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MAR 25 2016

DIV. OF OIL, GAS & MINING

#5017

J. CRAIG SMITH
jcsmith@SHutah.law

NATHAN S. BRACKEN
nbracken@SHutah.law

March 25, 2016

Via Hand Delivery

Coal Regulatory Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84114-5801

Re: ***Flat Canyon Lease Addition, Canyon Fuel Company, LLC. Skyline Mine, C/007/0005, Task ID #5017***

Huntington-Cleveland Irrigation Company re-submits the enclosed comments regarding Canyon Fuel Company's permit application for the Flat Canyon Lease Addition to the Skyline Mine, which the Division of Oil and Gas and Mining has determined is administratively complete. These comments are attached as Exhibit "A."

Huntington-Cleveland originally submitted these comments on January 29, 2016, in response to a letter it received from the Division dated November 23, 2015, attached as Exhibit "B," which requested comments on the amendment. The Division later informed Huntington-Cleveland that this was in error. Consequently, Huntington-Cleveland is resubmitting its comments per the notice it received from the Division on February 9, 2016, announcing the official comment period for the Flat Canyon Lease application.

Please let me know if you have any questions.

Sincerely,

SMITH HARTVIGSEN, PLLC

J. Craig Smith
Nathan S. Bracken
Attorneys for Huntington-Cleveland

cc: Huntington-Cleveland Irrigation Company

Encl.

EXHIBIT A



FILE COPY

J. CRAIG SMITH
jcsmith@SHUtah.law

NATHAN S. BRACKEN
nbrack@SHUtah.law

January 29, 2016

Coal Regulatory Program
Division of Oil, Gas & Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
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JAN 29 2016

DIV. OF OIL, GAS & MINING

**Re: Flat Canyon Lease Addition, Canyon Fuel Company, LLC, Skyline Mine,
C/007/0005, Task ID #5017**

Huntington-Cleveland Irrigation Company (“**Huntington-Cleveland**” or the “**Company**”) hereby submits the following comments regarding Canyon Fuel Company’s (“**CFC**”) permit application (the “**Application**”) for the Flat Canyon Lease Addition (“**Addition**”) to the Skyline Mine, which the Division of Oil and Gas (“**DOG M**”) has determined is administratively complete.

I. Huntington-Cleveland Overview

Huntington-Cleveland is a non-profit mutual water company and is the largest holder of “state-appropriated water” in the Huntington Creek Drainage as this term is used in Section 40-40-18(15)(c) of the Utah Code. The Company relies on its water rights to provide water for its many shareholders, which include nearly all of the agricultural users in northern Emery County as well as the municipalities of Huntington, Cleveland, and Elmo for culinary drinking water. Huntington-Cleveland also provides water for Pacificorp/Rocky Mountain Power, its largest shareholder, for the operation of the Huntington Power Plant. Importantly, Water Right 93-1134, one of the water rights held by Huntington-Cleveland, is a diligence claim that the Proposed Determination for the San Rafael Adjudication recognizes as the most senior right in the drainage, with an 1885 priority date. In sum, Huntington-Cleveland is the largest and most senior water right holder in the Huntington Creek drainage.

The Addition will, if approved, allow additional mining within the Huntington Creek drainage upon which the Company relies for water to its shareholders and ultimately the public. Under Utah water law, Huntington-Cleveland’s right to obtain its state-appropriated water extends from its approved points of diversion on Huntington Creek and springs in Huntington Canyon to the “farthest limits of the watershed.”¹ Thus, all of the surface and underground water that feeds the various gaining portions of Huntington Creek as well as the springs and seeps in the Huntington Creek drainage make up Huntington-Cleveland’s state-appropriated water.

¹ See *College Irrigation Co. v. Logan River & Black Smith Fork Irrigation Co.*, 780 P.2d 1241, 1244 (Utah 1989); *Richards Irrigation Co. v. Westview Irrigation Co.*, 80 P.2d 458, 465 (Utah 1938).



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**Re: Flat Canyon Lease Addition, Canyon Fuel Company, LLC, Skyline Mine,
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II. DOGM Should Ensure that the Application Will not Impair Huntington-Cleveland's Water Rights

Huntington-Cleveland recognizes the importance of mining for Emery County, and does not oppose Application, provided that DOGM ensures that CFC can carry out its proposed mining and reclamation activities without adversely affecting the hydrologic balance of water resources in the Addition and surrounding areas and causing unaddressed contamination, diminution, or interruption of Huntington-Cleveland's state appropriated water.

The Addition is located in the Huntington-Cleveland Creek Drainage and underlies Boulger Reservoir. Huntington-Cleveland is concerned about impacts to the water sources that supply its rights. Specifically, removing coal and allowing overlying material to fall in its place creates subsidence, which could cause the overlying material to become fractured. This, in turn, could cause groundwater or water that flows into the mine from the surface that would otherwise remain in the Huntington-Cleveland Creek Drainage to migrate through the fractured material into the Price River Drainage or elsewhere, thereby limiting the amount of water available to satisfy the Company's water rights.

The concern over adverse consequences to state appropriated water is not theoretical. As DOGM is well aware, a drastic loss of water from Electric Lake and the concurrent flooding of Skyline Mine occurred when mining directly beneath Electric Lake took place a decade ago. The timing between the large increase of inflow into the Mine and a precipitous drop in the water level of Electric Lake is difficult to ascribe to an unrelated coincidence, which had never occurred in the previous forty year history of Electric Lake. This event provides but one example of mining intercepting water flow in the Huntington Creek drainage. As you are aware, the environmental review of the Flat Canyon Tract and Record of Decision predates the Electric Lake Skyline Mine events. No effort has been made to update these studies in light of the Electric Lake/Skyline Mine events. We have attached, as **Exhibit A**, one post event report previously submitted to DOGM authored by D. Kip Solomon, Ph. D, a University of Utah Professor, who concluded that Electric Lake was indeed being drained through fractures caused by mining activity in the Skyline Mine. Although there are differing theories as to the cause of the loss of water from the lake and the flooding of the mine, Huntington-Cleveland believes there is sufficient evidence to show, at the very least, that the mining activities in the Skyline Mine directly below Electric Lake caused water to drain from the lake into the mine. The Company also notes that DOGM was unable to pinpoint the source of the water that flooded the mine, and was therefore unable to rule out Electric Lake as the source of the large mine inflow.

A similar concern regarding the impact of mining activity on water quality also has recent precedent in the Huntington Creek drainage. Elevated levels of iron in water are currently being discharged from the idle Crandall Canyon Mine operated by Genwell Resources, Inc. This requires monitoring, treatment and a bond. Even if water quantity is not affected by mining activity in the Addition, water quality could be and needs to also be addressed through the permit process.

Huntington-Cleveland is concerned that the proposed mining activities in the Addition could create similar impacts for its other water sources in the area, including Boulger Reservoir, which is within the Addition. Several other reservoirs which store water for the Company, Cleveland Reservoir, Huntington Reservoir and Rolfson Reservoir, are only a few miles away from the Addition and are hydrologically connected to other water sources that are located within the Addition. If the proposed mining activities alter or diminish the water sources that supply water for Huntington-Cleveland's state appropriated rights, including Boulger Reservoir, such a result would adversely impact the Company and have severe consequences on all who live, work and farm in Northern Emery County.

In 2005, Huntington-Cleveland submitted comments on CFC's application to amend the Skyline Mine Mining and Reclamation Plan to allow subsidence in the North Lease of the Project. Those comments, attached as **Exhibit B**, provided a detailed explanation of the reasons why mining activities in the area could impact water resources. Although these earlier comments pertained to the North Lease, Huntington-Cleveland believes they provide a useful overview of the possible connection between mining activities and hydrology in the overall Skyline Mine permit area. The Company therefore urges DOGM to consider these general concerns in evaluating the Application.

III. DOGM Should Require the Applicant to Have a Feasible, Effective Plan in Place to Replace Water that is Lost, Interrupted, or Contaminated

Section 40-40-18(15)(c) of the Utah Code expressly states that permittees "shall promptly replace **any state-appropriated water** in existence prior to the application for a surface coal mining and reclamation permit, which has been affected by contamination, diminution, or interruption resulting from underground coal mining operations" (emphasis added). Rule 645-301-731.530 of the Utah Administrative Code further requires the use of baseline hydrologic and geologic information to determine the impact of mining activities upon water supplies.

Given these requirements, Huntington-Cleveland respectfully requests that DOGM include the following conditions in any permit it may approve for the Addition. First, it requests that any determination regarding possible hydrological impacts recognize that it is possible that CFC's proposed mining and reclamation activities could impact the water rights and water supply of Huntington-Cleveland, including the possible migration of water from one drainage to another.

Second, Huntington-Cleveland requests that DOGM require, pursuant to Section 40-40-18(15)(c), that CFC replace any water from the Huntington-Creek drainage that is contaminated, interrupted, or diminished as a result of any mining activities that it may undertake in the Addition.

Third, Huntington-Cleveland requests that DOGM ensure that CFC identify specific replacement water that is both physically and legally available to CFC and the Huntington Creek drainage that will be immediately provided in the event of interruption, diminution or contamination of water in the Huntington Creek drainage due to the mining activities. The legal

and physical ability of CFC to provide specific replacement water should be demonstrated as a condition of Permit Approval.

Fourth, in order to identify and evaluate any adverse impacts to water resources that may occur to baseline hydrologic conditions, Huntington-Cleveland proposes the following conditions for any permit DOGM may issue for the Addition:

1. Monitoring quantity and quality of all water captured, produced or used in the mining operations in the Addition.
2. All water that is pumped in or out of the Addition should be run through a magnetic flow meter with real time measuring and reporting. Reporting should be monthly and the results of such reporting should be made available to Huntington-Cleveland.
3. All meters should be inspected on a semi-annual basis by the Division of Water Rights to ensure the meters are working properly, with the results of such inspections being made available to Huntington-Cleveland. The Company is also be willing to perform these inspections should the Division of Water Rights be unwilling or unable to do so.
4. CFC should repair and remediate all surface damage in the Addition that its mining operations may cause as soon as possible after the damage has been reported to protect the watershed.

IV. CONCLUSION

In sum, Huntington-Cleveland does not oppose mining generally or in the Addition as mining is critical to the economy of Emery County, but is concerned that the proposed mining activities have the potential to adversely impact water resources in the area and the Company's state-appropriated water rights. For this reason, Huntington-Cleveland urges DOGM to include the above conditions and protections in any permit that it may approve for CFC to protect its water rights and water sources in the Addition and surrounding areas. The Company further believes its requested conditions will go a long way in providing such protections. Huntington-Cleveland is also willing to work collaboratively with CFC and the DOGM to discuss other ways of protecting or augmenting water resources in the Addition and the Huntington Creek drainage. Consequently, the Company requests a hearing to provide the parties with an opportunity to discuss and address these and further critical issues.

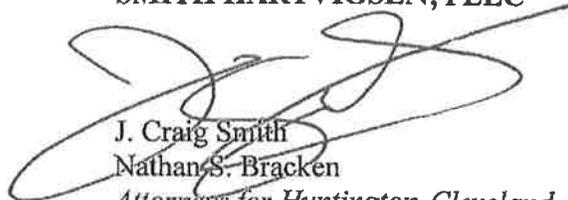
Huntington-Cleveland hopes that a common understanding can be reached as to how to protect its water rights and water resources in the Addition and surrounding areas. Nevertheless, it reserves its right to appeal any permit issued for the Addition to the Board of Oil, Gas, and Mining.

Thank you for considering the Company's comments. Please contact me with any questions.

Letter to the Coal Regulatory Program
January 29, 2016
Page 5 of 5

Sincerely,

SMITH HARTVIGSEN, PLLC



J. Craig Smith
Nathan S. Bracken
Attorneys for Huntington-Cleveland

cc: Huntington-Cleveland Irrigation Company

4829-4576-0301, v. 5

EXHIBIT A

PRELIMINARY DRAFT

Analysis of Groundwater Flow from Electric Lake Towards the
Skyline Mine

June, 2005

D. Kip Solomon
Ph.D.

Abstract

This report documents analyses of tritium, noble gases, and chlorofluorocarbons (collectively referred to as environmental tracers) that have been performed on waters collected in the vicinity of Electric Lake and Skyline Mine. These analyses provide insights regarding groundwater flow and the transport of solutes dissolved in this groundwater. They have been used to develop a conceptual hydrologic model that describes interactions between the surface and subsurface hydrologic systems.

The primary conclusion of this report is that substantial quantities of surface water in the vicinity of Electric Lake are being diverted towards subsurface discharge points (mine workings and dewatering wells.) The rapid introduction of surface water is likely to have resulted from fractures that were either intercepted, created, or enlarged as mining activities moved towards Electric Lake in 1999. The basis for this conclusion is that the isotopic character of subsurface discharge is evolving towards that of surface water with this evolution commencing in approximately 2001. A mathematical model of flow and transport along fracture pathways predicts that the isotopic character of subsurface discharge will continue to evolve for more than 10 years as water in pores surrounding fracture pathways is gradually replaced by surface water. While the model predicts a gradual evolution in the chemical and isotopic character of subsurface discharge, it predicts a rapid (nearly instantaneous) effect on the surface water hydrology. The model is fully consistent with losses on the order of 5000 gal/min of water from Electric Lake as documented by water balance studies.

This report is organized as follows. Evidence that shows the presence of surface water in subsurface discharge is first presented. The most direct evidence comes from a large number of tritium analyses, and is supported by a smaller number of dissolved gas measurements. These data are then evaluated in the context of a mathematical model that simulates the transport of environmental tracers along fracture pathways. Finally, the data and mathematical modeling are discussed in terms of a conceptual model for the impact of subsurface flow on the surface water hydrology of the site. For reference, an overview of the use of environmental tracers to evaluate groundwater flow is presented in Appendix A.

This report was originally prepared in May, 2004. It has been updated to include tritium data from samples collected through March, 2005.

Evidence for the Presence of Surface Water in Subsurface Discharge

Tritium

Tritium is a radioactive isotope of hydrogen with a half-life and 12.3 years. Tritium in natural waters is derived mostly from nuclear sources (reactors, weapons testing and productions, etc.) and because of its half-life is present at only very low concentrations in subsurface water that is older than about 50 years. Figure 1 shows tritium values as a

function of time for samples collected from wells JC1, JC3, and from underground mine workings. Also shown in Figure 1 are tritium values obtained by the Skyline Mine. Tritium data are located in Table 1. The most prominent feature of Figure 1 is the consistent increase in tritium with time. For example, the tritium value for JC1 was 0.2 TU in September of 2001 and has risen to 2.99 TU in March of 2005. While the only long-term time series is from well JC1, it is clear from Figure 1 that this well is also representative of water in mine workings (which could not be sampled directly after 2002 due to flooding in the mine.) Table 1 also shows tritium values from various surface sources including Electric Lake and Huntington Creek. These values range from 7.7 to 12.6 TU with an average of about 9.2 TU. The continuous increase in tritium through time with values reaching 2.99 TU (March 2005) can only occur by the rapid and downward movement of surface water to subsurface discharge points.

Tritium/Helium-3

In addition to tritium, samples were collected for analysis of dissolved gases. Dissolved noble gases (especially helium-3) can be combined with tritium to estimate groundwater ages. The utility of groundwater dating using tritium and helium-3 has been well documented in the scientific literature (Poreda et al. 1988; Solomon et al., 1992; Solomon et al. 1993; Cook and Solomon, 1997; Solomon and Cook, 2000.) These samples were analyzed at the University of Utah and the results are shown in Table 2. Also shown are calculated values such as the apparent age of the water (or recharge year) and the amount of terrigenous ⁴He (He that is derived from radioactive decay in the subsurface.)

Apparent tritium/helium-3 ages were 18 and 16 years for samples collected from JC1 and JC3 in 2003. Because this water is a mixture of old and young water (discussed later in more detail) the age calculation is sensitive to the isotopic composition of He produced in the subsurface (terrigenous He) and this value is not well known. As a result, there is significant uncertainty in these ages, probably on the order ± 7 years. In a mixture of young and old water, the tritium/helium-3 age is biased strongly towards the young fraction. Thus, I interpret these ages to represent the mean travel time of tritium moving from the surface towards the well intake. However, there is a broad range of travel times even within the young (tritiated) fraction of water that discharges at the wells. Thus, the apparent ages should not be confused with the shortest travel times in this system but rather is more representative of the mean travel time for the young fraction of water. Furthermore, as shown with the mathematical model later in this report, the travel distance divided by the apparent travel time does NOT provide a measure of fluid velocity in fracture pathways. This is because exchange with pore water that surrounds fracture pathways influences the chemical and isotopic composition of discharging waters.

CFCs

Samples were also analyzed for dissolved chlorofluorocarbons (CFC) that can also be used to estimate the occurrence of surface water in subsurface flow systems (Busenberg and Plummer, 1992, Cook and Solomon, 1997.) Apparent CFC recharge years were

computed and are shown in Table 3. Because CFC ages are determined using absolute concentrations, they are highly affected by dilution of young water with old (CFC-free) water. Thus, the CFC ages shown in Table 3 do NOT represent travel times. They are included in Table 3 to show that the apparent age has been declining through time as more and more young water makes it to the well intakes. The primary value of the CFCs is that they can be used to indicate the fraction of old versus young water that is discharging from the wells (discussed in next section of this report.)

Fraction of Surface Water in Subsurface Discharge

While the environmental tracer data clearly indicate the presence of “young” surface water in subsurface discharge, the data also indicate that older groundwater is also discharging. The analysis below provides estimates of the fraction of young surface water that is discharging from the subsurface.

The tritium value for JC1 was 0.2 TU in September of 2001 and had risen to 2.99 TU in March of 2005. Tritium in surface waters ranges from 7.7 to 12.6 TU with an average of about 9.2 TU. A simple binary mixing model can be developed to estimate the fraction of young surface water that has discharged in JC1 as a function of time. Because the tritium content of the old fraction is insignificant, the fraction of modern water (MF) can simply be computed as

$$MF = \text{“Mixture Tritium”} / \text{“Modern Tritium”}.$$

The results of this calculation are shown in Figure 2. The calculation was made using concentrations of both 9 and 12 TU for “Modern Tritium” and do not account for radioactive decay. The fraction of modern water ranges from near zero in 2001 to 0.33 (33%) in March of 2005. Figure 2 also shows linear regressions of the results for both the 9 and 12 TU values for “Modern Tritium.” The linear trends intercept the x axis (date) in May, 2001 (i.e. the date when the “Modern Fraction” is 0.) This linear mixing model was applied only to the data between 2001 and 2003 because non-linear behavior is clear in the data beyond 2004. The change in slope of the tritium versus time curve in early 2004 is probably the result of changes made in pumping within the mine.

Another indicator of the fraction of modern water present in JC1 discharge comes from the CFC data. An optimization technique (using the Solver in Microsoft Excel) was used to find the modern fraction that best fits all three of the CFC values measured (CFC-11, CFC-12, and CFC-113.) The results of these calculations are shown in Table 4. The CFC concentration of the old fraction was assumed to be 0. As shown in Table 4, the modern fraction in JC1 changed from 0.02 in March 2003 to 0.44 in August 2003. While these values are not in perfect agreement with the tritium results, they show the same general pattern of an increasing fraction of modern water with time. The CFC concentration of the old fraction is not well known and may in fact be greater than zero due to gas transport in the vadose zone. CFC concentrations greater than zero for the old fraction would result in a lower modern fraction that is closer to the tritium results. While the CFC results are less reliable than the tritium, they nevertheless show the same

trend and both techniques indicate that at the present point in time significant amounts modern surface waters are discharging in the subsurface.

Both the tritium and CFC data indicate that significant amounts of modern surface waters are discharging in the subsurface. The estimate of 33% modern water discharging from JC1 is probably a minimum value as it neglects both radioactive decay and exchange with old water in the Star Point Sandstone (discussed in the next section.) The effects of radioactive decay depend on the mean travel time of fluids in the subsurface and are not known precisely. Postulated mean travel times of 2, 5 and 10 years result in the calculated fraction of modern water discharging in JC1 being 37%, 44%, and 58% for the data collected in March 2005 when only radioactive decay is considered.

Simulation of Tritium Transport

The environmental tracer data clearly show a gradual increase in the presence of surface water at subsurface discharge points. On the other hand, water balance calculations show that major losses from Electric Lake began in late 1999 and have continued to the present. Furthermore, in April 2003 a dye tracer test was started by injecting 50 pounds of eosine dye mixture and 35 pounds of fluorescein mixture on the bottom of Electric Lake. Small, but above background concentrations of fluorescein were detected in JC1 discharge in June, 2003. The appearance of detectable dye in approximately 65 days suggests a minimum fluid velocity that is on the order of 30 m/day (approximately 8400 feet in 65 days.) A subsequent dye test was initiated in February of 2004 and the dye was detected in JC1 in early 2005 suggesting a velocity on the order of 7.2 m/day. This rapid transport is strong evidence for fluid movement along fractures rather than intergranular flow. However, the 65- and 355-day dye travel times and the rapid onset of losses from Electric Lake might appear to be inconsistent with the tritium and CFC binary mixing results (i.e. years to reach a modern fraction that approaches 1.) However, as discussed below, these results are consistent with a model of rapid fluid flow along fractures accompanied with mass exchange (due to molecular diffusion) into the surrounding porous matrix. This model illustrates how a rapid onset of the diversion of surface water accompanied with large fluid velocities along fracture pathways is consistent with a more gradual increase in tritium and other environmental tracers.

Fluid and solute transport in a fractured rock mass are controlled by both advection and molecular diffusion. Fluid velocities along fracture pathways can be very large (tens to thousands of meters per day) and very large quantities of fluid can be conveyed through millimeter-size fractures. When a dissolved tracer is introduced into the fracture flow system, it will be transported rapidly by flowing water (advection), but due to its thermal energy will tend to migrate out of the fracture into the surrounding porous matrix. This process is known as matrix diffusion (Grisak and Pickens, 1980; Tang et al., 1981; Sudicky, 1989) and results in a net tracer movement that can be substantially less than the fluid velocity in the fracture. When fractures exist in rocks that contain minimal intergranular porosity, the effects of matrix diffusion are small. In contrast, when small fractures exist in rocks or sediments with high intergranular porosity, the net transport rate of tracer can be orders of magnitude less than the fluid velocity in the fractures.

An analogy to matrix diffusion is when heat is introduced to one end of an efficient heat exchanger. Even though the fluid velocity inside the heat exchanger may be large, high temperature fluid introduced at one end does not rapidly appear at the downstream end of the exchanger because of heat loss out of the system. In fact, depending on the efficiency of the exchanger and the heat capacity of the surrounding system, the temperature at the downstream end may never reach that of the inlet and can remain at a significantly lower temperature. If the exchanger is surrounded by an insulator (as in the case when fractures are in crystalline rocks that have minimal matrix porosity), the temperature at the downstream end will rapidly approach that of the inlet.

I have utilized a computer program known as CRAFLUSH, developed by E. A. Sudicky at the University of Waterloo to simulate tritium transport. CRAFLUSH evaluates an analytical solution to differential equations that describe fluid advection in a system of parallel fractures along with molecular diffusion into the surrounding matrix. Figure 3 is a conceptual diagram that illustrates this model. Input data for two separate model runs (e12.dat and e15.dat) are shown below. The input concentration was set to 10 TU as a rounded average of the values measured in surface water.

Input Data for Model e12.dat

SOURCE CONCENTRATION AT FRACTURE ORIGIN= 10.0000 TU
INITIAL CONCENTRATION IN MATRIX AND FRACTURES= .0000 TU
VELOCITY IN FRACTURE= 25000.000 m/yr
FRACTURE DISPERSIVITY= 1.000 m
FRACTURE APERTURE= 0.8000E-03 m
FRACTURE SPACING= 1.000 m
MATRIX POROSITY= .100
MATRIX TORTUOSITY= .500
DIFF. COEFF. IN WATER= 0.3150E-01 m²/yr
FRACTURE RETARDATION FACTOR= 1.000
MATRIX RETARDATION FACTOR= 1.000
HALF-LIFE= 0.124E+02 yr

Input Data for Model e15.dat

SOURCE CONCENTRATION AT FRACTURE ORIGIN= 10.0000 TU
INITIAL CONCENTRATION IN MATRIX AND FRACTURES= .0000 TU
VELOCITY IN FRACTURE= 350000.000 m/yr
FRACTURE DISPERSIVITY= 1.000 m
FRACTURE APERTURE= 0.2500E-03 m
FRACTURE SPACING= 1.000 m
MATRIX POROSITY= .200
MATRIX TORTUOSITY= .700
DIFF. COEFF. IN WATER= 0.3150E-01 m²/yr
FRACTURE RETARDATION FACTOR= 1.000
MATRIX RETARDATION FACTOR= 1.000

HALF-LIFE= 0.124E+02 yr

In model e12.dat the fluid velocity in the fracture was set to 25,000 m/yr, and in model e15.dat the velocity was set to 350,000 m/yr. Other differences in the models are in the fracture aperture (fracture width) and the matrix porosity. Model e12.dat uses a matrix porosity of 10% and a fracture aperture of 0.8 mm, whereas model e15.dat uses a matrix porosity of 20% and a fracture aperture of 0.25 mm. Also, model e12.dat is for a transport distance of 2000 m whereas e15.dat uses a transport distance of 4000 m. These models cover a range of possible values that are reasonable for the system.

The results of these simulations are shown in Figure 4 along with observed tritium values from well JC1. Both of the models provide a good fit with the observed data, although the most recent values (late 2004 to early 2005) fall below the simulated values. This illustrates that the models are not unique (i.e. there are many combinations of parameters such as matrix porosity and fracture aperture that can fit the data equally well); however, these results show that it is possible to transport tritium from the surface without having the tritium concentration rapidly change to that of the input value. Furthermore, the model is consistent with the very rapid transport of small concentrations of dye.

An important result from the CRAFLUSH model is that the tritium concentration in JC1 will continue to increase in the coming years, but not in a linear fashion. Both the simulations shown in Figure 4 (e12.dat and e15.dat) predict that tritium will approach a stable value of about 6 TU. More than 10 years are required in both simulations to reach this steady state value. This value is less than the input value of 10 TU because of radioactive decay. A simulation was performed with input parameters identical to e12.dat except with no radioactive decay. Approximately 25 years were required to reach a concentration near 10 TU at a distance of 2000 m from the source. The difference between the simulation without and with radioactive decay represents the approximate amount of tritiogenic ^3He in the water. The ratio of tritiogenic ^3He to tritium is used to calculate the tritium/helium-3 age. The simulated age varies with time and is about 1 year after 2 years of transport and increases to about 8 years when the tritium value reaches a steady state. This increase in the apparent age is consistent with observations (see Table 1), but the absolute values of the observed ages are greater than the simulated values. This may be a result of the inherent uncertainty in the observed ages due to uncertainty in the $^3\text{He}/^4\text{He}$ ratio of terrigenic He. Nevertheless, the observed and simulated ages are of the same order of magnitude and both show a general increase with time.

A final important point about the tritium transport model is that all subsurface discharge is assumed to come from transport along fracture pathways that are connected to surface water. It is likely that some intergranular flow occurs in the vicinity of dewatering wells and mine discharge that mixes with fracture flow before discharging. A more realistic model of tritium transport might include both fracture and intergranular flow. Indeed, the fact that the most recent tritium data (late 2004 to early 2005) fall below the model may indicate the presence of a component of "old" intergranular flow. However, additional

site characterization is needed before such a model could be implemented in a meaningful manner. The CRAFLUSH model is not intended to be a precise representation of subsurface flow conditions at the site. Rather, it demonstrates that it is physically possible to rapidly transport measured losses from Electric Lake towards subsurface discharge points while having the chemical signal of the discharge gradually approach that of the surface water.

Fluid Flow Rates

The CRAFLUSH model includes fluid flow only in the fractures with intergranular flow being negligible. JC1 has been pumping approximately 4000 gal/min throughout the year 2003 with an additional 3000 to 5000 gal/min from JC3 beginning in July of 2003 to mid 2004. Water balance studies have shown that losses from Electric Lake are on the order of 5000 gal/min in 2002 and 2003. To evaluate the viability of a model in which all flow occurs in fractures, I have computed the total fluid flow rate possible for the two fracture apertures used in simulations el2.dat and el5.dat. This was done using the well-known cubic law that relates the total fluid flow to the cube of the fracture aperture as follows:

$$Q = \frac{\rho g W b^3}{12 \mu} i$$

where, Q is the fluid flow rate [m^3/s], ρ is the fluid density [kg/m^3], W is the total length of fractures (map view) [m], b is the fracture aperture [m], I is the hydraulic gradient, and μ is the fluid viscosity [$\text{kg}/\text{m}\cdot\text{s}$]. The water level in Electric Lake is approximately 8500 feet. On 6/19/2002 the water level in an observation well in Burnout Canyon (Well 79-35-1) was 8195 feet (Canyon Fuels Map No. PHC A-4). If this water level is representative of JC1, then the vertical hydraulic gradient is approximately $(8500 - 8195)/700 = 0.44$ (where 700 is the depth of the observation well below Electric Lake.) Setting Q to $0.315 \text{ m}^3/\text{s}$ (5000 gal/min), with $\rho = 1000 \text{ kg}/\text{m}^3$ and $\mu = 0.0013 \text{ kg}/\text{m}\cdot\text{s}$, it is possible to calculate the length of fractures (W) necessary to transmit 5000 gal/min from Electric Lake for the two different values of aperture (0.8 and 0.25 mm) used in the transport simulations. The results show that for an aperture of 0.8 mm a total length of 2226 m is needed. Electric Lake is approximately 200 m wide, and thus 11 fractures that extend the width of the lake that each has an aperture of 0.8 mm are sufficient to transmit 5000 gal/min of water from Electric Lake to subsurface discharge points. For an aperture of 0.25 mm, a total length of about 72,935 m, or 365 fractures that extends across Electric Lake is sufficient to transmit 5000 gal/min.

Although both of the simulations (el2.dat and el5.dat) provide reasonable fits to the observed data, it is important to note that fluid velocity used in simulation el2.dat is significantly less than the velocity that would occur along a fracture with an aperture of 0.8 mm when the hydraulic gradient is 0.44. In contrast, the velocity used in simulation el5.dat is consistent with an aperture of 0.25 mm (as used in the simulation) and a hydraulic gradient of about 0.3 that is similar to the gradient discussed above. Thus, only one of the two simulations presented appears to be consistent with both the time series of tritium in discharge and the observed hydraulic gradient. This suggests that a moderate

number of fractures (≈ 350) with apertures that are on the order of 0.25 mm may be responsible for fluid and mass transport in this system.

Conceptual Model

The environmental tracer data presented in this report are consistent with the following conceptual model. Pore waters within the Star Point Sandstone are part of a regional flow system that has a mean residence time on the order of thousands of years. This age is consistent with both the ^4He measurements presented in this report, and ^{14}C measurements presented by Mayo and Morris (2000.) It is highly unlikely that these pore waters are connate and hydraulically isolated from the near surface flow system. Instead, it is likely that sluggish (but finite) flow occurs in this system as a result of regional hydraulic gradients and the generally low permeability of shale-rich members of the Blackhawk and Star Point Sandstone formations. Superimposed on this regional flow system are fast fracture flow paths. A small number of these pathways may have existed prior to mining activities, but both water balance calculations and evolving (changing with time) environmental tracer data indicate that the onset of significant flow is coincident with mining activities in this area.

Tritiated water from the surface began moving towards subsurface discharge points at the onset of losses from Electric Lake. Initially, much of the discharge would have the isotopic and chemical character of old stored water, but is now evolving towards the character of surface water. In this model, the subsurface discharge may include a significant draining of old stored water as well as having a large impact on the surface water system.

Alternative Model

If one considers only the tritium data at a selected point in time, it is possible to explain small values in subsurface discharge resulting from a steady-state mixture of minor amounts of surface water with large amounts of old groundwater. For example, in September 2001 the tritium content of JC1 was 0.2 TU and this represents a modern fraction of only about 2 %. Without the benefit of other data, one might conclude that the majority of subsurface discharge is derived from the Star Point Sandstone that generally contains tritium-free water. Tritium in discharge is conveyed from the surface and mixes with the old water in the Star Point Sandstone. A characteristic feature of this model is that the majority of discharge is derived from stored water with only a modest input of modern water from the surface. Furthermore, this conceptual model implies that in the future, water will continue to drain from the Star Point Sandstone as it represents a very large volume of water. In other words, this alternative conceptual model represents a steady state mixture between mostly stored water and a small amount of surface water that will continue for a long period of time. However, when one considers (1) the increasing nature of the tritium and other environmental tracer data (2) large losses from Electric Lake beginning in 1999, and (3) the detection of dye in JC1 discharge, **this alternative conceptual model is not viable.**

Conclusions

The tritium, dissolved gas, and dye tracer results are consistent with a model of rapid fluid flow along fractures with mass exchange via diffusion with the surround porous matrix. These data are consistent with the onset of losses from Electric Lake derived from water balance calculations. The systematic increase in tritium in JC1 and other underground monitoring points is strong evidence for a fracture controlled flow system that is conveying water from surface sources towards underground workings and dewatering wells. Binary mixing calculations show that water discharging from well JC1 is currently a mixture of at least 33% and possibly greater than 50% modern water that is derived from surface sources. A mathematical model of fluid flow and rapid solute transport along fractures indicates that the tritium content of JC1 will continue to increase, but will approach a value that is less than the modern value of surface water due to radioactive decay in the subsurface and possibly the mixing of young surface water with some old water stored in the subsurface. This model also indicates that more than 10 years are required before the tritium value will stabilize. Even though fluid velocities along fractures are large (30 to 1000 m/day), the net rate of solute movement is substantially lower due to matrix diffusion. However, the hydraulic effect on the surface hydrology from fracture flow is essentially instantaneous (i.e. water began draining from the surface system immediately after the formation of a connected system of fractures.)

While the mathematical modeling is not unique in that multiple combinations of input parameter can fit the observed data equally well, the model clearly indicates that it is physically possible to transport large quantities (more than 5000 gal/min) of water along a relatively small number of fractures. However, the simulation that is most consistent with all of the data suggests that a moderate number (≈ 350) of smaller fractures (aperture on the order of 0.25 mm) may be responsible for conveying surface water towards mine workings and dewatering wells.

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Appendix A

Overview of Tritium, Dissolved Gases, and Chlorofluorocarbons as Indicators of Groundwater Flow

Tritium

Tritium (^3H) is a radioactive isotope of hydrogen (12.43 year half-life.) Large amount of ^3H were introduced into the atmosphere as a result of thermonuclear weapons testing in the 1950s and 1960s. Small quantities are also produced naturally in the upper atmosphere mainly through the bombardment of nitrogen by the flux of neutrons in cosmic radiation. Prior to 1950 the ^3H activity of precipitation ranged from about 3 to 6 TU (1 TU represents one molecule of $^3\text{H}^1\text{HO}$ in 10^{18} molecules of $^1\text{H}_2\text{O}$) in North America. In the mid 1960s, the ^3H activity of precipitation rose to more than 3000 TU in Ottawa, Canada, and to over 8000 TU in Salt Lake City. Although ^3H can also be produced in the subsurface (mostly through spontaneous fission of ^6Li ; $^6\text{Li}(n,\alpha)^3\text{H}$), the activity in water resulting from average crustal rocks should be less than about 0.2 TU (Lehmann et al., 1993).

Because (1) of the spike-like input of into groundwater, and (2) because it is a part of the water molecule, ^3H is one of the most widely used dating methods in hydrology. In North America groundwater that originated as precipitation prior to 1950 should have a present day ^3H activity of less than 0.5 TU. The simplest use of ^3H is to distinguish pre-1950 ("pre-bomb) water from post-1950 water.

If the history of ^3H activity in recharge is well known, it is possible to obtain a more precise estimate of age. However, long-term ^3H records exist for only selected stations (see <http://isohis.iaea.org/> for a comprehensive data base) and temporal variations (from season to season and even from storm to storm) make it difficult to define the ^3H input activity precisely at a given site. As a result, it is typically not possible to collect a single water sample and derive a precise age (e.g. ± 5 or 10 years) from a measurement of ^3H only.

Dissolved Gases

Gases dissolved in groundwater can be derived from either exchange with the atmosphere of the vadose zone, or can be generated within the aquifer. Noble gases that are primarily derived from the atmosphere include neon, argon, krypton, and xenon. Gases that are derived mostly from the atmosphere, but can be produced in significant amounts in the subsurface include nitrogen and helium.

For gases that are derived primarily from the atmosphere, the concentration in groundwater depends on the following.

1. The temperature at the water table (recharge temperature.)

2. The salinity at the water table.
3. The atmospheric pressure at the water table (controlled mostly by the elevation.)
4. The degree to which the water table fluctuates up and down trapping air bubbles which then dissolve (excess air.)

Items 1 through 3 result from equilibrium processes and the concentration associated with each of these can be calculated precisely using solubility equations. In contrast, item number 4 (excess air) is commonly observed in groundwater samples, but is difficult to estimate from a theoretical point of view. In practice, the concentration of each dissolved gas is expressed as follows:

$$C_i = P_t X_i K_i + X_i EA \quad (1)$$

where P_t is the total atmospheric pressure (and depends on elevation), X_i is the mole fraction of gas i in the atmosphere (e.g. 0.78 for N_2 ; 5.24×10^{-6} for 4He), K_i is Henry's coefficient for gas i (and depends on temperature and salinity), and EA is the amount of excess air. If a series of dissolved gases are measured (that have either no or minimal subsurface source), then equation (1) can be written for each gas. This system of equations is then solved simultaneously to obtain estimates of the input parameters (e.g. temperature, atmospheric pressure, etc.) that best fit the observed data. Usually, the salinity of the water at the water table is low (and therefore does not significantly affect the concentration), and the elevation of recharge (and therefore the atmospheric pressure) is known. Under such conditions the only unknowns are the recharge temperature and the amount of excess air. If three or more atmospherically derived gases are measured, the determination of recharge temperature and excess air is relatively unique with a typical uncertainty in recharge temperature being $\pm 2^\circ C$.

For gases that are derived from the atmosphere but are also produced in the subsurface, the concentration in groundwater depends on items 1 through 4 above, but also depends on the amount produced in the subsurface. The processes that produce gas in the subsurface are specific to each gas and are discussed below.

1. Dissolved nitrogen is mostly derived from the atmosphere, but can be produced in the subsurface as a result of denitrification of nitrates. Thus, values of dissolved nitrogen that are in excess of atmospheric solubility generally indicate that geochemical conditions in the aquifer are causing nitrate (NO_3^-) to be reduced to nitrogen gas (N_2).
2. Dissolved helium-4 is mostly derived from the atmosphere that contains 5.24 ppmv helium-4. However, as uranium and thorium decay to stable daughters, helium-4 is produced. This production occurs mostly within minerals in the subsurface. If these minerals completely retained the helium-4, there would be essentially no source for groundwater. However, most minerals do not retain helium-4 but rather it is released (e.g. due to solid state diffusion) into groundwater that flows past the minerals. As a result, the concentration of helium-4 in groundwater depends on the rate at which it is being released from minerals, and on the amount of time the water is in contact with these minerals

- (i.e. the travel time.) It is often assumed that the release of helium-4 from minerals is equal to the production from uranium and thorium decay (i.e. after a steady state is obtained in the mineral.) To the extent that the U and Th concentrations in minerals and the ^4He release rate is spatially constant, ^4He concentrations above atmospheric solubility indicate groundwater travel times. Helium-4 produced in the subsurface is known as terrigenic ^4He and is estimated by subtracting the atmospheric concentration of ^4He from the measured value.
3. Dissolved helium-3 is mostly derived from the atmosphere that contains 7.252×10^{-6} ppmv (i.e. 7.252 parts of ^3He for every 10^{12} parts of air). However, when groundwater contains tritium (^3H), ^3He will be produced as a result of ^3H decay. Because the decay of ^3H is a first order rate process, the production of ^3He in the subsurface depends on the travel time. Thus, measurements of both ^3H and ^3He can be used to date groundwater. The amount of ^3He in groundwater that is derived from ^3H decay is known as tritiogenic ^3He and is estimated by subtracting the atmospheric concentration of ^3He from the measured value. Helium-3 can also be produced by neutrons in the subsurface interacting with lithium-6; however, this is typically only significant in waters that are older than a few hundred years. Atmospheric concentrations of ^3H were low prior to 1950, and then increased dramatically as a result of above-ground testing of thermonuclear weapons. As a result, the use of ^3H and ^3He to date groundwater is generally limited to waters younger than 1950. In practice the ratio of ^3He to ^4He (known as R) is typically reported rather than the absolute concentration. Furthermore, this ratio is usually referenced to the ratio of ^3He to ^4He in air (R_a). For example, a reported value for R/R_a of 1.100 means that the ^3He to ^4He ratio of the sample was 1.1 times greater than air. The air ratio (R_a) is 1.384×10^{-6} . To compute the absolute concentration of ^3He from the reported value, multiply the R/R_a value by 1.384×10^{-6} and then multiply this by the absolute concentration reported for ^4He .

Chlorofluorocarbons

Chlorofluorocarbons (CFCs) are stable volatile organic compounds that were first produced in the 1930s as refrigerants and have since been used for a variety of industrial and domestic purposes. The global distribution and temporal variations of CFCs are relatively well known as a result of extensive atmospheric measurements since 1978 at stations throughout the world.

The concentration of CFCs in recharging groundwater is given by Henry's law:

$$C_{CFC} = K_{CFC,T} P_{CFC}$$

where K is the Henry's law constant for the i th CFC compound at temperature T , and P is the atmospheric partial pressure of the i th CFC compound. By combining the atmospheric CFC growth curves and Henry's law solubilities at a given temperature it is possible to determine the expected concentrations of CFCs in water recharged between

approximately 1950 and the present. Thus, measurements of CFCs dissolved in groundwater can be related to the year in which the water was in equilibrium with the atmosphere providing a measure of groundwater travel times.

Table 1 Results of Tritium Analyses.

Site	Date	Tritium (TU)
10L Sump	7/2/02	1.31
10L Sump	7/16/02	1.16
10L Sump (alternate)	8/1/02	1.19
10L Sump	8/15/02	1.21
10L Sump	8/28/02	1.20
10L Sump (alternate)	9/13/02	1.18
10L Sump	9/23/02	1.46
9L Borehole XC59	4/10/02	0.16
9L Horizontal Borehole	7/2/02	0.17
9L Horizontal Borehole	8/15/02	0.86
9L Horizontal Borehole	8/28/02	0.83
9 Left Horizontal Borehole	9/23/02	0.24
JC-1	26-Sep-01	0.24
JC-1	24-May-02	1.00
JC-1	24-May-02	1.04
JC-1	4-Jun-02	0.96
JC-1	19-Jun-02	1.11
JC-1	28-Jun-02	1.18
JC-1	16-Jul-02	1.09
JC-1	1-Aug-02	1.22
JC-1	13-Sep-02	1.25
JC-1	24-Sep-02	1.50
JC-1	28-Sep-02	1.42
JC-1 argon purged	10-Dec-02	1.62
JC-1 triple rinsed	10-Dec-02	1.69
JC-1 argon purged	11-Dec-02	1.66
JC-1 triple rinsed	11-Dec-02	1.64
JC-1	31-Jan-03	1.80
JC-1	15-Feb-03	2.12
JC-1	10-Mar-03	1.59
JC-1	10-Mar-03	2.50
JC-1	10-Mar-03	1.70
JC-1	26-Mar-03	2.05
JC-1	21-Apr-03	1.94
JC-1	19-May-03	2.17
JC-1	7-Aug-03	2.43
JC-1	3-Sep-03	2.48
JC-1	23-Dec-03	2.57
JC-1	4-Mar-04	2.59

Site	Date	Tritium (TU)
JC-1	15-Apr-04	2.68
JC-1	4-Aug-04	2.72
JC-1	11-Oct-04	1.72
JC-1	28-Dec-04	2.91
JC-1	17-Feb-05	2.80
JC-1	17-Mar-05	2.99
JC-3	7-Aug-03	1.45
JC-3	20-Oct-03	2.23
JC-3	23-Dec-03	1.81
JC-3	4-Mar-04	1.94
JC-3	15-Apr-04	1.70
Upper Electric Lake	26-Aug-01	12.6
E. Lake-1 Mid Lake	24-May-02	7.67
E.Lake-2 North End	24-May-02	8.52
North End Shallow Elect.	11-Jul-02	8.48
North End Deep Elect.	11-Jul-02	8.49
South End Shallow Elect.	11-Jul-02	8.57
South End Deep Elect.	11-Jul-02	8.74
Huntington Creek	7-Aug-03	10.5

Table 2 Results of Dissolved Gas Analyses, Tritium, and Calculated Water Age.

Sample ID	Sample Date	Location	N ₂ (ccSTP/g)	Ar-40 (ccSTP/g)	Ne-20 (ccSTP/g)	He-4 (ccSTP/g)	¹ R/Ra	Tritium (TU)	Apparent Age (yr)	TerriHe4 (ccSTP/g)
2002 Samples										
EL1-1	23-Sep-02	XC5E	0.0221	5.53E-04	3.00E-07	1.93E-07	0.426	0.0		1.1E-07
EL2-1	24-Sep-02	10 Left	0.0182	4.59E-04	2.37E-07	9.10E-08	0.701	1.6	4.0	2.8E-08
EL2-2	25-Sep-02	10 Left	0.0178	4.48E-04	2.15E-07	8.02E-08	0.717	1.6	6.1	2.4E-08
EL3-1	26-Sep-02	9L	0.0188	5.27E-04	2.55E-07	8.78E-08	0.693	0.3		1.9E-08
EL3-2	27-Sep-02	9L	0.0237	5.54E-04	2.60E-07	1.00E-07	0.699	0.3		3.0E-08
2003 Samples										
JC1-2	26-Mar-03	James Cny	0.0130	3.24E-04	1.62E-07	5.62E-08	0.844	1.8	18.0	1.5E-08
JC3-a	7-Aug-03	James Cny	0.0157	3.64E-04	1.87E-07	6.21E-08	0.838	1.5	15.7	1.3E-08

¹R is the ³He/⁴He ratio of the sample, Ra is the ³He/⁴He ratio of the air standard (1.384 X 10⁻⁵)

Table 3 Results of CFC Analyses and Apparent Recharge Years.

SAMPLE ID and Collection Date	CFC-11 (pmoles/kg)	CFC-12 (pmoles/kg)	CFC-113 (pmoles/kg)	CFC-11 Rech. year	CFC-12 Rech. year	CFC-113 Rech. year
JC1-A mar 26, 2003	0.105	0.124	0.000	1956	1957	1943
JC1-C mar 26, 2003	0.118	0.131	0.000	1956.5	1957.5	1943
JC1-E mar 26, 2003	0.053	0.021	0.000	1953.5	1947.5	1943
JC1-B mar 26, 2003	0.076	0.029	0.000	1954.5	1948.5	1943
JC1-D mar 26, 2003	0.136	0.182	0.000	1957	1959.5	1943
JC1-F mar 26, 2003	0.066	0.031	0.000	1954.5	1949	1943
JC1-A aug 7, 2003	2.235	1.446	0.193	1974	1977.5	1981.5
JC1-B aug 7, 2003	2.263	1.444	0.158	1974	1977.5	1980
JC1-C aug 7, 2003	2.292	1.457	0.179	1974	1977.5	1980.5
JC1-D aug 7, 2003	2.352	1.483	0.190	1974	1977.5	1981
JC1-E aug 7, 2003	2.345	1.494	0.207	1974	1978	1982
JC1-F aug 7, 2003	2.347	1.519	0.204	1974	1978	1982
JC3-A aug 7, 2003	2.401	1.486	0.206	1974.5	1977.5	1982
JC3-B aug 7, 2003	2.444	1.466	0.214	1974.5	1977.5	1982
JC3-C aug 7, 2003	2.443	1.442	0.205	1974.5	1977.5	1982
JC3-D aug 7, 2003	2.362	1.513	0.221	1974.5	1978	1982.5
JC3-E aug 7, 2003	2.390	1.489	0.200	1974.5	1977.5	1981.5
JC3-F aug 7, 2003	2.359	1.513	0.196	1974.5	1978	1981.5

Table 4 CFC Concentrations (average of replicates) and Results of Binary Mixing Calculations.

SAMPLE and Collection Date	CFC-11 (pmoles/kg)	CFC-12 (pmoles/kg)	CFC-113 (pmoles/kg)	Modern Fraction	CFC-11 modern fraction (pmoles/kg)	CFC-12 modern fraction (pmoles/kg)	CFC-113 modern fraction (pmoles/kg)	CFC-11 mixture (pmoles/kg)	CFC-12 mixture (pmoles/kg)	CFC-113 mixture (pmoles/kg)
JC1 Mar 26, 2003	0.092	0.087	0.000	0.021	5.652	2.901	0.552	0.120	0.062	0.012
JC1 Aug 7, 2003	2.305	1.474	0.188	0.439	5.652	2.901	0.552	2.480	1.273	0.242
JC3 Aug 7, 2003	2.400	1.485	0.207	0.452	5.652	2.901	0.552	2.552	1.310	0.249

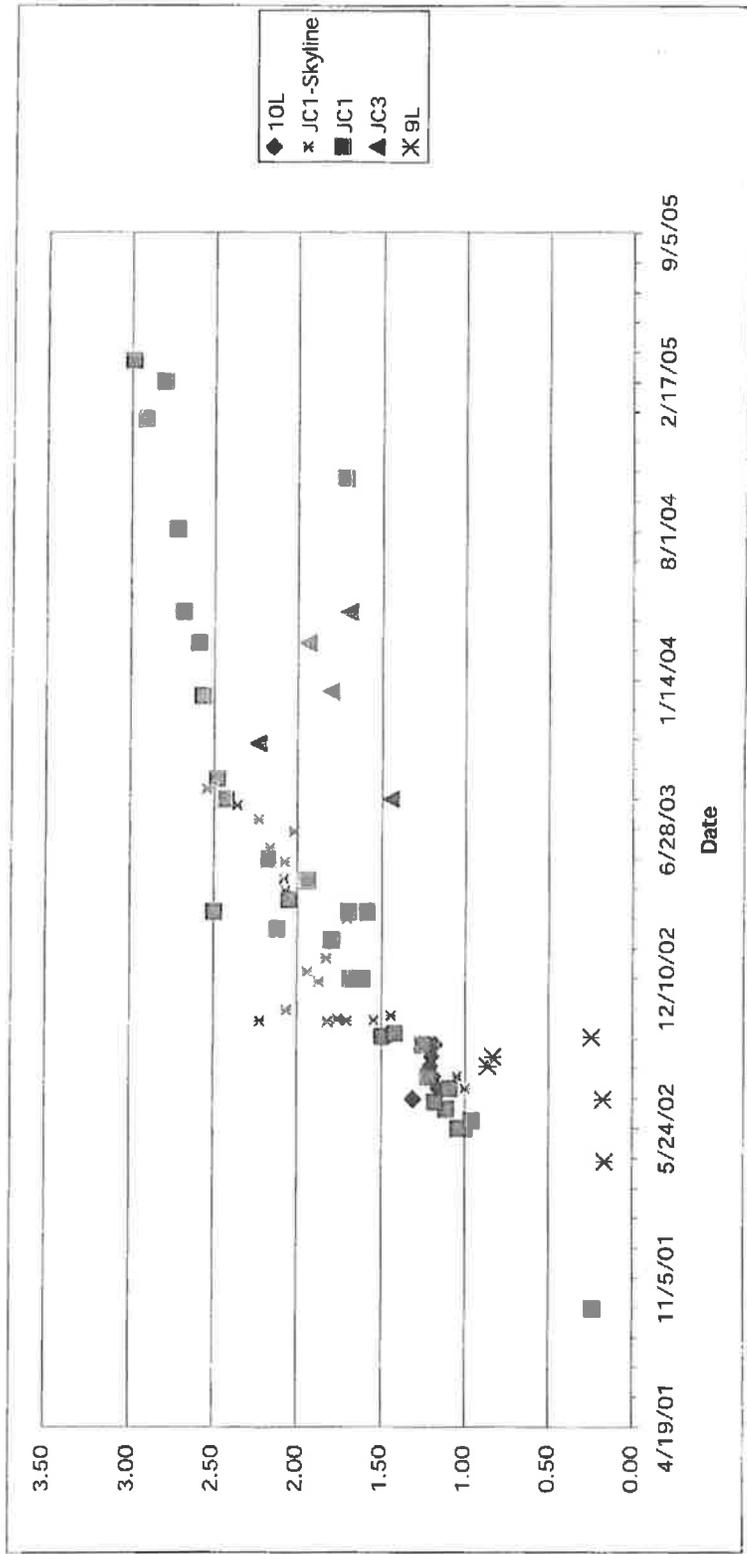


Figure 1 Time series of tritium values from underground mine workings (10L and 9L) and dewater wells (JC1 and JC3) in the vicinity of Electric Lake. The change in the slope of the data in early 2004 is likely a result of a decrease in mine dewatering that occurred in early 2004.

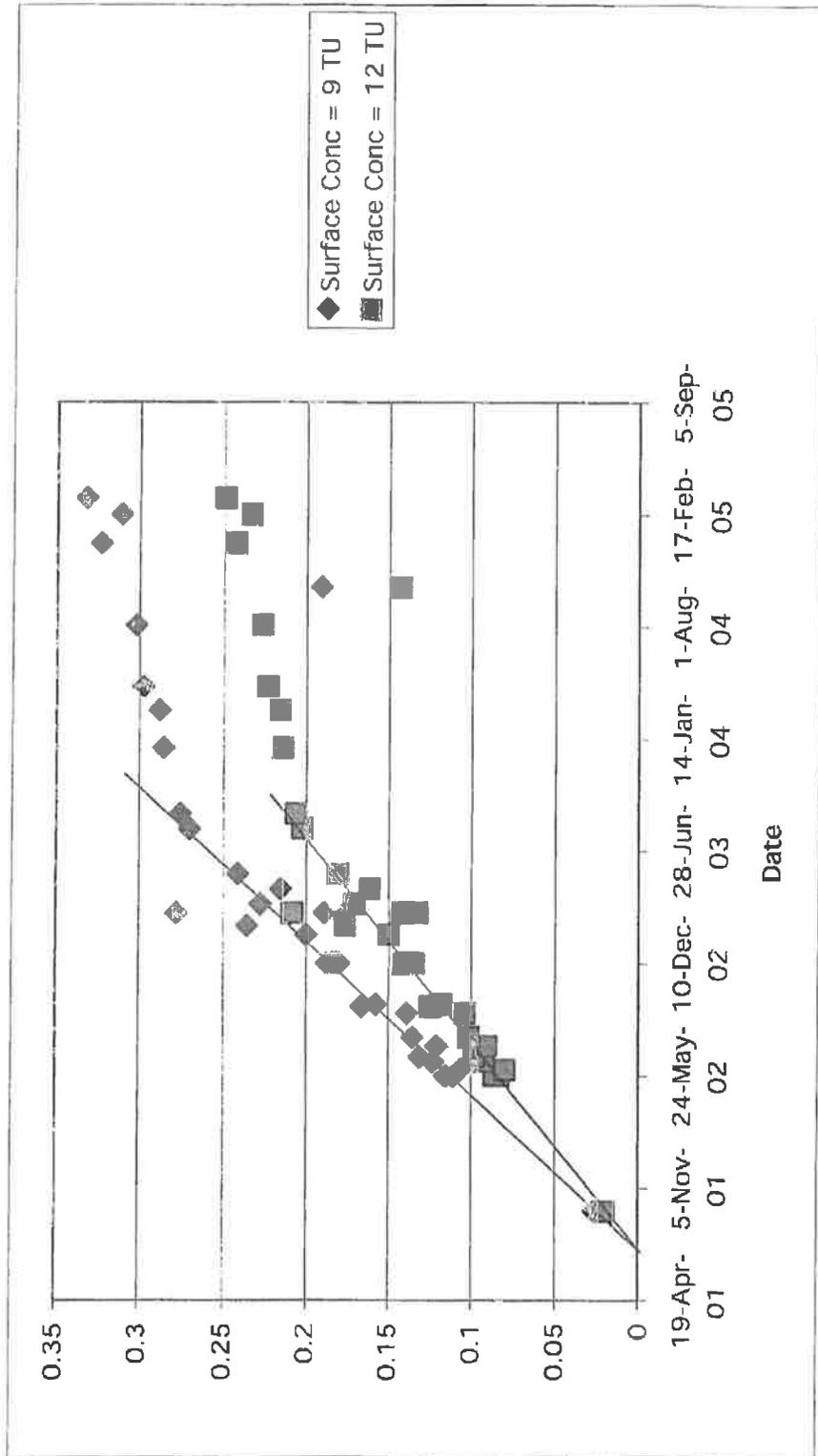


Figure 2 Computed fraction of modern water in discharge of well JC1 using a modern tritium values of 9 and 12 TU. The modern fractions was computed assuming a binary mixture of tritium-free and modern water, and does not account for radioactive decay. The data extrapolate to a modern fraction of zero in mid 2001.

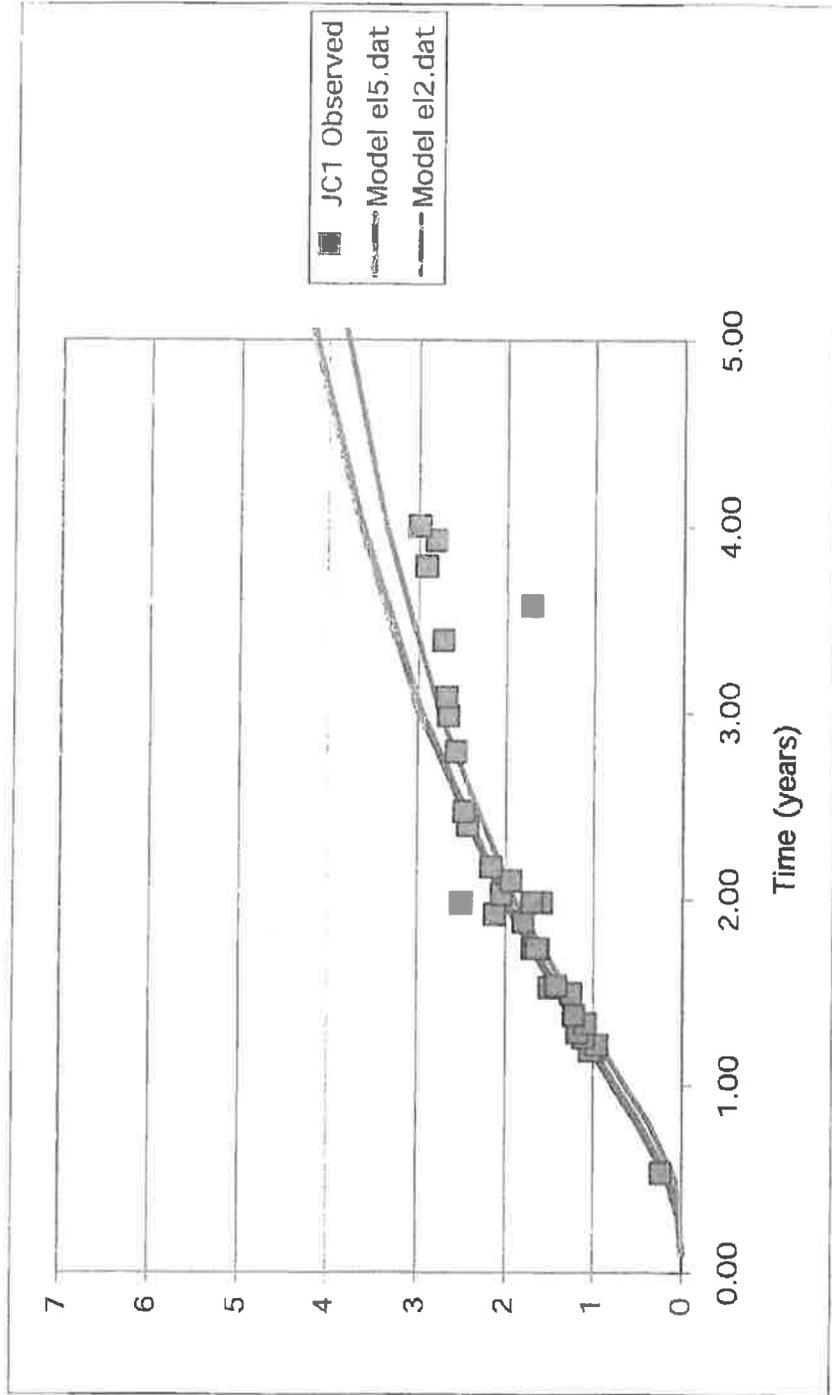


Figure 4 Comparison of observed and modeled tritium values for JC1 using a parallel fracture transport model that accounts for advection in fractures and diffusion into the surround porous matrix. While the model fits the observed data well, a sensitivity analysis shows that different combinations of input values fit the observed data equally well and thus the model does not uniquely define the physical properties of the system. However, the model does show that the observed increase in tritium can occur by flow along fractures that connect surface water (Electric Lake) and the well intake.

EXHIBIT B

4829-4576-0301, v. 5

S M I T H | H A R T V I G S E N P L L C
ATTORNEYS AT LAW

215 South State Street
Suite 650
Salt Lake City, Utah 84111

T 801.413.1600
F 801.413.1620
www.smithhartvigsen.com

J. CRAIG SMITH
jcsmith@smithlawonline.com

January 7, 2005

Pamela Grubaugh-Littig, Permit Supervisor
Attention Coal Regulatory Program
Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P. O. Box 145801
Salt Lake City, Utah 84114-5801

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JAN 07 2005

OFFICE OF THE PERMITTING

Re: Canyon Fuel Company, LLC's Application to Amend the Skyline Mine Mining and Reclamation Plan C/007/005 to Allow Subsidence in the "North Lease."

Dear Ms. Grubaugh-Littig:

The purpose of this letter is to provide the comments of Huntington-Cleveland Irrigation Company ("Huntington-Cleveland") to the above referenced Application in response to the request for such comment published in the *Sun Advocate* on December 9, 2004.

Huntington-Cleveland's concerns relate to impacts of mining on the hydrologic balance of the Huntington Creek drainage and water replacement to address any such impacts. Huntington-Cleveland is particularly concerned with the astounding loss of water from Electric Lake, a part of the Huntington Creek drainage. The participation of Huntington-Cleveland in the permit process will be most beneficial in ascertaining what water replacement requirements should be added to the permit.

As the Division is undoubtedly aware, Huntington-Cleveland is the largest holder of state-appropriated water in the Huntington Creek drainage, as such phrase is used in Utah Code Annotated section 40-10-18(15)(c). Water rights of Huntington-Cleveland provide water for beneficial use of its shareholders which include not only nearly all of the agricultural users in northern Emery County but also the municipalities of Huntington, Cleveland and Elmo and domestic use in the unincorporated county surrounding these communities. In addition and of critical importance to the present discussion, Huntington-Cleveland provides water for the use of its largest stockholder, Pacificorp/Utah Power, for the operation of the Huntington Power Plant. These demands for water have been impacted by Applicant's mining operation. As recognized in the most recent CHIA, "[t]he agricultural needs of the Huntington-Cleveland area were at a minimum or were not met during the 2003 growing season due to minimal water being delivered."

Under Utah Water Law, Huntington-Cleveland's right to state-appropriated water extends from its various approved points of diversion on Huntington Creek and springs in Huntington

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Canyon to the "farthest limits of the watershed." See *College Irrigation Co. v. Logan River & Bluck Smith Fork Irrigation Co.*, 780 P.2d 1241, 1244 (Utah 1989); *Richlands Irrigation Co. v. Westview Irrigation Co.*, 80 P.2d 458, 465 (Utah 1938). Thus all of the surface and underground water which feeds various springs, seeps in the Huntington Creek drainage, and gaining portions of Huntington Creek are part of Huntington-Cleveland's state-appropriated water. Such area of water right extends into permit areas of the Skyline Mine. Even though the proposed amendment appears to change only areas underlying the Price River Basin, there remains potential for impacts to the critical balance between river basins. In short, Huntington-Cleveland is concerned with the possibility of additional interbasin exchange—specifically, loss of Huntington Creek water into the Price River Drainage.

Huntington-Cleveland does not oppose continued mining by Applicant in the North Lease, so long as such mining as well as mining and reclamation within the remaining permit area can be accomplished without affecting the hydrologic balance and causing any unaddressed contamination, diminution or interruption of State Appropriated water for which Huntington-Cleveland holds the right. See Utah Code Ann. § 40-10-18(15)(c). Huntington-Cleveland believes that, given the studies showing mining-related losses to Electric Lake, it is necessary to update and revise the current PHC and CHIA to acknowledge the hydrologic impact of mining in the Skyline Mine permit area and to provide suitable water replacement provisions. The current versions of the PHC and the CHIA seek to explain away any connection between the large mine-water inflows starting in 1999 (and intensifying in 2001 and 2002) and the drastic loss of water from Electric Lake. However, the position that there is no connection is unreasonable given the substantial evidence to the contrary.

Although this comment letter is not intended to give an exhaustive history or analysis of the water issues surrounding Skyline Mine,¹ Huntington-Cleveland would like to briefly set forth the evidence which it believes mandates amendment of the current PHC and CHIA. As a preliminary matter, the loss of water from Electric Lake may only be a perceptible manifestation of water loss from other sources. Applicant and DOGM have apparently discounted the possibility of a connection between the increased inflows and the loss of water from Electric Lake for two reasons: first, Pacificorp, the owner of Electric Lake, did not measure the in-flows of Electric Lake directly until 2002; and second, age dating and other tracking methods have not shown a *direct* connection between the water in the mine and surface water. Huntington-Cleveland has no reason to doubt either of these underlying facts. However, these facts are insufficient to outweigh the numerous facts that support the opposite conclusion—that there is in fact a connection.

First, the CHIA states that "it is hard to have *complete* confidence in the [Pacificorp Report] because the majority of inflow are a 'back-calculation' of data." CHIA, 21 (emphasis added). As an initial matter, the threshold of "complete confidence" is not appropriate. Indeed, it would be difficult to have "complete confidence" in any study, but that does not justify disregarding a study completely. Furthermore, as noted in the *Hydrologic Framework of the Skyline Mines Area*, by Kravits Geological Services, LLC ("Kravits Report"), most of the

¹ A more exhaustive analysis is set forth in *Hydrologic Framework of the Skyline Mines Area*, by Kravits Geological Services, LLC. DOGM received a copy of this report on March 19, 2004.

analyses showing adverse impacts on Electric Lake are not based on the back-calculated inflow values. Kravits Report, 12-13. Another analysis compares calculated inflow values to the measured inflow numbers to show the trend of increased error as it relates to pumping and reduced outflow numbers. Thus, there is plenty of evidence of a connection without relying on back-calculated inflow numbers.

Second, both the PHC and the CHIA rely heavily on age dating and other source-tracking analyses to substantiate the conclusion that there is no connection between the mine inflows and surface or near-surface sources. While the conclusion that "no direct conduit exists between the mine and the lake" may be justified based on the data, PHC A-13, the conclusion that there is no connection at all between the mine water and surface water is not justified. By all reports, the source-aquifer is enormous. That being the case, it is entirely reasonable, indeed probable based on the evidence, that a conduit exists to recharge the aquifer at some remote point as aquifer water enters the mine. The correlation between the amount of water pumped from JC1 and JC3 and the increased losses of water from the Lake is strong proof of such a conduit because there would be no such correlation if the aquifer was truly "isolated." See Kravits Report, 7. Due to the size of the aquifer, it may take a long time for dyes or other indicators of surface or near-surface water to show up in the mine. Furthermore, although the PHC implies that the significant losses in Electric Lake are due to the drought (PHC A-9), the Kravits Report shows that the Lake responses are totally unlike the effects to the Lake during past droughts. Kravits Report, 10. The spurious Lake responses started in 1999, the same time that Skyline Mine was unexpectedly inundated by water—an inundation which underscored the deficiencies of the PHC and CHIA in place at the time which forecasted no such inundation. Though circumstantial, the fact that these events happened at roughly the same time makes a connection more likely than not. Finally, to Huntington-Cleveland's knowledge, neither the mine nor the DOGM has set forth any other potential cause of the radical change in Electric Lake behavior. Thus, the PHC and CHIA conclusion that there is no connection is against the weight of the evidence. There is a connection between surface and near-surface water sources and the mine, and the PHC and CHIA should be amended to recognize that connection.

Ironically, although the CHIA recognizes that "changes in the potentiometric surface [from draining the aquifer] may influence recharge and movement of ground water through the overlying unsaturated zone," the CHIA totally discounts the potential consequences of just such an "influence" by simply concluding that "the potentiometric surface is expected to recover to approximate pre-mining conditions after mining ceases." See CHIA, 58. As noted in the Kravits Report, the post-mining potentiometric surface will likely be more than 400 feet deeper than pre-mining surface at some locations, so the CHIA's ultimate conclusion is severely suspect. See Kravits Report, 19. Furthermore, even if the potentiometric surface were to return to pre-mining levels, there is ample evidence that, currently and over the past 5 years, the mine dewatering has had a significant influence on the movement of surface and underground water. As water is taken from the aquifer, the conclusion is inescapable that water from the Huntington Creek drainage, has been lost to compensate for the lost underground water. Thus, DOGM should act now to ensure replacement of Huntington-Cleveland's water that has been diminished as a result of the Applicant's mining activity.

Ultimately, Huntington-Cleveland is looking to the Division, pursuant to the Division's obligations under Utah law, to require the Applicant and Permit Holder to replace water from the Huntington Creek drainage that is contaminated, interrupted, or diminished due to underground Coal Mining. It is our understanding that the Administrative Rules which put into effect Utah Code Ann. §40-10-18(15)(c) require that a determination be made if underground mining activities may result in contamination, diminution or interruption of State-Appropriated Water (Rule R645-301-728.350). If there has been contamination, diminution or interruption of State-Appropriated Water, then the Rules require a prompt replacement of such contaminated, diminished or interrupted water supply (Rule R645-301-731.530). As a hydrologic connection between the water encountered in the Skyline Mine and Electric Lake (along with other water sources which feed the Huntington Creek drainage) is evident, Huntington-Cleveland expects the Division to put in place a mechanism to require the Permit Holder to promptly replace the water lost from the Huntington Creek drainage as required by Utah law and Division Rule, including an appropriate adjustment to the bond amount to guarantee such prompt replacement (R645-301-525.550).

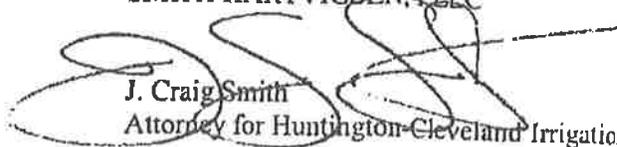
Much of this comment letter has been directed to the loss of water from Huntington Creek, the aquifer, and Electric Lake. Huntington-Cleveland recognizes that the amendment at issue is apparently remote from Electric Lake. However, this does not mean that the application will not have any effect on the Huntington Creek drainage. First, as you know, subsidence results from removing coal and allowing the overlying material to fall in the missing coal's place. In the process, the overlying material becomes fractured. Groundwater can move more easily, at least initially, through the fractured material. Thus, there is a risk that water from the Huntington Creek drainage will migrate into the newly fractured material and be lost into the Price River Basin. Furthermore, the post-mining potentiometric surface could be further lowered by water flowing to the additional fractured material which was previously virtually impermeable. Thus, there is even more danger of "continued and permanent hydrologic effect upon the local and regional aquifer system." Kravits Report, 19. The potential, additional dangers caused by continued subsidence makes it more critical than ever that the Division provide for protection of the hydrologic balance and water replacement to affected water right holders where appropriate.

Finally, Huntington-Cleveland hereby requests a hearing to resolve these issues and work towards necessary revisions to the PHC/CHIA. Huntington-Cleveland also reserves its rights of appeal of the Permit to the Board of Oil, Gas & Mining.

I appreciate your attention in this important matter. Please feel free to contact me with any questions.

Yours truly,

SMITH HARTVIGSEN, PLLC



J. Craig Smith

Attorney for Huntington-Cleveland Irrigation Co.

Letter to Pam Grubaugh-Littig

January 7, 2005

Page 5 of 5

cc: Board of Directors, Huntington-Cleveland
Dennis Ward, President
Sherrel Ward, Vice President
Kay Jensen, Secretary
Jery D. Olds, P.E., State Engineer
Mark Page, Regional Engineer

EXHIBIT B



GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

State of Utah

DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER
Executive Director

Division of Oil, Gas and Mining

JOHN R. BAZA
Division Director

November 23, 2015

RECEIVED

NOV 25 2015

SMITH HARTVIGSEN

J. Craig Smith
Smith Hartvigsen, PLLC
175 South Main Street, Suite 300
Salt Lake City, Utah 84111

Subject: Agency Notification of Flat Canyon Lease Addition, Canyon Fuel Company, LLC,
Skyline Mine, C/007/0005, Task ID #5017

Dear Mr. Smith:

On November 20, 2015 the Utah Division of Oil, Gas and Mining has determined that the Canyon Fuel Company, LLC permit application for the Flat Canyon Lease Addition to the Skyline Mine permit is administratively complete. The lease addition will add 2,692.16 acres to the authorized mining area of this site. In compliance with the Utah Coal Mining Rules R645-300-121.300, R645-300-121.310, R645-300-121.320, and the Utah Coal Mining Act (UCA Section 40-10-1 et. seq.), notice is hereby given to all local, state and federal agencies having a jurisdiction or an interest in the area of the operations that this application is available for review.

The Skyline Mine Flat Canyon Lease Addition is located in Carbon County, as shown on the attached map.

The legal description of the proposed expansion area is as follows:

Federal Coal Lease Serial # UTU - 771114

T.13 S., R.6.E., SL Meridian, Utah

Section 21, lots 1-4, E1/2E1/2;

Section 28, Lots 1-8, S1/2NW1/4, SW1/4;

Section 33, E1/2, E1/2W1/2, NW1/4NW1/4, SW1/4SW1/4;

T. 14 S., R.6 E, SL Meridian, Utah

Section 4, lots 1-4, S1/2N1/2, S1/2;

Section 5, lots 1-4, S1/2N1/2, S1/2;

Containing 2,692.16



This permit application is available for public review at:

Coal Regulatory Program
Division of Oil, Gas & Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Carbon County Courthouse
120 East Main Street
Price, Utah 84501

Please send your comments by January 29, 2016 to:

Coal Regulatory Program
Division of Oil, Gas & Mining
P.O. Box 145801
Salt Lake City, Utah 84114-5801

If you have any questions, please call me at (801) 538-5325.

Sincerely,



Daron R. Haddock
Coal Program Manager

