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915049

SNYDER TANK
SITE # 915049

Weston Geophysical
CORPORATION

November 14, 1990

Mr. Edward Chen
YEC, INC.
Clarkstown Executive Park
612 Corporate Way
Suite 4M
Valley Cottage, New York 10989

Subject: Results from Geophysical Survey
Snyder Tank Property
Hamburg, New York

Dear Mr. Chen:

In accordance with your authorization, Weston Geophysical conducted terrain conductivity and electrical resistivity surveys on November 6 and 7, 1990 at the Snyder Tank Property, Hamburg, New York. The purpose of this investigation was to provide information to help locate possible utilities and other buried objects which could be a hazard during the drilling and installation of monitoring wells. The methodologies employed and results of investigations are summarized below.

LOCATION AND SURVEY CONTROL

The general area of investigation is shown on Figure 1. The terrain conductivity (EM-31) data were acquired along nine lines within the enclosed parking lot and beach areas. Survey line locations were staked in the field and their positions determined by taped measurements and compass bearings relative to buildings, fences, and other cultural features.

Electrical resistivity soundings were conducted in 4 locations; two of these locations were in the beach area, while the other two were in areas in the parking lot where anomalous EM-31 data were obtained. Figure 2 shows the location of EM-31 survey lines and electrical resistivity sounding locations.

METHODS OF INVESTIGATION

The EM-31 D terrain conductivity meter measures the conductivity of earth materials to a depth of about 20 feet. The technique is an "induction" technique, which measures the strength of the secondary magnetic field generated in the presence of a conductor, such as a metallic object. In the presence of metallic objects, negative conductivity values or "polarity reversals" are observed, making them readily detectable by the EM-31 methodology. Data are recorded digitally and transferred to a computer for immediate evaluation. An expanded discussion of the electromagnetic induction method may be found in Appendix A.

Resistivity data were acquired using an ABEM model SAS-300 resistivity instrument in conjunction with copper-plated steel electrodes and ancillary connecting cables. All resistivity data were obtained using the Lee modification of the Wenner electrode configuration with electrode separations ("A-spacings") of 2 to 100 feet at the four sounding locations.

GEOLOGY GEOPHYSICS HYDROGEOLOGY SEISMOLOGY
Lyons Street, Box 550, Westboro MA 01581-0550, Tel. (508)366-9191, FAX (508)366-9197, Telex No. 920491

RESULTS

Terrain Conductivity Measurements

Data obtained using the EM-31 terrain conductivity meter indicate that there is a general decrease in conductivity toward Lake Erie. Conductivity values inside the fenced area generally ranged from 30 to 50 mmhos/m, with the highest values exceeding 100 mmhos/m. Conductivity values on the beach ranged from 20 to 27 mmhos/m.

Conductivity results also revealed the presence of metallic objects, as evidenced by highly variable conductivity values. Two distinct anomalous areas indicative of buried metal were detected. One area is located in the vicinity of GW-3, along Line 3, north of Station 2+80, Line 4, north of Station 3+25, and along all of Lines 2A, 3B, and W3. The high frequency and moderate amplitude of conductivity values suggest the presence of smaller metallic objects, such as utilities. Well GW-3 appears to be located in this anomalous area, although it appears that the buried target (possible pipe) may be as much as 10 feet south. Nevertheless, caution should be exercised while drilling in this area. Figure 3 is a generalized conductivity map showing this anomalous area.

The other area, characterized by high amplitude and high frequency conductivity values, is indicative of more massive metallic objects. This area is located in the center of the truck turnaround area, where above ground metal objects which interfere with data acquisition were not present. Anomalous conductivity readings were obtained along Line 4, Stations 0+95 through 1+90, and along Line 5, Stations 1+10 through 2+00, as shown on Figure 3.

Conductivity values were slightly anomalous in the vicinity of GW-2; however, the presence of above ground metal objects, such as fences and trailers, probably influenced the data.

Electrical Resistivity Measurements

Results of the electrical resistivity survey are interpreted from curves depicting recorded data and computer generated models. The sounding data are most reliably modeled with a three layer, high-low-high, resistivity sequence.

PT-2, located to the northwest of Line 1, Station 6+00 and north of the facility, is probably the best representative of "natural" earth conditions. The top layer, having an apparent resistivity of 460 Ohm-feet, is indicative of a partially saturated sand, as observed in the field. The relatively low resistivity (161 Ohm-feet)/high conductivity intermediate layer probably delineates the saturated-unsaturated sand boundary, approximately 4 to 6 feet below grade. The more resistive (543 Ohm-feet) third layer is probably indicative of the shale bedrock speculated to exist in this area. Model data at PT-2 indicate that material with resistivity values indicative of bedrock occur at 14 feet below grade.

Modeled electrical resistivity results at PT-1 were somewhat irregular. These resistivity values are indicative of nonhomogeneous/anisotropic conditions, such as may be caused by the presence of concrete rubble and/or other "fill" material. The uppermost resistivity layer, having an apparent resistivity of 2100 Ohm-feet, corresponds to unsaturated sand and contains blocks of concrete (observed in the field). This layer has an approximate thickness of 6 to 8 feet. The more conductive layer(s) probably correspond to the saturated natural material, found at about 8 feet below grade. Resistivity values indicative of bedrock were not detected at PT-1.

Within the fenced area on the Snyder Tank property, the high-low- high resistivity sequence is evident. However, because of the presence of a thin layer of fill material, the resistivity values of the uppermost layer ranges from 1060 to 3420 Ohm-feet and has a thickness of 0.8 to 1.5 feet at PT-3 and PT-4, respectively. A resistivity value of 529 Ohm-feet was detected at PT-3, which may be indicative of the partially saturated natural material. Resistivity values of 156 and 132 Ohm-feet, indicative of saturated conditions, were detected at PT-3 and PT-4, respectively, 3 to 6 feet below grade. Resistivity values indicative of bedrock were not detected at PT- 3.

SUMMARY

Two anomalous areas indicative of buried metal were detected along conductivity survey lines. One anomalous area, detected in the vicinity of GW-3 may be indicative of small metal objects, such as pipes or rebar. The anomalous area located by Line 4, Stations 0+95 through 1+90 and Line 5, Stations 1+10 through 2+00, have conductivity values that exceed 50 mmhos/m, and are also indicative of buried metal.

A minor conductivity anomaly detected at proposed well location GW-2 may be attributed to the proximity of a fence and trailer.

Electrical Resistivity data indicate that the water table is about 3 to 6 feet below grade at "point test" areas, while bedrock type resistivity layering appears to be within 14 feet of ground surface at PT-2 and about 6 feet below grade around PT-4.

RECOMMENDATIONS

Two test pits are recommended in each of the anomalous areas outlined in Figure 3. In addition, modeling variability obtained in PT-1 and other point tests may be reduced when ground truth methods such as well borings are used and data are input into the current models. We would, therefore, recommend that well bore information be sent upon completion of the drilling program for further refinement of these models, and better identification of terrain conductivity anomalies.

Mr. Edward Chen
YEC, INC.

November 14, 1990

We will be pleased to provide you with any additional information that you may require, and appreciate the opportunity to provide YEC, Inc. with our geophysical services.

Sincerely

WESTON GEOPHYSICAL CORPORATION

Charlene Sullivan

Charlene Sullivan
Geophysicist

Doria Kutrubes

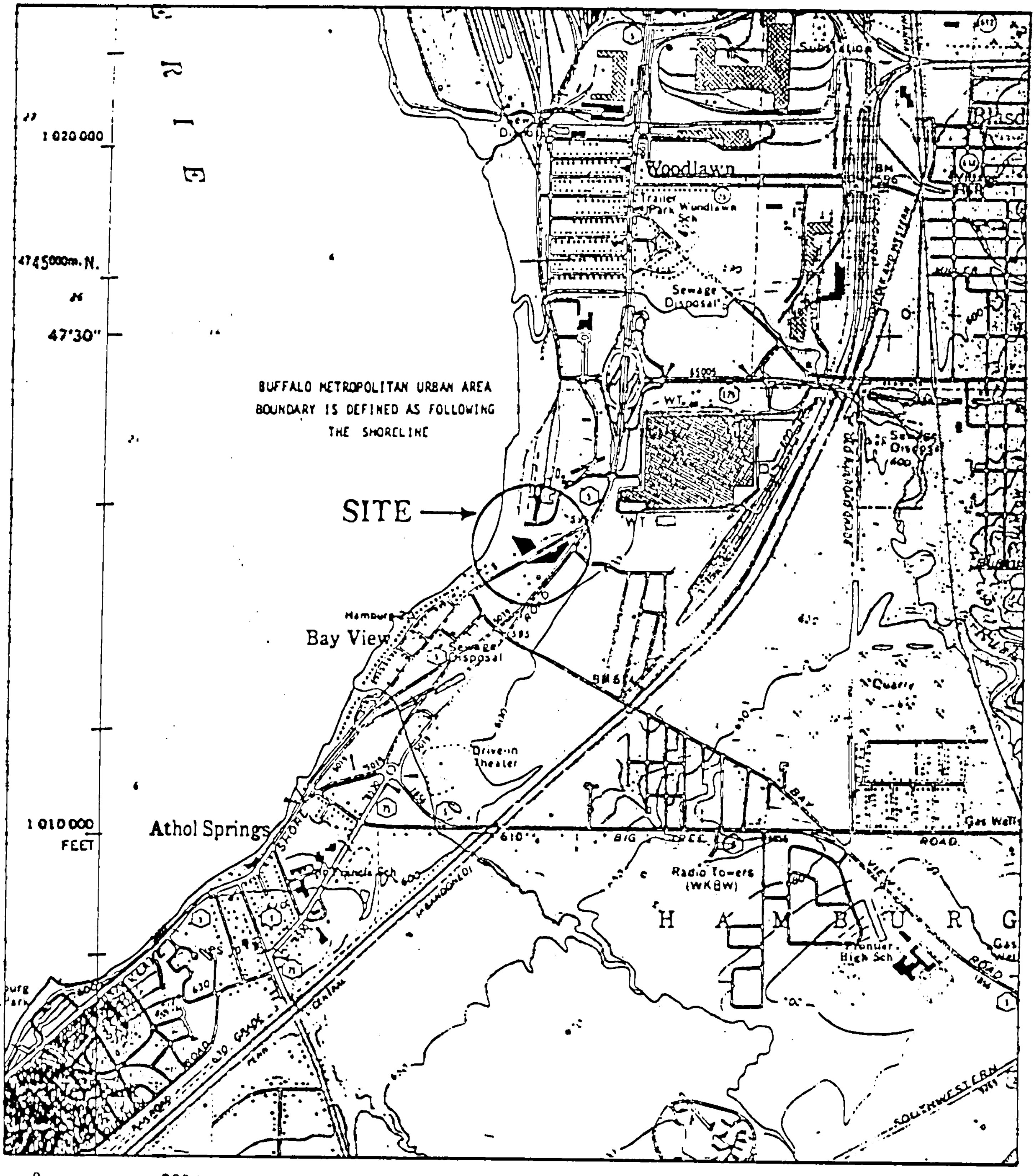
Doria Kutrubes
Project Geophysicist

CS/DLK:cc
WGC - 18295-06
Attachments

TABLE 1 - WELL CLEARING

GW-1	Relocated by YEC personnel
GW-2	Proximity to metal fence, but below ground appears to be free of large metal objects
GW-3	Located in a very "noisy" area in which numerous pipes and/or other metal objects are present.

FIGURES



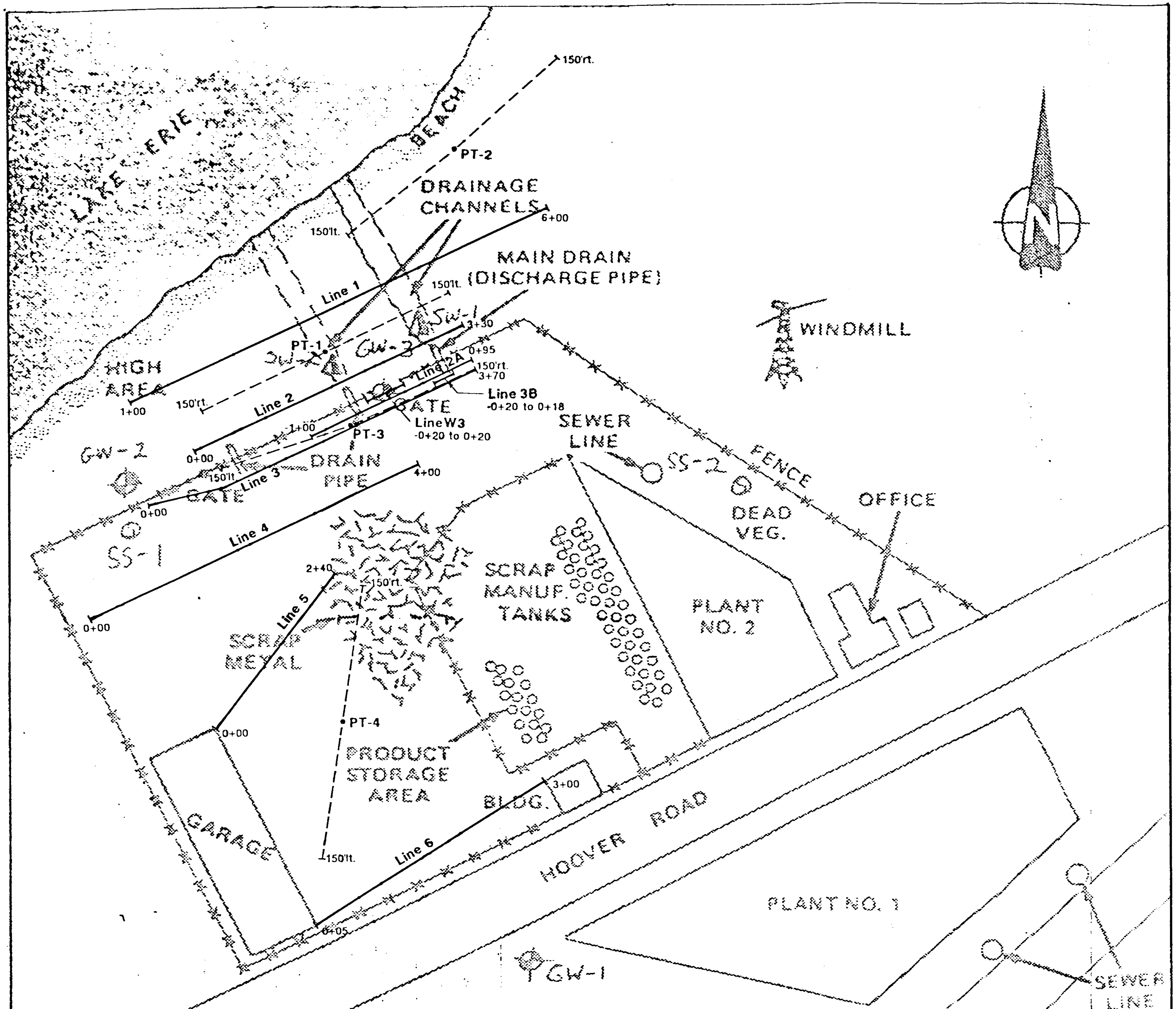
0 2000

FEET

Source:
NYSDOT Buffalo SE Quad

prepared by CVS	GEOPHYSICAL SURVEYS SNYDER TANK PROPERTY HAMBURG, NEW YORK prepared for YEC, INC.	General Area of Investigation	
checked by			
reviewed by		Weston Geophysical	Fig. 1

11/90



EXPLANATION

EM-31 Survey Coverage

Resistivity Point Test Location and Array Alignment

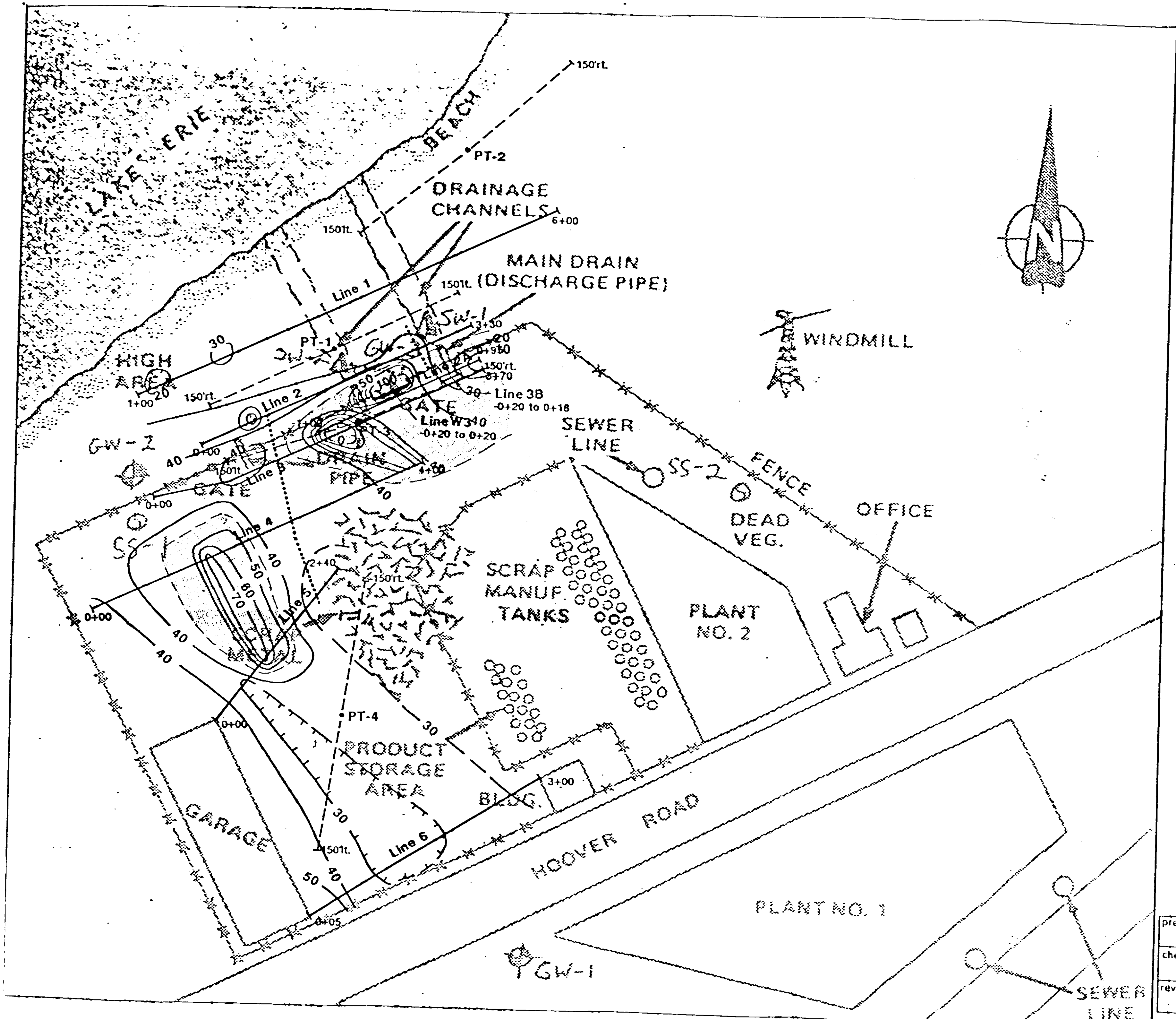
0 100 200

Approx. Scale in Feet

Basemap: SITE MAP provided by YEC, Inc.

prepared by CVS	**Geophysical Survey Coverage Map**
checked by	GEOPHYSICAL SURVEYS SNYDER TANK PROPERTY HAMBURG, NEW YORK prepared for YEC, INC.
reviewed by	Weston Geophysical — Fig. 2

11/90



EXPLANATION

EM-31 Survey Coverage

Resistivity Point Test Location and Array Alignment

Conductivity Contour, Dashed Where Inferred

Contour Interval: 10 millimhos/meter

Inferred Utility Location

Area of Highly Anomalous Conductivity Values Indicative of Buried Metal

0 100 200

Approx. Scale in Feet

Basemap: SITE MAP provided by YEC, Inc.

Conductivity Contour and Anomaly Map

GEOPHYSICAL SURVEYS
SNYDER TANK PROPERTY
HAMBURG, NEW YORK
prepared for
YEC, INC.

prepared by CVS

checked by

reviewed by

Weston Geophysical

Fig. 3

APPENDIX A

ELECTROMAGNETIC TERRAIN CONDUCTIVITY METHOD OF INVESTIGATION

GENERAL CONSIDERATIONS

The electromagnetic terrain conductivity [EM] survey is a method of obtaining subsurface information through "remote" inductive electric measurements made at the surface of the earth. Although limited in application, the EM method has significant advantage in speed and definition for certain problems. The parameter measured with this technique is the apparent conductivity of the subsurface. The conductivity meter consists of receiver coil and a separate transmitter coil which induces an electrical source field [a circular eddy current loop] in the earth [Figure 1]. Each current loop generates a magnetic field proportional to the value of the current flowing within the loop. Part of the magnetic field from each current loop is intercepted by the receiver coil and converted to an output voltage which is linearly related to terrain conductivity. EM instrument readings are in millimhos per meter.

Geologic materials can be characterized by their electrical characteristics; lateral variations in conductivity values generally indicate a change in subsurface conditions. The relative conductivity of earth materials is particularly sensitive to water content and dissolved salts or ions. Accordingly, dry sands and gravels, and massive rock formations have low conductivity values; conversely, most clays and materials with a high ion content have high conductivity values.

FIELD PROCEDURE FOR DATA ACQUISITION

Weston Geophysical generally uses two common terrain conductivity meters: the Geonics EM-31 and the EM-34-3. The EM-31 has a fixed intercoil spacing of 3.7 meters and an effective depth of penetration of approximately 6 meters. The EM-34-3 has two coils which can be separated by 10, 20, or 40 meters and can be oriented in either the horizontal or vertical dipole modes. Intercoil separations increase the effective depth of investigation as shown below.

Intercoil Spacing [meters]	Depth of Investigation [meters] Horizontal Dipoles	Vertical Dipoles
10	7.5	15
20	15	30
40	30	60

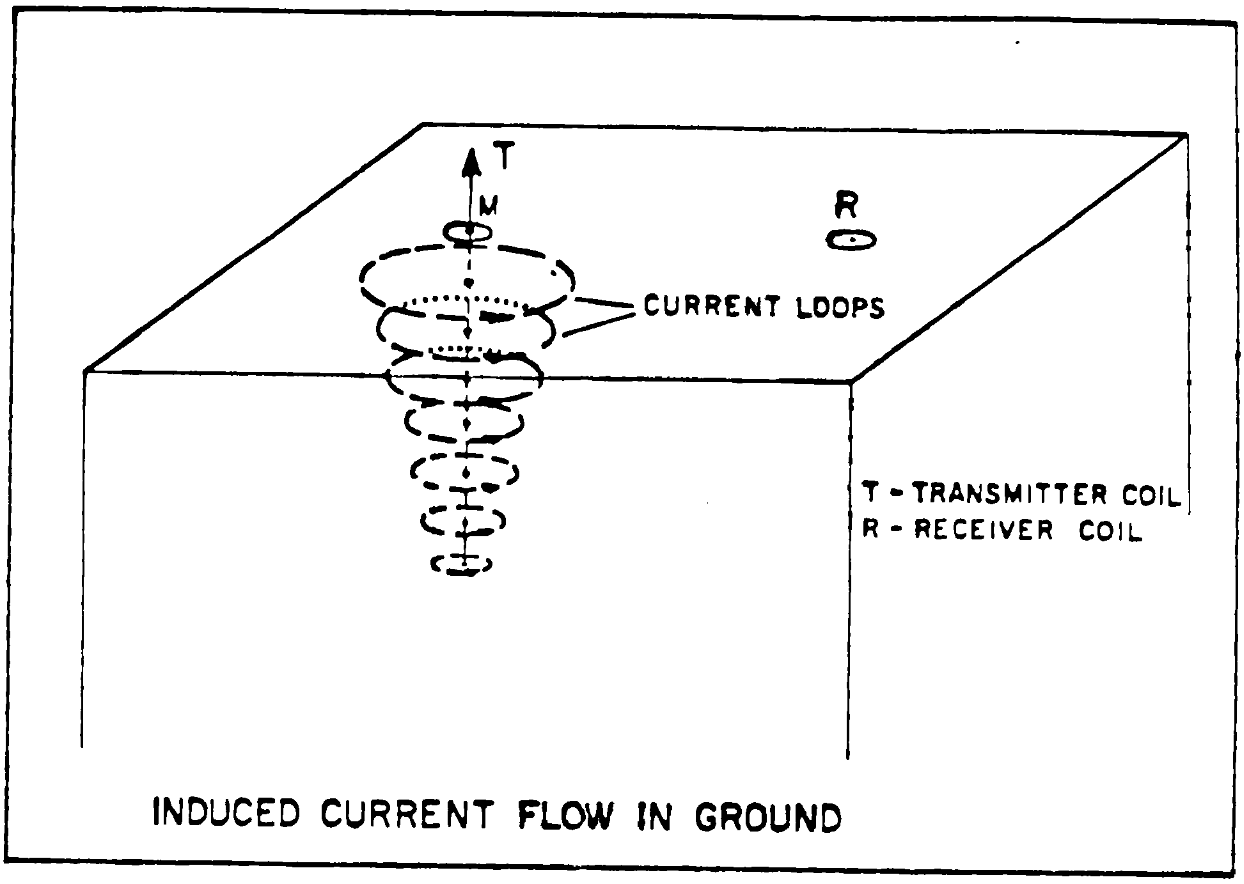
The coil orientation [horizontal or vertical] allows the EM-34-3 to respond to materials of different depths.

Conductivity measurements obtained with the EM-31 and/or the EM-34-3 can be obtained at any spacing along a survey line. EM-31 readings have the added flexibility of being recorded on a continuous chart recorder providing continuous data along a survey line.

DATA INTERPRETATION

EM data interpretation is generally subjective, that is measured EM values are contoured or profiled to identify high or low conductivity locations. Conductivity values obtained by an EM survey are relative values and depth estimates to conductive surface or bodies are best accomplished with an on-site calibration.

The EM-31 and EM-34-3 measure terrain conductivity in millimhos/meter. These values can be converted to resistivity [ohm/meters] for comparison with resistivity results by dividing the conductivity values into 1000.



Horizontal coplanar configuration (vertical dipole mode)

Figure 1

APPENDIX B

ELECTRICAL RESISTIVITY METHOD OF INVESTIGATION

INTRODUCTION

Electrical resistivity measurements obtained at ground surface may be used to evaluate subsurface materials. The resistivity of earth materials is inversely proportional to their temperature, permeability, porosity, water content, and salinity or ion content. Dry sands, gravels, and massive unweathered rock exhibit relatively high resistivities whereas clays, water-saturated sediments or weathered rock have lower resistivities. Therefore, resistivity surveying is a good technique for mapping the water table, tracing ground water contaminant plumes, delineating zones of weathered bedrock, fractures or solution cavities, determining depth to bedrock, and locating bedrock and sediment lithologic contacts [particularly mineralized zones].

The "apparent" resistivity value of a particular material, as measured in the field, is a function of the material's true resistivity, the thickness of the unit, thicknesses and resistivities of adjacent layers, and the electrode spacing. Apparent resistivity values are calculated based on the configuration of current and potential [Figure 1] electrodes. Interpretation of electrical resistivity data is based upon either comparison of field derived apparent resistivity values with an appropriate theoretical case or inverse modeling performed by a computer.

FIELD PROCEDURES

Two field techniques, point tests [vertical sounding] and [lateral] profiling, are conducted during most resistivity surveys. A resistivity point test is analogous to drilling; the results of a point test consist of a vertical profile of units defined by resistivity characteristics, similar to a lithologic sequence developed from drilling data. Resistivity profiling is used to trace the lateral extent of a particular condition, such as a contaminant plume, water table, mineralized zone, etc.

A point test is conducted by incrementally increasing the spacing between electrodes, maintaining the chosen configuration about a single point [Figure 1]. Resistivity measurements obtained at greater electrode separations are sampling deeper in the earth. Resistivity profiling requires moving a fixed array of electrodes along a prearranged traverse. Three of the most commonly used electrode configurations are described and discussed in the following sections and shown on Figure 1.

WENNER CONFIGURATION

The Wenner Configuration, one of the most widely used electrode arrangements, consists of four equally spaced electrodes [Figure Ia]. An electric current is applied across the outer electrodes and the change in voltage is measured between the inner pair of potential electrodes. The Wenner Configuration has less penetration than a Schlumberger or dipole-dipole array and is more sensitive to lateral changes. It is a reasonable compromise between the various electrode arrays for detecting both vertical and horizontal changes if used with Lee Partitioning Configuration.

- LEE PARTITIONING CONFIGURATION

  A third potential electrode is added to the center of the Wenner Configuration to create the Lee Partitioning Configuration [Figure Ib]. Three measurements of the change in voltage are taken at each positioning of the array; readings are made between P_1-P_2, P_0-P_1 and P_0-P_2.

SCHLUMBERGER CONFIGURATION

The Schlumberger Configuration is a four electrode array [Figure 1-II] in which the distance between the outer current electrodes is at least five times the distance between the inner potential electrodes. A single measurement of voltage change is taken between the potential electrodes, similar to the Wenner method. Penetration is better than Wenner and the method is much less affected by horizontal [lateral] changes. It is almost exclusively used for vertical sounding.

DIPOLE-DIPOLE

The dipole-dipole configuration of electrodes [Figure 1-III] allows deep penetration with a distinct logistical advantage in that the current electrodes can remain fixed while only the potential electrodes need be moved.

The choice of configuration depends on the type of survey, point test and/or profiling, as well as the projected target. The Wenner Configuration is useful for both point test and profiling surveys in a variety of settings. If local, lateral variations in resistivity between potential electrodes are expected, the Lee Partitioning Configuration should be used. The Schlumberger Configuration is employed for vertical soundings or in conjunction with Wenner soundings or constant spacing to discriminate between lateral and vertical variations in resistivity.

The dipole–dipole configuration is best adapted to detecting such anomalies as ore bodies at depth.

DATA INTERPRETATION

The interpretation of resistivity sounding data by Weston Geophysical is accomplished by computer modeling of the field data curves. Wenner and Schlumberger soundings are interpreted by a numerical inversion process which models subsurface structure, in terms of resistivity variation with depth, by varying an initial trial model until the theoretical resistivity values accurately fit the field data. Weston interprets dipole–dipole data by forward modeling using a two–dimensional finite–element program; the two–dimensional geo–electric model is varied by the interpreter to match the dipole–dipole field data.

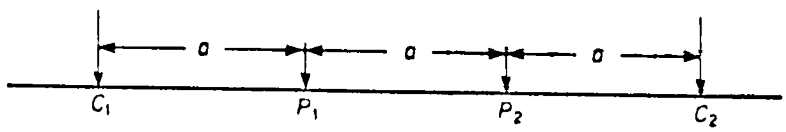
An example of Wenner field data and a computer–generated theoretical curve is shown in Figure 2.

ELECTRICAL RESISTIVITY ELECTRODE CONFIGURATIONS

Ia WENNER

$\rho_a = 2\pi a \, \Delta V / I$

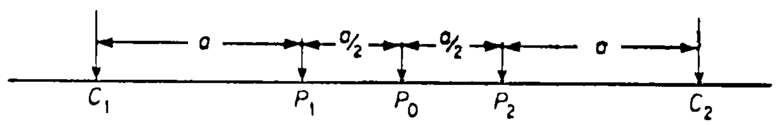
ΔV taken between $P_1 P_2$



Ib LEE MODIFICATION OF WENNER

$\rho_a = 4\pi a \, \Delta V / I$

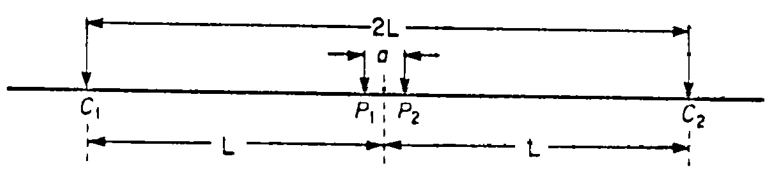
ΔV taken between $P_1 P_0$ and $P_0 P_2$



II SCHLUMBERGER

$\rho_a = \frac{\pi L^2}{a} \frac{\Delta V}{I}$

ΔV taken between $P_1 P_2$



III DIPOLE-DIPOLE

$\rho_a = \pi (a^3/b^2 - a) \Delta V / I$

ΔV taken between $P_1 P_2$

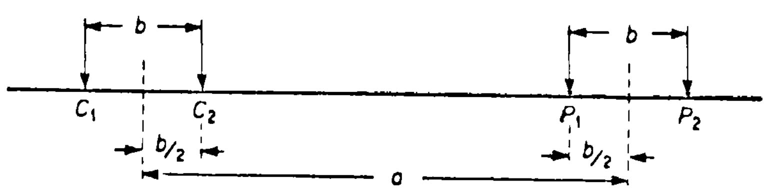
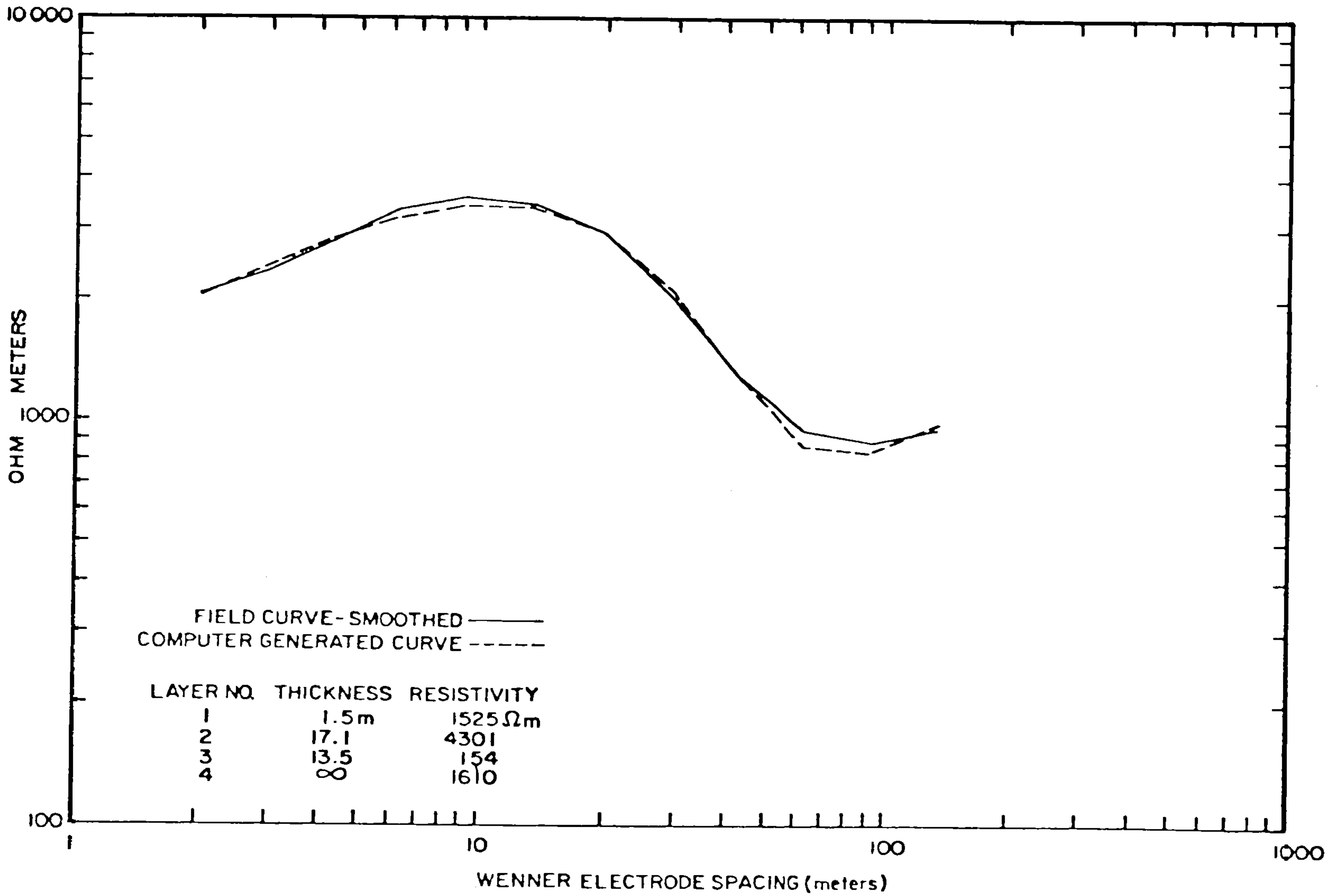


Figure 1

Weston Geophysical



RESISTIVITY MODEL

Figure 2