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August 5, 2003

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Attn.: Gregg Galecki

RE: A Brief Response to PacifiCorp's "Data and Finding Summary for Investigation of Technical Issues Related to the Electric Lake and Huntington Creek Drainage Controversy, June 25, 2003"

Dear Gregg:

Canyon Fuel Company, LLC and its consultants (hereinafter collectively "CFC") recently completed a preliminary review of the PacifiCorp "Data and Finding Summary for Investigation of Technical Issues Related to the Electric Lake and Huntington Creek Drainage Controversy, June 25, 2003" (hereinafter "Summary"). While it is apparent that PacifiCorp spent time and effort to study the problem of water entering Skyline Mine, its main goal appeared to be to demonstrate that the water entering the mine must be coming from Electric Lake. While CFC appreciates the problem that a leaking Electric Lake reservoir presents to PacifiCorp and its ability to produce electrical power at the Huntington Power Plant during this fifth consecutive year of drought, CFC believes that the single-minded approach in trying to prove that the lack of water in the lake is attributable to the Skyline Mine inflows is both confining and without merit. While CFC remains fully committed to continuing to work hand-in-hand with PacifiCorp to ensure that operation of the Huntington Plant is not compromised, the conclusions drawn regarding the source of the mine inflows and presented in the Summary are inappropriate and CFC feels compelled to respond to a few of these erroneous conclusions. This letter briefly addresses a few of the more obvious errors contained in the Summary.

As a general note, Canyon Fuel again asserts, as it has previously pointed out to PacifiCorp and DOGM, that using the lake's water "Elevation" or "Lake Level" as the vertical axis as has been done in Figures 2, 3, 4, 5 and 7 is misleading due to the fact that the lake is a V-bottomed reservoir. Using the lake elevation as the vertical axis in these figures would be a meaningful representation only if the reservoir had vertical walls. These figures would be significantly different if a vertical axis of "Storage Volume" (e.g., acre-feet) were used.

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Executive Summary

The document's Executive Summary would want the reader to believe that the hydrologic system in the Skyline Mine area is unique and does not occur in any other place in the Wasatch Plateau. However, no discussion is presented in the body or appendices of the Summary to warrant this assertion. Indeed, much of the data presented supports the CFC's contention that the water entering the Skyline

Mine is sourced from the underlying Star Point Sandstone, discharges to the mine through a system of fractures and faults, and that the individual, and ultimately cumulative, inflow rates have been declining since March 1999. Similar mine inflows have occurred at other mines within the Wasatch Plateau – they have just had steeper decline curves.

Lake History

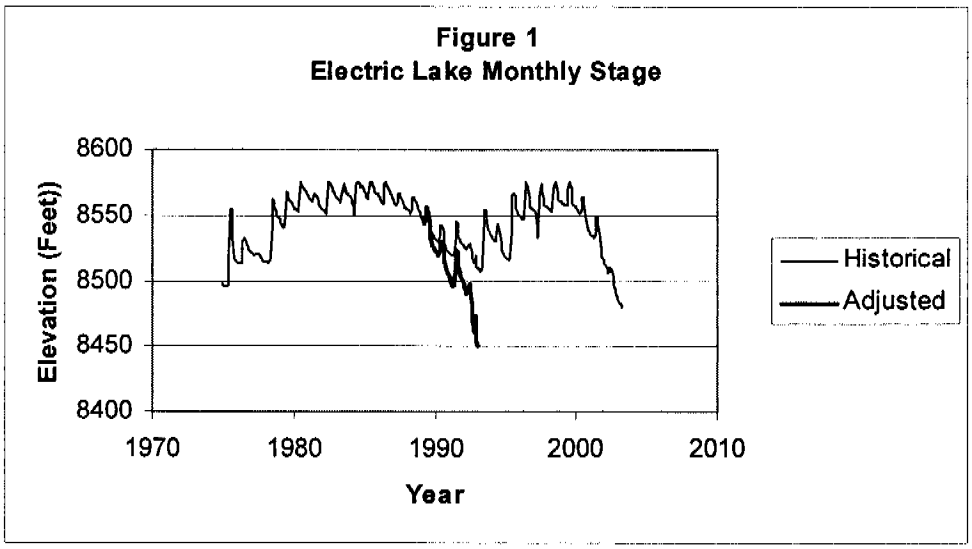
Several graphs and text on pages 1 through 4 of the Summary purport to present accurate inflow and outflow histories of Electric Lake. Tim Durbin (Timothy J. Durbin, Inc., Consulting Hydrogeologists, Fair Oaks, California) investigated the assertion in the Summary that Electric Lake is currently at its lowest level not because of the current drought conditions but because of the loss of water to the Skyline Mine. Presented in the following paragraphs and Figure 1 are his analyses of this particular assertion.

The Summary states (pages 2 through 4) that a drought occurred during the early 1990's that was similar in magnitude to the current drought. The Summary further states that, even though the droughts were similar, Electric Lake has reached a much lower elevation during the current drought than during the earlier drought. The conclusion drawn is that the current lower stage is the result of water inflows into Skyline Mine. However, the conclusion is not supported by the facts, had all the facts been considered. An important fact ignored is that the releases from Electric Lake have been larger during the current drought than were the releases during the earlier drought. The larger drawdown of the reservoir is explained by the larger releases, not by Skyline Mine.

The current and earlier droughts in fact were similar, based on the inflows to Electric Lake. According to PacifiCorp's records, the total inflows during the 4-year period 1999-2002 have been 39,300 acre-feet, and the total inflows during the 4-year period 1989-1992 were 41,600 acre-feet. However, the releases from Electric Lake have been larger during the current drought than during the earlier drought. The total releases during 1999-2002 have been 59,300 acre-feet, while the releases during 1989-1992 were 50,300 acre-feet. During both droughts, the releases exceed the inflows, and the reservoir storage was depleted. Nevertheless, the greater storage depletion during the current drought is explained not by Skyline Mine but by the greater releases from storage.

This effect is illustrated on Figure 1, which is a graph showing the elevation of Electric Lake during November 1974 through March 2003. The thin line on the figure indicates the historical elevation, which represents the elevation data collected by PacifiCorp. The bold line represents what the Electric Lake elevation would have been during 1989-1992, had the releases from the reservoir been the same as during 1999-2002,a total release of 59,300 acre-feet. Comparison of the bold and thin lines indicates that the drop in lake elevation during the earlier drought would have been larger than the current drought had the releases been identical.

[Note: As previously pointed out, this comparison would be more meaningful using "Storage Volume" as the vertical axis rather than "Elevation". However, the Summary utilizes "Elevation" so that is what was considered here.]



Monitoring Wells

CFC asked Roger Howell of HCI to evaluate the data presented on pages 7, 8 and 9 of the Summary regarding the drawdown noted in the Skyline Mine ground water monitoring wells and how it could be related to mine inflows and Electric Lake water levels. Following is a summary of his comments.

The Summary presents indisputable evidence that water levels in wells screened in deep sandstones and coals have declined dramatically as a result of the withdrawal of water from both JC-1 and from the several mine inflows. The decline of water levels in wells screened in the deep sandstones and coals is well documented (see HCI, 2002 and HCI, 2003, for instance). However, the Summary presents no evidence (and CFC has also found no evidence) that water levels in shallower wells, screened in the Blackhawk Formation above the coals, have also declined as a result of mine inflows or pumping.

The water level declines documented in the Summary have resulted in a very large drawdown cone in the deep aquifer, just as the Summary asserts. The Summary, however, does not touch on the most obvious and most important implication of that drawdown cone. That is, the drawdown cone occurs because water has been ***removed*** *from storage in the deep sandstones. CFC has previously shown (HCI, 2003) that the development of the drawdown cone through time can be analyzed, using literature-supported hydraulic parameters for the fractured sandstones, to estimate the volume of water removed from storage in the deep aquifer. As shown in HCI (2003), and as described in the oral presentation of numerical ground-water modeling efforts, the total water that has been discharged into the mine and has*

been pumped from JC-1 (about 15 billion gallons) is about equal to the amount of water that would have to be removed from ground-water storage in order to create the drawdown cone seen in the data. No other source of water is required to account for the inflows. In fact, if another source of water other than the deep ground-water aquifer were contributing significantly to the inflows, then the water-level declines would not be as seen.

The monitoring well hydrographs presented by PacifiCorp controvert their theories in other ways. For instance, the Summary suggests that it is the decline in ground-water levels that has induced water to flow out of the lake; and the lake is now recharging the ground-water system. However, if another source of water had begun to recharge the declining ground-water system, that recharge would be clearly seen by sharp breaks in slope of the drawdown curves. No such feature can be seen in any of the plotted data. Further, if the lake were acting as a constant-head boundary as the Summary's arguments imply, then there would be no drawdown at all on the far side of that boundary (in any wells west of the lake) after water began flowing out of the lake. However, the hydrographs clearly show continuing, steady declines in the ground-water levels.

Diving Investigations

The Summary presents a detailed description of lake floor investigations performed by divers and underwater equipment. This description is contained on pages 16 through 19 and Appendix B of the Summary. The Summary professes to present evidence in the form of a video of highlights from the diving activities that purports to show water exiting the lake bottom through cracks and "venturi-shaped" holes in the lake bottom sediments. Furthermore, gasses escaping from the holes are purported to be methane possibly originating from the mine area. CFC asked Alan Mayo of Mayo & Associates to evaluate the accuracy of the assertions made in the Summary that the video clearly illustrates water leaving Electric Lake through the cracks and "venturi-shaped" holes in the lake bottom and the likelihood that methane bubbles discharged from the holes could be related to Skyline Mine. A summary of his evaluation is presented in the following paragraphs.

PacifiCorp's "Data and Finding Summary" asserts that fractures observed in lake bottom mud of Electric Lake are related to underlying bedrock fractures and that appreciable water leaves the lake by downward flow into the fractures (pages 16 – 19 and Appendix B). The Summary further suggests that this water discharges into Skyline Mine. The Summary also asserts that gas bubbles observed escaping the lake bottom mud is methane gas from Skyline Mine (pages 18 – 19). These assertions are unsubstantiated and in many instances incorrect.

In the dive video numerous small aperture fractures are observed in the lake bottom mud. However, the video provides evidence that: 1) the fractures are not related to underlying bedrock fractures, and 2) lake water does not leak from the lake via the fractures. The fractures are in very soft, lake-bottom mud and appear to be large sub-aqueous desiccation fractures (i.e., mud cracks). Polygonal fracture patterns

are clearly visible in the video. Bedrock stress related fractures would not have polygonal shapes.

There was no evidence in the video that lake water flows into the fractures or cylindrical holes associated with gas bubbles. The video shows that particulate material suspended in the lake flows across and past the fractures and cylindrical holes, and when disturbed the mud creates a density cloud that lingers above the lake bottom before merely settling back to the lake bottom. In some instances much of the density cloud migrates away from the fractures. Most of the density cloud does not settle in the fractures or cylindrical holes. The sides of the linear desiccation fractures are very steep and show no evidence of erosion, which should occur if lake water were flowing into the very soft mud of the fractures.

On page 26 the Summary asserts that gas seeping from the lake bottom mud:

1. *is typical of natural gas,*
2. *has low CO_2 content suggesting that the gas is not from a shallow, biogenic source in the lake sediments,*
3. *is coming from depth, and*
4. *indicates open pathways.*

The Summary states that the lake gas data are contained in Tables 8 – 10 (page 25); however, the data in Tables 8 – 10 appear to be for well JC-1. Assuming that Table 10 is the lake gas analysis, the conclusions are based on a single sample. This assumption of a single sample is confirmed on page 2 of Appendix B where it states "An analysis of a sample of the gas being liberated from the bottom of the lake proved it to be 75% methane." However, the result reported in Table 10 indicates 66.4% methane.

Regardless, there are several outstanding issues related to PacifiCorp's lake bottom gas analysis:

1. *A low CO_2 content does not preclude lake sediment origin. Exsolving gas with elevated CH_4 and low CO_2 contents occur in the shallow sediments of the San Luis Valley, Colorado (unpublished data, Alan Mayo).*
2. *The origin of the gas (i.e., lake bottom vs. coal bed methane) needs to be determined by isotopic analysis, including both $\delta^{13}C$ on the methane and CO_2, and $\delta^{2}H$ on the methane.*
3. *Exsolution of gas at depth is not consistent with the elevated hydrostatic pressure of the groundwater system at that location.*

According to the theory presented, once exsolved at or near the mine the gas would have to migrate upward against the proposed strong downward flow of groundwater from the lake to the mine. Coal bed methane gas could evolve in JC-1 or in mine openings because the hydrostatic pressure is reduced (much like opening a bottle of soda pop). However, upward migration of exsolved gas from depth under hundreds of feet of hydrostatic pressure is unlikely, particularly if the gas must migrate against water allegedly flowing in the opposite direction. Exsolving gas and gas bubbles are observed in many fracture flow and shallow groundwater systems worldwide; however, such exsolution occurs as upward-flowing groundwater reaches the near surface environment.

The Summary needs to provide calculations demonstrating that gas exsolution can occur at the mine depth and that the gas can remain exsolved as it migrates laterally and upward to the lake against the purportedly opposing directional movement of groundwater. It is important to remember that mining activities and fault related mine inflows do not occur directly beneath Electric Lake, but rather some 11,000 feet horizontally distant.

Tracer Dye Study

A brief summary of the tracer dye study initiated by PacifiCorp is presented on pages 19 and 20 of the Summary. Additional detail regarding the study is also presented in Appendix F. The discussions on pages 19 and 20 and in Appendix F are centered on when and what kind of dyes were placed in Electric Lake and where dye collection packets were placed. The tracer dye study is summarized on page 20 of main body of the document in the statement that "However, a negative dye detection does not confirm that a flow path does not exist between the lake and the mine since it can mean that either 1) travel times are long and dye has not yet made it to the sampling point, or 2) the systems are not connected." CFC could not agree more with point 2.

Roger Howell of HCI was also asked to review the tracer dye study presented in the Summary and evaluate its conclusions. Specifically, he was asked to address the assertion in the Summary that dye was not expected to be found in mine water prior to June 25, 2003, even though dye was placed in the lake in mid-February and again on April 1, 2003. His response is presented in the following paragraphs.

The tracer dye study appears not to follow the standard scientific procedure of collecting baseline samples in order to rule out positive detections from sources other than the pre-ordained source. For instance, the presence of trace amounts of fluorescein dye (from antifreeze) can be expected in any stream alongside a well-traveled highway (such as Eccles Creek, Mud Creek, Huntington Creek, Crandall Creek, etc.). Trace background amounts of dye are especially likely in Eccles Creek and Crandall Creek which receive runoff and treated process water from industrial operations with diesel shop facilities (i.e., Skyline Mine and Genwal Mine).

PacifiCorp states in its "Data and Findings Summary" that the dye, injected on 1 April 2003, was not expected to reach the mine workings or the JC-1 pump screen by report time, 25 June 2003 (Appendix F, page 4). However, PacifiCorp offers no explanation for the delay in arrival of the tracer. The dye still had not arrived by 31 July, 122 days after injection. The majority of the Summary is given over to the idea (erroneous, we believe) that the Diagonal and Connelville Faults are major structures through which a veritable river, 10-plus cubic feet of water per second (cfs), flows rapidly enough to suck silt through cracks in the lake bottom. Yet the distance from lake bottom to mine workings is only about 600 feet vertically and 11,000 feet horizontally, and no dye has yet completed the journey. The Summary asserts that water from the lake "may take several months as the water mixes with other base water and moves through the fault / fracture systems" (page 20). CFC believes that this theory is flawed in several ways.

First, if the Summary's concept of a direct fault connection between the floor of the lake and the mine workings were correct, given the volume of water being considered, the dye should have arrived in as little as one day after injection. If a direct fault connection were to exist, it would be a simple matter to calculate the volume of aperture required to contain the water that PacifiCorp believes is missing from the lake since 1 April, when dye was introduced into the fractures, and 31 July, with no dye having yet arrived at JC-1 or the mine. (Actually, dye was first introduced into the lake/fractures in mid-February, so the time required to travel the distance is even greater.) Two dimensions, the vertical and horizontal distances from the lake to the mine, are known, so it is a simple matter to calculate the width of the aperture necessary to contain the full volume of water missing. Assuming a rate of "missing" water of 10.9 cfs (Appendix F, page 1, "the lake is leaking at a rate of about 650 acre feet per month"), the required aperture width would be:

122 days x 10.9 ft^3/sec x 60 sec/min x 60 min/hr x 24 hr/day x 1/600 ft x 1/11000 ft = 17.4 ft

This required width is increasing at a rate of:
17.4 ft / 122 days = 0.14 ft/day, as long as dye does not appear.

A second problem with the purported theory is a little more technical, and deals with PacifiCorp's suggestions that the water might be flowing out of the fault and through an unspecified storage medium. The discharge of water from the Diagonal Fault into the mine workings is well documented. The Summary goes to a lot of trouble to demonstrate (we believe erroneously) that large volumes of water can be seen entering the same fault in the lake bottom. The stated conclusion is that the fault is a hydraulic conduit carrying very large volumes of water from the lake to the mine inflow point.

The implication is that the conduit exists because the hydraulic conductivity of the fault zone is much higher than the hydraulic conductivity of the material through which it cuts. The problems are these:

1. *The Summary's inter-connected hydrologic system can have only one discharge point: the mine. (If there were another discharge point, as CFC believes to be the case, the lake would have been draining to it for the last 29 years.) By definition, the mine discharge would be the point at which the head (elevation plus pressure) is lowest, and consequently, all ground water in all corners of the interconnected hydrologic system would be flowing toward the mine; no ground water, if connected in any way, could be flowing away from the mine.*
2. *Water that has entered and is flowing through a high-hydraulic-conductivity pathway toward a discharge cannot detour into any material of a hydraulic conductivity lower than the conduit itself. Low hydraulic conductivity means nothing more or less than high resistance to flow – water will always follow the least resistant pathway.*

In summary, if the mine is the point of lowest head in the hydrologic system, and if the Diagonal Fault brings water into the mine, then water will flow into the Diagonal Fault from any water-bearing medium that is hydraulically connected to the fault.

That is, any conceivable large storage medium would be yielding water into the fault at all points of contact. No lake water could possibly flow into the fault and then out of the fault and into the large storage medium – the heads involved physically will not allow it. Because there is no evidence that any dye-laden lake water has made the journey from the lake to JC-1 or the mine in now over 122 days, it is most likely that the Diagonal Fault, where it cuts through the Blackhawk Formation mudstones beneath the lake, is of very-low hydraulic conductivity, as CFC has asserted from the start, and does not allow any significant flow of water.

CFC does not believe that a response to all of the assertions made in the Summary that Electric Lake is losing significant water to Skyline Mine is warranted at this time. However, CFC has made an effort in this letter to respond to those that appear to be most obviously misstated. We believe that the Summary, particularly those portions of the Summary suggesting a flow of water from Electric Lake to the Skyline Mine, do not withstand the scrutiny of hydrogeologic analysis and are not supported by appropriate factual data.

If you have any questions regarding this response to the Summary, please call me at (435) 448-2669.

Sincerely,

Chris D. Hansen

Chris D. Hansen
Environmental Coordinator
Canyon Fuel Company, LLC

xc: Dave Sharp, Huntington Plant
Ira Hatch, Emery County Commissioner
Bruce Blackham, Sanpete County Commissioner
Mike Milovich, Carbon County Commissioner
Dennis Ward, Huntington Cleveland Irrigation Company