BICENTENNIAL UNIT-FELTON PRAIRIE RESISTIVITY SURVEYS
OCTOBER, 2000

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INTRODUCTION

The purpose of this study is to further examine the aggregate potential of the Bicentennial Prairie. The method of examination was an electrical resistivity survey. Three additional resistivity lines (10, 11, and 12) were completed across Bicentennial Prairie in August 2000 (Figure 1). Lines 1 through 9 were made in May 1999. Due to system limitations, each line was split into three parts, A through C. The lines overlap by approximately 20 meters. Using the data from the survey, three areas of different aggregate potential were delineated.

GEOLOGIC OVERVIEW

Sand and gravel is found in the western portion of the Bicentennial Prairie. However, the southern half of the sand and gravel deposit is below thick overburden. Therefore, only the northwestern portion contains significant gravel with little to no overburden. Based on the resistivity survey, lines crossing the eastern half of the Bicentennial Prairie indicate little to no gravel. From the geologic trends of the gravel deposit, the Bicentennial Prairie can be delineated into three categories of aggregate potential.

1. Sand and gravel with thin overburden is considered to have a high aggregate potential.
2. Sand and gravel with thick overburden is considered to have limited aggregate potential.
3. Silts and sands have low aggregate potential.

A map of the geologic interpretation of the Bicentennial Prairie is attached as Figure 2. Changes of sediment along the geophysical lines are marked by a station number (i.e. 330, 520 and 380). At these stations there are dramatic changes from sand and gravel to silt (which marks the boundary of the sand and gravel deposit). Lines delineating the sand and gravel deposit are based on these known points. Further delineation of the sand and gravel deposit into “thin overburden” and “thick overburden” is based upon geophysical data, rotosonic drilling and geologic observation:

- Line 5, station 520 is the most northern indication of sand and gravel with overburden and it is at the edge of the deposit. The deposit thickness is greater than 100 feet along this transect and pinches out near station 520.
- The western portion of Line 11 indicates a surficial deposit of sand and gravel, interburden, and a significant, deep deposit of sand and gravel. The surficial deposit is not a source of significant gravel as seen by rotosonic drilling through similar geophysical profiles (see drill hole log 8 and 10). If sand and gravel is present at the surface, the deposit would be

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relatively shallow, discontinuous, and would be difficult to accurately map. The overburden thickness is approximately 30 feet.

- The overburden trend continues to the south and is confirmed by drill hole 6 (where 55+ feet of overburden was encountered). East of the Bicentennial Prairie at drill hole 5, thirty feet of overburden was also confirmed.

The lines defining the three areas of aggregate potential are drawn straight to known points of data. An approximate acreage of each area can be calculated, but it is important to note that this is an approximation:

1. Sand and gravel with thin overburden: 40 acres
2. Sand and gravel with thick overburden: 30 acres
3. Silts and Sands: 90 acres

In conclusion, the northwest corner of the Bicentennial Prairie contains a significant amount of sand and gravel with little overburden. However, a geophysical assessment can not confirm the ratio of sand vs. gravel. The sand and gravel found in the southwestern corner contains shallow, discontinuous deposits of sand and gravel (beach ridges) which are insignificant compared to the buried, deep deposit (outwash channel). The accessibility of mining the buried deposit is limited due to the thickness of the overburden. Therefore, this portion has limited aggregate potential. The rest of the parcel has low aggregate potential.

GEOPHYSICAL OVERVIEW

The scale on the bottom of the inversion figures shows the approximate correlation of resistivity to lithology in the Felton Prairie Area. Resistivity does not uniquely correspond to lithology, but high resistivity values typically indicate sand and gravel and low values indicate clay and silt.

Felton Line 10

High resistivity values indicate probable gravel from stations 0 to 380. From station 380 to 790 there is a significant amount of finer material. There is probably both clay and sand present below station 380. East of station 380, any potential gravel is limited to thin surficial deposits.

Felton Line 11

This line also shows probable gravel on the western portion of the line. The gravel deposit is not quite as extensive as on line 10. From station 0 to 330, a significant clay layer separates surficial gravel from deeper gravel. East of station 330, sand and gravel is largely confined to the near surface. Moderate sized pockets of gravel may exist below approximately 50 feet of overburden at station 650 and at station 720.

Felton Line 12

The resistivity data from line 12 was collected using both the dipole-dipole and the Schlumberger electrode arrays. The dipole-dipole arrays produced very noisy data, so we decided to use Schlumberger arrays for the rest of the lines. Dipole-dipole surveys were completed for both line 12A and line 12B. The signal/noise ratio was poor for both lines, but especially bad for line 12B. Line 12B was redone with the Schlumberger array, and line 12C was recorded only with the Schlumberger array.

Line 12A has very noisy data with the least integrity of all of the lines. The near surface resistivity highs are probably gravel. The deeper resistivity highs that suggest gravel at 30 meters depth may or may not be real.

Schlumberger array Line 12B is of very good quality. The data suggest that the near surface gravel is less than 2 meters thick. There is possible deeper gravel between stations 500 and 540.

Line 12C also has a layer of surficial gravel, as well as the most significant area of potential gravel on line 12 (between stations 635 and 675). But, there appears to be a silt/sand lens above the thickest gravel layer.

METHODS

The resistivity data in this report were gathered using a fairly new technique called resistivity imaging. This method uses standard arrays developed as sounding techniques and modifies them to create 2-D resistivity profiles. A line of electrodes is placed at equal intervals along the desired profile. Four electrodes are used at one time. Two inject current into the ground and two read the electrical potential between them. The resistivity meter and switch box automatically read many combinations of current and potential electrodes from short offsets to long offsets starting at one side of the electrode spread and moving towards the opposite end. The short offsets look at the shallow earth, and the longer offsets look more deeply.

At Bicentennial Prairie, the data were collected with a Sting R1 Resistivity Meter in conjunction with the Swift automatic multi-electrode system. Fifty-six electrodes spaced 5 meters apart (for a total length of 275 meters) were used to collect one segment of data. In order to survey the entire Bicentennial Prairie (which is ½ mile long and ½ mile wide), three 275-meter long segments (A – C) formed each resistivity line. Two array types were selected: dipole-dipole and Wenner-Schlumberger.

The dipole-dipole array gives good horizontal resolution, but may have a poor signal to noise ratio (S/N) because the potential electrodes are outside of the current electrodes. The Wenner-Schlumberger array is more directed for vertical resolution, but it also gives reasonable horizontal resolution. This method has greater S/N than the dipole-dipole method, because the potential electrodes are placed between the two current electrodes. This arrangement was important at the Bicentennial Prairie because the near surface soils are dry, sandy, and highly resistive.

The first data (lines 12A and 12B) were collected with the dipole-dipole array. Because of extremely poor data quality, line 12B was resurveyed using the Wenner-Schlumberger array. This array provided a much better S/N and was used for all of the rest of the lines.

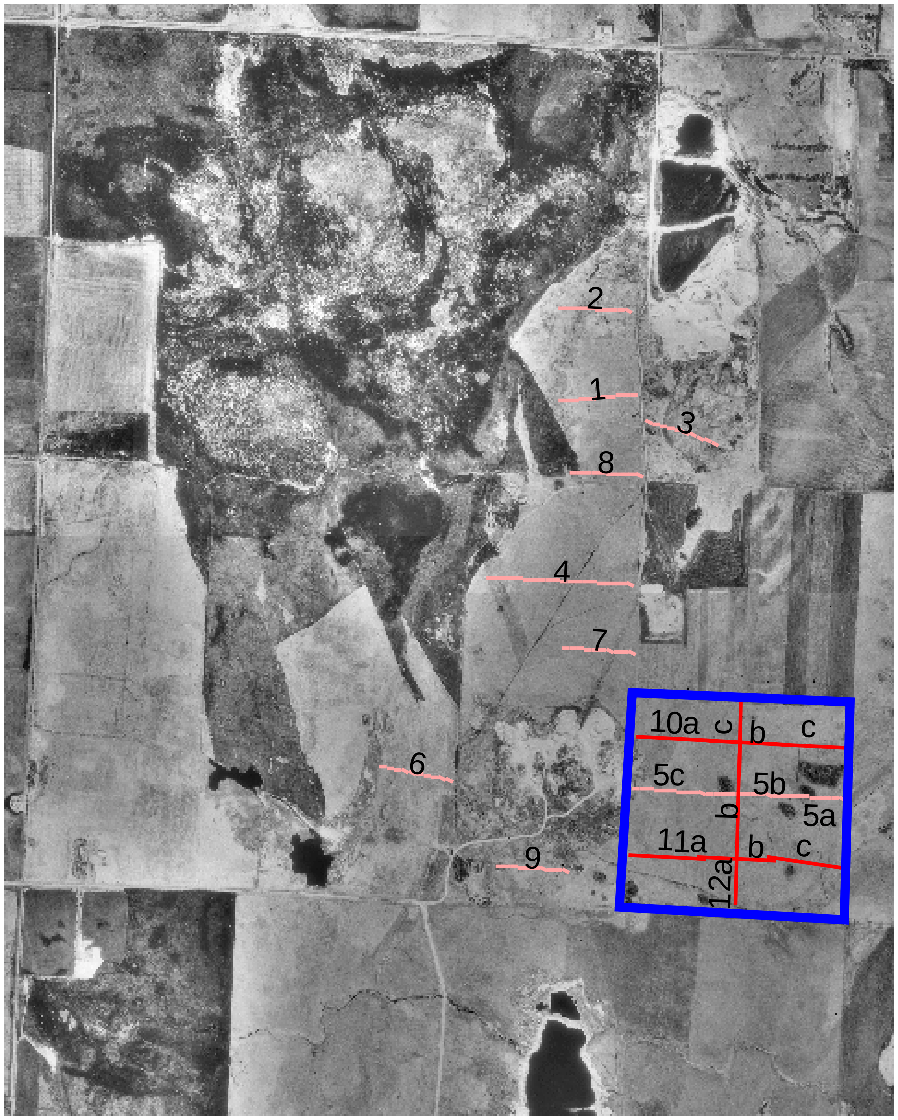
DATA PROCESSING

The field data contain apparent resistivity values and geometry information. The data are plotted as a pseudosection, which is a plot of the apparent resistivity values based on the geometry of the electrodes. Each apparent resistivity value is plotted midway between the set of electrodes used in making the measurement. The pseudo depth of each point is plotted at the median depth of investigation for the particular array. Pseudosections are difficult to work with, and are not very meaningful to non-geophysicists. For this reason, a data inversion is done to help with the interpretation. The inversion produces a plot that shows a resistivity value for each horizontal and vertical node. This resistivity inversion section is then used to interpret subsurface lithology.

These data were inverted with RES2DINV, a commercially available program. Programming steps include editing out bad data points, setting up appropriate horizontal and vertical filters, selecting the inversion method, and then interpreting the data.

LIST OF FIGURES

Felton Prairie Resistivity Lines from 1999 and 2000 Surveys



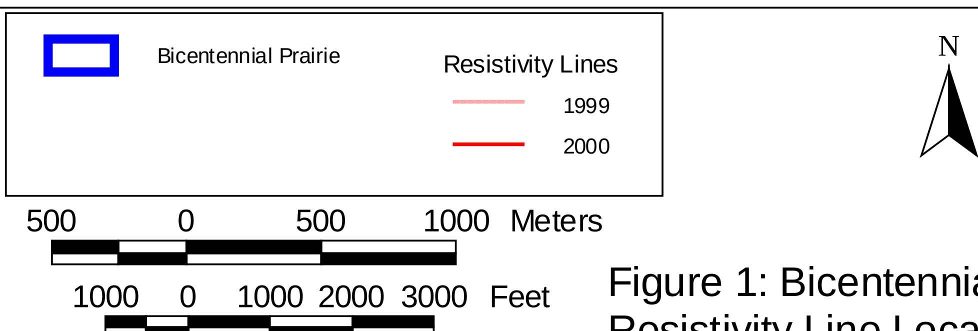
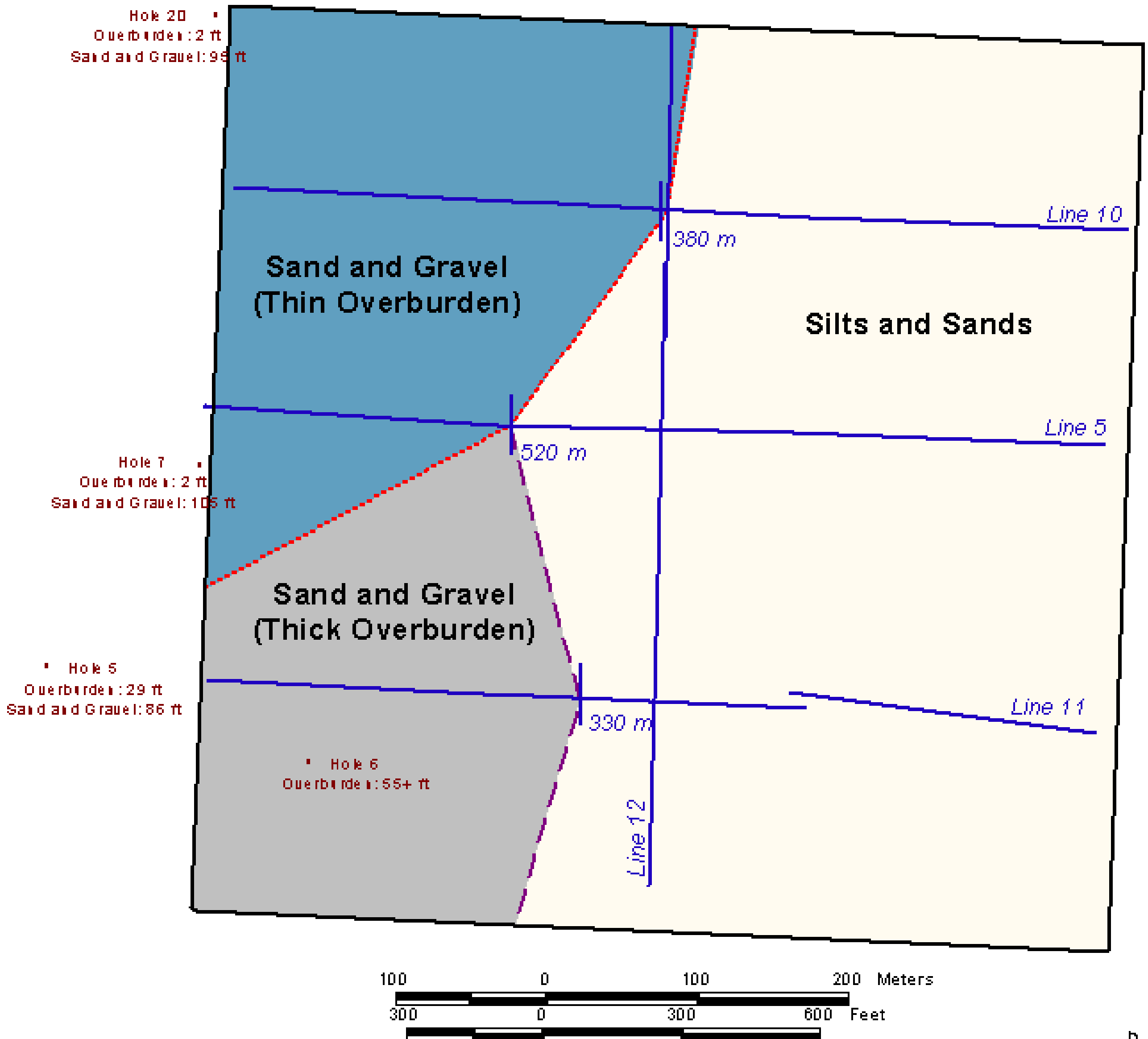
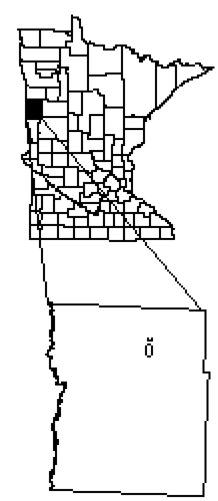


Figure 1: Bicentennial Prairie Resistivity Line Locations

Figure 2
Geologic Interpretation of the Bicentennial Prairie



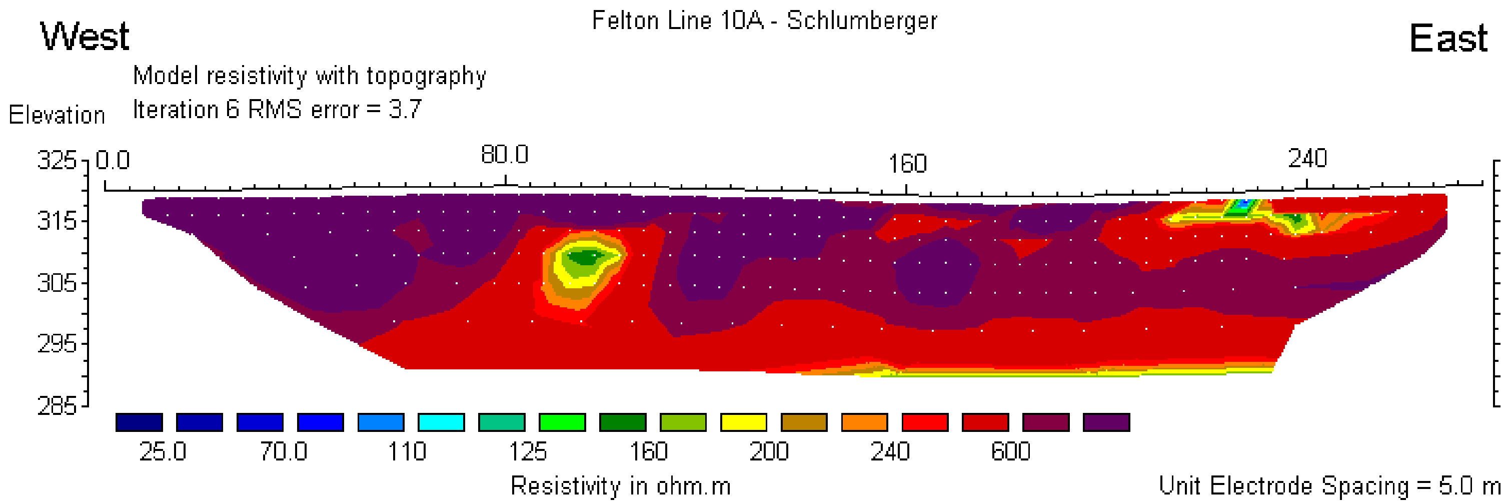


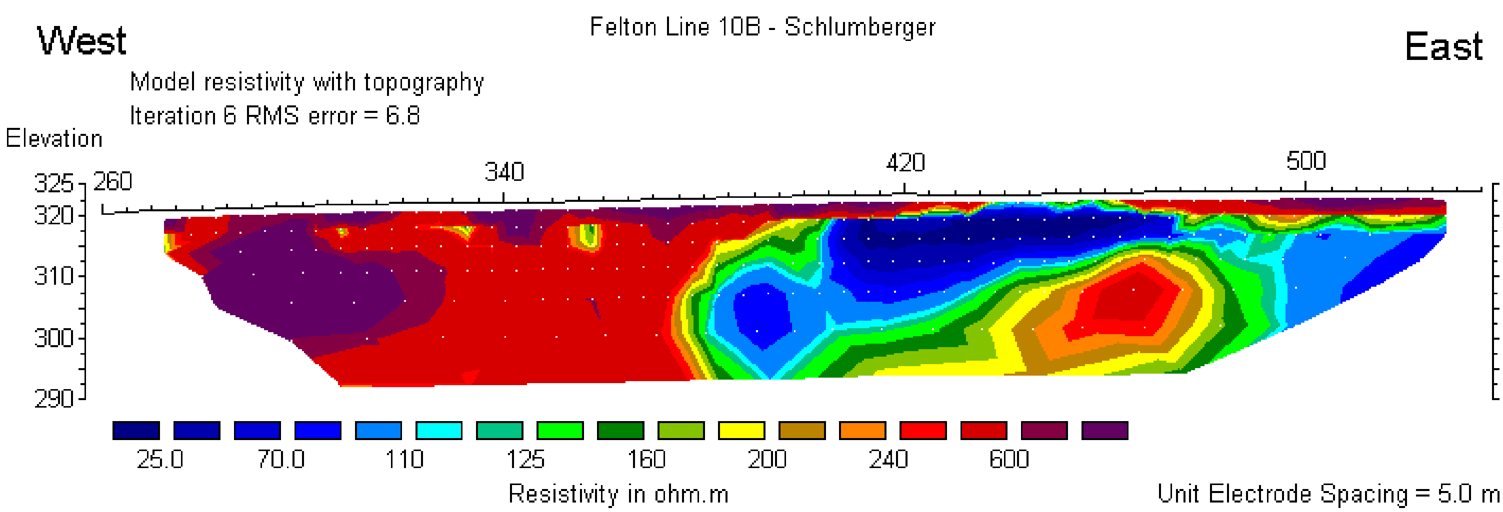
- DNR Rotosonic Drill Hole
- Sand and Gravel with Thin Overburden
- Sand and Gravel with Thick Overburden
- Silts and Sands
- Inferred Geologic Contact: Boundary of sand and gravel with thin overburden between known points.
- Inferred Geologic Contact: Between sand and gravel with thick overburden and sands and silts.
- Electrical Resistivity Lines*: 330 m, 520 m, and 380 m, represent edge of sand and gravel deposit along respective transects.

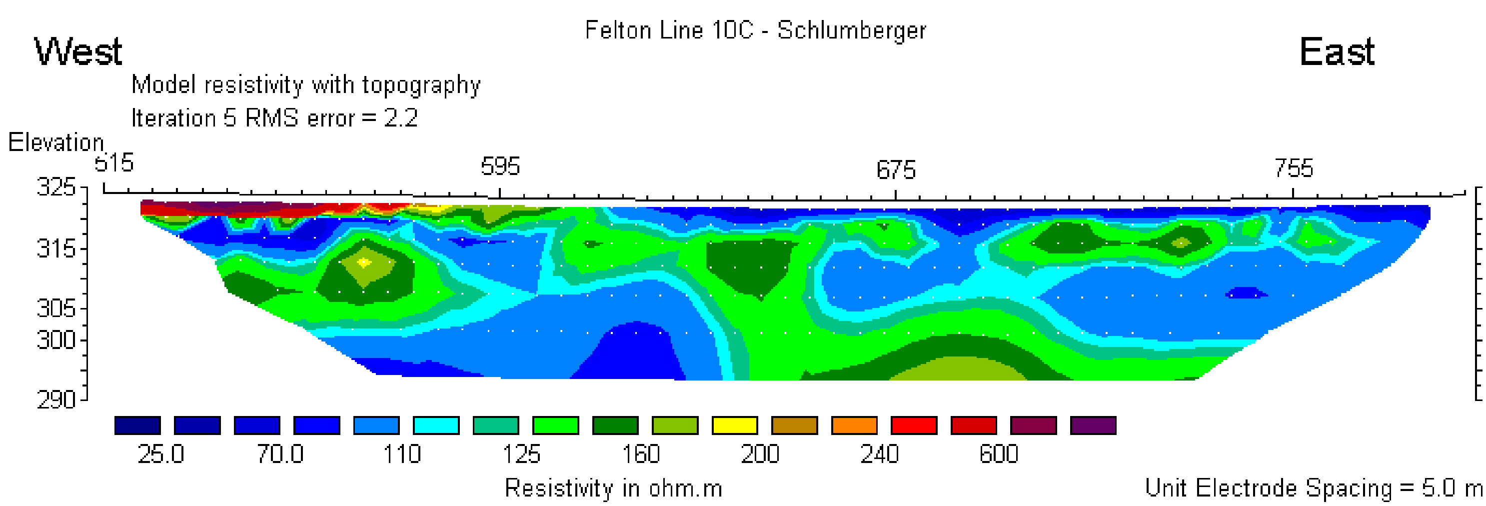
* Electrical Resistivity Lines: Line 5 was completed in May 1999 and is measured from east to west. Lines 10, 11, and 12 were completed in August 2000. Lines 10 and 11 are measured from west to east. Line 12 is measured from south to north.

DNR Rotosonic Holes: Drilling was completed January 2000 and surveyed in March 2000.

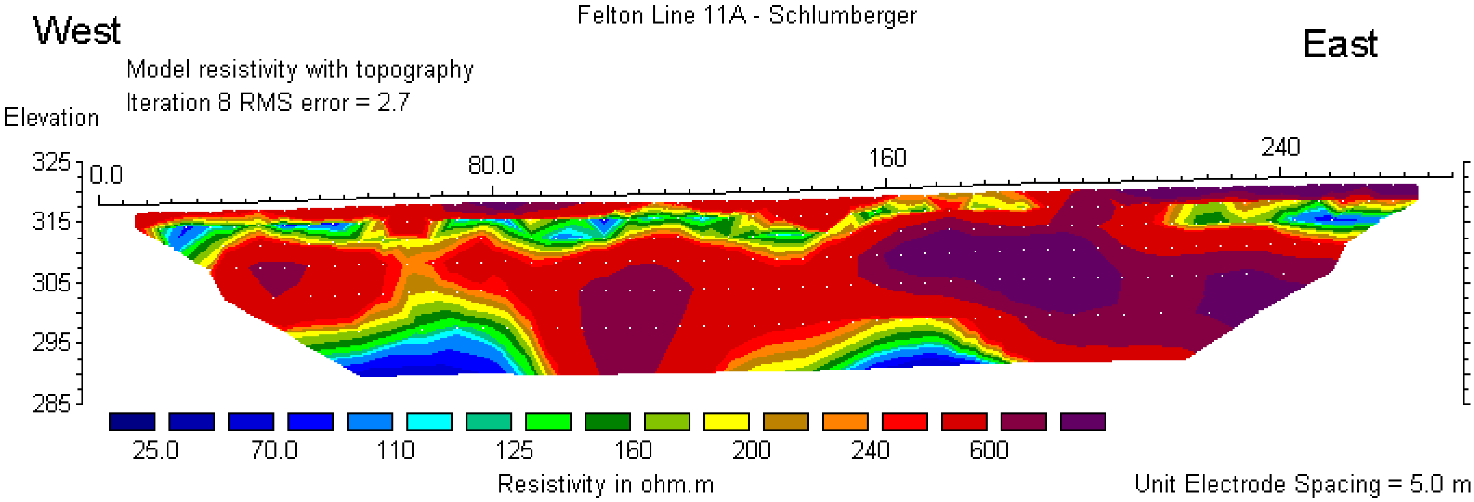
Felton Electrical Resistivity - Line 10
October 2000

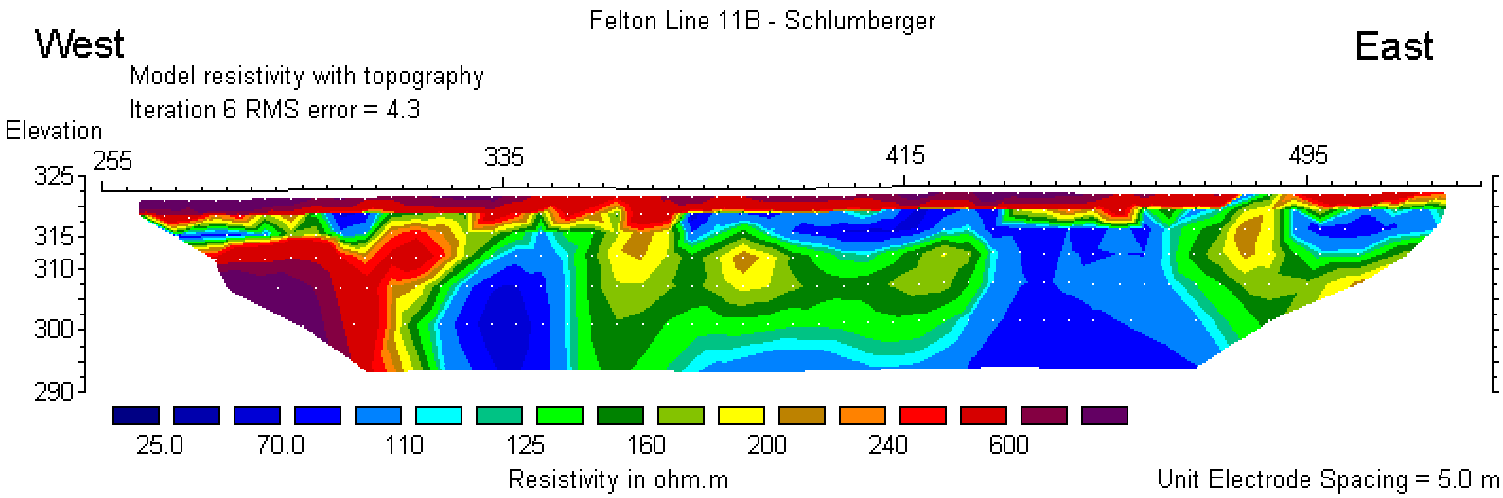


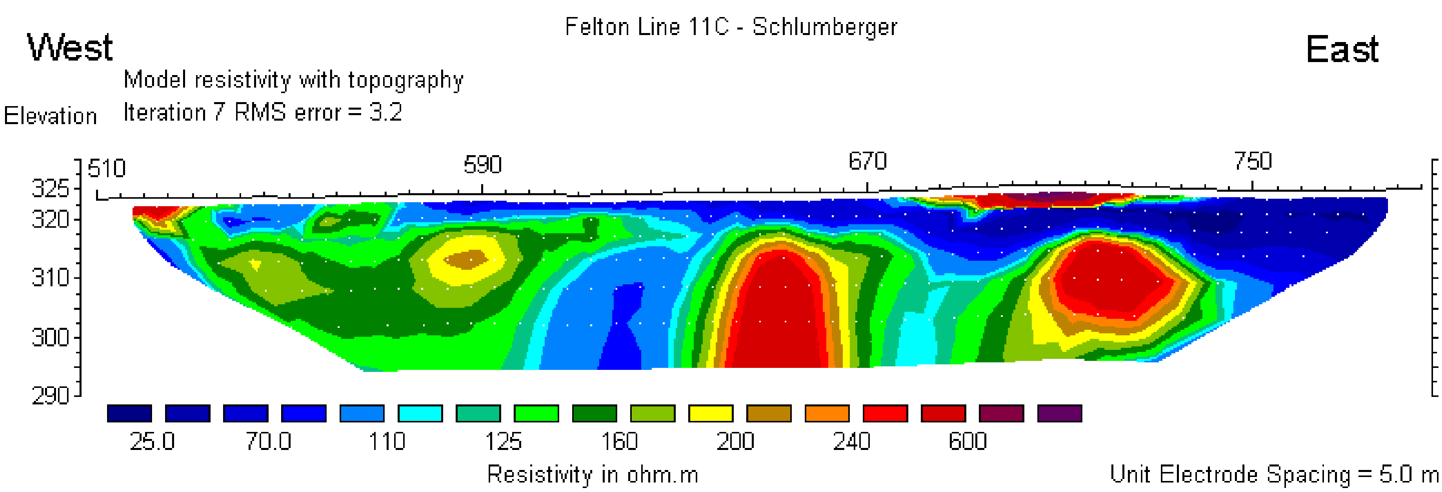




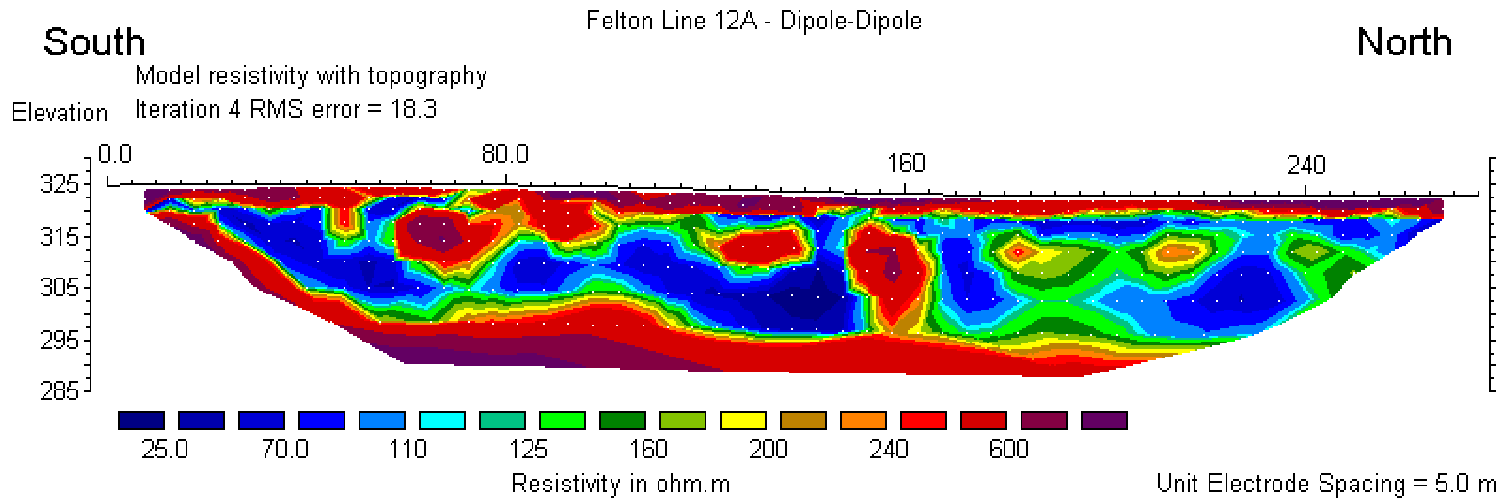
Felton Electrical Resistivity - Line 11
October 2000

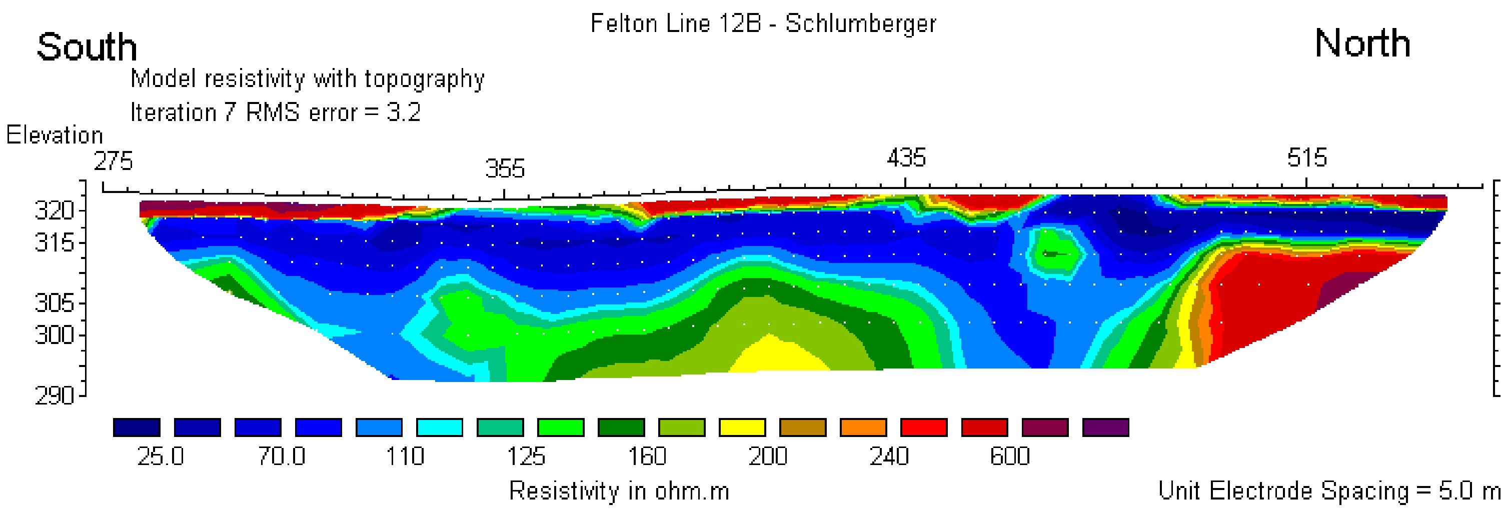


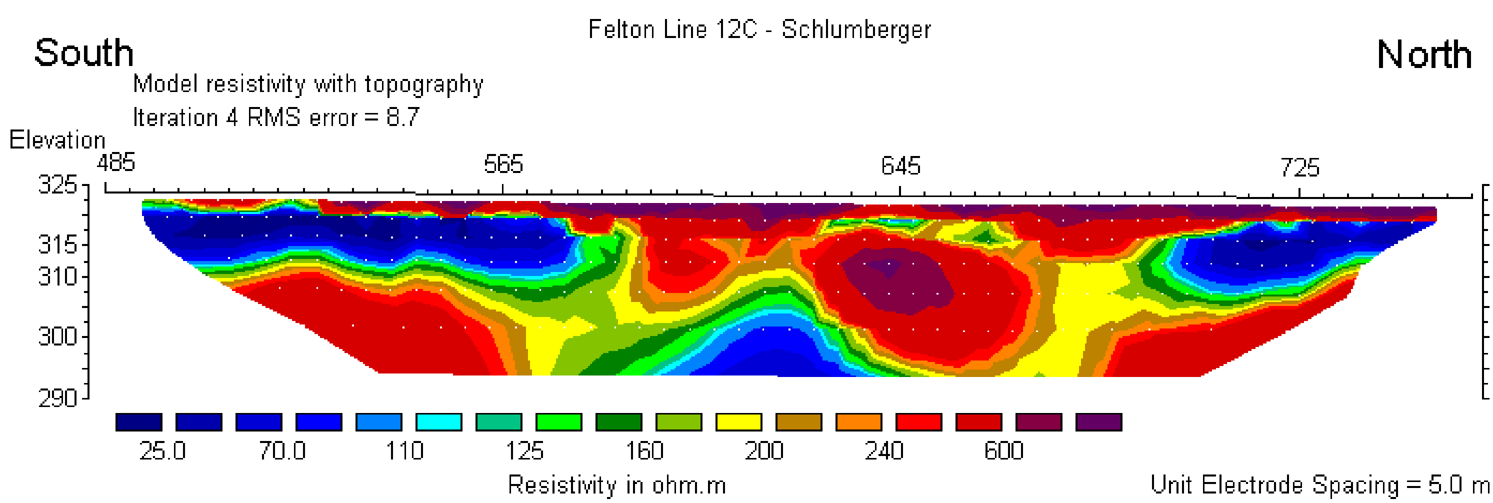




Felton Electrical Resistivity - Line 12
October 2000







Felton Resistivity Survey
May 1999

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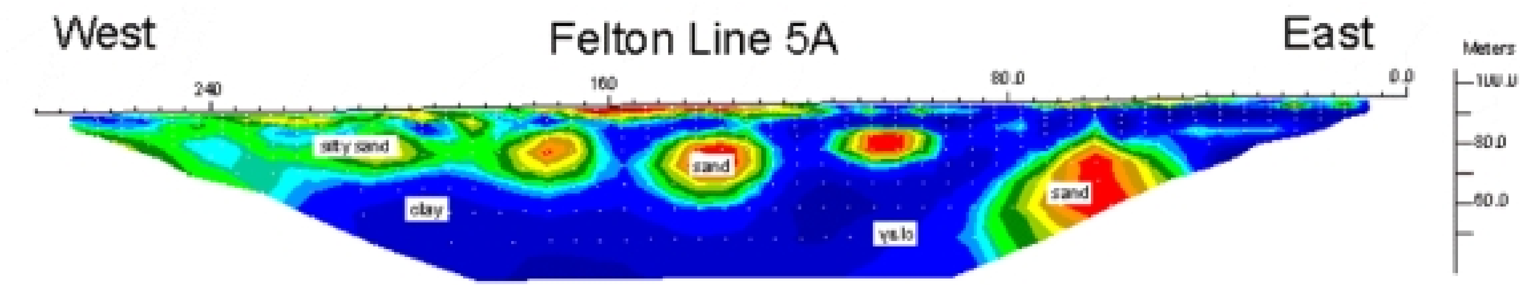

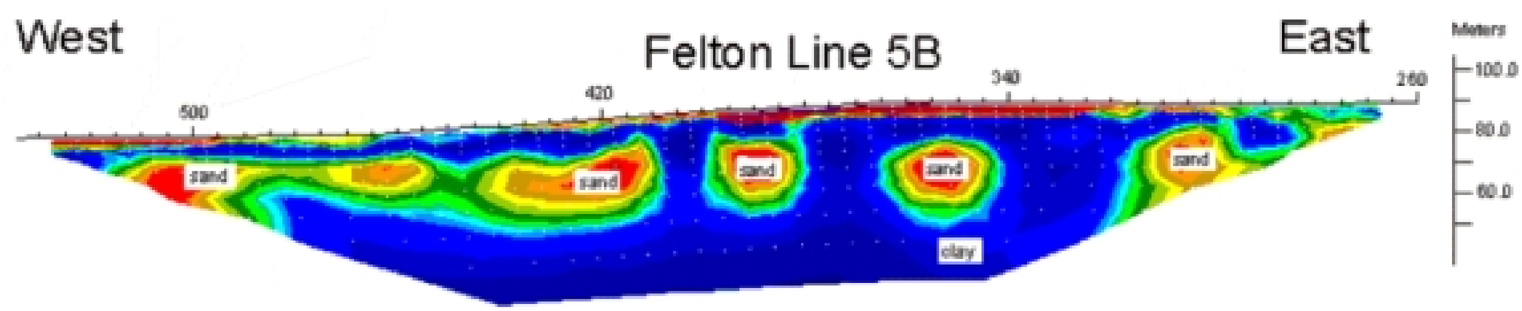

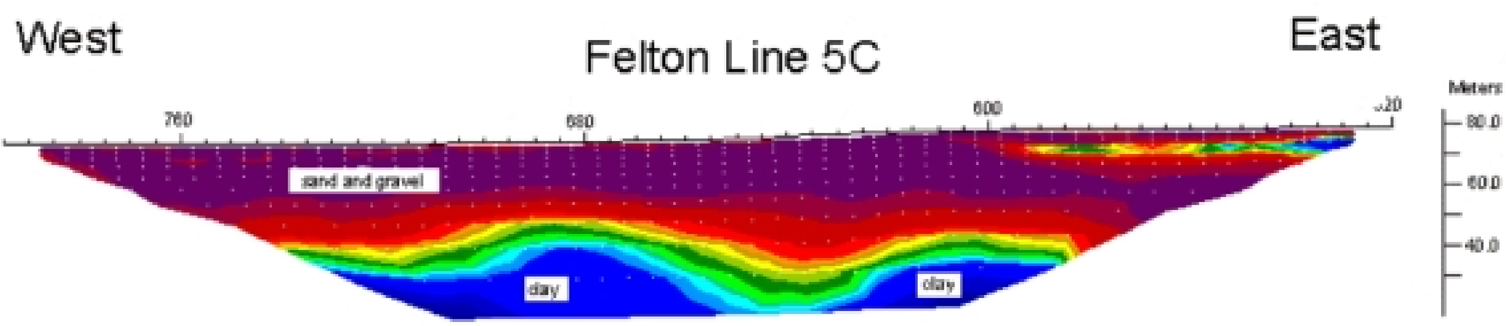

Lines are measured from east to west.