C/041/0002 #5852

Canyon Fuel Company, LLC
A Subsidiary of Wolverine Fuels, LLC

Sufco Mine
John D. Byars
General Manager
597 South SR24
Salina, Utah 84654
(435) 286-4400
Fax (435) 286-4499

January 17, 2019

RECEIVED
JAN 23 2019
DIV OF OIL, GAS & MINING

Permit Supervisor
Utah Coal Regulatory program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
PO Box 145801
Salt Lake City, UT 84114-5801

Re: Pines East Panels, Task ID#5777, Canyon Fuel Company, LLC, Sufco Mine, C/041/002

Dear Sirs:

Please find enclosed with this letter an amendment to address the mining of coal panels in the eastern region of the Pines Lease Tract (UTU-76195).

The M&RP contains text, appendices, tables and drawings previously submitted and approved for the lease. Information pertaining to the lease and the proposed mining already within the permit have been highlighted in the review information submitted for this Pines East Panels amendment. Link Canyon is adjacent to the planned panels with springs and surface monitoring locations and has several studies referenced in the text which are applicable to understanding the characteristics of the Pines East Panels area, therefore the references in the text have been highlighted and submitted with this amendment.

On the drawings the proposed mine plan has been outlined and the subsidence boundary delineated on Plate 5-10.

Due to the size and age (1999) of the "Pines Tract Project Final Environmental Impact Statement" it has not been included. A copy of the document should be on file with the Division, however if information sited in the permit is needed for review and is not easily accessible at the Division, please contact us with what is needed and we will attempt to provide the information.

Locations of Pines East Panels Information:
Chapter 1 - Legal & Financial- Legal Description Lease UTU-76195
Chapter 2 – Soils- Pines Tract Soil Types Plate 2-2 and Appendix 2-1, 2-8
Chapter 3 – Biology- Vegetation and Wildlife Pines Tract – Appendix 3-9, Plates 3-1, 3-2, 3-3
Raptors in Appendix 3-4 and Plate 3-3
Mexican Spotted Owls – Appendix 3-12
Bat Survey – Appendix 3-8
Chapter 4 - Land Use & Historical-Appendix 4-2, 4-5, 4-6, Plate 4-1
Chapter 5 - Engineering – Plates 5-1, 5-2D, 5-2E, 5-2F, 5-6, 5-7, 5-8, 5-10, 5-10C, 5-11
Chapter 6 - Geology – Plates 6-1, 6-2, 6-3, 6-4

Pines East Panels

Chapter 7 – Hydrology – Pines Tract Hydrology 7-18, Plates 7-2, 7-3, 7-10, Appendix 7-1, 7-4, 7-17, 7-18, 7-22
Appendix 7-1 Contains: Water Rights and Location Drawing (2018)
Appendix 7-4 Contains:
Baseline Hydrologic Monitoring at the Link Canyon Mine Portals (2002)
Hydrology and Effects of Mining in the Quitchupah and Pines Coal Lease Tracts, Central Utah (1991)
Appendix 7-18 Contains:
Investigation of Surface-Water and Groundwater Systems in the Pines Tract Area (1999)
Hydrologic Evaluation of Spring Pines 310 (2018)
Appendix 7-22 Contains:
Investigation Plan for Springs Pines 105, Joes Mill Pond, Pines 310 and 311 (2006)

Exploration drilling occurred during 2018, the raptor, wildlife and archeological reports associated with the drilling have been included in the submittal. They are to be included in Confidential Appendices 3-4 and 4-2.

Two water monitoring locations have been added with this submittal at the request of Keenan Storrar. The locations appear on the water monitoring Plate 7-10 and the monitoring tables within Chapter 7 have been updated with the commitment for monitoring these locations.

If you have questions or need addition information please contact Vicky Miller at (435)286-4481.

CANYON FUEL COMPANY
SUFCO Mine

Vicky S Miller for

Jacob Smith
Technical Services Manager

Encl.

cc: DOGM Correspondence File

APPLICATION FOR COAL PERMIT PROCESSING

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

Permittee: Canyon Fuel Company, LLC
Mine: Sufco Mine **Permit Number:** C/041/002
Title: Revision to M&RP to Add Pines East Panels, Task ID # 5777
Description, Include reason for application and timing required to implement:

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

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

Please attach one (1) review copy of the application.

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.

Jacob Smith
Print Name

, Engineering Manager, 1/17/2019
Sign Name, Position, Date

Subscribed and sworn to before me this 17 day of January, 20 19

Notary Public
My commission Expires: _____, 20___}
Attest: State of _____} ss:
County of _____

JACQUELYN NEBEKER
Notary Public
State of Utah
My Commission Expires 03/24/2019
COMMISSION NUMBER 681827

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
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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/041/002
Title: Revision to M&RP to Add Pines East Panels, Task ID# 5777

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	M&RP Confidential
☒ Add	☐ Replace	☐ Remove	Appendix 3-4 - Add information to the back of the existing appendix
☒ Add	☐ Replace	☐ Remove	Appendix 4-2 - Add information to the back of the existing appendix
☐ Add	☒ Replace	☐ Remove	Plate 5-10C
☐ Add	☐ Replace	☐ Remove	
☐ Add	☒ Replace	☐ Remove	Chapter 2, Page 2-8
☐ Add	☒ Replace	☐ Remove	Chapter 3, Pages 3-11, 3-12, 3-17, 3-18, 3-29 thru 3-33
☐ Add	☒ Replace	☐ Remove	Plate 3-3
☐ Add	☒ Replace	☐ Remove	Chapter 4, Page 4-13
☐ Add	☒ Replace	☐ Remove	Chapter 5, Pages 5-16 and 5-25
☐ Add	☒ Replace	☐ Remove	Plates 5-1, 5-7, 5-10, 5-11
☐ Add	☒ Replace	☐ Remove	Chapter 6, Page 6-4
☐ Add	☒ Replace	☐ Remove	Plate 6-1
☐ Add	☒ Replace	☐ Remove	Chapter 7, Pages 7-5, 7-7, 7-49, 7-50, 7-53, 7-55, 7-56, 7-62, 7-128
☒ Add	☐ Replace	☐ Remove	Appendix 7-1 - Add information to the back of the existing appendix
☒ Add	☐ Replace	☐ Remove	Appendix 7-4 - Add information to the back of the existing appendix
☒ Add	☐ Replace	☐ Remove	Appendix 7-18 - Add information to the back of the existing appendix
☐ Add	☒ Replace	☐ Remove	Plate 7-2, 7-3, 7-10
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

January 17, 2019

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CHAPTER 1

GENERAL CONTENTS

Federal Coal Lease UTU-76195 - (4,148.15 acres +/-) - Approved October 1999
Modified December 2006, January 2017

T. 21 S., R. 5 E., SLM

Sec. 2, lots 3,4, S1/2SW1/4, SW1/4SE1/4

Sec. 10, NE1/4NE1/4

Sec. 11, NE1/4, SE1/4, NW1/4NW1/4, NE1/4NW14, SE1/4NW1/4, N1/2SW1/4NW1/4, SW1/4SW1/4NW1/4, E1/2SW1/4, E1/2NW1/4SW1/4,SE1/4SW1/4NW1/4

Sec. 12, S1/2SW1/4, NW1/4SW1/4

Sec. 13, NW1/4, S1/2

Sec. 14, NE1/4, E1/2NW1/4, E1/2E1/2SE1/4

Sec. 22, S1/2S1/2SE1/4

Sec. 23, SE1/4, E1/2SW1/4, S1/2SW1/4SW1/4, S1/2SE1/4NW1/4, SE1/4NW1/4NE1/4, S1/2NE1/4NE1/4, NE1/4NE1/4NE1/4, S1/2SW1/4NE1/4, NE1/4SW1/4NE1/4, SE1/4NE1/4

Sec. 24, all

Sec. 25, N1/2, N1/2S1/2

Sec. 26, N1/2, NE1/4SW1/4, E1/2NW1/4SW1/4, SE1/4

T. 21 S., R. 6 E., SLM

Sec. 19, lots 3-4, E1/2SW1/4

Sec. 30, lots 1-3, E1/2NW1/4, NE1/4SW1/4

Federal Coal Lease UTU-84102 - (6,175.39 acres) - Effective April 1, 2017

T. 20 S., R. 4 E., SLM

Sec. 36, lot 4, E1/2NE1/4, NE1/4SE1/4

T. 20 S., R. 5 E., SLM

Sec. 19, lots 5-8, E1/2SW1/4, SE1/4

Sec. 20, S1/2

Sec. 21, W1/2SW1/4

Sec. 28, W1/2

CHAPTER 2

SOILS

LIST OF PLATES

Plate

2-1 Native Soil Types Present in SUFCO Mine Disturbed Area & Surrounding Area

2-2 Soil Types Pines Tract

2-3 Soil Types SITLA Muddy Tract

LIST OF APPENDICES

(Appendices appear in Volume 4)

Appendix

2-1 Prime Farmland Determination Documents

2-2 Report of Studies of Vegetation and Soils for SUFCO Mine

2-3 Water and Soil Data Report

2-4 Submittal of Drainage Plan and Slope Stability for Reclamation for Convulsion Canyon Mine, Sergent, Hauskins & Beckwith

2-5 Final Reclamation Cut and Fill Quantities

2-6 Link Canyon Substation Soils Investigation

2-7 Quitchupah Tract Supplemental Environmental Assessment 1989 and Environmental Assessment for Coastal States Energy Company, Coal Lease Application U-63214 Quitchupah Tract

2-8 Pines Tract Soils Types

2-9 Link Canyon Portal Vegetation, Aquatic Fauna, and Soil Investigations

2-10 Muddy Tract Soils Types

and limestone are also present. The landscape is steep and rocky with massive sandstone ledges, and siltstone/shale slopes. Surface and subsurface layers are often rocky.

2.2.1 Prime Farmland Investigation

No prime farmland exists in the SUFCO Mine disturbed area, Link Canyon disturbed area, or in any of its lease areas. Mining activities will not impact prime farmland. In compliance with R645-302-313, a pre-application investigation was conducted by the Applicant to determine if any prime farmland would be impacted by the project. Based on the federal criteria for determining the presence or absence of prime farmland, the Convulsion Canyon area, Link Canyon, the Pines Tract area, and the SITLA Muddy Tract area cannot be classified as prime farmland. Consultation with Dr. Theron B. Hutchings, State Soil Scientist for the Soil Conservation Service, substantiated the absence of prime farmland in the Convulsion Canyon and Link Canyon areas. (Appendix 2-1).

2.2.2 Soil Survey

A Level I soil survey of the entire SUFCO Mine disturbed area, including the Link Canyon Substations No. 1 and 2 , has been conducted. Soil survey data are presented in Appendix 2-2 for the majority of the permit area, Appendix 2-6 for the Link Canyon Substation areas, and are herein summarized in Sections 2.2.2.1 through 2.2.2.3. Survey data includes the following information: taxonomic classification, horizon name and depth, dry and moist color, texture (percent sand, silt, and clay), class, structure, percent rock fragments and organic matter, pH, effervescence, EC, and solubility of calcium, magnesium, and sodium (Appendices 2-2 and 2-6). A cross-reference list of map unit, soil taxonomic classification, and sample site appears in pages 17 through 19 of Appendix 2-2.

A site specific soil survey will be completed for the Overflow Pond prior to disturbance and this information will be utilized in determining topsoil salvage depth. The results of this soil survey will be included in the as-built addendum to be included in Appendix 2-2.

An Order 2 soil survey has been completed for the Link Canyon Substation No. 1 disturbed area and is included in Appendix 2-2. Additionally, an Order 1 soil survey was conducted of the substation Nos. 1 and 2 pad areas and the results are included in Appendix 2-6.

An Order 3 soil survey has been conducted for the Pines Tract and the results are included in Appendix 2-8. (Plate 2-2)

An Order 3 soil survey has been conducted for the SITLA Muddy Tract and the results are included in Appendix 2-10. (Plate 2-3). Soils associated with the 70 Acre BLM Right of Way are part of the Order 3 soil survey located in Appendix 2-10.

2.2.2.1 Soils Map

Plates 2-1 and 2-2 delineates the soil types present in the disturbed and adjacent areas.

2.2.2.2 Soil Identification

Soils present in the narrow V-shaped East Spring Canyon, which lie within and immediately adjacent to the disturbed area of the SUFCO Mine have been identified, characterized, and their spatial occurrences documented (Appendix 2-2). Four soil types are present in the disturbed area, and are herein referred to as soil types O, W, T, and X (Plate 2-1). Soil type O is a loamy-skeletal, mixed, frigid Ustic Torriorthent. Soil W is a loamy-skeletal, mixed, frigid Typic Xerothent. Soil type T is a loamy-skeletal, mixed, frigid, Calcixerollic Xerochrept. Soil X is a complex composed of both a clayey-skeletal, mixed, frigid, shallow Lithic Calcixeroll, and a fine, mixed, frigid Mollic Haploxeralf.

Analytical and field methodology utilized in characterizing these soil types and their soil horizons are found in pages 13 and 14 of Appendix 2-2. Soils were classified to family unit using the Soil Conservation Service's classification system (Johnson, 1975).

2.2.2.3 Soil Description

Soil Type O

Soil type O is found at the north end of the disturbed area, in the area of the confluence of the Mud Spring Hollow and East Spring Canyon drainages (Plate 2-1). The taxonomic classifications of Soil O are that of a loamy-skeletal, mixed, frigid Ustic Torriorthent. This soil is found on slopes with grades of 60 percent or greater; consists of well-drained soils that have formed from residuum and

Overflow Pond Soils

A general description of the soils located in the Overflow Pond area will be provided in Appendix 2-2.

Link Canyon Soils

A description of the soils located in the Link Canyon Substation Nos. 1 and 2 disturbed areas is provided in Appendix 2-6.

Link Canyon Mine Portals

A description of the soils located in the Link Canyon Mine Portals area is provided in Appendix 2-9. The description of the soils was prepared by Dan Larsen, a soils scientist with EIS Environmental and Engineering Consultants.

Pines Tract

The general description of the soils within the Pines Tract is provided in Appendix 2-8. No surface disturbance associated with the mining of the Pines East Panel(s) is planned on the Pines Tract Lease.

SITLA Muddy Tract and Greens Hollow Tract

The general description of the soils within the SITLA Muddy Tract and Greens Hollow Tract is provided in Appendix 2-10.

3 Right 4 East - Quitchupah Tract

A general description of the soils associated with the Quitchupah Tract is provided in the Supplemental Environmental Assessment prepared by UDOGM October 27, 1989, included in Appendix 2-7. No surface disturbance as in the construction of facilities, etc. is associated with the ming of the 3 Right 4 East panel(s)

CHAPTER 3

BIOLOGY

LIST OF TABLES

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3-3 Deer Range & Raptor Nests

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3-1 Report of 1983 Field Investigations

3-2 Aquatic Resource Inventory of Southern Utah Fuel Company Permit Area

3-3 Wildlife Assessment of the Southern Utah Fuel Company Mining Property and Adjacent Areas

3-4 Raptor and General Avifauna Studies

3-5 Fauna of Southeastern Utah and Life Requisites Regarding their Ecosystems

3-6 Vegetation Information Guidelines, Appendix A

3-7 Power Line Correspondence

3-8 Bat Survey for the SUFCO Mine

3-9 Vegetation and Wildlife of the Pines Tract Project.

3-10 Monitoring and Mitigation Plan for Mining Under the East Fork of Box Canyon

3-11 Muddy Creek Technical Report-Wildlife

3-12 Mexican Spotted Owl Survey Muddy Tract

3-13 Vegetation and Wildlife of the West Coal Lease Modifications

3-14 Monitoring and Mitigation Plan for Undermining the South Fork of Quitchupah 2R2S Block "A" and 3R2S Block "B"

3-15 3R4E & 4R4E Reports (Confidential)

3-16 Greens Hollow Tract

CHAPTER 3
BIOLOGY

3.10 Introduction

This chapter presents a description of the biological resources found on the SUFCO Mine site. The mine is located approximately 30 miles east of Salina, Utah.

Several consultant reports will be referenced in this M&RP, so for simplicity purposes the report titles will appear as the following abbreviations:

EPS - Report of Studies of Vegetation and Soils for SUFCO Mine - 1980 (Appendix 2-2)

INV - Report of 1983 Field Investigations - 1983 (Appendix 3-1)

AQU - Aquatic Resource Inventory of Southern Utah Fuel Company Permit Area - 1980 (Appendix 3-2)

WIL - Wildlife Assessment of the Southern Utah Fuel Company Mining Property and Adjacent Areas - 1980 (Appendix 3-3)

RAP - Raptor and General Avifauna Studies - 1980 (Appendix 3-4)

FSW - Fauna of Southeastern Utah and Life Requisites Regarding their Ecosystems - 1990 (Appendix 3-5)

VWP - Vegetation and Wildlife of the Pines Tract Project - 1999 (Appendix 3-9).

Reports in the appendices are provided only to present Baseline Data in support of the Mining and Reclamation Plan. Proposals or recommendation presented by consultants were duly considered in preparation of the Mining and Reclamation Plan chapter commitments but not all of them were determined to be appropriate or advisable.

Greens Hollow Lease

Much of the information presented for the permitting of the Greens Hollow Lease (GHL) was prepared with a conceptual mine plan assuming full extraction mining, associated subsidence and represents maximum impacts in the Bureau of Land Management's Environmental Impact Statement (FSEIS) . The information in the text represents the permittees accepted obligations and commitments, the information provided in appendices from the (FSEIS) unless reference

Aspen-deciduous forest

Additional plant communities are designated on Plate 3-1.

Field sampling of these plant communities was initially done in July of 1983 and the findings were documented in the INV report. A Level II riparian inventory has been conducted along portions of East Fork of Box Canyon (USDA-USFS, 1993). The plant communities and reference areas are outlined on Plate 3-1. In 1999, another vegetation (and wildlife) report (VWP) was prepared for the proposed mine expansion called the Pines Tract Project. Vegetation communities were described and shown on a map included in that document, most of which are also listed in the plant communities shown above. The vegetation types in the SITLA Muddy Tract were identified by Cirrus and reported in EIS documents for the entire BLM and SITLA Muddy Tract. The vegetation types in the SITLA Muddy Tract are illustrated on Plate 3-1. This plate will be updated in the appropriate season of 2006 to more clearly indicate types and extent of vegetation in the SITLA Muddy Tract. As of October 2005, the available Forest Service information used to create the map is essentially correct but Sufco has agreed the vegetation boundaries and descriptions can be further refined. The work to be performed in 2006 will include the evaluation of available aerial photos of the area by a qualified person who then will create an updated vegetation map of the tract. The updated version of the plate will be submitted to the Division before the end of 2006.

Greens Hollow. The following is a listing of the approximate coverage of habitat vegetation. Mahogany and mountain brush constitutes the most abundant habitat, covering 27.4 percent of the tract and associated extended analysis area. Sagebrush covers 23.3 percent, aspen and aspen-mixed conifer 17.2 percent, grassland/forbland 11.7 percent, ponderosa pine 5.3 percent , pinyon-juniper 2.9, Rock outcrops/barren 2.1 percent and mixed conifer 1.1 percent. Limber and or/bristlecone pine were in the extended analysis area only covering 1 percent.

A description of the potential impacts of mining on vegetation is included in Section 3.3.3.3 of this permit.

3.2.1.2 Land Productivity Prior to Mining

The land productivity of the mine area was not measured in 1941 when mining began. However, Appendix 2-2 contains a consultant study (EPS, pgs. 45 - 78) compiled in 1980, which states total cover, production pounds per acre and species within the permit area. Additional information was presented in INV Report, August 12, 1983 (Appendix 3-1).

3.2.2 Fish and Wildlife Information

A summary of the fish and wildlife resource information for the permit and adjacent areas is contained in Sections 3.2.2.1 through 3.2.2.3. As mentioned above, a wildlife report was included with a vegetation report in 1999 (VWP) for the proposed mine expansion called the Pines Tract Project. Fish and wildlife resources in the SITLA Muddy tract are as described in Sections 3.2.2.1 through 3.2.2.3 and in the "Muddy Creek Summary Report - Wildlife" prepared by Cirrus and included as Appendix 3-11. Fish and wildlife resources within the West Coal Lease Modifications and the area of the 2016 sinkhole repair are summarized in Appendix 3-13 and Section 3.2.2.2. A description of the potential impacts and mitigation of impacts of mining on fish and wildlife is included in Section 3.3.3.3 of this permit.

Due to either their small size, intermittent flows, poor habitat or water quality, the surface waters in the lease area are not of game fish quality. The low importance of the streams as a fishery resource, has categorized them as being of little value for extensive study. An inventory of the aquatic resources is located in Appendix 3-2. Aquatic resources of the Pines Tract Project are briefly described in the wildlife section of Appendix 3-9. Aquatic resources within the Muddy Tract are summarized in Appendix 3-11. Aquatic resources within the West Coal Lease Modifications and the area of the 2016 2RWL sinkhole repair are summarized in Appendix 3-13. Aquatic resources for the Greens Hollow Tract are summarized in Appendix 3-16.

3.2.2.1 Level of Detail

The scope and level of detail within this M&RP are sufficient to design the protection and enhancement plan for wildlife and fish in the area.

This assessment of wildlife resources has been compiled pursuant to guidelines issued by the State of Utah Division of Oil, Gas and Mining (UDOGM). Appendices 3-3, 3-4, 3-5, and 3-9 contain wildlife studies related to their resources in the mine area.

3.2.2.2 Site-specific Resource Information

The following information was summarized from the WIL, RAP, AQU, and VWP Reports. Additional information is available in Appendix 3-2 through 3-5, and 3-9.

Reptiles and Amphibians

Increasing elevation rapidly reduces the number and kind of reptiles and amphibians. Furthermore, in Utah the effects of the more northern latitude reduces the number of reptiles in much the same way as does the increase in elevation.

These geographical and associated climatic factors have eliminated most desert species, leaving species that are adapted either to mountain habitats or montane type habitats developed in the more northern areas.

Literature pertaining to the amphibians and reptiles is extensive; but, much of it refers to species occurring in the desert areas and has only limited reference to forms inhabiting Utah mountains.

Based on the extensive literature review and limited field work it was determined that potentially 8 species of amphibians (Appendix 3-5) inhabit the area of concern which provides substantial value habitat . All amphibians are legally protected, but since the species listed are all widespread throughout the mountains of Utah, none are treated as high-interest species. It is doubtful that the proposed action would seriously impact populations, but localized individuals may be involve in habitat destruction due to subsidence. An exception to this would be if subsidence interrupted underground aquifers and caused drying of present wet habitats essential to reproduction.

Based on the literature search and limited field work, it was determined that potentially 14 species of reptiles (Appendix 3-5) occupy the mine land area, a substantial value habitat for all species. All reptiles are legally protected but since the species listed are all widespread throughout montane habitats in Utah, none are treated as high-interest species and, therefore, are not individually discussed. It is doubtful that the proposed action would seriously impact populations.

Information about reptiles and amphibians specific to the Pines Tract Project area is provided in the VWP report (Appendix 3-9). Information about reptiles and amphibians specific to the Muddy Tract area is provided in the Cirrus report (Appendix 3-11). Information about reptiles and amphibians specific to the West Coal Lease Modifications are summarized in Appendix 3-13.

Wetlands and riparian areas exist within the permit area and have been estimated to represent less than one percent of the total acreage within Pines Tract Project Area and SITLA Muddy Tract. These areas are supported by streams, springs, and seeps located throughout the drainages. Studies in the semi-arid West comparing riparian areas with adjacent uplands showed that riparian zones support up to 400 percent more plant biomass, up to 200 percent more species, and

contribute to large increases in density and species richness for birds when compared to upland areas.

Between 69% to 92% of all amphibian occur in wetland ecosystems. The scaleless, permeable amphibian skin requires constant moisture to retain body fluids. Both water quantity and quality parameters are of importance to the survival of individual amphibians and ultimately populations of the species.

Reptiles are not nearly as dependent on wetlands since their scaly covering provide resistance to desiccation. Riparian areas are heavily utilized (50% to 72% of all species) for the available drinking water, prey, and vegetative resource (cover). The moist soil characteristic of riparian zones also provide preferred nesting habitat for many reptiles.

The riparian areas for the Pines Tract Project Area, Link Canyon, and SITLA Muddy Tract are shown on Plate 3-1. A survey for amphibians and mollusks was conducted in the Link Canyon Portal area in June of 2002. No amphibians or mollusks where found in the portal area nor where any protected or sensitive species found in the area. A copy of a report of the investigation is contained in Appendix 2-9.

Raptors

Only one nest, that of a Cooper's Hawk, was found in 1980 (Appendix 3-4). The one Cooper's Hawk nest found was in an area seemingly less favorable than surrounding canyons. Quitchupah Canyon appeared to be prime habitat, but no nests were found.
Golden Eagles were seen on nearly every survey day during the 1980 survey by Clayton White of Brigham Young University (Appendix 3-4). The presence of two adults accompanied by a juvenile suggest their nearby breeding, however no nests were located.

Appendix 3-4, Table 1 contains a list and the number of sightings for the birds inventoried during the 1980 raptor survey.

A raptor survey conducted April 14, 1987, located three Golden Eagle nests (Appendix 3-4). Two of the nests were tended and contained greenery, the third had an adult eagle incubating eggs.

In October of 1988 an environmental assessment of the Quitchupah Lease area was performed by personnel from the Forest Service and Bureau of Land Management. During the assessment

6 Golden Eagle nests were located.

The SUFCO Mine portions of the annual raptor surveys conducted by UDWR and others are located in Appendix 3-4 in the Sufco Mine MRP Confidential file. Refer to Section 3.3.3.3 for commitments and other raptor survey information.

The Prairie Falcon has also been reported by U.S. Forest Service and Bureau of Land Management personnel for the planning unit that encompasses the SUFCO Mine area.

The Quitchupah Drainage, of which Link Canyon is a tributary, was identified in the Quitchupah Creek Road DEIS (2001) as not likely to contain Mexican Spotted Owls and dedicated surveys were not necessary. However, the Manti-La Sal National Forest reported that a Mexican Spotted Owl survey of the area was being conducted as part of their Muddy Creek EIS Data Adequacy study. Results of surveys conducted in 2002 and 2003 indicated no Mexican Spotted Owls were found in the Link Canyon Portal area or the Muddy Tract area (Appendix 3-12). Additionally, Sufco does not plan to conduct construction activities during the nesting and rearing times (February 1 through August 31) of the owl.

The lack of permanently running water has an effect on raptors. Many species, such as accipiters, appear to rely on streams and the associated riparian vegetation (Hennessy, 1978).

Known raptor nests are shown on Plate 3-3, refer to Section 3.3.3.3 for additional raptor information.

Information about raptors specific to the Pines Tract Project area is provided in the VWP report (Appendix 3-9). Information about raptors specific to the Muddy Tract area is provided in the Cirrus report (Appendix 3-11). Information about raptors specific to the West Coal Lease Modifications and the area of the 2016 2RWL sinkhole repair are summarized in Appendix 3-13 and Section 3.2.2.2. Raptor surveys conducted in the Greens Hollow Tract are located in Appendix 3-4 and a discussion of raptors and bird species from technical reports prepared by Cirrus Ecological Solutions, LC is located in Appendix 3-16.

3 Right 4 East Panel(s) - Township 21 South, Range 5 East

A helicopter survey to locate raptors and migratory bird species was conducted in 1982 and 1988 by UDWR, USFWS, BLM, and USFS. In 1988 ten golden eagle nests were located within the

4 Right 4 East Panel - Elk & Mule Deer

The 4R4E panel is located in the southern portion of the Quitchupah Lease (See Plated 5-6 and 5-7 of the M&RP). The panel is located just outside of within what is considered crucial or critical winter range for deer and elk. The escarpment in the southeastern portion of the tract which lies between Quitchupah Canyon and Link Canyon is known as an elk migration route, providing access to and from the winter range from the plateau top (See Plates 3-2 and 3-3 of the M&RP). The permittee is obligated to monitor and mitigate subsidence that poses a risk to livestock and wildlife as soon as feasibly possible. This will be done according to the subsidence monitoring plan (See Section 5.2.5.1) and migration commitments (See Sections 3.3.3.3 and 3.4.1.2) within the MRP. An effort will be made by the permittee to monitor subsidence between 60 and 90 days following completion of the 4R4E longwalll panel or as soon as access is feasible. The permittee recognizes that this time constraint commitment only apples to the 4R4E panel.

4 Right 4 East Panel - Greater Sage-Grouse

Data provided to the public by the Utah Division of Wildlife Resources (UDR) show approximately 30,000 acres of designated sage grouse habitat north of where the 4R4E panel is located. A small portion of the panel is located in this area, but the majority of the panel lies outside of the designated habitat boundary. After consulting with UDWR, Division (DOGM) personnel determined that the proposed 4R4E panel is not likely to have an impact on sage grouse lekking, nesting, or brood rearing activity.

4 Right 4 East Panel - Seed Mix Information

Should a seed mix be required to be used on soil filled subsidence cracks the seed mix previously used for the sinkhole repair and reclamation project will be used. See Section 3.4.1.2 for information regarding the sinkhole project seed mix. Soils used to fill subsidence cracks which receive seed will not receive mulch or fertilizer. Refer to Section 5.2.5.2 (Correction of Material Damage) for additional information.

Pines East Panel(s)

Should a seed mix be required to be used on soil filled subsidence cracks associated with the Pines East panels the 3Right 4 East Panel seed mix (See Section 3.4.1.2) will be used. Soils used to fill subsidence cracks which receive seed will not receive mulch or fertilizer. Refer to Section 5.2.5.2 (Correction of Material Damage) for additional subsidence information.

The wildlife habitats above the panel(s) include critical elk winter range and high value elk and deer range (Plates 3-2, 3-3). The escarpment in the southeastern portion of the tract which lies between Quitchupah Canyon and Link Canyon is known as an elk migration route, providing transition to and from the winter range from the plateau top. There is no potential spotted owl habitat (Pines Tract Project FEIS, 1999). During a biological survey (Appendix 3-4, Tetra Tech June 2018) of the area done for surface exploration drill no new raptor nests were identified and the Northern Goshawk territory was deemed inactive. In addition the Tetra Tech Biologist detected no threatened, endangered or sensitive species in the area, including greater sage grouse. The panels are not within a known sage grouse lek and it was not verified if sage grouse travel through area above the panels. Utah Division of Wildlife Resources designated sage grouse habitat lies west and north of the panels.

Historic Raptor Nests information for the area:
322 (Eagle) - Dilapidated in 1998, not surveyed since
326 (Eagle) - Inactive 2001, 2007
327 (Eagle) - Dilapidated 2001, no surveyed since
801 (Eagle) - No found 1998
803 (Eagle) - Inactive 2001, 2007
804 (Eagle) - Tended 2001, not surveyed since
806 (Hawk) - Not surveyed 2001 thru 2006, Inactive 2007
810 (Eagle) - Not Found 1999, not surveyed since

The area of the Pines East panels will be surveyed for raptor again in 2019 and will continue to be surveyed as described in Section 3.3.3.3.

Pines Tract Project FEIS (1999) contains figures of Vegetation Types Figure 3-10 and Riparian Areas Figure 3-11.

Elk

The elk herd (#14) is a significant wildlife resource to the citizens of Utah and there is considerable hunting pressure. Winter and summer range is in generally good conditions, but drought is an immediate concern (Big Game Annual Report, 1991).

Although the potential area of impact is not critical to the continued existence and perpetuation of the herd, it is important to maintenance of current population levels, and portions of the entire lease

question do not always winter on the rims nor the plateau but in the lower elevation areas to the southeast. This observation was substantiated by a conversation with a local forest ranger out of Richfield. The amount of snow is probably the determinant, with the elk wintering wherever there is available forage from the rim to the low brush areas in the southeast.

The fact that elk utilize the entire area of concern during some time of the year means that all aspects and timing of the actions must be considered. However, since the SUFCO Mine has been operational since the early 1940's and since there are no plans for additional surface facilities other than ventilation portals along the cliffs, there should be little additional disturbance to the elk. The animals have already accommodated the human disturbance associated with the mining and hauling of coal.

Information about elk winter-range and migration routes specific to the Pines Tract Project area is provided in the VWP report (Appendix 3-9). Information about elk winter-range and migration specific to the Muddy Tract area is provided in the Cirrus report (Appendix 3-11). Information about elk winter-range and migration specific to the West Coal Lease Modifications and the area of the 2016 2RWL sinkhole repair are summarized in Appendix 3-13.

3 Right 4 East Panel(s)

The southern portion of the lease area is considered crucial winter range for deer and elk. The escarpment in the southeastern portion of the tract which lies between Quitchupah Canyon and Link Canyon is known as a elk migration route, providing access to and from the winter range from the plateau top.

Mule Deer

Mule deer on the mine area are considered part of Herd Unit 43 by the UDWR. The animals in the environs of concern utilize the entire assessment area but seasonally concentrate in and more heavily utilize specific habitat types.

During the summer the mule deer generally utilize all of the habitats near watering areas. The most heavily used communities were the sage, mountain brush and the composite of aspen, mountain mahogany, manzanita and ponderosa. This is as expected since there is considerably more browse in these communities than in the others sampled.

With the onset of fall and winter the mule deer latitudinally migrate. Initially (late fall and early winter) they concentrate on the plateau area where they intermingle with the elk but when the snow gets too deep for them to traverse they move into the low elevation sage, and pinyon juniper areas to the southwest. The wintering areas for mule deer make them susceptible to road strikes in the vicinity of the haul and access road for the SUFCO Mine and Interstate 70.

Information about mule deer winter-range and migration routes specific to the Pines Tract Project area is provided in the VWP report (Appendix 3-9). Information about mule deer winter-range and migration specific to the Muddy Tract area is provided in the Cirrus report (Appendix 3-11). Information about mule deer winter-range and migration specific to the West Coal Lease Modifications are summarized in Appendix 3-13.

Cougar

The entire SUFCO Mine area provides substantial value, and year long habitat for cougar. The animal ranges throughout the area as evidenced by a sighting one third of the way down the slope in Quitchupah Canyon, one half mile below the confluence of South Fork, and tracks in the mud near Jack Adley's Monument, Broad Hollow, and in the dust of the road near Acord Lakes. Though animals range throughout the area, their movements are often dictated by migration patterns of their primary food source (mule deer) and human disturbance. Concern must be given to the cougars particularly when the females are accompanied by their young who are learning to hunt and survive. This is considered a sensitive period for cougars and it is best if disturbance is minimized during this time. However, this period in their life cycle is difficult to determine for cougars since they are known to reproduce year round.

Fur bearers

Limited portions of the mine and adjacent areas provide substantial value habitats for a few species categorized by management agencies as fur bearers: ermine, long-tailed weasel, badger and the striped skunk. The breeding and rearing activities of these non-migratory species occurs within the area and their dens and burrow systems are important to maintenance of their populations, but it is unlikely that the proposed actions will seriously impact them for any length of time. Subsidence will be localized and new burrows will be built or old ones reconstructed after it occurs. These species are widespread and adaptable to the activities of man.

Small Mammals

Small mammals represent a significant part of the ecosystem. The majority are herbivores and are the primary source of food for higher trophic levels, particularly raptorial birds, canids and felids. The potential exists for caving burrows in and/or changing burrow continuity due to fracturing of the strata. Should this occur, it is likely that young mammals in the nest would be crushed or cut off from parental care. Although this would temporarily alter the population density and age structure, recovery would be imminent and rapid. The 1997 Bat Survey for the SUFCO Mine conducted by J. Mark Perkins & Joshua R. Peterson is included in Appendix 3-8.

Information about small mammals specific to the Pines Tract Project area is provided in the VWP report (Appendix 3-9). General information about small mammals specific to the Muddy Tract area is provided in the Cirrus report (Appendix 3-11). General information about small mammals specific to the West Coal Lease Modifications and the area of the 2016 2RWL sinkhole repair are summarized in Appendix 3-13 and Section 3.2.2.2 and in Appendix 3-16 for the Greens Hollow Tract.

Threatened and Endangered Plant and Wildlife Species. Passage of the Endangered Species Act of 1973 (Public Law 23-20S) provided the legal basis for establishment of lists of endangered and threatened plant species. Such lists were prepared under direction of the Smithsonian Institution, and were published subsequently in the Federal Register (40: 2782 427924, 1975; and 41: 2452 4 24572, 1976). The region under investigation was included in a report on threatened and endangered species of the Central Coal lands of Utah (Welsh 1976). An inventory of endangered wildlife species performed in 1989 by the Division of Wildlife Resources recorded no species within the proposed permit area (conversation with Pamela Hill, DWR, Cedar City, 1991). Table 3-1 provides a list of Federally listed Threatened and Endangered Species that have been

identified in the Utah counties in which Sufco lies. However, this list does not necessarily indicate these species are found within the mine permit boundaries.

A survey of the literature has failed to indicate the presence of any endangered or threatened plant species in the area. This lack of critical or unique species is supported by the field surveys of the lease areas. The region was searched by walking parallel transects on a quarter-section by quarter-section basis, with each community type within each quarter-section being traversed. No endangered or threatened species were encountered in the lease area or in the adjacent areas.

There are no federally listed threatened or endangered fish species inhabiting the aquatic habitat.

A discussion about threatened, endangered or otherwise sensitive plant and animal species of the Pines Tract Project area is given in Appendix 3-9. A discussion about threatened, endangered or otherwise sensitive plant and animal species of the Muddy Tract area is provided in the Cirrus report (Appendix 3-11). A discussion about threatened, endangered or otherwise sensitive plant and animal species of the West Coal Lease Modifications and the area od the 2016 2RWL sinkhole repair are summarized in Appendix 3-13 and Section 3.2.2.2.

Table 3-1
Federally Listed and Proposed Endangered Species in Utah
Sevier, Sanpete and Emery Counties
~~**April 2, 2013 (2016)**~~ November 1, 2017

Plants		Status	Present
Barneby Reed-Mustard	Schoenocrambe barnebyi	E	NP
Heliotrope Milk-Vetch	Astragalus montii	T	NP
Jones Cycladenia	Cycladenis humilis var. jonesii	T	
Last Chance Townsendia	Townsendia aprica	T	NP
~~San Rafael Cactus~~	~~Pediocactus despainii~~	~~E~~	~~NP~~
Wright Fishhook Cactus	Sclerocactus wrightiae	E	NP
Winkler Pincushion Cactus	Pediocactus winkleri	T	NP
~~Dwarf Bear-poppy*~~	~~Arctomecon humilis~~	~~E~~	~~NP~~
~~Kodachrome Bladderpod*~~	~~Lesquerella tumulosa~~	~~E~~	~~NP~~
~~Autumn Buttercup*~~	~~Ranunculus aestivalis (acriformia)~~	~~E~~	~~NP~~
Despain Pincushion Cactus	Pediocactus despainii	E	NP

Mammals

Utah Prairie Dog	Cynomys parvidens	T	NP
Canada Lynx	Lynx canadensis	T	NP
~~Desert Tortoise*~~	~~Gopherus agassizii~~	~~T~~	~~NP~~

Birds

Mexican Spotted Owl	Strix occidentalis lucida	T	NP
~~Southwestern Willow Flycatcher*~~	~~Empidonax traillii extimus~~	~~E~~	~~NP~~
~~Gunnison Sage-grouse*~~	~~Centrocersus minimus~~	~~T~~	~~NP~~
Western Yellow-billed Cuckoo	Coccyzus americanus	T	NP
~~Three-toed Woodpecker~~	~~Picoides ridactytus~~	~~S~~	~~P~~

Fish

Bonytail Chub	Gila elegans	E	NP
Colorado Pikeminnow	Ptychocheilus lucius	E	NP
Humpback Chub	Gila cypha	E	NP
Razorback Sucker	Xyrauchen texanus	E	NP
~~June Sucker*~~	~~Chasmistes liorus~~	~~E~~	~~NP~~
~~Greenback Cutthroat Trout*~~	~~Oncorhynchus clarki stomias~~	~~T~~	~~NP~~
~~Lahontan Cutthroat Trout*~~	~~Onxhohynchus clarkii henshawi~~	~~T~~	~~NP~~
~~Virgin River Chub*~~	~~Gila seminuda (robusta)~~	~~E~~	~~NP~~
~~Woundfin*~~	~~Plagopterus aregantissimus~~	~~E~~	~~NP~~

Amphibians & Reptiles & Snails

None listed in the Counties

~~Snails~~

~~Kanab Ambersnail*~~	~~Oxyloma haydeni kanabensis~~	~~E~~	~~NP~~

E - Endangered T - Threatened Extirpated - No longer occur in Utah C - Candidate
NP - Not Present (BLM, USFWS, FSEIS) P - Present (BLM, FSEIS)

For additional information contact: U. S. Fish and Wildlife Service, ~~2078 Administration Building, 1745 West 1700 South, Salt Lake City, Utah 84204-5110~~ Telephone:(801) 975-3300

plateau area through the cliffs to the valley floor to the southeast. It appears that these trails are important to elk migration from summer to winter range, and therefore construction of ventilation portals has not been allowed to interrupt this limited number of access routes.

No endangered or threatened mammal species occur within the mine boundary as recorded in a study performed by H. Duane Smith and Clyde L. Pritchett (WIL, Appendix 3-3).
A peregrine falcon eyrie existed in 1997 about one half mile from the site but during aerial surveys conducted in 1998 and 1999 no falcons were sighted. Discussion about threatened, endangered or otherwise sensitive plant and animal species of the Pines Tract Project area is given in Appendix 3-9.

The disturbed area of the Link Canyon Mine Portals contains approximately 0.05 acres (2000 square feet) of riparian vegetation typified by willow, alder, stinging nettle, rose, horsetail, carex, Kentucky Bluegrass, rush, and clematis (Zobell, 2000). A vegetation study of the western portal area was conducted by Mt. Nebo Scientific in July 2002 and September 2013. The 2002 report of this study includes a detailed map of the western portal area vegetation. A copy of the reports are included in Appendix 2-9. The vegetation is supported by discharge from the abandoned Link Canyon Mine and subsurface moisture within the Link Canyon Drainage. Only the western-most portal area will be disturbed as part of Sufco's plan to re-open Link Canyon portals to establish an escape-way and ventilation for mining in the Pines Tract and access to the Link Canyon substation. The natural discharge of water from the portals will be maintained at rates similar to those that existed prior to reopening of the western portal. Only water from the existing abandoned works will be allowed to discharge from the portals. Thus, no harm due to a reduction in flow is anticipated to the riparian areas downstream of the portals. Additionally, the discharges from the portals have the potential to remain after the western Link Canyon Portal is reclaimed.

A vegetation study was performed by Keith Zobell from 2000 through 2013(discontinued). The reports identified the vegetation and their associated vigor at the Link Canyon Mine portal which has been similar for the past thirteen years. The primary impacts to the vegetation have been from grazing and drought conditions. Discharge for the portal has been discussed in these reports, the water discharge has been low to non-existent the majority of the years. The drainage adjacent to the portals runs with waters associated with storm events. Refer to Appendix 2-9 for a copy of the study information collected in 2013, study information from previous years is located in the annual reports for the corresponding years.

3.2.3.3 Facilities for Protection and Enhancement

Sections 3.3.3.3 and 3.5.8.5 contain additional discussion pertaining to protective measures taken by the applicant in behalf of wildlife.

Power lines within the SUFCO Mine permit area were modified during the summer of 1981 to comply with the guidelines of REA Bulletin 61-10, "Power Line Contacts by Eagles and Other Large Birds" (see Plate 5-5 for the power pole locations).

3.2.3.4 Vegetation Type and Plant Communities

Vegetative types and plant communities are outlined on Plate 3-1 of this application.

Table 3-2

Utah Sensitive Species List ~~Wildlife Species of Special Interest~~ - Sevier, Sanpete and Emery Counties

~~October 1, 2015~~ November 1, 2017

Mammals		**State Status**
Brown (Grizzly) Bear- Historically	Ursus arctos	S-ESA (S,SV)
Black-footed Ferret- Unconfirmed	Mustela nigripes	S-ESA (E)
Utah Prairie Dog	Cynomys parvidens	S-ESA (S,SV)
Fringed Myotis	Myotis thysanodes	SPC (SV)
Big Free-tailed Bat	Nyctinomops macrotis	SPC (SV)
Townsend's Big-eared Bat	Plecotus townsendii	SPC (E,S,SV)
Canada Lynx - Possibly/Historically	Lynx canadensis	S-ESA (E,S,SV)
Kit Fox	Vulpes macrotis	SPC (E,S,SV)
White-tailed Prairie-dog	Cynomys leucurus	SPC (E)
Pygmy Rabbit	Brachylagus idahoensis	SPC (SV)
Birds		
~~Southwestern Willow Flycatcher~~	~~Empidonax traillii extimus~~	~~S-ESA~~
Bald Eagle	Haliaeetus leucocephalus	SPC (E,S,SV)
Ferruginous Hawk	Buteo regalis	SPC (E,S,SV)
~~Yellow-billed Cuckoo~~	~~Coccyzus americanus occidentalis~~[3]	~~S-ESA~~

~~Spotted (Mexican) Owl~~	~~Strix occidentalis~~[2]	~~S-ESA~~
Northern Goshawk	Accipiter gentilis	CS (E,S,SV)
Burrowing Owl	Athene cunicularia	SPC (E,S,SV)
Short-eared Owl	Asio flammeus	SPC (SV)
American White Pelican	Pelecanus erythrorhynchos	SPC (SV)
Three-toed Woodpecker	Picoides tridactylus	SPC (S,SV)
Greater Sage-Grouse	Centrocercus urophasianus	SPC (E,S,SV)
Long-billed Curlew	Numenius americanus	SPC (S,SV)
Black Swift	Cypseloides niger	SPC (SV)
Lewis's Woodpecker	Melanerpes lewis	SPC (S)
Grasshopper Sparrow	Ammodramus savannarum	SPC (S)
Fish		
Bonytail	Gila elegans	S-ESA (E)
Humpback Chub	Gila cypha	S-ESA (E)
Razorback Sucker	Xyrauchen texanus	S-ESA (E)
Roundtail Chub	Gila robusta	CS (E)
Flannelmouth Sucker	Catostomus latipinnis	CS (E)
Bluehead Sucker	Catostomus discobolus	CS (E,S)
Colorado River Cutthroat Trout	Oncorhynchus clarki pleuriticus	CS (E,S,SV)
Bonneville Cutthroat Trout	Oncorhynchus clarki utah	CS (S,SV)
Colorado Pikeminnow	Ptychocheilus lucius	S-ESA (E)
Southern Leatherside Chub	Lepicomeda aliciae	SPC (S,SV)
Reptiles and Amphibians		
Western (Boreal) Toad	Bufo boreas	SPC (E,S,SV)
Great Plains Toad	Bufo cognatus	SPC (E)
Columbia Spotted Frog	Rana luteiventris	CS (S)
Mollusk		
Carinate Glenwood Pyrg	Pyrgulopsis inopinata	SPC (SV)

Otter Creek Pyrg	Pyrgulopsis fusca	SPC (SV)
Smooth Glenwood Pyrg	Pyrgulopsis chamberlini	SPC (SV)
Ninemile Pyrg	Pyrgulopsis nonaria	SPC (S)
South Bonneville Springsnail	Pyrgulopsis transversa	SPC (S)

None of these species are known to be located in the mine lease area.

Key to State Status Field (Table 3-2)

Symbol	Definition
S-ESA	Federally-listed or candidate species under the Endangered Species Act.
SPC	Wildlife species of concern.
CS	Species receiving special management under a Conservation Agreement in order to preclude the need for Federal listing.
E	Emery County List
S	Sanpete County List
SV	Sevier County List

Utah Division of Wildlife Resources, 1596 West North Temple, Salt Lake City, Utah 84116-3195

Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS)

Table 3-3

USDA-FS Region 4 Sensitive Species - Fishlake and Manti-LaSal

February 2013 Update (June 2016)

Plants		**Status**	**Present**
Link Trail Columbine*	Aquilegia flavescens var. rubicunda	K	NP
Cruetzfeldt-flower Cryptanth*	Cryptantha creutzfeldii	K	NP
Carrington Daisy*	Erigeron carringtoniae	K	NP
Canyon Sweetvetch*	Hedysarum occidentale var. canone	K	NP
Maguire Campion*	Silene petersonii	K/P	NP
Musinea Groundsel	Senecio musinensis	K	NP
Arizona Willow*	Salix arizonica	K	NP

Wonderland Alice Flower*	Aliciella caespitosa	K	NP
Chatterley Onion*	Allium geyeri var. chatterleyi	K	NP
Sweet-flower Rock Jasmine*	Androsace chamaejasme ssp. Carinata	K	NP
Bicknell Milkvetch*	Astragalus consobrinus	K/P	NP
Isely's Milkvetch*	Astragalus iselyi	K	NP
Desert Milkvetch*	Astragalus desereticus	K	NP
Tushar Paintbrush*	Castilleja parvula var. parvula	K	NP
Pinnate Spring-parsley*	Cymopterus beckii	K	NP
Abajo Peak Draba*	Draba abajoensis	K	NP
Mt. Belknap Draba*	Draba ramulosa	K	NP
Creeping Draba*	Draba sobolifera	K	NP
Nevada Willowherb*	Epilobium nevadense	K	NP
Abajo Daisy*	Erigeron abajoensis	K	NP
Kachina Daisy*	Erigeron kachinensis	K	NP
Maquire Daisy*	Erigeron maguirei	K	NP
LaSal Daisy*	Erigeron mancus	K	NP
Elsinore Buckwheat*	Eriogonum batemanii var. ostlundii	K	NP
Canyonlands Lomatium*	Lomatium latilobum	K	NP
Fish Lake Naiad*	Nafas caespitosa	K	NP
Beaver Mountain Groundsel*	Packera castoreus	K	NP
Little Penstemon*	Penstemon parvus	K	NP
Ward Beardtongue Penstemon*	Penstemon wardii	K	NP
Bicknell Thelesperma*	Thelesperma subnudum var. alpinum	K	NP
Barneby Woody Aster*	Tonestus kingii var. barnebyana	K	NP
Sevier Townsendia*	Townsendia jonesii var. lutea	K	NP
San Rafael Cactus*	Pediocactus despainii	K	NP
Clay Phacelia*	Phacelia argillacea	P	NP
Last Chance Townsendia*	Townsendia aprica	K	NP
Ute Ladies'Tresses Orchid*	Spiranthes diluvialis	K	NP
Heliotrope Milk-Vetch*	Astragalus montii	P	NP
Winkler Cactus*	Pediocactus winkleri	K	NP
Desert Milk-Vetch*	Astragalus desereticus	K	NP

Mammals

Townsend's Western Big-eared Bat*	Corynothinus townsedii townsendii	K	NP
Spotted Bat*	Euderma maculatum	K	NP
Bighorn Sheep*	Ovis canadensis	K	NP
Pygmy Rabbit*	Brachylagus idahoensis	K	NP
Utah Prairie Dog*	Cynomys parvidens	K	NP

Birds

Northern Goshawk*	Accipiter gentilis	K	P
Flammulated Owl*	Otus flammeolus	K	P
Northern Three-toed Woodpecker*	Picoides tridactylus	K	P
Bald Eagle*	Haliaeetus leucocephalus	K	P
Greater Sage-grouse*	Centrocercus urophasianus	K	P
Peregrine Falcon*	Falco peregrinus anatum	K	P
Yellow-billed Cuckoo*	Coccyzus americanus	K/P	NP
Southwestern Willow Flycatcher*	Empidonax traillii extimus	K	NP
Mexican Spotted Owl*	Strix occidentalis lucida	K	NP

Fish

Colorado River Cutthroat Trout*	Oncorhynchus clarki pleuriticus	K	NP
Bonneville Cutthroat Trout*	Oncorhynchus clarki utah	K	NP
Southern Leatherside Chub*	Lepidomeda aliciae	K	NP
Greenback Cutthroat Trout*	Oncorhynchus clarki stomias	K	NP

Amphibians

Columbia Spotted Frog*	Rana luteiventris	K	NP
Boreal Toad*	Bufo boreas	K	NP

K - Known distribution species and or habitat

P - Suspected species or potential habitat NP- Not Present (BLM FSEIS)

USDA-Manti-LaSal National Forest, 599 Price River Dr., Price , Utah 84501

During breeding seasons, disturbance by man can negatively affect reproductive success by disrupting territorial selection or defense, interrupting courtship displays and disturbing mating animals.

Young animals need to be undisturbed during parturition, lactation and the early rearing process. It is during this time that young animals gain the strength and ability to elude predators and man. Undisturbed habitats allow the young animals to develop in a relatively unstressed situation and to utilize habitats that are secure from predators.

The company will make every effort to educate all employees associated with the SUFCO Mine operation to the intricate values of the wildlife resources associated with the mine area. Each employee will be advised not to unnecessarily or without proper permits or licenses harass or take any wildlife. It is especially important that wildlife not be harassed during sensitive periods in their life history. During winter, wildlife are often in a delicate energy state and unnecessary disturbance by man causes them to use up critical and limited energy reserves that may result in mortality. In less severe cases the fetus being carried by gestating mammals may be reabsorbed or aborted thus reducing reproductive success and productivity of the population. Surface activities are curtailed from November 1 through April 1, and between May 1 and July 1 in the calving area, except in the portal areas, so as not to disturb wintering elk. Employees will be encouraged to report violators to the proper company and management authorities for reprimand or prosecution. Employees should be impressed that they as hunting and recreation users stand to gain the most by preserving what they have in proximity to their places of work and abode.

Livestock and wildlife will be protected from the effects of mining related subsidence to the extent possible. Surface cracks that open to the point of creating a physical hazard to livestock and wildlife will be mitigated. This mitigation may include but not limited to backfilling the cracks with available local native materials and soil, partially backfilling with imported fill, or simply reshaping of the nearby ground surface to lessen the offset or abruptness of the crack faces and depth. The repaired areas will then be reseeded with a seed mix appropriate to the area and one approved by the Division and land owner/agency. Several such mitigation efforts have already been successfully conducted in the Quitchupah and Pines Tract areas.

short-term construction activity (pages 14-15, Manti-La Sal National Forest, SUFCO Mine Link Canyon Portal Record of Decision, Oct. 10, 2002). The area will be surveyed for raptor nests. If any are found within the prescribed buffer zone, they will be monitored for activity and work at the portal site will occur following the same guidelines as those described for the Link Canyon Substation.

Mining within the SITLA Muddy Tract will be limited to underground activities; no surface disturbance, other than exploration drilling, is anticipated in this area. Exploration drilling is typically handled by the Division under a separate permit application process. No known raptor nests are known to exist within the SITLA Muddy tract where subsidence will occur. However, if future raptor monitoring finds any raptor nest that has a potential to be disturbed by subsidence, the nest and potential damage will be evaluated with DWR and FWS. An appropriate plan of action will be developed on a case by case basis. The Division of Oil Gas and Mining will be informed in advance when such an evaluation is necessary. The applicant will obtain any permits necessary for disturbance of the nest if this is the course of action decided upon.

Generally, vegetation within the lease and permit areas outside of disturbed areas is protected from mining related impacts, such as subsidence, by the depth of overburden and depth of soil. Experience in mining the Pines and Quitchupah leases has shown that upland vegetation does not appear to be significantly affected by subsidence. Cracks that form in the soil tend to heal quickly and the majority of the vegetation in the area of surface cracks does not appear to be suffering from undue stress. The only cases of damage to vegetation related to mining appears to occur when subsidence cracks form in areas where a brittle sandstone body is near the surface with little soil cover and a crack either visibly bifurcates a plants root system or opens wide enough for soils and small plants to fall into. In a few locations, tree roots have been weakened by surface cracks and have resulted in the trees toppling shortly after the cracking occurs. This impact appears to be typically limited to areas near a canyon rim such as in the West and East Forks of Box Canyon. In areas where there are at least a few feet of soils over bedrock, such as in the previously mined portions of the Quitchupah Lease, this phenomenon has not been observed. Significant impacts to upland vegetation from subsidence are not anticipated in the SITLA Muddy Tract since most of the tract area has a relatively thick mantle of soils.

H - D - SU
C - D - SU
C - D - SU
H - D - SU
GREENS HOLLOW LEASE
H - D - WT
C - D - WT
H - D - SU
C - D - SU SITLA MUDDY LEASE
H - D - WT 11/1 - 4/15
C - D - WT 11/1 - 4/15
H - D - SU 5/16 - 10/31
H - D - WT 11/1 - 4/15
QUITCHUPAH LEASE
PINES LEASE
H - D - SU 5/16 - 10/31
H - D - WT 11/1 - 4/15
C - D - WT 11/1 - 4/15
H - D - WT 11/1 - 4/15
H - D - WT 11/1 - 4/15
C - D - WT 11/1 - 4/15
H - D - WT 11/1 - 4/15
C - D - WT 11/1 - 4/15

EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- 100000 MC — MINE COORDINATES
- 2020000 SPC — STATE PLANE COORDINATES
- C - D - SU — CRITICAL DEER SUMMER RANGE
- C - D - WT — CRITICAL DEER WINTER RANGE
- H - D - SU — HIGH PRIORITY DEER SUMMER RANGE
- H - D - WT — HIGH PRIORITY DEER WINTER RANGE
- 11/1 – 4/15 — PERIOD OF HEAVIEST RANGE USE
- HIGH PRIORITY SUMMER RANGE BOUNDARY
- CRITICAL WINTER RANGE BOUNDARY
- x — GUZZLER
- ○ — BUTEO
- ◑ — FALCON
- ● — PRAIRIE FALCON
- ✱ — PEREGRINE FALCON
- ■ — RAVEN
- ◪ — REDTAIL HAWK
- ▲ — GOLDEN EAGLE

SOURCE:

RAPTOR NESTS:

DIVISION OF WILDLIFE RESOURCES
475 WEST PRICE RIVER DRIVE
PRICE, UTAH
RAPTOR SURVEY 2004
ANTHONY WRIGHT, JUNE 16, 2004
TETRA TECH
2012–2014

DEER RANGE:

1. QUITCHUPAH TRACT
   DIVISION OF WILDLIFE RESOURCES
   CEDAR CITY, UTAH
   PAMELA HILL, NOV. 12, 1991

2. PINES TRACT
   DIVISION OF WILDLIFE RESOURCES
   PRICE, UTAH
   PINES TRACT CRITICAL/HIGH VALUE DEER RANGES MAP
   CHRIS COLT, FEB. 27, 1999

3. SITLA MUDDY TRACT
   COAL TRACT EVALUATIONS ON THE MANTI–LA SAL NATIONAL FOREST
   MUDDY TRACT DEER RANGE MAP
   MARCH 2004
   CIRRUS ECOLOGICAL SOLUTIONS, LC
   965 SOUTH 100 WEST, SUITE 200
   LOGAN, UTAH 84321

4. DEER HERD UNIT MANAGEMENT PLAN
   DEER UNIT 16C. OCT. 2015

PROFESSIONAL ENGINEER
No. 9073261
JACOB D. SMITH
STATE OF UTAH

I CERTIFY THE ITEMS SHOWN ON THIS DRAWING ARE ACCURATE TO THE BEST OF MY KNOWLEDGE

2000 0 2000

REVISIONS				
NO.	DATE	REQ. BY	DWG. BY	REMARKS
9	03/02/2015	V.M	T.R.B.	ADDED 70 ACRE R.O.W. FOR 5 WEST BOUNDARY
10	04/27/2016	V.M.	J.G.C.	ADD GREEN HOLLOW AND SOTH FORK LEASE
11	12/14/2016	V.M	T.L.M	REMOVE SOUTH FORK LEASE BOUNDARY
12	04/12/2017	V.M.	B.R.	GREENS HOLLOW

Canyon Fuel Company, LLC
SUFCO Mine
597 South SR 24 – Salina, UT 84654
(435) 286-4880 Phone
(435) 286-4499 Fax

DEER RANGE AND RAPTOR NESTS

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
fSlnd4-SUFDP1.ctb		3/2/2015			M.L.D.	PLATE 3-3
SHT SET: #### / PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 3-3.dwg					

CHAPTER 5

ENGINEERING

LIST OF PLATES

Plate

5-1 Previously Mined Areas

5-2A Detail of East Spring Canyon Surface Facilities

5-2B Extended East Spring Canyon Surface Facilities

5-2C Detail of Portal Surface Facilities

5-2D Detail of Link Canyon Surface Facilities

5-2E Detail of Link Canyon Surface Facilities No. 2

5-2F Detail of Link Canyon Portal Facilities

5-3A Post-Reclamation Surface Configuration

5-3B Extended Post-Reclamation Surface Configuration

5-4 Post-Reclamation Cross Sections

5-5 Existing Surface and Subsurface Facilities and Features

5-6 Land Ownership and Permit Area Map

5-7 Upper Hiawatha Mine Plan - 5 Year Projection

5-8 Lower Hiawatha Mine Plan - 5 Year Projection

5-9 Transportation Facility Cross Sections

5-10 Potential Subsidence Limits Sufco Mine

5-10C Potential Subsidence Limits - SITLA Muddy Tract & Greens Hollow Tract (Confidential)

5-11 Overburden Isopach Map

- Pre-mining analysis of drill-hole data allows estimates to be made of the nature, depth, and thickness of the coal seam and associated partings. Using these data, the mine plan and mining methods are evaluated and amended as necessary to maximize coal recovery.
- Experience gained during mining is used to amend future mine plans if coal recovery can be increased.
- The mine converted from an exclusive room-and-pillar extraction method to a combination of room-and-pillar and longwall extraction methods in October 1985. As a result of this conversion, coal recovery at the mine increased from approximately 75 percent under exclusive room-and-pillar methods to 88 percent under the combined room-and-pillar and longwall methods.

The mine layout has been planned relative to panels, barriers, and pillars to optimize both coal recovery and safety using a combination of longwall and room-and-pillar mining techniques.

An evaluation of geologic data collected in the southern portion of lease U-28297 indicates that the Upper Hiawatha seam in this area contains a paleochannel system and associated parting. The parting attains a thickness in excess of 20 feet and occurs in a northeast-southwest trending band varying in width from 2,000 feet to 7,500 feet. Because of this parting, most of the southern portion of lease U-28297 is deemed unminable from both technological and economic viewpoints.

Mining is not planned on parts of the extreme east and southeast portions of the Pines Tract Lease UTU-76195 as a result of poor quality and seam height. A parting located in the middle of the seam, will not allow mining to occur at the minimum height without putting quality at unacceptable levels. Much of the seam height in these areas is between 4-6 feet. Reserves are also lost to burn in these areas as a result of several promontories in the area which allow greater exposure of the outcrop to the atmosphere.

Mining is not planned on the northern portion of the SITLA Muddy Tract Lease ML 49443-OBA in the Upper Hiawatha Seam as a result of a sand channel and seam height that will not allow mining to occur.

The Lower Hiawatha seam will be mined in the northwest portion of the lease area where the interburden thickness between the Upper and Lower Hiawatha seams exceeds 30 feet. The mine plans are columnized or stacked where both seams are to be extracted. The Duncan seam does not contain sufficient minable reserves to warrant mining within the lease area.

The Duncan seam occurs about 100 to 130 feet above the Upper Hiawatha seam in a small portion of lease U-28297. The unsplit area of the Duncan seam is of small extent, probably less than 50 acres. Federal Lease U-28297 grants Canyon Fuel Company, LLC SUFCO Mine only the right to mine the Upper Hiawatha seam.

The Quitchupah Tract Resource Recovery and Protection Plan (R2P2) for Canyon Fuel Company, LLC SUFCO Mine is on file with the Bureau of Land Management. The R2P2 contains detailed mine plan and reserve calculations for all of the Quitchupah Tract leases operated by Canyon Fuel Company, LLC SUFCO Mine.

The Pines Tract Resource Recovery and Protection Plan (R2P2) for Canyon Fuel Company, LLC SUFCO Mine is on file with the Bureau of Land Management. The R2P2 contains detailed mine plan and reserve calculations for the Pines Tract lease operated by Canyon Fuel Company, LLC SUFCO Mine.

The SITLA Muddy Tract Plan of Operations Resource Recovery and Protection Plan (R2P2) for Canyon Fuel Company, LLC SUFCO Mine is on file with the State of Utah, School and Institutional Trust Lands Administration. The Plan of Operations Resource Recovery and Protection Plan (R2P2) contains detailed mine plan and reserve calculations for the SITLA Muddy Tract lease operated by Canyon Fuel Company, LLC SUFCO Mine.

Upper Hiawatha coal seam. Overburden ranges approximately from 300-900 feet. The projected subsidence across the 4R4E panel ranges from 1 -5 feet and the projected average subsidence is approximately 2 feet. See the 4R4E Projected Subsidence Map in Appendix 6-4. No surface disturbance, new surface facilities or infrastructure will be associated with the mining of the 4R4E panel therefore no bonding will be needed.

Pines East Panel(s)

Mining of these panel will occur in Lease UTU-76195 which is referred to as the Pines Tract throughout the M&RP in text, appendices and on drawings. This lease was issued to the permittee in October 1999 (Appendix 1-2), portions of the lease were relinquished in 2016 (Appendix 1-1). See Plate 5-6 and Plate 5-7 for the mine plan and respective timing. Mining will occur only in the Upper Hiawatha coal seam. Overburden ranges approximately from 750-1000 feet. The projected subsidence across the panels is 5 feet or less. Subsidence control points have been previously established near the panels (Table 5-2). No surface disturbance, new surface facilities or infrastructure will be associated with the mining of the panels.

5.2.5.1 Subsidence Control Plan

Potential Areas of Subsidence. Structures that are present above the existing or planned mine workings that may be affected by mining are shown on Plate 5-5. Renewable resource lands within the lease and permit areas are shown on Plates 4-1 A, B, C, 5-10C, 7-2 and 7-3. Two subsidence monitoring locations were added in 2017, one west of the Greens Hollow lease(#2251), the second is within the Greens Hollow lease (#2250), additional subsidence monitoring locations will be added as mining progresses to the north.

Green Hollow. Various information for the Greens Hollow Lease is located in Appendix 7-27 and the renewable resource lands plates listed above. The Greens Hollow area contains troughs, stock and natural ponds which may be affected by subsidence. They are shown on drawing in this appendix under divider "Natural and Stock Ponds" The area of the Greens Hollow lease is not known to contain non-commercial buildings; public buildings and facilities; churches; schools; hospitals; occupied residential dwellings or related structures. The Rough Brothers cabin the only one known of in the area was demolished in 2016 according the USFS personnel owners of the

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 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. Subsidence cracks in the area of the West Fork of Box Canyon are located in Longwall area 10 that has been mined out since 2001, and the area is now assumed to be dormant. 2008 will be the last year these cracks will be monitored since there will not be anymore movement in this area.

Anticipated Effects of Subsidence. Future subsidence in the lease 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.

TABLE 5-2 (Continued)
Subsidence Control Point Survey Data

Station Name	Northing	Easting	Elevation
P.K. Nail	118833.45	109123.60	8380.36
Pot Hole	108988.85	099782.73	8294.55
Prairie View	131204.98	125857.42	8451.01
Rain Gauge	102916.00	101948.87	7558.53
Rain Rock	121342.03	130240.93	8691.08
Ramble On	121927.63	131923.04	8758.11
Range Pole	125342.96	113084.37	8356.94
Rattle Snake	105717.67	105315.88	8411.86
Red Nose	111823.28	124354.97	8667.55
Ridge	117278.21	107079.21	8630.86
Rim Rock	102804.40	100422.90	8367.60
Rocknest	144458.05	129952.07	7154.21
Rock On	122072.13	131499.36	8738.41
Rocky II	126969.22	109539.79	8320.28
Sage	128102.11	134164.59	8718.55
Sandhill	122060.12	134109.81	8811.25
Sandridge	121328.27	127907.98	8648.74
Scales	103185.47	101587.37	7548.18
Sedpond1	102002.12	101463.23	7562.73
Shady Pines	125570.58	133937.70	8766.82
Single Tree	131237.84	127470.34	8460.00
SKS	123193.35	135241.06	8832.12
Slab Rock	119915.33	104763.90	8549.06
Slaughter Hill	144554.25	122928.40	8560.94
South Fork	122360.32	102147.28	8217.44

TABLE 5-2 (Continued)
Subsidence Control Point Survey Data

Station Name	Northing	Easting	Elevation
Spike	106426.93	100039.17	8325.62
Split Rock	129534.95	128829.31	8519.39
Standard	133589.26	108900.52	9139.56
Stock Pond	132382.89	118400.29	8390.90
Stonewood	121550.07	134283.71	8815.21
Stumpy	127542.00	131932.07	8660.21
Substation B.M.	102787.93	102081.34	7563.46
Sunspot	122068.81	130374.08	8705.83
Switchback	120172.62	126162.50	7826.13
Terrace	103533.00	101612.28	7598.64
That	134704.05	121439.83	8354.24
This	133853.23	122161.75	8385.37
Three Pines	128994.27	131195.32	8610.37
Thunder Ridge	145713.29	121585.36	8502.52
Two Flats	121612.91	132938.78	8783.19
U.S.G.S.	130065.44	100406.72	8648.16
Valley View	115797.62	099307.50	9054.37
Vanwinkle	120967.82	131485.30	8738.62
Wasatch2	176502.69	091318.15	11130.23
White Rocks	119944.80	116486.58	8530.16
White Rocks II	119945.83	116485.02	8526.53
Wilco	120846.31	129130.30	8685.09
Wildcat	121403.85	122435.42	9030.03
Wileys	130032.60	134664.80	8652.51
Window	125525.90	111439.67	8290.13

CHAPTER 4

LAND USE AND AIR QUALITY

season. Additional hunter use information reported by the Utah Division of Wildlife Resources can be found in the Utah Big Game Annual Report for 1991 (Appendix 4-1).

Pines Tract Area

The existing land uses in the Pines Tract area include: timber production, livestock grazing, wildlife habitat, recreation, transportation corridors and underground coal mining (SUFCO Mine). The existing land uses not previously discussed are the transportation corridors and underground coal mining (SUFCO Mine, Quitchupah Lease). The roads/transportation corridors are generally single-lane native surface forest development roads which are passable during the drier months of the year. The forest development roads connect with local roads that access major highways.

In the late 1970s two Roadless Area Review and Evaluation (RARE) II areas were inventoried. Neither area was designated as wilderness, nor were they classified as roadless or semi-primitive recreation management areas under the Forest Plan in 1986 (Pines Tract Project EIS, 1999).

The Pines grazing unit is part of the Emery C&H grazing allotment. The Pines unit supports 1,387 head of cattle during the early grazing season. Eight ponds for livestock and wildlife use have been developed in the Pines Tract area (see Chapter 3, Appendix 3-9, Figure 2 - Springs, Seeps and Riparian Areas). The Link Canyon troughs and the Joe Mill ponds are the most reliable sources of developed water within the tract area.

The limited amount of perennial water within the analysis area reduces the potential for many species of fish to be present. However, Muddy Creek and the lower portion of Box Canyon Creek support fish populations.

The Sevier County Zoning Resolution designates the area as GRF-1. The primary uses designated for GRF-1 areas include gravel pits, clay pits, rock quarries, oil and gas wells, mines, mineral reduction, processing structures and facilities. There are no oil or gas leases associated with the Pines Tract area.

and has the potential for National Register classification. This site is not considered to be at-risk or susceptible to surface subsidence.

Site 42 SV 2494 - The site consists of a dispersed scatter of debris and lithic tool fragments and is situated on the bedrock on the east rim overlooking Box Canyon. This site is not considered to be a significant resources and lacks potential for National Register classification.

Site 42 SV 2495 - The site consists of a scatter of debris primarily on the north facing slope below the base of a shallow shelter under a sandstone ledge. The site is considered to be a significant resource and has limited potential for National Register classification. This site is not considered to be at-risk or susceptible to surface subsidence.

The Applicant agrees, however, to notify the regulatory authority and the Utah State Historical Society of previously unidentified cultural resources discovered in the course of mining operations. The Applicant also agrees to have any such cultural resources evaluated in terms of National Register of Historic Places eligibility criteria. Protection of eligible cultural resources will be in accordance with regulatory authority and Utah SHPO requirements. The Applicant will also instruct its employees that it is a violation of federal and state laws to collect individual artifacts or to otherwise disturb cultural resources.

Pines Tract Area

Cultural and Historic Information. Cultural resource information and maps identifying cultural and historical study areas are located in Appendix 4-2. Dr. Richard Hauck of AERC made a record search at the State Historic Preservation office, National Register of Historic Places and conducted field investigations under state project numbers UT-96-AF-0443f and UT-97-AF-0598f. AERC coordinated the research and field investigations with SHPO.

Information concerning the potential of specific sites as to being either in the subsidence zone or out of the zone or being evaluated or unevaluated is contained in the Memorandum of Agreement between Federal and State agencies.

The monitoring, treatment plans and mitigation of the cultural resource sites will be in accordance with the Memorandum of Agreement (MOA) 00-MU-11041000-017, and any amendment to it, between the USFS - Manti-La Sal, USHPO, the Advisory Council on Historic Places, UDOGM, and the SUFCO Mine located in Appendix 4-5.

Sufco intends to undermine portions of the East Fork of Box Canyon beginning in the Fall of 2003 as they extract coal from the 3LPE and 4LPE longwall panels. This change in the mining plan will change the required monitoring schedule in accordance with the Memorandum of Agreement for site 42SV2430/ML-3446 - Elusive Peacock which will be undermined under the 3LPE longwall panel. In accordance with pages 11-12 of the MOA the required monitoring schedule of this site will change from Monitor Schedule A (Sites in areas that will be mined using full-support methods) to Monitor Schedule B (Sites in areas which will be mined under and subsided) requiring the implementation of additional monitoring of the site. Monitoring results will be provided in DOGM Annual Reports. (2003, 2004, 2005, 2006, and indefinitely until movement ceases)

Historic properties documented in the Pines Tract area include 42SV2424, a sawmill, and site 42SV2391 a complex of trash scatters. Both sites are considered ineligible for the NRHP.

Pines East Panels - The area has been previously subject to many cultural resource inventories. Sites recorded within the search area are documented in inventories of the Pines Area located in Confidential-Appendix 4-2 (AERC, Pines Locality,11/2/1997). SHPO clearance for the Pines East Panels is being sought in 2018/2019 following a review by the USFS and DOGM, see Appendix 4-2 for documentation of the clearance. Site 42SV2426 is the only prehistoric site in the immediate area of the panels and is considered insignificant. Site 42SV2426 consists of a lithic scatter of debitage (flakes, scraper, a projectile point fragment) on the rim of the Wasatch Plateau. As expected the artifacts scatter as encountered was isolated, sparse and of low complexity. In 2018 portions of Sections 13, 24 and 25 of T21S, R5E (Figure 2) were inventoried in association with an exploration drilling project, no artifacts or cultural resources were encountered. The inventory report has been incorporated into Appendix 4-2 (Tetra Tech July 2018).

The Applicant agrees, however, to notify the regulatory authority and the Utah State Historical Preservation Office (SHPO) of previously unidentified cultural resources discovered in the course of mining operations. The Applicant also agrees to have any such cultural resources evaluated in terms of National Register of Historic Places eligibility criteria.

Muddy Creek Coal Tract Area

Cultural and Historic Information. Cultural resource information and maps identifying cultural and historical study areas are located in Appendix 4-2. Cirrus Ecological Solutions, LC conducted an intensive evaluation of the Muddy Tract Area. Thirty-four sites were documented during the evaluation. Refer to Confidential Appendix 4-2, "Muddy Creek Technical Report, Heritage Resources".

The three sites located in the SITLA Muddy Tract lease area are located on or near the east rim of Box Canyon. The sites include two significant lithic scatters (42SV2554 and 42SV2597), and a non-significant lithic scatter (42SV2594). None of these three sites will be undermined under the present mine plan.

The Applicant agrees, however, to notify the regulatory authority and the Utah State Historical Preservation Office (SHPO) of previously unidentified cultural resources discovered in the course of mining operations. The Applicant also agrees to have any such cultural resources evaluated in terms of National Register of Historic Places eligibility criteria.

Results from USDA Manti-La Sal National Forest, Price Ranger District, Project #ML-02-1033, Utah State Project #U-02-MM-0311f, s, b, p

Site #	Site Type	Evaluation (Cirrus Ecological Solutions, LC)	Undermined/potential for impact by mining	Date Surveyed
42SV2584*	LS, RS,C	Significant	No/Not expected	1966(PI 1976)

people. Based-on an average round trip of 62 miles per day, 3.0 million miles of personal car transportation is saved annually by the use of company transportation. This represents an extremely significant limitation of vehicular emissions.

Fugitive dust emissions from the load out area are moderate. Coal load out operations are the source of most of the fugitive dust emissions. Trucks are routed near the emergency coal storage area. Because some stored material must be loaded with a front end loader, physical separation of the driveway and the storage area is not feasible. Trucks encroach upon the coal storage piles resulting in a thin layer of pulverized coal dust. This emission source is controlled through regular water applications. The area is within the sediment pond collection system.

c. Coal crushing and conveying - All crushing is conducted in closed areas. The main conveyor belts are covered, as are most lifts and drop points. Fugitive emissions observed are extremely low. The low emissions were evidenced even during winds of approximately 15 miles per hour. The extremely good dust control in this area is attributed to the excellent condition of covers and seals and to the relatively high water content of the product.

d. Truck loading - Loading is primarily accomplished by dropping the product from a bin-hopper into the haul trucks. Drop points are well protected from the prevailing wind directions. Loading is accomplished almost immediately after the product is removed from the mine and the water content of the product is assumed responsible for severely limiting dust emissions. Loading of temporarily stored material by front end loader results in significantly increased fugitive emissions. The limited use of this method of loading allows discounting its overall contribution.

The operator controls fugitive dust by application of water to areas where needed. An assessment of the particulate emissions at the mine site are included as Appendix 4-3.

Due to the general excellent air quality and the Pines Tract area's high air mixing, cumulative impacts on the quality of the ambient air are minimal (Pines Tract Project EIS, 1999).

Pinyon-juniper condition standards studies. Forest Service, R-4 - reports and data.

Phillips, T. A. 1965. Black pine juniper study. Unpub. Forest Service report.

U.S. Department of the Interior, Final Supplemental Impact Statement for Leasing and Underground Mining of the Greens Hollow Federal Coal Lease Tract UTU-84102, Sanpete and Sevier Counties, Utah, February 2015

U.S. Forest Service. 1971. Unpublished data, Range suitability and condition map, Quitchupah C & H allotment, Fishlake National Forest, Grazing impact analyzes, and record of permanent line transects.

U.S. Forest Service. 1976. Final environmental statement for land use plan, Salina Planning Unit, Fishlake National Forest. USDA, Forest Service, Intermountain Regional.

U.S. Forest Service. 1986. Land and resource management plan, Fishlake National Forest. USDA, Forest Service, Intermountain Region.

U.S. Forest Service. 1986. Land and resource management plan, Manti-La Sal National Forest. USDA, Forest Service, Intermountain Region.

U.S. Forest Service. 1999. Final Environmental Impact Statement, Pines Tract Project, Manti-La Sal National Forest. USDA, Forest Service. Western Regional.

WESTECH. 1978. Environmental assessment and impact evaluation of underground coal mining at the Southern Utah Fuel Company Mine property in central Utah. Technical report prepared for Coastal States Energy Company.

WESTECH. 1978. Environmental assessment and monitoring for the Southern Utah Fuel Company Mine near Salina, Utah. Technical report prepared for Coastal States Energy Company.

GREENS HOLLOW LEASE

SITLA MUDDY LEASE

QUITCHUPAH LEASE

PINES LEASE

T. 20 S
T. 21 S
R. 4 E
R. 5 E
R. 6 E

EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- 100000 MC — MINE COORDINATES
- 2020000 SPC — STATE PLANE COORDINATES
- PROPOSED LEASE BOUNDARY
- CONTROL POINT
- AERIAL TARGET
- LIMIT OF POTENTIAL SUBSIDENCE
- UNDERGROUND PERENNIAL STREAM AND PROTECTED CULTURAL SITE BUFFER CORRIDOR

1000 0 1000

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REVISIONS				
NO.	DATE	REQ. BY	DWG. BY	REMARKS
2	07/13/09	V.M.	J.G.C.	ADD GREENS HOLLOW BOUNDARY
3	4/16/2017	V.M.	B.R.	GREENS HOLLOW
4	12/8/2017	V.M.	B.R.	ADD 3R4E & 4R4E
5	3/19/2018	V.M.	B.R.	GREENS HOLLOW TECHNICAL ANALYSIS
6	10/31/2018	V.M./B.B.	J.G.C.	SUB LIMITS FOR PINES EAST & SOUTH FORK
7	1/15/2019	V.M.	J.G.C.	REVISED SUB LIMITS FOR PINES EAST

Canyon Fuel Company, LLC
SUFCO Mine
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(435) 286-4880 Phone
(435) 286-4499 Fax

POTENTIAL SUBSIDENCE LIMITS

SCALE:	DATE:	DRAWN BY:	ENGINEER:	SHEET NO.
1" = 1000'	08/13/09	JMB		PLATE 5-10

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GREENS HOLLOW LEASE

SITLA MUDDY LEASE

QUITCHUPAH LEASE

PINES LEASE

FUTURE LOWER HIAWATHA POINT OF ACCESS FROM UPPER HIAWATHA

RICCI MINE

LINK CANYON MINE

UTU-84102

UTU-76195

ML 49443-OBA

U-63214

U-47080

SL-062583

U-062453

U-28297

U-0149084

FEE

PB 36

PB 38

PB 40

PB 41

PB 42

EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- ESCARPEMENT
- OUTCROP
- PROPOSED LEASE BOUNDARY

MINING LEGEND

- REMAINING 2017
- 1ST QUARTER 2018
- 2ND QUARTER 2018
- 3RD QUARTER 2018
- 4TH QUARTER 2018
- 2019
- 2020
- 2021
- 2022

PROFESSIONAL ENGINEER
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JACOB D. SMITH
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REVISIONS				
NO.	DATE	REQ. BY	DWG. BY	REMARKS
12	4/13/2017	V.M.	B.R.	GREENS HOLLOW
13	12/19/2017	B.B.	B.R.	Add 4R4E Panel
14	3/27/2018	V.M.	B.R.	GREEN HOLLOW TECHNICAL ANALYSIS
15	10/31/2018	V.M./B.B.	J.G.C.	ADDED PROPOSED SOUTH FORK LEASE
16	1/15/2019	V.M.	J.G.C.	ADDED PINE EAST

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SUFCO MINE PLAN
5 YEAR PROJECTION

PEN TBL: _15mfrd-SUFENPT.ctb
SHT SET: ####
PROJECT NUMBER: ####
SCALE: 1" = 1,500'
DATE: 03/01/2000
DRAWN BY: B.D.H.
ENGINEER: JDB
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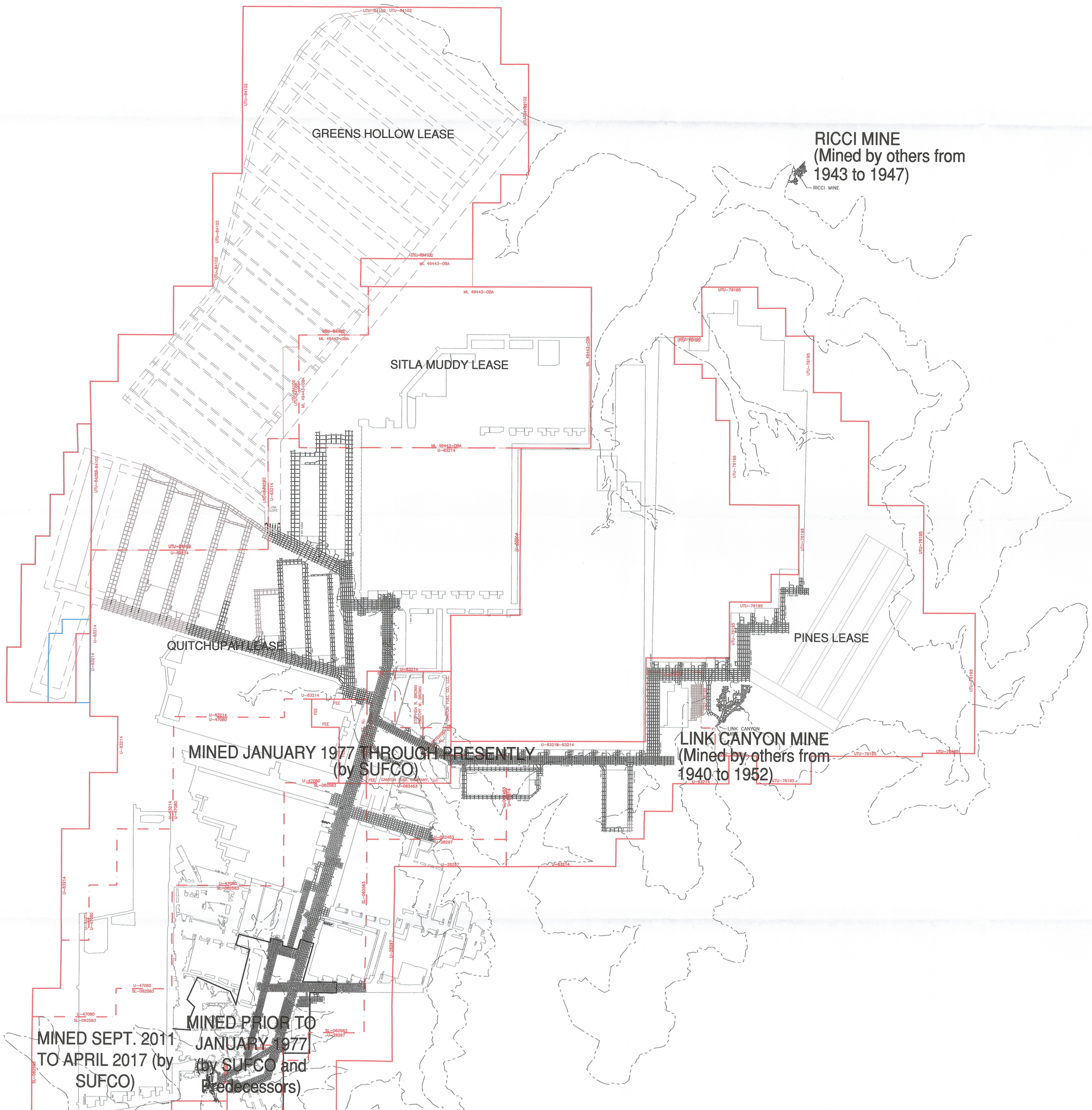
FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 5-7.dwg
SHEET NO. PLATE 5-7



EXPLANATION

- MINED AREA BOUNDARY
- OUTCROP
- ESCARPMENT
- EXTERIROR LEASE BOUNDARY
- INTERIOR LEASE BOUNDARY
- PROPOSED LEASE BOUNDARY

PROFESSIONAL ENGINEER
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STATE OF UTAH

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REVISIONS				
NO.	DATE	REQ. BY	DWG. BY	REMARKS
2	1/20/2005	M.L.D.	B.D.H.	
3	5/8/2007	M.L.D.	K.B.B.	
4	6/11/2010	M.L.D.	K.B.B.	
5	3/2/2015	V.M.	T.R.B.	ADDED 70 ACRE R.O.W. AREA FOR 5 WEST
6	4/12/2017	V.M.	B.R.	GREENS HOLLOW
7	3/27/2018	V.M.	B.R.	GREENS HOLLOW TECHNICAL ANALYSIS
8	10/31/2018	V.M./B.B.	J.G.C.	ADD PINES EAST AND SOUTH FORK
9	1/15/2019	V.M.	J.G.C.	MODIFIED PINES EAST

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PREVIOUSLY MINED AREAS

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
JStnd4-SUFDNP1.ctb	1" = 2,000'	6/18/1999	A.D.D.		M.L.D.	PLATE 5-1
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OVERBURDEN ISOPACH MAP

GREENS HOLLOW LEASE

SITLA MUDDY LEASE

QUITCHUPAH LEASE

PINES LEASE

EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- 100000 MC — MINE COORDINATES
- 2000000 SPC — STATE PLANE COORDINATES
- PROPOSED LEASE BOUNDARY

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2000 0 2000

REVISIONS				
NO.	DATE	REQ. BY	DWG. BY	REMARKS
6	12/15/2016	V.M.	T.L.M.	REMOVE SOUTH FORK LEASE BOUNDARY
7	4/18/2017	V.M.	B.R.	GREENS HOOLOW
8	10/18/2017	B.B.	B.R.	Add 4R4E Panel
9	3/27/2018	V.M.	B.R.	GREENS HOLLOW TECHNICAL ANALYSIS
10	10/31/2018	V.M./B.B.	J.G.C.	ADDED PROPOSED SOUTH FORK LEASE AND
				MINING IN SOUTH FORK AND PINES EAST
11	1/15/2019	V.M.	J.G.C.	MODIFIED PINES EAST

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PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_150ndd-SUFDIP1.ctb	1" = 2,000'	01/20/2005	BDH/TRB	JDB	VM	PLATE 5-11
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CHAPTER 6

GEOLOGY

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6-2 Geologic Cross Section A-A'

6-3 Geologic Cross Section B-B'

6-4 Geologic Cross Section C-C'

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(Appendices appear in Volume 6)

Appendix

6-1 Drill Logs (Confidential)

6-2 Chemical Analyses

6-3 Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining

6-4 3 Right 4 East and 4 Right 4 East Panels (Confidential)

6-5 Greens Hollow Lease

3 Right 4 East Panel(s)

Refer to Section 5.2.1.1 for reference to various maps, including those containing topography of the 3 Right 4 East panel. Additional geology maps requested by the Manti-La Sal forest geologist are located in Appendix 6-4 (Confidential). The maps are of subsidence, geology and overburden superimposed over the panel(s) mine plan and cross-sections of longwall panel within the coal seam. The information on the geology maps within Appendix 6-4 with the label "Panel 3R4E" are specific and more comprehensive than generalized information presented within this chapter.

4 Right 4 East Panel(s)

The 4R4E panel is located within Lease U-63214 which is referred to as the Quitchupah Tract. This tract is located within the southern region of the Wasatch Plateau which lies with the Basin and Range-Colorado Plateau Province. The topography of the tract consists of a flat plateau that is deeply dissected by narrow canyons., The coal seams crop out in the southeastern portion of the tract along the steep escarpments of Quitchupah Canyon, Dry Fork Canyon, East Fork Canyon and Link Canyon, The 4R4E panel is located in Dry Fork Canyon. See Appendix 5-14, Plate 5-6 and Plate 5-7 for the 4R4E mine plan, lease locations and mine timing respectively. Mining will occur only in th Upper Hiawatha coal seam. Overburden ranges approximately from 300-900 feet. The projected subsidence across the 4R4E panel ranges from 1-5 feet and the projected average subsidence is approximately 2 feet. See the 4R4E Projected Subsidence Map in Appendix 6-4.

The Applicant has a Resource Recovery and Protection Plan (R2P2) on file with the Bureau of Land Management. This R2P2 contains a detailed description of the two mineable coal seams on the SUFCO Mine leasehold. The overlying Duncan Seam is not considered mineable (see Section 5.2.2).

Pines East Panel(s)

The panel is located within Lease UTU-76195 which is referred to as the Pines Tract. This tract is located within the southern region of the Wasatch Plateau which trends north and south. The topography of the tract consists of a flat plateau that is deeply dissected by narrow incised canyons. Generally canyon walls are steep and canyon bottoms are narrow. The overburden ranges approximately from 750-1000 feet. Geologic units in the area on the plateu include the Price River Formation, small areas of the Castlegate Sandstone Formation and the Blackhawk Formation - Upper Member and Blackhawk Formation - Starpoint Sandstone member in the canyons.

There is a plugged and abandoned gas well located in Section 23, T21S, R5E in the Pines Tract. No other oil or gas wells are known to exist within a quarter mile of the mine area. No other water wells have been drilled in the lease area except those drilled by the applicant for the purpose of monitoring the groundwater.

6.2.3 Geologic Determinations

The information required by UDOGM to make a determination of the acid or toxic forming characteristics of the site strata is presented in Section 6.2.4.3 of this M&RP.

The information required by UDOGM to make a determination as to whether the reclamation plan, described in Section 5.40, can be accomplished is presented in Section 6.2.4.

The information required to prepare the subsidence control program is addressed in Section 6.2.4.

6.2.4 Geologic Information

6.2.4.1 Regional Setting

The SUFCO Mine is located beneath the Old Woman Plateau, 20 miles east of Salina, Utah. The Old Woman Plateau lies in the Wasatch Plateau Subprovince of the Colorado Plateau Physiographic Province.

Stratigraphy. All rock units within the SUFCO Mine property boundaries are sedimentary (Plate 6-1 and Figure 6-1). No igneous or metamorphic units are found in the area. Most exposed, consolidated sedimentary rocks in the area were deposited during the Cretaceous Age of the Mesozoic Era. The uppermost North Horn Formation is Upper Cretaceous to lower Tertiary (Paleocene) in age. The oldest unit is the Upper Cretaceous Masuk Member of the Mancos Shale, which is overlain in order of increasingly younger rocks, by the Star Point Sandstone Member of the Blackhawk Formation; the Upper Blackhawk Formation, the Castlegate Sandstone, the Price River Formation and the overlying North Horn Formation (Figure 6-1).

<u>Mancos Shale-Masuk Member</u>

The Masuk Member of the Mancos Shale has been mapped throughout eastern Utah and western Colorado. The Masuk Member crops out along the entire eastern edge of the Wasatch Plateau and varies in thickness from 300 to 1,300 feet (Davis, and Doelling, 1976). It thins from north to

6.30 Operation Plan

6.3.1 Casing and Sealing of Exploration Holes

The information addressing regulations for casing and sealing of exploration holes is found in Section 7.6.5 of this M&RP. This includes both the temporary and permanent casing and sealing of exploration holes. The applicant believes all exploration boreholes that have not been used for piezometers have been plugged properly prior to abandonment as required by the regulatory authority. This plugging was the final step in the drilling process prior to abandonment of the well.

6.3.2 Subsidence Monitoring

Subsidence and subsidence monitoring points are discussed in detail in Section 5.2.5 of this M&RP. The extent of the subsidence is shown on Plate 5-10. Subsidence monitoring is performed on an annual basis and the results of the monitoring are reported in the annual report.

Surface cracking related to mine subsidence has occurred above the existing mine workings at the Sufco mine. The cracks are surveyed and illustrated on the Mine Subsidence Map included in the annual report. Subsidence cracks that form due to mining generally occur over mined panels and above the inside edges of the gateroads. Where the overlying topography is relatively flat, such as in the Pines tract, cracks will form in the soils and bedrock parallel, sub-parallel and perpendicular to the long axis of the panel. In this type of area, the cracks will typically have minimal aperture and minor vertical offset. Subsidence in areas of the Quitchupah and Pines Tract where a deep drainage with steep canyon walls capped by Castlegate Sandstone exist, cracks have formed parallel to the drainage rim and may or may not be parallel to the axis of the panel. Occasionally, these cracks remain open after subsidence is complete. Sufco has repaired several cracks on the rim above the East Fork of Box Canyon where it was determined they presented a safety hazard.

Where bedrock is exposed at the surface and the local joint pattern is evident, subsidence fractures appear to be parallel or sub-parallel to the orientation of the panel. The cracks typically form an en echelon pattern on either side of the joint and may intersect with the joint. After the crack intersects the joint, it will travel within the joint itself for a short distance. However, the crack will reappear in the bedrock again outside of the joint as the en echelon pattern continues. In the Pines Tract and Quitchupah areas, jointing generally does not appear to have significant effect on the location or propagation of subsidence related fractures. Exceptions to this occur where the Castlegate Sandstone has been subsided at or near the rim of steep drainages or canyons. In these areas, large blocks of sandstone have been observed to rotate toward the drainage during subsidence. Often, after subsidence is complete, the blocks remain at their new attitudes leaving an opening

between the block and the in-place sandstone. Where the aperture is deemed hazardous, Sufco has backfilled the openings.

Subsidence in the Muddy tract area will occur in the Price River and North Horn Formations. Because these formations consist of ledge/slope forming interbedded sandstone, siltstone, shale and limestone and are typically overlain by a mantle of soil, little bedrock is exposed at the surface. Therefore, it would be difficult to determine the relationship of subsidence crack formation and bedrock jointing. It would be appropriate to assume, however, that subsidence cracks will form in this tract similarly to those found in the previously mined and subsided areas of the Sufco mine.

6.3.3 Exploration Drilling

The purpose of exploration drilling is to obtain stratigraphic and coal quality information to make for more accurate mine planning and maintain a high level of miner safety. The exploration area is located within the current mining lease boundary of Permit C/041/0002 as shown on Plate 6-1. The SUFCO Mine is planning to drill approximately 10 drill holes over the next 5 years. In the case of the SITLA lease, drilling will be conducted as approved under a Division-approved Minor Coal Exploration Permit. As in the past, drilling on federal leases with USFS administered surface will continue to be permitted through the BLM Exploration Plan process. The SUFCO Mine understands that UDOGM, the BLM, and the USFS all have a important roles in approval of drilling and will continue to work diligently to ensure requirements of all involved agencies are met prior to conducting surface exploration work.

Drill site preparation, drilling, and final reclamation work will last approximately two weeks per year. Reclamation will be concurrent with drilling to minimize the duration of the project.

The type of exploration to be used is rotary drilling or continuous wireline core drilling using a 2,000 ft rated drill rig. The drilling procedure for rotary drilling will be as follows: rotary drill using a tri-cone bit to core point, core the coal intervals using air with a diamond or carbide bit, ream the cored interval and rotary drill to total depth. Air will be used as a drilling medium as much as possible though conditions may warrant water, foam or mud. The drilling procedure for continuous wireline core drilling will be as follows: continuous core drill through total depth. Drilling medium will be water, polymer, and/or mud. Upon completion of drilling, the holes will be geophysically logged then plugged the full depth with concrete or a combination of concrete and bentonite hole plug or abandonite as approved by the BLM. A total of up to 4.0 acre-feet of water will be pumped from the North and/or South Fork of Quitchupah Creek, Muddy Creek , or the Sufco minesite for use during drilling and hole plugging operations. No coal will be removed beyond that which is cored.

GREENS HOLLOW LEASE

SITLA MUDDY LEASE

QUITCHUPAH LEASE

PINES LEASE

NOTE:
1. CONTACTS HAVE NOT BEEN FIELD CHECKED.
2. FAULTS PROJECTED TO SURFACE FROM MINE

EXPLANATION

- UPPER HIAWATHA COAL SEAM OUTCROP
- EXTERIOR LEASE BOUNDARY
- INTERIOR LEASE BOUNDARY
- MINE BASE COORDINATES (100000 MC)
- STATE PLANE COORDINATES (2000000 SPC)
- US–79–2 O (8497) — DRILLHOLE LOCATION AND NUMBER / DRILLHOLE SURFACE ELEVATION
- PROPOSED LEASE BOUNDARY
- FORMATION OR MEMBER CONTACT
- FAULTS WITH GREATER THAN 2' DISPLACEMENT MAPPED IN MINE
- A'------A — CROSS–SECTION (SEE PLATE 6–2, 6–3, 6–4 AND 6–5)
- PROPOSED NEWLY BUILT ACCESS ROUTES
- PROPOSED ACCESS ROUTES USING EXISTING WHEEL TRACKS OR EXISTING SURFACE

GEOLOGIC KEY

AGE	SYMBOL	NAME
QUATERNARY	Qa	ALLUVIUM, HILL WASH, SLUMPS UNDIFFERENTIATED
TERT–CRET	T–Knh	NORTH HORN FORMATION
CRETACEOUS	Kpr	PRICE RIVER FORMATION
"	Kc	CASTLEGATE SANDSTONE FORMATION
"	Kbh	BLACKHAWK FORMATION–UPPER MEMBER
"	Ksp	BLACKHAWK FORMATION–STARPOINT SANDSTONE MEMBER
"	Kmm	MANCOS SHALE–MASUK MEMBER

1.5/N 42 E — CALCULATED STRIKE AND DIP TOP UPPER HIAWATHA COAL SEAM

COAL BURN

SOURCES:

1. QUITCHUPAH LEASE ADDITION, VOLUME 10, MAPS 5.2, 5.3, 6.1, 1989 HYDROMETRICS INC. SOUTHERN UTAH FUEL COMPANY'S HYDROLOGICAL RESPONSE TO OSM'S APPARENT COMPLETENESS REVIEW
2. MANTI–LA SAL NATIONAL FOREST–PINES TRACT PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT (FEIS) FIGURE 3–1 GEOLOGY MAP JANUARY 1999 USDA FOREST SERVICE, REGION FOUR MANTI–LA SAL NATIONAL FOREST EMERY AND SEVIER COUNTIES, UTAH
3. COAL TRACT EVALUATIONS ON THE MANTI–LASAL NATIONAL FOREST MUDDY CREEK AND NORTH HORN SURFACE AND GROUND WATER TECHNICAL REPORTS FIGURE 2 GEOLOGY MAP WITH SPRING LOCATIONS. MUDDY COAL TRACT EIS, EMERY CO. UTAH OCTOBER 2004

No. 9073281 JACOB D. SMITH PROFESSIONAL ENGINEER STATE OF UTAH

I CERTIFY THE ITEMS SHOWN ON THIS DRAWING ARE ACCURATE TO THE BEST OF MY KNOWLEDGE

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REVISIONS				
NO.	DATE	REQ. BY	DWG. BY	REMARKS
8	03/02/2015	V.M.	T.R.B.	ADDED70 ACRE R.O.W. AREA FOR 5 WEST
9	07/14/2016	V.M.	J.G.C.	ADD GREEN HOLLOW & SOUTH FORK LEASE BOUNDARIES
10	12/15/2016	V.M	T.L.M.	REMOVE SOUTH FORK BOUNDARY
11	4/18/2017	V.M.	B.R.	GREENS HOLLOW
12	10/3/2017	V.M.	B.R.	Castle Gate Sandstone
13	11/7/2018	V.M.	J.G.C.	ADDED 2018 DRILLING

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GEOLOGY & DRILL HOLE LOCATION MAP

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_Shdrd-SUFDPI.ctb	1" = 2,000'	3/5/2015	KJW/TRB	JDB	VM	PLATE 6–1
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CHAPTER 7

HYDROLOGY

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7-3 Hydrologic Monitoring Stations

7-4 Sedimentation Pond Topography

7-4A Overflow Pond Topography

7-5 Sedimentation Pond Cross Sections

7-5A Overflow Pond Cross Sections and Details

7-5B Overflow Pond Details

7-6 East Spring Canyon Drainage Details

7-7 (Revisions have eliminated this plate)

7-8 Watersheds Draining to The East Spring Canyon Surface Facilities

7-9 Link Canyon Watershed

7-10 Operational Hydrologic Monitoring Stations (Greens Hollow)

7-10C 4R4E Drill Logs (CONFIDENTIAL)

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(Appendices appear in Volumes 7, 8 and 9)

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7-18 Investigation of Surface and Groundwater Systems in the Pines Tract Area, Sevier County, Utah: Probable Hydrologic Consequences of Coal Mining in the Pines Tract and Recommendations for Surface and Groundwater Monitoring

7-19 Probable Hydrologic Consequences of Longwall Mining of the 3 Left Panel Modification Area at the SUFCO Mine

7-20 Investigation of Surface and Groundwater Systems in the SITLA Muddy Tract Area, Sevier County, Utah: Probable Hydrologic Consequences of Coal Mining in the SITLA Muddy Tract and Recommendations for Surface and Groundwater Monitoring

7-21 Muddy Tract Hydrologic Baseline Data (Includes SITLA Tract baseline data)

7-22 Investigation Plan for Springs Pines 105, Joes Mill Pond, Pines 310, and 311

7-23 Overflow Pond Calculations

7-24 Investigation of Surface and Groundwater Systems in the West Lease Modifications Area, Sevier County, Utah: Probable Hydrologic Consequences of Coal Mining in the West Lease Modifications and Recommendations for Surface and Groundwater Monitoring

7-25 North Water Mitigation Plan

7.2.4.1 Groundwater Information

This section presents a discussion of baseline groundwater conditions in the mine area. A discussion of the groundwater conditions in the SUFCO leased area is presented in this section and appended by Appendix 7-17. A discussion of groundwater conditions in the Pines Tract is presented in Appendix 7-18 of this Chapter. A discussion of groundwater conditions in the West Coal Lease Modifications is presented in Appendix 7-24 of this Chapter and in Appendix7-25, Attachment A for the Northwater wells. A discussion of groundwater conditions at the waste rock disposal site is provided in Waste Rock Volume of this M&RP.

The locations of wells and springs in the mine area are presented on Plate 7-3. The wells in the mine area are all water monitoring wells, not water supply wells. Water rights for the mine and adjacent areas are addressed in Section 7.2.2.2 of this M&RP. With the exception of the potable use of source 94-87 by SUFCO, all other groundwater use (seeps and springs) is confined to stock watering. The hydrology in the area of the 2RWL sinkhole are discussed in the PHC located in Appendix 7-24.

Greens Hollow. Appendix 7-27 contains selected water monitoring data for the Green Hollow Tract. The appropriated water rights within the Greens Hollow Lease belong to the USFS. The PHC for the Greens Hollow Lease is located in Appendix 7-28.

AQUIFERS

Geologic conditions in the permit and adjacent areas are described in detail in Chapter 6 of this M&RP. Groundwater occurrences within the permit and adjacent areas occurs predominantly in the Blackhawk Formation and Star Point Sandstone. However, perched aquifers of limited areal extent are present in the geologic formations. Hydrogeologic conditions within the permit and adjacent areas are summarized below. Refer to the PHC's in Appendices 7-17 thru 7-20, 7-24, 7-26, 7-28 for more specific information.

North Horn Formation. The North Horn Formation crops out in the northwest portion of the lease area. This formation consists of interbedded shale, sandstone, and limestone. Data presented in Appendix 7-2 indicate that only one seep and one spring issue from the North Horn Formation within the lease area. Recharge occurs to outcrops of the North Horn Formation west of the lease

groundwater (more than 2 gpm) were encountered in any of the exploration holes nor was groundwater identified in all drill holes.

Of the observation wells completed in the Castlegate Sandstone, two (US-77-9 and 89-16-1W) have been dry during their entire period of record. Two additional wells (US-77-8 and 89-20-2W) have only a brief period of record (due to lack of water or time since installation, respectively). Hydrographs of the remaining two Castlegate Sandstone observation wells (US-80-2 and US-80-4) are presented in Figure 7-2. Water-level data for all wells are provided in Appendix 7-3. Seasonal fluctuations of groundwater levels in these wells have typically been less than one foot.

Coal exploration holes drilled in and near the Pines Tract by the USGS, have geophysical logs indicating similar conditions for the Castlegate Sandstone. Exploration Hole W-TP-4-EW found fluids present at a depth of 82 feet below ground surface, within the Castlegate Sandstone. Exploration holes W-TP-3-EW and W-TP-2-EW did not encounter fluids within the Castlegate Sandstone. Exploration drilling (2018) completed in the Pine East Panel area encountered no water within the holes drilled: 8-13-1, 18-24-1, 18-124-2, 18-24-3 and 18-25-1(locations shown on Plate 6-1). Monitoring well NW4-09 is discussed in Appendix 7-25 , Attachment A.

This formation is not considered to be a significant regional aquifer. It is assumed that the groundwater occurrence within the Castlegate Sandstone is limited to isolated perched zones contained in the more permeable sandstone lenses or within weathered bedrock and fractures/joints at and near the escarpments within Box Canyon. Because groundwater occurrence within the Castlegate Sandstone is not continuous over the permit and adjacent areas, no potentiometric surface could be developed for the unit.

The data presented in Figure 7-2 indicate a downward trend in static water levels for the Castlegate Sandstone. This trend is most probably due to decreased precipitation during the last several years. A discussion of climatic conditions in the permit and adjacent areas is provided in Section 7.2.4.4 of this M&RP.

Groundwater recharge to the Castlegate Sandstone is from precipitation and snowmelt. Over much of the area, the Castlegate Sandstone and the remainder of the Price River Formation form

the surface of the plateau. However, as evidenced by the fact that the Castlegate is not continuously saturated, total recharge is probably low. This is due to the lack of a significant developed soil to encourage infiltration and the presence of low permeability shales in the upper Price River Formation (see Waddell et al., 1979).

Discharge from the Castlegate Sandstone occurs mainly as springs along the outcrop and as through-flow to the underlying Blackhawk Formation. As indicated above, spring flow from the unit is limited in flow and in occurrence. These springs are used only for livestock and wildlife watering. Besides the monitoring wells completed in the Castlegate Sandstone, no known wells are completed in the formation.

Blackhawk Formation. The Blackhawk Formation underlies the Castlegate Sandstone and consists of about 710 to 830 feet of interbedded sandstone, siltstone, shale, and coal. The Upper Hiawatha coal seam, mined by SUFCO, is located near the base of the Blackhawk Formation. During the drilling of the exploration and observation holes, groundwater was encountered in each of the drill holes; however, no significant quantities of water were identified in any of the holes.

Recharge to the Blackhawk Formation occurs mainly from vertical movement of water from the overlying Castlegate Sandstone. Recharge from direct infiltration where the Blackhawk Formation is exposed is considered to be negligible due to the limited area of exposure. The quantity of groundwater recharge in the region area has been estimated to be 3 to 8 percent of the average annual precipitation (Danielson and Sylla, 1983).

Discharge from the Blackhawk Formation occurs from springs, seeps, and the SUFCO Mine. Based on both the drilling and underground observations, groundwater flow in the Blackhawk Formation appears to occur primarily along fractures. Few springs or seeps are present in the Blackhawk sandstone lens outcrop areas. This suggests that general flow through the pores in the sandstone is not significant.

Generally, flow rates from the springs and seeps issuing from the Blackhawk Formation are moderate to low in the spring and decline through the summer and into the fall (Appendix 7-1). These flow rates are typically less than 1 gpm with a few flowing at a slightly higher rate in the Pines Tract area.

northern margins of the permit area may increase secondary permeability, thus locally increasing recharge.

Recharge occurs in the northwest corner (T.21 S., R.4 E., sections 11 and 23) and the northeastern part of the permit area (T.21 S., R.5 E., section 16). The first area is a topographic high and fractured where the North Horn Formation crops out. The second area is a topographic high, capped by the Price River Formation. Linear features that imply fracturing are located in this area (Plate 6-1 and SUFCO, 1992).

Recharge to shallowly circulating groundwater systems within the Castlegate Sandstone and Blackhawk Formation also occurs in the Pines Tract area. These shallow groundwater systems appear to occur within approximately 1000 feet of the Box Canyon escarpments.

The recharge age for water flowing into the SUFCO mine was estimated at 70 years or older (Thiros and Cordy, 1991). Mayo and Associates (1997a and 1997b) identified mean groundwater residence times for in-mine discharges of 7,000 to 20,000 years. This indicates that recharge to the Blackhawk aquifer is not being affected by the increased hydraulic conductivities created by subsidence.

Assuming mass-balance and stable hydrologic conditions in the permit area, over the long term, recharge must be equal to discharge. Recharge occurs mostly on the plateaus and over time moves vertically downward primarily along fractures. Where perched aquifers are encountered, the groundwater may flow through the aquifer until it meets an impermeable layer. Vertical flow typically does not extend below the top of the Mancos Formation.

Greens Hollow Tract

In 2015 and 2016 samples were collected at underground locations as close as possible to the Greens Hollow Tract to be analyzed for age and one sample was analyzed for water chemistry. Three locations were sampled with the recharge age for the waters sampled being similar to conclusions previously in this section. Refer to information/drawing provided and discussed in the PHC in Appendix 7-28, including a sampling location drawing.

Pre-mine head in the coal has been measured in four observation wells completed in the Upper Hiawatha coal seam in the vicinity of Duncan Mountain. The three wells near the edge of the Wasatch Plateau were found to be dry. The head in the mine following cessation of mining and pumping would be expected to recover to approximately 80 percent of the premining level. Based

three wells (with the exception of one apparent outlier manganese value). Data concerning total iron and total manganese are not available. Although there are no historic seasonal trends in the available data, the water quality data show that in 1991, sulfate and bicarbonate concentrations increased and chloride concentrations and pH values decreased from spring to fall (Appendix 7-4 and Waste Rock Volume).

TDS concentrations generally increase in the downgradient direction beneath the waste-rock disposal site. This increase is natural as evidenced by data collected prior to the onset of waste-disposal operations. The relatively high TDS concentrations at the site (compared, for example, with spring GW-13) and the downgradient increases in these concentrations are considered to be the result of natural dissolution of minerals in the general vicinity of the site.

Three springs issuing from the Castlegate Sandstone (SUFCO-001, SUFCO-089, and GW-21) were sampled as part of the SUFCO hydrologic monitoring program. All water issuing from these springs is a calcium bicarbonate type, with historic mean TDS concentrations varying from 82 to 302 mg/l. The average TDS concentration between all three springs was 238 mg/l.

Spring waters issuing from the Castlegate Sandstone and Blackhawk Formation in the Pines Tract area are also calcium bicarbonate type. Historic TDS concentrations vary from 90 to 450 mg/l. Additional information regarding the physical and chemical characteristics of the springs in the Pines Tract is contained in Appendix 7-18 in the Probable Hydrologic Consequences of Mining in the Pines Tract Area, SUFCO Mine.

The pH of water issuing from the Castlegate Sandstone springs is approximately neutral. Dissolved iron and dissolved manganese historically averaged 0.03 and 0.01 mg/l, respectively, at SUFCO-001 and GW-21. At SUFCO-089, dissolved iron and dissolved manganese averaged 0.47 and 0.17 mg/l, respectively. At SUFCO-001, total iron and total manganese concentrations historically averaged 0.11 and 0.01 mg/l, respectively. None of the chemical data have exhibited consistent seasonal trends.

Historical data collected from stations SUFCO-047 and SUFCO-062 are considered representative of the Blackhawk-Star Point aquifer. Although station SUFCO-047 consists of seepage collected from alluvium and used for the mine domestic water supply, it is regarded as being fed by outflow from the adjacent Blackhawk-Star Point aquifer. Station SUFCO-062 represents inflow to the mine from the surrounding Blackhawk Formation.

7.2.4.2 Surface Water Information

WATER QUANTITY

Major surface drainages in the permit and adjacent areas are depicted in Figure 7-4. As indicated, the lease area exists entirely within the Muddy Creek watershed. Most of the lease area drains southward into Quitchupah Creek via the North Fork of Quitchupah Creek and various ephemeral tributaries. Quitchupah Creek flows southeastward into Ivie Creek which in turn flows eastward into Muddy Creek. The northeast portion of the lease area, including the majority of the Pines Tract, drains into Muddy Creek via Box Canyon.

Based on flow data obtained during the collection of water-quality samples, the following streams are considered perennial:

- North Fork of Quitchupah Creek (as measured at stations SUFCO-007 and SUFCO-042
- South Fork of the North Fork of Quitchupah Creek (as measured at station SUFCO-006)
- Quitchupah Creek (as measured at stations SUFCO-041 and SUFCO-046)
- Box Canyon, including East Fork Box Canyon (as measured at stations SUFCO-090, Pines 403, Pines 407 and Pines 408)
- Muddy Creek (as measured at stations Pines 405 and Pines 406)
- Cowboy Creek (as measured at station M-STR4)

According to Thiros and Cordy (1991), Link Canyon contains an ephemeral stream. Two small areas of riparian vegetation are supported in the canyon by discharge from springs near the head of the canyon (Link Canyon Spring GW-21, Plate 7-3) and the abandoned Link Canyon Mine workings (Link Portal West and Link Portal East, Plate 7-3). Water from Spring GW-21 near the head of Link Canyon typically flows only about 300 to 750 feet below the source, depending upon the season. Water discharged from the Link Canyon portals typically flows on the surface for 500 feet or less during early spring. In 2002, the surface flow only reached about 250 feet downstream of the portals.

Link Canyon, in the area of the portals, is typified by four types of stream gradient segments or reaches. The initial drainage segment, Segment 1, flows across a low gradient surface with a slope of approximately 3 percent (Plate 7-9). The drainage sits on top of the Castlegate Sandstone

and the channel floors consist of bed rock with a thin covering of loose, fine to coarse grain sands and silts. Channels can be shallow and broad or narrow and deeply incised in the minimal soil cover. Surface water is observed flowing in this reach only after significant storm events or on a few warm days during the spring runoff. No significant riparian vegetation is associated with this reach of the drainage.

From the point where the drainage enters the canyon near spring GW-21 (which discharges from the Castlegate Sandstone) to a point approximately 1200 feet downstream, the gradient increases to approximately 12 percent. In this reach, Segment 2, the drainage is cutting through the Castlegate Sandstone and the channel floors are typified by very shallow soils consisting of sand. Bedrock is exposed at or near the surface in the channel walls in this reach. The channel itself is in the very bottom of the canyon and in locations where soil is present, it is deeply incised in the soils with steep, eroding banks. This area of the drainage is typically heavily grazed by livestock. Water flows from the springs for about 300 to 750 feet in the channel bottom before disappearing into the sands of the channel floor, into the bedrock, or evaporates. Riparian vegetation is supported in this reach beginning at spring Pines 100 and continuing downstream about 1200 feet. The riparian vegetation consists of alders, willows, wild rose, horsetails, etc. The riparian vegetation is limited generally to the floor of the channel and the spring areas (Plate 7-9). The riparian vegetation does extend further downstream than typical surface flows suggesting water does continue to flow in the subsurface downstream of where surface water disappears. The vegetation typical of this area has been described in Chapter 3 of this M&RP.

The third segment of the stream, Segment 3, is approximately 1500 feet long and extends from a point approximately 1200 feet below Pines 100 to a point approximately 250 feet below the Link Canyon Mine Portals. The slope of the gradient in this reach is approximately 50 percent. The drainage cuts through the Blackhawk Formation and the upper Star Point Sandstone. This reach is typified by alternating sandstone ledges and shaley slopes with little to no soil cover. The channel contains large boulders, cobbles and gravel and at times is poorly defined. Surface water above the mine portals has only been observed in this reach during and shortly after significant storm events. Surface water flows downstream of the portals for a distance typically less than 500 feet. Riparian vegetation is located slightly upstream and for approximately 800 feet below the Link Canyon portals. This vegetation is typified by willow, alder, stinging nettle, rose, horsetail, carex, Kentucky Bluegrass, rush, and clematis. As in segment 2, the riparian vegetation is typically

plan for the Greens Hollow Lease area is approved the Division's Coal Water Quality On-line Electronic Database will be updated to include the added monitoring sites and their associated water data.

The drainages, canyons and ridges in the following sections were traversed by foot with the assistance of motorized transportation between areas during annual monitoring (April - December, 2015 - 2017): T21S R 4E Sections 1, 2,10,11,12, 13, 22, 23, 24; T21S R5E Sections 5, 6, 7: T20S R 5E Sections 19, 20, 21, 28, 30, 31,32,33: and T20S R 4E Sections 35, 36. The areas were visited by Mr. Petersen as well as personnel from Sufco familiar with hydrology monitoring during these years, however some areas have been visited since the early 2000's.

The following Sections were traversed by air or motorized vehicle T20S R 5E Section 29

The monitoring was completed when weather conditions and safety issues did not interfere

It is Mr. Petersen's professional opinion that, based on the observations and monitoring activities performed to date as described herein, the current identification of springs and seeps in the Greens Hollow Tract (as of 2017) has been reasonably and adequately performed in a manner consistent with good hydrogeologic practice.

7.2.8.2 Baseline Hydrologic and Geologic Information

Baseline geologic information is presented in Chapter 6 of this M&RP. Confidential drill logs and other information related to geology is located in Appendix 6-1. Appendix 6-4 contains geologic information related to the Greens Hollow Lease. Baseline hydrologic information is presented in Sections 7.2.4.1 and 7.2.4.2 of this M&RP. The baseline monitoring sources are believed to be representative of existing ground water and surface water. An additional inventory is not planned unless circumstances dictate a need for change.

7.2.8.3 PHC Determination

Potential Impacts to the Hydrologic Balance. Potential impacts to the hydrologic balance are addressed in the following subsections of this M&RP and in Appendices 7-17, 7-18, 7-19, 7- 20 and 7-24. Appendices 7-18, 7-20 and 7-24 contain PHC determinations for mining activities in the

Pines Tract, SITLA Muddy Tracts and West Coal Lease Modifications, respectively. The PHC for the area of Greens Hollow Lease is located in Appendix 7-28.

Acid- or Toxic- Forming Materials. Information on acid-and toxic-forming materials is presented in Chapter 6. These data reveal boron, sodium absorption ratio, and specific conductance exceedances of the Table 2 guidelines for management of topsoil and overburden (Leatherwood and Duce, 1988) in waste rock from the SUFCO mine. As noted in Section 7.2.4.2 of this M&RP, the alkalinity of the mine discharge water typically exceeds the acidity of this water by a factor of 20. Additionally, mine discharge water typically meets the standards for water quality for the state of Utah (Utah Water Quality Board, 1987). Thus, analytical data obtained from mine-water discharges indicate that although potential exists in localized portions of the mine for acid- or toxic-forming materials to be present, there has been no known impact to the surface or groundwater in the permit and adjacent areas.

Sediment Yield. The potential impact of mining and reclamation on sediment yield is an increase in sediment in the surface waters downstream from disturbed areas. Sediment-control measures (such as sedimentation ponds, diversions, etc.) have been installed to minimize this impact. These facilities are regularly inspected (see Section 5.1.4) and maintained.

Data on file with the Utah Department of Environmental Quality (formerly the Utah Division of Environmental Health) indicate that waters discharging from the mine have typically not exceeded the total suspended solids standards (40 CFR 434) of 70.0 mg/l maximum, 35.0 mg/l 7-day average, and the 25.0 mg/l average daily. Samples of sedimentation pond discharge have rarely exceeded the maximum standard with the exceedances ranging from 26.0 to 261 mg/l. Except under unusual circumstances, the average total suspended solids concentration of the sedimentation pond discharge is less than the average daily standards. Thus, although a limited number of exceedances of the standards have occurred, the sediment-control measures at the mine are considered effective at minimizing the impacts of increased sediment yield on adjacent streams.

Sediment yields may increase locally due to subsidence. Subsidence cracks which intersect ephemeral drainages with steep gradients could, for a short period of time, increase the sediment yield of the stream. However, this sediment increase would cause the crack to be quickly filled,

groundwater in the permit and adjacent areas were addressed previously in this section. Impacts to water quality parameters within the Pines Tract area are addressed in Appendix 7-18.

Data presented in Appendix 7-4 and summarized in Section 7.2.4.1 of this M&RP indicate that the average TDS concentration of water entering the mine (as measured at SUFCO-062) is 397 mg/l. This a calcium-bicarbonate water with an average sulfate concentration of 63 mg/l. As noted in Section 7.2.4.2, the average TDS concentration of water discharging from the mine (as measured at SUFCO-021) is 667 mg/l (with a historical range of 350 to 970 mg/l). This is a calcium-bicarbonate-sulfate water with an average sulfate concentration of 277 mg/l (with a historical range of 40 to 469 mg/l).

These data indicate that the TDS concentration of water flowing through the mine increases by a factor of approximately 1.6. The sulfate concentration of this water increases by a factor of about 3.5. As noted in Section 7.2.4.2, this increase in TDS and sulfate concentrations may be the result of dissolution of calcium-sulfate rock dust used in the mine.

Subsidence may cause some surface water to be diverted into the groundwater. As the water flows slowly through the ground, the water dissolves the salts available in the formations and TDS concentrations increase. When the diverted water is later discharged to the surface, TDS concentrations may be higher than if it had flowed over the surface. Due to the nature of ephemeral streamflow, these subsidence-caused diversions would be small in volume. When a fracture becomes sealed with bentonitic materials available in the area (Thiros and Cordy, 1991), the diversion either ceases or flows into a higher stratigraphic unit. Thus, potential impacts would be minor and not of significant concern.

The impact of the TDS and sulfate concentration increases on surface-water resources in the permit and adjacent areas is considered minimal for three reasons. First, surface water in the permit and adjacent areas has been classified in the Utah Department of Environmental Quality Wastewater Disposal Regulations as Class 3a and 4 water (protected for cold water aquatic life and agricultural uses, respectively). No sulfate discharge standard exists for either of these two classifications. The only TDS standard is for Class 4 water, with a discharge limitation of 1200 mg/l. Thus, the mine water does not exceed the applicable discharge standard and small amounts of surface water diverted through the groundwater system would not cause exceedances of the applicable standards.

Second, according to data presented in Section 7.2.4.2, although the discharge of mine water into the North Fork of Quitchupah Creek increases the TDS and sulfate concentrations of the receiving

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 Sufco 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.

TABLE 7-1A

FLOW OBSERVATIONS IN LINK CANYON WATER MONITORING SITES

Link 001, Link 002, Link Portal West, and Link Portal East

LOCATION	DATE OF OBSERVATION	FLOW (gpm)	SAMPLER
Link 001 and Link 002	06-03-97	No Flow	E. Petersen
	10-29-97	No Flow	E. Petersen
	11-03-97	No Flow	E. Petersen
	06-29-98	No Flow	E. Petersen
	09-16-98	No Flow	E. Petersen
	11-04-98	No Flow	E. Petersen
	06-22-99	No Flow	E. Petersen
	08-25-99	No Flow	E. Petersen
	10-28-99	No Flow	E. Petersen
	06-01-00	No Flow	E. Petersen
	08-22-00	No Flow	E. Petersen
	11-14-00	No Flow	E. Petersen
	06-13-01	No Flow	E. Petersen
	08-22-01	No Flow	E. Petersen
	10-01-01	No Flow	E. Petersen
	05-18-02	No Flow	E. Petersen
	09-26-02	No Flow	E. Petersen
	10-08-02	No Flow	E. Petersen

Mr. Petersen discusses in his report that water issuing from the Link Canyon portals is likely not sourced from the springs at the head of the canyon but probably from surface water that enters the mine through the weathered bedrock near the surface. It appears that during periods of normal or greater than normal precipitation, the water discharged from the mine has a TDS level of near 500 mg/l. However, in drought years, as has occurred in the area beginning in 1999 and continuing through 2002, the TDS levels in the water naturally rises due to a lack of fresh water flushing of the abandoned mine workings water. Hence, the samples obtained in the fall of 2002 had TDS concentrations greater than 1400 mg/l.

A hydrograph of the discharges from the Link Canyon Mine is provided in the USGS report by Thiros and Cordy (1991). This hydrograph, along with the additional data collected by Mayo and Associates and Erik Petersen suggest the discharge from the mine is influenced by seasonal changes in precipitation. Significantly, the flow from the mine has nearly ceased as a result of the area drought which began in 1999 and has continued through at least 2002.

Water discharged from the mine will continue to be monitored at sites Link Portal West and Link Portal East, as part of the quarterly water monitoring program. Significant changes in water chemistry and the apparent causes will be reported to the Division.

The only actual loss of groundwater from the hydrologic balance is that water which is the difference between the average as-shipped moisture minus the inherent moisture or in-situ moisture of the coal and leaves the basin upon mining. Based on an average coal moisture loss of groundwater content of 1.8 percent and a long-term coal production rate of 6 million tons per year, approximately 80 AF/yr of groundwater is removed from the basin. This represents about 2 percent of the average annual flow of Quitchupah Creek above Link Canyon.

Several springs and stream locations in the leased area are monitored for quantity and quality as prescribed by the M&RP water monitoring program. Analysis of the monitored flows indicated that very little impact has occurred to springs and streams. Erik Petersen of Petersen Hydrologic, Inc evaluated the flow data collected from several springs and surface flows in the Box Canyon drainage. His evaluation was forwarded to Sufco in the form of a letter report dated August 14, 2003 and is included in Appendix 7-19. Mr. Petersen determined that since mining began in the Pines Tract, a few the area springs have exhibited an increase in flow during a period of prolonged

fracture, the ground water would not be drained to the mine or lost from the hydrogelogic system" (FSEIS, 2015).

"Petersen (2009) provides an assessment of subsidence impacts observed in the adjacent Pines Lease Tract and local confirmation of Wilkowske et. al. (2007) indicate that there is minimal risk of water loss from perennial streams where overburden cover is greater than 600 feet and on the order of 60 times mining height." FSEIS, 2015).

Potential Hydrocarbon Contamination. Diesel fuel, oils, greases, and other hydrocarbon products are stored and used at the site for a variety of purposes. Diesel and oil stored in above-ground tanks at the mine surface facilities may spill onto the ground during filling of the storage tank, leakage of the storage tank, or filling of the vehicle tank. Similarly, greases and other oils may be spilled during use in surface and underground operations.

The probable future extent of the contamination caused by diesel and oil spillage is expected to be small for three reasons. First, because the tanks are located above ground, leakage from the tanks can be readily detected and repaired. Second, spillage during filling of the storage or vehicle tanks is minimized to avoid loss of an economically valuable product. Finally, the Spill Prevention Control and Countermeasure Plan presented in Appendix 7-6 provides inspection, training, and operation measures to minimize the extent of contamination resulting from the use of hydrocarbons at the site.

The potential for hydrocarbon contamination of the environment at the Link Canyon Substation or the reopened Link Canyon Mine Portal is minimal since no fuels or lubricants will be stored at this site. If a catastrophic failure of the transformers at the substation occurred, the minimal volume of oil would be contained behind the berm to be built around the equipment.

Periodically due to difficult recovery conditions or roof collapse, mining equipment is abandoned underground. Abandoned mining equipment locations are shown on Figure 7-7. Prior to leaving equipment underground, lubricating and hydraulic fluids are removed to the extent possible. Since the equipment is steel and not too different compositionally from the roof support throughout the mine, contamination to ground water from abandoned equipment will cause minimal, if any,

7.3.1.2 Water Monitoring

Groundwater Monitoring. Groundwater monitoring is proposed to be conducted in the SUFCO permit and adjacent areas according to the water monitoring plans presented in Tables 7-2 through 7-5A and for the rock waste disposal site in Section 731 in Waste Rock Volume of this M&RP. These tables are based on the studies done by Mayo and Associates (Appendices 7-17 and 7-18) and supersede previous plans.

The location of the monitoring points are presented on Plate 7-3 and 7-10. The location of the monitoring wells for the rock waste disposal site are presented on Map 5A, Waste Rock Volume of this M&RP. The monitoring plans were developed based on information presented in the PHC determinations, the baseline hydrologic data, and the geology chapter of this M&RP.

The monitoring programs provide data that are reviewed and compared to the baseline data. Any significant changes are evaluated to determine their impact on the hydrologic balance. These comparisons have taken the form of reports prepared by Hydrometrics early in the permit term (1978-1987). Results of these evaluations are submitted periodically to the UDOGM. The annual Water Quality Report submitted to the Division contains the monitoring data.

Baseline data collected for the Pines Tract area included performing field surveys to identify existing springs. Additionally, springs identified in the USGS publication "Hydrology and Effects of Mining in the Quitchupah and Pines -Coal Lease Tracts, Central Utah " (Thiros and Cordy, 1991) were searched for and, when found, included in the baseline survey. Those springs identified and found within the Pines Tract in the above referenced publication are labeled on Plate 7-3 with the prefix "GW - ". During the baseline surveys, several springs identified in the publication could not be found as illustrated on the document maps or by using the printed location descriptions. It is assumed the springs that could not be found have a) stopped flowing; b) were miss mapped; or c) were in close proximity to springs found during the baseline surveys but could not be positively identified as USGS located springs and were therefore given new number designations.

Pines East Panel(s) - The closest historical quarterly groundwater monitoring locations are springs GW-21 and Pines 100 located in Link Canyon. Pines 101 spring was monitored twice in 1997 and is located approximately 0.2 mile from the potential area of subsidence (Plate 7-3). A report has been included which discusses Pines 310 a spring northeast of the panels and spring

GW-21 located east of the panels (Appendix 7-18). Pines 310 spring was previously mined beneath and is part of a migration project completed by the Permittee. Water right spring 94-591 will be added to the monitoring plan in 2019 and monitoring will cease in 2023 following mining of the Pines East panels. The table below provides water sampling information for springs and surface water locations contiguous to the mining panels.

Pines East Panels - Water Sampling

Sampling Locations	Years Monitored	No. of Samples	Flow Max	Flow Average	Subsided	Miles from Panels (Approx.)
Groundwater						
GW-21*	1979/1995 - Present	67	2.29	0.33	N	0.2
Pines 100*	1997/2000 - Present	55	0.96	0.22	N	0.2
Pines 310*	1997/2006 - Present	41	5.36	0.7	Y	1.0
Pines 311*	1997/2006 - Present	39	1.26	0.07	Y	1
Link Portal East	2002 - Present	46	0.06	0.0015	N	0.57
Link Portal West	2003 - Present	44	0	0	N	0.57
Pines 101*	1997	2	0.02	0.01	N	0.19
Pines 102*	1997	2	0.17	0.08	N	0.24
Pines 103*	1997	2	0.18	0.1	Y	1
Surface Water						
Link 001	2003 - Present	44	0.2	0.004	N	0.57
Link 002	2005 - Present	44	0	0	N	1

* Issue from Castlegate Sandstone

Monitoring data for groundwater sampling locations GW-21, Pines 100, Pines 310, Pines 311, Link Portal East, and Link Portal West are available for review in the DOGM Water Database.

Baseline data collected for the Muddy Tract area is located in the "Coal Tract Evaluations on the Manti-La Sal National Forest" report prepared for the Manti-La Sal National Forest by Cirrus Ecological Solutions, LC. Those springs identified and found within the Muddy Tract in the above referenced publication are labeled on Plate 7-3 with the prefix "M- ".

Sampling for the SUFCO Mine and adjacent areas is accomplished in accordance with the schedule outlined on Tables 7-2 through 7-5A. Sampling for the waste rock disposal site is

TABLE 7-2
Water Monitoring Program

Monitoring Wells	Protocol	Comments
US-80-2	A	Screened in Castlegate Sandstone
US-80-4	B	Screened in Castlegate Sandstone
89-20-2W	A	Screened in Castlegate Sandstone
	Protocol	Comments
US-79-13	B	Screened in Blackhawk Formation
US-81-3	A	Screened in Blackhawk Formation
US-81-4	A	Screened in Blackhawk Formation
01-8-1	A	Screened in Blackhawk Formation
MW-15-5-2	A	Screened in Castlegate Sandstone
NW4-09***	A	Screened in Castlegate Sandstone
In-mine Well (Proposed)	A	Screened in Starpoint Sandstone

~~**TABLE 7-2 (Continued) Water Monitoring Program**~~

Streams		
SUFCO 006	C,2	Upper South Fork Quitchupah Creek
SUFCO 006D	F,1	Upper South Fork Quitchupah Creek
SUFCO 007 (North Fork Lower)	C,2	Upper North Fork Quitchupah Creek
SUFCO 041	C,2	Lower Quitchupah Creek
SUFCO 042	C,2	Lower North Fork Quitchupah Creek
SUFCO 046	C,2	Upper Quitchupah Creek
SUFCO 047A	C,2	Lower East Spring Canyon Creek
SUFCO 090	C,1	Upper Box Canyon Creek
Pines 106	C,2	Upper East Fork Box Canyon
Pines 302	C,1	Muddy Creek-Last Water Creek Confluence
Pines 403	C,2	Lower Box Canyon Creek
Pines 405	C, 2	Muddy Creek - Box Creek Confluence
Pines 406	C,1	Lower Muddy Creek
Pines 406b*	C,1	Lower Muddy Creek
Pines 407	C,1	Box Canyon Creek
Pines 408	C,1	East Fork Box Canyon Creek
USFS-109	C,1	Upper Main Fork of Box Canyon Creek
Link 001	C,2	Link Canyon Drainage
Link 002	C,2	Link Canyon Drainage
FP-1	G,6	East Fork of Main Fork of Box Canyon
FP-2	G,6	East Fork of East Fork of Box Canyon

GW-21	D,3	Castlegate Sandstone
Pines 100	D,4	Castlegate Sandstone
Pines 105	D,3	Castlegate Sandstone
Pines 206	D,5	Blackhawk Formation
Pines 209	D,5	Blackhawk Formation
Pines 212	D,5	Blackhawk Formation
Pines 214	D,5	Blackhawk Formation
Pines 218	D,3	Castlegate Sandstone
Pines 303	D,3	Blackhawk Formation
Pines 310	D,7	Castlegate Sandstone
Pines 311	D,7	Castlegate Sandstone
Link Portal-West	D,4	Link Canyon Portal

TABLE 7-2 (Continued) Water Monitoring Program

Springs	Protocol	Comments
Link Portal-East	D,4	Link Canyon Portal
M-SP01	D,3	Price River Formation
M-SP02	D,3	Price River Formation
M-SP04	D,9	North Horn Formation
M-SP05	D,9	North Horn Formation
M-SP06	D,9	North Horn Formation
M-SP08	D,3	North Horn Formation
M-SP09	D,9	North Horn Formation
M-SP11	D,9	North Horn Formation
M-SP12	D,9	North Horn Formation
M-SP15	D,9	North Horn Formation
M-SP18	D,3	Price River Formation
M-SP19	D,9	North Horn Formation
M-SP20	D,9	North Horn Formation
M-SP39	D,3	Price River Formation
M-SP40	D,9	North Horn Formation
M-SP41	D,9	North Horn Formation
M-SP44	D,9	North Horn Formation
M-SP45	D,9	North Horn Formation
M-SP53	D,3	North Horn Formation
M-SP60	D,9	North Horn Formation
M-SP87	D,9	Price River Formation
M-SP100	D,9	North Horn Formation

M-SP103	D,9	North Horn Formation
M-SP104	D,9	North Horn Formation
M-SP105	D,9	North Horn Formation
M-SP106	D,9	North Horn Formation
Mud Spring	D,5	Price River Formation
Broad Hollow	D,5	Blackhawk Formation
USP-2	D,9	Price River Formation
94-591***	D,3	Castlegate Sandstone

Springs	Protocol	Comments
Wedge Spring	H,3	Castlegate Sandstone
Amanda Spring	H,3	Castlegate Sandstone
94-113 Seep	H,3	Price River Formation

*** Added to the monitoring plan in 2019 and monitoring will cease following the 4th Quarter of 2024 after mining of the Pines East panels.

Monitoring point 406B is located at an old USGS monitoring location (circa 1999) located in the NW1/4NE1/4, Sec. 21, T21S. R6E.

Should a spring listed in Table 7-2 change locations, the Division will be notified in the note section during the entry of the quarterly data into the Division's database.

TABLE 7-3
Field and Laboratory Measurement Protocol

Water level and flow measurements

A	Monitoring well:	quarterly water level measurement (3 quarters per year)
B	Monitoring well:	annual water level measurement (3rd quarter)
C	Stream:	quarterly discharge measurements
D	Spring:	quarterly discharge measurements
E	Spring Pool:	quarterly water level measurement
F	Stream:	Bi-weekly measurements while mining is occurring under the stream in 2013, thereafter quarterly for two years.
G	Stream:	Identify perennial portion of stream on or near October 1 of each year.
H	Spring:	Quarterly measurements while mining is occurring under the 2R2S panel stream in 2013, thereafter quarterly for two years.

- Mayo did not include dissolved iron and dissolved manganese in the operational monitoring plan because iron and manganese do not readily exist in dissolved form in basic (pH>7) waters but exist instead as hydroxide complexes. All waters in the leased area are basic. Measurements of total iron and manganese quantify both the dissolved and complex forms of these elements.

Equipment, structures, and other devices used in conjunction with monitoring the quality and quantity of the surface water in the permit and adjacent areas have been installed, maintained, and operated in accordance with accepted procedures. This equipment will be removed by SUFCO when no longer needed.

Pines East Panel(s) - Monitoring data for surface water sampling locations Link 001 and 002 in the Link Canyon drainage are available for review in the DOGM Water Database. Due to the ephemeral nature of the canyon's drainage and the lack of accessibility in a storm when the drainage would flow, a sample from Link 002 has never been collected. Refer to Section 7.2.4.2 for additional information pertaining to the Link Canyon drainage.

Stock Water Ponds

Several stock watering ponds are located in the Pines Tract and Quitchupah Lease area. The ponds are identified as Big Ridge South Draw, Big Ridge East Draw, Box, Jensen, Johnson, Rock, Dry Point, Joes Mill, Slab and Verdus. The stock ponds are located either within the lease area or within one-half mile of the lease area. Surface cracking due to mining related subsidence within the Quitchupah Lease has apparently adversely affected a few of the ponds. Action has been taken by SUFCO in the past to mitigate the damage, including applying bentonitic seals to the pond floors and hauling water for livestock. However, ranchers and State and Federal agencies have erroneously claimed that subsidence has adversely affected several ponds outside of the mining areas. In order to more adequately monitor the effects of mining on the stock watering ponds, SUFCO has been negotiating with DOGM, USFS, and the local rancher's association to create a workable monitoring plan for the ponds that can be agreed upon by all participants. DOGM has taken the lead in this process, and as of May 2000, a plan had not yet been finalized. In the interim, SUFCO commits to visiting the ponds within

Disposal of noncoal mine waste is discussed in Chapter 5.

7.4.8 Casing and Sealing of Wells

Each water well has been cased, sealed, or otherwise managed, as approved by the UDOGM, to prevent acid or other toxic drainage from entering ground or surface water, to minimize disturbance to the hydrologic balance, and to ensure the safety of people, livestock, fish and wildlife, and machinery in the permit and adjacent area. The drill logs and completion diagrams for the water wells are contained in Appendix 6-1 and 7-25 for the Northwater well(s).

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the UDOGM.

7.50 Performance Standards

All mining and reclamation operations will be conducted to minimize disturbance to the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area and support approved postmining land uses.

7.5.1 Water Quality Standards and Effluent Limitations

Discharges of water from disturbed areas will be in compliance with all Utah and federal water quality laws and regulations and with effluent limitations for coal mining contained in 40 CFR Part 434.

7.5.2 Sediment Control Measures

All sediment control measures will be located, maintained, constructed and reclaimed according to plans and designs presented in Sections 7.3.2, 7.4.2, and 7.6.0.

7.5.2.1 Siltation Structures and Diversions

Siltation structures and diversions will be located, maintained, constructed and reclaimed according to plans and designs presented in Sections 7.3.2, 7.4.2, and 7.6.3.

7.5.2.2 Road Drainage

Mining in the Trail Mountain Area, Central Utah. U.S. Geological Survey Water-Supply Paper 2259. Washington, D.C.

Mayo and Associates, 1997a, Investigation of surface and groundwater systems in the vicinity of the SUFCO Mine, Sevier County, Utah: Probable hydrologic consequences of coal mining at the SUFCO Mine and recommendations for surface and groundwater monitoring. Unpublished consulting report prepared for Southern Utah Fuel Company, 7 January 1997.

Mayo and Associates, 1997b, Probable impacts from longwall coal mining at the SUFCO Mine to the hydrologic balance of Box Canyon Creek, Sevier County, Utah. Unpublished consulting report prepared for Canyon Fuel Company, LLC, 1 December 1997.

Petersen, 2009. Final report of hydrologic monitoring of the East Fork of Box Canyon Creek, 2003-2008. Sufco Mine. Prepared for Canyon Fuel Company, LLC

National Weather Service. 1989. Climatological Data Annual Summary - Utah. volume 91, Number 13. National Oceanic and Atmospheric Administration. Asheville, North Carolina.

SUFCO. 1992. Chris Kravitz, SUFCO, personal communication with Mindy Rosseland, EarthFax Engineering. Salt Lake City, Utah.

Thiros, S.A. and Cordy, G.E. 1991. Hydrology and Potential Effects of Mining in the Quitchupah and Pines Coal-Lease Tracts, Central Utah. U.S. Geological Survey Water-Resources Investigations Report 90-4084. Salt Lake City, Utah.

Utah Division of Water Resources. 1977. Hydrologic Inventory of the Dirty Devil Study Unit. Utah Department of Natural Resources. Salt Lake City, Utah.

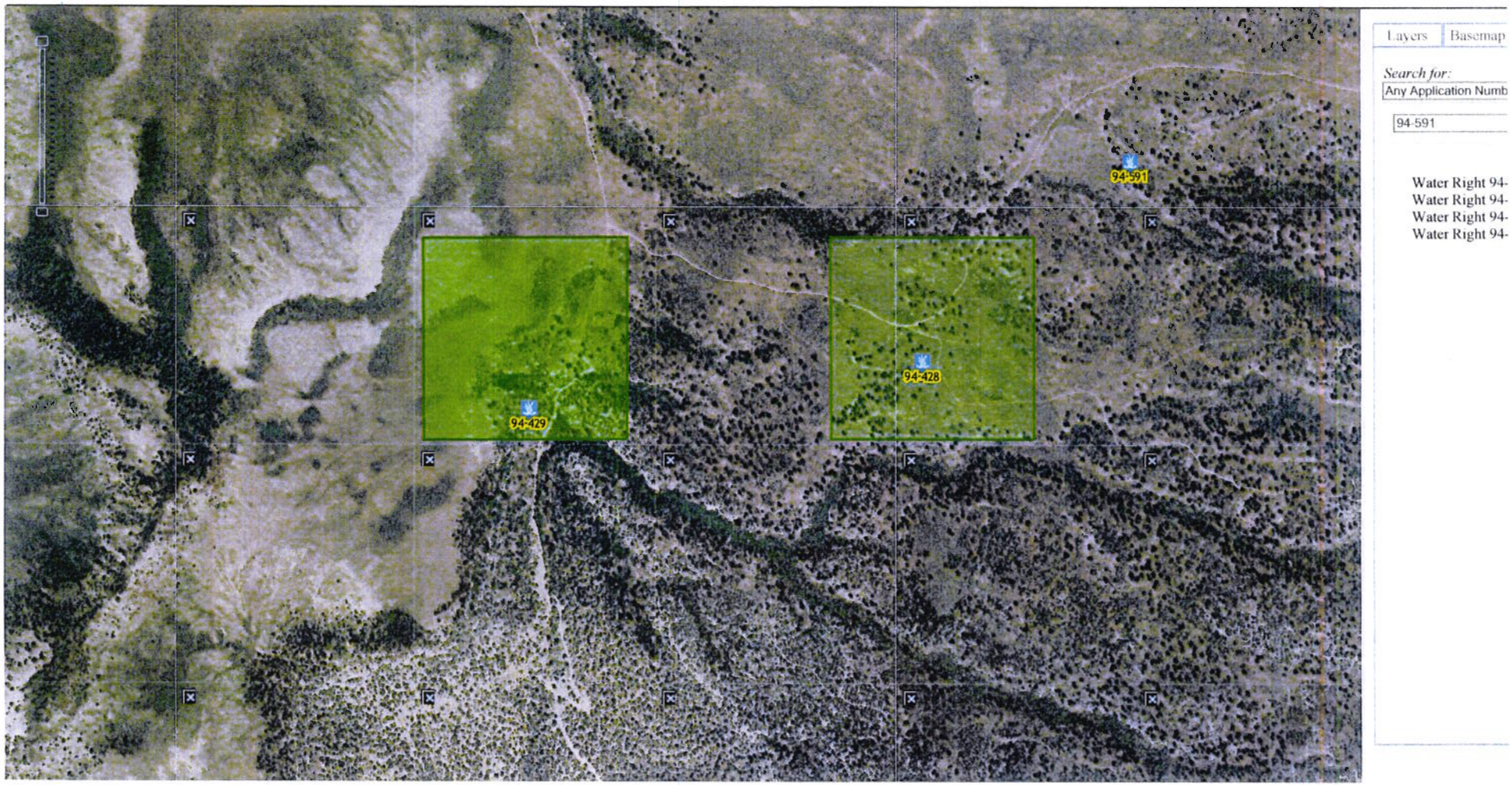
U.S. Department of the Interior, Final Supplemental Impact Statement for Leasing and Underground Mining of the Greens Hollow Federal Coal Lease Tract UTU-84102, Sanpete and Sevier Counties, Utah, February 2015

Waddell, K.M., Vickers, H.L., Upton, R.T., and Contratto, P.K., 1979. Selected hydrologic data, Wasatch Plateau-Book Cliffs coal fields area, Utah: Utah Basic-Data Release 31. Utah Water Resources. Salt Lake City, Utah.

APPENDIX 7-1

Water Rights Data

Services Agencies



Water Right Details for 94-428

Utah Division of Water Rights 11/8/2018 9:05 AM

(WARNING: Water Rights makes NO claims as to the accuracy of this data.)

Water Right: 94-428 Application/Claim: Certificate:

Changes:

a36154 (Filed: 12/21/2009) Lapsed

Owners:

Name: USA Forest Service
Address: 324 - 25th Street
Ogden UT 84401

Interest: 100%

Remarks:

General:

Type of Right: Diligence Claim Source of Info.: Proposed Determination Status: Water User's Claim
Quantity of Water: 0.011 CFS

Source: Link Canyon Spring #1
County: Sevier
Common Description:
Proposed Det. Book: 94-1 Map: * Pub. Date:
Land Owned by Appl.: County Tax Id#:
Distribution System:

Dates:

Filing:
Filed: 08/07/1981 Priority: / /1879

Advertising:
Publication Began: Publication End: Newspaper:
Protest End Date: Protested: Not Protested Hearing Held:

Approval:
State Eng. Action: Action Date:
Recon. Req. Date: Recon. Req Action:

Certification:
Proof Due Date: Extension Filed Date:
Election or Proof: Election/Proof Date:
Certificate Date: 08/07/1981 Lapsed, Etc. Date: Lapsed Letter

Wells:
Prov. Well Date: Well Renov. Date:

Points of Diversion:

Points of Spring:

(1) N 500 ft. W 2050 ft. from SE corner, Sec 23 T 21S R 5E SLBM
Diverting Works: Source:
Elevation: UTM: 471945.651, 4313431.532

Water Uses:

Water Uses - Group Number: 618240

Water Rights Appurtenant to the following use(s):

94-417(WUC), 94-418(WUC), 94-419(WUC), 94-420(WUC), 94-421(WUC),
94-422(WUC), 94-423(WUC), 94-424(WUC), 94-426(WUC), 94-427(WUC),
94-428(WUC), 94-429(WUC), 94-430(WUC), 94-431(WUC), 94-432(WUC),
94-433(WUC), 94-434(WUC), 94-435(WUC), 94-436(WUC), 94-437(WUC),
94-438(WUC), 94-439(WUC), 94-440(WUC), 94-441(WUC), 94-442(WUC),
94-443(WUC), 94-444(WUC), 94-445(WUC), 94-446(WUC), 94-447(WUC),
94-448(WUC), 94-449(WUC), 94-450(WUC), 94-451(WUC), 94-452(WUC),
94-453(WUC), 94-454(WUC), 94-455(WUC), 94-456(WUC), 94-457(WUC),
94-458(WUC), 94-459(WUC), 94-460(WUC), 94-462(WUC), 94-463(WUC),
94-464(WUC), 94-465(WUC), 94-466(WUC), 94-467(WUC), 94-468(WUC),
94-469(WUC), 94-470(WUC), 94-471(WUC), 94-472(WUC), 94-473(WUC),
94-474(WUC), 94-475(WUC), 94-476(WUC), 94-477(WUC), 94-478(WUC),
94-479(WUC), 94-480(WUC), 94-481(WUC), 94-482(WUC), 94-483(WUC),
94-484(WUC), 94-485(WUC), 94-486(WUC), 94-487(WUC), 94-488(WUC),
94-489(WUC), 94-490(WUC), 94-491(WUC), 94-492(WUC), 94-493(WUC),
94-494(WUC), 94-495(WUC), 94-496(WUC), 94-497(WUC), 94-498(WUC),
94-499(WUC), 94-500(WUC), 94-501(WUC), 94-502(WUC), 94-503(WUC),
94-504(WUC), 94-505(DIS), 94-506(WUC), 94-507(WUC), 94-508(WUC),
94-509(WUC), 94-510(WUC), 94-511(WUC), 94-512(WUC), 94-513(WUC),
94-583(WUC), 94-584(WUC), 94-585(WUC), 94-586(WUC), 94-587(WUC),
94-588(WUC), 94-589(WUC), 94-590(WUC), 94-591(WUC), 94-592(WUC),
94-596(WUC), 94-597(WUC), 94-598(WUC), 94-599(WUC), 94-601(WUC),
94-603(WUC), 94-604(WUC), 94-612(WUC),

Water Use Types:

Stock Water-Beneficial Use Amount: Unevaluated Group Total: 1367 Period of Use: 06/16 to 09/30

Comments: Emery Allotment

Place of Use Stock:

	North West				North East				South West				South East			
	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE
Sec 23 T 21S R 5E SLBM															X	

Use Totals:

Stock Water sole-supply total: Unevaluated ELUs for a group total of: 1367 ELUs

Water Right Details for 94-429

Utah Division of Water Rights 11/8/2018 9:06 AM

(WARNING: Water Rights makes NO claims as to the accuracy of this data.)

Water Right: 94-429 Application/Claim: Certificate:

Changes:

a36154 (Filed: 12/21/2009) Lapsed

Owners:

Name: USA Forest Service
Address: 324 - 25th Street
Ogden UT 84401

Interest: 100%

Remarks:

General:

Type of Right: Diligence Claim Source of Info.: Proposed Determination Status: Water User's Claim
Quantity of Water: 0.011 CFS

Source: Link Canyon Spring #2
County: Sevier
Common Description:
Proposed Det. Book: 94-1 Map: * Pub. Date:
Land Owned by Appl.: County Tax Id#:
Distribution System:

Dates:

Filing:
Filed: 08/07/1981 Priority: / /1879

Advertising:
Publication Began: Publication End: Newspaper:
Protest End Date: Protested: Not Protested Hearing Held:

Approval:
State Eng. Action: Action Date:
Recon. Req. Date: Recon. Req Action:

Certification:
Proof Due Date: Extension Filed Date:
Election or Proof: Election/Proof Date:
Certificate Date: 08/07/1981 Lapsed, Etc. Date: Lapsed Letter

Wells:
Prov. Well Date: Well Renov. Date:

Points of Diversion:

Points of Spring:

(1) N 180 ft. E 680 ft. from SW corner, Sec 23 T 21S R 5E SLBM
Diverting Works: Source:
Elevation: UTM: 471167.652, 4313339.964

Water Uses:

Water Uses - Group Number: 618240

Water Rights Appurtenant to the following use(s):

94-417(WUC), 94-418(WUC), 94-419(WUC), 94-420(WUC), 94-421(WUC),
94-422(WUC), 94-423(WUC), 94-424(WUC), 94-426(WUC), 94-427(WUC),
94-428(WUC), 94-429(WUC), 94-430(WUC), 94-431(WUC), 94-432(WUC),
94-433(WUC), 94-434(WUC), 94-435(WUC), 94-436(WUC), 94-437(WUC),
94-438(WUC), 94-439(WUC), 94-440(WUC), 94-441(WUC), 94-442(WUC),
94-443(WUC), 94-444(WUC), 94-445(WUC), 94-446(WUC), 94-447(WUC),
94-448(WUC), 94-449(WUC), 94-450(WUC), 94-451(WUC), 94-452(WUC),
94-453(WUC), 94-454(WUC), 94-455(WUC), 94-456(WUC), 94-457(WUC),
94-458(WUC), 94-459(WUC), 94-460(WUC), 94-462(WUC), 94-463(WUC),
94-464(WUC), 94-465(WUC), 94-466(WUC), 94-467(WUC), 94-468(WUC),
94-469(WUC), 94-470(WUC), 94-471(WUC), 94-472(WUC), 94-473(WUC),
94-474(WUC), 94-475(WUC), 94-476(WUC), 94-477(WUC), 94-478(WUC),
94-479(WUC), 94-480(WUC), 94-481(WUC), 94-482(WUC), 94-483(WUC),
94-484(WUC), 94-485(WUC), 94-486(WUC), 94-487(WUC), 94-488(WUC),
94-489(WUC), 94-490(WUC), 94-491(WUC), 94-492(WUC), 94-493(WUC),
94-494(WUC), 94-495(WUC), 94-496(WUC), 94-497(WUC), 94-498(WUC),
94-499(WUC), 94-500(WUC), 94-501(WUC), 94-502(WUC), 94-503(WUC),
94-504(WUC), 94-505(DIS), 94-506(WUC), 94-507(WUC), 94-508(WUC),
94-509(WUC), 94-510(WUC), 94-511(WUC), 94-512(WUC), 94-513(WUC),
94-583(WUC), 94-584(WUC), 94-585(WUC), 94-586(WUC), 94-587(WUC),
94-588(WUC), 94-589(WUC), 94-590(WUC), 94-591(WUC), 94-592(WUC),
94-596(WUC), 94-597(WUC), 94-598(WUC), 94-599(WUC), 94-601(WUC),
94-603(WUC), 94-604(WUC), 94-612(WUC),

Water Use Types:

Stock Water-Beneficial Use Amount: Unevaluated Group Total: 1367 Period of Use: 06/16 to 09/30

Comments: Emery Allotment

Place of Use Stock:

	North West				North East				South West				South East			
	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE
Sec 23 T 21S R 5E SLBM											X					

Use Totals:

Stock Water sole-supply total: Unevaluated ELUs for a group total of: 1367 ELUs

Water Right Details for 94-591

Utah Division of Water Rights 11/8/2018 9:06 AM

(WARNING: Water Rights makes NO claims as to the accuracy of this data.)

Water Right: 94-591 Application/Claim: Certificate:

Changes:

a36154 (Filed: 12/21/2009) Lapsed

Owners:

Name: USA Forest Service
Address: 324 - 25th Street
Ogden UT 84401

Interest: 100%

Remarks:

General:

Type of Right: Diligence Claim Source of Info.: Proposed Determination Status: Water User's Claim
Quantity of Water: 0.011 CFS
Source: Link Canyon Spring
County: Sevier
Common Description:
Proposed Det. Book: 94-1 Map: * Pub. Date:
Land Owned by Appl.: County Tax Id#:
Distribution System:

Dates:

Filing:
Filed: Priority: / /1879
Advertising:
Publication Began: Publication End: Newspaper:
Protest End Date: Protested: Not Protested Hearing Held:
Approval:
State Eng. Action: Action Date:
Recon. Req. Date: Recon. Req Action:
Certification:
Proof Due Date: Extension Filed Date:
Election or Proof: Election/Proof Date:
Certificate Date: 08/07/1981 Lapsed, Etc. Date: Lapsed Letter
Wells:
Prov. Well Date: Well Renov. Date:

Points of Diversion:

Points of Spring:
(1) N 1800 ft. W 700 ft. from SE corner, Sec 23 T 21S R 5E SLBM
Diverting Works: Source:
Elevation: UTM: 472357.131, 4313827.772

Water Uses:

Water Uses - Group Number: 618240

Water Rights Appurtenant to the following use(s):

94-417(WUC), 94-418(WUC), 94-419(WUC), 94-420(WUC), 94-421(WUC),
94-422(WUC), 94-423(WUC), 94-424(WUC), 94-426(WUC), 94-427(WUC),
94-428(WUC), 94-429(WUC), 94-430(WUC), 94-431(WUC), 94-432(WUC),
94-433(WUC), 94-434(WUC), 94-435(WUC), 94-436(WUC), 94-437(WUC),
94-438(WUC), 94-439(WUC), 94-440(WUC), 94-441(WUC), 94-442(WUC),
94-443(WUC), 94-444(WUC), 94-445(WUC), 94-446(WUC), 94-447(WUC),
94-448(WUC), 94-449(WUC), 94-450(WUC), 94-451(WUC), 94-452(WUC),
94-453(WUC), 94-454(WUC), 94-455(WUC), 94-456(WUC), 94-457(WUC),
94-458(WUC), 94-459(WUC), 94-460(WUC), 94-462(WUC), 94-463(WUC),
94-464(WUC), 94-465(WUC), 94-466(WUC), 94-467(WUC), 94-468(WUC),
94-469(WUC), 94-470(WUC), 94-471(WUC), 94-472(WUC), 94-473(WUC),
94-474(WUC), 94-475(WUC), 94-476(WUC), 94-477(WUC), 94-478(WUC),
94-479(WUC), 94-480(WUC), 94-481(WUC), 94-482(WUC), 94-483(WUC),
94-484(WUC), 94-485(WUC), 94-486(WUC), 94-487(WUC), 94-488(WUC),
94-489(WUC), 94-490(WUC), 94-491(WUC), 94-492(WUC), 94-493(WUC),
94-494(WUC), 94-495(WUC), 94-496(WUC), 94-497(WUC), 94-498(WUC),
94-499(WUC), 94-500(WUC), 94-501(WUC), 94-502(WUC), 94-503(WUC),
94-504(WUC), 94-505(DIS), 94-506(WUC), 94-507(WUC), 94-508(WUC),
94-509(WUC), 94-510(WUC), 94-511(WUC), 94-512(WUC), 94-513(WUC),
94-583(WUC), 94-584(WUC), 94-585(WUC), 94-586(WUC), 94-587(WUC),
94-588(WUC), 94-589(WUC), 94-590(WUC), 94-591(WUC), 94-592(WUC),
94-596(WUC), 94-597(WUC), 94-598(WUC), 94-599(WUC), 94-601(WUC),
94-603(WUC), 94-604(WUC), 94-612(WUC),

Water Use Types:

Stock Water-Beneficial Use Amount: Unevaluated Group Total: 1367 Period of Use: 06/16 to 09/30

Comments: Emery Allotment

Water Uses - Group Number: 618250

Water Rights Appurtenant to the following use(s):

94-342(WUC), 94-514(WUC), 94-515(WUC), 94-516(WUC), 94-517(WUC),
94-518(WUC), 94-519(WUC), 94-520(WUC), 94-521(WUC), 94-522(WUC),
94-523(WUC), 94-524(WUC), 94-525(WUC), 94-526(WUC), 94-527(WUC),
94-528(WUC), 94-529(WUC), 94-530(WUC), 94-531(WUC), 94-532(WUC),
94-533(DIS), 94-534(WUC), 94-535(WUC), 94-536(DIS), 94-537(WUC),
94-538(WUC), 94-539(WUC), 94-540(WUC), 94-541(WUC), 94-542(WUC),
94-543(WUC), 94-544(WUC), 94-545(WUC), 94-546(WUC), 94-547(WUC),
94-548(WUC), 94-549(WUC), 94-550(WUC), 94-551(WUC), 94-552(WUC),
94-553(WUC), 94-554(WUC), 94-555(WUC), 94-556(WUC), 94-557(WUC),
94-558(WUC), 94-559(WUC), 94-560(WUC), 94-561(WUC), 94-562(WUC),
94-563(WUC), 94-564(WUC), 94-565(WUC), 94-566(WUC), 94-567(WUC),
94-568(WUC), 94-569(WUC), 94-570(WUC), 94-571(WUC), 94-572(WUC),
94-573(WUC), 94-574(WUC), 94-575(WUC), 94-576(WUC), 94-577(WUC),
94-578(WUC), 94-579(WUC), 94-580(WUC), 94-581(WUC), 94-582(WUC),
94-583(WUC), 94-584(WUC), 94-585(WUC), 94-586(WUC), 94-587(WUC),

Water Uses - Group Number: 618250

Water Rights Appurtenant to the following use(s):

94-588(WUC), 94-589(WUC), 94-590(WUC), 94-591(WUC), 94-592(WUC), 94-593(WUC), 94-594(WUC), 94-595(WUC), 94-596(WUC), 94-597(WUC), 94-598(WUC), 94-599(WUC), 94-600(WUC),

Water Use Types:

Stock Water-Beneficial Use Amount: Unevaluated Group Total: 238 Period of Use: 07/06 to 09/15

Comments: Blue Lake Allotment

Place of Use Stock:

	North West				North East				South West				South East			
	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE
Sec 26 T 21S R 5E SLBM														X		

Use Totals:

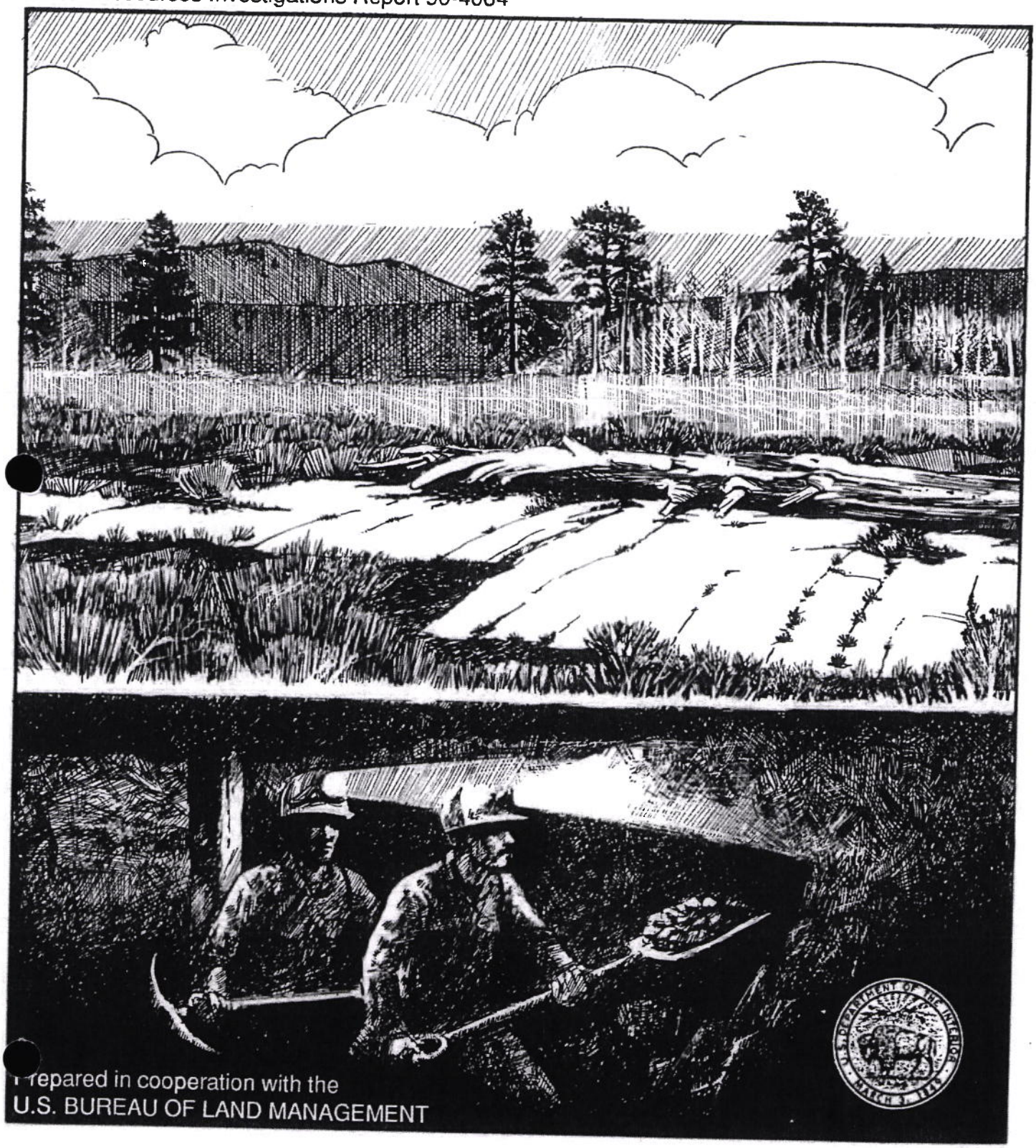
Stock Water sole-supply total: Unevaluated ELUs for a group total of: 1605 ELUs

APPENDIX 7-4

Water Quality Data Summaries

HYDROLOGY AND EFFECTS OF MINING IN THE QUITCHUPAH AND PINES COAL-LEASE TRACTS, CENTRAL UTAH

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 90-4084



Prepared in cooperation with the
U.S. BUREAU OF LAND MANAGEMENT

HYDROLOGY AND POTENTIAL EFFECTS OF MINING IN THE QUITCHUPAH AND PINES COAL-LEASE TRACTS, CENTRAL UTAH

By S.A. Thiros and G.E. Cordy

U.S. GEOLOGICAL SURVEY

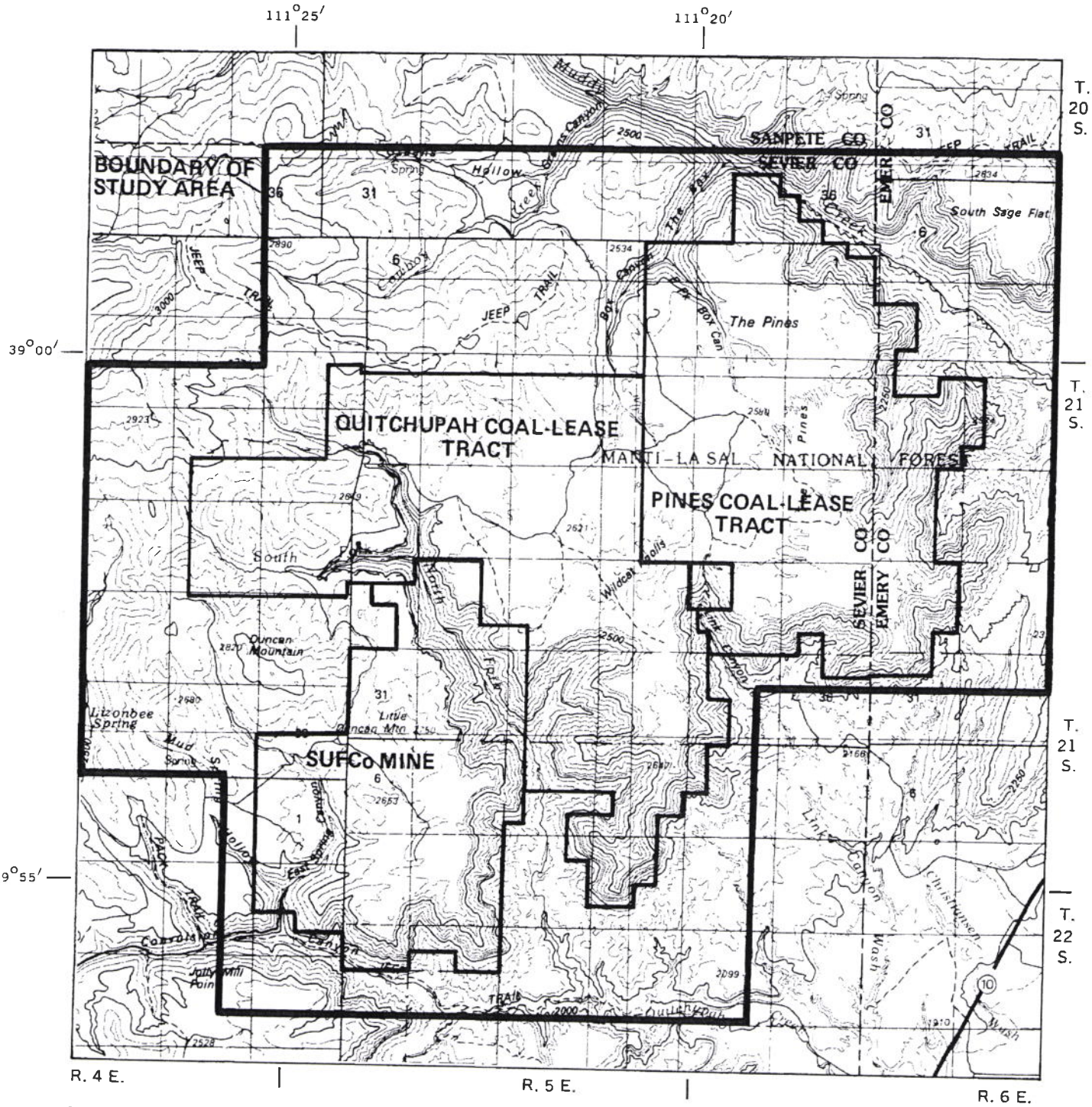
Water-Resources Investigations Report 90-4084

Prepared in cooperation with the

U.S. BUREAU OF LAND MANAGEMENT

Salt Lake City, Utah

1991



Base from U.S. Geological Survey 1:100,000 quadrangles, Salina, 1980 and Manti, 1981

0 1 2 3 MILES
0 1 2 3 KILOMETERS

CONTOUR INTERVAL 50 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Figure 2.--Location of the Quitchupah and Pines coal lease tracts, the tract containing the Southern Utah Fuel Co. (SUFCo) mine, and the boundary of the study area.

SUMMARY AND CONCLUSIONS

The Quitchupah and Pines coal-lease tracts, located in the Wasatch Plateau coal field of central Utah, include a total of about 30 square miles. Hydrologic data were collected from these tracts and the surrounding area in order to describe the hydrology and determine the potential effects of underground coal mining on the hydrologic system. The upper Hiawatha coal seam of the Cretaceous Blackhawk Formation currently is (1987) being mined in an area adjacent to the Quitchupah coal-lease tract by the Southern Utah Fuel Company.

Streams in the area drain to either Quitchupah or Muddy Creeks. Peak streamflow generally occurs in the spring due to snowmelt, although large flows can occur in the late summer and fall in response to thunderstorms.

The specific conductance of surface water in the study area decreases as streamflow increases because of dilution from runoff. Prior to the water's flowing across the lower part of the Blackhawk Formation, calcium, magnesium, and bicarbonate plus carbonate are the predominant ions. Surface water that has flowed across the Blackhawk Formation, Star Point Sandstone, and part of the Mancos Shale shows an increase in sulfate concentration.

Suspended-sediment concentrations are generally related to stream discharge. Although the largest concentration was measured on North Fork Quitchupah Creek during spring runoff, the largest suspended-sediment concentrations are usually the result of runoff from intense thunderstorms.

Parts of the Blackhawk Formation and the Star Point Sandstone are saturated in most of the study area. Water levels in several observation wells completed in the upper Hiawatha coal seam of the Blackhawk Formation are artesian (above the top of the perforated zone). The Blackhawk Formation and Star Point Sandstone are not saturated near the edge of the plateau, near canyons, and near the SUFCo mine where they are being dewatered.

Recharge to the saturated zones is principally by snowmelt seeping into outcrops. The annual recharge to the Castlegate Sandstone and the Price River Formation is estimated to be only about 1.2 percent of the annual normal precipitation. Water movement is controlled mainly by fractures, dip of the beds, and hydraulic conductivity of the materials. Most springs inventoried discharge near formation contacts and all of the springs found discharging from the Castlegate Sandstone were located on the east side of canyons, downdip from recharge areas.

Concentrations of dissolved solids in ground water sampled from springs and mines in the area ranged from 61 mg/L for water issuing near the top of the Castlegate Sandstone to 1,080 mg/L for water issuing from alluvium near the base of the North Horn Formation. Solubility indices indicate that water from most formations in the study area is undersaturated with respect to gypsum, anhydrite, and magnesite. The Flagstaff Limestone, North Horn Formation, and Price River Formation are supersaturated with respect to calcite and dolomite.

Water discharged from the SUFCo mine portal shows a greater concentration of sulfate than ground water discharging from the mine roof.

Tritium concentrations indicate that water discharging from a fault in the SUFCo mine must have entered the ground-water system at least 70 years ago while some of the water discharging from a spring at the base of the Castlegate Sandstone must have been recharged to the ground-water system sometime after 1952.

Observed effects of underground coal mining at the nearby Southern Utah Fuel Company mine are considered indicative of the changes that can be expected in the Quitchupah and Pines coal-lease tracts. Subsidence above the mined area could cause dewatering of the Blackhawk Formation and Star Point Sandstone, changes in the natural drainage patterns, and alteration of both surface- and ground-water quality. Additional studies are needed to gain a better understanding of the hydrologic effects of underground mining in the Quitchupah and Pines coal-lease tracts.

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APPENDIX 7-18

Investigation of Surface and Groundwater Systems in the Pines Tract Area, Sevier County, Utah: Probable Hydrologic Consequences of Coal Mining in the Pines Tract and Recommendations for Surface and Groundwater Monitoring

Probable Hydrologic Consequences of Mining in the 960-Acre Pines IBC Area, SUFCO Mine

Canyon Fuel Company, LLC, Salina, Utah

23 February 1999

Mayo and Associates, LC
Consultants in Hydrogeology

Probable Hydrologic Consequences of Mining in the 960-Acre Pines IBC Area, SUFCO Mine

Canyon Fuel Company, LLC, Salina, Utah

23 February 1999

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File name: Pines IBC PHC.doc

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Introduction

This document describes the probable hydrologic consequences (PHC) of underground coal mining in the 960-acre Pines Incidental Boundary Change (IBC) area (Figure 1). The determination of the PHC is required by part R645-301-728 of the State of Utah Coal Mining Rules.

Potential Impacts to Surface Water and Groundwater

Potential impacts of coal mining on the quality and quantity of surface water and groundwater flow in the 960-acre IBC may include:

- Contamination from acid- or toxic-forming materials;
- Increased sediment yield from disturbed areas;
- Increased total dissolved solids concentrations;
- Flooding or stream flow alteration;
- Impacts to groundwater or surface water availability;
- Hydrocarbon contamination from above ground storage tanks or from the use of hydrocarbons in the permit area;
- Contamination of surface water and groundwater from road salting; and
- Contamination of surface water from coal spillage due to hauling operations;

These potential impacts are addressed in the following sections of this document.

Baseline Hydrologic and Geologic Information

Baseline geologic information is presented in Chapter 6 of the M&RP. Baseline hydrologic information for springs and streams in the vicinity of the 960-acre IBC area is presented in Table 1. The solute chemical compositions of springs and wells are plotted as Stiff diagrams in Figure 1. The isotopic compositions and calculated groundwater radiocarbon ages of groundwaters and surface waters in the vicinity of the 960-acre IBC area are presented in Table 2. The baseline monitoring data are believed to be representative of existing groundwater and surface water resources in the 960-acre IBC area.

PHC Determination

Potential adverse impacts to the hydrologic balance

Potential impacts to the hydrologic balance in the 960-acre IBC area are addressed in the following subsections of this document.

Presence of acid-forming or toxic-forming materials

Information on acid- and toxic-forming materials is presented in Chapter 6 of the M&RP. These data reveal boron, sodium absorption ratio, and specific conductance exceedances of the Table 2 guidelines for management of topsoil and overburden (Leatherwood and Duce, 1988) in waste rock from the SUFCO Mine. Acid-forming materials in western coal mines generally consist of sulfide minerals, which, when exposed to air and water, are oxidized causing the production of H^+ ions (acid). The sulfide mineral pyrite (FeS_2) has been identified in the SUFCO mine. Although the oxidation of pyrite occurs in the mine, acidic waters are not observed in the mine. The acid is quickly consumed by dissolution of

abundant, naturally occurring carbonate minerals. As noted in Section 7.2.4.2 of the M&RP, the alkalinity of mine discharge water typically exceeds the acidity of this water by a factor of 20. Iron is readily precipitated as iron-hydroxide and excess iron is not observed in the mine discharge water. Mine discharge water typically meets the standards for water quality for the State of Utah (Utah Water Quality Board, 1987).

No other acid-forming materials or any toxic-forming materials have been identified or are suspected to exist in materials disturbed by mining in the 960-acre IBC area.

Impact of coal mining on sediment yield from disturbed areas

The potential impact of mining and reclamation on sediment yield is an increase in the sediment load in surface waters downstream from disturbed areas. No surface facilities or disturbances are planned within the 960-acre IBC. Locally, sediment yields may temporarily increase where subsidence fractures intersect steep ephemeral drainages. However, most of the land surface in the IBC area is of relatively low relief and stream gradients are low. No land subsidence in the vicinity of the East Fork of Box Canyon or any of its tributaries will occur, thus, no increase in sediment yield in Box Canyon Creek is anticipated. Additionally, any increase in sediment yield in ephemeral drainages would be short lived, because sediment carried in the stream would quickly fill the subsidence fracture, and pre-subsidence conditions would be reestablished in the drainage. There are no major ephemeral drainages on the steep northern flanks of Wildcat Knolls within the IBC area.

No increase in the sediment load of mine discharge water above current levels is anticipated as a result of underground mining in the 960-acre IBC area.

Impacts to important water quality parameters

Solute and trace element compositions and field parameters of springs and creeks on the 960-acre IBC area have been monitored regularly since 1997 to determine baseline water quality. The results of these analyses are listed in Table 1. All of the groundwaters and surface waters monitored in the vicinity of the IBC area are of good quality.

There is no reason to suspect the quality of groundwater which will be intercepted during mining operations in the IBC will be significantly different than that encountered elsewhere in the SUFCO Mine. Thus, the potential for degradation of the receiving water for the SUFCO Mine discharge above current levels as a result of mining in the IBC area is minimal. The impacts to important water quality parameters in Quitchupah Creek (the mine discharge receiving water) as a result of mining in the SUFCO Mine are described in Section 7.2.8.3 of the SUFCO M&RP.

Inspection of the field parameters and solute and trace element compositions of springs in the existing SUFCO permit area (Mayo and Associates, 1997a) indicates no mining-related impacts on spring water quality. Indeed, it is difficult to envision a mechanism to significantly affect the water quality of springs in horizons above the mine. Similarly, water quality in creeks (excluding those receiving mine discharge water) has not been impacted. Because the conditions in the 960-acre IBC area are similar to those in the existing SUFCO

permit area, it is likely that there will be no degradation in the water quality of groundwaters and surface waters in the area as a result of mining in the 960-acre IBC area.

Flooding or streamflow alteration

Because there are no surface facilities, surface disturbances, or mine water discharges planned for the IBC area, there should be no significant changes to the flooding or streamflow alteration potential of streams in the area.

Generally, it is possible that mining-induced subsidence fractures occurring in areas near springs can alter groundwater recharge and discharge mechanisms, which in turn can impact streamflows. These impacts, which have been described in detail in several hydrologic investigations (USFS, 1999; Mayo and Associates, 1993, 1997a, 1997b), can result in either increases or decreases to spring and stream discharges. However, because there is only one spring (SUFCO 089) which discharges in the 960-acre IBC area, and this spring has been designated for protection by the USFS and will not be subsided, these impacts will likely not occur in the 960-acre IBC area.

Groundwater and surface water availability

Mining in the 960-acre Pines IBC area will not significantly affect the availability of groundwater. Previous hydrogeologic investigations (USFS, 1999; Thiros and Cordy, 1991; Mayo and Associates, 1993, 1997a, 1997b) have shown that groundwaters in the lower Blackhawk Formation exist in highly compartmentalized partitions, both vertically and horizontally, and that the formation does not act as a hydraulically continuous aquifer.

Groundwater systems in the Blackhawk Formation were also demonstrated to be hydraulically isolated from overlying, modern groundwaters. Groundwaters encountered in the SUFCO mine recharged many thousands of years ago (Table 2) and are not related to overlying shallow groundwater systems from which most springs discharge. The effects of locally dewatering the Blackhawk Formation adjacent to mine openings will not have any significant impact on groundwater availability in the region surrounding the IBC area.

There are no groundwater supply wells in the 960-acre Pines IBC or surrounding area. The removal of water from horizons immediately above and below the mined horizon will not impact any water supplies. Rather, underground mining makes water available from the Blackhawk Formation that was previously inaccessible.

Several springs are located in the regions immediately west and east of the 960-acre Pines IBC area. These springs are important because they provide baseflow to Box Canyon Creek and the East Fork of Box Canyon Creek and sustain local ecosystems. For several reasons, which are discussed later in this text, the potential to impact the quantity of discharge from springs surrounding the IBC area is believed to be minimal.

Two general types of springs occur in the Pines Tract and adjacent area. These include 1) shallowly circulating, fracture controlled springs, and 2) springs flowing through sandstone channels in the Blackhawk Formation deeper beneath the upland plateau. These two spring types and the potential mining-related impacts to each type are discussed below.

Shallowly circulating fracture controlled springs

Geologic, geochemical and isotopic evidence suggests that most of the springs that occur in the vicinity of the Pines IBC area discharge from shallowly circulating groundwater systems in the Castlegate Sandstone and upper Blackhawk Formation which recharge near the canyon escarpments (USFS, 1999; Mayo and Associates, 1997b). These springs discharge modern groundwater and are highly responsive to seasonal variations in recharge. Recharge to the groundwater systems supporting the springs occurs within approximately 1,000 feet of the escarpment, where naturally occurring fractures dilate due to removal of confining pressure on the rocks (USFS, 1999). Unfractured Castlegate Sandstone is relatively impermeable because of the pervasiveness of cementing in the intergranular spaces. Further away from the escarpment, fracture apertures are very small and the ability of the rocks to transmit water is minimal. Groundwater is generally unable to migrate downward deeper into the rock section because of the pervasiveness of shale and mudstone layers in the upper Blackhawk Formation. Thus, the lateral distance from the recharge area to the spring is less than about 1,000 feet. The springs surrounding the IBC area are located at distances which are greater than approximately 1,000 feet from the closest planned longwall mining in the IBC area. Therefore, no detrimental impacts to these springs are anticipated as a result of mining in the IBC. An exception to this will occur at spring SUFCO 089, which is located within the 960-acre Pines IBC area. However, this spring has been designated for protection by the USFS and should not be impacted (USFS, 1999). Additionally, all of the springs immediately adjacent to the IBC area discharge where the overburden thickness is greater than 720 feet, suggesting that these springs will likely not be affected by mining (USFS, 1999).

Deeply circulating sandstone paleochannel springs

A few springs in the vicinity of the Pines IBC area discharge from groundwater systems which flow more deeply beneath the plateau. Examples of these springs area include Pines 206 and Pines 204. These springs discharge water which is up to several thousand years old and do not exhibit significant seasonal variations in discharge rates. According the USFS (1999), these springs likely flow horizontally down-dip through permeable sandstone paleochannels in the Blackhawk Formation from recharge areas near the cliff faces along the eastern edges of the Pines Tract to the discharge locations near the bottom of Box Canyon. Because the sandstone channels are commonly three-dimensionally encased in low permeability shales and mudstones, the flowpaths of these groundwater systems are constrained by the geometry of the paleochannels in which they flow. Thus, the groundwater flowpath is more or less horizontal and controlled by the stratigraphic dip of the Blackhawk Formation. Longwall mining will occur beneath the sandstone channels which support the sandstone channel springs. Based on this model, it is possible to calculate the stratigraphic separation between the bottom of the groundwater system which supports individual springs and the top of the interval to be mined. These calculations (including those for the shallowly circulating fracture controlled springs) are listed in Table 3. Using the commonly accepted estimate that the height to which subsidence fractures propagate upward from longwall mined areas equals approximately 30 times the extraction height (approximately 10 feet in the IBC area), an estimate of 300 feet is predicted (Kadnuk, 1994). Thus, because all of the groundwater systems from which the deeply circulating sandstone paleochannel springs discharge are separated from the mined horizon by more than 400 feet, detrimental impacts to these springs are not anticipated. A minimum 60 times mining height (600 feet) overburden

thickness is suggested by the Society of Mining Engineers, which would represent a 300 foot (two-times) safety factor. The likely recharge locations for the sandstone paleochannel springs lie in undisturbed areas well beyond the IBC boundary.

Stock watering ponds

Previous experience has shown that some stock watering ponds in the region have been impacted by surface fracturing when they have been undermined with longwall mining, while others have not (USFS, 1999). It is not unlikely that Pines 409 (Slab Pond) and Pines 410 (Verdes Pond) will be adversely impacted in their ability to hold water as a result of cracking of the substrate of the pond. These ponds are fed by surface water runoff in ephemeral drainages and are not fed by springs, and, thus, the volume of water available to fill the ponds should not change as a result of mining in the IBC area. It is possible that some of the water flowing in the ephemeral drainages could be rerouted downward into subsidence fractures before it reaches the ponds. However, these impacts should be short-lived because sediments will eventually fill the subsidence fractures and the water pathways should be restored to essentially pre-mining conditions. As a result of variable subsidence at the surface on the relatively flat plateau, subtle changes to surface water drainages can occur. As a result, surface waters may be diverted some small distance away from stock watering ponds.

Potential Hydrocarbon Contamination

Diesel fuels, oils, greases, and other hydrocarbon products are stored and used at the SUFCO Mine site for a variety of purposes. However, none of these products will be stored in the 960-acre IBC area, and only minimal use of these products in the IBC area will occur. These

uses will be limited primarily to the fuel and oils used in vehicles during surface activities such as hydrologic and subsidence monitoring, and the transportation of water in trucks. The potential for spills of hydrocarbons under these circumstances is remote. Additionally, a Spill Prevention Control and Countermeasure Plan has been implemented which will help minimize any potential detrimental impacts to the environment (SUFCO M&RP, Appendix 7-6).

Road Salting

No salting of the roads within the 960-acre IBC occurs. This potential impact is not a significant concern.

Coal Haulage

Mining in the 960-acre IBC area should not result in increased contamination of surface waters from coal spillage due to hauling operations above current levels. This impact is not a significant concern. The environmental impacts resulting from coal haulage at the SUFCO Mine are described in Section 7.2.8 of the SUFCO M&RP.

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Table 2 Groundwater isotopic compositions and calculated mean residence times

unstable_isotopeall.xls 23FEB99

Site	Date	$\delta^{13}C$ ‰	^{14}C pmc	^{3}H TU	Overburden feet	Mean Residence Time years
Current SUFCO Lease Area						
Creeks						
007	10/3/95			15.6		
North Horn Formation Springs						
057A	10/3/95	-15.8	109.5	13.0		modern
GW-13	10/3/95	-11.1	80.89	8.64		modern
GW-13	6/10/96			8.57		modern
Upper Blackhawk Formation Springs						
001	10/3/95	-12.4	90.7	18.8		modern
Lower Blackhawk (In-Mine roof-drips)						
R01	4/12/93	-10.1				
R02	4/12/93	-5.7	7.2	<3.0	1000	
R03	4/12/93	-7.5				
R04	9/20/96	-7.7		0.00	800	
R05	4/12/93	-12.1		0.52	500	
R06	4/12/93	-6.6				
R07	4/12/93	-9.9				
R08	4/12/93	-11.6		1.10	1200	
R09	4/12/93	-9.6				
R11	4/12/93	-10.1				
R12	4/12/93	-7.7		1.10	1000	
R12	4/11/96			0.24	1000	
R13	4/12/93	-11.2				
R14	4/11/96	-8.9	12.34		1000	12,000
R15	4/11/96	-8.9	8.91		1200	15,000
R16	4/11/96	-8.2	5.31	0.00	800	19,500
R17	4/11/96	-8.7	9.51	0.00	1000	14,500
1L 6E Seal	10/28/96	-7.7	11.51	0.17		13,000
12L 4E test hole	9/18/97	-11.2	21.07	0.00	1000	7,500
12L 4E fault	9/18/97	-7.1	20.38	0.10	1000	7,500
Star Point Sandstone Springs						
047	10/4/95	-12.3	25.27	0.23		7,300
047	6/10/96			0.10		
047A	10/2/95			0.77		
047A	6/10/96			0.78		
Pines Tract Sites						
Creeks						
Pines 106	11/3/97			6.01		
Pines 403	10/22/97			4.16		
Castlegate Sandstone Springs						
GW-21	10/3/95	-12.4	105	5.67		modern
GW-21	6/10/96			5.63		modern
Pines 100	6/28/97	-14.1	103.51	5.15		modern
Pines 105	6/28/97	-15.6	92.55	6.48		modern
Pines 105	11/3/97			5.89		
Pines 310	11/3/97	-14.0	108.69	16.4		modern
Blackhawk Formation Springs						
Pines 204	6/27/97	-9.5	49.90	0.74		500
Pines 206	6/27/97			0.69		
Pines 206	10/29/97	-10.9	38.40	0.52		3,000
Pines 214	6/27/97	-10.1	62.32	8.55		modern
Pines 214	11/3/97			4.62		
Pines 301	6/27/97			16.1		
Pines 303	6/27/97	-9.9	30.27	0.20		4,000
Pines 303	10/29/97	-9.5	32.57	0.08		3,500

Table 3 Stratigraphic separation between spring discharge locations and the top of the coal seam to be mined.

Spring elevations relative to hiawatha xls 23 Feb 99

Spring	Spring elevation	Elevation of coal seam below spring	Feet above the top of Hiawatha coal seam
Pines 307	7700	7373	327
Pines 205	7740	7363	377
Pines 204	7800	7355	445
Pines 208	8000	7370	630
Pines 206	8000	7368	632
Pines 207	8040	7375	665
Pines 213	8120	7448	672
Pines 214	8160	7466	694
Pines 215	8180	7473	707
Pines 203	8080	7360	720
Pines 209	8080	7360	720
Pines 216	8210	7476	734
Pines 216A	8210	7476	734
Pines 202	8100	7365	735
Pines 210	8100	7360	740
Pines 201	8120	7365	755
Pines 217	8250	7485	765
Pines 217A	8250	7485	765
Pines 211	8140	7365	775
Pines 212	8140	7365	775
Pines 218	8190	7390	800
Pines 219	8210	7400	810
SUFCO 089	8320	7492	828
GW-21	8480	7641	839
Pines 100	8480	7638	842
Pines 103	8380	7530	850
Pines 101	8600	7685	915
Pines 102	8560	7628	932

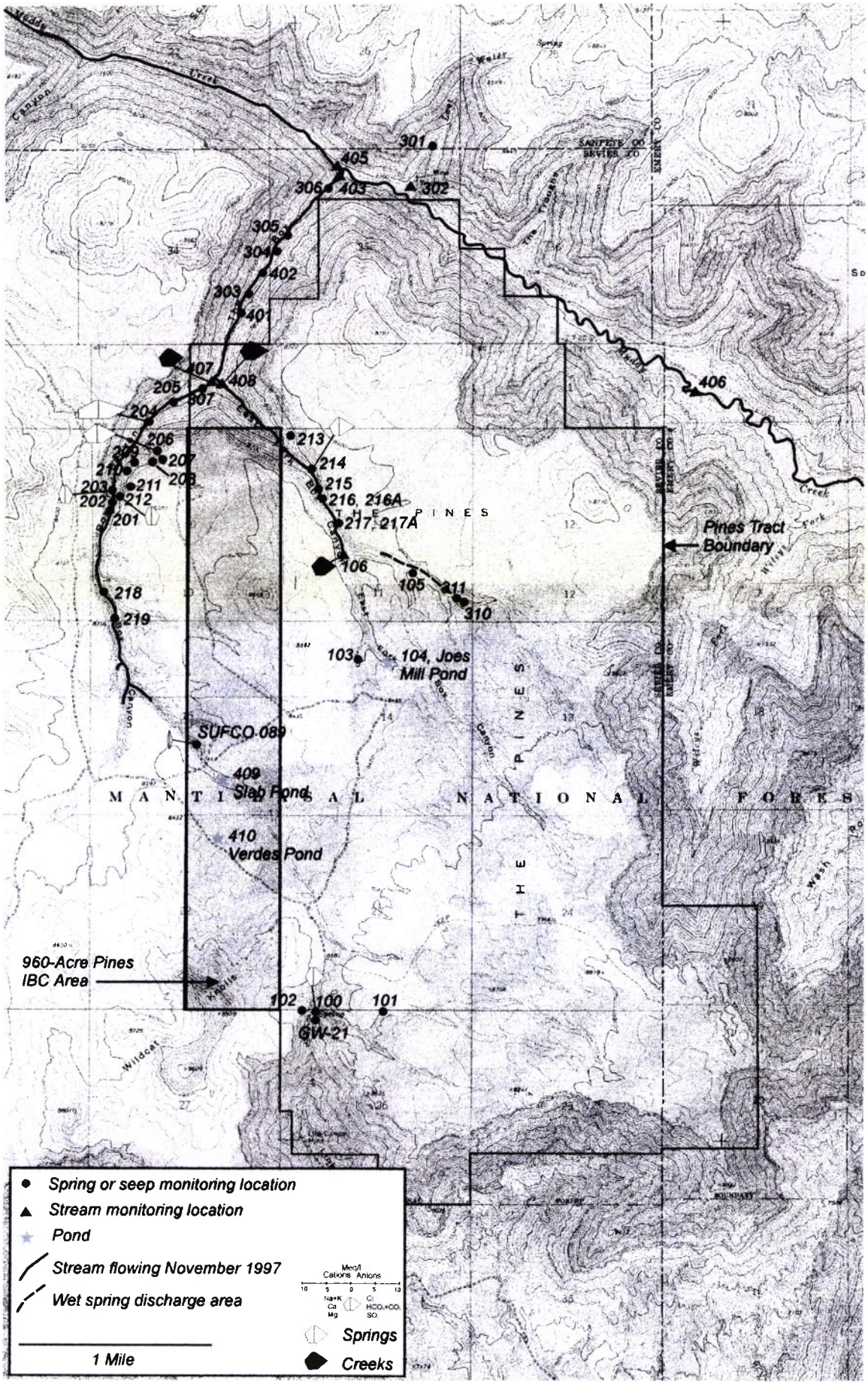

Figure 1 Location of 960-Acre Pines IBC Area, with spring and creek locations and selected stiff diagrams.

Table 1 Baseline discharge and water quality data from the Pines Tract

pines, baseline xls; 23-Feb-98

Site	Date	Flow gpm	T °C	pH	Cond µS/cm	TDS mg/l	TSS mg/l	Turb NTU	DO mg/l	O&G mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	HCO_3 mg/l	CO_3 mg/l	SO_4 mg/l	Cl mg/l	B mg/l	NO_3 NO_2 mg/l	PO_4 mg/l	Fe(t) mg/l	Fe(d) mg/l	Mn(t) mg/l	Mn(d) mg/l	Se mg/l	As(d) mg/l	As(t) mg/l	Cd(d) mg/l	Cd(t) mg/l	Pb(d) mg/l	Pb(t) mg/l	Hg(d) ug/l	Hg(t) mg/l	Mo(t) mg/l	Zn(t) mg/l
SPRINGS																																				
Pines 100	03-Jun-97	0.13	16.6	7.7	372	210					35	8	15	3	144	<5	26	17	<0.1	<0.1	0.05	<0.1	<0.1	<0.1	<0.1	<0.01										
Pines 100	28-Jul-97			7.3		210					43	11	16	2	131	<5	23	16	0.1	<0.1	0.07	0.5	0.2	0.1	<0.1											
Pines 100	26-Aug-97	1.4	11.5	7.45	306	180		0.8			35	8	14		140	<5	17	16	<0.1	0.2	0.02	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 100	29-Oct-97	2.5	4.4	7.3	241	190	<5	0.7			32	8	14	1	189	<5	20	16	0.2	<0.1	0.03	8.3	<0.1	0.2	<0.1	<0.01		<0.01		<0.01	<0.1	<0.1		<0.2	<0.1	0.09
Pines 100	16-Sep-98	0.83	12.5	7.8	280	211		0.9			34	8	14	1	138	<5	22	18	0.2	<0.1		0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 100	29-Jun-98	0.61	12.5	7.77	260	201		2.4			39	11	16	2	159	<5	27	22	0.2	<0.1		0.5		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 101	04-Jun-97	0.02	17.6	7.1	210	160					22	4	5	2	84	<5	<5	5	<0.1	<0.1	0.06	2.1	1.4	0.2	0.2	<0.01										
Pines 101	29-Oct-97	dry																																		
Pines 102	04-Jun-97	0.17	25.2	8.34	171	140					14	4	5	4	66	<5	3	8	<0.1	<0.1	0.22	1	0.4	<0.1	<0.1	<0.01										
Pines 102	29-Oct-97	dry																																		
Pines 103	04-Jun-97	0.18	17.6	7.2	137	90					9	1	4	1	38	<5	7	4	<0.1	0.3	0.02	0.7	0.2	<0.1	<0.1	<0.01										
Pines 103	03-Nov-97	<0.5	3.5	8.2	106																															
Pines 105	17-Jun-97	12	7	6.31	252	130					24	5	8	1	94	<5	5	9	<0.1	0.3	0.04	0.2	<0.1	<0.1	<0.1	<0.01										
Pines 105	28-Jun-97	10	5.2	7.1	202	140					25	5	8	1	87	<5	13	8	0.1	0.3	0.03	<0.1	<0.1	<0.1	<0.1											
Pines 105	26-Aug-97	2.61	5.5	7.5	306	120		3			23	5	8		92	<5	10	9	<0.1	0.3	0.01	0.3	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 105	03-Nov-97	10	5.3	7.5	193	120	28	4.5			22	5	7	<1	88	<5	9	9	0.2	0.4	0.02	0.2	<0.1	<0.1	<0.1	<0.01		<0.01		<0.01	<0.1	<0.1		<0.2	<0.1	0.02
Pines 105	29-Jun-98	3	6.9	8.35	260	135		62.5			23	5	8	4	100	<5	11	11	0.1	<0.1		1.6		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 105	16-Sep-98	11.1	5.5	7.7	190	157		0.2			23	5	8	<1	98	<5	13	11	0.2	0.3		<0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 201	27-Jun-97	<1	7.4	7.4	150	120		0.7			26	7	8	1	87	<5	23	9	<0.1	0.3	0.02	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 202	27-Jun-97	<1	7.4	7.8	153																															
Pines 202	29-Oct-97	1	4.3	7.9	126																															
Pines 203	27-Jun-97	7	6.6	7.8	175																															
Pines 203	28-Aug-97	4	11	8	303	170		0.4			30	10	15		110	<5	53	13	0.1	0.5	<0.01	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 204	27-Jun-97	<1	8.3	7.7	518	450		5.9			89	54	13	1	389	<5	116	15	0.2	<0.1	0.02	0.3	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 205	27-Jun-97	<1	8.4	8	628																															
Pines 206	27-Jun-97	3	7.7	8.2	377	300		0.4			66	27	11	1	358	<5	53	14	<0.1	0.1	0.02	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 206	28-Aug-97	3.23	12	7.6	535	300		0.2			63	26	10		230	<5	100	13	0.1	0.5	<0.01	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 206	29-Oct-97	1.2	6.8	7.4	362	310	180	48			59	24	10	1	195	<5	52	14	0.2	0.1	0.01	0.4	<0.1	<0.1	<0.1	<0.01		<0.01		<0.01	<0.1	<0.1		<0.2	<0.1	0.03
pines 206	29-Jun-98	3.2	5.9	7.81	430	316		0.6			55	25	13	1	282	<5	56	18	0.2	<0.1		<0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 206	16-Sep-98	2.7	6.8	7.9	450	345		0.7			63	26	10	1	285	<5	52	14	0.2	<0.1	1	<0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 207	27-Jun-97	<1	7.7	8	310																															
Pines 207	29-Oct-97	2	2.7	8	258																															
Pines 208	27-Jun-97	6	5.9	7.9	244																															
Pines 209	27-Jun-97	<1	7.4	8.1	270																															
Pines 209	29-Oct-97	4	6.3	7.4	251																															
Pines 210	27-Jun-97	<1	11.4	7.9	340																															
Pines 210	29-Oct-97	dry																																		
Pines 211	27-Jun-97	<1	10.8	8	235																															
Pines 211	29-Oct-97	<0.1	6.7	7.6	189																															
Pines 211A	29-Oct-97	<0.1	7.1	7.5	292																															
Pines 212	27-Jun-97	1	7.9	7.5	213																															
Pines 212	29-Oct-97	4.6	5.1	7.8	191																															
Pines 212	29-Jun-98	3	6.9	8.35	260	164		0.4			28	11	15	2	104	<5	46	14	0.2	0.1		<0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 212	16-Sep-98	4	7.5	8.5	220	218		0.7			29	9	15	1	114	<5	50	14	0.2	0.5		<0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 213	27-Jun-97	<1	10.5	8	850																															
Pines 213	03-Nov-97	<0.1	4.7	8.1	212																															

Site	Date	Flow cumec	T °C	pH	Cond µS/cm	TDS mg/l	TSS mg/l	Turb NTU	DO mg/l	O&G mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	HCO_3 mg/l	CO_3 mg/l	SO_4 mg/l	Cl mg/l	S mg/l	NO_3 mg/l	PO_4 mg/l	Fe(t) mg/l	Fe(d) mg/l	Mn(t) mg/l	Mn(d) mg/l	Se mg/l	As(d) mg/l	As(t) mg/l	Cd(d) mg/l	Cd(t) mg/l	Pb(d) mg/l	Pb(t) mg/l	Hg(d) mg/l	Hg(t) mg/l	Mo(t) mg/l	Zn(t) mg/l
Pines 214	27-Jun-97	2	7.4	8.6	350	230					46	13	7	1	188	<5	23	6	0.6	0.3	0.04	3.7	<0.1	0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2				
Pines 214	28-Aug-97	1.33	10	9.2	354	230		2.1			47	16	8		227	<5	14	3	<0.1	<0.1	0.01	0.3	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2				
Pines 214	03-Nov-97	1.7	0.5	8.1	206	210	13	1			44	15	7	<1	218	<5	17	8	0.2	<0.1	0.02	0.2	<0.1	<0.1	<0.1	<0.01		<0.01	<0.01	<0.1	<0.1		<0.2	<0.1	0.02	
Pines 214	29-Jun-98	2	11.1	8.26	290	190		0.6			42	14	8	1	207	<5	17	10	0.2	<0.1		<0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2				
Pines 214	16-Sep-98	0.81	12.2	7.5	340	240		2.6			46	15	8	<1	215	<5	19	9	0.2	<0.1		<0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2				
Pines 215	27-Jun-97	<1	9	8	340																															
Pines 215	03-Nov-97	<0.5	1.6	8.1	248																															
Pines 216	27-Jun-97	<1	8.7	7.7	264																															
Pines 216	03-Nov-97	<1	2.3	8.4	190																															
Pines 216A	03-Nov-97	1	5.3	8.3	153	170	137	18			30	10	7	<1	141	<5	13	6	0.2	0.3	0.03	<0.1	<0.1	<0.1	<0.1	<0.01		<0.01	<0.01	<0.1	<0.1		<0.2	<0.1	0.04	
Pines 217	27-Jun-97	<1	12.4	7.5	334																															
Pines 217	03-Nov-97	<0.5	1.5	8	150																															
Pines 217A	03-Nov-97	<0.1	1.2	7.9	172																															
Pines 218	27-Jun-97	<1																																		
Pines 218	29-Oct-97	dry																																		
Pines 219	27-Jun-97	<1	8.8																																	
Pines 219	29-Oct-97	<0.1	3.3	8.2	85																															
Pines 301	27-Jun-97	<0.1	17	7.7	1175						81	86	86	4	666	<0.1	200	35		0.36																
Pines 301	22-Oct-97	<0.1	8.7	8.2							82.2	76	92.1	2.86	443		279	28.6		0.14																
Pines 303	27-Jun-97	2.8	9	8.5	275	240		2.9			49	19	6	1	222	<5	32	9	0.1	<0.1	0.02	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2				
Pines 303	27-Aug-97	3.18	9	8.2	367	220		1.3			49	19	6		217	<5	27	10	<0.1	<0.1	<0.01	0.2	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2				
Pines 303	29-Oct-97	3.2	7.9	8.4	410	240	<5	0.6			45	19	6	1	737	<5	79	16	0.7	<0.1	0.02	0.1	<0.1	<0.1	<0.1	<0.01		<0.01	<0.01	<0.1	<0.1	<0.1		<0.2	<0.1	0.01	
Pines 303	30-Jun-98					218		1.4			45	19	6	1	221	<5	32	11	0.2	<0.1		1.3		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2				
Pines 303	16-Sep-98		8.6	8.1	380	272		5			49	18	5	1	222	<5	34	9	0.3	<0.1		2		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2				
Pines 304	27-Jun-97	<0.1	9.7	7.7	719																															
Pines 304	29-Oct-97	1	6.6	7.9	926																															
Pines 305	27-Jun-97	<0.1																																		
Pines 305	29-Oct-97	dry																																		
Pines 306	27-Jun-97	damp																																		
Pines 306	29-Oct-97	dry																																		
Pines 307	27-Jun-97	damp																																		
Pines 307	29 Oct 97	dry																																		
Pines 310	03-Nov-97	1.5	6.6	8.2	89	280	143	15			19	5	7	<1	78	<5	14	8	<0.1	0.2	0.02	0.1	<0.1	<0.1	<0.1	<0.01		<0.01	<0.01	<0.1	<0.1		<0.2	<0.1	0.03	
Pines 311	03-Nov-97	1	5.7	8	116																															
Pines 401	29-Oct-97	1	6		910																															
Pines 402	29-Oct-97	<1	7	7.8	867																															
GW-20	16-Sep-86	1.6	7.0	6.8	215	142					22	5.6	9.4	1.7	91		26	9.2					0.665		-0.210										
GW-21	11-Aug-79		20.5	7.5	310						35	8.6	12	1.3	117		20	15					0.950		<0.01										
GW-21	11-Aug-79	0.2	7		290																															
GW-21	30-Jun-79	0.3	8		320																															
GW-21	30-Jun-80	0.4	5.5		290																															
GW-21	23-Jul-80	0.3	8		275																															
GW-21	05-Aug-80	0.2	6.6		290																															
GW-21	21-Aug-80	0.2	8		285																															
GW-21	11-Sep-80	0.2	6.6		275																															
GW-21	16-Sep-80	0.2	8		280																															
GW-21	29-Sep-80	0.3	6		300																															
GW-21	15-Jul-85	0.7	6.5		300																															
GW-21	04-Aug-86	0.6	7		295																															
GW-21	20-Aug-86	0.6	7		315																															

Site	Date	Flow gpm	T °C	pH	Cond µS/cm	TDS mg/l	TSS mg/l	Turb NTU	DO mg/l	O&G mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	HCO_3 mg/l	CO_3 mg/l	SO_4 mg/l	Cl mg/l	B mg/l	NO_2 mg/l	PO_4 mg/l	Fe(t) mg/l	Fe(d) mg/l	Mn(t) mg/l	Mn(d) mg/l	Se mg/l	As(d) mg/l	As(t) mg/l	Cr(d) mg/l	Cd(d) mg/l	Pb(d) mg/l	Pb(t) mg/l	Hg(d) ug/l	Hg(t) mg/l	Mo(t) mg/l	Zn(t) mg/l
GW 21	15-Sep-86	0.7	7.5		300																															
GW 21	04-Nov-86	0.9	6		300																															
GW 21	11-May-87	1.1	5		310																															
GW-21	16-Jun-87	0.9	5.5		310																															
GW-21	20-Jul-87	0.7	6.5		310																															
GW-21	08-Sep-87	0.6	7		310																															
SUFCO 089	27-Jul-89		14	7.2	97	104					12.32	2.54	2.28	2.94	54	0	5	2.7					0.54	0.19	0.001												
SUFCO 089	22-Aug-89		9	6.5	111	43					7.48	1.95	0.97	2.86	41	0	30	1.5					0.83	0.22	0.001												
SUFCO 089	18-Sep-89	1.29	7	6	125	85					11.22	2.81	2.24	2.28	28	0	16	2.4					0.19	0.04	0.001												
SUFCO 089	09-Oct-89	1.3	2	5.9	139	108					11.5	2.44	2.29	2.4	51	0	3	2.3					0.31	0.28	0.001												
SUFCO 089	23-May-90	1.17	4	7.2	64	50					8.36	1.94	1.85	1.47	51	0	6	1.9					0.37	0.03	0.002												
SUFCO 089	20-Aug-90	1.07	12	7.4	79	100					10.51	4.98	5.66	1.49	66	0	11.5	6.1					0.24	0.03	0.001												
SUFCO 089	15-Oct-90	0.98	2	6.8	107	82					10.84	2.33	4.44	2.8	58	0	3.3	2.3					0.79	0.4	0.1												
SUFCO 089	29-May 91	1.14	3.9	7.2	86	54					10.07	2.36	1.78	1.52	42	0	5	1.6					0.84	0.22	0.013												
SUFCO 089	27-Aug-91	0.88	11	7.08	89	56					9.91	2.83	2.27	1.3	31	0	4.2	2.8					0.34	0.033	0.003												
SUFCO 089	03-Oct-91	1.02	6.2	7.02	90	64					10.38	2.41	1.58	2.17	54	0	3.6	2.6					0.013	0.16	0.003												
SUFCO 089	12-May 92	1.13	6.5	7.71	54	32					8.16	1.36	0.9		35.2	0	4.3	2.2					0.22	0.19													
SUFCO 089	04 Aug-92	0.57	12.5	8.62	99	60						1.97	1.52	2.74	29	0	3	3.3					0.5	0.03													
SUFCO 089	06-Oct-92	0.66	5	7.29	202	50					7.7	2.5	2.12	2.46	26	0	6	9.2					0.75	0.13													
SUFCO 089	09-Jun-93	1.18	5	7.98	92	38					9.25	2.05	2.86	1.79	36.4	0	3.8	2.55					0.14	0.2													
SUFCO 089	11-Aug-93	0.95	11	7.9	106	36					8.73	2.39	2.57	1.86	33.2	0	4.8	4.72					0.24	0.2													
SUFCO 089	04-Oct-93	0.7	3	7.89	106	64					9.11	2.42	2.42	1.43	34.5	0	4.9	3.04					0.11	0.02													
SUFCO 089	07-Jun-94	1.11	9.1	8.09	141	30					7.99	1.81	2.02	1.1	33	0	6.1	0					0.14	0.01													
SUFCO 089	22-Aug-94	0.26	13	7.94	106	58					10	3	2	2	32	0	4	2					0.02	0.01													
SUFCO 089	05-Jun-95	1.18	10.7	7.52	96	100					7	2	3	2	30	0	0	2					0.1	0													
SUFCO 089	24-Aug-95	1.14	12	7.91	89	60					9	1	3	3	60	0	0	1					0.2	0.1													
SUFCO 089	03-Oct-95	1.1	5	7.6	126	30					9	2	1	3	45	0	0	3					0.7	0.3													
PONDS																																					
Pines 104	17-Jun-97		15	7.3	347	200					34	8	13	6	135	<5	21	14	<0.1	<0.1	0.03	0.6	0.3	<0.1	<0.1	<0.01											
Pines 104	29-Oct-97		1	7.2	222	250	10390	240			43	10	17	9	194	<5	12	20	0.4	<0.1	0.001	86	0.1	1.4	0.4	<0.01		<0.01		<0.01	<0.1	0.01		<0.2	<0.1	0.37
Pines 409	17-Jun-97	dry																																			
Pines 409	03-Nov-97	dry																																			
Pines 410	17-Jun-97	nearly dry																																			
Pines 410	03-Nov-97	1 foot deep, 2 ponds 20' in diameter																																			
CREEKS																																					
Pines 106	18 Jun-97		8	7.5	411	200					44	14	9	1	177	<5	30	11	<0.1	<0.1	0.05	0.1	<0.1	<0.1	<0.1	<0.01											
Pines 106	28-Aug-97	25	18.5	7.9	381	220		3.4			46	16	9		192	<5	27	11	0.1	<0.1	0.02	0.3	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 106	03-Nov-97	1	6.3	7.6	420	260	19	4.5	6.3	<2	43	16	8	1	219	<5	39	11		0.1	0.02	1.4	<0.1	<0.1	<0.1	<0.01		<0.01		<0.01		<0.1		<0.2	<0.1	0.04
Pines 106	29-Jun-98		23.4	7.55	340	214	14	18	4.7	<2	40	13	9	4	186	<5	31	13	0.3	<0.1		0.9		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 106	10-Sep-98	2.2	20.3	7.4	380	274	10	3.3	6.1	<2	45	17	9	2	204	<5	40	13	0.2	<0.1			<0.1	<0.1	9	<0.01		<0.01		<0.1		<0.2			
Pines 107	18-Jun-97		12.2	8.8	432	200					47	21	5	<1	245	<5	19	3	<0.1	0.6	0.03	0.7	<0.1	<0.1	<0.1	<0.01											
Pines 107	03-Nov-97		4.1	8.3	445	260	538	165	7.7		43	24	11	1	269	<5	21	4		0.5	0.03	4.8	<0.1	<0.1	<0.1	<0.01		<0.01		<0.01		<0.1		<0.2	<0.1	0.04
Pines 302	26-Jun-97		17	8.5	300	260		30			34	26	34	2	247	18	22	6	<0.1	<0.1	0.02	0.5	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 302	27-Aug-97	dry																																			
Pines 302	22-Oct-97	15	4.3	8.49	648	380	28	14	5.6	<2	29	28	61	3	359	8	20	14	0.02	<0.1	<0.01	0.5	<0.1	<0.1	<0.1	<0.01		<0.01		<0.01		<0.1		<0.2	<0.1	0.04
Pines 403	27-Jun-97	40																																			
Pines 403	27-Aug-97	104	14.5	8.5	448	270		1.6		<2	50	22	10		246	<5	37	14	0.1	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 403	22-Oct-97	81	2.3	8.26	519	280	<5	1.2	5	<2	54	27	11	1	259	<5	49	13	0.2	<0.1	0.01	<0.1	<0.1	<0.1	<0.1	<0.01		<0.01		<0.01		<0.1		<0.2	<0.1	0.03

Site	Date	Flow gpm	T °C	pH	Cond µS/cm	TDS mg/l	TSS mg/l	Turb NTU	DO mg/l	O&G mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	HCO_3 mg/l	CO_3 mg/l	SO_4 mg/l	Cl mg/l	B mg/l	NO_3 mg/l	PO_4 mg/l	Fe(t) mg/l	Fe(d) mg/l	Mn(t) mg/l	Mn(d) mg/l	Se mg/l	As(d) mg/l	As(t) mg/l	Cd(d) mg/l	Cd(t) mg/l	Pb(d) mg/l	Pb(t) mg/l	Hg(d) µg/l	Hg(t) mg/l	Mo(t) mg/l	Zn(t) mg/l
Pines 403	30-Jun-98					313	217	0.7	6.7	<2	49	27	12	2	255	<5	65	21	0.2	<0.1		<0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 403	17-Sep-98		16	8.1	470	330	5	3.9	3.7	<2	55	26	11	2	255	<5	56	15	0.3	<0.1		0.1		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 405	26-Jun-97		13.6	8.4	282	210		56			56	23	6	<1	230	<5	9	2	<1	0.5	0.02	0.7	<0.1	<0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 405	27-Aug-97	41.5 cfs	12	8.5	365	230		32		<2	62	27	11		257	<5	14	3	0.2	0.5	0.01	5.4	<0.1	<0.1	<0.1	<0.01		<0.01		<0.01		<0.1		<0.2	<0.1	0.05
Pines 405	22-Oct-97	22 cfs	3.4	8.36	435	210	437	190	5.2	<2	39	23	10	<1	265	<5	13	4	0.2	0.5	0.01	5.4	<0.1	<0.1	<0.1	<0.01		<0.01		<0.01		<0.1		<0.2		
Pines 405	30-Jun-98					155	<5	81.5	6.2	<2	43	20	5	<1	257	<5	<10	<1	0.2	<0.1		1.9		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 406	17-Sep-98		14.8	8.2	410	152	756	725	4.4	<2	39	21	15	<1	300	<5	11	3	0.2	0.6		11.5		0.2		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 406	27-Aug-97	39.6 cfs	15	8.5	355	210		31		<2	60	27	11		262	<5	28	3	0.1	0.6	<0.01	3.4	<0.1	0.1	<0.1	<0.01	<0.01		<0.01		<0.1		<0.2	<0.1	0.03
Pines 406	22-Oct-97	28.8 cfs	6.8	8.37	435	250	409	210	5.5	<2	25	22	11	<1	277	<5	11	4	0.2	0.5	0.01	4	<0.1	<0.1	<0.1	<0.01		<0.01		<0.01		<0.1		<0.2		
Pines 406	30-Jun-98					120	233	109	6.7	<2	43	19	5	<1	256	<5	<10	4	0.1	<0.1		1.6		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 406	17-Sep-98		14.8	8.3	390	88	562	665	4.6	<2	39	22	16	<1	291	<5	11	3	0.2	0.6		12.2		0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 407	29-Oct-97	39																					<0.1	<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 407	16-Sep-98		12.1	8.4	340	9532	10	6.1	6.3	<2	46	17	9	2	209	<5	42	12	0.2	<0.1		0.2		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 407	29-Jun-98		15.3	8.53	380	240	<5	3.1	4.4	<2	43	18	13	2	168	24	43	13	0.2	<0.1		0.2		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 408	29-Oct-97	20																					<0.1	<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 408	29-Jun-98		18.8	8.54	390	250	<5	2.9	5.2	<2	47	16	10	2	221	<5	36	14	0.2	<0.1		0.5		<0.1		<0.01	<0.01		<0.01		<0.1		<0.2			
Pines 408	16-Sep-98		15	8.3	390	290	58	15.5	5.5	<2	52	17	10	1	236	<5	34	13	0.3	<0.1																
SUFCO 090	27-Jul-89	0.021	19	7.03	127	118					20.08	5.17	5.54	3.16	55	0	32	5.6					0.14		0.02											
SUFCO 090	22-Aug-89	0.078	17	6.5	247	98					21.87	5.58	5.07	2.2	67	0	26	5.7					0.64		0.04											
SUFCO 090	18-Sep-89	0.052	6	6.2	221	110					20.36	5.22	5.3	1.6	62	0	24	5.9					0.11		0.01											
SUFCO 090	09-Oct-89	0.089	7	6.7	235	89					19.4	4.87	5.85	1.62	73	0	12	5.8					0.11		0.02											
SUFCO 090	23-May-90	0.064	19	7.2	159	50					20.5	5.15	5.86	1.76	80	0	15	6.9					0.14		0.02											
SUFCO 090	20-Aug-90	0.047	20.5	8.4	247	70					8.28	2.09	1.82	2.71	38	0	2.7	1.9					0.63		0.13											
SUFCO 090	15 Oct-90	0.035	12	7.4	176	116					17.65	4.41	9.13	1.8	77	0	12.5	6					0.12		0.01											
SUFCO 090	29-May-91	0.058	13.8	7.3	207	104					22.19	5.27	9.15	1.5	73	0	13.9	6.1					0.17		0.04											
SUFCO 090	27-Aug-91	0.076	12	7.56	155	86					19.63	5.73	5.86	1.28	83	0	10.2	5.4					0.24		0.033											
SUFCO 090	03-Oct-91	0.042	9.9	7.45	171	94					20.31	5.42	5.57	1.05	81	0	13.3	6.7					0.11		0.025											
SUFCO 090	12-May-92	0.042	14	8.35	136	88					21.45	5.04	5.77		69.1	0.2	12	5.3					0.07		0.06											
SUFCO 090	04-Aug-92	0.03	16	7.08	185	90						3.99	4.99	1.45	58	0	11	7.3					0.24		0.02											
SUFCO 090	06-Oct-92	0.056	12.5	7.36	178	110					13.9	4.4	6.85	1.84	64	0	12	7.8					0.21		0.018											
SUFCO 090	09-Jun-93	0.082	14	7.49	207	102					23.4	6.08	5.57	1.61	73.1	0	14.6	5.92					0.14		0.2											
SUFCO 090	11-Aug-93	0.07	13	7.88	200	66					21.4	5.91	6.4	1.48	70.2	0	11.3	4.91					0.11		0.2											
SUFCO 090	04-Oct-93	0.058	13	7.53	183	98					18.8	5.25	5.56	1.45	64.6	0	12.9	6.02					0.1		0.02											
SUFCO 090	07-Jun-94	0.053	17.5	7.54	169	124					18.3	4.59	6.42	1.1	74	0	12.5	8					0.15		0.01											
SUFCO 090	22-Aug-94	0.023	23.3	8.21	177	102					19	5	8	2	96	0	19	6					0.05		0.01											
SUFCO 090	05-Jun-95	0.08	20.4	7.92	209	170					21	7	12	2	70	0	16	7					0.2		0											
SUFCO 090	24-Aug-95	0.09	16.5	7.8	210	120					24	5	6	3	92	0	9	6					0.1		0											
SUFCO 090	03-Oct-95	0.12	16.4	8.12	203	40					18	4	5	1	85	0	6	8					0.1		0											

PETERSEN HYDROLOGIC

7 November 2018

Ms. Vicky Miller
Environmental Engineer
Canyon Fuel Company, LLC, Sufco Mine
597 South SR24
Salina, UT 84654

Vicky,

At your request, we have performed a hydrogeologic evaluation of spring Pines 310 at the Canyon Fuel Company, LLC Sufco Mine. Our findings in this regard are presented in the letter report that follows below.

Hydrologic Evaluation of Spring Pines 310 and the
Proposed Mining of the
Pines Panels at the Sufco Mine.

Introduction

Pines 310 is a spring located in The Pines area at the Canyon Fuel Company, LLC Sufco Mine (Figure 1). Discharge from Pines 310 for the period from June 2014 through September 2018 averages 0.34 gpm (Table 1, Figure 2). The Sufco Mine proposes to mine longwall mining panels located at The Pines mining district within the existing mine permitted area (Figure 1). Spring Pines 310 is located approximately 0.84 miles northwest of the closest mine workings of the proposed Pines Panels, and 1.0 miles northwest of the mine workings along a probable groundwater flow path (Figure 1). It is noted that there are two potential layouts shown on Figure 1 for the proposed Pines Panels layouts. One potential layout is shown in Black, the other in blue. Coal mining

operations were previously conducted in the Pines mining district at locations west of the Pines 310 location.

Spring Pines 310 Groundwater Regime

Pines 310 discharges from a groundwater system in the Cretaceous Castlegate Sandstone. The Castlegate is a cliff-forming sandstone of fluvial origin that is comprised predominantly of resistant sandstone with thin, interbedded layers of low-permeability siltstones and shale that are distributed locally throughout the formation (Thiros and Cordy, 1991). The Castlegate Sandstone within The Pines area dips to the northwest at about 2 degrees and is intensely jointed and fractured naturally in the Pines 310 area (Thiros and Cordy, 1991; Figure 3). The primary fracture orientation is north, 26 degrees west. Within the region surrounding Pines 310, the Castlegate sandstone is exposed directly at the land surface or covered only by a thin veneer of sand or sandy soil (Figure 3).

Recharge to Pines 310 occurs in up-dip areas (southeast of the spring) on the Pines plateau surface. Groundwater movement in the Castlegate Sandstone coincides generally with the direction of bedrock dip and orientation of bedrock fracturing, both of which trend generally towards the northwest (Figures 1 and 3). Fracturing and jointing of the rocks in the Castlegate Sandstone potentially providing conduits for rapid groundwater movement (Thiros and Cordy, 1991). As shown on Figure 1, potential recharge areas are constrained to regions within the upland plateau only, as the land surfaces further to the north, east, and south are truncated by the presence of the precipitous Muddy Creek Canyon escarpment (Figure 1). It is apparent in field observations that spring Pines 310 discharges to the surface as a perched groundwater system with groundwater flow occurring on a low-permeability shaley layer which is less than about 6 inches thick. The spring discharges at an elevation only a few tens of feet below the elevation of the top of the plateau surface directly south of the spring, suggesting shallow groundwater circulation depths. Additionally, the low dissolves solids concentrations of groundwaters discharging from Pines 310, as reflected by the specific conductance values (Table 1), are

suggestive that the groundwater discharging at the spring has not encountered sediments of the Price River Formation. Such sediments are present on the top of the plateau surface to the south of the Pines 310 area within the northern portions of the proposed Pines Panels areas (See Plate 1 in Thiros and Cordy, 1991). In the Sufco Mine area, groundwaters that have interacted with Price River Formation sediments commonly have specific conductance values that are about an order of magnitude greater than waters from the Castlegate Sandstone that have not come into contact with Price River Formation sediments (see data for monitoring sites GW-13, GW-8, and M-SP87 in the Division of Oil, Gas and Mining on-line coal water quality database). This information suggests that shallow Price River Formation groundwaters from the northern portion of the proposed Pines Panels location do not contribute appreciably to the groundwater currently discharging at Pines 310.

Thiros and Cordy (1991), as part of a United States Geological Survey study, estimated that recharge to the Castlegate Sandstone is about 1.2 percent of the annual average precipitation, with groundwater recharge occurring primarily from the infiltration of precipitation. Precipitation in the Sufco Mine area has been monitored at National Weather Service weather station Salina 24E since 1984, with the average annual precipitation during this period of 13.8 inches. Using the average annual discharge from the Pines 310 spring (0.34 gpm, or 0.55 acre-feet per year), the average annual precipitation (13.8 inches), and the reported recharge rate (1.2% of annual recharge), it is possible to calculate a hypothetical recharge area associated with the discharge at spring Pines 310. Using these values it is determined that a region of approximately 39.7 acres would provide the groundwater recharge to the Castlegate Sandstone that would support the 0.34 gpm average discharge from spring Pines 310. Using this information in conjunction with the direction of bedrock dip and the primary fracture orientation, a hypothetical groundwater recharge area for Pines 310 is plotted on Figure 4. It is noteworthy that the calculated hypothetical recharge area is relatively small, with the recharge area existing in close proximity to the spring discharge location. This is consistent with the apparent shallow depth of groundwater circulation along the perched

groundwater flowpath that leads to the spring (i.e. a shallow, local groundwater system that is recharged from direct infiltration of local precipitation in the nearby vicinity of the spring). Using a reasonably plausible groundwater flowpath/recharge area geometry (based on the direction of dip and fracturing locations and orientations) a length of the hypothetical area is about 2,850 feet (0.54 miles; Figure 4).

Potential for impacts to spring Pines 310 associated with mining the Pines Panels

Based on the information presented above, it is considered unlikely that mining of the Pines Panels will impact discharge rates or water quality at spring Pines 310. The basis of this conclusion is summarized below:

- The spring Pines 310 is *one mile* away from the proposed Pines Panels location in the up-gradient direction (i.e. up dip and generally along the primary fracture trend). The spring is 0.85 miles away from the nearest portion of the Pines Panels mining area. This large buffer between proposed Pines Panels mining areas and Pines 310 minimizes the potential for impacts to water quantity or quality at the spring.

- The calculated hypothetical recharge area for the spring (Figure 4) does not intersect the proposed Pines Panel mining areas. Rather it is separated from the proposed Pines Panels mining area by about 2,400 feet (Figures 1 and 4). Thus, based on this information, there would be little possibility that mining in the Pines Panels area could impact discharge rates or water quality at spring Pines 310.

- Water quality information from groundwater discharging from Pines 310 does not indicate that appreciable quantities of the groundwater arriving at the spring has intermingled with Price River Formation sediments – such as those present in the northern portions of the proposed Pines Panels area.

Based on this information, it is our opinion that the potential for impacting groundwater quantity or quality at spring Pines 310 as a result of mining in the Pines Panels area is low.

References Cited

Thiros, S.A., and Cordy, G.E., 1991, Hydrology and potential effects of mining in the Quitchupah and Pines coal-lease tracts, central Utah, U.S. Geological Survey, Water-Resources Investigations Report 90-4084.

Please feel free to contact me should you have any questions in this regard.

Sincerely,

Erik C. Petersen, P.G.
Principal Hydrogeologist
Utah PG #5373615-2250

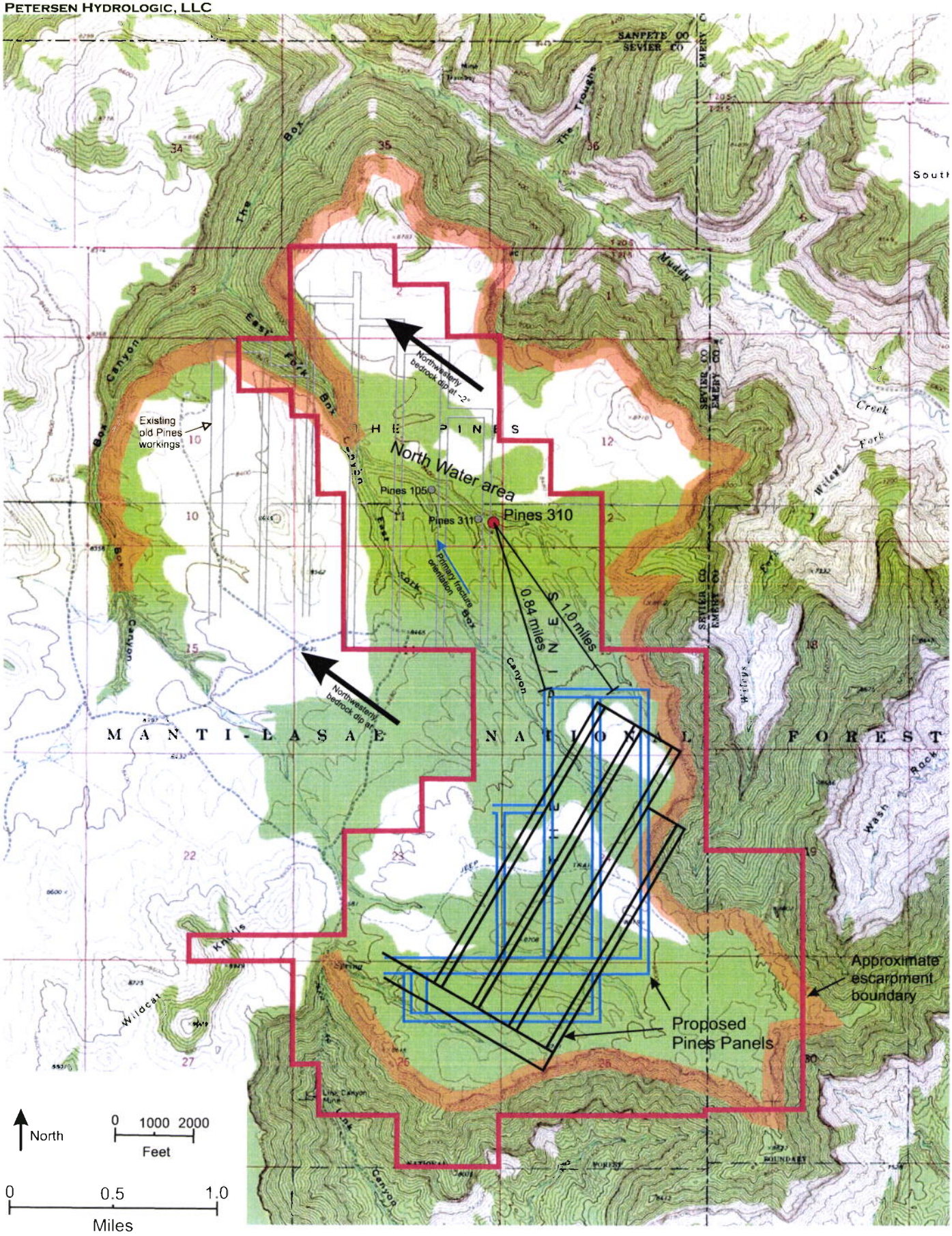

Figure 1 Locations of spring Pines 310 and the proposed Pines Panels mine workings

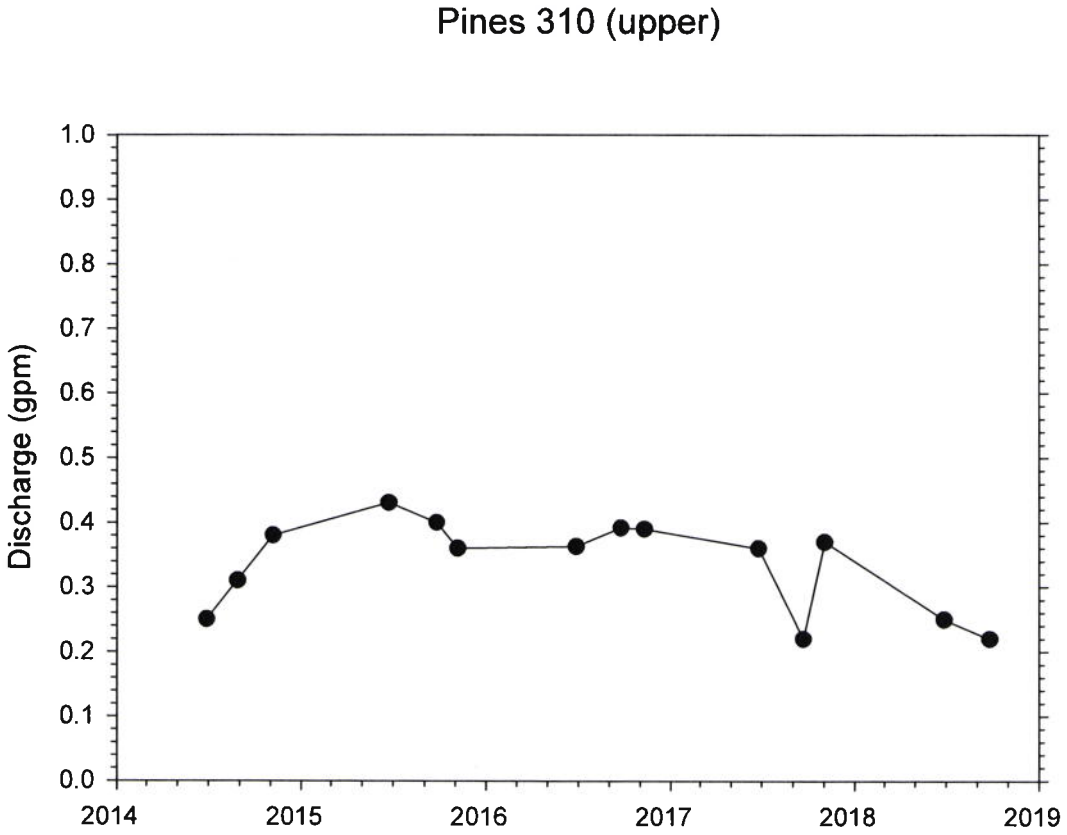

Figure 2 Discharge hydrograph for spring Pines 310 upper.

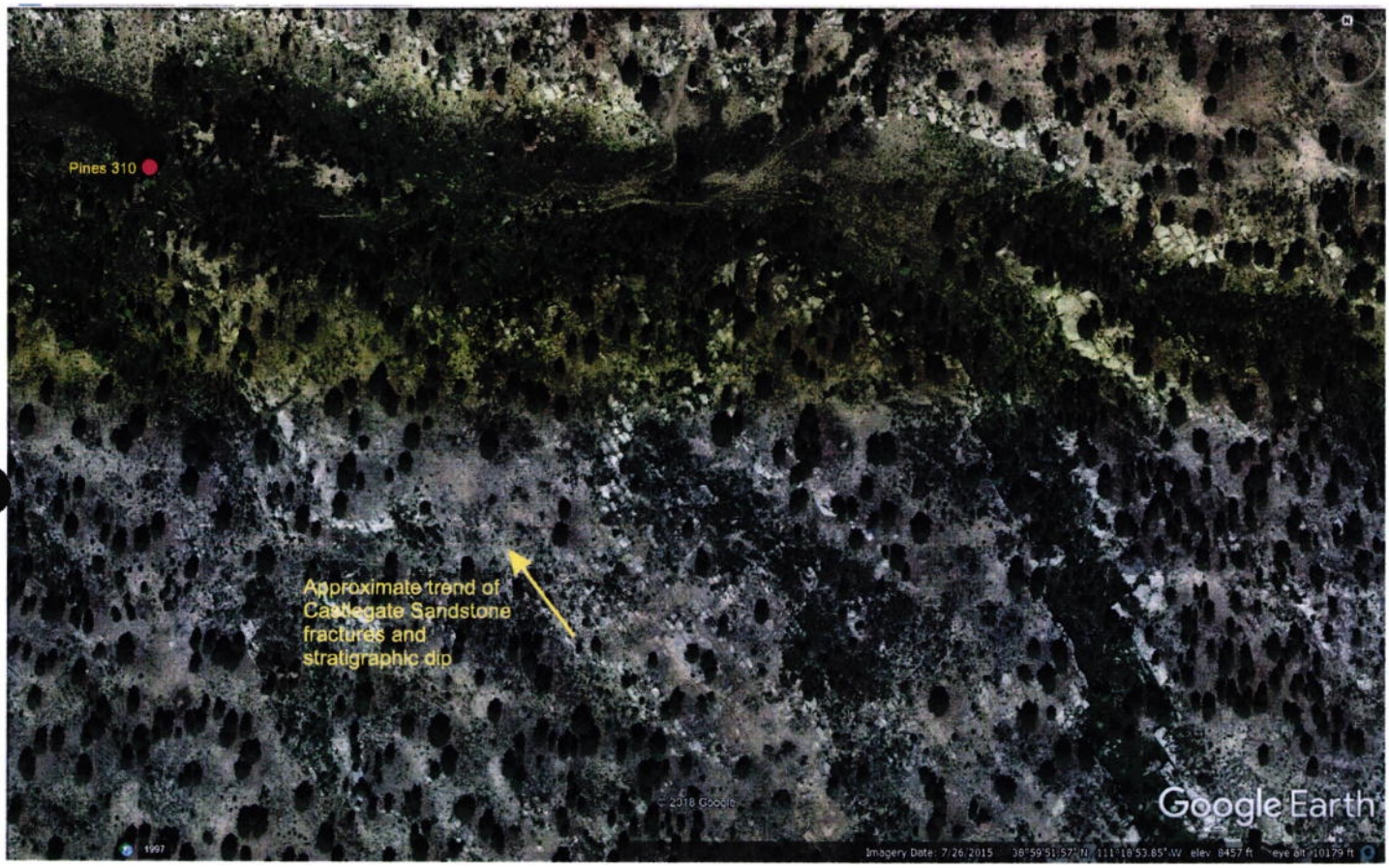

Figure 3 Photographic image showing the naturally occurring Castlegate Sandstone fracturing/jointing patterns (best expressed in the center of the image) and Castlegate Sandstone bedrock exposure at the land surface up-gradient of the Pines 310 spring location.

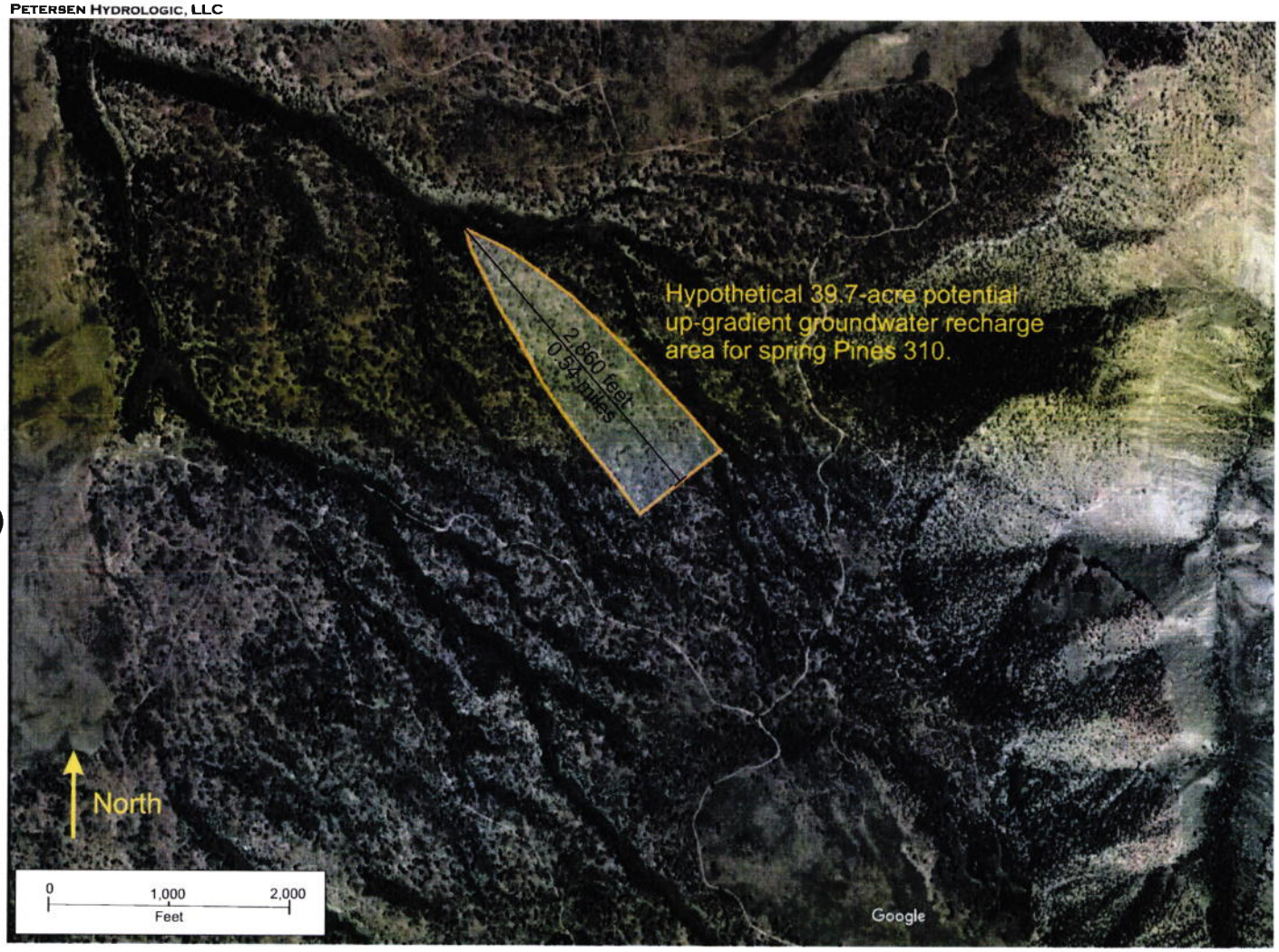

Figure 4 39.7-acre region up-gradient of spring Pines 310 (upper). This represents a hypothetical region that could potentially support adequate recharge to sustain the 0.34 gpm average discharge rate from the spring (based on USGS estimate of 1.2% of average annual precipitation recharging the Castlegate Sandstone and 13.8 inch average precipitation at the Sufco Mine area).

Table 1 Discharge and water quality data for Pines 310 (upper).

DATE	Wat. Temp Deg. C	Flow GPM	Cond(FLD) umhos/cm	F-pH pH units
9/26/2018	8.0	0.22	191	7.11
6/28/2018	6.9	0.25	213	7.46
11/3/2017	6.3	0.37	180	7.51
9/22/2017	10.3	0.22	226	7.5
6/25/2017	6.8	0.36	178	6.98
11/10/2016	6.7	0.39	183	7.44
9/24/2016	7.9	0.392	195	7.59
6/27/2016	7.1	0.363	176	7.19
11/6/2015	4.2	0.36	186	7.67
9/25/2015	8.1	0.4	168	7.37
6/23/2015	8.7	0.431	207	7.67
11/6/2014	6.6	0.38	180	7.2
8/28/2014	8.1	0.31	169	7.27
6/28/2014	6.3	0.25	174	7.12
Average:	**7.3**	**0.34**	**188**	**7.36**

GREENS HOLLOW LEASE

SITLA MUDDY LEASE

SKUTUMPAH LEASE

PINES LEASE

M-SP07(USP-1) (7922)
USP-2
U-MUD
Horse Creek
Muddy Creek below Horse
Muddy Creek above Horse
M-SP18 (8095)
M-SP11 (9237)
M-SP45 (8505)
GH ol Road
M-SP01
M-SP02 (8335)
(8420)
M-STR6 (8170)
URGH
M-SP12 (8739)
ULGH
M-SP04A (8812)
M-SP05 (8937)
M-SP06 (8952)
M-STR4 (8164)
M-SP39 (8225)
Cowboy Bottom
MW-15-5-2B
Pines 405 (7260)
Pines 403 (7270)
Pines 302 (7140)
RIDGE MINE
Pines 303 (7540)
Pines 407
Pines 408 (7685)
(7685)
406
Cowboy Top
M-SP41
M-SP40 (9163)
(9223)
Cowboy Mid
CW-13 (8600)
M-SP14 (9599)
M-SP20 (9395)
M-SP00 (8820)
M-SP09 (8849)
M-SP53 (8941)
01-8-1 (8988)
CPC Upper
M-SP100 (8975)
M-SP15 (8811)
Pines 209(8080)
PINES 206(8180)
Pines 214(8160)
Pines 212(8140)
FP-2
Pines 106 (8200)
Pines 105 (8260)
NW4-09
Pines 311(8410)
Pines 310(8420)
SUFCO 090 (8320)
Pines 218 (8190)
North Fork Upper
A2S-1 (A2S-1)
D SPRING
94-110
SPRING 99
M-SP104 (9052)
M-SP103 (8998)
M-SP106 (8997)
M-SP105 (8971)
M-SP50 (8801)
M-SP19 (8958)
SP-50 CREEK
CPC Middle
CPC Lower
North Fork Middle
007 (North Fork Lower) (8480)
CW-20 (8260)
USFS-109 (8280)
FP-1
SUFCO-089 (8360)
Muddy-ABF
408B (6870)
S. FORK QUITCHUPAH CREEK UPPER
DIVIDE SPRING
SKUTUMPAH CREEK UPPER
A SPRING
B-SPRING
SKUTUMPAH SPRING
HANSEN SEEP
CH 001 (8307)
AMMON (8000)
WEDGE SPRING
SUFCO-006 (8227)
89-20-2W (8358)
Pines 100 (8480)
94-591
CW-21 (8420)
001 (7780)
PINK PORTAL-WEST (7663)
PINK PORTAL-EAST (7665)
MINE
LINK 002 (7300)
057A (8720)
US-81-4 (8388)
UPDES-003 (7500)
SUFCO-021
US-81-3 (8027)
GW-9 (8180)
LIZONBEE SPRINGS
GW-8 (8195)
MUD SPRING (8287)
US-50-2 (8378)
001 (8080)
US-80-4 (8380)
US-79-3 (8526)
CORRAL KNOLL
BROAD HOLLOW (8157)
SINKHOLE
UPDES-001 (7600)
UPDES-002 (7560)
046 (7400)
047 (7160)
047A (7160)
042 (6350)
041 (6400)
EMERY
SAGE FLAT
SOUTH SAGE FLAT
DRY WASH
FLAGSTAFF PEAK
SANPETE CO.
SEVIER CO.
EMERY CO.
T 20 S
T 21 S
T 21 S
T 22 S
R 5 E
R 6 E

NOTES:

1. HISTORIC STREAM, SPRING AND WELL MONITORING SITES ARE OLD BASELINE MONITORING SITES OR SITES THAT HAVE BEEN DISCONTINUED OR MINED THROUGH THAT ARE NOT CURRENTLY BEING MONITORED.

EXPLANATION

- PROPOSED LEASE BOUNDARY
- SUFCO MINE EXTERIOR LEASE BOUNDARY
- SUFCO MINE INTERIOR LEASE BOUNDARY
- 100000 MC — MINE COORDINATES
- 2020000 SPC — STATE PLANE COORDINATES
- UPDES MONITORING POINT
- STREAM MONITORING
- (7600) — ELEVATION OF SITE
- MONITORING WELL SITE
- PERENNIAL FLOWS
- SPRING MONITORING

1000 0 1000

PROFESSIONAL ENGINEER — No. 9073291 — JACOB D. SMITH — STATE OF UTAH

I CERTIFY THE ITEMS SHOWN ON THIS DRAWING ARE ACCURATE TO THE BEST OF MY KNOWLEDGE

REVISIONS				
NO.	DATE	REQ. BY	DWG. BY	REMARKS
1	9/20/2017		B.R.	ADDED PINES NOTATION
2	12/18/2017		B.T.N.	REMOVED SPRINGS
3	3/14/2018	V.M.	B.R.	UPDATE MONITORING POINTS
4	3/27/2018	V.M.	J.G.C.	GREENS HOLLOW TECHNICAL ANALYSIS
5	10/31/2018	V.M.	J.G.C.	ADD SOUTH FORK LEASE PROPOSAL
6	1/15/2019	V.M.	J.G.C.	ADDED MONITORING WELL NW4-09

Canyon Fuel Company, LLC
SUFCO Mine
597 South SR 24 – Salina, UT 84654
(435) 286-4880 Phone
(435) 286-4499 Fax

OPERATIONAL HYDROLOGIC MONITORING STATIONS

PEN TBL:		SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_19ndnf-SUFEMP1.ctb		1" = 1,000'	8/15/2017	B.T.N.	J.D.B.	V.M.	PLATE 7-10
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 7-10.dwg					

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GREENS HOLLOW LEASE

SITLA MUDDY LEASE

SKUTUMPAH LEASE

PINES LEASE

NOTES:

1. HISTORIC STREAM, SPRING AND WELL MONITORING SITES ARE OLD BASELINE MONITORING SITES OR SITES THAT HAVE BEEN DISCONTINUED OR MINED THROUGH THAT ARE NOT CURRENTLY BEING MONITORED.

EXPLANATION

- SUFCO MINE EXTERIOR LEASE BOUNDARY
- SUFCO MINE INTERIOR LEASE BOUNDARY
- 100000 MC — MINE COORDINATES
- 2020000 SPC — STATE PLANE COORDINATES
- HISTORIC STREAM
- STREAM MONITORING
- HISTORIC MONITORING WELL
- MONITORING WELL SITE
- HISTORIC SPRING MONITORING SITE
- SPRING MONITORING
- UPDES MONITORING POINT
- IN MINE MONITORING SITE
- (7600) — ELEVATION OF SITE
- PERENNIAL FLOW LOCATION MONITORING POINT
- PERENNIAL FLOWS
- SPRING NOT MONITORED

1000 0 1000

I CERTIFY THE ITEMS SHOWN ON THIS DRAWING ARE ACCURATE TO THE BEST OF MY KNOWLEDGE

PROFESSIONAL ENGINEER — No. 9073281 — JACOB D. SMITH — STATE OF UTAH

REVISIONS				
NO.	DATE	REQ. BY	DWG. BY	REMARKS
19	7/14/2016	V.M.	J.G.C.	ADD GREENS HOLLOW & SOUTH FORK LEASE BOUNDARIES
21	12/15/2016	V.M.	T.L.M.	REMOVED SOUTH FORK LEASE BOUNDARY
22	4/12/2017	V.M.	J.G.C.	GREENS HOLLOW
23	9/19/2017	V.M.	B.R.	ADD PINS NOTATION
24	12/8/2017	V.M.	B.R.	ADD 4R4E PANEL
25	12/18/2017	V.M.	J.G.C.	ABOVE AMD BELOW
26	1/15/2019	V.M.	J.G.C.	ADDED MONITORING POINT NW4-09

Canyon Fuel Company, LLC
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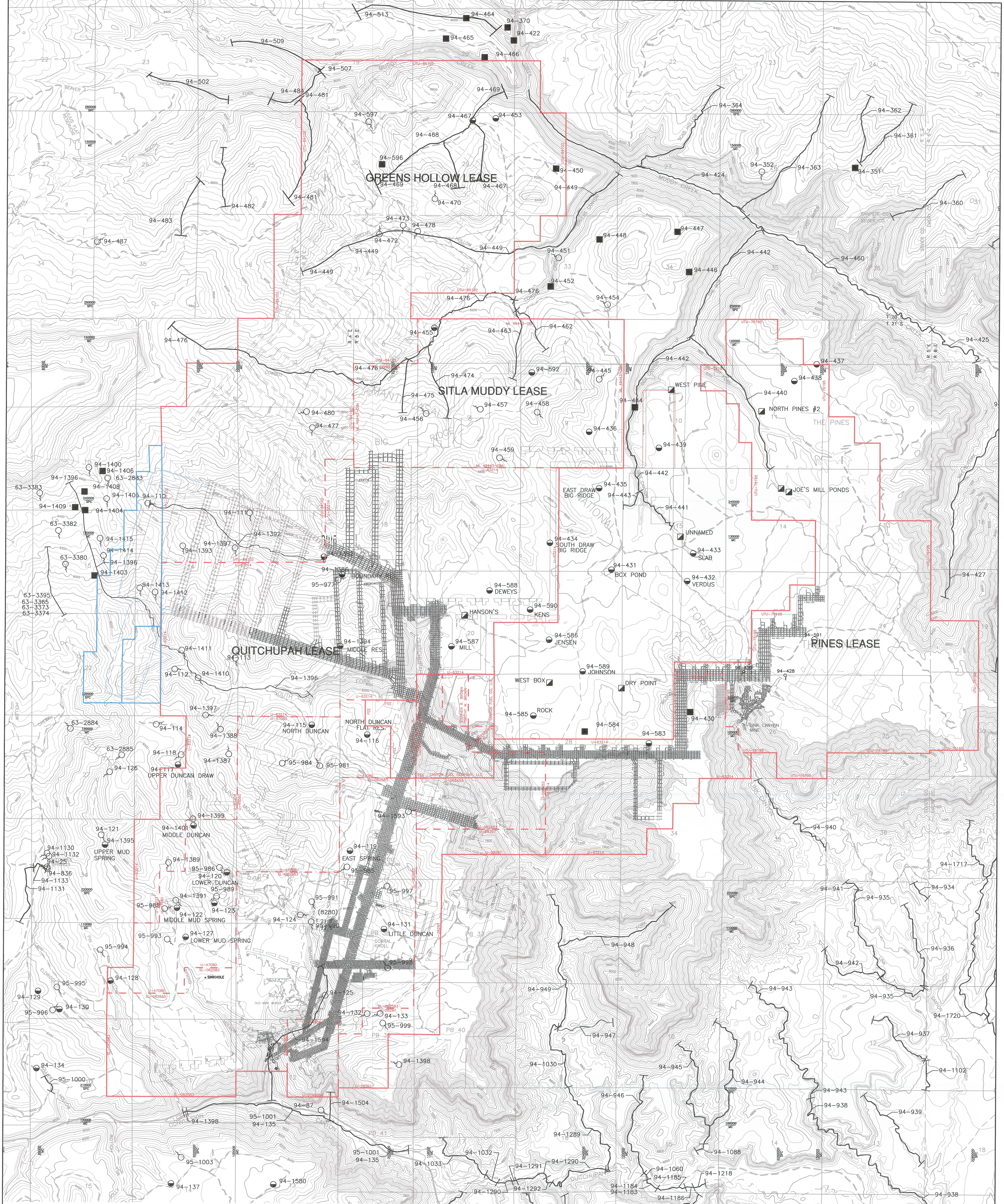
HYDROLOGIC MONITORING STATIONS

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
JShd4-SFDP1.ctb	1" = 1,000'	10/26/2006	JMB/TRB	J.D.B.	V.M.	PLATE 7-3
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 7-3.dwg				

Jobstatus: 1/17/2019 10:09 AM



EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- 100000 / MC — MINE COORDINATES
- 2020000 / SPC — STATE PLANE COORDINATES
- WATER RIGHT SPRING
- RUNOFF CATCHMENT POND W/ WATER RIGHT
- RUNOFF CATCHMENT POND W/O WATER RIGHT
- SURFACE WATER RIGHT POINT TO POINT
- SURFACE WATER RIGHT

NOTES:

1. SEE APPENDIX 7–1 FOR DETAILED LISTING OF WATER RIGHTS

- PROPOSED LEASE BOUNDARY

Jchristensen: 1/16/2019 7:15 AM

QUITCHUPAH TRACT

CATCHMENT PONDS WITH WATER RIGHTS NUMBER	NAME	CURRENT COMMON NAME USED BY USFS, CATTLEMEN AND OTHERS	OTHER HISTORICAL NAMES USED FOR CATCHMENT PONDS
94–115	NORTH DUNCAN RES.		
94–116	NORTH DUNCAN FLAT RES.		
94–117	UPPER DUNCAN DRAW RES.		
94–119	EAST SPRING RES.		
94–120	LOWER DUNCAN RES.		
94–122	MIDDLE MUD SPRING RES.		
94–123	SHORT HOLLOW RES.		
94–127	LOWER MUD SPRING RES.		
94–128	PIN HOLLOW RES.		
94–129	ELDRIDGE HOLLOW RES. #1		
94–130	ELDRIDGE HOLLOW RES. #2		
94–131	LITTLE DUNCAN RES.		
94–134	COLLIER RES.		
94–137	JOLLY MILL POINT RES.		
94–430	UNNAMED RES.	LINK CANYON #1	
94–431	UNNAMED RES.	BOX POND	TRIANGLE, THREE CORNER
94–434	UNNAMED RES.	SOUTH DRAW BIG RIDGE	
94–435	UNNAMED RES.	EAST DRAW BIG RIDGE	
94–436	UNNAMED RES.		
94–439	UNNAMED RES.		

QUITCHUPAH TRACT

CATCHMENT PONDS WITH WATER RIGHTS NUMBER	NAME	CURRENT COMMON NAME USED BY USFS, CATTLEMEN AND OTHERS	OTHER HISTORICAL NAMES USED FOR CATCHMENT PONDS
94–444	UNNAMED RES.		
94–583	DRY POINT RES.		
94–584	SEEPS RES.	SEEPS POND	
94–585	WHITE KNOLL RES.	ROCK POND	
94–586	BOX CANYON RES.	JENSEN	
94–587	MILL RES.	MILL POND	
94–588	DWEYS RES.	DEWYS POND	
94–589	SAGE CREEK RES.	JOHNSON POND	JENSEN, SAGE GROUSE POND
94–590	KENS RES.		
94–592	BIG RIDGE RES.		
94–730	QUITCHUMPAH RES. #1	QUITCHUPAH RES. #1	
94–1386	BOUNDARY RES.		
94–1394	MIDDLE RES.		
94–1395	UPPER MUD SPRINGS RES.		
94–1401	MIDDLE DUNCAN RES.		
94–1580	JOLLY MILL GUZZLER RES.		
OTHER CATCHMENT PONDS WITHOUT WATER RIGHTS			
		WEST BOX	
		DRY POINT	
		HANSON'S POND	JOHNSON, HANS

PROFESSIONAL ENGINEER
JACOB D. SMITH
STATE OF UTAH

I CERTIFY THE ITEMS SHOWN ON THIS DRAWING ARE ACCURATE TO THE BEST OF MY KNOWLEDGE

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N

REVISIONS				
NO.	DATE	REQ. BY	DWG. BY	REMARKS
1	7/13/2016	V.M.	J.G.C.	ADD GREENS HOLLOW & SOUTH FORK LEASE
				BOUNDARIES; COMBINE 7–2A,B,C DRAWINGS
2	4/18/2017	V.M.	B.R.	GREENS HOLLOW
3	10/18/2017	B.B.	B.R.	Add 4R4E Panel
4	3/27/2018	V.M.	B.R.	GREENS HOLLOW TECHNICAL ANALYSIS
5	10/31/2018	V.M.	J.G.C.	ADDED PROPOSED MINING IN PINES EAST
				AND SOUTH FORK WITH PROPOSED LEASE
6	1/15/2019	V.M.	J.G.C.	RELOCATED SPRING 94–591

PEN TBL: _1Stndrd-SUFENP1.ctb
SHT SET: ####
PROJECT NUMBER: ####

Canyon Fuel Company, LLC
SUFCO Mine
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(435) 286–4880 Phone
(435) 286–4499 Fax

SURFACE AND GROUNDWATER RIGHTS–QUITCHUPAH TRACT

SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
1" = 1,500'	07/13/2016	J.G.C	V.M.	V.M.	PLATE 7–2

FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 7–2.dwg

CHAPTER 9

ALLUVIAL VALLEY FLOOR

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3.2.2 Operations Affecting Designated Alluvial Valley Floor 9-7

LIST OF PLATES

Plate

9-1 Alluvial Valley Floor Characteristics Determination

LIST OF APPENDICES

(Appendices appear in Volume 9)

Appendix

9-1 Environmental Assessment for Quitchupah Lease

3.2.2 Operations Affecting Designated Alluvial Valley Floor

Based on hydrology and geology of the mine permit area and the adjacent area, there appear to be no alluvial valley floors in these areas. A possible AVF exists in the general area along Quitchupah Creek downstream of the adjacent area boundary. Approximately 110 acres are being irrigated at this location (Plate 9-1). There appear to be no other potential alluvial valley floors in the general area.

All of the surface on the Quitchupah Lease is owned by the United States. The surface management agencies (USFS and BLM) have determined that no alluvial valley floors exist on the lease. Their finding is documented on page 6 in the Environmental Assessment for the Quitchupah Lease Tract included as Appendix 9-1.

All of the surface on the Pines Tract Lease is owned by the United States. Based on the above discussions, the Natural Resources Conservation Service Determination on the Pines Tract (located in Appendix 2-1), and the information provided in Chapters 2, 3, 6, and 7, alluvial valley floors are not present within the Pines Tract.

All of the surface on the SITLA Muddy Tract Lease is owned by the United States. Based on the above discussions, and the information provided in Chapters 2, 3, 6, and 7, alluvial valley floors are not present within the SITLA Muddy Tract.

The Greens Hollow Tract Lease is owned by the United States. Based on the above discussions, and the information provided in Chapters 2, 3, 6, and 7, alluvial valley floors are not present within the Tract.