



LEAK LOCATION SERVICES, INC.

August 30, 2018

Mr. Chris Clark
Laramie Energy
1401 17th St., STE 1400
Denver, CO 80202

Email: MHall@Laramie-Energy.com

Subject: Report for the Geomembrane Leak Location Survey of the Pond 2 Water
Impoundment at the Harrison Creek Water Treatment Facility in
Mesa County, Colorado
LLSI Project 2935

Dear Mr. Shafer,

On August 28, 2018, Edgardo Barraza of Leak Location Services, Inc. (LLSI) conducted a geomembrane leak location survey of the subject pond. The pond has an area of approximately 168,000 square feet and is lined from the bottom up with a subgrade, geosynthetic clay liner, 80-mil HDPE secondary geomembrane, geonet and an 80-mil HDPE primary geomembrane. This report documents the results of the survey.

I. RESULTS

A. Survey

Five leaks were found in the primary geomembrane of Pond 2. Figure 1 shows the approximate locations of the leaks and Table 1 lists the approximate locations of the leaks found in Pond 2.

B. Leak Detection Sensitivity Test

The leak location equipment was tested to document the leak detection sensitivity. A simulated leak was constructed by placing a 0.055 inch-diameter hole in a plastic container with a thickness approximating the thickness of the geomembrane. An insulated wire with a stripped end will enter the container through a sealed insulating penetration. The other end of the wire was connected to earth ground. The container was filled with water from the impoundment and submerged in the impoundment. Leak location scans were made to determine the maximum distance that the simulated leak can be reliably detected. The simulated leak could be detected from 3 feet away.

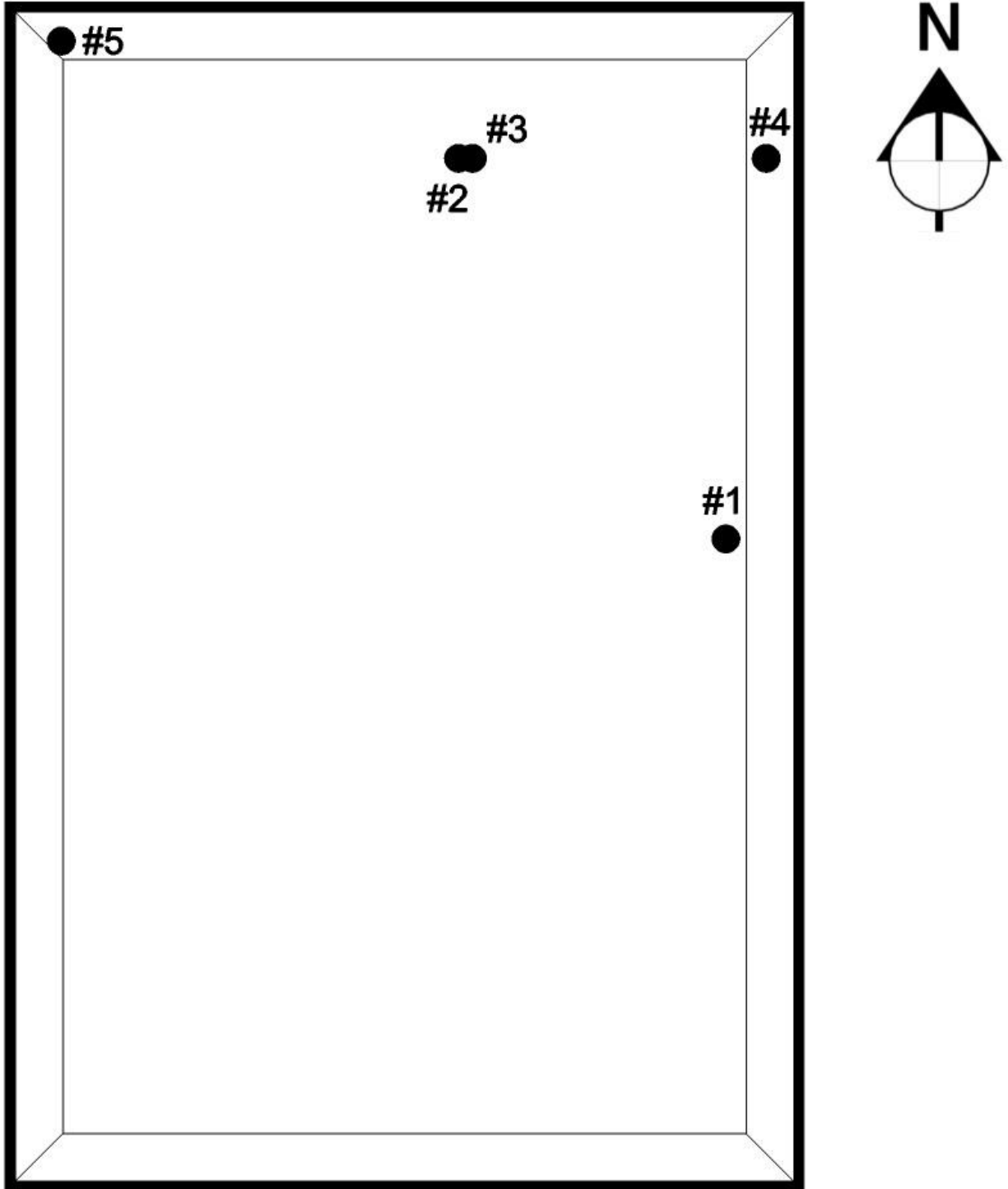


FIGURE 1. APPROXIMATE LOCATIONS OF LEAKS IN POND 2

Table 1. Locations of Leaks in Pond 2

LEAK	LOCATION
1	Approximately 25 feet west from the mark at line 230, which is 230 feet north of the south slope.
2	Approximately 124 feet west from the mark at line 370, which is 370 feet north of the south slope.
3	Approximately 121 feet west from the mark at line 370, which is 370 feet north of the south slope.
4	Approximately 10 feet west from the mark at line 370, which is 370 feet north of the south slope.
5	Approximately 15 feet south from the mark at line 290, which is 290 feet west of the east slope.

To relocate the leaks, stretch a string line between the corresponding survey line markers on the opposite sides of the lagoon and then lower the line onto the geomembrane. Use a tape measure to measure the distance from the mark on the geomembrane along the string line to the leak. The tape measure should go down the slope to the toe of the slope and then along the floor to the leak. Draw a short line perpendicular to the end of the tape measure. The leak should be close to the perpendicular line. If two measurements are provided, repeat this process from the second mark. The leak will be close to the intersection of the lines perpendicular to the end of the tape measures.

II. PRINCIPLE OF THE ELECTRICAL SURVEY METHOD

A. General

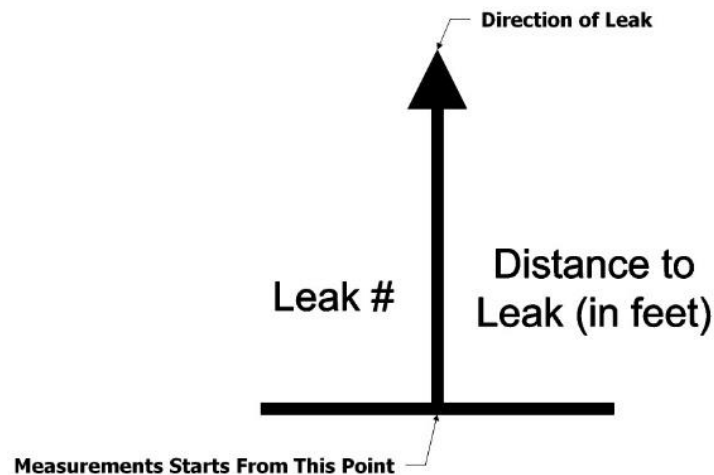
The electrical leak location method detects electrical paths through the liner caused by water or moisture in the leaks. A voltage is impressed across the geomembrane being tested. Electrical current flowing through any leaks in the geomembrane produces localized anomalous areas of high current density near the leaks. These areas are located by making electrical potential measurement scans in or on the electrically conductive material covering the geomembrane.

B. Deep Water Survey

A towed probe survey is used to locate leaks in geomembranes that are covered with more than 30 inches of water and for testing side slopes covered with water. The sensor is towed down the side-slope across the short dimension of the basin and then back up the opposite side-slope along the established survey lines while the survey operators stand on opposite banks of the basin. The probe and cable are then moved to the next survey line and the process reversed.

The survey lines spaced approximately 2.5 feet apart are established by placing temporary marks on the liner side-slope near where the survey operators will stand. In this manner, the water does not have to be lowered for the testing and the geomembrane is tested under full hydrostatic load. In addition, long side-slopes can be tested by pulling the sensor up and down the side slope while survey personnel move around the perimeter of the basin.

When a leak is located, the position of the leak is determined by measuring the distance to the sensor when the sensor is at the leak. However, because the probe can only be maneuvered along the survey line, and because of the tolerances in the measurement accuracy, the positioning accuracy for located leaks is anticipated to be about two feet plus one or two percent of the distance to the leak to the edge of the lagoon. When the water is removed for repair, the leak must be located visually by the leak repair crew using the distance marks provided to guide the repair personnel. An example of the provided distance marker is below:



If there are any questions regarding the electrical survey or this report, please contact us at (210) 408-1241. We appreciate the opportunity to have been of service to you.

Respectfully,

Matthew Kemnitz
President