0067

Canyon Fuel Company, LLC.
Sufco Mine
A Subsidiary of Arch Western Bituminous Group, LLC.

Ken May, General Manager
397 South 800 West
Salina, UT 84654
(435) 286-4400 - Office
(435) 286-4499- Fax

November 17, 2005

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

Incoming
C/041/0002

Re: Second Submittal - Midterm Permit Review, Canyon Fuel Company, LLC, SUFCO Mine
C/041/002, Task ID #2068

Dear Permit Supervisor:

The enclosed eight copies of materials are being submitted to update the Midterm Permit Review amendment for the Mine Plan M&RP Permit. Attached are DOGM forms C-1 and C-2 and appropriate pages.

These new additions or replacement pages have been revised to help clarify the previously submitted pages as discussed with your staff by phone.

If you have any questions or need additional information, please contact Chris Hansen at (435) 448-2669 or Mike Davis at (435) 286-4421.

Sincerely,
CANYON FUEL COMPANY, LLC
SUFCO Mine

Kenneth E. May
Mine Manager

Encl.

KEM/MLD:kb

File in:
C/041/0002 Incoming
Refer to:
☐ Confidential
☐ Shelf
☒ Expandable
Date 11/17/2005 For additional information

cc: DOGM Price Office
DOGM Correspondence File

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APPLICATION FOR COAL PERMIT PROCESSING

Permit Change ☒ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☐ Transfer ☐

Permittee: CANYON FUEL COMPANY, LLC
Mine: SUFCO MINE **Permit Number:** C/041/002
Title: Second Submittal - MRP Midterm Review
Description, Include reason for application and timing required to implement:
Division midterm review deficiency response.

Instructions: If you answer yes to any of the first eight (gray) questions, this application may require Public Notice publication.

☒ Yes ☐ No 1. Change in the size of the Permit Area? Acres: _____ Disturbed Area: 0.15 ☒ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes ☒ No 6. Does the application require or include public notice publication?
☐ Yes ☒ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes ☒ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # _____
☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: _____
☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☒ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☐ Yes ☒ No 13. Does the application require or include collection and reporting of any baseline information?
☐ Yes ☒ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☐ Yes ☒ No 15. Does the application require or include soil removal, storage or placement?
☐ Yes ☒ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes ☒ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☐ Yes ☒ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
☐ Yes ☒ No 21. Have reclamation costs for bonding been provided?
☐ Yes ☒ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes ☒ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

Please attach four (4) review copies of the application. If the mine is on or adjacent to Forest Service land please submit five (5) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

KENNETH E. MAY, MINE MANAGER — Print Name
Kenneth E May 11/21/05 — Sign Name, Position, Date

Subscribed and sworn to before me this 21st day of November, 20 05

Ella Ruth Wayman — Notary Public

My commission Expires: _____, 20
Attest: State of _____
County of _____

ELLA RUTH WAYMAN
NOTARY PUBLIC • STATE of UTAH
30 NORTH 500 WEST • PO BOX 32
AURORA, UT 84620
COMM. EXP. MARCH 19, 2007

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Form DOGM- C1 (Revised March 12, 2002)

APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

Permittee: CANYON FUEL COMPANY, LLC
Mine: SUFCO MINE **Permit Number:** C/041/022
Title: Second Submittal - MRP Midterm Review

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Replace pages 3-40, 3-40A and 3-40B in Chapter 3, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Replace pages 5-30, 5-39, 5-39A, 5-39B, 5-39C, 5-39D and 5-40 in Chapter 5, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Replace pages 7-37, 7-37A and 7-38 in Chapter 7, Volume 2 of MRP.
☐ Add	☐ Replace	☐ Remove	
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

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Form DOGM - C2 (Revised March 12, 2002)

APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

Permittee: CANYON FUEL COMPANY, LLC
Mine: SUFCO MINE **Permit Number:** C/041/022
Title: Final - MRP Midterm Review

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Replace pages 1-11 and 1-12 in Chapter 1, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Replace pages 2-13, 2-14, 2-19 and 2-24 in Chapter 2, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Replace page 3-40 in Chapter 3, Volume 1 of MRP.
☒ Add	☐ Replace	☐ Remove	Add new pages 3-40A and 3-40B in Chapter 3, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Replace pages 5-29, 5-30, 5-39, 5-39A, 5-39B, 5-39C, 5-39D and 5-40 in Chapter 5, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Replace pages 7-28, 7-37, 7-38, 7-52, 7-53, 7-63, 7-63A, 7-74 to 7-79 in Chapter 7, Volume 2 of MRP.
☒ Add	☐ Replace	☐ Remove	Add new page 7-37A in Chapter 7, Volume 2 of MRP.
☐ Add	☒ Replace	☐ Remove	Replace pages WRDS 3-4 and 3-13 in Part 3, Volume 3 of MRP.
☐ Add	☒ Replace	☐ Remove	Replace page WRDS 4-1 in Part 4, Volume 3 of MRP.
☒ Add	☐ Replace	☐ Remove	Add new page WRDS 4-1A in Part 4, Volume 3 of MRP.
☐ Add	☒ Replace	☐ Remove	Plates 5-2F, and 5-6 in Chapter 5, Volume 1 of MRP.
☐ Add	☒ Replace	☐ Remove	Map 4 in Volume 3 of MRP.
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

This form includes all revised pages for the Midterm Permit Review amendment originally submitted on September 1, 2005, and the revised pages for the deficiency responses submitted on November 17, 2005.

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M&RP TEXT PAGES

REDLINE AND STRIKEOUT FORMAT

(These pages are for review only)

DO NOT INSERT
THESE TEXT PAGES
IN M&RP

Mine # C/041/0002
File Incoming #0067
Doc. Date 11.17.05
Recd. Date 11.25.05

increase wildlife numbers, and attract wildlife away from impacted areas. Since much of the area is public domain, wildlife habitat enhancement is a viable management tool. However, any such effort should be carefully coordinated among appropriate regulatory agencies. Some examples of these measures include:

1. Development of springs, wells or other water supplies outside the mine area.
2. Fencing of developed water sources to restrict cattle trampling of vegetation, control erosion, and provide non-game habitat;
3. Altered livestock management policies, to avoid potential competition with wildlife.
4. Control of other human-related impacts, including recreation and timber harvest.

Revegetation of disturbed areas, as part of the reclamation effort, will include a mixture of grasses, forbs, shrubs and trees.

The total disturbed area acreage to be revegetated is small enough that fencing is considered to be an economically feasible means of protection, if deemed necessary. If grazing animals do prove detrimental to revegetation attempts, measures will be implemented following consultation with the regulatory authorities.

Water is perhaps the most limiting resource and as mentioned in the subsidence discussion, the present resources must not be decreased. The applicant herein commits to restore stream water resources in addition to previously identified springs which are contaminated, diminished, or interrupted as a result of the applicant's underground coal mining activities and which will not obviously be restored naturally within a reasonable period of time.

Potential water depletions from mining operations that may have an effect on endangered fish species identified in pertinent fish recovery programs of the USFWS have been evaluated by the Windy Gap Process as it applies to existing coal mines in the Upper Colorado River Basin.

1. Mining Consumption

   Water used underground to mine coal:

   2.29% moisture added to coal by cutting and dust suppression operations

Projected 2005 tonnage of coal mined	7,605,685 tons
Projected 5-year average tonnage of coal mined	7,510,217 tons
Tons water/year (based on projected 5 yr average)	171,984 tons
Pounds water/yr	343,967,939 pounds
Gallons/year (8.337 lbs/gal of water)	41,257,999 gallons
Acre feet/year	126.62 ac-ft

2. Ventilation Consumption

33,068 gallons/day (05/02 ventilation survey)

33,068 gallons/day x 365 days/year = 12,069,820 gallons/year = 37.05 ac-ft/year

3. Coal Producing Consumption

No washing or processing of coal involving water occurs at the Sufco Mine. Therefore, Coal Producing Consumption = 0 ac-ft/yr

4. Sediment Pond Evaporation

Mine Site Pond 0.236 acres (surface area)

Evaporation 18.1 in/yr

18.1 in/yr = 1.508 ft/yr

1.508 ft/yr x 0.236 acres = 0.356 ac-ft/yr

Waste Rock Pond 0.219 acres (surface area)

Evaporation 18.1 in/yr

18.1 in/yr = 1.508 ft/yr

1.508 ft/yr x 0.236 acres = 0.330 ac-ft/yr

Total Annual Pond Evaporation = 0.686 ac-ft/yr

5. Subsidence Effects on Springs and Seeps

Spring Pines 303 appears to have reduced flow due to mining. Prior to mining, flow appears to have averaged about 2.8 gpm (Pines EIS data). The flow was reduced to 0 gpm by late summer 2001. Flow measured in summer of 2005 indicated the flow is returning at a rate of about 0.17 gpm. Assuming the flow stabilizes at 0.2 gpm, the 2005 reduction of flow is 2.6 gpm. Note: The spring flow may return to its premining rate over time as the drained aquifer recovers. Modification to this calculation will then be required.

2.6 gpm x 1440 min/day x 365 days/yr = 1,366,560 gal/yr

Annual reduction in flow in 2005 = 1,366,560 gal/yr ÷ 325,850 gal/ac-ft = 4.2 ac-ft/yr

6. Alluvial Well Pumpage

Sufco does not pump water from an alluvial well.

7. Alluvial Aquifer Abstractions into Mine

The mine has not created alluvial aquifer abstractions into the mine.

8. Deep Aquifer Pumpage

Sufco does not pump from deep aquifers.

9. Postmining Inflow to Workings

Current data indicates postmining inflows to the mine will be minimal and from aquifers storing water several thousand years old. Inflows will not consist of intercepted surface water or ground water that would discharge to the surface at a perceptible rate.

10. Coal Moisture Loss

8.34% inherent moisture - source Sufco Geologist

Projected Tonnage 2005	7,605,685 tons
Tons water/yr	634,314 tons
Pounds water/yr	1,268,628,258 pounds
Gallons water/yr	152,168,437 = 466.9 ac-ft/yr

* This amount of water is *not* included in the overall calculation of the water removed from the drainage system since it is inherent moisture (water locked in the coal) and is not considered as part of the active or inactive ground water system.

11. Direct Diversions

Culinary Water - from spring (Water Right 94-87) = 10.50 ac-ft (2004 consumption)

Mine Discharge:

2004 Average 4,948,260gpd = 1,806,114,900 gal/yr = 5544.3 ac-ft/yr.

Consumption Volume from items 1 - 11 above = 179.1 ac-ft/yr

Total mining operations net water gain/loss = 5365.2 ac-ft/yr gain.

Deer regularly migrate through and graze in the surface facilities and down the canyons to lower altitudes during severe winters. Numerous side canyons to Convulsion Canyon have been left undisturbed to allow uninterrupted big game movement.

Additional aerial photography of the permit area is currently obtained on an annual basis. New elevations are then determined at each of the previously-selected horizontal coordinates and the differences between the original and the new elevation measurements are used to generate a subsidence contour map. This map and supporting narrative are submitted annually to the UDOGM in the form of a subsidence report. This subsidence report outlines the history of subsidence at SUFCO Mine as well as the status of subsidence during the previous year.

Numerous control points have been established within the permit area to assist in the subsidence surveys (see Plate 5-10). Current (1991) coordinates and elevations of these control points are provided in Table 5-2. Additional control points will be added as necessary when existing points become influenced by subsidence. Future points will typically consist of 3-foot lengths of No. 4 rebar embedded in concrete with a stamped brass cap for identification. Since geologic and mining uncertainties often force a change in planned mining sequences, future control points will be installed only after the mine panels are in their development phase.

All subsidence areas will be monitored and reported in the Annual Subsidence Report for a minimum of three years after no additional subsidence is detected within the area. The applicant will map and report areas 3 and 4 in the 1993 Subsidence Report as required by Division Order #93A issued May 11, 1993.

A ~~bi-~~annual monitoring program ~~will be~~was developed to analyze the subsidence cracks related to undermining of the West Fork of Box Canyon. Mining in the area in 1999 did produce visible fracturing at the surface on both the northwest and southeast walls of the canyon in this area. The monitoring program ~~will~~ includes measuring the offset and/or width of portions of selected subsidence cracks. Similar data will also be collected from specified segments of subsidence cracks that have occurred away from the walls of the canyon and do not appear to be influenced by the lack of bedrock support created by the canyon. Information gathered from this monitoring program, along with previous studies that SUFCO has performed, will be used to predict the effects of subsidence within other areas of the Pines Tract and other areas of the

mine where similar geomorphologic and geologic conditions occur. This program ~~will be~~was developed and implemented by the Fall~~September~~of 2000. Subsidence cracks in the area of the West Fork of Box Canyon were surveyed for their location. However, in the years 2000 through 2003 the width and/or offset of the cracks were not measured or the records were not kept. Width and/or offset measurements were made in the Fall of 2004 and will again be made in the Fall of 2005 and every year thereafter. It is believed by the permittee that any change in the width of the cracks can easily be tracked on an annual basis rather than a semi-annual basis. The permittee has observed that most subsidence cracks that develop in the mining area do not change significantly after the first 4 to 6 months following their creation. The crack measurement records will be reported in the mines annual report.

Anticipated Effects of Subsidence. Future subsidence in the permit area is anticipated to be similar to that which has occurred in the past. Subsidence is expected to average about 4 feet above longwall panels, with a draw angle of about 15 degrees. Tension cracks are expected to occur in areas of subsidence with these cracks healing to some degree following formation. Tension cracks are anticipated to be less pronounced above longwall workings than above continuous-miner workings.

Previous surveys have indicated that no substantial damage has occurred to vegetation as a result of subsidence within the permit area. The only effects observed have been exposed plant roots where tension cracks have formed.

It is anticipated that subsiding under portions of East Fork Box Canyon will result in a slight flattening of the stream gradient, which will increase pooling of the stream through a stretch of several hundred feet of the stream. Cracks will also likely develop across the East Fork Box Canyon Creek directly above the longwall panels and along the gate roads. These crack zones will form shortly after undermining of the stream bed. They are anticipated to be 1 to 2 inches or less in width with these cracks healing to some degree following formation. Details of the expected location of the cracks are given in Appendix 7-19. If cracks do develop in the channel floor and appear to be taking

surface water from the creek, sealing of these cracks will be done with bentonite grout. Use of bentonite grout for the sealing of the cracks in the channel floor is discussed in Section 3 of the Pines Tract FEIS (1999) and in more detail in the following section.

East Fork of Box Canyon Subsidence Monitoring and Mitigation

Portions of the East Fork of Box Canyon will be undermined and subsided as longwall panels 3LPE and 4LPE are extracted in 2003 through 2005. A monitoring plan that is more intensive than the general permit area has been proposed for monitoring vegetation, surface and ground water flows, and subsidence cracks and repair of the cracks in the portions of the East Fork to be undermined. The subsidence portion of the monitoring program is discussed in detail in the following text.

Prior to the initiation of undermining and subsidence, a presubsidence survey will be conducted in the East Fork of Box Canyon from the Joe's Mill Ponds downstream to a location above the west gate roads associated with the 3LPE panel. The survey will consist of video taping the condition of the stream channel paying particular note to surface flows and ground water discharge, vegetation types and conditions, animal life in the area including macroinvertabrates in the stream channel, soil conditions, and the general geomorphology of the area. A follow-up video survey will be made at the same time of year on the third year following undermining. A general comparison between the two tapes will be made to determine what, if any, effects to the parameters described above have occurred. The biological aspects of the video tape are discussed in greater detail in Section 3.2.2.2 while the monitoring of surface and ground water flows are discussed in Section 7.3.1.2.

The subsidence monitoring plan for the East Fork of Box Canyon will include frequent inspection of the stream channel during and after active subsidence. While mining is occurring under the stream channel and within the 15-degree angle-of-draw above the active longwall face, that area of the channel will be inspected twice a week for subsidence cracks or other related features. As the longwall face advances and the 15-degree angle-of-draw area follows, the portions of the channel that now lie outside the 15-degree angle-of-draw will be monitored for subsidence features on an every two week basis for eight weeks. Following the eight week period, the features will be monitored on a quarterly basis for two years following the cessation of subsidence related effects,

if any, due to mining. Table 7-5A in Chapter 7 lists the schedule for water and subsidence monitoring frequency.

Mitigation of cracks that would appear to interrupt or divert flows from the stream channel will be sealed immediately with bentonite. Sufco will use hand placement methods when sealing cracks with bentonite. The individual(s) conducting the survey will be equipped with an adequate volume of bentonite, in powder, granular, and/or chip form, to seal small cracks. The bentonite may be placed by pouring it directly into the crack and hydrating with stream water or, if in an actively flowing portion of the stream, temporarily diverting the flow around successive portions of the crack using native soils and placing the bentonite in the exposed section of the crack until the crack is sealed. Sealing of the lower portions of the channel walls may also be required if the crack occurs where the channel is defined by bedrock. If cracks are present in channel walls defined by soil, the soil cracks will be hand filled using a native soil/bentonite mix. The sealing of the channel floor and walls will be accomplished with hand tools such as shovel, picks, trowels, etc. In the unlikely event that cracks too large to be sealed through the efforts of one or two persons in one day do occur and it appears there is a danger of water being diverted from the channel for an extended period of time, arrangements will be made to get additional help to the site as soon as possible.

Sufco will conduct longwall mining operations in such a manner as to minimize surface disturbance while mining within the 15-degree angle-of-draw area that includes the East Fork stream channel. This will be accomplished by advancing the longwall on a schedule where mining will not be suspended for a period to exceed 48 hours. This mining schedule has been discussed with the BLM. A similar mining schedule was successfully implemented at the Canyon Fuel Company Skyline Mine while the lower sections of Burnout Canyon were undermined. No damage to the stream channel or reduction in stream flows were noted as a result of undermining that portion of Burnout Canyon using the approved mining schedule.

A weekly report will be submitted via e-mail to the Division detailing the results of the inspections. The reports will include, but not necessarily be limited to: a map illustrating the current location of the longwall face; descriptions and dates of field activities; noted changes in stream and local

geommorphology; location, width, frequency of cracks; and a description of repairs, if any, conducted. If the prescribed inspections cannot be conducted, the reason for the missed inspection and a record of the attempt to conduct the inspection will be submitted to the Division in the weekly report. The Division will be notified immediately after mining-induced cracks, if any, are found in the East Fork stream channel and the steps taken or planned to be taken as mitigation. Thereafter, the Division will be advised of continuing mitigation efforts, if needed, in the weekly report.

A copy of the October 2003 "Monitoring and Mitigation Plan for Mining Under the East Fork of Box Canyon" prepared by the Division and reviewed and accepted by the Forest with some modifications has been included in Appendix 3-10. The preceding paragraphs have been prepared based on this plan. Sufco will meet all of the monitoring and mitigation responsibilities described in the plan as it pertains to the undermining of the East Fork of Box Canyon.

Mining within the area of the East Fork of the Box Canyon will be conducted in accordance with State and Federal rules and regulations and the requirements and stipulations presented in the BLM's Conditions of Approval of the Resource Recovery and Protection Plan (July 31, 2003) located in Appendix 1-2.

5.2.5.2 Subsidence Control

Adopted Control Measures. As indicated above, SUFCO Mine has adopted subsidence-control measures in areas where surface resources are to remain protected. These controls consist primarily of leaving support pillars in place in those areas designated on Plate 5-10 as not planned for subsidence. Based on experience and data collected from the permit area, the design of support pillars for those areas where subsidence is not planned has been based on the following equations:

$$SF = SD/OS \qquad (5\text{-}1)$$

where SF = safety factor against pillar failure (fraction)

SD = support strength density (psi)
= $(Y_c)(1\text{-}ER)$

Y_c = average compressive yield strength of the coal (psi)

= 3090 psi for the Upper Hiawatha seam

ER = extraction ratio (fraction)
= $1-(A_p/A_t)$

A_p = pillar area (ft^2)

A_t = area supported by pillar (ft^2)

OS = overburden stress (psi)
= $(d)(D_o)/144$

d = overburden depth (ft)

D_o = overburden density (lb/ft^3)
= 160 lb/ft^3 for the permit area

Based on these equations and data, the support pillar designs summarized in Table 5-3 have been derived. This equation does not take into account either size effect or shape effects and is based on a one-dimensional stress field. Historically this equation has provided good results when used in areas where a number of uniform pillars are extracted. One area (5 North panels) of the mine experienced pillar failure when the area was flooded with water after mining of the panels had been completed. This particular area was mined using a double pass technique and the mining height was from 14 to 18 feet. The resulting pillars varied from 25 feet x 25 feet to 40 feet x 40 feet. The underlying floor was a weak mudstone that lost its cohesive strength when wet. When the 1R5N and 2R5N panels were flooded the underlying mudstone became saturated and lost its cohesive strength. This allowed the pillars in the area with SF < 2.5 to fail, because frictional confinement on the bottom of the pillar was lost. To prevent reoccurrence the Applicant will commit to not flood areas of the mine that have small pillars and a weak mudstone floor in areas where subsidence is to be prevented.

Compliance With Control Plan. SUFCO Mine will comply with all provisions of the approved subsidence control plan.

Correction of Material Damage. No material damage of surface resources is anticipated as a result of subsidence in the permit area. However, should material damage occur, SUFCO Mine will correct any material damage resulting from subsidence caused to surface lands to the extent technologically and economically feasible by restoring the land to a condition capable

of time. A discussion of the potential impacts to water resources due to subsidence is provided in Section 7.2.8.3 of this M&RP and in Appendix 7-17. DeGraff (Appendix 5-4) indicates that tension cracks in the permit area typically heal quickly. There are no sustained above normal inflows in the mine due to mining or subsidence. Thus, most fractures in the permit area appear to become sealed in a relatively short period of time.

Intersection of locally perched aquifers by subsidence cracks could divert groundwater from a spring. Water will not be lost from a specific basin, but may become diverted within the basin.

The discharge from the abandoned Link Canyon Mine ~~will~~was to be maintained during and after utilization of the western portal for Sufco Mine access. The water naturally ~~discharged~~discharging from the abandoned mine is not considered to be a UPDES mine discharge point by the Utah Division of Water Quality so long as the water is not contaminated or comes in contact with Sufco mining related activities. The initial plan by Sufco ~~will design and implement a water collection system that will allow water in the abandoned sections~~was to maintain the flow of water from the ~~Link Canyon Mine to continue to discharge at both portals~~flooded old works to the abandoned eastern portal and out the rehabilitated western portal. ~~The system will isolate~~However, when the ~~water in the abandoned workings~~old works were accessed, both from ~~any water~~inside the Sufco Mine and the surface, very little water was encountered ~~in the active workings, thus allowing for~~and the ~~discharge of water only from the~~ old works did not appear to be flooded. ~~It is anticipated that only a portion~~The majority of ~~the~~ water ~~in the old Link Canyon Mine will need to be removed~~encountered during rehabilitation ~~of the portion of the mine utilized by Sufco~~efforts was located just inside the western portal. ~~Bulkheads or seals will be placed~~A small pond of water had formed behind a roof fall in ~~cross-cuts or entries between~~ the old mine ~~and the area used by Sufco~~. ~~This activity should maintain a flow~~It was apparent that shallow ground water or surface water entered the mine just in by the portals and upgradient of ~~water from the old works to the undisturbed east portal~~the roof fall, forming the small pond. ~~In addition to~~Once the ~~water naturally discharging from the east portal, a pipeline will be constructed underground to take a part of the water from the old works~~roof fall was removed and ~~discharge it at the rehabilitated west portal~~the water drained, water ceased discharging from the western portal. The ~~water discharge rate will be controlled to a rate~~volume of ~~about 1 gpm or less and care will be taken to maintain the flow~~water discharging from the ~~east~~eastern portal area also appeared to decrease. ~~This is the apparent rate~~It further appears that most of ~~discharge of~~the water

~~from the west~~that currently seeps into the old workings near the portal evaporates before it can accumulate and ~~east portals prior to disturbance~~discharge out the western portal. ~~The~~Small volumes of runoff and ground water ~~may gravity feed or may~~still accumulates in the eastern portal area and can be ~~pumped to~~seen in the ~~west portals~~spring and fall discharging over the rock ledges below the portal.

The riparian vegetation in the area of the ~~west portal~~Link Canyon portals is feed not only by the discharge from this portal but also by subsurface flow discharged by springs above the mine in the Castlegate Sandstone. Thus, ~~it is anticipated~~ the riparian vegetation above and below the west portal ~~will be~~was sustained during site construction by subsurface flows from the upgradient springs and flows from the east portal.

Water, if any, that enters the portion of the Link Canyon Mine utilized by Sufco will be discharged at UPDES discharge point 003.

~~Water from a portion of the old works removed during rehabilitation of the western Link Canyon Mine portal will be drained into the existing Sufco mine and discharged at its UPDES permitted discharge point 003. Water, if any, that enters the portion of the Link Canyon Mine utilized by Sufco during and after construction is complete will be discharged at UPDES discharge point 003. The Link Canyon Portal elevation is 7663 feet and the elevation where the old works will connect to the existing SUFCO Mine is 7658 feet with the mine average dip being 2% N45°W.~~

~~The activity related to reopening the western Link Canyon portal should not have a negative impact on surface water flows in Link Canyon Creek. As discussed above, water discharged from the Link Canyon Portals will be maintained to maintain the riparian vegetation that exists just below the old portals.~~ The Link Canyon Portal elevation is 7663 feet and the elevation where the old works will connect to the existing ~~SUFCO~~Sufco Mine is 7658 feet with the mine average dip being 2% N45°W.

~~The activity related to reopening the western Link Canyon portal should not have a negative impact on surface water flows in Link Canyon Creek.~~ As ~~discussed above~~of August 2005, water ~~discharged~~

~~from~~had not accumulated in the abandoned Link Canyon Mine and draining and discharging the water through the existing Sufuco Mine has not been necessary.

The activity related to reopening the western Link Canyon ~~Portals will be maintained to maintain the riparian vegetation that exists just below the old portals~~portal should not have a significant negative impact on surface water flows in Link Canyon Creek. While the creek has been designated as an intermittent stream under the R645 rules as a result of its drainage area size, the stream functions primarily as an ephemeral stream (Thiros and Cordy, 1991). As described in Section 7.2.4.2 of this chapter, the majority of the stream's reaches typically only flow as a result of runoff from significant precipitation events and during brief periods of snow melt runoff. The two surface water sites, Link 001 and Link 002 which are located above and below the portals (Plate 7-3), ~~have~~did not ~~had~~have measurable or monitorable flows during quarterly monitoring episodes ~~for the past three years~~from 1999 through 2002 (Erik Petersen, personnel communication, November 2002). Observable surface flows in the stream are generally limited to just below the developed springs *(Pines 100 and GW-21)* near the head of the canyon and just below and adjacent to the Link Canyon Portals. In both locations water flow or moist soils ~~are~~have been observable for only a few hundred feet below the source. Table 7-1A details the dates, flows, and monitoring personnel for sites Link 001, Link 002, Link Portal West and Link Portal East.

Vegetation in the Link Canyon channel below the mine will be photographically monitored on a quarterly basis, except in the winter months, to determine what, if any, impacts the reduction of discharge from the western portal has on the vegetative community. The vegetation monitoring was started in the summer of 2005 and will continue through the reclamation of the portals. The general health of the willows, Woods Rose, clematis, and wire grasses present in the vegetative community will be observed and the observations reported in the mine's annual report. If significant changes occur in the vegetation monitored, these changes will be reported to the Division and the Forest Service. A plan may be developed and instigated at that time to mitigate any damages to the vegetation as a result of mining activities.

Flows from the Link Canyon portals have been measured periodically since 1977 with discharges ranging from 5 gpm (estimated by Hydrometrics, 1977) to no discharge (Petersen 2002). Samples

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increase wildlife numbers, and attract wildlife away from impacted areas. Since much of the area is public domain, wildlife habitat enhancement is a viable management tool. However, any such effort should be carefully coordinated among appropriate regulatory agencies. Some examples of these measures include:

1. Development of springs, wells or other water supplies outside the mine area.
2. Fencing of developed water sources to restrict cattle trampling of vegetation, control erosion, and provide non-game habitat;
3. Altered livestock management policies, to avoid potential competition with wildlife.
4. Control of other human-related impacts, including recreation and timber harvest.

Revegetation of disturbed areas, as part of the reclamation effort, will include a mixture of grasses, forbs, shrubs and trees.

The total disturbed area acreage to be revegetated is small enough that fencing is considered to be an economically feasible means of protection, if deemed necessary. If grazing animals do prove detrimental to revegetation attempts, measures will be implemented following consultation with the regulatory authorities.

Water is perhaps the most limiting resource and as mentioned in the subsidence discussion, the present resources must not be decreased. The applicant herein commits to restore stream water resources in addition to previously identified springs which are contaminated, diminished, or interrupted as a result of the applicant's underground coal mining activities and which will not obviously be restored naturally within a reasonable period of time.

Potential water depletions from mining operations that may have an effect on endangered fish species identified in pertinent fish recovery programs of the USFWS have been evaluated by the Windy Gap Process as it applies to existing coal mines in the Upper Colorado River Basin.

1. Mining Consumption

   Water used underground to mine coal:

   2.29% moisture added to coal by cutting and dust suppression operations

Projected 2005 tonnage of coal mined	7,605,685 tons
Projected 5-year average tonnage of coal mined	7,510,217 tons
Tons water/year (based on projected 5 yr average)	171,984 tons
Pounds water/yr	343,967,939 pounds
Gallons/year (8.337 lbs/gal of water)	41,257,999 gallons
Acre feet/year	126.62 ac-ft

2. Ventilation Consumption

33,068 gallons/day (05/02 ventilation survey)

33,068 gallons/day x 365 days/year = 12,069,820 gallons/year = 37.05 ac-ft/year

3. Coal Producing Consumption

No washing or processing of coal involving water occurs at the Sufco Mine. Therefore, Coal Producing Consumption = 0 ac-ft/yr

4. Sediment Pond Evaporation

Mine Site Pond 0.236 acres (surface area)

Evaporation 18.1 in/yr

18.1 in/yr = 1.508 ft/yr

1.508 ft/yr x 0.236 acres = 0.356 ac-ft/yr

Waste Rock Pond 0.219 acres (surface area)

Evaporation 18.1 in/yr

18.1 in/yr = 1.508 ft/yr

1.508 ft/yr x 0.236 acres = 0.330 ac-ft/yr

Total Annual Pond Evaporation = 0.686 ac-ft/yr

5. Subsidence Effects on Springs and Seeps

Spring Pines 303 appears to have reduced flow due to mining. Prior to mining, flow appears to have averaged about 2.8 gpm (Pines EIS data). The flow was reduced to 0 gpm by late summer 2001. Flow measured in summer of 2005 indicated the flow is returning at a rate of about 0.17 gpm. Assuming the flow stabilizes at 0.2 gpm, the 2005 reduction of flow is 2.6 gpm. Note: The spring flow may return to its premining rate over time as the drained aquifer recovers. Modification to this calculation will then be required.

2.6 gpm x 1440 min/day x 365 days/yr = 1,366,560 gal/yr

Annual reduction in flow in 2005 = 1,366,560 gal/yr ÷ 325,850 gal/ac-ft = 4.2 ac-ft/yr

6. Alluvial Well Pumpage

Sufco does not pump water from an alluvial well.

7. Alluvial Aquifer Abstractions into Mine

The mine has not created alluvial aquifer abstractions into the mine.

8. Deep Aquifer Pumpage

Sufco does not pump from deep aquifers.

9. Postmining Inflow to Workings

Current data indicates postmining inflows to the mine will be minimal and from aquifers storing water several thousand years old. Inflows will not consist of intercepted surface water or ground water that would discharge to the surface at a perceptible rate.

10. Coal Moisture Loss

8.34% inherent moisture - source Sufco Geologist

Projected Tonnage 2005	7,605,685 tons
Tons water/yr	634,314 tons
Pounds water/yr	1,268,628,258 pounds
Gallons water/yr	152,168,437 = 466.9 ac-ft/yr

* This amount of water is *not* included in the overall calculation of the water removed from the drainage system since it is inherent moisture (water locked in the coal) and is not considered as part of the active or inactive ground water system.

11. Direct Diversions

Culinary Water - from spring (Water Right 94-87) = 10.50 ac-ft (2004 consumption)

Mine Discharge:

2004 Average 4,948,260gpd = 1,806,114,900 gal/yr = 5544.3 ac-ft/yr.

Consumption Volume from items 1 - 11 above = 179.1 ac-ft/yr

Total mining operations net water gain/loss = 5365.2 ac-ft/yr gain.

Deer regularly migrate through and graze in the surface facilities and down the canyons to lower altitudes during severe winters. Numerous side canyons to Convulsion Canyon have been left undisturbed to allow uninterrupted big game movement.

Additional aerial photography of the permit area is currently obtained on an annual basis. New elevations are then determined at each of the previously-selected horizontal coordinates and the differences between the original and the new elevation measurements are used to generate a subsidence contour map. This map and supporting narrative are submitted annually to the UDOGM in the form of a subsidence report. This subsidence report outlines the history of subsidence at SUFCO Mine as well as the status of subsidence during the previous year.

Numerous control points have been established within the permit area to assist in the subsidence surveys (see Plate 5-10). Current (1991) coordinates and elevations of these control points are provided in Table 5-2. Additional control points will be added as necessary when existing points become influenced by subsidence. Future points will typically consist of 3-foot lengths of No. 4 rebar embedded in concrete with a stamped brass cap for identification. Since geologic and mining uncertainties often force a change in planned mining sequences, future control points will be installed only after the mine panels are in their development phase.

All subsidence areas will be monitored and reported in the Annual Subsidence Report for a minimum of three years after no additional subsidence is detected within the area. The applicant will map and report areas 3 and 4 in the 1993 Subsidence Report as required by Division Order #93A issued May 11, 1993.

A annual monitoring program was developed to analyze the subsidence cracks related to undermining of the West Fork of Box Canyon. Mining in the area in 1999 did produce visible fracturing at the surface on both the northwest and southeast walls of the canyon in this area. The monitoring program includes measuring the offset and/or width of portions of selected subsidence cracks. Similar data will also be collected from specified segments of subsidence cracks that have occurred away from the walls of the canyon and do not appear to be influenced by the lack of bedrock support created by the canyon. Information gathered from this monitoring program, along with previous studies that SUFCO has performed, will be used to predict the effects of subsidence within other areas of the Pines Tract and other areas of the

mine where similar geomorphologic and geologic conditions occur. This program was developed and implemented by the Fall of 2000. Subsidence cracks in the area of the West Fork of Box Canyon were surveyed for their location. However, in the years 2000 through 2003 the width and/or offset of the cracks were not measured or the records were not kept. Width and/or offset measurements were made in the Fall of 2004 and will again be made in the Fall of 2005 and every year thereafter. It is believed by the permittee that any change in the width of the cracks can easily be tracked on an annual basis rather than a semi-annual basis. The permittee has observed that most subsidence cracks that develop in the mining area do not change significantly after the first 4 to 6 months following their creation. The crack measurement records will be reported in the mines annual report.

Anticipated Effects of Subsidence. Future subsidence in the permit area is anticipated to be similar to that which has occurred in the past. Subsidence is expected to average about 4 feet above longwall panels, with a draw angle of about 15 degrees. Tension cracks are expected to occur in areas of subsidence with these cracks healing to some degree following formation. Tension cracks are anticipated to be less pronounced above longwall workings than above continuous-miner workings.

Previous surveys have indicated that no substantial damage has occurred to vegetation as a result of subsidence within the permit area. The only effects observed have been exposed plant roots where tension cracks have formed.

It is anticipated that subsiding under portions of East Fork Box Canyon will result in a slight flattening of the stream gradient, which will increase pooling of the stream through a stretch of several hundred feet of the stream. Cracks will also likely develop across the East Fork Box Canyon Creek directly above the longwall panels and along the gate roads. These crack zones will form shortly after undermining of the stream bed. They are anticipated to be 1 to 2 inches or less in width with these cracks healing to some degree following formation. Details of the expected location of the cracks are given in Appendix 7-19. If cracks do develop in the channel floor and appear to be taking

surface water from the creek, sealing of these cracks will be done with bentonite grout. Use of bentonite grout for the sealing of the cracks in the channel floor is discussed in Section 3 of the Pines Tract FEIS (1999) and in more detail in the following section.

East Fork of Box Canyon Subsidence Monitoring and Mitigation

Portions of the East Fork of Box Canyon will be undermined and subsided as longwall panels 3LPE and 4LPE are extracted in 2003 through 2005. A monitoring plan that is more intensive than the general permit area has been proposed for monitoring vegetation, surface and ground water flows, and subsidence cracks and repair of the cracks in the portions of the East Fork to be undermined. The subsidence portion of the monitoring program is discussed in detail in the following text.

Prior to the initiation of undermining and subsidence, a presubsidence survey will be conducted in the East Fork of Box Canyon from the Joe's Mill Ponds downstream to a location above the west gate roads associated with the 3LPE panel. The survey will consist of video taping the condition of the stream channel paying particular note to surface flows and ground water discharge, vegetation types and conditions, animal life in the area including macroinvertabrates in the stream channel, soil conditions, and the general geomorphology of the area. A follow-up video survey will be made at the same time of year on the third year following undermining. A general comparison between the two tapes will be made to determine what, if any, effects to the parameters described above have occurred. The biological aspects of the video tape are discussed in greater detail in Section 3.2.2.2 while the monitoring of surface and ground water flows are discussed in Section 7.3.1.2.

The subsidence monitoring plan for the East Fork of Box Canyon will include frequent inspection of the stream channel during and after active subsidence. While mining is occurring under the stream channel and within the 15-degree angle-of-draw above the active longwall face, that area of the channel will be inspected twice a week for subsidence cracks or other related features. As the longwall face advances and the 15-degree angle-of-draw area follows, the portions of the channel that now lie outside the 15-degree angle-of-draw will be monitored for subsidence features on an every two week basis for eight weeks. Following the eight week period, the features will be monitored on a quarterly basis for two years following the cessation of subsidence related effects,

if any, due to mining. Table 7-5A in Chapter 7 lists the schedule for water and subsidence monitoring frequency.

Mitigation of cracks that would appear to interrupt or divert flows from the stream channel will be sealed immediately with bentonite. Sufco will use hand placement methods when sealing cracks with bentonite. The individual(s) conducting the survey will be equipped with an adequate volume of bentonite, in powder, granular, and/or chip form, to seal small cracks. The bentonite may be placed by pouring it directly into the crack and hydrating with stream water or, if in an actively flowing portion of the stream, temporarily diverting the flow around successive portions of the crack using native soils and placing the bentonite in the exposed section of the crack until the crack is sealed. Sealing of the lower portions of the channel walls may also be required if the crack occurs where the channel is defined by bedrock. If cracks are present in channel walls defined by soil, the soil cracks will be hand filled using a native soil/bentonite mix. The sealing of the channel floor and walls will be accomplished with hand tools such as shovel, picks, trowels, etc. In the unlikely event that cracks too large to be sealed through the efforts of one or two persons in one day do occur and it appears there is a danger of water being diverted from the channel for an extended period of time, arrangements will be made to get additional help to the site as soon as possible.

Sufco will conduct longwall mining operations in such a manner as to minimize surface disturbance while mining within the 15-degree angle-of-draw area that includes the East Fork stream channel. This will be accomplished by advancing the longwall on a schedule where mining will not be suspended for a period to exceed 48 hours. This mining schedule has been discussed with the BLM. A similar mining schedule was successfully implemented at the Canyon Fuel Company Skyline Mine while the lower sections of Burnout Canyon were undermined. No damage to the stream channel or reduction in stream flows were noted as a result of undermining that portion of Burnout Canyon using the approved mining schedule.

A weekly report will be submitted via e-mail to the Division detailing the results of the inspections. The reports will include, but not necessarily be limited to: a map illustrating the current location of the longwall face; descriptions and dates of field activities; noted changes in stream and local

geommorphology; location, width, frequency of cracks; and a description of repairs, if any, conducted. If the prescribed inspections cannot be conducted, the reason for the missed inspection and a record of the attempt to conduct the inspection will be submitted to the Division in the weekly report. The Division will be notified immediately after mining-induced cracks, if any, are found in the East Fork stream channel and the steps taken or planned to be taken as mitigation. Thereafter, the Division will be advised of continuing mitigation efforts, if needed, in the weekly report.

A copy of the October 2003 "Monitoring and Mitigation Plan for Mining Under the East Fork of Box Canyon" prepared by the Division and reviewed and accepted by the Forest with some modifications has been included in Appendix 3-10. The preceding paragraphs have been prepared based on this plan. Sufco will meet all of the monitoring and mitigation responsibilities described in the plan as it pertains to the undermining of the East Fork of Box Canyon.

Mining within the area of the East Fork of the Box Canyon will be conducted in accordance with State and Federal rules and regulations and the requirements and stipulations presented in the BLM's Conditions of Approval of the Resource Recovery and Protection Plan (July 31, 2003) located in Appendix 1-2.

5.2.5.2 Subsidence Control

Adopted Control Measures. As indicated above, SUFCO Mine has adopted subsidence-control measures in areas where surface resources are to remain protected. These controls consist primarily of leaving support pillars in place in those areas designated on Plate 5-10 as not planned for subsidence. Based on experience and data collected from the permit area, the design of support pillars for those areas where subsidence is not planned has been based on the following equations:

$$SF = SD/OS \qquad (5\text{-}1)$$

where SF = safety factor against pillar failure (fraction)

SD = support strength density (psi)
$= (Y_c)(1\text{-}ER)$

Y_c = average compressive yield strength of the coal (psi)

= 3090 psi for the Upper Hiawatha seam

ER = extraction ratio (fraction)
= $1-(A_p/A_t)$

A_p = pillar area (ft^2)

A_t = area supported by pillar (ft^2)

OS = overburden stress (psi)
= $(d)(D_o)/144$

d = overburden depth (ft)

D_o = overburden density (lb/ft^3)
= 160 lb/ft^3 for the permit area

Based on these equations and data, the support pillar designs summarized in Table 5-3 have been derived. This equation does not take into account either size effect or shape effects and is based on a one-dimensional stress field. Historically this equation has provided good results when used in areas where a number of uniform pillars are extracted. One area (5 North panels) of the mine experienced pillar failure when the area was flooded with water after mining of the panels had been completed. This particular area was mined using a double pass technique and the mining height was from 14 to 18 feet. The resulting pillars varied from 25 feet x 25 feet to 40 feet x 40 feet. The underlying floor was a weak mudstone that lost its cohesive strength when wet. When the 1R5N and 2R5N panels were flooded the underlying mudstone became saturated and lost its cohesive strength. This allowed the pillars in the area with SF < 2.5 to fail, because frictional confinement on the bottom of the pillar was lost. To prevent reoccurrence the Applicant will commit to not flood areas of the mine that have small pillars and a weak mudstone floor in areas where subsidence is to be prevented.

Compliance With Control Plan. SUFCO Mine will comply with all provisions of the approved subsidence control plan.

Correction of Material Damage. No material damage of surface resources is anticipated as a result of subsidence in the permit area. However, should material damage occur, SUFCO Mine will correct any material damage resulting from subsidence caused to surface lands to the extent technologically and economically feasible by restoring the land to a condition capable

of time. A discussion of the potential impacts to water resources due to subsidence is provided in Section 7.2.8.3 of this M&RP and in Appendix 7-17. DeGraff (Appendix 5-4) indicates that tension cracks in the permit area typically heal quickly. There are no sustained above normal inflows in the mine due to mining or subsidence. Thus, most fractures in the permit area appear to become sealed in a relatively short period of time.

Intersection of locally perched aquifers by subsidence cracks could divert groundwater from a spring. Water will not be lost from a specific basin, but may become diverted within the basin.

The discharge from the abandoned Link Canyon Mine was to be maintained during and after utilization of the western portal for Sufco Mine access. The water naturally discharging from the abandoned mine is not considered to be a UPDES mine discharge point by the Utah Division of Water Quality so long as the water is not contaminated or comes in contact with Sufco mining related activities. The initial plan by Sufco was to maintain the flow of water from the flooded old works to the abandoned eastern portal and out the rehabilitated western portal. However, when the old works were accessed, both from inside the Sufco Mine and the surface, very little water was encountered and the old works did not appear to be flooded. The majority of water encountered during rehabilitation efforts was located just inside the western portal. A small pond of water had formed behind a roof fall in the old mine. It was apparent that shallow ground water or surface water entered the mine just in by the portals and upgradient of the roof fall, forming the small pond. Once the roof fall was removed and the water drained, water ceased discharging from the western portal. The volume of water discharging from the eastern portal area also appeared to decrease. It further appears that most of the water that currently seeps into the old workings near the portal evaporates before it can accumulate and discharge out the western portal. Small volumes of runoff and ground water still accumulates in the eastern portal area and can be seen in the spring and fall discharging over the rock ledges below the portal.

The riparian vegetation in the area of the Link Canyon portals is feed not only by the discharge from this portal but also by subsurface flow discharged by springs above the mine in the Castlegate Sandstone. Thus, the riparian vegetation above and below the west portal was sustained during site construction by subsurface flows from the upgradient springs and flows from the east portal.

Water, if any, that enters the portion of the Link Canyon Mine utilized by Sufco will be discharged at UPDES discharge point 003. The Link Canyon Portal elevation is 7663 feet and the elevation where the old works will connect to the existing Sufco Mine is 7658 feet with the mine average dip being 2% N45°W. As of August 2005, water had not accumulated in the abandoned Link Canyon Mine and draining and discharging the water through the existing Sufuco Mine has not been necessary.

The activity related to reopening the western Link Canyon portal should not have a significant negative impact on surface water flows in Link Canyon Creek. While the creek has been designated as an intermittent stream under the R645 rules as a result of its drainage area size, the stream functions primarily as an ephemeral stream (Thiros and Cordy, 1991). As described in Section 7.2.4.2 of this chapter, the majority of the stream's reaches typically only flow as a result of runoff from significant precipitation events and during brief periods of snow melt runoff. The two surface water sites, Link 001 and Link 002 which are located above and below the portals (Plate 7-3), did not have measurable or monitorable flows during quarterly monitoring episodes from 1999 through 2002 (Erik Petersen, personnel communication, November 2002). Observable surface flows in the stream are generally limited to just below the developed springs *(Pines 100 and GW-21)* near the head of the canyon and just below and adjacent to the Link Canyon Portals. In both locations water flow or moist soils have been observable for only a few hundred feet below the source. Table 7-1A details the dates, flows, and monitoring personnel for sites Link 001, Link 002, Link Portal West and Link Portal East.

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Flows from the Link Canyon portals have been measured periodically since 1977 with discharges ranging from 5 gpm (estimated by Hydrometrics, 1977) to no discharge (Petersen 2002). Samples of the water discharged from the west portal have been obtained and analyzed by Thiros and Cordy (1991), Mayo and Associates during the Pines Tract EIS process (1998), and recently by Petersen (2002, Appendix 7-4).