:

PHOLH BROTHERS LANDFILL

TOWN OF LANCASTER

ERIE COUNTY , N.Y.



NOTES:

1. This map was produced entirely by photogrammetric methods from 1"=500' photography taken on December 29, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.

2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, and elevation +/- one quarter of a contour interval in 90% of the areas which were clearly visible photogrammetrically.

3. In instances where digital information is supplied to a client on magnetic medium, we can not be responsible for the accuracy of any

PHOTOGRAMMETRY BY:

EA

CROMAN ANTHONY ASSOCIATES

12
16
25
53

PHOLH BROTHERS LANDFILL
TOWN OF LANCASTER
ERIE COUNTY, N.Y.

CONTOUR INTERVAL: 1 FOOT
SCALE: 1"=50'

SHEET NO. 4 OF 6

E 466250 E 466500 E 466750 E 467000 E 467250 E 467500 E 467750 E 468000 E 468250

N 1072750 N 1072500 N 1072250 N 1072000 N 1071750 N 1071500 N 1071250

MATCH TO SHEET NO. 3

MATCH TO SHEET NO. 6

ELECTROMAGNETIC DATA

- 1: >75 - 100 mm/m
- 2: >50 - 75 mm/m
- 3: >25 - 50 mm/m
- 4: ≤25 mm/m
- Areas of strong metal influence resulting in unuseable conductivity data

PHOTOGRAMMETRY BY:

EA

ERDMAN, ANTHONY, ASSOCIATES

DATE OF MAPPING SEPTEMBER 1988

NOTES:

1. This map was produced entirely by photogrammetric methods from 1"=500' photography taken on December 22, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.

2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, spot elevation +/- one quarter of a contour interval in 90% of the areas when were clearly visible photogrammetrically.

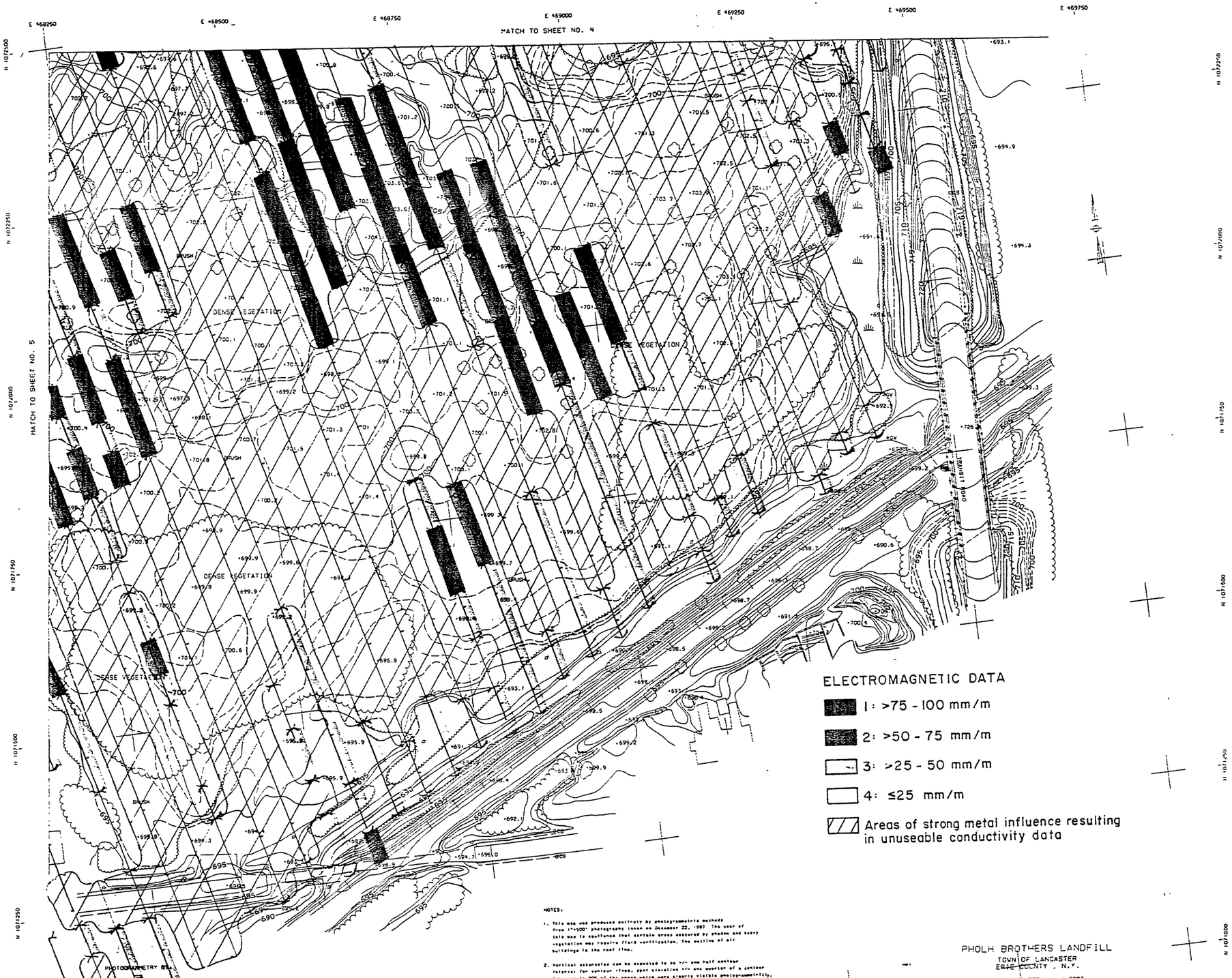
3. In instances where digital information is supplied to a client on magnetic medium, we can not be responsible for the accuracy of any consequent computer generated mapping, beyond the original intended map scale.

PHOLH BROTHERS LANDFILL

TOWN OF LANCASTER
ERIE COUNTY, N.Y.

CONTOUR INTERVAL : 1 FOOT
SCALE : 1"=50'

SHEET NO. 5 OF 6


E 468250
E 468500
E 468750
E 469000
E 469250
E 469500
E 469750
N 1072500
N 1072250
N 1072000
N 1071750
N 1071500
N 1071250
N 1071000
MATCH TO SHEET NO. 4
MATCH TO SHEET NO. 5
DENSE VEGETATION
BRUSH
PHOTOGRAMMETRY STA.
ELECTROMAGNETIC DATA
1: >75 - 100 mm/m
2: >50 - 75 mm/m
3: >25 - 50 mm/m
4: ≤25 mm/m
Areas of strong metal influence resulting in unuseable conductivity data
NOTES:
1. This map was produced entirely by photogrammetric methods from 1"=500' photography taken on December 22, 1987. The user of this map is cautioned that certain areas obscured by shadow and heavy vegetation may require field verification. The outline of all buildings is the roof line.
2. Vertical accuracies can be expected to be +/- one half contour interval for contour lines, spot elevation +/- one quarter of a contour interval in 90% of the areas which were clearly visible photogrammetrically.
3. In instances where digital information is supplied to a client on
PHOLH BROTHERS LANDFILL
TOWN OF LANCASTER
ERIE COUNTY , N.Y.
CONTOUR INTERVAL = 1 FOOT
SCALE = 1"=50'