willowstick

Tetra Tech

STILLWATER NO. 1 DAM

Scope of Work & Price Estimate

willowstick

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March 29, 2011

Daniel L. Johnson
Vice President
Tetra Tech
350 Indiana Street, Suite 500
Golden, CO 80401

Re: Proposal to Perform Geophysical Investigation of Stillwater No. 1 Dam

Dear Dan:

Willowstick Technologies, LLC is pleased to submit this scope of work and cost estimate to perform a geophysical investigation of the Stillwater No. 1 Dam southwest of Yampa, Colorado.

Project Objective

We understand the objective of the survey is to identify the specific pathway(s) of seepage through, around or under the earthen embankment dam of the Stillwater No. 1 Dam.

Background

The Willowstick methodology uses Controlled Source–Audio Frequency Domain-Magnetics (CS-AFD-M) to map groundwater. The groundwater body to be investigated and mapped is energized with a low-amperage alternating current introduced to the groundwater through source electrodes placed in wells, ponds, seeps, etc., that have contact with the groundwater of interest. Return electrodes are placed strategically away from the source electrodes to allow injected electricity to flow through the groundwater of interest. The electricity follows the path of least resistance and because the groundwater is a conductor, the electrical current follows it between the electrodes. As the electrical current flows through the groundwater, the electrical current generates a magnetic field characteristic of the injected electrical current. This specific magnetic field is measured at multiple points on the ground surface, typically in a grid pattern. The magnetic field measurements are recorded using a data logger and the location of the field measurements stations are identified and recorded using a Global Positioning System (GPS). The measured magnetic field data are processed, mapped and modeled.

It is important to note that the Willowstick methodology identifies areas of highest electrical conductance, which is interpreted as the areas with greatest water concentration through the area being energized. This technique best characterizes the contrast between areas of high electrical conductance and low electrical conductance. If no contrasts are found then it must be considered that the water content in the

subsurface is uniform. On the other hand if contrasts are observed then these areas can be identified, mapped and modeled.

Approach to the Work

The Willowstick investigation takes advantage of the reality that groundwater tends to be the most prevalent and one of the best conductors of electrical current in the subsurface. Because groundwater acts as an electrical conductor we energize the groundwater of interest directly with a signature electric current. This electrical current follows higher effective porosity water bearing zones from one electrode to the other to complete an electrical circuit. By identifying the preferential flow of electrical current between strategically placed electrodes, the Willowstick methodology can successfully answer questions about where and how electrical current preferentially flows through the subsurface water and how it moves through and/or beneath the area of investigation.

Survey

In order to characterize the multiple seepage manifestations through the Stillwater No. 1 Dam it will be necessary to perform multiple surveys, each with its own energizing perspective. Each of these surveys can be performed independently or all as a group. Each of these surveys consists of measurement stations that will be collected along the crest and downstream embankment of the dam. We will place one electrode in the reservoir water and another electrode in seepage locations downgradient of the dam (see Figure A). A wire will connect the two electrodes to a power supply that will apply a low voltage low amperage electrical current to this circuit. Electric current will flow through the groundwater connecting these two electrodes energizing any existing preferential groundwater flow paths until it completes an electrical circuit.

Survey 1 will energize between the reservoir and the seep farthest to the north that is adjacent to the dam outlet (see attached Figure 1).

Survey 2 will energize the second seep from the north as shown in the attached Figure 2.

Survey 3 will energize between reservoir and the seep shown in the attached Figure 3.

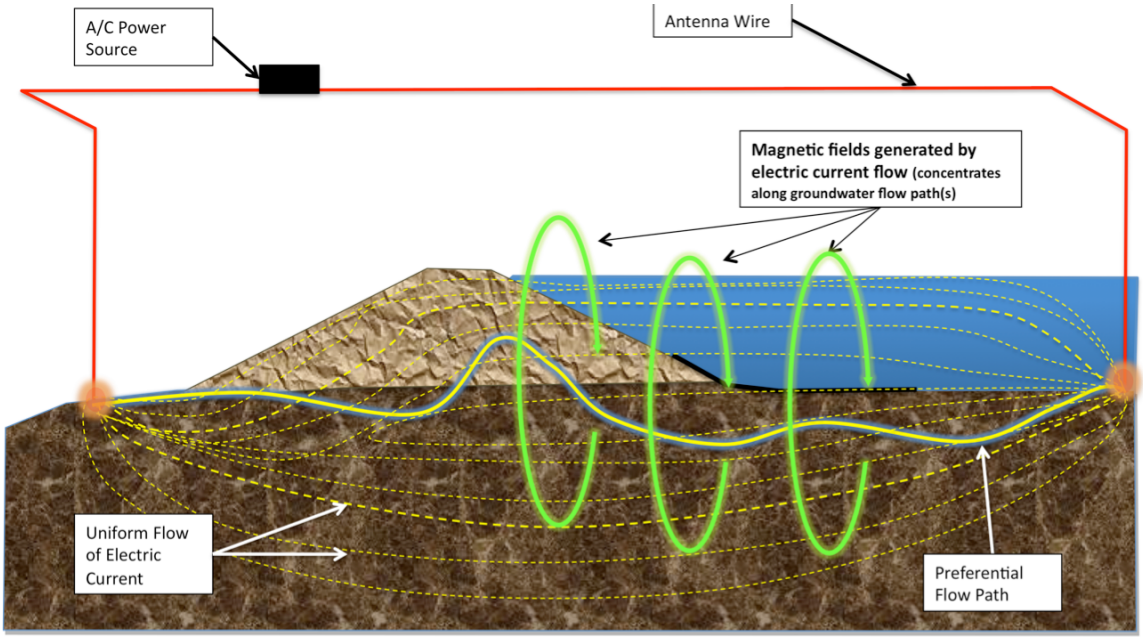

Figure A – Horizontal dipole configuration illustrating the electrode placement

Risk Factors

The data, interpretations and recommendations obtained from the geophysical survey will be based upon sound applied physics and Willowstick's experience in working with and developing the technology. By definition geophysical and hydro-geophysical techniques are complex and inexact sciences. However, we feel strongly that our technique has significant potential in yielding information that can greatly help in characterizing groundwater locations and flow paths.

Deliverables

Interpretation and Report – Willowstick will submit copies of the project investigation with a report identifying site conditions, constraints, project background, methodology, survey data, data reduction procedures, interpretations, maps (final interpretation map, vertical and horizontal magnetic contour maps, 50 Hz power map, signal to noise ratio map, spheric noise map, signal repeatability map), models, findings, summary and conclusions.

Electronic Survey Results – Willowstick will submit the tabulated data and visualization of interpretation of each survey in Excel and AutoCAD format respectively for inclusion with in-house reports, files and modeling needs.

Statement Concerning Electrodes and Antenna Wire

The electrodes and associated antenna wire used to energize the groundwater are located outside of the area of investigation. The reason for this is that directly around the energized electrodes and wire, the current flow and resultant magnetic field is so strong that no discernable information can be obtained from the current in the targeted groundwater. A physical example of this effect would be like looking directly at the sun. The sun is too bright and domineering to see any distinguishable features in or immediately around the sun. However, as one looks away from the sun, things become

very clear. This is the concept behind the electrode and antenna wire placement. The antenna/electrode configuration proposed herein is designed to provide the most advantageous way to energize the groundwater in order to maximize current flow through the study area and to minimize and/or remove the effects of the antenna and electrodes.

Responsibilities of the Client

The following is a list of items that need to be supplied and/or arranged by the client:

1. The placement of the antenna wire may require access to private property. We require that all permission be granted to access these properties for the duration of the survey prior to our arriving on site.

2. It is the responsibility of the client to notify Willowstick as to the existence of all known unsafe working conditions, all potential risks or hazards that include, but that are not limited to, poisonous plants, insects or animals; the location of high voltage power lines, gas lines or other noxious chemicals or liquids; the existence of steep slopes and terrain, heavy traffic areas (automobile or other motorized vehicles) and heavy equipment (trucks, heavy machinery, drill rigs) operating in the area.

3. It is the responsibility of the client to notify Willowstick of any known conductors and/or possible influences that may have a negative impact our ability to appropriately conduct the AquaTrack survey. These items include buried cables, pipelines, gas lines water mains, overhead power lines, radio transmitters, metal fencing, or any other long metal conductors that has the potential to cause interference to survey.

Cost Estimate

The cost to perform the geophysical investigation of the Stillwater No. 1 Dam depends upon which option listed in the matrix below is selected. Each survey provides the option of either having two Willowstick employees perform the fieldwork or having one Willowstick employee and one Tetra Tech employee work together.

	Field Crew	Cost
Survey 1 (90 total measurement stations)	1WST 1TetraTech	$30,370
	2WST	$35,632
Surveys 1 & 2 (178 total measurement stations)	1WST 1TetraTech	$43,899
	2WST	$50,455
Surveys 1, 2 & 3 (263 measurement stations)	1WST 1TetraTech	$55,918
	2WST	$63,639

On occasion clients request additional work to be done that goes beyond the original scope of work. Because Willowstick cannot know what any survey will identify until it actually begins the survey work, adjustments to the original scope may be necessary. In the event that this occurs each additional 100 measurements will cost $11,694.

It is proposed that the surveys, as described herein, be performed for the lump sums listed above. A breakdown of the costs for any of the above options is available upon request.

Schedule

The fieldwork for the Stillwater No. 1 Dam project will take approximately 3 to 6 days to complete depending upon which option is selected. Upon completion of the fieldwork, an additional 4 to 5 weeks will be required to complete the interpretation and modeling and to prepare a report and final deliverables for presentation to Tetra Tech.

Willowstick requires all invoices to be paid within 30 days of receipt of invoice and the project fees shall be paid according to the following timeline:

1. 20% of total project fees to be paid prior to mobilization to the site.
2. 30% of total project fees to be invoiced upon completion of field work.
3. 40% of total project fees to be invoiced upon submittal of draft report.
4. 10% of total project fees to be invoiced upon submittal of final report.

Conclusion

In summary, Willowstick feels confident that it will produce information that will help in the characterization of the groundwater influencing the seepage in question. Willowstick looks forward to your consideration of this proposal.

Please contact me by phone (801) 984-9865 office or (801) 678-7655 cell or by email (vgardner@willowstick.com) with any questions you may have regarding this proposal. We look forward to hearing from you in the near future.

Sincerely,

Val Gardner
Business Development Manager
Willowstick Technologies

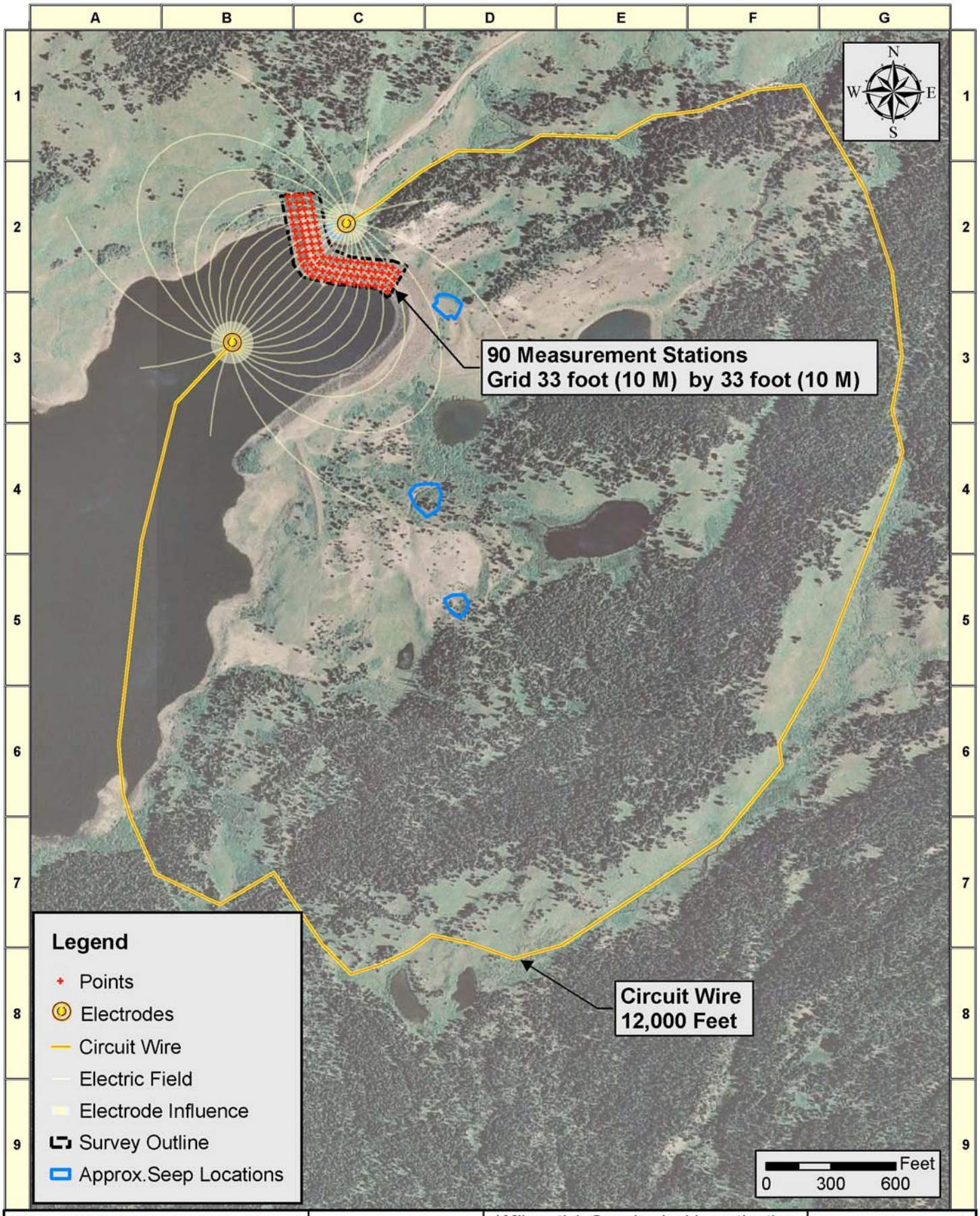

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Figure 1 - 1st Survey

PROJECT #:	Proposal
DATE:	28-March-2011
SCALE:	1:7,200

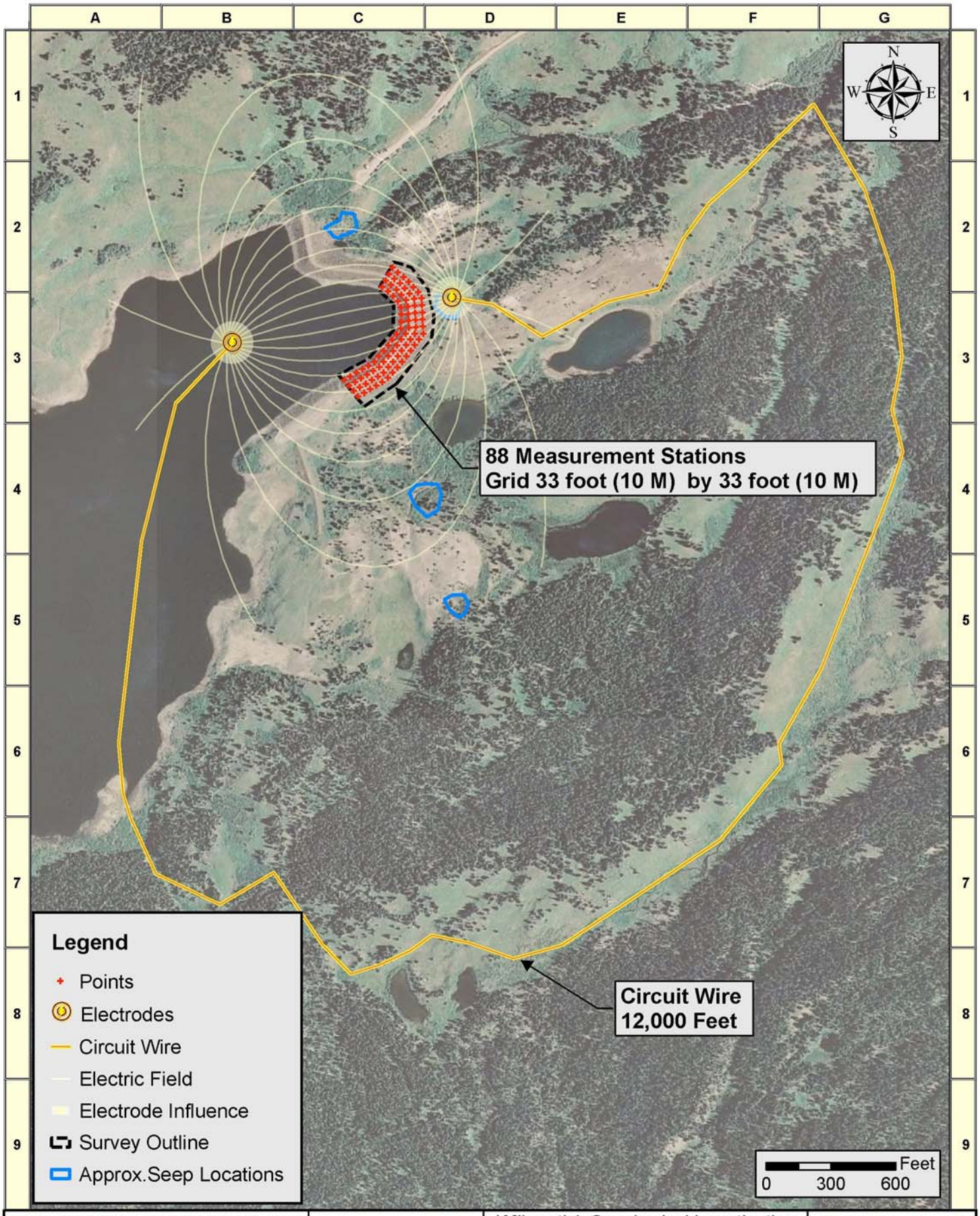

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Figure 2 - 2nd Survey

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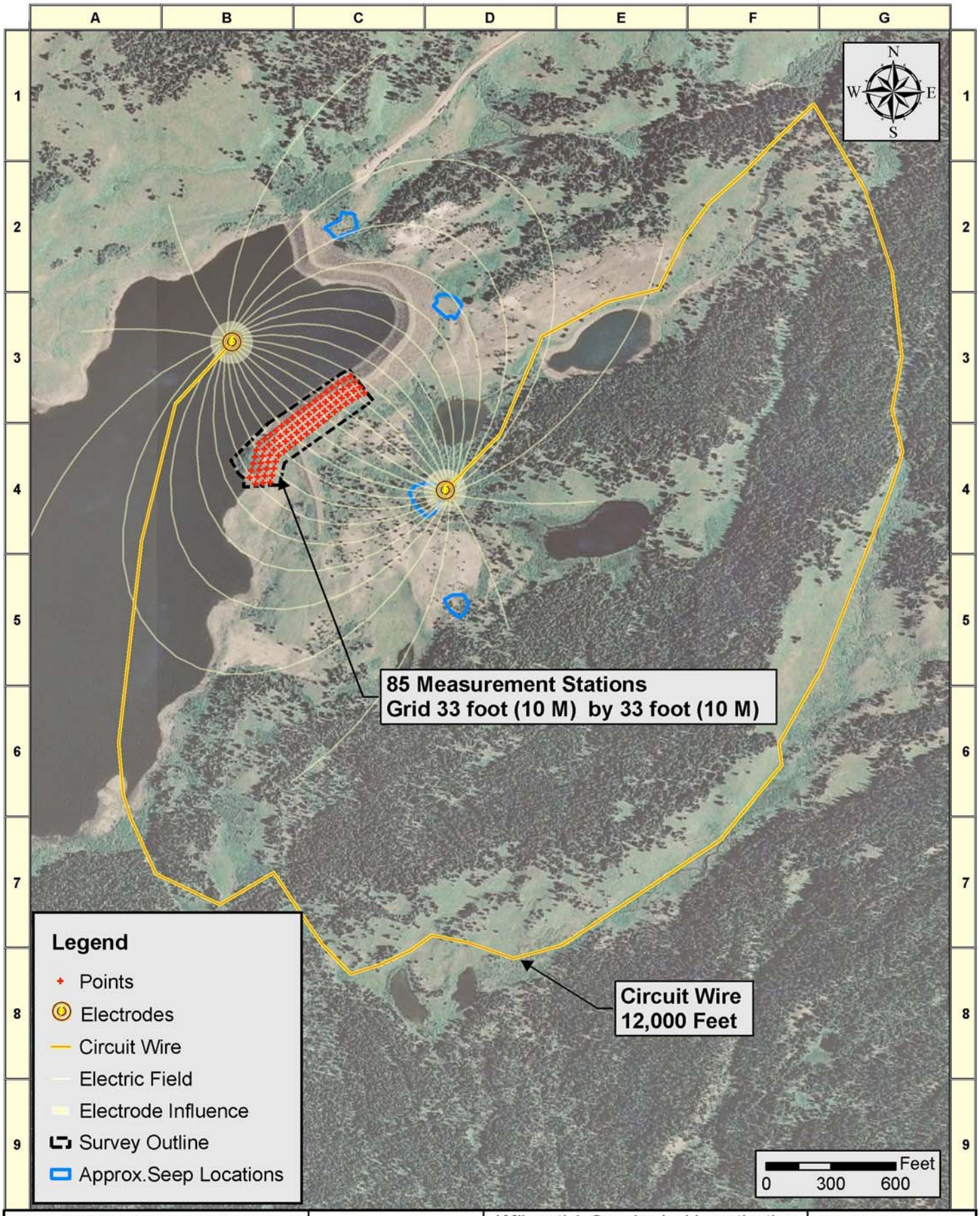

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Figure 3 - 3rd Survey

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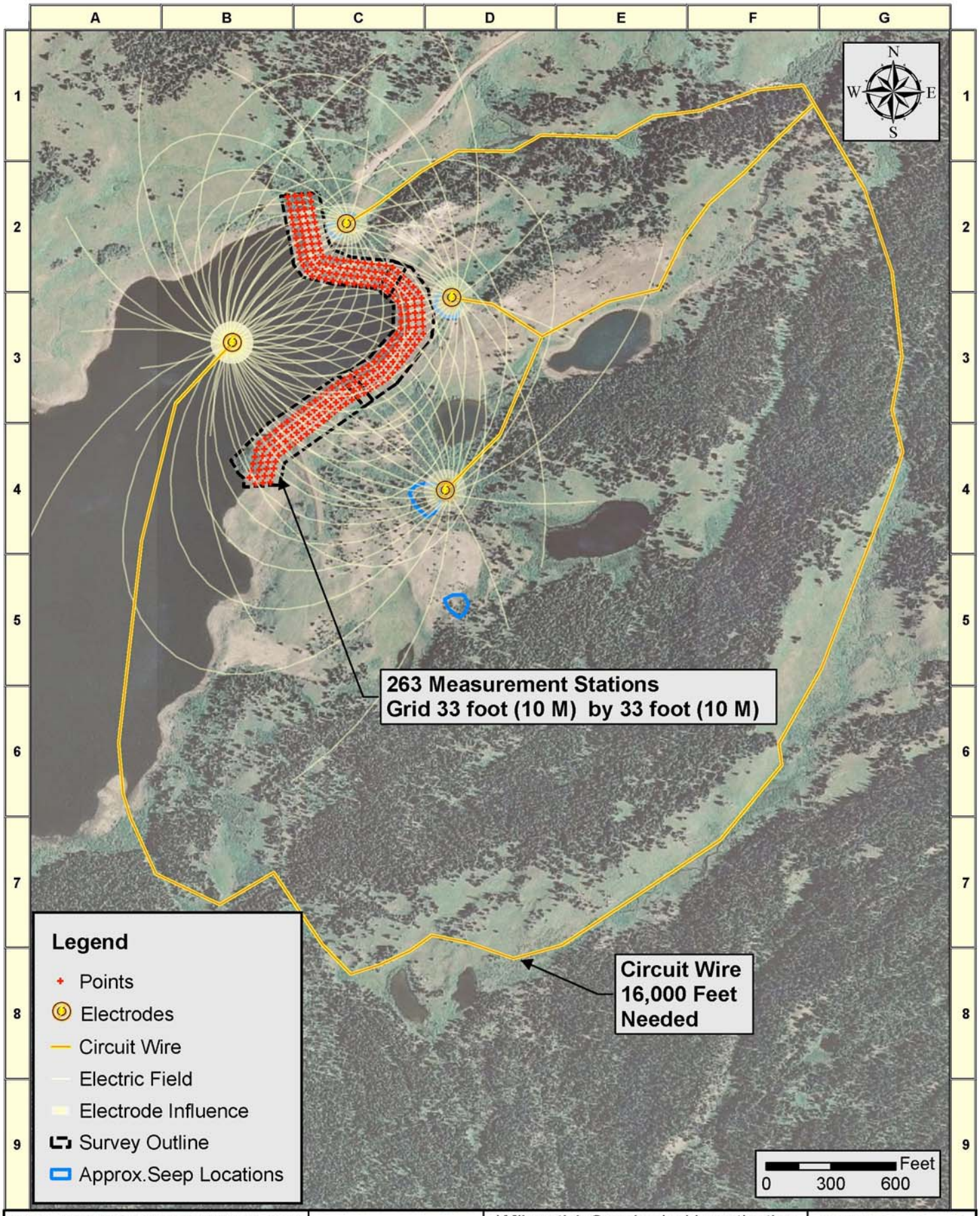

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Figure 4 - All Surveys

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10/30/2012


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