APPENDIX 7-62

LITTLE BEAR SPRING STUDY (2ND EXPANDED STUDY, 1999)

AQUA TRACK

INCORPORATED

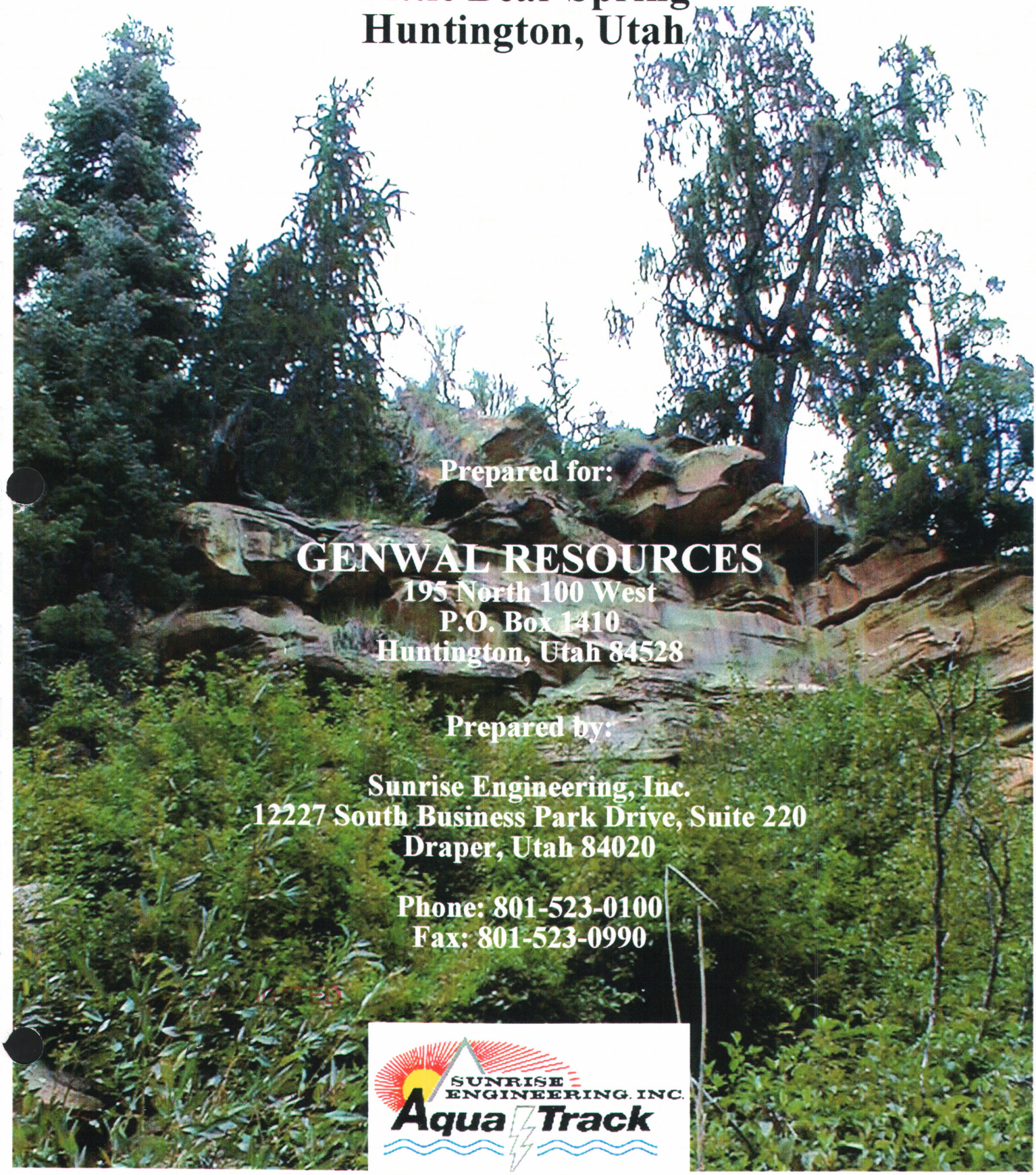
APR 15 2005

DIV OF OIL GAS & MINING

SEP 16 2003

AQUATRACK SURVEY

Little Bear Spring
Huntington, Utah



Prepared for:

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Prepared by:

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Aqua Track

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MESA, AZ
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SALT LAKE CITY, UT
PRESCOTT VALLEY, AZ

November 1, 2001

Mr. Dave Shaver
GENWAL Resources
195 North 100 West
P.O. Box 1410
Huntington, Utah 84528

Re: AquaTrack Survey
Little Bear Canyon
Sunrise Project No. 00560

Dear Mr. Shaver:

Sunrise Engineering, Inc. (Sunrise) has completed an AquaTrack survey at the above referenced site. The survey was conducted in general accordance with our proposal dated March 6, 2001.

Our services consist of professional opinions and recommendations made in accordance with generally accepted hydrogeological principles and practices at the time of execution. This warranty is in lieu of all other warranties either expressed or implied. The information in this report relates only to the subject site and should not be extrapolated or construed to apply to any other areas.

We appreciate this opportunity to be of service to you. If you have any questions regarding this report, please feel free to contact us at (801) 523-0100 or (435) 743-6151.

Sincerely,
SUNRISE ENGINEERING, INC.

Prepared by:

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INCORPORATED

APR 15 2005

DIV OF OIL GAS & MINING

EXECUTIVE SUMMARY

Sunrise Engineering, Inc. (Sunrise) has completed an AquaTrack survey for GENWAL Resources in Little Bear Canyon where Little Bear Spring, a culinary water source for the Castle Valley Special Service District, is located. The spring yields approximately 300 gallons per minute (gpm) of culinary water. The purpose of this survey was to investigate the north slope of Little Bear Canyon and determine if any preferential groundwater pathway exists and connects Little Bear Canyon and Crandall Canyon approximately 1.5 mile north of Little Bear Spring. Near Crandall Canyon, coalmining operations are active. If a preferential groundwater pathway exists which conveys water from Crandall Canyon to Little Bear Canyon, the quality of water from Little Bear Spring may become degraded.

Previous investigation data was also reviewed and incorporated into this report.

The tool used in this survey was AquaTrack, a geophysical technology that uses electrical current injected into the subsurface to track, map and monitor groundwater. As the current flows through groundwater, it follows the path of the least resistance. In most cases, the path of the least resistance is the water bearing strata. The groundwater acts as a subsurface conductor. AquaTrack employs electrons as tracers to follow the subsurface continuous conductor. As the current flows through the groundwater, the current creates a magnetic field characteristic of the injected audio-frequency current. This magnetic field can then be detected and surveyed from the ground surface using a special magnetic receiver.

Mapping the magnetic field is to delineate where the electrical current is flowing, and identifying the location of the electrical current is to map where groundwater is located. The end results provide a map showing the most probable groundwater flow pattern(s) for the area of investigation.

The findings of this survey and previous surveys is summarized below:

- A preferential groundwater pathway along a fault line was identified to connect Mill Fork Canyon and Little Bear Canyon. Little Bear Spring is located on this pathway.
- The saturated sediments in Mill Fork Canyon are capable of supporting continuous recharge to Little Bear Spring.
- Mill Fork Creek loses approximately 300 gpm of surface water. The lost water likely recharges Little Bear Spring.

- The primary groundwater source of Little Bear Spring is from the preferential groundwater pathway leading to Mill Fork Canyon where small sinkholes were identified to be within the fault zone.
- The fault that is believed to connect Mill Fork Canyon and Little Bear Canyon was inferred to extend to the northern slope of Little Bear Canyon. It appears that the fault intercepts all groundwater from the area up-gradient (northwest) of the fault and conducts the water to the canyon creek. This inference is also supported by the fact that the area down-gradient (southeast) of the fault is not a groundwater-bearing zone. The survey data also indicates that the water north of Little Bear Spring is minimal and probably incidental.
- Groundwater as a result of natural recharge resulting from precipitation moves from the northern slope of Little Bear Canyon towards the canyon creek. The amount of water is not significant.

This survey does not cover the area across the northeast topographic divide, Sunrise cannot infer that no preferential groundwater pathway runs across the divide that may potentially introduce groundwater to Little Bear Canyon from Crandall Canyon where mining operations are active. However, the data from this survey indicates a very low probability of any water from Crandall Canyon Creek to Little Bear Canyon.

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Appendix A - Field Data Records

AQUATRACK SURVEY

Little Bear Canyon
Huntington, Utah
November 1, 2001

1.0 INTRODUCTION

Sunrise Engineering, Inc. (Sunrise) has completed an AquaTrack survey for GENWAL Resources in Little Bear Canyon where Little Bear Spring, a culinary water source for the Castle Valley Special Service District, is located. The purpose of this survey was to investigate the north slope of Little Bear canyon and to determine if any preferential groundwater pathway exists which connects Little Bear Canyon and Crandall Canyon approximately 1.5 mile north of Little Bear Spring. Near Crandall Canyon, coalmining operations are active. If a preferential groundwater pathway exists which conveys water from Crandall Canyon to Little Bear Canyon, the quality of water from Little Bear Spring may become degraded.

1.1 Background

Little Bear Spring, located in Little Bear Canyon approximately 12 miles northwest of Huntington, Utah, is a culinary water source utilized by the Castle Valley Special Service District to supply water to the towns of Huntington, Cleveland and Elmo. Historical data indicates that the spring can continuously yield more than 200 gallons per minute (gpm) of water with a maximum of about 500 gpm. Because of the proximity of Little Bear Spring to the existing and proposed coal mining area to the north of the spring, considerable attention has been given to the hydrogeologic conditions surrounding the spring. Delineating the spring recharge or contribution zone can help assess any potential adverse impacts of the mining operations on the spring. Hydrogeologic studies previously conducted in the area (e.g., Mayo and Associates, 1999; Water Technology and Research, 1999; Sunrise, 2001) have indicated that the spring recharge is primarily from Mill Fork Canyon. However, the area north of Little Bear Spring may also contribute water to the spring.

1.2 Previous Studies

Mayo and Associates (1999) conducted a groundwater and surface water study at Little Bear Spring and in the surrounding area and concluded that the recharge to Little Bear

Spring is most likely from the surface water and alluvial groundwater from Mill Fork Canyon, a creek located approximately 1.5 miles south of Little Bear Spring.

Water Technology and Research (1998, 1999) conducted AquaTrack surveys surrounding the Little Bear Spring area. Based on the data collected from these two surveys, Water Technology and Research (1999) concluded that Little Bear Spring is fed by a fault that cuts the axis of a syncline and receives recharge probably from Mill Fork Canyon.

Water Technology and Research (1999) further concluded that the primary source is from Mill Fork Canyon. Groundwater was found to follow a fault line in the mountain range south of Little Bear Spring. This fault extends beyond the mountain ridge between Little Bear Canyon and Mill Fork Canyon and connects small sinks in the bottom of Mill Fork Creek. The secondary source could potentially be from the area north of Little Bear Canyon.

Sunrise (2001) conducted a resistivity survey in Mill Fork Canyon. The purpose of that survey was to estimate the volume of alluvium saturated with groundwater upstream and downstream of the fault identified in the previous AquaTrack surveys to divert water from the Mill Fork Canyon drainage to Little Bear Spring. Two profiles, one up-gradient of the fault and the other down-gradient of the fault, were surveyed. The thickness of the saturated sediments was estimated to range from 0 to 30 feet in the down-gradient profile and from 0 to 50 feet in the up-gradient profile. The cross-sectional area of saturated sediments was estimated from the survey data to be about 2,000 square feet at the downstream profile and 3,300 square feet at the upstream profile. Depth to groundwater in the surveyed area ranged from 0 to 30 feet below grade. This survey indicated that the saturated sediments in Mill Fork Canyon are capable of supporting continuous recharge to Little Bear Spring.

Mayo and Associates (2001) used the comprehensive basin approach to study the potential for Little Bear Spring recharge in Mill Fork Canyon. Mayo and Associates estimated that Mill Fork Creek loses approximately 300 gpm of surface water. The lost water likely recharges to Little Bear Spring.

1.3 Project Objective

Because the previous studies clearly indicated that Mill Fork Creek is the primary source of Little Bear Spring, and the area north of Little Bear Creek is at best a secondary recharge zone. The extent of this zone has not been demarcated. The objective of this

survey was to determine if the existing and proposed mining area north of Little Bear Creek would impact the secondary recharge zone.

1.4 Scope of Work

To accomplish the above stated project objective, Sunrise proposed to investigate an approximately one-square-mile area north of Little Bear Creek.

Data collected from the field reconnaissance was analyzed and presented in this report. The data collected by Water Technology and Research (1998 and 1999) was also incorporated into this report.

2.0 METHODS OF INVESTIGATION

2.1 General Description

The tool used in this investigation is AquaTrack. AquaTrack is a geophysical technology that uses electrical current injected into the subsurface to track, map and monitor groundwater. Understanding the location and extent of groundwater can be a complex matter. However, when there is a need to know where groundwater is located, the right tool results in the greatest insight. AquaTrack is that tool.

The greatest benefit of this patented technology is its ability to reduce the cost of subsurface investigations and remediation. AquaTrack provides the ability to direct electricity into specific aquifers, thereby tying the results of the survey to existing sources of groundwater.

Traditional electromagnetic and electrical survey equipment does not have the range or capability that AquaTrack can provide. These types of geophysical technology are limited to less than 100 feet. The AquaTrack technology has the horizontal range between 1,000 and 5,000± feet depending on subsurface conditions. Thus, AquaTrack technology can provide better and more accurate information about the location and flow pattern of groundwater under the ground surface. Using the AquaTrack technology requires an in-depth knowledge of geophysical, geological and hydrogeological principles, methods and practices for correct interpretation of the survey data.

The method of mapping and monitoring groundwater and subsurface aqueous systems used in AquaTrack is protected by Patent 5,825,188, and other patents pending.

2.2 Theory and Scientific Principles

The AquaTrack technology uses a low-voltage, low-amperage and audio-frequency electrical current. Electrodes are placed strategically in wells, springs or surface water bodies and emit an audio-frequency electrical current into the groundwater being investigated. The distance between electrodes can vary from tens to thousands of feet, depending upon the access to groundwater and the aquifer characteristics and the area to be investigated.

One of the basic principles utilized in this technology is Ohm's Law. As the current flows through groundwater, according to Ohm's Law, it follows the path of the least resistance. In most cases, the path of the least resistance is the water bearing strata. The few exceptions are ore bodies, buried metal pipes and wires. The groundwater acts as a subsurface conductor. AquaTrack employs electrons as tracers to follow the subsurface continuous conductor. As the current flows through the groundwater, the current creates a magnetic field characteristic of the audio-frequency current. This magnetic field runs perpendicular to the electrical current and can be described by Bio-Savart Law. This magnetic field can then be detected and surveyed from the ground surface using a special magnetic receiver.

Mapping the magnetic field is to map where the electrical current is flowing, and mapping the electrical current is to map where groundwater is located. The end results provide a map showing the most probable groundwater flow pattern(s) for the area of investigation.

2.3 Magnetic Field Measurement

A magnetic receiver, which consists of a magnetic sensor, filters and amplifiers, measures the magnetic field, filters out unwanted frequencies, amplifies the signal and converts the information into an electrical current that can be measured and recorded. Because the magnetic field is a three-dimensional vector, like the speed of an airplane flying in the air, quantification of the magnetic strength at a specific point can be accomplished by measuring its magnitude and direction, or magnitudes of different components in three normal directions like X, Y and Z. In application of the AquaTrack technology, the magnetic receiver has been designed to measure the magnetic field in a horizontal plane (X-Y plane) and the vertical direction (Z-direction). In the horizontal plane, the receiver can detect the maximum and minimum magnetic values in two normal directions on the plane. For each survey station, the maximum and minimum magnetic values on the

horizontal plane, the vertical magnetic value, location relative to the designated survey origin, and survey time are recorded. These recorded data are called raw or field data.

Surveys are normally conducted on a grid system or parallel survey lines. The survey design is dependent on the size of aquifer being investigated, the complexity of the system being mapped and area accessibility. It is possible to miss important features, or anomalies, by gridding or spacing stations too sparsely. Site-specific survey design can be typically established from a hydrogeological assessment of the area and the type of investigation being performed. Normally a survey starts with a course grid and tightening of the grid occurs in areas where additional information is required.

Magnetic field surveys are subject to variation throughout the day due to a variety of natural and manmade electromagnetic interference. Repeated base station readings throughout the survey are made and used to track and correct possible variations resulting from outside interference.

2.4 Data Normalization

The field data contains magnetic interference generated from the environment such as the AquaTrack antenna wire, power source, transmitter, receiver, phone lines, power cables or even special local geology setting (such ore bodies or iron rich volcanic rock) and interference from nature (earth and sun). Because the readings cannot all be taken at the same time, temporal interference and variations exist in the raw data. Therefore, data normalization needs to be performed on all the readings to remove any significant interference before the final presentation of analyzed data. Data normalization consists of removing drift caused by fluctuations in the ambient field, adjusting for current drift of the transmitter and correcting for the antenna wire using Biot-Savart Law.

2.5 Data Interpretation

AquaTrack survey data is interpreted in much the same way as traditional magnetic surveys. The normalized data shows relative highs and lows when it is plotted. These are referred to as anomalies that represent areas of different physical conditions. A high magnetic reading represents a high conductivity, while a low magnetic reading represents a low conductivity. These highs and lows are traceable from profiles to the adjacent profiles. The results of tracing highs on the profiles can then be transferred to a contour map.

The changes in conductivity represent an increase or decrease in the presence of groundwater. At this point in the development of the AquaTrack technology, it is not possible to determine the quantity or quality of water present. The AquaTrack technology simply identifies the highest probability of where groundwater is present in the area of investigation.

Survey results can be mapped using a computer program that utilizes vector mathematics helping identify the location of groundwater reservoirs, aquifers and/or flow patterns of the study area.

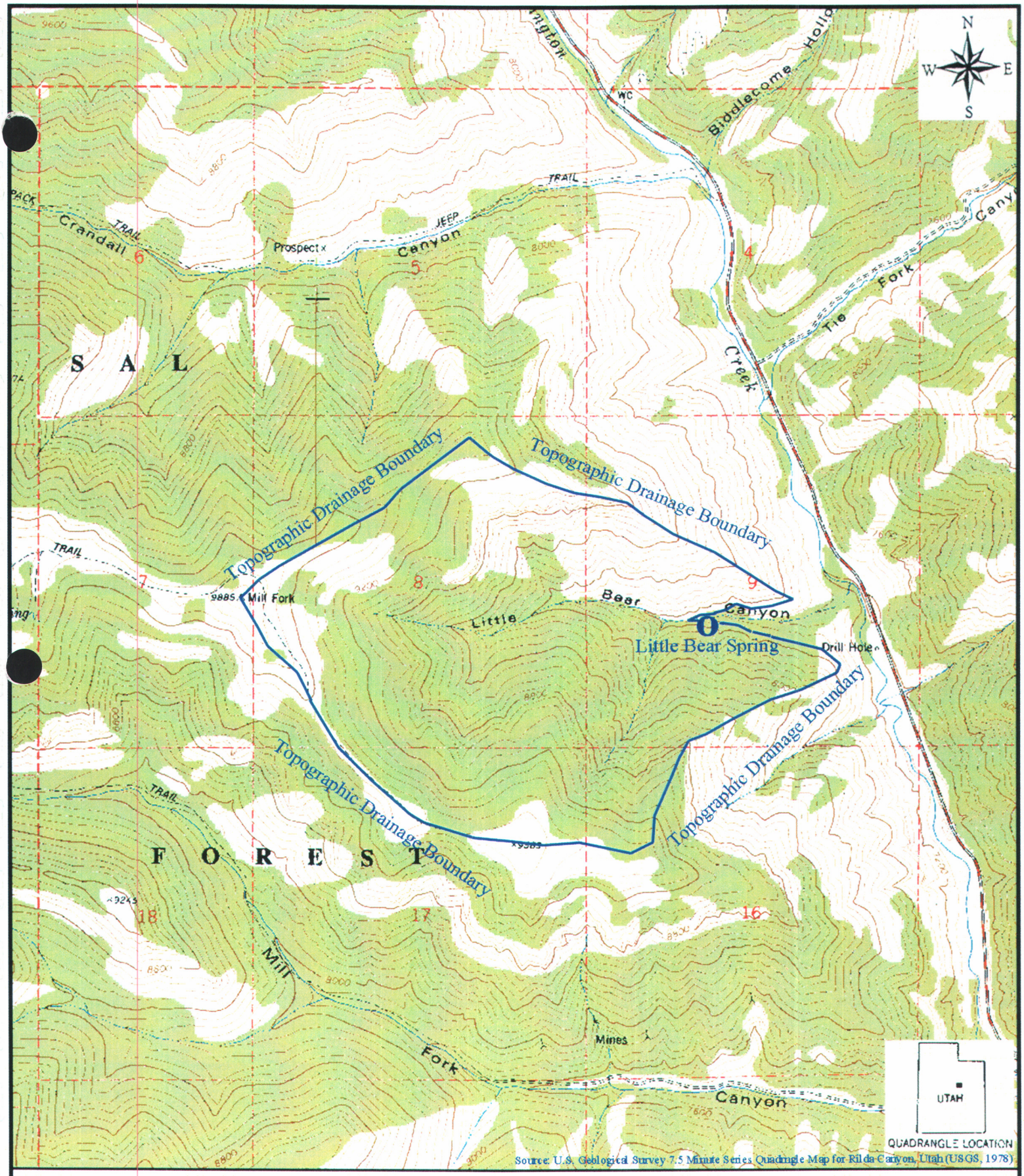
3.0 DESCRIPTION OF STUDY AREA

3.1 Project Location

The study area is depicted on **Figure 1**, consisting of a portion of U.S. Geologic Survey (USGS) 7.5-Minute Topographic Quadrangle Map for Rilda Canyon, Utah (USGS, 1978). Little Bear Spring is the focus of the project and is located in the northeastern quarter of the southwestern quarter of Section 9, Township 16 South, Range 7 East, Salt Lake Base and Meridian. The spring is located approximately 12 miles northwest of Huntington, Utah. The spring is located in Little Bear Canyon on the east slope of the central Wasatch Plateau.

3.2 Topography and Drainage

The topography in the study area is depicted on **Figure 1**. Little Bear Spring is located at an elevation of approximately 7,520 feet above mean sea level and on the south side of the Little Bear Canyon floor. The canyon floor slopes towards the east and the mountain slopes on both sides of the canyon dip towards the canyon creek. It is unlikely that the area with lower elevation would recharge to the spring. Thus, the 7,520-foot topographic contour line was assumed to be the lower drainage boundary of the spring. The up-gradient drainage boundaries coincide with the local mountain ridges, as shown in **Figure 1**. The total surface drainage area of Little Bear Canyon that is available to the spring is estimated to be approximately 1.2 square miles. This catchment area is small compared to the spring yield of 300 gpm (Mayo and Associates, 2001).



Source: U.S. Geological Survey 7.5 Minute Series Quadrangle Map for Rilda Canyon, Utah (USGS, 1978)

FIGURE 1. SITE VICINITY MAP

AquaTrack Survey - Little Bear Canyon
Huntington, Utah

Sunrise Project No.: 00560	Scale = 1" : 2000' Drawn by: Dao Yang	Date: September 7, 2001	SUNRISE ENGINEERING, INC. Aqua Track

3.3 General Geology and Hydrogeology

The Wasatch Plateau is a flat-topped mass about 80 miles long and 25 miles wide, and it appears as a huge upland that trends about North 20 degrees East, separating Sanpete Valley on the west from Castle Valley on the east. The top of the plateau is at an altitude of about 10,000 feet. The west flank of the plateau is a continuous westward-facing downwarp - the Wasatch monocline - that extends for almost the full length of the plateau. Westward-flowing consequent streams on the monocline have locally cut through the mantle of tilted beds to form deep, serpentine canyons that extend far back toward the crest of the plateau. In striking contrast to the west flank, the east flank is cliffy. The study area is located on the east flank of the Wasatch Plateau. The cliff-forming formations are pockmarked with small cave-like structures, indicating the formations were not well cemented or the cement was calcite that was leached away leaving these voids or holes in the cliff-forming rocks (Water Technology and Research, 1999). These holes and voids probably are the structures that form the small sinkholes in Mill Fork Creek.

Figure 2 shows the surficial geology of the project area and **Figure 3** is a geologic cross-section showing the generalized geologic stratification in the Little Bear Spring area. The location of this approximately west-east oriented cross-section is shown in **Figure 2**.

Little Bear Canyon is located approximately along the axis of a low angle syncline, as shown in **Figure 2**.

Figure 2 indicates that seven bedrock formations crop out in the project area. These formations are: Flagstaff Limestone (Tf) and North Horn Formation (Tknh) of Tertiary and Mesozoic sedimentary rocks; Price River Formation (Kpr), Castlegate Sandstone (Kc), Blackhawk Formation (Kbh), Star Point Sandstone (Ksp) and Mancos Shale (Km) of Mesozoic Sedimentary rocks.

According to Montgomery (1993), there is a regional aquifer consisting of the coal-bearing Blackhawk Formation and the underlying Star Point Sandstone. The Star Point Sandstone is underlain by the basically impervious Mancos Shale that inter-fingers with the overlying sandstone units. Within the mountain masses, groundwater is accumulated in storage within the pervious rock units, their bedding planes, and within all fractures, joints and permeable fault planes. Some water is perched or held up by non-pervious or low-permeability rock beds, such as shale or siltstone. Most of water is stored in the regional aquifer. Towards and within the bottom of the overall groundwater system, all

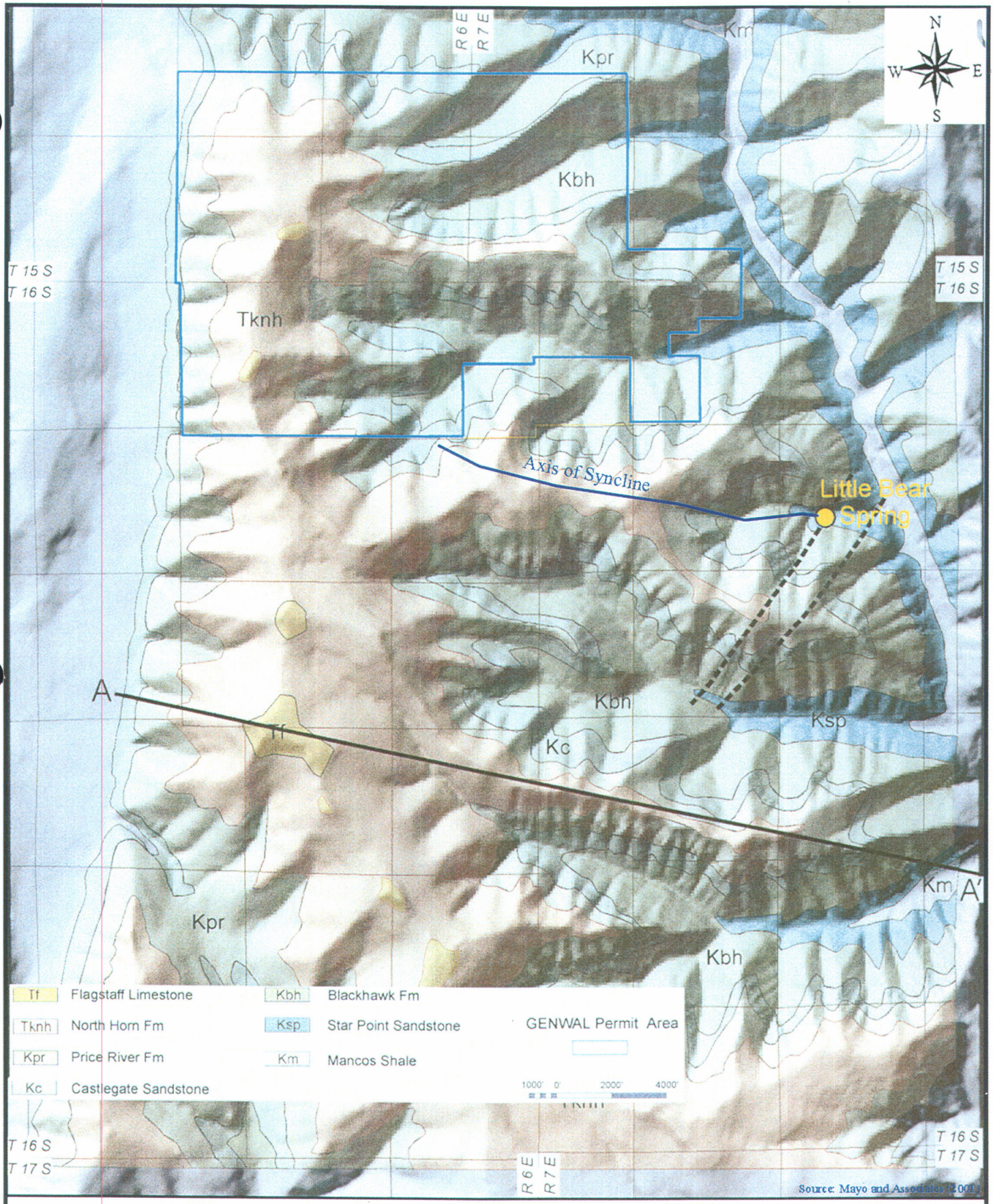
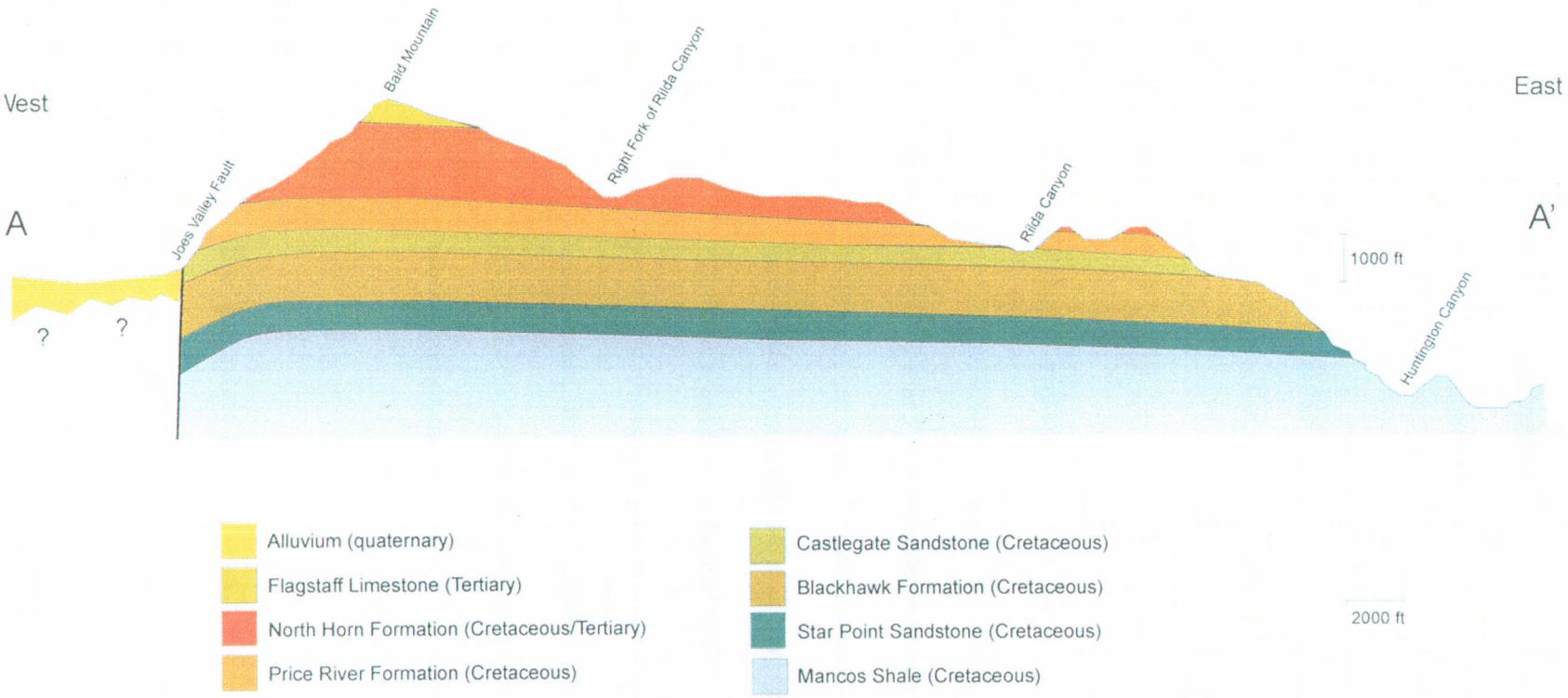


FIGURE 2. GEOLOGIC MAP

AquaTrack Survey - Little Bear Canyon
Huntington, Utah

Sunrise Project No.: 00560	Scale = 1" : 4800' Drawn by: Dao Yang	Date: October 4, 2001	SUNRISE ENGINEERING, INC. AquaTrack



Source: Mayo and Associates (2001)

FIGURE 3. GENERALIZED CROSS-SECTION A-A'
AquaTrack Survey - Little Bear Canyon
Huntington, Utah

Sunrise Project No.: 00560	Scale = AS SHOWN Drawn by: Dao Yang	Date: October 4, 2001	SUNRISE ENGINEERING, INC. AquaTrack

interconnected, pervious rock units and fracture openings are filled and saturated with groundwater. Those low-permeability rock units may be saturated or partly saturated (where interconnection is poor) with groundwater but do not yield much water, if any, to penetrating drill holes or coal-mine excavations, whereas adjacent or nearby rock units may yield appreciable water quantities beneath the overall groundwater surface. Near the edges of deeply incised canyons, those parts of the rock units above the groundwater surface have and continue to be drained naturally through all available permeability, mostly readily through open faults, joints and bedding planes.

The recharge to this groundwater system is from snowmelt and rainfall. The higher mountainous areas receive more precipitation and thus provide greater groundwater recharge. The extensive, high Wasatch Plateau above all of the stream drainage, springs and coal mines of the Huntington Canyon and adjacent coal mining and water producing areas cover hundreds of square miles and receive an average annual precipitation of 16-40 inches, with the greatest part of it resulting in stream runoff. Because of the higher storage capacity of the regional aquifer within the lower part of the groundwater system, its yield to springs, coal-mine interceptions and base flow to streams is consistent and less susceptible to seasonal precipitation and drought fluctuations, compared to local perched aquifers.

Because of the abundance of joints, fractures and faults present within the groundwater system, the permeability varies appreciably within various rock units and at different structural positions. Almost all springs in the area discharge from either joints or faults, and depending upon their length, width, degree of sediment or gouge filling, their interconnection and relation to adjacent rock units and nearby large faults, and their position within the aquifer system, will determine the amount of spring yield. The near-vertical faults generally trend northerly with some local exceptions, and the near-vertical joints trend widely from northwest to northeast.

Little Bear Spring discharges from the regional aquifer, the basal formation of which is the Star Point Sandstone. Farther back into the mountains from the facing slope where the spring discharges, the overlying formation to the Star Point Sandstone also is a part of the regional aquifer. This is the Blackhawk Formation from which all of the various beds of the area are mined, which is approximately 800 feet thick and is composed of interbedded sandstone, shale, siltstone, mudstone and coal.

Coal mining in the area is taking place within the higher slopes and has not penetrated far enough back into the mountain to intersect the groundwater surface of the regional

aquifer system, very little, if any, water has been intercepted and produced in the mines. This is the present condition of the GENWAL Coal Mine located in the upper part of Crandall Canyon, as shown in **Figure 2**.

The Star Point Sandstone Formation has a total thickness of 350-450 feet and consists of interbedded sandstone and shale with gradations of both into three distinct sandstone and shale members. The upper unit is the cliff-forming Spring Canyon Member, 50-100 feet thick; the middle unit is the semi-cliff-forming Storrs Member, 45-100 feet thick; and the basal unit is the cliff-forming Panther Member, 50-80 feet thick. Since the Panther Sandstone Member is underlain by the main body of the Mancos Shale, composed of impervious bentonitic clay and silt, it is the bottom of the groundwater system of the region. Any groundwater not exiting naturally at some higher position as springs and seeps, or intercepted by coal mining operations, will eventually exit from the aquifer system, except for that water retained in crevices of the rock material against the force of gravity. Thus, commencing at the land surface where precipitation infiltrates into the subsurface, on-down through the various soil and rock units and fracture-fault systems, groundwater recharge to the regional aquifer is an accumulation of it all, less that which spills naturally as seeps and springs, and is intercepted by coal mining operations. These overlying geologic formations of the area successively upward above the Blackhawk Formation are as follows: Castlegate Sandstone, approximately 250 feet thick; Price River Formation of interbedded sandstone and shale approximately 700 feet thick; North Horn Formation of shale, mudstone and interbedded sandstone approximately 800 feet thick; the Flagstaff Limestone 0-400 feet thick; and the alluvium of variable thickness.

4.0 FIELD RECONNAISSANCE/DATA COLLECTION

The fieldwork was conducted during July 16-25, 2001. Survey was conducted along four curving lines. The orientation of the lines was determined based on the topographic contour outline as displayed in **Figure 1**.

4.1 Equipment and Setup

The equipment used during the field survey consisted of a transmitter, a receiver, two electrodes, wires, a global positioning system (GPS) and other tools used for distance measurements.

4.1.1 Transmitter

The transmitter consists of a Honda 500-watt generator, an ELGAR (Model 501SL) power supply and an impedance matching circuit.

The generator provides power. The ELGAR power supply receives 60-hertz power from the generator and provides a 400-hertz 130-volt sinusoidal signal. The accuracy of the frequency is within one part in 10,000.

The ELGAR power supply feeds power to an impedance matching circuit. This circuit is designed to provide the best impedance match between the ground and the audio frequency (400-hertz) power supply. The voltage in the impedance matching circuit is adjustable from 0 to 400 volts with the maximum current output of 2 amperes. The optimal power and impedance match is 200 watts. The impedance matching circuit is connected to two electrodes used to energize the subsurface. Current is measured as part of the impedance matching circuit.

4.1.2 Receiver

The receiver consists of a magnetic sensor tuned to 400 hertz, and a receiver electronics package.

The magnetic sensor has a Q factor of 15 with an overall sensitivity of roughly 10^{-12} Tesla. The sensor itself tunes and resonates at 11,000 hertz. Sympathetic capacitive effects begin to appear in the sensor's response at 800 hertz. Thus, at 400 hertz, there is an adequate inductive response from the magnetic sensor without capacitive interference.

The receiver electronics package contains 60-, 360- and 420-hertz notch filters, several amplifiers, 400-hertz band-pass filters and other components, and filters and amplifies electrical signal from the sensor. Amplification can be set at 1, 10, 100 and 1,000 times. The electronics package has a Q factor of 200 and an electronics noise level of 1 millivolt at an output of 1,000 times. The total sensitivity of the whole package is about 10^{-15} Tesla.

The sensor output is amplified as a voltage and the electronically amplified signal output is read directly from the instrument.

4.1.3 Electrode Setup and Return Circuit

An electrode consists of a ¼-inch diameter 2-foot long stainless steel rod. A group of four steel electrodes were placed into the collection box of Little Bear Spring. Two other groups each consisting of three steel electrodes, used as return circuits, were driven into the ground and located 1,883 feet west and 2,302 feet east of the collection box of Little Bear Spring, respectively, as shown in **Figures 4a and 4b**. The Xs in **Figures 4a and 4b**

represent the electrode locations used in the survey. The electrodes were connected to the impedance matching circuit using an antenna consisting of a single insulated 18 gauge copper wire, represented by a yellow line in **Figures 4a and 4b**. Because of the cliffy terrain, it took 3 days to install the antenna and electrodes.

4.1.4 GPS

A GPS (Trimble Pathfinder) unit was used to determine the spatial location/coordinates (X, Y and Z) of each survey station. The location information is important for data analysis. It is very efficient and effective in the field using a GPS unit to determine the coordinates of each survey station.

4.2 Survey Stations and Lines

Survey stations are represented with red +s and shown in **Figures 4a and 4b**. A total of 115 stations were surveyed for this project.

A survey line consists of a number of survey stations used for data collection along a line with a certain horizontal distance or interval. For this project, the horizontal distance between stations ranged from 100 feet to 150 feet along a survey line. Four lines (Lines 1 through 4) were surveyed and are shown in **Figures 4a and 4b**. 1998 and 1999 survey stations are also shown in **Figures 4a and 4b**.

4.3 Raw Data Gathering

Because of the remote, steep and cliffy terrain, it took 150 man-hours to collect the raw data.

4.3.1 General Description

After a 400-hertz frequency electric current was injected into the subsurface through the electrodes, a magnetic field was generated about the ground where electricity flowed in the subsurface. The magnetic receiver was used to measure the magnetic strength at survey stations from the ground surface. The receiver was moved around from one survey station to another on the ground surface. The data from the receiver and transmitter were entered directly into a portable computer. Manual records were also made in the field for backup purposes. On-site communication was conducted through portable two-way radios.

All the field data records were re-organized and are attached in **Appendix A**.

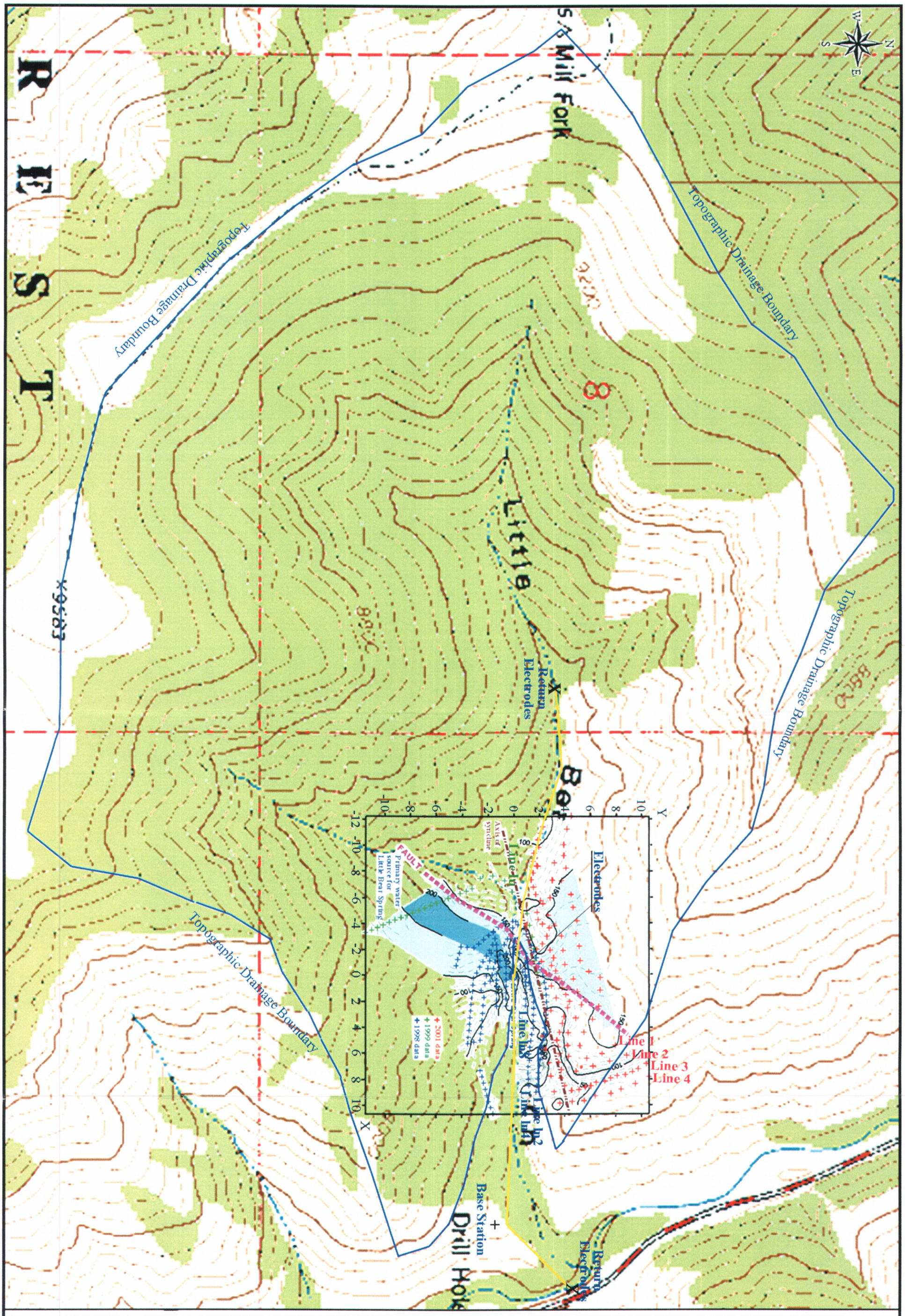


FIGURE 4a. TWO-DIMENSIONAL PRESENTATION WITH ANTENNA LAYOUT, SURVEY STATIONS AND SURVEY LINES

AquaTrack Survey - Little Bear Canyon
Huntington, Utah

Sunrise Project No.: 00560	Scale = 1" : 700' Drawn by: Dr. Montgomery	Date: October 29, 2001	SUNRISE ENGINEERING, INC. AquaTrack

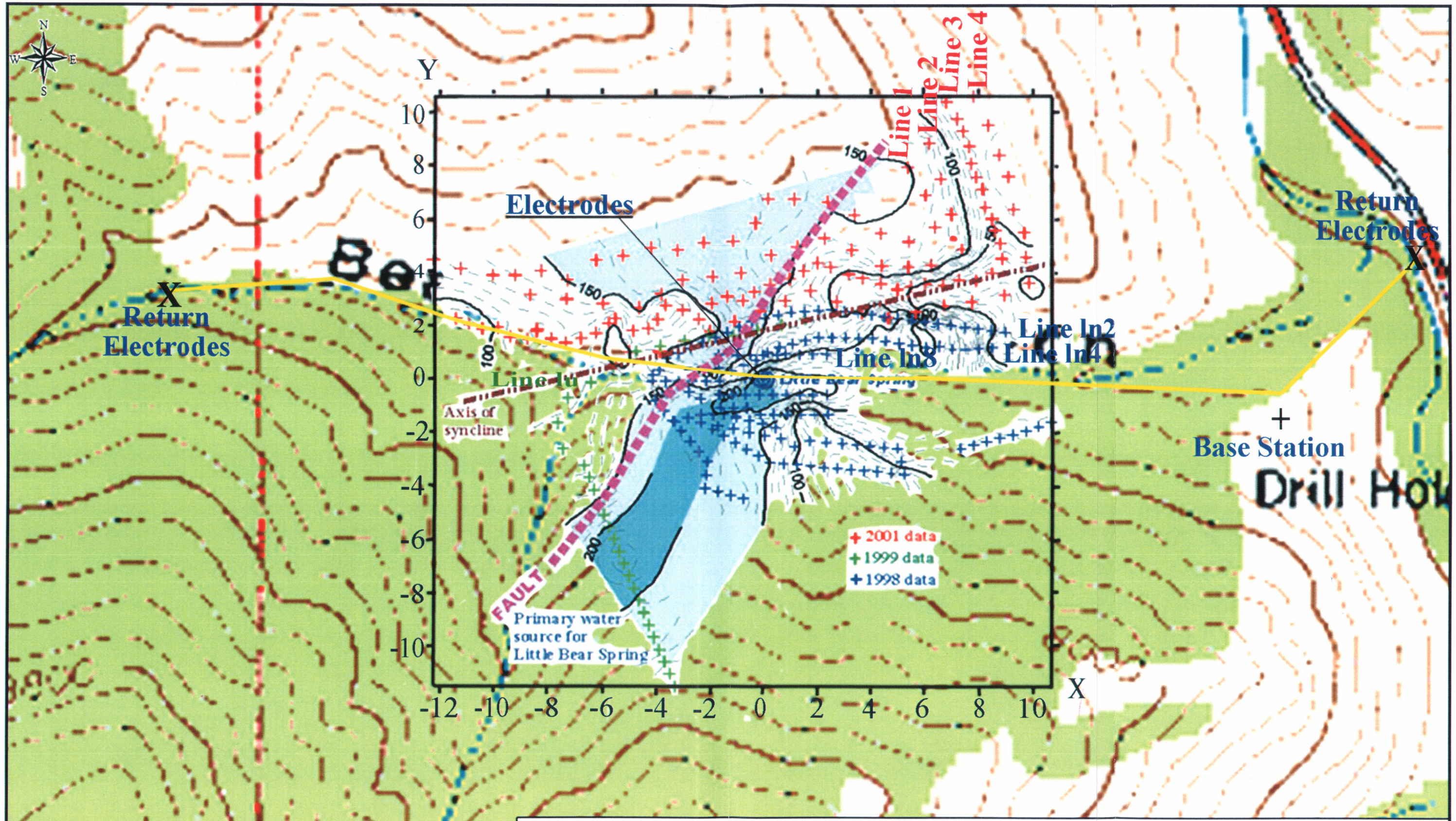


FIGURE 4b. ENLARGED TWO-DIMENSIONAL PRESENTATION WITH ANTENNA LAYOUT, SURVEY STATIONS AND SURVEY LINES

AquaTrack Survey - Little Bear Canyon
Huntington, Utah

Sunrise Project No.: 00560	Scale = 1" : 350' Drawn by: Dr. Montgomery	Date: October 31, 2001	SUNRISE ENGINEERING INC AquaTrack

4.3.2 Spatial Positioning Survey

For each survey station, the Trimble Pathfinder GPS unit was used to determine the spatial coordinates (X-easting, Y-northing, and Z-elevation). The horizontal coordinate system (X-Y) is presented in **Figures 4a and 4b**.

4.3.3 Base Station Survey

To record the temporal variations in magnetic field, Sunrise used a base station. The field personnel surveyed the base station at least twice a day during the field reconnaissance. This information is called drift data and used for data normalization. The location of the base station is shown in **Figures 4a and 4b.**

4.3.4 Antenna Survey

The antenna wire location was also surveyed. The antenna wire itself also generates a magnetic field when it was energized. This magnetic field could cause significant interference with the magnetic field emanating from the energized groundwater. Other physical conditions were also investigated to identify any potential sources of interference. During the survey, no other apparent sources of potential interference were noted.

5.0 DATA NORMALIZATION AND INTERPRETATION

The field data consists of the horizontal magnetic field data, the vertical magnetic field data, and survey station locations. Interference was removed from the field data to provide representative information that reflects the actual impact of the electricity injected into the subsurface.

5.1 Data Normalization

For this project, the effects of the antenna wire were removed from the raw data. The temporal variation (drift), measured by repeating base station readings, was also removed from the field data. As stated in Section 2.3, because the magnetic field is a three-dimensional vector, like the speed of an airplane flying in the air, the magnetic receiver used in the AquaTrack survey has been designed to measure the magnetic field in a horizontal plane (X-Y plane) and the vertical direction (Z-direction). In the horizontal plane, the receiver can detect the maximum and minimum magnetic values in two normal directions on the plane (not exactly the X- or Y-directions). The maximum horizontal magnetic component is the most important in the data analysis. Therefore, the data

normalization is primarily conducted on the maximum horizontal magnetic component. Once the need arises to normalize other components, the normalization procedure is the same.

5.1.1 Correction of Interference from Antenna Wire

Biot-Savart Law was used to remove the impact from the antenna wire. According to Biot-Savart Law, the magnetic strength vector (magnitude and direction) from the antenna wire can be calculated for any survey station based on the coordinates (X-easting, Y-northing and Z-elevation), and the current and layout of the antenna wire. The reading at each survey station is corrected by vectorially deducting the magnetic strength from the antenna wire.

5.1.2 Correction of Drift Impact

Impact from the drift was adjusted based on the relative values of the repeated readings (**Appendix A**). For example, if the all-time average value of the maximum horizontal magnetic strength at a base station was 200 mV and a repeating reading was 220 mV on a day, all the readings obtained during the day would be corrected by multiplying by 110% (220/200 = 110%).

5.2 Data Interpretation

To facilitate the data analysis, the normalized data were plotted as contour maps or profiles. Generally, a relatively large value of maximum horizontal magnetic strength (measured in mV) in a profile indicates that a higher water content exists beneath the survey station.

5.2.1 Profiles

A profile is a mathematical presentation of the survey data obtained from each station along a survey line. The number along the bottom of a profile are in hundreds of feet (e.g., the distance between –5 and 5 would be 1,000 feet) and signal strength on the left side of the profile is in millivolt (mV).

Figure 5 shows the profiles of normalized data for lines 1 through 4. Four more profiles were also plotted in **Figure 5** for lines lu, Ln2, Ln4 and Ln8 displaying partial data collected north of the spring in 1998 and 1999. The data collected south of the spring in 1998 and 1999 are not plotted in the profiles. All the profiles run from west to east (left to right) and were created for an observer to look north. The horizontal axis represents

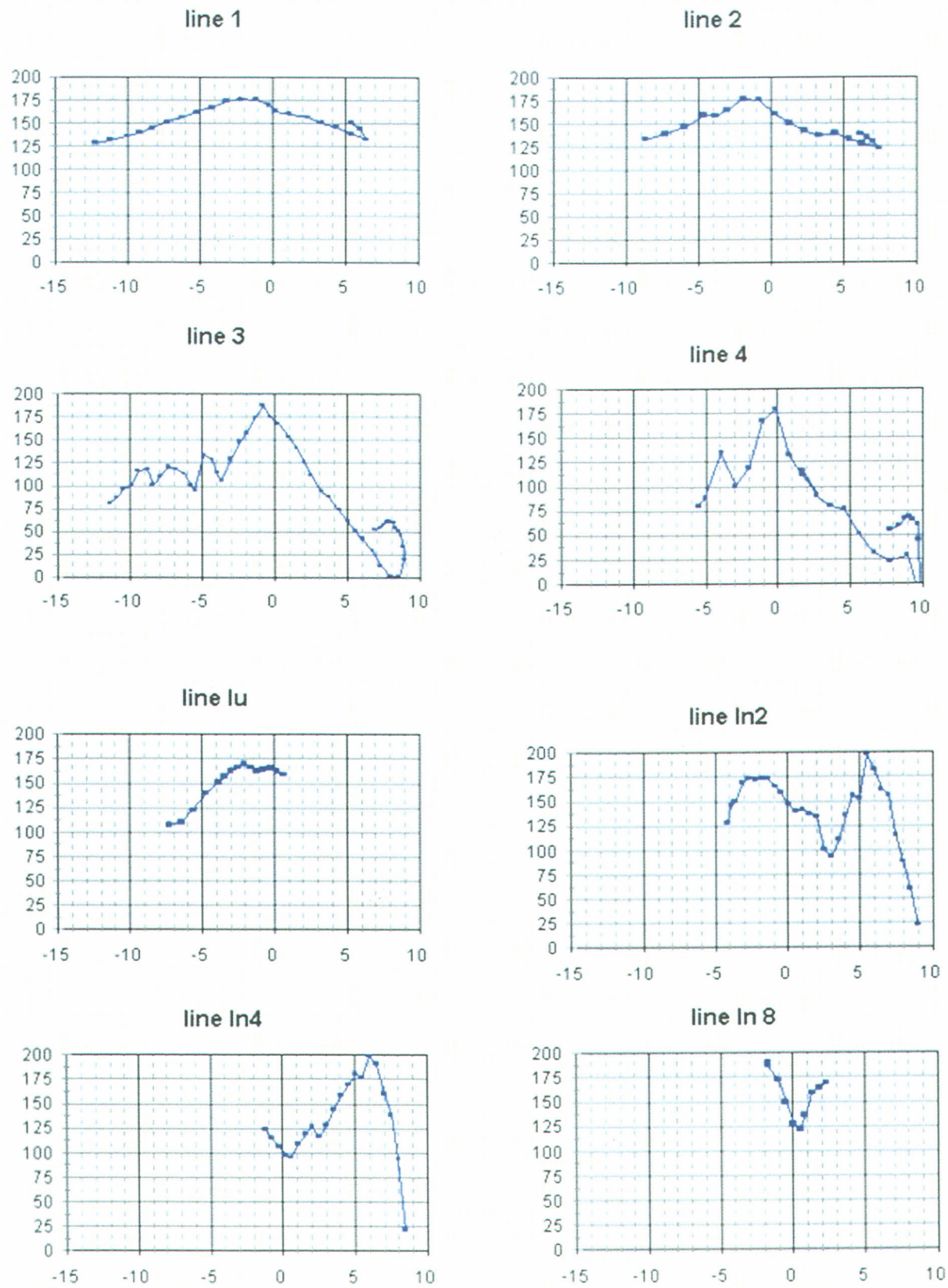


FIGURE 5. PROFILES

AquaTrack Survey - Little Bear Canyon
Huntington, Utah

Sunrise Project No.: 00560	Scale = NOT TO SCALE Drawn by: Dr. Montgomery	Date: October 26, 2001	SUNRISE ENGINEERING INC AquaTrack

the coordinates of easting, or X. A detailed explanation of five profiles (lines 1 through 4 and lu) is given to demonstrate how the profiles are interpreted.

Profile Line 1: Line 1 is a curved survey line running between the 8,800- and 7,840-foot contour lines and was survey in 2001. Profile Line 1 indicates that a weak flattop with a value of 175 mV occurs between X = -300 and –100 feet, indicating weak groundwater movement exists in the vicinity and the center of the flow is at X = -200 feet. The profile also shows flat slopes on both sides of the flattop, indicating there is no distinct groundwater channel. This profile generally indicates general presence of groundwater in the area and there is not much groundwater.

Profile Line 2: Line 2 is a curved survey line running between the 7,920- and 7,840-foot contour lines and was surveyed in 2001. Profile Line 2 indicates that a weak flattop with a value of 175 mV occurs between X = -200 and -100 feet, indicating weak groundwater movement exists in the vicinity and the center of the flow is at X = -150 feet. The profile also shows flat slope on both sides of the flattop, indicating there is no distinct groundwater channel. This profile generally indicates general presence of groundwater in the area and there is not much groundwater.

Profile Line 3: Line 3 is a curved survey line running between the 7,920- and 7,760-foot contour lines and was survey in 2001. Profile Line 3 indicates that a peak with a value of 190 mV occurs at X = -100 feet, indicating a groundwater channel is present in the vicinity and the center of the channel is at X = -100 feet. It appears that this channel is associated with the fault and it probably follows the fault to the northeast.

Profile Line 4: Line 4 is a curved survey line running between the 7,920- and 7,760-foot contour lines and was surveyed in 2001. Profile Line 4 indicates that a weak peak with a value of approximately 170 mV occurs at X = 0, indicating a weak groundwater channel exists in the vicinity and the center of the channel is at X = 0. Again, it appears that this channel is associated with the fault, running to the northeast.

Profile Line lu: Line lu is the northern part of the 1999 curved survey line. Line lu basically runs along the 7,600-foot contour line. Profile Line lu indicates that a weak flattop occurs between X = -200 feet and 0, indicating a weak groundwater channel exists in the vicinity and it is centered at X = -100 feet.

A detailed explanation of other profiles is not given here to avoid tediousness. The findings from each of the profiles are summarized **Table 1**.

Table 1. Findings from Profiles

Survey Line #	Number of Stations	Description of Findings
1	21	Weak groundwater movement is centered at X = -200 feet. The groundwater is probably surface fed.
2	20	Weak groundwater movement is centered at X = -150 feet.
3	50	Groundwater moving into a weak channel that is centered at X = 0.
4	24	A weak groundwater channel is centered at X = 0.
lu	16	A 200-foot wide weak groundwater channel is centered at X = -100 feet.
Ln2	28	A 200-foot weak groundwater channel is centered at X = -200 feet and a groundwater channel is centered at X = 50 feet.
Ln4	20	A groundwater channel is centered at X = 600 feet.
Ln8	9	Line Ln8 was too close to the electrodes. The reading is not accurate which is a limitation of the AquaTrack technology.

5.2.2 Two-Dimensional Presentation

Figures 4a and 4b show the contours (in mV) of the normalized maximum horizontal magnetic strength and groundwater channels in the area. Areas with high maximum horizontal magnetic strength are considered as groundwater channels beneath the ground surface. A vertex-type curvature is an indication of the orientation for a water channel. On the other hand, a valley-type curvature indicates a dry zone. **Figures 4a and 4b** also incorporate the results for the area south of the spring, which were interpreted by Water Technology and Research (1998, 1999). In **Figures 4a and 4b**, the dark blue shading represents a preferential groundwater pathway and the light blue shading denotes an area with less groundwater present while the area without any shading in the surveyed zone indicates that this area has little groundwater or insignificant groundwater present.

Figure 4a also shows the surface drainage of the spring. As described in Section 1.2, Water Technology and Research (1998, 1999) concluded that Little Bear Spring is located near the axis of a syncline, denoted by a dashed dark red line. Water Technology and Research (1999) further concluded that the primary source is from Mill Fork Canyon. Groundwater was found to follow a fault line, represented by a dashed pink line, in the mountain range south of Little Bear Spring. This fault extends beyond the mountain ridge (topographic divide) between Little Bear Canyon and Mill Fork Canyon and connects sinks in Mill Fork Canyon. The dark blue shading south of Little Bear Spring in **Figures 4a and 4b** represent a preferential groundwater pathway along the fault line.

The fault line is also shown in **Figure 2**. The light blue shading on both sides of the dark blue shading south of the spring indicates that groundwater also moves towards the spring outside the fault zone based on the 1998 and 1999 survey results.

Water Technology and Research (1999) also concludes that the secondary water source of Little Bear Spring is potentially from the area north of the spring. The triangular-shaped light blue shading north of the spring, as shown in **Figures 4a and 4b**, was derived from the data gathered during this survey. This shading indicates that there is not any preferential groundwater pathway in the surveyed area. However, groundwater generally moves along the mountain slope towards the axis of the syncline. The groundwater movement indicated by the light blue shading can be explained as the result of natural recharge resulting from precipitation. The survey data indicates the northeastern survey area is not a groundwater-bearing zone where no shading was derived from the survey data. Based on the survey data, Sunrise inferred that the fault identified to connect Little Bear Canyon and Mill Fork Canyon extends to the north of Little Bear Spring. On the northern slope of Little Bear Canyon, it appears that the fault intercepts all groundwater from the area up-gradient (northwest) of the fault and conducts the water to the canyon creek. This inference is supported by the fact that the area down-gradient (southeast) of the fault is not a groundwater-bearing zone. However, this does not appear to contribute significant amount of water to Little Bear Spring.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Sunrise has completed an AquaTrack Survey for GENWAL Resources in an area north of Little Bear Canyon.

The findings of this survey and previous surveys is summarized below:

- A preferential groundwater pathway along a fault line was identified to connect Mill Fork Canyon and Little Bear Canyon. Little Bear Spring is located on this pathway.
- The saturated sediments in Mill Fork Canyon are capable of supporting continuous recharge to Little Bear Spring.
- Mill Fork Creek loses approximately 300 gpm of surface water. The lost water likely recharges Little Bear Spring.
- The primary groundwater source of Little Bear Spring is from the preferential groundwater pathway leading to Mill Fork Canyon where small sinkholes were identified to be within the fault zone.

- The fault that is believed to connect Mill Fork Canyon and Little Bear Canyon was inferred to extend to the northern slope of Little Bear Canyon. It appears that the fault intercepts all groundwater from the area up-gradient (northwest) of the fault and conducts the water to the canyon creek. This inference is also supported by the fact that the area down-gradient (southeast) of the fault is not a groundwater-bearing zone. The survey data also indicates that the water north of Little Bear Spring is minimal and probably incidental.
- Groundwater as a result of natural recharge resulting from precipitation moves from the northern slope of Little Bear Canyon towards the canyon creek. The amount of water is not significant.

This survey does not cover the area across the northeast topographic divide, Sunrise cannot infer that no preferential groundwater pathway runs across the divide that may potentially introduce groundwater to Little Bear Canyon from Crandall Canyon where mining operations are active. However, the data from this survey indicates a very low probability of any water from Crandall Canyon Creek to Little Bear Canyon.

6.0 GENERAL COMMENTS

This report was prepared for the exclusive use of Little Bear Spring for specific application to this project and has been prepared in accordance with currently generally accepted principles and practices in the field of geophysics. No warranties, expressed or implied, are intended or made. As additional information becomes available the interpretations and recommendations expressed in this report will be subject to revision.

7.0 REFERENCES

Mayo and Associates, LC. 2001. Investigation of the Potential for Little Bear Spring Recharge in Mill Fork Canyon, Emery County, Utah.

Montgomery, Bryce. 1993. Hydrogeologic Study for "Wellhead Protection Program," Drinking Water Source Protection Regulations R309-113, of Castle Valley Special Service District Water Sources.

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Water Technology and Research. 1999. AquaTrack Survey – Little Bear Spring Study, Huntington Canyon, Utah.

ID	EASTING	NORTHING	ELEVATION	+N/-S	+E/-W	MIN	DIR	MAX	VERT	REPORT	TIME	DATE
1				base	-	193.8	0.0	626.0	2540.0	950 time	10:59:54am	07/18/01
2				2	a	20.5	0.0	1469.0	2592.0		11:05:29am	07/18/01
3	1598343.894	14324912.718	7793.197	1	1	5.3	0.0	65.0	12.3		12:18:48pm	07/18/01
4	1598444.516	14324880.521	7800.482	1	2	7.9	0.0	76.2	15.1		12:31:11pm	07/18/01
5	1598564.290	14324856.787	7803.588	1	3	9.8	0.0	91.6	20.8		12:35:34pm	07/18/01
6	1598646.254	14324855.943	7808.098	1	4	12.2	0.0	104.6	28.5		12:40:26pm	07/18/01
7	1598742.015	14324873.233	7803.200	1	5	13.8	0.0	123.0	39.2		12:45:19pm	07/18/01
8	1598839.442	14324838.964	7819.519	1	6	15.5	0.0	144.6	52.6		12:50:43pm	07/18/01
9	1598946.451	14324913.045	7809.086	1	7	18.8	0.0	163.0	82.5		12:56:23pm	07/18/01
10	1599045.967	14324930.765	7809.158	1	8	23.7	0.0	182.3	108.6		01:02:35pm	07/18/01
11	1599148.224	14324960.345	7808.813	1	9	29.8	0.0	200.0	148.2		01:07:29pm	07/18/01
12	1599248.125	14324950.212	7807.379	1	10	33.6	0.0	225.0	196.0		01:19:58pm	07/18/01
13	1599344.868	14324978.383	7800.270	1	11	40.8	0.0	232.1	259.0		01:26:55pm	07/18/01
14	1599454.989	14324986.453	7804.948	1	12	44.2	0.0	230.6	322.0		01:33:17pm	07/18/01
15	1599539.169	14325052.533	7802.643	1	13	50.1	0.0	209.0	345.0		01:39:59pm	07/18/01
16	1599587.306	14325142.442	7814.878	1	14	54.8	0.0	187.3	333.1	30 feet from run off spring	02:06:25pm	07/18/01
17	1599683.398	14325141.289	7801.581	1	15	63.6	0.0	175.9	377.0		02:36:51pm	07/18/01
18	1599806.599	14325131.563	7798.341	1	16	69.6	0.0	162.3	438.0		02:43:44pm	07/18/01
19	1599905.589	14325082.170	7783.354	1	17	73.2	0.0	142.3	511.0		02:47:28pm	07/18/01
20	1600005.213	14325013.554	7785.366	1	18	67.8	0.0	125.0	576.0		02:51:09pm	07/18/01
21	1600107.239	14324983.261	7785.759	1	19	59.2	0.0	99.8	601.0		02:56:54pm	07/18/01
22	1600205.353	14325037.454	7787.038	1	20	53.0	0.0	80.6	584.0		03:05:35pm	07/18/01
23	1600169.357	14325157.807	7794.130	1	21	47.9	0.0	119.9	485.0	min paralell w wire max parll w river	03:11:59pm	07/18/01
24	1600104.481	14325260.721	7807.262	1	22	37.0	0.0	141.3	393.3		03:18:24pm	07/18/01
25	1600183.286	14325349.320	7739.950	2	1	20.8	0.0	186.6	377.0		03:26:00pm	07/18/01
26	1600226.498	14325217.614	7739.530	2	2	22.8	0.0	165.8	503.0		03:36:14pm	07/18/01
27				2	3	38.0	0.0	145.0	601.0		03:47:43pm	07/18/01
28	1600306.991	14324953.562	7720.932	2	4	42.5	0.0	104.7	760.0		03:56:15pm	07/18/01
29	1600191.720	14324895.746	7696.999	2	5	71.0	0.0	132.5	864.0		04:02:32pm	07/18/01
30	1600106.102	14324888.688	7696.918	2	6	61.0	0.0	157.8	863.0		04:09:05pm	07/18/01
31	1600007.422	14324892.716	7694.885	2	7	70.2	0.0	190.8	836.0		04:13:28pm	07/18/01
32	1599896.331	14324951.696	7694.266	2	8	96.4	0.0	178.1	772.0		04:30:01pm	07/18/01
33	1599793.365	14324994.780	7700.467	2	9	91.8	0.0	207.8	680.0		04:41:16pm	07/18/01
34				2	10	78.8	0.0	247.2	578.0	in canyon below L1 14	04:47:58pm	07/18/01
35	1599595.752	14324931.856	7712.637	2	11	70.6	0.0	300.5	614.0		04:57:21pm	07/18/01
36	1599484.284	14324865.871	7699.016	2	12	60.3	0.0	383.0	567.0		05:06:10pm	07/18/01
37				2	13	53.8	0.0	386.0	386.0		05:16:23pm	07/18/01
38	1599266.665	14324838.611	7721.719	2	14	40.5	0.0	328.0	365.0		05:23:32pm	07/18/01
39				2	15	35.8	0.0	292.6	190.6		05:32:11pm	07/18/01
40	1599105.061	14324735.102	7705.235	2	16	26.0		298.0	128.9		05:48:53pm	07/18/01
41	1598970.615	14324750.943	7704.280	2	17	20.6	0.0	230.6	79.2		05:57:57pm	07/18/01
42				2	18	15.3	0.0	192.8	46.0		06:05:03pm	07/18/01
43				2	19	13.0	0.0	160.7	31.6		06:21:23pm	07/18/01
44	1601504.670	14324550.880	7247.030	BASE	-	279.0	0.0	1093.0	2599.0		07:13:33pm	07/18/01
45	1601508.571	14324547.525	7235.801	base	-	176.0	0.0	717.0	2568.0		09:06:12am	07/20/01
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50	1598422.102	14324747.383	7699.918	2	23	9.0	0.0	1013.0	1586.0		10:28:36am	07/20/01
51	1598425.698	14324692.529	7661.735	3	1	3.3	0.0	1653.0	2123.0	100 feet east of 2a	10:35:56am	07/20/01
52				3	1.5	10.2	0.0	1415.0	2200.0		10:46:47am	07/20/01

53	1598524.661	14324654.040	7667.969	3	2	6.0	0.0	1470.0	1960.0	10:52:56am	07/20/01
54	1598581.909	14324659.095	7671.113	3	2.5	11.5	0.0	1243.0	1860.0	10:55:52am	07/20/01
55	1598627.341	14324624.527	7654.457	3	3	7.9	0.0	1540.0	2076.0	11:00:50am	07/20/01
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58	1598725.526	14324645.964	7649.256	3	4	5.6	0.0	793.0	1708.0	11:42:01am	07/20/01
59	1598779.447	14324617.240	7646.204	3	4.5	14.0	0.0	869.0	1740.0	11:45:18am	07/20/01
60	1598833.056	14324602.770	7646.464	3	5	16.8	0.0	938.0	1672.0	11:50:25am	07/20/01
61	1598890.080	14324619.214	7645.641	3	5.5	23.7	0.0	812.0	1513.0	11:55:42am	07/20/01
62	1598944.439	14324638.621	7650.317	3	6	25.3	0.0	704.0	1308.0	11:58:37am	07/20/01
63	1598991.429	14324673.907	7655.455	3	6.5	26.3	0.0	543.0	1175.0	12:01:49pm	07/20/01
64	1599017.171	14324693.136	7649.476	3	7	31.5	0.0	478.0	1166.0	12:05:11pm	07/20/01
65	1599081.891	14324648.246	7627.294	3	7.5	24.3	0.0	761.0	1293.0	12:09:58pm	07/20/01
66	1599137.265	14324655.699	7631.642	3	8	18.0	0.0	680.0	1104.0	12:13:06pm	07/20/01
67	1599172.621	14324690.340	7625.398	3	8.5	22.9	0.0	563.0	1043.0	12:19:45pm	07/20/01
68	1599202.595	14324744.198	7632.036	3	9	30.0	0.0	489.0	858.0	12:25:15pm	07/20/01
69	1599266.073	14324725.755	7624.152	3	10	20.6	0.0	603.0	817.0	12:28:49pm	07/20/01
70	1599326.792	14324691.484	7621.010	3	10	16.2	0.0	671.0	687.0	12:38:31pm	07/20/01
71	1599373.252	14324751.125	7632.605	3	10.5	17.3	0.0	688.0	366.0	12:46:17pm	07/20/01
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74	1599534.387	14324793.446	7619.311	3	12	2.8	0.0	670.0	116.6	01:03:09pm	07/20/01
75	1599591.843	14324820.831	7617.615	3	12.5	8.9	0.0	615.0	242.0	01:07:00pm	07/20/01
76	1599665.771	14324842.646	7614.971	3	13	16.5	0.0	530.0	349.0	01:19:02pm	07/20/01
77				3	13.5	24.8	0.0	472.0	350.0	01:25:31pm	07/20/01
78	1599769.379	14324903.515	7621.410	3	14	32.5	0.0	414.0	396.0	01:35:54pm	07/20/01
79	1599817.052	14324886.840	7620.836	3	14.5	37.0	0.0	360.0	473.0	01:39:20pm	07/20/01
80	1599884.270	14324859.837	7626.366	3	15	43.0	0.0	301.0	558.0	01:44:31pm	07/20/01
81	1599936.973	14324846.445	7628.599	3	15.5	41.9		280.0	576.0	01:51:26pm	07/20/01
82	1600004.572	14324825.708	7633.410	3	16	40.8	0.0	238.0	605.0	01:57:24pm	07/20/01
83	1600065.751	14324804.325	7632.346	3	16.5	49.6	0.0	206.0	643.0	02:03:46pm	07/20/01
84				3	17	42.0	0.0	181.0	638.0	02:11:57pm	07/20/01
85	1600168.425	14324824.623	7638.945	3	17.5	48.9	0.0	162.8	634.0	02:19:22pm	07/20/01
86	1600236.304	14324821.073	7624.486	3	18	53.3	0.0	135.3	668.0	02:29:14pm	07/20/01
87	1600295.250	14324839.224	7627.413	3	18.5	55.0	0.0	106.0	637.0	02:34:21pm	07/20/01
88	1600358.301	14324838.901	7617.967	3	19	56.4	0.0	89.0	663.0	02:37:53pm	07/20/01
89	1600417.017	14324864.678	7623.880	3	20	44.3	0.0	91.3	653.0	02:45:53pm	07/20/01
90	1600453.982	14324919.866	7622.138	3	20.5	25.2	0.0	124.3	600.0	02:54:29pm	07/20/01
91	1600448.579	14324976.475	7622.356	3	21	22.2	0.0	148.0	533.0	02:58:41pm	07/20/01
92	1600430.441	14325024.560	7621.534	3	21.5	20.8	0.0	167.6	469.0	03:02:09pm	07/20/01
93	1600418.032	14325069.063	7630.727	3	22	18.8	0.0	178.0	421.0	03:07:06pm	07/20/01
94	1600393.089	14325113.311	7631.987	3	22.5	20.0	0.0	182.6	372.0	03:10:30pm	07/20/01
95	1600382.519	14325180.356	7631.339	3	23	16.4	0.0	194.5	330.0	03:16:00pm	07/20/01
96	1600359.730	14325225.194	7634.115	3	23.5	16.5	0.0	196.0	305.0	03:19:07pm	07/20/01
97	1600340.238	14325274.621	7635.494	3	24	15.3	0.0	198.0	275.0	03:21:54pm	07/20/01
98	1600332.679	14325338.590	7634.988	3	24.5	13.8	0.0	195.0	245.0	03:28:12pm	07/20/01
99	1600308.614	14325394.814	7638.238	3	25	14.8	0.0	191.8	213.7	03:31:22pm	07/20/01
100	1600287.135	14325440.420	7641.900	3	25.5	13.3	0.0	185.0	194.0	03:34:29pm	07/20/01
101	1600247.882	14325502.821	7638.317	3	26	12.6	0.0	182.0	169.0	03:37:58pm	07/20/01
102	1600347.782	14325524.478	7578.944	4	1	10.7	0.0	192.8	180.0	03:48:51pm	07/20/01
103	1600402.307	14325416.642	7573.563	4	2	9.6	0.0	206.0	226.0	03:53:35pm	07/20/01
104	1600443.690	14325307.098	7561.595	4	3	9.6	0.0	225.0	290.0	03:57:11pm	07/20/01
105	1600477.437	14325226.513	7554.798	4	4	7.2	0.0	230.0	342.3	03:58:57pm	07/20/01

106	1600497.518	14325104.861	7560.563	4	5	7.1	0.0	220.8	458.0		04:01:55pm	07/20/01
107	1600535.704	14325017.045	7560.497	4	6	4.9	0.0	206.8	548.0		04:06:19pm	07/20/01
108	1600542.427	14324925.167	7556.731	4	7	3.9	0.0	165.4	658.0		04:08:36pm	07/20/01
109	1600553.834	14324829.807	7552.621	4	8	7.6	0.0	16.8	785.0		04:11:40pm	07/20/01
110	1600464.180	14324782.941	7520.865	4	9	22.5	0.0	120.0	900.0		04:35:29pm	07/20/01
111	1600342.518	14324756.986	7515.636	4	10	63.0	0.0	94.5	964.0		04:40:36pm	07/20/01
112	1600237.390	14324743.630	7520.449	4	11	69.0	0.0	111.2	998.0		04:45:22pm	07/20/01
113	1600133.037	14324719.789	7516.573	4	12	53.5	0.0	176.9	1082.0		04:48:27pm	07/20/01
114	1600031.415	14324697.070	7528.255	4	13	36.2	0.0	284.6	1113.0		04:51:36pm	07/20/01
115	1599934.200	14324715.910	7527.012	4	14	45.7	0.0	308.0	1110.0		04:55:54pm	07/20/01
116	1599838.326	14324757.336	7523.300	4	15	61.8	0.0	376.0	994.0		05:02:17pm	07/20/01
117				4	16	53.7	0.0	587.0	1003.0		05:10:40pm	07/20/01
118				BASE	-	181.0	0.0	716.0	2560.0		05:57:02pm	07/20/01
119	1601504.080	14324542.500	7240.716	base	-	171.8		704.0	2577.0		09:40:31am	07/21/01
120				4	15	60.6	0.0	390.0	997.0		10:24:50am	07/21/01
121				4	16	59.8	0.0	553.0	1008.0		10:36:29am	07/21/01
122				4	17	31.6	0.0	774.0	1140.0	30 feet east ofold line 2 n 6	10:39:53am	07/21/01
123				4	18	20.2	0.0	1364.0	691.0		10:52:00am	07/21/01
124				4	19	11.9	0.0	1478.0	396.0		10:55:25am	07/21/01
125				4	20	22.8	0.0	1046.0	1557.0		11:02:38am	07/21/01
126				4	21	33.7	0.0	893.0	2052.0		11:12:53am	07/21/01
127	1599179.497	14324569.372	7507.998	4	22	32.8	0.0	2575.0	2644.0	at old station - LU +5	11:16:22am	07/21/01
128	1599066.394	14324567.190	7515.179	4	23	44.0	0.0	1648.0	2650.0	20 feet north west of old station line U +6.00	11:25:29am	07/21/01
129	1599019.168	14324523.829	7501.026	4	24	20.0	0.0	2596.0	2775.0	followed cliff to canyon floor. this station approx 35 feet from wire	11:39:03am	07/21/01
130	1598789.599	14324705.447	7706.910	2	19	22.8	0.0	478.0	1193.0	r	12:27:43pm	07/21/01
131	1598881.310	14324702.004	7713.329	2	18	27.3	0.0	442.0	1039.0	r	12:31:35pm	07/21/01
132	1598978.301	14324753.464	7699.128	2	17	34.9	0.0	338.0	924.0	r	12:39:36pm	07/21/01
133	1599107.442	14324732.786	7698.254	2	16	25.8	0.0	416.0	780.0	r	12:43:24pm	07/21/01
134				2	15	30.6	0.0	366.0	603.0	r	12:48:07pm	07/21/01
135	1599267.482	14324845.462	7717.601	2	14	20.3	0.0	440.0	387.0	r	12:52:08pm	07/21/01
136	1599371.307	14324870.284	7695.705	2	13	14.8	0.0	478.0	215.2	r	12:57:42pm	07/21/01
137	1599479.570	14324868.882	7698.233	2	12	4.8		491.0	46.5	r	01:00:21pm	07/21/01
138	1599593.109	14324935.926	7709.355	2	11	3.1	0.0	410.0	104.8	r	01:08:43pm	07/21/01
139	1599656.827	14325025.287	7714.856	2	10	9.2	0.0	348.3	135.4	r	01:19:35pm	07/21/01
140	1599789.880	14324996.999	7696.523	2	9	23.2	0.0	319.0	244.0	r	01:23:10pm	07/21/01
141	1599894.716	14324960.567	7695.882	2	8	30.0	0.0	266.8	323.3	r	01:27:29pm	07/21/01
142	1600007.257	14324896.470	7696.441	2	7	36.5	0.0	211.0	395.0	r	01:31:27pm	07/21/01
143	1600102.626	14324894.084	7694.630	2	6	40.0	0.0	177.7	459.0	r	01:35:08pm	07/21/01
144	1600189.731	14324900.529	7692.483	2	5	43.8	0.0	147.0	469.0	r	01:40:24pm	07/21/01
145	1600310.881	14324956.986	7717.888	2	4	36.6	0.0	110.9	406.0	r-ridge line	01:47:33pm	07/21/01
146				2	3	24.6	0.0	146.2	320.2	r	01:56:25pm	07/21/01
147	1600228.807	14325216.576	7735.990	2	2	20.1	0.0	163.2	250.0	r	01:59:06pm	07/21/01
148	1600184.359	14325344.543	7742.306	2	1	14.8	0.0	165.6	193.3	r	02:05:10pm	07/21/01
149	1601506.843	14324547.914	7238.891	base	-	168.0	0.0	670.0	2550.0		03:12:41pm	07/21/01
150	1601693.650	14325038.377	7153.566	ant-river-x	-	0.0	0.0	0.0	0.0	antenna crosses river at steel cable	10:26:52am	07/25/01
151	1602081.518	14323631.515	7104.792	riv	wst	0.0	0.0	0.0	0.0	west side river at crossing	11:11:39am	07/25/01
153	1601504.043	14324540.509	7239.595	base	-	0.0	0.0	0.0	0.0	base station	11:21:10am	07/25/01
154	1600864.278	14324365.068	7304.108	antenna	inter	0.0	0.0	0.0	0.0	antenna intsects with road	11:26:50am	07/25/01
156	1599688.194	14324517.573	7390.376	hill	-	0.0	0.0	0.0	0.0	lower stop start exit --- line 4	11:36:41am	07/25/01
157	1599567.290	14324506.206	7412.173	new	box	0.0	0.0	0.0	0.0	new spring collection box	11:40:16am	07/25/01
158	1599490.631	14324483.968	7416.588	old	box	0.0	0.0	0.0	0.0	old spring collection box and electrode 2	11:41:51am	07/25/01
159	1598881.760	14324445.450	7479.211	horse	tie	0.0	0.0	0.0	0.0	tied horses	11:51:22am	07/25/01
160	1598848.886	14324433.505	7511.675	stop	start	0.0	0.0	0.0	0.0	middle stop start exit--- line 2	11:53:10am	07/25/01

161	1598724.072	14324486.299	7522.140	canyon	south	0.0	0.0	0.0	0.0	mouth east canyon	11:56:56am	07/25/01
162	1598350.850	14324621.205	7566.344	line	start	0.0	0.0	0.0	0.0	start-end line 1 2 3	12:05:37pm	07/25/01
163	1598273.545	14324660.930	7529.452	wire	broke	0.0	0.0	0.0	0.0		12:11:45pm	07/25/01
164	1597894.097	14324736.281	7666.637	canyon	north	0.0	0.0	0.0	0.0		12:49:43pm	07/25/01
165				top	elec	0.0	0.0	0.0	0.0	200-+- feet north -above electrode	01:44:20pm	07/25/01
166	1597614.125	14324868.880	7810.477	top	elec	0.0	0.0	0.0	0.0	150-+- feet north -above electrode	01:57:41pm	07/25/01
167	1597631.779	14324802.243	7762.404	upper	electrode	0.0	0.0	0.0	0.0	70 feet north -- above	02:08:59pm	07/25/01