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

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

September 25, 2019

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: South Fork Lease Modification Amendment, Canyon Fuel Company, LLC, Sufco Mine, Permit Number C/041/0002

Dear Sirs,

Attached to this letter is a response to deficiencies associated with the South Fork Lease Modification Amendment (task ID #5920). Below is a summary of the deficiencies included in the technical analysis and findings document. The summary includes the author of each deficiency and the changes included in this amendment that were requested.

Technical Analysis & Findings - South Fork Lease Modification Amendment			
Section	**Author**	**Deficiency**	**Change to Amendment**
Historical & Archeological Resource Information	T Miller	Proof of SHPO Clearance	Clearance Letter Added to Appendix 4-2 (CONF).
Maps Archeological Site Maps	T Miller	Asked for contours to be more clear on Plate 5-10C	Removed Isopac contours and lightened elevation contours.
Subsidence Control Plan	J Eatchel	Asked for contours to be more clear on Plates 5-10C & 5-10	Removed Isopac contours and lightened elevation contours.
Hydrologic Ground Water Monitoring	K Storrar	Asked for water right 94-1397 to be added to the WM program	Added water right 94-1397 to the WM program (Table 7-12, Plate 7-3, Plate 7-10).
Hydrologic Surface Water Monitoring	K Storrar	Asked for a stream monitoring site along the SFQ Creek near the southern most longwall panel in the new lease.	Added a stream monitoring site (S. Fork Quitchupah Creek Lower) along the SFQ Creek near the southern most longwall panel (Table 7-12, Plate 7-3, Plate 7-10).
Maps Monitoring and Sampling Locations	K Storrar	Asked that discrepancies between Figure 2 (Appendix 29), Table 7-12, Table 7-2, and Plates 7-2,7-3 & 7-10 be resolved.	All discrepancies were resolved between figures, tables and plates.

Any teal lines on the plates included in this amendment are for ease of review and will be changed to black according to the legend on each plate.

The chapter text submitted contains redline/strikeout text and in most chapters only the pages that are modified will be included. Clean copies of this amendment will include adjusted pagination and updated tables of contents.

Thank you for reviewing this amendment. If you have questions or need additional information, please contact Bryant Bunnell at (435) 286-4490.

Regards,

Bryant Bunnell
Environmental Engineer

Canyon Fuel Company, LLC
SUFCO Mine
P: (435) 286 – 4490
E: bbunnell@wolverinefuels.com

Encl.

cc: DOGM Correspondence File

APPLICATION FOR COAL PERMIT PROCESSING

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

Permittee: Canyon Fuel Company, LLC

Mine: Sufco Mine, Amendment to MRP to Address the South Fork Lease Modification **Permit Number:** C/041/0002

Title: South Fork Lease Modification Amendment

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 ☐ No 1. Change in the size of the Permit Area? Acres: 790 Disturbed Area: _____ ■ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes ☒ No 6. Does the application require or include public notice publication?
☒ Yes ☐ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes ☒ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # _____
☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: _____
☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
☒ Yes ☐ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☒ Yes ☐ No 13. Does the application require or include collection and reporting of any baseline information?
☐ Yes ☒ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☐ Yes ☒ No 15. Does the application require or include soil removal, storage or placement?
☐ Yes ☒ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes ☒ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☐ Yes ☒ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
☐ Yes ☒ No 21. Have reclamation costs for bonding been provided?
☒ Yes ☐ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes ☒ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

Please attach 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.

Jim Abshire
Print Name

Sr Mine Engineer 9/25/19
Sign Name, Position, Date

Subscribed and sworn to before me this 25th day of September, 2020

Jill White
Notary Public

My commission Expires: 3/28, 2020

Attest: State of Utah } ss:
County of Sevier

JILL WHITE
Notary Public
State of Utah
My Commission Expires 03/28/2020
COMMISSION NUMBER 687959

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining

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

Permittee: Canyon Fuel Company, LLC
Mine: Sufco Mine, Amendment to MRP to Address the South Fork Lease Modification **Permit Number:** C/041/0002
Title:

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	Chapter 1, Pages 10, 11, and 12
☐ Add	■ Replace	☐ Remove	Chapter 2, Page 9
☐ Add	■ Replace	☐ Remove	Chapter 2, Plate 2-3
☐ Add	■ Replace	☐ Remove	Chapter 3, Page 13
■ Add	☐ Replace	☐ Remove	Chapter 3, Add information to the back of Appendix 3-17
☐ Add	■ Replace	☐ Remove	Chapter 3, Plates 3-1, 3-2
☐ Add	■ Replace	☐ Remove	Chapter 4, Page 17
☐ Add	■ Replace	☐ Remove	Chapter 4, Plate 4-1C
☐ Add	■ Replace	☐ Remove	Chapter 5, Page 25
☐ Add	■ Replace	☐ Remove	Chapter 5, Plates 5-1, 5-5, 5-6, 5-7, 5-10, 5-11
☐ Add	■ Replace	☐ Remove	Chapter 6, Page 5
☐ Add	■ Replace	☐ Remove	Chapter 6, Plate 6-1
☐ Add	■ Replace	☐ Remove	Chapter 7, Pages 16, 54 thru 57
☐ Add	■ Replace	☐ Remove	Chapter 7, Plates 7-2, 7-3, 7-10
■ Add	☐ Replace	☐ Remove	Chapter 7, Appendix 7-29
☐ Add	■ Replace	☐ Remove	Chapter 9, Plate 9-1
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	CONFIDENTIAL
☐ Add	■ Replace	☐ Remove	Chapter 3, Plate 3-3
■ Add	☐ Replace	☐ Remove	Chapter 4, add information to Appendix 4-2
☐ Add	■ Replace	☐ Remove	Chapter 5, Plate 5-10C
■ Add	☐ Replace	☐ Remove	Chapter 6, add information to Appendix 6-1
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	

Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	**Received by Oil, Gas & Mining**

CHAPTER 1

GENERAL CONTENTS

T. 22 S., R. 4 E., SLM, Utah

Sec. 2, lots 1-4, S1/2NE1/4, S1/2NW1/4, N1/2SW1/4;

Sec. 3, NE1/4SE1/4

Federal Coal Lease U-63214 - (6506.34 ~~6336.34~~ acres +/-) - Approved July 1989

Modified June 1999, December 2009, May 2011, January 2017, November 2018

Tract 1:

T. 21 S., R. 4 E., SLM, Utah

Sec. 12, E1/2SE1/4

Sec. 13, E1/2NE1/4, S1/2

Sec. 14, E1/2SW1/4, SE1/4

Sec. 23, E1/2, E1/2W1/2

Sec. 24, all.

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

Sec. 16, W1/2NW1/4, W1/2SW1/4, W1/2E1/2NW1/4, W1/2E1/2SW1/4

Sec. 17-19, all

Sec. 20, NE1/4, W1/2 SE1/4, SW1/4, NW1/4

Sec. 21, W1/2NW1/4, W1/2E1/2NW1/4

Sec. 26, W1/2NW1/4SW1/4, SW1/4SW1/4

Sec. 27, NE1/4, SE1/4, S1/2SW1/4, S1/2N1/2SW1/4

Sec. 28, S1/2SE1/4, S1/2N1/2SE1/4, S1/2N1/2SW1/4, SE1/4SW1/4

Sec. 29, S1/2NE1/4SE1/4

Sec. 30, lot 1, N1/2NE1/4

Sec. 33, NE1/4, E1/2NW1/4, NE1/4SW1/4, N1/2SE1/4

Sec. 34, NW1/4NE1/4, NW1/4, NW1/4SW1/4.

Tract 3:

T. 21 S., R. 4 E., SLM, Utah

Sec. 26, E1/2, E1/2SW1/4;

Sec. 35, NW1/4, W1/2SW1/4.

Tract 4:

T. 21 S., R. 4 E., SLM, Utah

Sec. 22, E1/2SE1/4NE1/4, E1/2NE1/4SE1/4, NE1/4SE1/4SE1/4

Sec. 23, S1/2NW1/4NW1/4, SW1/4NW1/4, NW1/4SW1/4, N1/2SW1/4SW1/4

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 - (6795.39 ~~6,175.39~~ acres) - Effective April 1, 2017

Modified November 2018

Tract 1:

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

Sec. 29, all

Sec. 30, all

Sec. 31, all

Sec. 32, N1/2, N1/2S1/2

Sec. 33, NW1/4NW1/4

T. 21 S., R. 4 E., SLM

Sec. 1, all

Sec. 2, SE1/4

Sec. 11, E1/2, E1/2W1/2

Sec. 12, NE1/4, W1/2, W1/2SE1/4

Sec. 13, W1/2NE1/4, NW1/4

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

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

Sec. 6, all

Tract 2:

T. 21 S., R. 4 E., SLM

Sec. 11, SW1/4SW1/4, S1/2NW1/4SW1/4, NE1/4NW1/4SW1/4, SE1/4SW1/4NW1/4

Sec. 14, W1/2W1/2

Sec. 15, E1/2SE1/4, E1/2SW1/4SE1/4, SE1/4NW1/4SE1/4, SW1/4SE1/4NE1/4, E1/2E1/2NE1/4

Sec. 22, NE1 /4NE1/4, E1/2W1/2NE1/4, SW1/4SW1/4NE1/4, W1/2SE1/4NE1/4, NW1/4SE1/4, W1/2NE1/4SE1/4, N1/2SW1/4SE1/4, NW1/4SE1/4SE1/4

Sec. 23, N1/2NW1/4NW1/4

CHAPTER 2

SOILS

4 Right 4 East - Quitchupah Tract

The 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. The soils above the 4 Right panel support sagebrush, grassland, mountain brush and Pinyon/Juniper, with islands of quaking aspen and scattered pines. No other disturbance as in the construction of facilites, etc. is associated with mining of the 4Right 4 East panel.

South Fork Lease Modification

No surface disturbance is anticipated within the South Fork Lease Modification area.

2.2.2.4 Soil Productivity

In areas where soil disturbance has resulted from mining activities, the soils have lost their native identities. In most cases the soils have been quite thoroughly mixed. As a result, soil textures and horizons have been altered. Textures are now primarily loams and silty clay loams; depths over indurated material or shale are generally greater than 30 inches, except along "cut" slopes of the mountain where geologic strata are exposed.

As a result of this disturbance in "fill" areas, the potential for reclamation has been enhanced. The soils are deeper and the resulting textures are more desirable for plant growth.

Saturation percentages are unavailable. When the original sampling and analyses of soils for the portal yard area were completed, saturation percentage was not required by the regulatory agencies.

Appendix 2-1

Lease Documents

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FEB 1 9 2019

Serial No. UTU-63214

MODIFIED COAL LEASE

Date of Lease: July 1, 1989

PART I.

THIS MODIFIED COAL LEASE is entered into on MAR 0 1 2019, by and between the **UNITED STATES OF AMERICA**, hereinafter called the Lessor, through the Bureau of Land Management, and

Canyon Fuels Company LLC
9815 South Monroe Street
Suite 203
Sandy, Utah 84070

hereinafter called Lessee.

This modified lease shall retain the effective date of July 1, 1989, of the original **COAL LEASE UTU-63214**, and is effective for a period of 20 years from the date of issuance of the lease, dated July 1, 1989, and for so long thereafter as coal is produced in commercial quantities from the leased lands, subject to readjustment of lease terms on July 1, 2019 and at the end of each 10 year lease period thereafter.

Sec. 1. This lease is issued pursuant and subject to the terms and provisions of the: (NOTE: Check the appropriate Act or Acts.)

XX Mineral Lands Leasing Act of 1920, as amended, 41 Stat. 437, 30 U.S.C. 181-287, hereinafter referred to as the Act;

_ Mineral Leasing Act for Acquired Lands of 1947, 61 Stat. 913, 30 U.S.C. 351-359;

and to the regulations and formal orders of the Secretary of the Interior which are now or hereafter in force, when not inconsistent with the express and specific provisions herein.

Sec. 2. Lessees as the holders of Coal Lease UTU- 63214, issued effective July 1, 1989, were granted the exclusive right and privilege to drill for, mine, extract, remove or otherwise process and dispose of the coal deposits in, upon, or under the lands described below as Tracts 1-3.

The Lessor in consideration of fair market value, rents and royalties to be paid, and the conditions and covenants to be observed as herein set forth, hereby grants and leases to Lessee the exclusive right and privilege to drill for, mine, extract, remove, or otherwise process and dispose of the coal deposits in, upon, or under the lands described below as Tract 4.

RECEIVED
FEB 1 9 2019
BUREAU OF
LAND MANAGEMENT
USO

Tract 1:
Salt Lake Meridian, Utah

T. 21 S., R., 4 E.,
sec. 12, E½,SE¼;
sec. 13, E½NE¼, S½;
sec. 14, E½SW¼,SE¼;
sec. 23, E½, E½W½;
sec. 24;

T. 21 S., R., 4 E.,
sec. 15, W½;
secs. 16 thru 21;
sec. 22, W½
sec. 26, W½NW¼SW¼SW¼SW¼;
sec. 27;
sec. 28, N½, N½SW¼, SE¼SW¼, SE¼;
sec. 29, E½NE¼, NE¼SE¼;
sec. 30, lot1, N½NE¼;
sec. 33, lots 2 thru 4, NE¼, E½NW¼,
NE¼SW¼, N½SE¼.
sec. 34;
sec. 35, lots 1 and 2, W½NW¼, N½SW¼

T. 22 S., R., 5 E.,
sec. 3, lots 1 thru 4, S½N½, NE¼SW¼,
S½SW¼, N½SE¼, SW¼SE¼;
sec. 4, lots 1 and 2, S½NE¼, SE¼SE¼;
sec. 9, NE¼NE¼;
sec. 10, W½NE¼, NW¼, N½SW¼.

Tract 2:
Salt Lake Meridian, Utah
T. 21 S., R. 5 E., SLM
Sec. 10, SE¼NW¼, E½SW¼, E½E½SW¼NW¼, E½E½NW¼SW¼, E½E½SW¼SW¼.

Tract 3:
Salt Lake Meridian, Utah
T. 21 S., R., 4 E.,
sec. 26, E½,E½SW¼;
sec. 35, NW¼, W½SW¼.

Tract 4:
Salt Lake Meridian, Utah
T. 21 S., R. 4 E., SLM
sec. 23, E½SW¼NW¼, E½NW¼SW¼, NE¼SW¼SW¼.

containing 10,745.46 acres, more or less, together with the right to construct such works, buildings, plants, structures, equipment and appliances and the right to use such on-lease rights-of-way which may be necessary and convenient in the exercise of the rights and privileges granted, subject to the conditions herein provided.

Part II. TERMS AND CONDITIONS

Sec. 1.(a) RENTAL RATE - Lessee shall pay Lessor rental annually and in advance for each acre or fraction thereof during the continuance of the lease at the rate of $3.00 per acre for each lease year.

(b) RENTAL CREDITS - Rental shall not be credited against either production or advance royalties for any year.

Sec. 2.(a) PRODUCTION ROYALTIES - The royalty shall be 8 percent of the value of the coal as set forth in the regulations. Royalties are due to Lessor the final day of the month succeeding the calendar month in which the royalty obligation accrues.

(b) ADVANCE ROYALTIES - Upon request by the Lessee, the authorized officer may accept, for a total of not more than 20* years, the payment of advance royalties in lieu of continued

operation, consistent with the regulations. The advance royalty shall be based on a percent of the value of a minimum number of tons determined in the manner established by the advance royalty regulations in effect at the time the Lessee requests approval to pay advance royalties in lieu of continued operation.

* 20 years (Public Law 109-58)

Sec. 3. BONDS - Lessee shall maintain in the proper office a lease/LMU bond in the amount of $5,209,000. The authorized officer may require an increase in this amount when additional coverage is determined appropriate.

Sec. 4. DILIGENCE - This lease has achieved diligent development on February 1, 2003, and is subject to the conditions of continued operation. Continued operation may be excused when operations under the lease are interrupted by strikes, the elements, or casualties not attributable to the Lessee. The Lessor, in the public interest, may suspend the condition of continued operation upon payment of advance royalties in accordance with the regulations in existence at the time of the suspension.

The Lessor reserves the power to assent to or order the suspension of the terms and conditions of this lease in accordance with, inter alia, Section 39 of the Mineral Leasing Act, 30 U.S.C. 209.

Sec. 5. **LOGICAL MINING UNIT (LMU)** – Either upon approval by the Lessor of the Lessee's application or at the direction of the Lessor, this lease shall become an LMU or part of an LMU, subject to the provisions set forth in the regulations.

The stipulations established in an LMU approval in effect at the time of LMU approval or modification will supersede the relevant inconsistent terms of this lease so long as the lease remains committed to the LMU. If the LMU of which this lease is a part is dissolved, the lease shall then be subject to the lease terms which would have been applied if the lease had not been included in an LMU.
This lease was placed in the Sufco LMU effective April 2, 1990.

Sec. 6. DOCUMENTS, EVIDENCE AND INSPECTION - At such times and in such form as Lessor may prescribe, Lessee shall furnish detailed statements showing the amounts and quality of all products removed and sold from the lease, the proceeds therefrom, and the amount used for production purposes or unavoidably lost.

Lessee shall keep open at all reasonable times for the inspection of any duly authorized officer of Lessor, the leased premises and all surface and underground improvements, works, machinery, ore stockpiles, equipment, and all books, accounts, maps, and records relative to operations, surveys, or investigations on or under the leased lands.

Lessee shall allow Lessor access to and copying of documents reasonably necessary to verify Lessee compliance with terms and conditions of the lease.

While this lease remains in effect, information obtained under this section shall be closed to inspection by the public in accordance with the Freedom of Information Action (5 U.S.C. 552).

Sec. 7. DAMAGES TO PROPERTY AND CONDUCT OF OPERATIONS - Lessee shall comply at its own expense with all reasonable orders of the Secretary, respecting diligent operations, prevention of waste, and protection of other resources.

Lessee shall not conduct exploration operations, other than casual use, without an approved exploration plan. All exploration plans prior to the commencement of mining operations within an approved mining permit area shall be submitted to the authorized officer.

Lessee shall carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health, or property, and prevention of waste, damage or degradation any land, air, water, cultural, biological, visual, and other resources, including mineral deposits and formations of mineral deposits not leased hereunder, and to other land uses or users. Lessee shall take measures deemed necessary by Lessor to accomplish the intent of this lease term. Such measures may include, but not limited to, modification to proposed siting or design of facilities, timing of operations, and specifications of interim and final reclamation procedures. Lessor reserves to itself the right to lease, sell, or otherwise dispose of the surface or other mineral deposits in the lands and the right to continue existing uses and to authorize future uses upon or in the leased lands, including issuing leases for mineral deposits not covered hereunder and approving easements or rights-of-way. Lessor shall condition such uses to prevent unnecessary or unreasonable interference with rights of Lessee as may be consistent with concepts of multiple use and multiple mineral development.

Sec. 8 **PROTECTION OF DIVERSE INTERESTS, AND EQUAL OPPORTUNITY** - Lessee shall: pay when due all taxes legally assessed and levied under the laws of the State or the United States; accord all employees complete freedom of purchase; pay all wages at least twice each month in lawful money of the United States; maintain a safe working environment in accordance with standard industry practices; restrict the workday to not more than 8 hours in any one day for underground workers, except in emergences; and take measures necessary to protect the health and safety of the public. No person under the age of 16 years shall be employed in any mine below the surface. To the extent that laws of the State in which the lands are situated are more restrictive than the provisions in this paragraph, then the State laws apply.

Lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and the rules, regulations, and relevant orders of the Secretary of Labor. Neither Lessee nor Lessee's subcontractors shall maintain segregated facilities.

Sec. 9.(a) **TRANSFERS**
(Check the appropriate space)

X This lease may be transferred in whole or in part to any person, association or corporation qualified to hold such lease interest.

___ This lease may be transferred in whole or in part to another public body, or to a person who will mine the coal on behalf of, and for the use of, the public body or to a person who for the limited purpose of creating a security interest in favor of a lender agrees to be obligated to mine the coal on behalf of the public body.

___ This lease may only be transferred in whole or in part to another small business qualified under 13 CFR 121.

Transfers of record title, working or royalty interest must be approved in accordance with the regulations.

(b) **RELINQUISHMENTS** - The Lessee may relinquish in writing at any time all rights under this lease or any portion thereof as provided in the regulations. Upon Lessor's acceptance of the relinquishment, Lessee shall be relieved of all future obligations under the lease or the relinquished portion thereof, whichever is applicable.

Sec. 10. **DELIVERY OF PREMISES, REMOVAL OF MACHINERY, EQUIPMENT, ETC.** - At such times as all portions of this lease are returned to Lessor, Lessee shall deliver up to Lessor the land leased, underground timbering, and such other supports and structures necessary for the preservation of the mine workings on the leased premises or deposits and place all workings in condition for suspension or abandonment. Within 180 days thereof, Lessee shall remove from the premises all other structures, machinery, equipment, tools, and materials that it elects to or as required by the authorized officer. Any such structures, machinery, equipment, tools, and materials remaining on the leased lands beyond 180 days, or approved extension thereof, shall become the property of the Lessor, but Lessee shall either remove any or all such property or shall continue to be liable for the cost of removal and disposal in the amount actually incurred by the Lessor. If the surface is owned by third parties, Lessor shall waive the requirement for removal, provided the third parties do not object to such waiver. Lessee shall, prior to the termination of bond liability or at any other time when required and in accordance with all applicable laws and regulations, reclaim all lands the surface of which has been disturbed, dispose of all debris or solid waste, repair the offsite and onsite damage caused by Lessee's activity or activities incidental thereto, and reclaim access roads or trails.

Sec. 11. **PROCEEDINGS IN CASE OF DEFAULT** - If Lessee fails to comply with applicable laws, existing regulations, or the terms, conditions and stipulations of this lease, and the noncompliance continues for 30 days after written notice thereof, this lease shall be subject to cancellation by the Lessor only by judicial proceedings. This provision shall not be construed to prevent the exercise by Lessor of any other legal and equitable remedy, including waiver of the default. Any such remedy or waiver shall not prevent later cancellation for the same default occurring at any other time.

Sec. 12. **HEIRS AND SUCCESSORS - IN-INTEREST** - Each obligation of this lease shall extend to and be binding upon, and every benefit hereof shall insure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 13. **INDEMNIFICATION** - Lessee shall indemnify and hold harmless the United States from any and all claims arising out of the Lessee's activities and operations under this lease.

Sec. 14. **SPECIAL STATUTES** - This lease is subject to the Federal Water Pollution Control Act (33 U.S.C. 1151 - 1175); the Clean Air Act (42 U.S.C. 1857 et seq.), and to all other applicable laws pertaining to exploration activities, mining operations and reclamation, including the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et seq.)

Sec. 15. **SPECIAL STIPULATIONS** -

SEE ATTACHED STIPULATIONS

CANYON FUEL Company LLC Company or Lessee Name	The United States of America BY Joseph Balash
James C Dunn (Signature of Lessee)	(Signing Officer)
CEO (Title)	ASLM (Title)
2/06/2019 (Date)	2/14/19 (Date)

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

SPECIAL STIPULATIONS FOR
COAL LEASE UTU-63214

1. Before undertaking activities that may disturb the surface of previously undisturbed leased lands, the lessee may be required to conduct a cultural resource inventory and a paleontological appraisal of the areas to be disturbed. These studies shall be conducted by qualified professional cultural resource specialists or qualified paleontologists, as appropriate, and a report prepared itemizing the findings. A plan will then be submitted making recommendations for the protection of, or measures to be taken to mitigate impacts for identified cultural or paleontological resources.

If cultural resources or paleontological remains (fossils) of significant scientific interest are discovered during operations under this lease, the lessee, prior to disturbance, shall immediately bring them to the attention of the appropriate authorities. Paleontological remains of significant scientific interest do not include leaves, ferns, or dinosaur tracks commonly encountered during underground mining operations.

The cost of conducting the inventory, preparing reports, and carrying out mitigating measures shall be borne by the lessee.

2. If there is reason to believe that Threatened or Endangered (T&E) species of plants or animals, or migratory bird species of high Federal interest occur in the area, the Lessee shall be required to conduct an intensive field inventory of the area to be disturbed and/or impacted. The inventory shall be conducted by a qualified specialist and a report of findings will be prepared. A plan will be prepared making recommendations for the protection of these species or action necessary to mitigate the disturbance.

The cost of conducting the inventory, preparing reports, and carrying out mitigating measures shall be borne by the lessee.

3. The Lessee shall be required to perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area. Existing data may be used if such data are adequate for the intended purposes. The study shall be adequate to locate, quantify, and demonstrate the interrelationship of the geology, topography, surface and ground water hydrology, vegetation and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison.

4. Power lines used in conjunction with the mining of coal from this lease shall be constructed so as to provide adequate protection for raptors and other large birds. When feasible, power lines will be located at least 100 yards from public roads.

5. The limited area available for mine facilities at the coal outcrop, steep topography, adverse winter weather, and physical limitations on the size and design of the access road, are factors which will determine the ultimate size of the surface area utilized for the mine. A site specific environmental analysis will be prepared for each new mine site development and for major modifications to existing developments to examine alternatives and mitigate conflicts.

6. Consideration will be given to site selection to reduce adverse visual impacts. Where alternative sites are available, and each alternative is technically feasible, the alternative involving the least damage to the scenery and other resources shall be selected. Permanent structures and facilities will be designed, and screening techniques employed, to reduce visual impacts, and where possible achieve a final landscape compatible with the natural surroundings. The creation of unusual, objectionable, or unnatural land forms and vegetative landscape features will be avoided.

7. The lessee shall be required to establish a monitoring system to locate, measure, and quantify the progressive and final effects of underground mining activities on the topographic surface, underground and surface hydrology and vegetation. The monitoring system shall utilize techniques which will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the lease area. The monitoring shall incorporate and be an extension of the baseline data.

8. The lessee shall provide for the suppression and control of fugitive dust on haul roads, permitted roads, and at coal handling and storage facilities. On National Forest System Roads (NFSR), lessees may perform their share of road maintenance by a commensurate share agreement if a significant degree of traffic is generated that is not related to their activities.

9. Except at locations specifically approved by the Authorized Officer, with the concurrence of the Forest Service, underground mining operations shall be conducted in such a manner so as to prevent surface subsidence that would: (1) cause the creation of hazardous conditions such as potential escarpment failure and landslides, (2) cause damage to existing surface structures, and (3) damage or alter the flow of perennial streams. Where the Forest Service specifically approves exceptions to the above restrictions on subsidence, the lessee shall provide specific measures for the protection of escarpments, and determine corrective measures to assure that hazardous conditions are not created.

10. In order to avoid surface disturbance on steep canyon slopes and to preclude the need for surface access, all surface breakouts for ventilation tunnels shall be constructed from inside the mine, except at specifically approved locations.

11. If removal of timber is required for clearing of construction sites, etc., such timber shall be removed in accordance with the regulations of the surface management agency.

12. The coal contained within, and authorized for mining under this lease, shall be extracted only by underground mining methods.

13. Existing Forest Service owned or permitted surface improvements will need to be protected, restored, or replaced to provide for the continuance of current land uses.

14. In order to protect big game wintering areas, elk calving and deer fawning areas, sagegrouse strutting areas, and other critical wildlife habitat and/or activities, specific surface uses outside the mine development area may be curtailed during specific periods of the year.

15. Support facilities, structures, equipment, and similar developments will be removed from the lease area within 2 years after the final termination of use of such facilities. This provision shall apply unless the requirement of Section 10 of the lease form is applicable. Disturbed areas and those areas previously occupied by such facilities will be stabilized and rehabilitated, drainages reestablished, and the areas returned to a pre-mining land use.

16. The Lessee at the conclusion of the mining operation, or at other times as surface disturbance related to mining may occur, will replace all damaged, disturbed, or displaced corner monuments (section corners, quarter corners, etc.) their accessories and appendages (witness trees, bearing trees, etc.), or restore them to their original condition and location, or at other locations that meet the requirements of the rectangular surveying system. This work shall be conducted at the expense of the Lessee, by Bureau of Land Management (BLM) land surveyors, to the standards and guidelines found in the Manual of Surveying Instructions, U.S. Department of Interior.

17. The Lessee, at their expense, will be responsible to replace any surface water and/or developed ground water sources identified in Record of Decision for protection, that may be lost or adversely affected by mining operations, with water from an alternate source in sufficient quantity and quality to maintain existing riparian habitat, fishery habitat, livestock and wildlife use, or other land uses (authorized by 36 CFR 251).

18. The Licensee/Permittee/Lessee must comply with all the rules and regulations of the Secretary of Agriculture set forth at Title 36, Chapter II, of the Code of Federal Regulations governing the use and management of the National Forest System (NFS) when not inconsistent with the rights granted by the Secretary of the Interior in the license/permit/lease. The Secretary of Agriculture's rules and regulations must be complied with for (1) all use and occupancy of the NFS prior to approval of a permit/operation plan by the Secretary of Interior, (2) uses of all existing improvements, such as Forest Development Roads, within and outside the area licensed, permitted or leased by the Secretary of Interior, and (3) use and occupancy of the NFS not authorized by a permit/operation plan approved by the Secretary of the Interior.

All matters related to this stipulation are to be addressed to:

Forest Supervisor
Manti-LaSal National Forest
599 West Price River Drive
Price, Utah 84501
Telephone No.: 435-637-2817

who is the authorized representative of the Secretary of Agriculture.

19. Notwithstanding the approval of a resource recovery and protection plan (R2P2) by the BLM, lessor reserves the right to seek damages against the operator/lessee in the event (i) the operator/lessee fails to achieve maximum economic recovery [as defined at 43 CFR §3480.0-5(21)] of the recoverable coal reserves or (ii) the operator/lessee is determined to have caused a wasting of recoverable coal reserves. Damages shall be measured on the basis of the royalty that would have been payable on the wasted or unrecovered coal.

The parties recognize that under an approved R2P2, conditions may require a modification by the operator/lessee of that plan. In the event a coal bed or portion thereof is not to be mined or is rendered unminable by the operation, the operator shall submit appropriate justification to obtain approval by the AO to leave such reserves unmined. Upon approval by the AO, such coal beds or portions thereof shall not be subject to damages as described above. Further, nothing in this section shall prevent the operator/lessee from exercising its right to relinquish all or a portion of the lease as authorized by statute and regulation.

In the event the AO determines that the R2P2 as approved will not attain MER as the result of changed conditions, the AO will give proper notice to the operator/lessee as required under applicable regulations. The AO will order a modification if necessary, identifying additional reserves to be mined in order to attain MER. Upon a final administrative or judicial ruling upholding such an ordered modification, any reserves left unmined (wasted) under that plan will be subject to damages as described in the first paragraph under this section.

Subject to the right to appeal hereinafter set forth, payment of the value of the royalty on such unmined recoverable coal reserves shall become due and payable upon determination by the AO that the coal reserves have been rendered unminable or at such time that the lessee has demonstrated an unwillingness to extract the coal.

The BLM may enforce this provision either by issuing a written decision requiring payment of the Office of Natural Resource Revenue (ONRR) demand for such royalties, or by issuing a notice of non-compliance. A decision or notice of non-compliance issued by the lessor that payment is due under this stipulation is appealable as allowed by law.

20. WASTE CERTIFICATION: The lessee shall provide upon abandonment and/or sealing off a mined area and prior to lease termination/relinquishment, certification to the lessor that, based upon a complete search of all the operator's records for the mine and upon their knowledge of past operations, there has been no **hazardous substances** per (40 CFR 302.4) or **used oil** as per Utah State Management Rule R-315-15, deposited within the lease, either on the surface or underground, or that all remedial action necessary has been taken to protect human health and the environment with respect to any such substances remaining on the property. The back-up documentation to be provided shall be described by the lessor prior to the first certification and shall include all documentation applicable to the Emergency Planning and Community Right-to-know Act (EPCRA, Public Law 99-499), Title III of the Superfund Amendments and Reauthorization Act of 1986 or equivalent.

21. ABANDONMENT OF EQUIPMENT: The lessee/operator is responsible for compliance with reporting regarding toxic and hazardous material and substances under Federal Law and all associated amendments and regulations for the handling such materials on the land surface and in underground mine workings.

The lessee/operator must remove mine equipment and materials not needed for continued operations, roof support and mine safety from underground workings prior to abandonment of mine sections. Exceptions can be approved by the Authorized Officer (BLM) in consultation with the surface management agency. Creation of a situation that would prevent removal of such material and by retreat or abandonment of mine sections without prior authorization would be considered noncompliance with lease terms and conditions and subject to appropriate penalties under the lease.

22. UNDERGROUND INSPECTION: All safe and accessible areas shall be inspected prior to being sealed. The lessee shall notify the Authorized Officer in writing 30 days prior to the sealing of any areas in the mine and state the reason for closure. Prior to seals being put into place, the lessee shall inspect the area and document any equipment/machinery, hazardous substances, and used oil that is to be left underground.

The purpose of this inspection will be: (1) to provide documentation for compliance with 42 U.S.C. 9620 section 120(h) and State Management Rule R-315-15, and to assure that certification will be meaningful at the time of lease relinquishment, (2) to document the inspection with a mine map showing location of equipment/machinery (model, type of fluid, amount remaining, batteries etc.) that is proposed to be left underground. In addition, these items will be photographed at the lessee's expense and shall be submitted to the Authorized Officer as part of the certification. The abandonment of any equipment/machinery shall be on a case by case basis and shall not be accomplished unless the Authorized Officer has granted a written approval.

23. GOB VENT BOREHOLES: The lessee shall submit a gov bent borehole plan for approval by the AO as part of an R2P2 for all gob vent boreholes. The plugging portion of the plan must meet 43 CFR 3484.1(a)(3) as a minimum. If variations to the approved plugging procedures are necessary, they shall also be approved by the AO in writing prior to implementation of the procedures

24. FAIR MARKET VALUE BONUS: Pursuant to 43 CFR 3432.2(c), "the lands applied for shall be added to the existing lease without competitive bidding, but the United States shall receive the fair market value of the lease of the added lands, either by cash payment or adjustment of the royalty applicable to the lands added to the lease by the modification." Therefore, the lessee will pay the fair market value (FMV) bonus payment for the coal resources mined in the area of Federal coal lease modification (UTU-63214) Tract 2: Due to the uncertainty of the amount of recoverable coal tons in this modification and the uncertainty in mining conditions, the lessee will pay the fair market value (FMV) for the coal resources mined in the area of Federal Coal Lease Modification (UTU-63214 Tract 2) at the rate of $0.25 per ton for the actual tonnage mined. Payment of the FMV at the specified rate and tonnage mined will be on the schedule required for payment of production royalties to the Office of Natural Resources Revenue (ONRR). The lessee will clearly indicate which portion of the payment is for royalty and what is for lease bonus payment. Tract 3: in the amount of $155,666, prior to approval of the modification adding Tract 3 to lease UTU-63214. A payment of $159,333 will be due prior to one year anniversary of the approval of the modification and a final payment of $163,333 will be required to be paid prior to the second year anniversary of the approval of the modification. Finally, an additional bonus payment will be due for the coal resources mined on the areas comprised of Federal coal lease modification acreage added to coal leases SL-062583 (Tract 2), UTU-47080 (Tract 2) and UTU-63214 (Tract 3), which exceed 6,930,000 tons mined, at a rate of $.41 per ton for the actual tonnage mined, adjusted annually using the U. S. Bureau of Labor Statistics CPI West Urban Energy Index; or if that index is not available, an index that is mutually agreed to by the lessee and the authorized officer will be used. Payment of this part of the FMV at the specified rate and tonnage mined will be on the schedule required for payment of production royalties to ONRR. The lessee will clearly indicate which portion of the payment is for royalty and what is for the lease bonus payment.

(Tract 4), The bonus bid shall be at the rate of $.41 per ton for the actual tonnage mined, adjustment annually using the U.S. Bureau of Labor Statistics CPI West Urban Energy Index; or if that index is not available, an index that is mutually agreed to by the lessee and the authorized officer will be used. Payment of this part of the FMV at the specified rate and tonnage mined will be on the schedule required for payment of production royalties to the Office of Natural Resources Revenue (ONRR). The lessee will clearly indicate which portion of the payment is for royalty and what is for the lease bonus payment.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FEB 1 9 2019

Serial No. UTU-84102

MODIFIED COAL LEASE

Date of Lease: April 1, 2017

PART I.

MAR 0 1 2019

THIS MODIFIED COAL LEASE is entered into on _____, by and between the **UNITED STATES OF AMERICA**, hereinafter called the Lessor, through the Bureau of Land Management, and

Canyon Fuels Company LLC
9815 South Monroe Street
Suite 203
Sandy, Utah 84070
hereinafter called Lessee.

RECEIVED
FEB 1 9 2019
BUREAU OF LAND MANAGEMENT
USO

This modified lease shall retain the effective date of April 1, 2017, of the original **COAL LEASE UTU-84102**, and is effective for a period of 20 years from the date of issuance of the lease, dated April 1, 2017, Coal must be produced in commercial quantities no later than 10 years from the effective date of the lease dated April 1, 2017. The lease, is subject to readjustment of lease terms on April 1, 2037 and at the end of each 10 year lease period thereafter.

Sec. 1. This lease is issued pursuant and subject to the terms and provisions of the: (NOTE: Check the appropriate Act or Acts.)

XX Mineral Lands Leasing Act of 1920, as amended, 41 Stat. 437, 30 U.S.C. 181-287, hereinafter referred to as the Act;

_ Mineral Leasing Act for Acquired Lands of 1947, 61 Stat. 913, 30 U.S.C. 351-359;

and to the regulations and formal orders of the Secretary of the Interior which are now or hereafter in force, when not inconsistent with the express and specific provisions herein.

Sec. 2. Lessees as the holders of Coal Lease UTU- 84102, issued effective April 1, 2017, were granted the exclusive right and privilege to drill for, mine, extract, remove or otherwise process and dispose of the coal deposits in, upon, or under the lands described below as Tract 1 and 2.

The Lessor in consideration of fair market value, rents and royalties to be paid, and the conditions and covenants to be observed as herein set forth, hereby grants and leases to Lessee the exclusive right and privilege to drill for, mine, extract, remove, or otherwise process and dispose of the coal deposits in, upon, or under the lands described below as Tract 2.

Tract 1:
Salt Lake Meridian, Utah

T. 20 S., R., 4 E.,
sec. 36, lot 4, E½NE¼, NE¼SE¼;

T. 20 S., R., 5 E.,
sec. 19, lots 5 thru 8, E½SW¼, SE¼;
sec. 20, S½;
sec. 21, W½,SW¼;
sec. 28, W½;
secs. 29 thru 31;
sec. 32, N½,N½S½;
sec. 33, NW¼NW¼.

T. 21 S., R., 4 E.,
sec. 1;
sec. 2, SE¼
sec 11, E½, E½W½
sec 12, NE¼, W½, W½SE¼
sec. 13, W½NE¼, NW¼;
sec. 14, NE¼, E½NW¼.

T. 21 S., R., 5 E.,
sec. 6.

Tract 2:
Salt Lake Meridian, Utah
T. 21 S., R. 4 E., SLM
sec. 11, SE¼SW¼NW¼, NE¼NW¼SW¼, S½NW¼SW¼, SW¼SW¼;
sec. 14, W½ NW¼, W½ SW¼,
sec. 15, E½ NE¼NE¼, E½SE¼NE¼, SW¼SE¼NE¼, E½SE¼, SE¼NW¼SE¼, and E½SW¼SE¼;
sec. 22, E½NE¼, E½NW¼ NE¼, E½SW¼NE¼, SW¼SW¼NE¼, N½SE¼, N½SW¼SE¼, and N½SE¼SE¼;
sec. 23, NW¼NW¼, W½SW¼NW¼, W½NW¼SW¼, NW¼SW¼SW¼.

containing 6,915.39 acres, more or less, together with the right to construct such works, buildings, plants, structures, equipment and appliances and the right to use such on-lease rights-of-way which may be necessary and convenient in the exercise of the rights and privileges granted, subject to the conditions herein provided.

Part II. TERMS AND CONDITIONS

Sec. 1.(a) RENTAL RATE - Lessee shall pay Lessor rental annually and in advance for each acre or fraction thereof during the continuance of the lease at the rate of $3.00 per acre for each lease year.

(b) RENTAL CREDITS - Rental shall not be credited against either production or advance royalties for any year.

Sec. 2.(a) PRODUCTION ROYALTIES - The royalty shall be 8 percent of the value of the coal as set forth in the regulations. Royalties are due to Lessor the final day of the month succeeding the calendar month in which the royalty obligation accrues.

(b) ADVANCE ROYALTIES - Upon request by the Lessee, the authorized officer may accept, for a total of not more than 20* years, the payment of advance royalties in lieu of continued operation, consistent with the regulations. The advance royalty shall be based on a percent of the value of a minimum number of tons determined in the manner established by the advance royalty regulations in effect at the time the Lessee requests approval to pay advance royalties in lieu of continued operation.

* 20 years (Public Law 109-58)

Sec. 3. BONDS - Lessee shall maintain in the proper office a lease bond in the amount of $4,590,000. The authorized officer may require an increase in this amount when additional coverage is determined appropriate.

Sec. 4. DILIGENCE – Sec. 4. DILIGENCE - This lease is subject to the conditions of diligent development and continued operation, except that these conditions are excused when operations under the lease are interrupted by strikes, the elements, or casualties not attributable to the lessee. The lessor, in the public interest, may suspend the condition of continued operation upon payment of advance royalties in accordance with the regulations in existence at the time of the suspension. Lessee's failure to produce coal in commercial quantities at the end of 10 years will terminate the lease. Lessee must submit an operation and reclamation plan for the BLM's approval pursuant to 30 U.S.C. 207(c) prior to conducting any development or mining operations or taking any other action on a leasehold which might cause a significant disturbance of the environment.

The lessor reserves the power to assent to or order the suspension of the terms and conditions of this lease in accordance with, inter alia, Section 39 of the Mineral Leasing Act, 30 U.S.C. 209.

Sec. 5. **LOGICAL MINING UNIT (LMU)** – Either upon approval by the Lessor of the Lessee's application or at the direction of the Lessor, this lease shall become an LMU or part of an LMU, subject to the provisions set forth in the regulations.

The stipulations established in an LMU approval in effect at the time of LMU approval or modification will supersede the relevant inconsistent terms of this lease so long as the lease remains committed to the LMU. If the LMU of which this lease is a part is dissolved, the lease shall then be subject to the lease terms which would have been applied if the lease had not been included in an LMU.

Sec. 6. DOCUMENTS, EVIDENCE AND INSPECTION - At such times and in such form as Lessor may prescribe, Lessee shall furnish detailed statements showing the amounts and quality of all products removed and sold from the lease, the

proceeds therefrom, and the amount used for production purposes or unavoidably lost.

Lessee shall keep open at all reasonable times for the inspection of any duly authorized officer of Lessor, the leased premises and all surface and underground improvements, works, machinery, ore stockpiles, equipment, and all books, accounts, maps, and records relative to operations, surveys, or investigations on or under the leased lands.

Lessee shall allow Lessor access to and copying of documents reasonably necessary to verify Lessee compliance with terms and conditions of the lease.

While this lease remains in effect, information obtained under this section shall be closed to inspection by the public in accordance with the Freedom of Information Action (5 U.S.C. 552).

Sec. 7. DAMAGES TO PROPERTY AND CONDUCT OF OPERATIONS - Lessee shall comply at its own expense with all reasonable orders of the Secretary, respecting diligent operations, prevention of waste, and protection of other resources.

Lessee shall not conduct exploration operations, other than casual use, without an approved exploration plan. All exploration plans prior to the commencement of mining operations within an approved mining permit area shall be submitted to the authorized officer.

Lessee shall carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health, or property, and prevention of waste, damage or degradation any land, air, water, cultural, biological, visual, and other resources, including mineral deposits and formations of mineral deposits not leased hereunder, and to other land uses or users. Lessee shall take measures deemed necessary by Lessor to accomplish the intent of this lease term. Such measures may include, but not limited to, modification to proposed siting or design of facilities, timing of operations, and specifications of interim and final reclamation procedures. Lessor reserves to itself the right to lease, sell, or otherwise dispose of the surface or other mineral deposits in the lands and the right to continue existing uses and to authorize future uses upon or in the leased lands, including issuing leases for mineral deposits not covered hereunder and approving easements or rights-of-way. Lessor shall condition such uses to prevent unnecessary or unreasonable interference with rights of Lessee as may be consistent with concepts of multiple use and multiple mineral development.

Sec. 8 PROTECTION OF DIVERSE INTERESTS, AND EQUAL OPPORTUNITY - Lessee shall: pay when due all taxes legally assessed and levied under the laws of the State or the United States; accord all employees complete freedom of purchase; pay all wages at least twice each month in lawful money of the United States; maintain a safe working environment in accordance with standard industry practices; restrict the workday to not more than 8 hours in any one day for underground workers, except in emergences; and take measures necessary to protect the health and safety of the public. No person under the age of 16 years shall be employed in any mine below the surface. To the extent that laws of the State in which the lands are situated are more restrictive than the provisions in this paragraph, then the State laws apply.

Lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and the rules, regulations, and relevant orders of the Secretary of Labor. Neither Lessee nor Lessee's subcontractors shall maintain segregated facilities.

Sec. 9.(a) **TRANSFERS**
(Check the appropriate space)

_X_ This lease may be transferred in whole or in part to any person, association or corporation qualified to hold such lease interest.

___ This lease may be transferred in whole or in part to another public body, or to a person who will mine the coal on behalf of, and for the use of, the public body or to a person who for the limited purpose of creating a security interest in favor of a lender agrees to be obligated to mine the coal on behalf of the public body.

___ This lease may only be transferred in whole or in part to another small business qualified under 13 CFR 121.

Transfers of record title, working or royalty interest <u>must</u> be approved in accordance with the regulations.

(b) **RELINQUISHMENTS** - The Lessee may relinquish in writing at any time all rights under this lease or any portion thereof as provided in the regulations. Upon Lessor's acceptance of the relinquishment, Lessee shall be relieved of all future obligations under the lease or the relinquished portion thereof, whichever is applicable.

Sec. 10. **DELIVERY OF PREMISES, REMOVAL OF MACHINERY, EQUIPMENT, ETC.** - At such times as all portions of this lease are returned to Lessor, Lessee shall deliver up to Lessor the land leased, underground timbering, and such other supports and structures necessary for the preservation of the mine workings on the leased premises or deposits and place all workings in condition for suspension or abandonment. Within 180 days thereof, Lessee shall remove from the premises all other structures, machinery, equipment, tools, and materials that it elects to or as required by the authorized officer. Any such structures, machinery, equipment, tools, and materials remaining on the leased lands beyond 180 days, or approved extension thereof, shall become the property of the Lessor, but Lessee shall either remove any or all such property or shall continue to be liable for the cost of removal and disposal in the amount actually incurred by the Lessor. If the surface is owned by third parties, Lessor shall waive the requirement for removal, provided the third parties do not object to such waiver. Lessee shall, prior to the termination of bond liability or at any other time when required and in accordance with all applicable laws and regulations, reclaim all lands the surface of which has been disturbed, dispose of all debris or solid waste, repair the offsite and onsite damage caused by Lessee's activity or activities incidental thereto, and reclaim access roads or trails.

Sec. 11. **PROCEEDINGS IN CASE OF DEFAULT** - If Lessee fails to comply with applicable laws, existing regulations, or the terms, conditions and stipulations of this lease, and the noncompliance continues for 30 days after written notice thereof, this lease shall be subject to cancellation by the Lessor only by judicial proceedings. This provision shall not be construed to prevent the exercise by Lessor of any other legal and equitable remedy, including waiver of the default. Any such remedy or waiver shall not prevent later cancellation for the same default occurring at any other time.

Sec. 12. **HEIRS AND SUCCESSORS - IN-INTEREST** - Each obligation of this lease shall extend to and be binding upon, and every benefit hereof shall insure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 13. **INDEMNIFICATION** - Lessee shall indemnify and hold harmless the United States from any and all claims arising out of the Lessee's activities and operations under this lease.

Sec. 14. **SPECIAL STATUTES** - This lease is subject to the Federal Water Pollution Control Act (33 U.S.C. 1151 - 1175); the Clean Air Act (42 U.S.C. 1857 et seq.), and to all other applicable laws pertaining to exploration activities, mining operations and reclamation, including the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et seq.)

Sec. 15. **SPECIAL STIPULATIONS** -

SEE ATTACHED STIPULATIONS

CANYON FUEL COMPANY LLC	The United States of America
Company or Lessee Name	BY Joseph Balash
(Signature of Lessee)	(Signing Officer)
CEO	ASLM
(Title)	(Title)
02/06/2019	2/14/19
(Date)	(Date)

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

SPECIAL STIPULATIONS FOR
COAL LEASE UTU-84102

1. In accordance with Sec. 523(b) of the "Surface Mining Control and Reclamation Act of 1977," surface mining and reclamation operations conducted on this lease are to conform with the requirements f this act and are subject to compliance with Office of Surface Mining regulations, or as applicable the Utah program approved under the cooperative agreement in accordance with sec. 523(c). The United States Government does not warrant that the entire tract will be susceptible to mining.

2. Before undertaking activities that may disturb the surface of previously undisturbed leased lands, the lessee may be required to conduct a cultural resource inventory and a paleontological appraisal of the areas to be disturbed. These studies shall be conducted by qualified professional cultural resource specialists or qualified paleontologists, as appropriate, and a report prepared itemizing the findings. A plan will then be submitted making recommendations for the protection of, or measures to be taken to mitigate impacts for identified cultural or paleontological resources.

If cultural resources or paleontological remains (fossils) of significant scientific interest are discovered during operations under this lease, the lessee, prior to disturbance, shall immediately bring them to the attention of the appropriate authorities. Paleontological remains of significant scientific interest do not include leaves, ferns, or dinosaur tracks commonly encountered during underground mining operations.

The cost of conducting the inventory, preparing reports, and carrying out mitigating measures shall be borne by the lessee.

3. If there is reason to believe that Threatened or Endangered (T&E) species of plants or animals, or migratory bird species of high Federal interest occur in the area, the Lessee shall be required to conduct an intensive field inventory of the area to be disturbed and/or impacted. The inventory shall be conducted by a qualified specialist and a report of findings will be prepared. A plan will be prepared making recommendations for the protection of these species or action necessary to mitigate the disturbance.

The cost of conducting the inventory, preparing reports, and carrying out mitigating measures shall be borne by the lessee.

4. The Lessee shall be required to perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area. Existing data may be used if such data are adequate for the intended purposes. The study shall be adequate to locate, quantify, and demonstrate the interrelationship of the geology, topography, surface and ground water hydrology, vegetation and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison.

5. Power lines used in conjunction with the mining of coal from this lease shall be constructed so as to provide adequate protection for raptors and other large birds. When feasible, power lines will be located at least 100 yards from public roads.

6. The limited area available for mine facilities at the coal outcrop, steep topography, adverse winter weather, and physical limitations on the size and design of the access road, are factors which will determine the ultimate size of the surface area utilized for the mine. A site specific environmental analysis will be prepared for each new mine site development and for major modifications to existing developments to examine alternatives and mitigate conflicts.

7. Consideration will be given to site selection to reduce adverse visual impacts. Where alternative sites are available, and each alternative is technically feasible, the alternative involving the least damage to the scenery and other resources shall be selected. Permanent structures and facilities will be designed, and screening techniques employed, to reduce visual impacts, and where possible achieve a final landscape compatible with the natural surroundings. The creation of unusual, objectionable, or unnatural land forms and vegetative landscape features will be avoided.

8. The lessee shall be required to establish a monitoring system to locate, measure, and quantify the progressive and final effects of underground mining activities on the topographic surface, underground and surface hydrology and vegetation. The monitoring system shall utilize techniques which will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the lease area. The monitoring shall incorporate and be an extension of the baseline data.

9. The lessee shall provide for the suppression and control of fugitive dust on haul roads, permitted roads, and at coal handling and storage facilities. On National Forest System Roads (NFSR), lessees may perform their share of road maintenance by a commensurate share agreement if a significant degree of traffic is generated that is not related to their activities.

10. Except at locations specifically approved by the Authorized Officer, with the concurrence of the Forest Service, underground mining operations shall be conducted in such a manner so as to prevent surface subsidence that would: (1) cause the creation of hazardous conditions such as potential escarpment failure and landslides, (2) cause damage to existing surface structures, and (3) damage or alter the flow of perennial streams. Where the Forest Service specifically approves exceptions to the above restrictions on subsidence, the lessee shall provide specific measures for the protection of escarpments, and determine corrective measures to assure that hazardous conditions are not created.

11. In order to avoid surface disturbance on steep canyon slopes and to preclude the need for surface access, all surface breakouts for ventilation tunnels shall be constructed from inside the mine, except at specifically approved locations.

12. If removal of timber is required for clearing of construction sites, etc., such timber shall be removed in accordance with the regulations of the surface management agency.

13. The coal contained within, and authorized for mining under this lease, shall be extracted only by underground mining methods.

14. Existing Forest Service owned or permitted surface improvements will need to be protected, restored, or replaced to provide for the continuance of current land uses.

15. In order to protect big game wintering areas, elk calving and deer fawning areas, sagegrouse strutting areas, and other critical wildlife habitat and/or activities, specific surface uses outside the mine development area may be curtailed during specific periods of the year.

16. No new surface facilities shall be authorized in sage grouse priority habitat management areas.

17. Support facilities, structures, equipment, and similar developments will be removed from the lease area within 2 years after the final termination of use of such facilities. This provision shall apply unless the requirement of Section 10 of the lease form is applicable. Disturbed areas and those areas previously occupied by such facilities will be stabilized and rehabilitated, drainages reestablished, and the areas returned to a pre-mining land use.

18. The Lessee at the conclusion of the mining operation, or at other times as surface disturbance related to mining may occur, will replace all damaged, disturbed, or displaced corner monuments (section corners, quarter corners, etc.) their accessories and appendages (witness trees, bearing trees, etc.), or restore them to their original condition and location, or at other locations that meet the requirements of the rectangular surveying system. This work shall be conducted at the expense of the Lessee, by Bureau of Land Management (BLM) land surveyors, to the standards and guidelines found in the Manual of Surveying Instructions, U.S. Department of Interior.

19. The Lessee, at their expense, will be responsible to replace any surface water and/or developed ground water sources identified in Record of Decision for protection, that may be lost or adversely affected by mining operations, with water from an alternate source in sufficient quantity and quality to maintain existing riparian habitat, fishery habitat, livestock and wildlife use, or other land uses (authorized by 36 CFR 251).

Table 1. Spring sources identified for protection during mining operations

Spring Site ID[a]	Elevation	Easting	Northing
M_SP01	8420	465615	4319979
M_SP02	8335	466086	4319977
M_SP04	8812	464246	4319267
M_SP05	8937	464212	4319133
M_SP06	8952	464215	4319121
M_SP08	8820	464754	4317178
M_SP09	8849	464791	4317141
M_SP012	8739	464583	4319397
M_SP015	8811	463884	4316685
M_SP018	8295	465794	4320892
M_SP019	8968	462644	4316124
M_SP020	9395	462191	4316826
M_SP040	9163	463677	4318041
M_SP041	9223	463475	4318025
M_SP045	8505	465156	4319780
M_SP060	8801	462887	4316092
M_SP087	7922	465309	4322427
M_SP100	8975	463616	4316719
M_SP103	8999	463271	4316302
M_SP104	9052	463250	4316335
M_SP105	8971	463233	4316280
M_SP106	8997	462626	4316155

[a] Derived from Table 3.2 in the Greens Hollow Federal Coal Lease Tract Final SEIS

20. The Licensee/Permittee/Lessee must comply with all the rules and regulations of the Secretary of Agriculture set forth at Title 36, Chapter II, of the Code of Federal Regulations governing the use and management of the National Forest System (NFS) when not inconsistent with the rights granted by the Secretary of the Interior in the license/permit/lease. The Secretary of Agriculture's rules and regulations must be complied with for (1) all use and occupancy of the NFS prior to approval of a permit/operation plan by the Secretary of Interior, (2) uses of all existing improvements, such as Forest Development Roads, within and outside the area licensed, permitted or leased by the Secretary of Interior, and (3) use and occupancy of the NFS not authorized by a permit/operation plan approved by the Secretary of the Interior.

All matters related to this stipulation are to be addressed to:

Forest Supervisor
Manti-LaSal National Forest
599 West Price River Drive
Price, Utah 84501
Telephone No.: 435-637-2817

who is the authorized representative of the Secretary of Agriculture.

21. The licensee/lessee must comply with the Roadless Area Conservation Rule, 36 CFR Part 294- Special Areas, Subpart B- Protection of Inventoried Roadless Areas, January 12, 2001.

In addition, on lands within inventoried roadless areas any surface disturbance from authorized temporary cross-country motorized access will be restricted to the minimum necessary to safely and efficiently complete surface activities.

22. Notwithstanding the approval of a resource recovery and protection plan (R2P2) by the BLM, lessor reserves the right to seek damages against the operator/lessee in the event (i) the operator/lessee fails to achieve maximum economic recovery [as defined at 43 CFR §3480.0-5(21)] of the recoverable coal reserves or (ii) the operator/lessee is determined to have caused a wasting of recoverable coal reserves. Damages shall be measured on the basis of the royalty that would have been payable on the wasted or unrecovered coal.

The parties recognize that under an approved R2P2, conditions may require a modification by the operator/lessee of that plan. In the event a coal bed or portion thereof is not to be mined or is rendered unminable by the operation, the operator shall submit appropriate justification to obtain approval by the AO to leave such reserves unmined. Upon approval by the AO, such coal beds or portions thereof shall not be subject to damages as described above. Further, nothing in this section shall prevent the operator/lessee from exercising its right to relinquish all or a portion of the lease as authorized by statute and regulation.

In the event the AO determines that the R2P2 as approved will not attain MER as the result of changed conditions, the AO will give proper notice to the operator/lessee as required under applicable regulations. The AO will order a modification if necessary, identifying additional reserves to be mined in order to attain MER. Upon a final administrative or judicial ruling upholding such an ordered modification, any reserves left unmined (wasted) under that plan will be subject to damages as described in the first paragraph under this section.

Subject to the right to appeal hereinafter set forth, payment of the value of the royalty on such unmined recoverable coal reserves shall become due and payable upon determination by the AO that the coal reserves have been rendered unminable or at such time that the lessee has demonstrated an unwillingness to extract the coal.

The BLM may enforce this provision either by issuing a written decision requiring payment of the Office of Natural Resource Revenue (ONRR) demand for such royalties, or by issuing a notice of non-compliance. A decision or notice of non-compliance issued by the lessor that payment is due under this stipulation is appealable as allowed by law.

23. WASTE CERTIFICATION: The lessee shall provide upon abandonment and/or sealing off a mined area and prior to lease termination/relinquishment, certification to the lessor that, based upon a complete search of all the operator's records for the mine and upon their knowledge of past operations, there has been no **hazardous substances** per (40 CFR 302.4) or **used oil** as per Utah State Management Rule R-315-15, deposited within the lease, either on the surface or underground, or that all remedial action necessary has been taken to protect human health and the environment with respect to any such substances remaining on the property. The back-up documentation to be provided shall be described by the lessor prior to the first certification and shall include all documentation applicable to the Emergency Planning and Community Right-to-know Act (EPCRA, Public Law 99-499), Title III of the Superfund Amendments and Reauthorization Act of 1986 or equivalent.

24. ABANDONMENT OF EQUIPMENT: The lessee/operator is responsible for compliance with reporting regarding toxic and hazardous material and substances under Federal Law and all associated amendments and regulations for the handling such materials on the land surface and in underground mine workings.

The lessee/operator must remove mine equipment and materials not needed for continued operations, roof support and mine safety from underground workings prior to abandonment of mine sections. Exceptions can be approved by the Authorized Officer (BLM) in consultation with the surface management agency. Creation of a situation that would prevent removal of such material and by retreat or abandonment of mine sections without prior authorization would be considered noncompliance with lease terms and conditions and subject to appropriate penalties under the lease.

25. UNDERGROUND INSPECTION: All safe and accessible areas shall be inspected prior to being sealed. The lessee shall notify the Authorized Officer in writing 30 days prior to the sealing of any areas in the mine and state the reason for closure. Prior to seals being put into place, the lessee shall inspect the area and document any equipment/machinery, hazardous substances, and used oil that is to be left underground.

The purpose of this inspection will be: (1) to provide documentation for compliance with 42 U.S.C. 9620 section 120(h) and State Management Rule R-315-15, and to assure that certification will be meaningful at the time of lease relinquishment, (2) to document the inspection with a mine map showing location of equipment/machinery (model, type of fluid, amount remaining, batteries etc.) that is proposed to be left underground. In addition, these items will be photographed at the lessee's expense and shall be submitted to the Authorized Officer as part of the certification. The abandonment of any equipment/machinery shall be on a case by case basis and shall not be accomplished unless the Authorized Officer has granted a written approval.

26. FAIR MARKET VALUE BONUS: Pursuant to 43 CFR 3432.2(c), "the lands applied for shall be added to the existing lease without competitive bidding, but the United States shall receive the fair market value of the lease of the added lands, either by cash payment or adjustment of the royalty applicable to the lands added to the lease by the modification." Therefore, the lessee will pay the fair market value (FMV) bonus payment for the coal resources mined in the area of Federal coal lease modification (U-84102) Tract 2, the bonus payment will be due for the coal resources mined on the areas comprised of Federal coal lease modification acreage added at a rate of $.41 per ton for the actual tonnage mined. This rate may be adjusted annually using the U. S. Bureau of Labor Statistics CPI West Urban Energy Index; or if that index is not available an index that is mutually agreed to by the lessee and the authorized officer will be used. Payment of this part of the FMV at the specified rate

and tonnage mined will be on the schedule required for payment of production royalties to the Office of Natural Resources Revenue (ONRR). The lessee will clearly indicate which portion of the payment is for royalty and what is for the lease bonus payment.

LEASE NOTICE:
Portions of federal coal lease UTU-84102 are in an inventoried roadless area (IRA) and may be subject to restrictions on road construction and timber harvest pursuant to rules and regulations of the Secretary of Agriculture pertaining to roadless area management applicable at the time such activities may be proposed on the lease. Locations of any proposed surface use will be verified for relationship to IRA boundaries using site-specific maps if/when surface operations are proposed.

CHAPTER 3

BIOLOGY

South Fork Lease Modification

Wildlife habitat within this area includes critical elk calving area and high priority deer and elk summer range (Plates 3-2, 3-3). There is no designated sage grouse habitat. A biological assessment and biological evaluation for the South Fork Lease Modifications (SFLM) were completed in 2018 (See Appendix 3-17). It was determined that no significant impact to threatened, endangered or sensitive species of both vegetation and wildlife is anticipated.

The SFLM area will be surveyed for raptors in 2019 and will continue to be surveyed as described in Section 3.3.3.3.

Plant communities and vegetation types in the SFLM area can be found on Plate 3-1. If a seed mix is required to be used on soil filled subsidence cracks associated with mining that occurs within the area 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 subsidence information.

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 area are used annually on a seasonal basis. The aspen areas of Duncan Mountain serve as calving areas for the small herd, (10-20 animals observed during the 1980 summer in that area) but based on pellet counts (WIL, Table 7) the major portion of the lease area is utilized in late fall, winter, and early spring.

In May, while there was still snow on the ground, considerable fresh elk sign (pellets and tracks) was found around the Acord Lakes. By June 5, 1980, when access was available to the other areas, elk tracks were concentrated in the ponderosa, mahogany, aspen and manzanita communities along the ridges and rims of the canyon, plus in the canyons such as Duncan's Draw and Lizonbee Springs. During the summer the elk and elk signs were sighted near the top of Duncan Mountain and at the head of the South Fork of Quitchupah. It seems that the elk in

APPENDIX 3-17

Vegetation and Wildlife of the South Fork Lease Modifications

Biological Assessment and Biological Evaluation for the South Fork Federal Coal Lease Modifications

Revision 1

#114-520378
May 2018

PRESENTED TO

U.S. Department of Agriculture, Forest Service
Fishlake National Forest
115 E. 900 N.
Richfield, UT 84747

and

Manti-La Sal National Forest
599 West Price River Dr.
Price, UT 84501

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APPENDICES

1.0 INTRODUCTION

Canyon Fuel Company, LLC. is requesting modifications to the lease boundaries for federal coal deposits near the Sufco Mine in Sevier County, Utah. The requested lease modifications are for federal coal leases UTU-84102 (Greens Hollow Lease) and U-63214 (Quitchupah Lease), together referred to as the South Fork Lease Modifications (**Figure 1**). The South Fork Lease Modifications are composed of National Forest Lands, Fishlake National Forest and Manti-La Sal National Forest, and federal minerals are administered by the U.S. Department of the Interior, Bureau of Land Management (BLM) Price Field Office. Canyon Fuel Company's request to modify the lease boundaries was submitted to the BLM Utah State Office in May 2017.

Environmental impacts from the proposed action are being reviewed in an Environmental Assessment (EA). In support of the EA, this Biological Assessment and Biological Evaluation (BA/BE) has been prepared to analyze the potential effects of the lease modifications on threatened, endangered, and proposed (TEP) species listed under the Endangered Species Act (ESA); on the Regional Forester's list of sensitive species; and management indicator species identified in the Forest Plans for the Fishlake and Manti-La Sal National Forests. This BA/BE follows standards established in Forest Service Manual (FSM) 2670. Section 7 of the ESA requires federal agencies to determine if any activities they authorize, fund, or carry out would jeopardize the continued existence of TEP species or result in the destruction or adverse modification of critical habitats. This BA/BE analyzes potential project impacts on TEP species, and provides determinations on whether the proposed action is likely to affect TEP species or their critical habitat. The U.S. Fish and Wildlife Service (USFWS) must be consulted if TEP species or their critical habitats may be affected by authorized activities.

The Forest Service has developed policy for sensitive species (FSM 2670.32). Sensitive species are those plants and animals identified by the Regional Forester for which population viability is a concern as evidenced by: 1) significant current or predicted downward trends in population numbers of density, or (2) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution. This BA/BE identifies sensitive species that may occur in the project area and analyzes the effects in sufficient detail to determine whether impacts on these species or their habitat would adversely affect their viability. Management indicator species are "plant and animal species, communities, or special habitats selected for emphasis in planning, and which are monitored during forest plan implementation in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent" (FSM 2620.5).

1.1 PROPOSED ACTION

The Forest Service proposed action is to consent to the BLM modifying federal coal leases UTU-84102 (Greens Hollow Lease) and U-63214 (Quitchupah Lease), held by Canyon Fuel Company. The Forest Service also proposes to require the parent lease stipulations from the Greens Hollow and Quitchupah Leases (Appendix A of the EA) with modifications to Stipulation #18 of the Greens Hollow Lease and Stipulation #17 of the Quitchupah Lease. These modifications include protection for spring sources within the project area.

Based on Forest Service consent the BLM proposed action is to approve the coal lease modifications submitted as described in the application letter (Canyon Fuel Company, 2017).

The modifications of these leases could result in the underground mining of approximately 6.25 million tons of coal in approximately 790 acres of federal coal lands. No new surface facilities are proposed nor are any surface disturbances foreseen.

<u>Lease UTU-84102 in Township 21 South, Range 4 East, Salt Lake Base and Meridian:</u>

All or parts of Sections 11, 14, 15, 22, and 23 - containing 620 acres, more or less

Lease U-63214 in Township 21 South, Range 4 East, Salt Lake Base and Meridian:

All or parts of Sections 22 and 23 - containing 170 acres, more or less.

Applicant: Canyon Fuel Company, LLC, 225 North 5th Street, Suite 900, Grand Junction, CO 81501.

In addition to the federal coal in the leases modifications, approval of the leases modifications would facilitate the recovery of 2.3 million additional tons of federal coal from the existing leases that would otherwise be bypassed (hereafter referred to as bypass coal) (Canyon Fuel Company, 2017). Recovering these coal resources was previously analyzed and approved in the Greens Hollow Federal Coal Lease Tract UTU-84102 Final Supplemental EIS (FSEIS) (BLM and Forest Service, 2015) and the Quitchupah Federal Coal Lease Tract U-63214 Environmental Assessment (BLM and Forest Service, 1988). The Greens Hollow FSEIS is incorporated by reference.

If mining begins upon approval of the lease modifications and associated DOGM permit, the modification areas and the bypass coal that would be accessed (a combined total of 8.55 million tons of coal) represents about 1.5 years of additional mine life.

Special coal lease stipulations for UTU-84102 (Greens Hollow Lease) and U-63214 (Quitchupah Lease) are included in the proposed action because they would also apply to the lease modifications. The special coal lease stipulations are included in Appendix A of the EA.

1.2 PURPOSE AND NEED

The BLM and the Forest Service have identified a need to carry out their statutory and regulatory responsibilities in the federal coal program and are responding to a request to modify two existing federal coal leases. The agencies have a need to consider issuing the two coal lease modifications for federal coal lands immediately adjacent to existing federal coal leases UTU-84102 and U-63214, under the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1976, and the Energy Policy Act of 2005, according to the regulatory process in 43 CFR 3432.

The purpose of the agencies actions is to implement direction in the applicable land management plans with respect to coal resource management. This direction is described below in Section 1.4.1 for the BLM, and Section 1.4.2 for the Fishlake and Manti-La Sal National Forests.

Additional purposes of the federal agencies' actions are to facilitate recovery of federal coal resources in an environmentally sound manner (30 U.S.C. 1265(b)(1)), to carry out the federal government's policy in the Mining and Minerals Policy Act of 1970, and to foster and encourage private enterprise in the development of economically sound and stable industries to help assure satisfaction of industrial, security and environmental needs. The lease modifications are to ensure that compliant and super-compliant coal reserves are recovered and not bypassed.

2.0 ACTION AREA DESCRIPTION

The action area for this BA/BE analysis is the approximately 790-acre lease modifications and an additional half-mile buffer. It is located in the Wasatch Mountains, approximately ten miles west-northwest of the town of Emery, Utah (**Figure 1**). The action area lies within the Wasatch Plateau physiographic province, where topography is characterized by plateaus broken up by deeply incised canyons. The action area is approximately 3.5 miles north of Convulsion Canyon and is adjacent to the limestone outcrop known as White Mountain (**Figure 2**). Elevations range from 8,200 to 9,775 feet. Climatically, the area is classified as subalpine with average winter season and summer season temperatures in the aspen-fir zone of 27 to 58 degrees Fahrenheit. Average annual precipitation is 29 inches in the aspen-fir zone, most of which falls as snow from November to May (Price and Evans 1937).

Drainages in the action area are shown on **Figure 2**. North Fork Quitchupah Creek and its South Fork tributary drain the eastern portion of the action area, flowing into the main stem of Quitchupah Creek and eventually into the Muddy River. This portion of the action area is within the larger Colorado River Basin. Skutumpah Creek (aka Skumpah) drains the southwestern portion of the action area, flowing into Salina Creek and eventually the Sevier River. The Sevier River Basin is a closed basin terminating at Sevier Lake. The action area encompasses only the upper reaches of these drainages where minimal erosion into the plateau has taken place. The streams are classified as perennial in the National Hydrography Dataset (NHD) (USGS 2017), but the headwater flows within the action area are often intermittent in duration (UDOGM 2018). Streams in the action area derive flow from snowmelt runoff, groundwater seepage, and thunderstorms. There are also small ponded areas present.

The headwaters in the action area have not been surveyed for fisheries. Drainages of North Fork Quitchupah Creek and South Fork are not expected to support fish due to the steep terrain and presence of road culverts that likely block fish passage up stream (Jewkes 2017a). Portions of Skutumpah Creek were surveyed in 2000 just below the action area and above Skutumpah Reservoir, and a marginal non-native fishery was present (Whelan 2017). The stream is not optimal trout habitat due to the lack of pools and minimal habitat diversity (Shell Valley Consulting 2003). Just below the reservoir, the stream is often dry in summer months (Whelan 2017; Shell Valley Consulting 2003). Skutumpah Reservoir contains rainbow trout, which are maintained through stocking (Hadley 2011).

The topography in the action area consists of steep hillsides and drainages. No cliff formations are present. White Mountain, a prominent limestone outcrop, is located 0.75 mile northwest of the lease modifications.

Vegetation within the action area is predominately aspen (*Populus tremuloides*) and mixed aspen-conifer (*Pinophyta* spp.) forest. Patches of mixed conifer forest are also present. The forest types are interspersed within open areas of montane sagebrush (*Artemisia tridentata* spp. *vaseyana*) steppe and grassland/meadow. In addition, mountain shrub communities are also present. Vegetation along streams is similar to adjacent upland areas. In some areas, a narrow band of willow (*Salix* spp.) and other shrubs line the banks.

Human access is limited due to the rugged terrain and limited road access. There are minor jeep trails but no highways or infrastructure are present.

Mining activities within the lease modifications would be underground. There would be no direct surface disturbance in the action area as a result of the proposed action. Surface land subsidence is expected to be minimal, resulting in negligible surface impacts.

Figure 1. Project Location

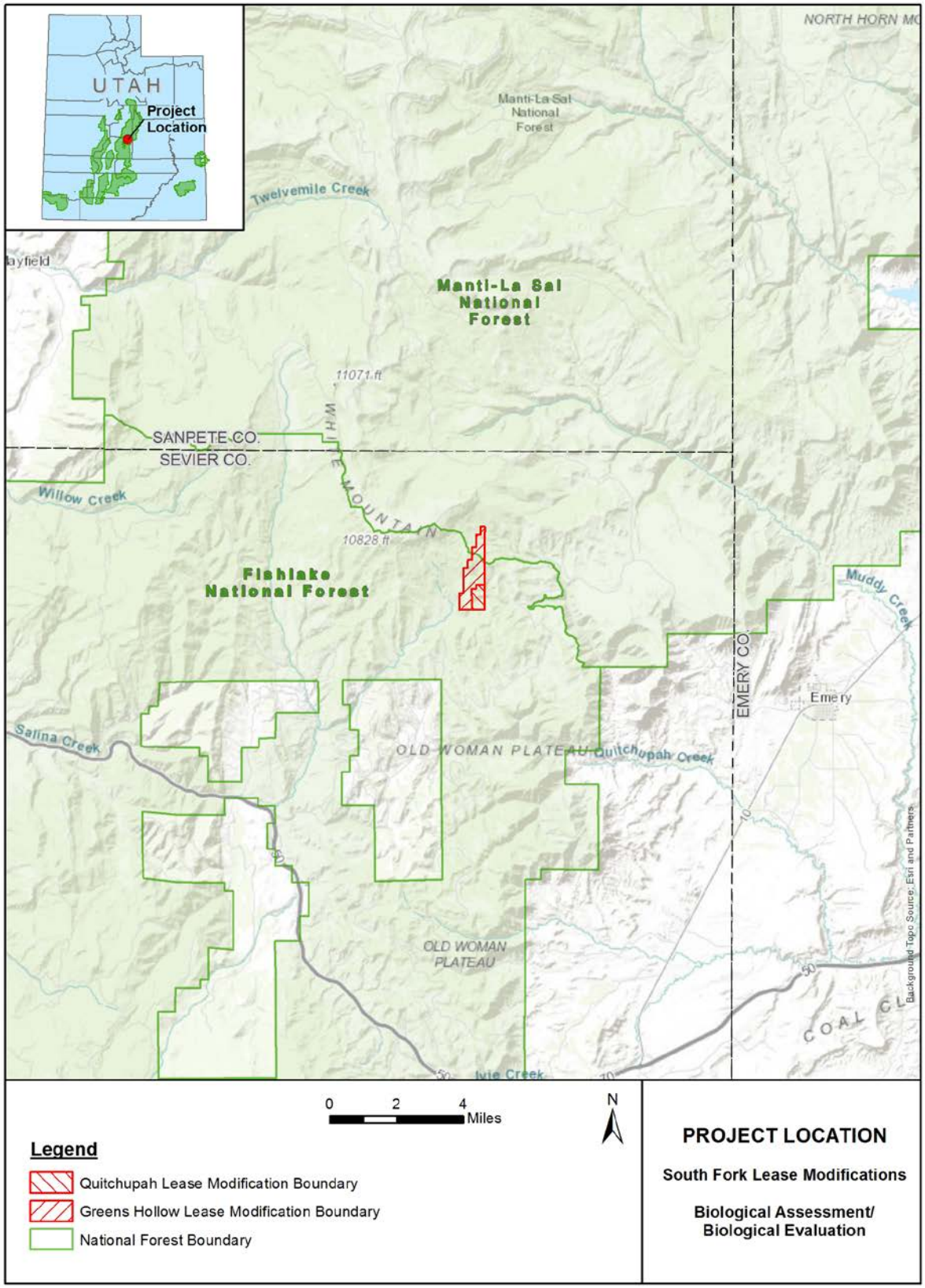
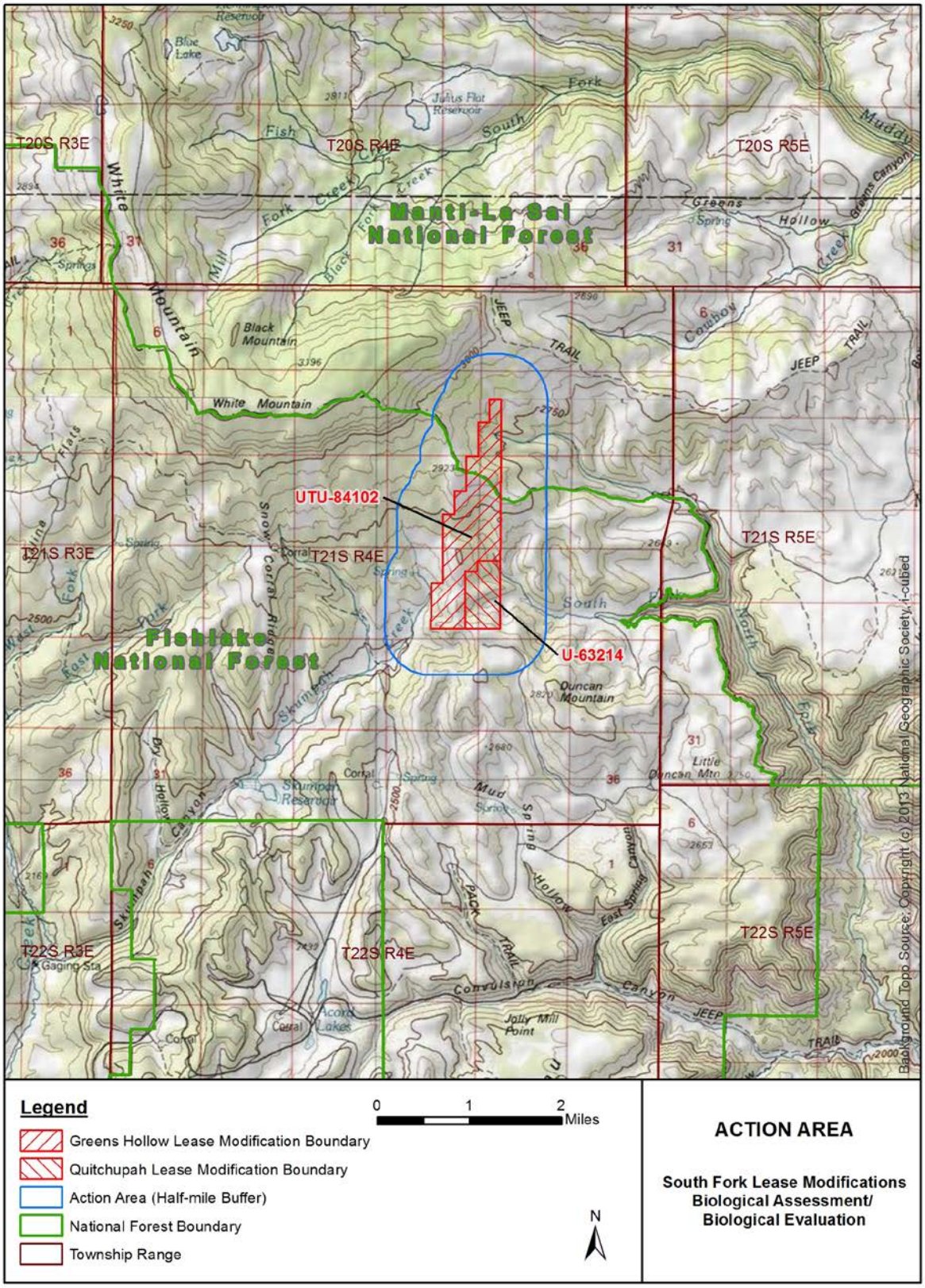


Figure 2. Action Area



3.0 GENERAL EFFECTS

If the lease modifications are approved, the coal would be mined as part of the existing Sufco Mine, which is an underground coal mine. No surface disturbance is proposed. Ongoing mining operations at the Sufco Mine are conducted according to their current mine and reclamation plan (MRP) approved by the Utah Division of Oil, Gas, and Mining. Mining would be initiated as soon as the lease modifications are obtained and the appropriate mining and reclamation permits are approved. Canyon Fuel Company anticipates that mining of the South Fork Lease Modifications would be completed in approximately 1.5 years. Mining would continue into the UTU-84102 (Greens Hollow Lease) as described in the Greens Hollow Coal Leasing Environmental Impact Statement (Forest Service and BLM, 2015).

Coal mining at the Sufco Mine is conducted underground via longwall mining methods. No direct surface disturbance would occur and minimal surface disturbance from subsidence is foreseen in the modification areas due to the thick overburden compared to the thin coal seam to be removed. No cliffs or escarpments are present in the action area, and therefore; cliffs would not be affected by the proposed project.

Streams in the action area are headwaters that are perennial to intermittent in flow. The springs and seeps located within the lease modifications are most likely supported by shallow water migration through the Flagstaff Limestone and discharged from the North Horn Formation. The springs and seeps located in the action area are separated from the coal seams proposed for mining by a low permeability, heterogeneous rock sequence, resulting in low potential for vertical groundwater flow. Due to this lack of connectivity, impacts to surface water systems due to the proposed action are not expected. Additionally, the interbedded claystones, siltstones, and sandstones of the Wasatch Plateau are known to be rich in swelling clays. These clays absorb water and expand appreciably relative to their dry volume, which reduces the hydraulic conductivity of the rock or soil that contains them and contributes to the relatively rapid closing or healing of tension fractures that may result from subsidence (UDOGM 2007).

Using methods from Darling (2011), it is estimated that based on the proposed 11-foot mining extraction height, effects to groundwater aquifers, springs, seeps, and streams may occur as a result of upwardly propagating fracturing only in areas where the overburden is less than 660 feet (Darling 2011). Actual overburden in the lease modifications area ranges from 1,250 feet to 2,650 feet. Therefore, measurable impacts to surface water or shallow groundwater systems from upwardly propagating fractures are not anticipated.

The lease modifications would include a stipulation that requires mining be done in a manner that prevents surface subsidence that may cause hazardous conditions, result in damage to existing surface structures, or damage the flow of perennial streams (see Appendix A and Appendix B of the EA). In addition, there is also a stipulation requiring inventory and monitoring of threatened or endangered species and migratory birds of high federal interest in the potentially affected area. The Sufco Mine conducts annual inventories and monitoring of raptors and other migratory birds, sensitive species, management indicator species, and TEP in potential subsidence areas.

4.0 THREATENED AND ENDANGERED SPECIES

The USFWS provided an official list of TEP species listed under the ESA to be considered for this proposed action. The list was obtained from the USFWS Information for Planning and Conservation (IPAC) website and is available in **Appendix A**. **Table 1** lists these species along with their habitat and range information and an evaluation of their potential occurrence within the action area. No proposed or designated final critical habitat exists within the action area for any of these species.

Projects resulting in water depletions from any watershed in the Colorado River Basin have typically required an analysis of potential effects to Colorado River endangered fish species. The action area is within the Colorado

River Basin but these fish were not listed on the official TEP species list obtained from IPAC for this project. Mr. George Weekley of the USFWS Utah Ecological Services Office stated that for this area of Utah, projects outside the San Raphael River drainage are not in the depletion consultation area (USFWS 2017). Quitchupah Creek and Muddy Creek, which drain the Sufco Mine, flow into the Dirty Devil River; therefore, watersheds for these streams and their tributaries are excluded from the water depletion consultation area for Colorado River endangered fish (USFWS 2017) and the species do not need to be analyzed for this project.

Table 1. Federally Threatened, Endangered, and Proposed Species

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action Area
BIRDS			
California Condor (*Gymnogyps californianus*)	E	Wide-ranging species that requires rock or cliff escarpments for nesting and wide expanses of open grasslands or savannas to scavenge for carrion. Individuals from the reintroduced population in northern Arizona often roosts in southern Utah, and have been documented flying as far north as Flaming Gorge (USFWS 2013).	**Unlikely to Occur**. May fly over the action area but foraging, nesting, or roosting would not occur due to the lack of suitable habitat. The action area is forested; no suitable cliff cavities or expansive open foraging areas are present.
Yellow-billed Cuckoo (*Coccyzus americanus*)	T	Occurs in scattered lowland riparian areas across Utah. Inhabits mature riparian forest, including an overstory of large trees and at least one layer of dense shrub in the understory. In Utah this is typically cottonwood (*Populus* spp.)-willow communities. Found at elevations below 8,500 feet (USFWS 2015).	**Unlikely to Occur.** There is no cottonwood-willow habitat in the action area.
MAMMALS			
Utah Prairie Dog (*Cynomys parvidens*)	T	Occurs only in southwestern and south-central Utah. Inhabits semi-arid shrub-steppe and grassland habitats from 5,100 to over 10,000 feet. Within these habitats, prefer swale-type formations where moist herbaceous vegetation is available and soils are well-drained (USFWS 2012).	**Unlikely to Occur**. Based on the Utah Division of Wildlife Resources range map (UDWR 2015a), the species does not currently occupy this portion of Sevier County. In addition, the forest habitat in the action area is not suitable habitat for prairie dogs, which require open vegetation.
PLANTS			
Heliotrope Milk-vetch (*Astragalus montii*)	T	Occurs in very limited limestone barren habitat at timberline, including openings in spruce (*Picea* spp.)-fir	**Unlikely to Occur**. There is a known population nearby on White Mountain but it is not within the action area.

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action Area
		(*Abies* spp.) forest or at plateau margins on Flagstaff Limestone. Elevation range is between 10,500 and 11,300 feet. Endemic to central Utah in Sanpete and Sevier counties, where it is found only on the MLNF. There are a total of three populations, all of which are within eight miles of each other: two in southern Sanpete County and one on White Mountain in Sevier County. The limestone cliffs of White Mountain are located approximately 0.75-mile from the lease modifications. Critical habitat for this species is designated only in Sanpete County, and is not present in the action area. The White Mountain population consists of approximately 60,000 individuals distributed in scattered small stands within a 300-acre area (UNPS 2016; USFWS 1995).	Based on geology maps (Hintz et al. 2000; UGS 2016), there is no exposed Flagstaff Limestone in the action area. The White Mountain population is confined to a 300-acre area and all other suitable habitat has been surveyed (USFWS 1995). For these reasons, this species is not expected to occur in the action area.
Jones Cycladenia (*Cycladenia humilis* var. *jonesii*)	T	Gypsiferous saline soils on the Chinle, Cutler, and Summerville Formations in *Eriogonum – Ephedera*, cool desert shrub, and juniper (*Juniperus* spp.) communities. Elevation range between 4,400 and 6,000 feet. Endemic to Utah in Emery, Garfield, Grand, and Kane counties (UNPS 2016; USFWS 2008).	**Unlikely to Occur**. The action area is well above the elevational range for this species, and lacks suitable shrub or juniper habitat. In addition, the species' known geographic range does not include Sevier County.

E= Endangered; T = Threatened; Manti-La Sal National Forest

The Utah Natural Heritage Program's (UNHP) database was queried for the action area. The UNHP database contained no occurrences of USFWS threatened or endangered species in the lease modifications or within the action area (**Appendix B**). Based on the desktop review and UNHP response, no threatened or endangered species or critical habitats occur in the action area. Therefore, the proposed action would have no effect on TEP species or their critical habitat. Because there would be no direct or indirect effects, there would also be no cumulative effects to TEP species. **Table 2** provides a summary of these determinations by species.

Table 2. Determination of Effects on USFWS Federally Listed Species

Species Name	Analysis of Impacts	Species Determination	Critical Habitat Determination
California Condor (*Gymnogyps* californianus)	Species not present in action area. No critical habitat present in the action area.	**No Effect**	**No Effect**
Yellow-billed Cuckoo (*Coccyzus americanus*)	Species not present in action area. No proposed critical habitat present in the action area.	**No Effect**	**No Effect**
Utah Prairie Dog (*Cynomys parvidens*)	Species not present in action area. No critical habitat has been designated for this species.	**No Effect**	**N/A**
Heliotrope Milk-vetch (*Astragalus montii*)	Species not present in action area. No critical habitat present in the action area.	**No Effect**	**No Effect**
Jones Cycladenia (*Cycladenia humilis* var. *jonesii*)	Species not present in action area. No critical habitat has been designated for this species.	**No Effect**	**N/A**

E= Endangered; T = Threatened; N/A = Not applicable because no critical habitat has been designated.

5.0 SENSITIVE SPECIES

Chapter 2670 of the FSM sets objectives for management of threatened, endangered, candidate, and sensitive species. The objectives include managing habitats and activities for threatened and endangered species to achieve recovery objectives so that special protection measures provided under the ESA of 1973, as amended (16 U.S.C. § 1531 et seq.) are no longer necessary, and to implement management practices to ensure that sensitive species do not become threatened or endangered due to Forest Service actions.

The Regional Forester in Region 4 publishes a list of Forest Service sensitive species by forest (**Appendix C**). **Table 3** and **Table 5** list the Fishlake and Manti-La Sal National Forest sensitive wildlife and plant species, respectively, along with their known range, habitat requirements, and potential to occur within the action area. The action area analyzed for sensitive species is a half-mile buffer around the lease modifications.

5.1 SENSITIVE WILDLIFE

Table 3 lists sensitive wildlife species of the Fishlake and Manti-La Sal National Forest along with their known range, habitat requirements, and potential to occur within the action area. Based on this review, no sensitive wildlife species have known occurrences or primary habitat within the action area. Some species may occur in the action area incidentally (i.e., flyover of birds) or in portions of the action area that provide secondary habitat for that species. Potential impacts to these species are analyzed below. No sensitive fish species occur in the action area, but these species are analyzed further to consider potential effects on occupied downstream water bodies.

Table 3. Fishlake and Manti-La Sal National Forest Sensitive Wildlife Species

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action Area
AMPHIBIANS			
Boreal (Western) Toad (Anaxyrus (=*Bufo) boreas*)	FLNF and MLNF Sensitive Species	Found in permanent water bodies in certain mountain ranges in Utah. Associated with a variety of habitats above 5,150 feet, including riparian, sagebrush (*Artemisia* spp.), pinyon (*Pinus* spp.)-juniper, mountain shrub, mixed conifer, and aspen-conifer forests (Hogrefe et al. 2005).	**May Occur**. Perennial water sources occur within the action area. Larvae were documented in two ponds west of the existing Greens Hollow tract in 2001 but were not present when resurveyed in 2003 (Cirrus 2014a). Regular breeding occurs on both the MLNF and FLNF to the north and south of the action area, but these sites are more than 40 miles away (Hogrefe et al. 2005). The MLNF has surveyed several times over the past ten years and has found only one breeding site (East Mountain, approximately 45 miles northeast of the project) (Jewkes 2017b).
Columbia Spotted Frog (*Rana luteiventris*)	MLNF Sensitive Species	Found in Utah in isolated populations along the Wasatch Front, West Desert, and San Pitch River (as far south as northern Sanpete County). In Utah, this species is usually found in semi-permanent ponds with cool, clear spring-fed water and organic substrates (Bailey et al. 2006).	**Does Not Occur**. Action area is outside species' known geographic range.
BIRDS			
Bald Eagle (*Haliaeetus leucocephalus*)	FLNF and MLNF Sensitive Species	Bald eagles may be found on the FLNF and MLNF occasionally in winter months but no active breeding sites are known. In the winter, they roost communally at night in deciduous and coniferous trees, typically near water that is not frozen (UDWR 2005). There is no winter roosting habitat within the action area.	**May Occur**. May use the action area incidentally for winter foraging. In November 2003, five eagles were observed along Cowboy Creek approximately 1.5 miles to the northeast of the lease modifications (Cirrus 2014a).
Flammulated Owl (*Otus flammeolus*)	FLNF and MLNF Sensitive Species	Found in mature pine and mixed-conifer forests, especially ponderosa pine (*Pinus ponderosa*)-Douglas fir (*Pseudotsuga menziesii*) forests (Rodriguez 2006). Require cavities excavated by woodpeckers for nesting. Migrates to Mexico and	**May Occur**. Occurs in the adjacent Greens Hollow Tract (Cirrus 2014a).

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action Area
		Central America in winter. Recent breeding surveys have found this owl in ponderosa pine, limber pine (*Pinus flexilis*)/aspen, and mixed conifer-aspen forest types adjacent to the action area (Cirrus 2014a).	
Greater Sage-grouse (*Centrocercus urophasianus*)	FLNF and MLNF Sensitive Species	Resident in sagebrush habitats across Utah. Based on current GIS data from UDWR, the lease modifications are not within mapped lekking, nesting, brood-rearing, or winter habitat. Based on current BLM GIS data, the lease modifications are not within a PHMA or a GHMA. There is a PHMA located 1.2 miles to the east, which is used by the Emery population (aka Biologically Significant Unit). The lease modifications are mostly forested and do not contain suitable habitat for sage-grouse. The nearest lek is approximately 4.1 miles east of the lease modifications.	**May Occur**. May occur in the action area incidentally (i.e., flyovers) due to the proximity to occupied sagebrush habitat to the east, but regular use is not expected due to the presence of trees.
Northern Goshawk (*Accipiter gentilis*)	FLNF and MLNF Sensitive Species	Nest in a variety of habitat conditions but show a preference for mature and older forests with large trees, dense canopy cover, and open understories (Graham et al. 1999). The majority of nesting in Utah occurs in mixed lodgepole pine (*Pinus cont*orta), aspen, Engelmann spruce (*Picea engelmannii*), and mixed spruce-pine forests. In winter may descend into the lower elevation woodlands and riparian areas (Graham et al. 1999).	**May Occur**. UNHP has records of this species within the action area (i.e., within half-mile of the lease modifications) (see **Appendix B**). May occur in the action area incidentally but no breeding is expected due to the lack of suitable mature forest habitat. Was not found in the action area during the 2017 annual goshawk surveys conducted for the Sufco Mine.
Peregrine Falcon (*Falco peregrinus anatum*)	FLNF and MLNF Sensitive Species	Nests on high ledges on mountain cliff faces as well as high-rise buildings near abundant avian prey populations (Rodriguez 2006). Nests are typically located within ten miles of water bodies or marshes. This species is uncommon in montane	**May Occur**. A pair was observed in Muddy Creek canyon in 2002 (Cirrus 2014a). There are two known eyries within ten miles of the action area; one is 6.5 miles to the southeast of the lease modifications and the other is 9.5 miles to the east (Jewkes 2017a). Annual raptor nest monitoring for the Sufco Mine has not documented the

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action Area
		areas and generally occurs at lower elevations in Utah (Bosworth 2003).	species in the action area and there is no suitable cliff nesting habitat in the action area. May occur incidentally (i.e., fly over), but action area does not contain primary habitat.
(American) Three-toed Woodpecker (*Picoides tridactylus*)	FLNF and MLNF Sensitive Species	Restricted to high elevation conifer forests above 8,000 feet, especially spruce-fir (Parrish et al. 2002). Excavates a nest cavity in trees and snags on forest edges, often in aspen trees. Forages for beetles and other insects on scaly-barked trees and is attracted to areas with numerous dead trees, such as from beetle infestations or fire. Movements are often irregular and populations irrupt locally in response to tree die-offs (Parrish et al. 2002).	**May Occur**. May occur in the action area since the area contains some patchy spruce-fir habitat. Occurs in adjacent coal tracts (Cirrus 2014a).
FISH			
Bonneville Cutthroat Trout (*Oncorhynchus clarki utah*)	FLNF and MLNF Sensitive Species	In Utah, occurs in streams and lakes of the Bonneville Basin and a limited portion of the Virgin River Drainage. Found in headwater streams and high-elevation river reaches (Bosworth 2003). Skutumpah Creek, located in the action area, drains into Salina Creek, which contains a conservation population (i.e., at least 90 percent genetically pure) of Bonneville cutthroat trout. The Salina Creek fish have tested as 100% genetically pure (Hadley et al. 2011).	**Does Not Occur**. This species does not occur within the action area. There would be no effects on occupied downstream waters.
Colorado River Cutthroat Trout (*Oncorhynchus clarki pleuriticus*)	FLNF and MLNF Sensitive Species	Restricted to tributaries of the upper Colorado River and Green River drainages, where it occurs in headwater streams and mountain lakes (Bosworth 2003; Young 2008). Not found in streams in the action area, but is found in the Muddy Creek drainage (Birdsey et al. 2008; Cirrus 2014a).	**Does Not Occur**. This species does not occur within the action area. There would be no effects on occupied downstream waters.

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action Area
Southern Leatherside Chub (*Lepidomeda aliciae*)	FLNF and MLNF Sensitive Species	Occur in desert streams throughout the southern and eastern Bonneville Basin. In Utah, it is found in Utah Lake and Sevier River drainages. Does not occur in the action area, but Skutumpah Creek flows into Salina Creek, where the species occurs (UDWR 2010).	**Does Not Occur**. This species does not occur within the action area. There would be no effects on occupied downstream waters.
MAMMALS			
Bighorn Sheep (*Ovis canadensis*)	FLNF and MLNF Sensitive Species	Occur in remote, rugged areas of Utah. To escape predators, they require terrain that is steep and rocky including snowy alpine zones as well as hot, dry canyonlands. Based on current GIS range data from UDWR, this species does not occur in the action area.	**Does Not Occur**. Action area is outside species' known geographic range.
Pygmy Rabbit (*Brachylagus idahoensis*)	FLNF Sensitive Species	Found in western Utah in the Great Basin region and edge of adjacent Intermountain region. Habitat is tall dense, sagebrush communities, especially where deep, loamy soils are present to facilitate burrowing (IPRWG 2008). Typical occupied areas include alluvial fans, swales in rolling hills, large flat valleys, along creeks and drainages, and other terrain where soils have accumulated. At a landscape scale, found in areas with flat to moderate slopes where soils are stable (IPRWG 2008).	**Unlikely To Occur**. There are sagebrush communities within the action area but these are not expected to support pygmy rabbits due to their isolated nature amongst forest stands, as well as the steep, eroded terrain and soils.
Spotted Bat (*Euderma maculatum*)	FLNF and MLNF Sensitive Species	There are scattered records of this rare species throughout eastern and southern Utah. Forages in a variety of open habitats from lowland riparian, desert shrub, to edges of montane coniferous forest. Limited by roosting habitat, which is cliff walls that have cracks and crevices and are near water (Oliver 2000). It is a solitary rooster, and does not form	**May Occur**. Cliffs and water bodies are present within this species' foraging range. Known to occur on the MLNF (Jewkes 2017a).

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action Area
		colonies. Forages up to six miles from day roosts (NatureServe 2017).	
Townsend's Western Big-eared Bat (*Corynorhinus towsendii townsendii*)	FLNF and MLNF Sensitive Species	Occurs throughout Utah in desert shrub, pinyon-juniper, mountain brush, ponderosa pine, and mixed forests. Requires caves or mines for roosting; sometimes will roost in buildings (Oliver 2000). Limited by availability of roost sites. Generally forages within 6.5 miles of roost sites (Fellers and Pierson 2002).	**May Occur**. Suitable foraging habitat is present. Few roost sites are known from the MLNF but there may be roosting habitat that has not yet been identified (Jewkes 2017b).

FLNF = Fishlake National Forest; MLNF = Manti-La Sal National Forest; GIS = Geographic Information System; UDWR = Utah Division of Wildlife Resources; Primary Habitat Management Area (PHMA); General Habitat Management Area (GHMA); Utah Natural Heritage Program (UNHP)

Impacts to Fishlake and Manti-La Sal National Forest sensitive wildlife species are expected to be negligible. The proposed action would not result in downward population trends. **Table 4** provides an analysis of potential impacts to Fishlake and Manti-La Sal National Forest sensitive wildlife species and determinations of effects.

Table 4. Determination of Effects on Fishlake and Manti-La Sal National Forest Sensitive Wildlife Species

Species Name	Status	Analysis of Impacts	Determination
AMPHIBIANS			
Boreal (Western) Toad (Anaxyrus (=*Bufo) boreas*)	FLNF and MLNF Sensitive Species	Due to the thick overburden compared to the thin coal seam to be removed, minimal surface disturbance from subsidence is expected. In addition, Stipulation #18 (Greens Hollow) and Stipulation #17 (Quitchupah) require mitigation measures for springs and seeps; therefore, no impacts would occur.	**No Impact**
Columbia Spotted Frog (*Rana luteiventris*)	MLNF Sensitive Species	No impacts. Species does not occur in the action area.	**No Impact**
BIRDS			
Bald Eagle (*Haliaeetus leucocephalus*)	FLNF and MLNF Sensitive Species	No impacts. May fly through the area but would not be affected.	**No Impact**

Species Name	Status	Analysis of Impacts	Determination
Flammulated Owl (*Otus flammeolus*)	FLNF and MLNF Sensitive Species	No disturbance of forest habitat in the action area is expected due to the minimal subsidence that may occur. Given higher quality habitat exists elsewhere on the FLNF and MLNF.	**No Impact**
Greater Sage-grouse (*Centrocercus urophasianus*)	FLNF and MLNF Sensitive Species	No impacts. May fly over the area but would not be affected.	**No Impact**
Northern Goshawk (*Accipiter gentilis*)	FLNF and MLNF Sensitive Species	No surface disturbance impacts on foraging habitat in the action area. Subsidence-induced alterations on individual trees/shrubs would not have a measurable effect. Higher quality breeding habitat is available elsewhere on the FLNF and MLNF.	**No Impact**
Peregrine Falcon (*Falco peregrinus anatum*)	FLNF and MLNF Sensitive Species	No impacts. May fly over the area but would not be affected.	**No Impact**
(American) Three-toed Woodpecker (*Picoides tridactylus*)	FLNF and MLNF Sensitive Species	No surface disturbance impacts on foraging habitat in the action area. Subsidence-induced alterations on individual trees/shrubs would not have a measurable effect. Higher quality breeding habitat is available elsewhere on the FLNF and MLNF.	**No Impact**
FISH			
Bonneville Cutthroat Trout (*Oncorhynchus clarki utah*)	FLNF and MLNF Sensitive Species	No impacts to surface waters in the action area. Due to the thick overburden compared to the thin coal seam to be removed and Stipulation #18 (Greens Hollow) and Stipulation #17 (Quitchupah) that require mitigation measures for springs and seeps, no impact from subsidence on the quantity and quality of occupied downstream waters is expected.	**No Impact**
Colorado River Cutthroat Trout (*Oncorhynchus clarki pleuriticus*)	FLNF and MLNF	No impacts to surface waters in the action area. Due to the thick overburden compared to the thin coal seam to be removed, and Stipulation	**No Impact**

Species Name	Status	Analysis of Impacts	Determination
	Sensitive Species	#18 (Greens Hollow) and Stipulation #17 (Quitchupah) that require mitigation measures for springs and seeps, no impact from subsidence on the quantity and quality of occupied downstream waters is expected.	
Southern Leatherside Chub (*Lepidomeda aliciae*)	FLNF and MLNF Sensitive Species	No impacts to surface waters in the action area. Due to the thick overburden compared to the thin coal seam to be removed and Stipulation #18 (Greens Hollow) and Stipulation #17 (Quitchupah) that require mitigation measures for springs and seeps, no subsidence impact on the quantity and quality of occupied downstream waters is expected.	**No Impact**
MAMMALS			
Bighorn Sheep (*Ovis canadensis*)	FLNF and MLNF Sensitive Species	No impacts. Species does not occur in the action area.	**No Impact**
Pygmy Rabbit (*Brachylagus idahoensis*)	FLNF Sensitive Species	No impacts because species is not expected to occur in the action area.	**No Impact**
Spotted Bat (*Euderma maculatum*)	FLNF and MLNF Sensitive Species	No roosting habitat would be affected since there are no cliffs in the action area. No surface disturbance impacts to foraging habitat in the action area from subsidence.	**No Impact**
Townsend's Western Big-eared Bat (*Corynorhinus towsendii townsendii*)	FLNF and MLNF Sensitive Species	No roosting sites are present in the action area. No surface disturbance impacts to foraging habitat in the action area.	**No Impact**

FLNF = Fishlake National Forest; MLNF = Manti-La Sal National Forest; MIIH = May impact individuals or habitat but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

5.2 SENSITIVE PLANTS

Many of the sensitive plant species have restricted geographic range, occurring in small localized areas and on specific soils/formations. These species were eliminated from further analysis because they do not have geographic range in Sevier County, Utah where the action area is located. There would be no impact to the following species because they do not occur in the action area:

- Abajo Daisy (*Erigeron abajoensis*)
- Abajo Peak Draba (*Draba abajoensis*)
- Barneby Woody Aster (*Tonestus* (=*Aster*) *kingii* var. *barnebyana*)
- Beaver Mountain Groundsel (*Packera* (=*Senecio*) *castoreus*)
- Bicknell Thelesperma (*Thelesperma subnudum* var. *alpinum*)
- Canyonlands Lomatium (*Lomatium latilobum*)
- Canyon Sweetvetch (*Hedysarum occidentale* var. *canone*)
- Chatterley Onion (*Allium geyeri* var. *chatterleyi*)
- Creeping Draba (*Draba sobolifera*)
- Fish Lake Naiad (*Najas caespitosa*)
- Isely's Milkvetch (*Astragalus iselyi*)
- Kachina Daisy (*Erigeron kachinensis*)
- La Sal Daisy (*Erigeron mancus*)
- Maguire Daisy (*Erigeron maguirei*)
- Mt. Belknap Draba (*Draba ramulosa*)
- Musinea Groundsel (*Senecio musiniensis*)
- Nevada Willowherb (*Epilobium nevadense*)
- Pinnate Spring-parsley (*Cymopterus beckii*)
- Sweet-flowered Rock Jasmine (*Androsace chamaejasme* ssp. *carinata*)
- Tushar Paintbrush (*Castilleja parvula* var. *parvula*)
- Wonderland Alice Flower (Aliciella (=*Gilia*) *caespitosa*)

Table 5 lists the sensitive plant species analyzed for potential occurrence within the action area and supporting information on their habitat and geographic range. These species are carried forward for impacts analysis.

Table 5. Fishlake and Manti-La Sal National Forest Sensitive Plant Species

Species	Status	Habitat and Range	Potential for Occurrence within the Action Area
Arizona Willow (*Salix arizonica*)	FLNF and MLNF Sensitive Species	Riparian areas and wet meadows above 8,300 feet, on calcareous or volcanic soils (UNPS 2016). Range in Utah includes Iron, Kane, Sanpete, and Sevier counties. One population known on the MLNF in the Muddy Creek drainage (Franklin 2005; Rodriguez 2006).	**Does Not Occur**. Muddy Creek is not located in the action area. However, because a portion of the action area is within the larger Muddy Creek watershed, this species is considered for potential impacts.
Bicknell Milkvetch (*Astragalus consobrinus*)	FLNF and MLNF[1] Sensitive Species	Pinyon-juniper and sagebrush communities on volcanic gravel, gravelly or sandy knolls, and barren stony hillsides between 6,000 and 8,500 feet (UNPS 2016). Range is central Utah, including Emery, Garfield, Piute, Sevier, and Wayne counties. Not known from the MLNF (UNPS 2016). All occurrences from	**Does Not Occur**. Records from the Intermountain Region Herbarium Network (2017) and Franklin (2005) indicate this species occurs in Sevier County at lower elevations approximately 13 miles to the east of the action area.

Species	Status	Habitat and Range	Potential for Occurrence within the Action Area
		the FLNF are from the Fremont District (Rodriguez 2006).	
Carrington Daisy (*Erigeron carringtonae*)	MLNF Sensitive Species	Subalpine zones in upland herb associations, which are present on ridgetops within scattered small stands of spruce and fir. Meadows and escarpment margins on Flagstaff Limestone between 10,000 and 11,000 feet (Franklin 2005; UNPS 2016).	**May Occur**. Habitat exists within the action area. The Intermountain Region Herbarium Network (2017) has records of this species occurring at higher elevations approximately 2.5 miles to the north of the lease modifications area.
Creutzfeldt-flower Cryptantha (*Cryptantha creutzfeldtii*)	MLNF Sensitive Species	Shadescale and mat *Atriplex* communities on the Mancos Shale Formation between 5,200 and 6,500 feet (UNPS 2016).	**Does Not Occur**. There is no suitable habitat within the action area.
Elsinore Buckwheat (*Eriogonum batemanii* var. *ostlundii*)	FLNF Sensitive Species	Prefer igneous outcrops and gravels in shadscale, ponderosa pine, mixed desert shrub, and juniper communities between 5,500 and 6,500 feet. Range includes Garfield, Piute, Sanpete, and Sevier counties (UNPS 2016).	**Does Not Occur**. There is no suitable habitat within the action area.
Link Trail Columbine (*Aquilegia flavenscens* var. *rubicunda*)	MLNF Sensitive Species	Ponderosa pine, aspen, and spruce-fir communities, generally associated with seeps in Mesa Verde Group sandstones near coal measures (6,000 to 8,500 feet). Endemic to Emery, Garfield, and Sevier counties (UNPS 2016). Known to occur in nearby drainages, including Link Canyon, Green Hollow, and Cowboy Canyon (Cirrus 2014b).	**May Occur.** Suitable habitat is present in the action area.
Little Penstemon (*Penstemon parvus*)	FLNF Sensitive Species	Black sagebrush (*Artemisia nova*), silver sagebrush (*Artemisia cana*), and grass (*Poaceae* spp.)-forb communities on sandy, gravelly loam and Tertiary volcanic gravels at 8,500 to 10,500 feet. Endemic to the Aquarius Plateau in Garfield,	**Does Not Occur.** Action area is not located on the Aquarius Plateau.

Species	Status	Habitat and Range	Potential for Occurrence within the Action Area
		Piute, and Sevier counties (Rodriguez 2006; UNPS 2016).	
Maguire Campion (*Silene petersonii*)	FLNF[1] and MLNF Sensitive Species	Ponderosa, aspen, and spruce-fir forests on Flagstaff Limestone and the Claron Formation between 7,000 and 11,300 feet (UNPS 2016).	**May Occur**. Suitable habitat is present in the action area. The Intermountain Region Herbarium Network (2017) has records of this species occurring on White Mountain, located 1.5 miles to the northwest of the lease modifications area.
Sevier Townsendia (*Townsendia jonesii var. lutea)*	FLNF Sensitive Species	Salt desert and mixed desert shrub and juniper-sagebrush communities on Arapien shale and clays in volcanic rubble, at 5,500 to 6,300 feet (UNPS 2016). Records from Sevier County are from the north-western portion of the county, and are not near the action area (Franklin 2005).	**Does Not Occur**. There is no suitable habitat within the action area.
Ward's Beardtongue (*Penstemon wardii*)	FLNF Sensitive Species	Desert scrub, pinyon-juniper, sagebrush, shadscale and greasewood (*Sarcobatus* spp.) communities on the Bald Knoll and Arapien Shale formations between 5,200 and 6,810 feet (UNPS 2016). Records from Sevier County are from the western portion of the county, and are not near the action area (Franklin 2005).	**Does Not Occur**. There is no suitable habitat within the action area

1 FLNF = Fishlake National Forest; MLNF = Manti-La Sal National Forest

Impacts to Fishlake and Manti-La Sal National Forest sensitive plant species would be negligible. In general, upland plants and plant communities would not be altered, as surface disturbance from subsidence is expected to be minimal due to the thick overburden compared to the thin coal seam to be removed. Therefore, there would be no measurable effect on riparian or aquatic plant species and cumulative effects are not anticipated. **Table 6** provides an analysis of potential impacts to Fishlake and Manti-La Sal National Forest sensitive plant species and determinations of effects.

Table 6. Determination of Effects on Fishlake and Manti-La Sal National Forest Sensitive Plant Species

Species Name	Status	Analysis of Impacts	Determination
Arizona Willow (*Salix arizonica*)	FLNF and MLNF Sensitive Species	No impacts to springs/seeps and streams in the action area. No impacts to surface waters in the action area. Due to the thick overburden compared to the thin coal seam to be removed and Stipulation #18 (Greens Hollow) and Stipulation #17 (Quitchupah) that require mitigation measures for springs and seeps, no impact from subsidence on the quantity and quality of occupied downstream waters is expected.	**No Impact**
Bicknell Milkvetch (*Astragalus consobrinus*)	FLNF and MLNF[1] Sensitive Species	No impacts because this species does not occur in action area.	**No Impact**
Carrington Daisy (*Erigeron carringtonae*)	MLNF Sensitive Species	No impacts to individuals of this species or on the overall plant community.	**No Impact**
Creutzfeldt-flower Cryptantha (*Cryptantha creutzfeldtii*)	MLNF Sensitive Species	No impacts because this species does not occur in action area.	**No Impact**
Elsinore Buckwheat (*Eriogonum batemanii* var. *ostlundii*)	FLNF Sensitive Species	No impacts because this species does not occur in action area.	**No Impact**
Link Trail Columbine (*Aquilegia flavenscens* var. *rubicunda*)	MLNF Sensitive Species	No impacts to springs/seeps and streams in the action area. No impacts to individuals of this species or on the overall plant community.	**No Impact**
Little Penstemon (*Penstemon parvus*)	FLNF Sensitive Species	No impacts because this species does not occur in action area.	**No Impact**
Maguire Campion (*Silene petersonii*)	FLNF[1] and MLNF Sensitive Species	No impacts to individuals of this species or on the overall plant community.	**No Impact**

Species Name	Status	Analysis of Impacts	Determination
Sevier Townsendia (*Townsendia jonesii var. lutea)*	FLNF Sensitive Species	No impacts because this species does not occur in action area.	**No Impact**
Ward's Beardtongue (*Penstemon wardii*)	FLNF Sensitive Species	No impacts because this species does not occur in action area.	**No Impact**

FLNF = Fishlake National Forest; MLNF = Manti-La Sal National Forest; MIIH = May impact individuals or habitat but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

6.0 FOREST SERVICE MANAGEMENT INDICATOR SPECIES

The National Forest Management Act of 1976 regulations directs the National Forests to identify management indicator species. FSM 2621.1 states: "…Wildlife, Fish, and Plant Species (or groups of species) shall be selected to assure the maintenance of viable populations of existing native and desired non-native plants and animals; to facilitate the attainment of Forest Rangeland Resources Planning Act of 1974 habitat capability goals; and to represent area specific issues, concerns, and opportunities." Management indicator species are species that are selected by the Forest Service because their population changes indicate effects of management activities on the plant and animal community (Forest Service 1986a; Forest Service 1986b; Forest Service 2003). Management indicator species are specific to the individual forests and their forest plans.

Table 7 lists the Fishlake and Manti-La Sal National Forest management indicator species along with their habitat and range information. The following management indicator species are also sensitive species and were previously discussed above; therefore, they are not included in **Table 7**:

- Northern goshawk (Fishlake and Manti-La Sal National Forests),
- Bonneville cutthroat trout (Fishlake National Forest), and
- Colorado River cutthroat trout (Fishlake National Forest).

The action area is unlikely to support large numbers of species in the riparian guild or sagebrush guild due to the limited amount of these habitat types.

Table 7. Fishlake and Manti-La Sal National Forest Management Indicator Species

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action area
BIRDS			
Cavity Nesters[1] (i.e., Hairy Woodpecker (*Picoides villosus*), Western Bluebird (*Sialia Mexicana*), and Mountain Bluebird (*Sialia currucoides*))	FLNF MIS	Generally favor open woodlands with a well-developed understory of shrubs and/or herbaceous vegetation (Forest Service and BLM 2015).	**May Occur**. Suitable habitat exists within the action area.
Golden Eagle (*Aquila chrysaetos*)	MLNF MIS	In winter, found in open country where there is sufficient mammalian, avian, and reptilian prey or carrion. Primarily nest on	**May Occur**. There are approximately 40 nests within ten miles of the lease

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action area
		cliffs, but also nest on trees or human structures. Utah is home to year-round residents and also hosts migrants and over-wintering eagles further north (UWAP Joint Team 2015).	modifications (Jewkes 2017a). There are no nests within the action area. The closest known nest is located in the North Fork Quitchupah Creek drainage, two miles from the action area. The nest was active in 2017. Suitable foraging habitat is present in the action area.
Riparian Dependent Guild[2] (i.e., Lincoln's Sparrow (*Melospiza lincolnii*), Song Sparrow (*Melospiza melodia*), Yellow Warbler (*Dendroica petechial*), and MacGillivray's Warbler (*Oporornis tolmiei*))	FLNF MIS	Riparian habitat (Forest Service and BLM 2015).	**May Occur**. A developed riparian zone is uncommon along streams in the action area. Typically the stream-side vegetation is similar to adjacent upland vegetation. However, in limited areas with gentler slopes, a narrow band of small willows and other riparian vegetation is present.
Sage Nesters (i.e., Brewer's Sparrow (*Spizella breweri*), Vesper Sparrow (*Pooectes gramineus*), and Sage Thrasher (*Oreoscoptes montanus*))	FLNF MIS	Require sagebrush during at least part of the year (Forest Service and BLM 2015).	**May Occur**. The action area is primarily forested. Sagebrush is present in small patches between forest stands, and is unlikely to support high numbers of sage nesters.
FISH			
Brook Trout (*Salvelinus fontinalis*)	FLNF MIS	Spawn in gravel riffles in spring-fed tributaries or spring seepage areas in lakes. Inhabit cool, clear, headwater ponds and spring-fed streams. Also, lakes with cool, well-oxygenated lower layers of water (Rodriguez 2006).	**May Occur**. Present in Muddy Creek Drainage (Birdsey et al. 2008).
Brown Trout (*Salmo trutta*)	FLNF MIS	Prefer cold water with temperatures ranging up to 26 degrees Celsius with boulders, cobble, logs, rootwads, and overhead cover. Prefer cool lakes and streams, but are present in many lower	**May Occur**. Suitable habitat exists within the action area. Occur downstream in Salina Creek.

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action area
		elevation waters which are quite warm at times and sometimes polluted (Rodriguez 2006).	
Lake Trout (*Salvelinus namaycush*)	FLNF MIS	Native to the Great Lakes. Prefer deep, coldwater lakes throughout North America. Usually found offshore in deep, well oxygenated water. On FLNF, they spawn on reefs in the fall (Rodriguez 2006).	**Does Not Occur**. There are no lakes in the action area, and species is not present in Skutumpah Reservoir (Hadley 2011).
Rainbow Trout (*Oncorhynchus mykiss*)	FLNF MIS	Typically small, cool-water streams for spawning. Water of low velocity with adequate protective cover for rearing habitat. Adult habitat consists of water depths of 0.3 meters or greater where rapid-flow water meets calm water with cover that consists of boulders, logs, vegetation, and undercut stream banks. Overwintering habitat consists of deep waters with an adequate amount of food (Rodriguez 2006).	**May Occur**. Suitable habitat exists within the action area. Present in Skutumpah Reservoir downstream (Hadley 2011). Present in Muddy Creek Drainage (Birdsey et al. 2008).
Aquatic Macroinvertebrates	FLNF and MLNF MIS	Aquatic habitat (Rodriguez 2006).	**May Occur**. However, macroinvertebrates are considered MIS only for trout-bearing streams, which are not present in the action area.
MAMMALS			
Abert's Squirrel (*Sciurus aberti*)	MLNF MIS	Optimum habitat is characterized by ponderosa pine stands with even-aged clumps of 12 to 19 inches in diameter at breast height and 45-75 foot height, with interlocking crowns and a ground cover of forbs, grasses, and shrubs. Occurs only on the Monticello District (Forest Service 1986b).	**Does Not Occur**. Action area is not within this species' geographic range.
Rocky Mountain Elk (*Cervus elaphus nelsoni*)	FLNF and MLNF MIS	Inhabit a variety of habitat types including all of Utah's mountains as well as some of the low deserts. Prefer to spend their summers at high elevations in aspen conifer forests and winter months at mid to low elevation in habitats that contain mountain shrub and sagebrush	**May Occur**. Action area is mapped as summer range and a small portion as winter range.

Species Name	Status	Habitat and Range	Potential for Occurrence within the Action area
		communities. In Utah, they are more closely tied to aspen than any other habitat type (UDWR 2015b).	
Mule Deer (*Odocoileus hemionus*)	FLNF and MLNF MIS	Inhabit a wide variety of habitats. Habitat is nearly always characterized by areas of thick brush or trees interspersed with small openings. In Utah, mule deer are found across the state, but are less abundant in the desert areas (UDWR 2015c).	**Known to Occur**. Action area is mapped as summer range.
PLANTS			
Rydberg's Milkvetch (*Astragalus perianus* Barneby)	FLNF MIS	Occupies tertiary igneous gravels, often on barrens in alpine or montane sites in tundra and spruce-fir communities. Also found in sagebrush stands. Elevation range of 7,000 and 11,400 feet (Rodriguez 2006).	**Does Not Occur**. This species occurs only in areas south of Interstate 75 (Franklin 2005). Therefore, the action area is not within this species' geographic range.

Sources: Forest Service 1986a; Forest Service 1986b; Rodriguez 2006
FLNF = Fishlake National Forest; MLNF = Manti-La Sal National Forest; MIS = Management Indicator Species
[1]Cavity Nesters include the primary and secondary species (to be monitored on a case by case basis).
[2]Riparian Dependent Guild include the species dependent upon the various niches of vegetation communities found in riparian zones, i.e., tall deciduous trees, willows, riparian shrubs, riparian grasses.

Table 8 provides an analysis of potential impacts to Fishlake and Manti-La Sal National Forest management indicator species. Impacts to management indicator species are expected to be negligible. No direct surface disturbance would occur and minimal surface disturbance from subsidence is foreseen in the modification areas due to the thick overburden compared to the thin coal seam to be removed; therefore, cumulative effects to Management Indicator Species are not anticipated.

Table 8. Determination of Effects on Fishlake and Manti-La Sal National Forest Management Indicator Species

Species Name	Status	Analysis of Impacts	Determination
Cavity Nesters[1] (i.e., Hairy Woodpecker (*Picoides villosus*), Western Bluebird (*Sialia Mexicana*), and Mountain Bluebird (*Sialia currucoides*))	FLNF MIS	No surface disturbance Impacts on foraging habitat in the action area Subsidence-induced alterations on individual trees/shrubs would not have a measurable effect. No impacts to habitat in the action area or the population in the area.	**No Impact**

Species Name	Status	Analysis of Impacts	Determination
Golden Eagle (*Aquila chrysaetos*)	MLNF MIS	No nests would be affected because there are no known nests or escarpments within the action area. No surface disturbance impacts on foraging habitat in the action area or on the population in the area. Subsidence-induced alterations on individual trees/shrubs would not have a measurable effect.	**No Impact**
Riparian Dependent Guild[2] (i.e., Lincoln's Sparrow (*Melospiza lincolnii*), Song Sparrow (*Melospiza melodia*), Yellow Warbler (*Dendroica petechial*), and MacGillivray's Warbler (*Oporornis tolmiei*))	FLNF MIS	No surface disturbance impacts on the limited habitat in the action area due to subsidence or on the population in the area. Subsidence-induced alterations on individual trees/shrubs would not have a measurable effect. Higher quality breeding habitat is available elsewhere on the FLNF and MLNF.	**No Impact**
Sage Nesters (i.e., Brewer's Sparrow (*Spizella breweri*), Vesper Sparrow (*Pooectes gramineus*), and Sage Thrasher (*Oreoscoptes montanus*))	FLNF MIS	No surface disturbance impacts on the limited habitat in the action area from subsidence or on the population in the area. Higher quality breeding habitat is available elsewhere on the FLNF and MLNF.	**No Impact**
Brook Trout (*Salvelinus fontinalis*)	FLNF MIS	No impacts to surface waters in the action area. Due to the thick overburden compared to the thin coal seam to be removed and Stipulation #18 (Greens Hollow) and Stipulation #17 (Quitchupah) that require mitigation measures for springs and seeps, no impact from subsidence on the quantity and quality of occupied downstream waters is expected.	**No Impact**
Brown Trout (*Salmo trutta*)	FLNF MIS	No impacts to surface waters in the action area. Due to the thick overburden compared to the thin coal seam to be removed and Stipulation #18 (Greens Hollow) and Stipulation #17 (Quitchupah) that require mitigation measures for springs and seeps, no impact	**No Impact**

Species Name	Status	Analysis of Impacts	Determination
		from subsidence on the quantity and quality of occupied downstream waters is expected.	
Lake Trout (*Salvelinus namaycush*)	FLNF MIS	No impacts. Lake trout require deep cold water lakes. No suitable habitat occurs in the action area or downstream waters.	**No Impact**
Rainbow Trout (*Oncorhynchus mykiss*)	FLNF MIS	No impacts to surface waters in the action area. Due to the thick overburden compared to the thin coal seam to be removed and Stipulation #18 (Greens Hollow) and Stipulation #17 (Quitchupah) that require mitigation measures for springs and seeps, no impact from subsidence on the quantity and quality of occupied downstream waters is expected.	**No Impact**
Aquatic Macroinvertebrates	FLNF and MLNF MIS	No impacts to surface waters in the action area. Due to the thick overburden compared to the thin coal seam to be removed and Stipulation #18 (Greens Hollow) and Stipulation #17 (Quitchupah) require mitigation measures for springs and seeps, no impact from subsidence on the quantity and quality of occupied downstream waters is expected.	**No Impact**
Abert's Squirrel (*Sciurus aberti*)	MLNF MIS	No impacts. Species does not occur in the action area.	**No Impact**
Rocky Mountain Elk (*Cervus elaphus nelsoni*)	FLNF and MLNF MIS	No impacts to summer range and the small portion of winter range in the action area or on the population in the area.	**No Impact**
Mule Deer (*Odocoileus hemionus*)	FLNF and MLNF MIS	No impacts to summer range in the action area or on the population in the area.	**No Impact**
Rydberg's Milkvetch (*Astragalus perianus* Barneby)	FLNF MIS	No impacts. Species does not occur in the action area.	**No Impact**

FLNF = Fishlake National Forest; MLNF = Manti-La Sal National Forest; MIS = Management Indicator Species; MIIH = May impact individuals or habitat but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

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APPENDIX A: Official IPAC List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
Phone: (801) 975-3330 Fax: (801) 975-3331
http://www.fws.gov
http://www.fws.gov/utahfieldoffice/

In Reply Refer To: October 26, 2017
Consultation Code: 06E23000-2018-SLI-0040
Event Code: 06E23000-2018-E-00110
Project Name: South Fork Lease Modifications EA

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having

similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
(801) 975-3330

Project Summary

Consultation Code: 06E23000-2018-SLI-0040

Event Code: 06E23000-2018-E-00110

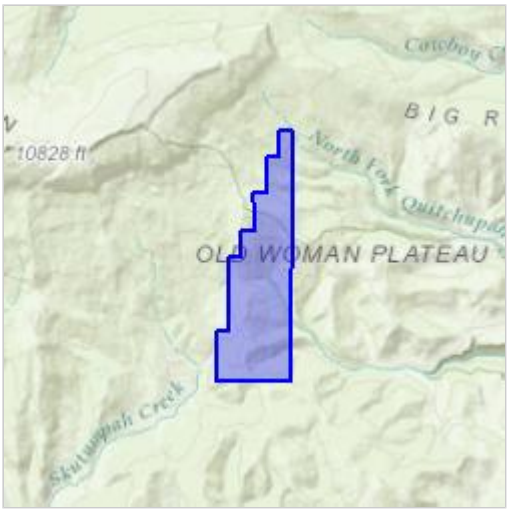
Project Name: South Fork Lease Modifications EA

Project Type: MINING

Project Description: Canyon Fuel Company LLC is requesting modifications to the lease boundaries for federal coal deposits near the Sufco Mine. The requested lease modifications are for federal coal leases UTU-84102 (Greens Hollow Lease) and U-63214 (Quitchupah Lease), together referred to as the South Fork Lease Modifications, and which total approximately 790 acres. The project area is located on public surface lands (Manti-La Sal National Forest and Fishlake National Forest) and federal mineral estate administered by the Bureau of Land Management. Potential environmental impacts of the project are being reviewed in an Environmental Assessment and Biological Assessment/Biological Evaluation. The coal would be mined as part of the Sufco Mine, an existing underground coal mine operation that uses longwall mining methods. No surface disturbance is proposed. Mining within the leases would occur over the course of approximately one year. The lease modifications are needed to prevent the bypass of valuable federal coal reserves at the Sufco Mine.

Project Location:

Approximate location of the project can be viewed in Google Maps:
https://www.google.com/maps/place/38.98171824097409N111.44182514594908W



Counties: Sevier, UT

Endangered Species Act Species

There is a total of 5 threatened, endangered, or candidate species on this species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

Mammals

NAME	STATUS
Utah Prairie Dog *Cynomys parvidens* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5517	Threatened

Birds

NAME	STATUS
California Condor *Gymnogyps californianus* Population: U.S.A. only, except where listed as an experimental population There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8193	Endangered
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **proposed** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

Flowering Plants

NAME	STATUS
Heliotrope Milk-vetch *Astragalus montii* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7704	Threatened
Jones Cycladenia *Cycladenia humilis var. jonesii* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3336	Threatened

Critical habitats

There are no critical habitats within your project area under this office's jurisdiction.

APPENDIX B: Utah Species of Concern

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

State of Utah

DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER
Executive Director

Division of Wildlife Resources

GREGORY SHEEHAN
Division Director

December 16, 2016

Wendy Rieth
Tetra Tech
4750 West 2100 South, Suite 400
Salt Lake City, UT 84120

Subject: Species of Concern Near the South Fork Coal Lease-by-Application Area, Sevier County, Utah

Dear Wendy Rieth:

I am writing in response to your email dated December 12, 2016 regarding information on species of special concern proximal to the proposed South Fork Coal Lease-by-Application Area located in Sections 10, 11, 14, 15, 22 and 23 of Township 21 South, Range 4 East, SLB&M in Sevier County, Utah.

Within a ½-mile radius of the project area noted above, the Utah Division of Wildlife Resources (UDWR) has recent records of occurrence for northern goshawk, a species included on the *Utah Sensitive Species List*.

The information provided in this letter is based on data existing in the Utah Division of Wildlife Resources' central database at the time of the request. It should not be regarded as a final statement on the occurrence of any species on or near the designated site, nor should it be considered a substitute for on-the-ground biological surveys. Moreover, because the Utah Division of Wildlife Resources' central database is continually updated, and because data requests are evaluated for the specific type of proposed action, any given response is only appropriate for its respective request.

In addition to the information you requested, other significant wildlife values might also be present on the designated site. Please contact UDWR's habitat manager for the southeastern region, Daniel Eddington, at (435) 613-3709 if you have any questions.

Please contact our office at (801) 538-4759 if you require further assistance.

Sincerely,

Sarah Lindsey
Information Manager
Utah Natural Heritage Program

cc: Daniel Eddington

APPENDIX C: US Forest Service TEPS Distribution

INTERMOUNTAIN REGION (R4) THREATENED, ENDANGERED, PROPOSED, AND, SENSITIVE SPECIES

June 2016

KNOWN / SUSPECTED DISTRIBUTION BY FOREST

STATUS	FOREST															
ENDANGERED	**ASH**	**BOI**	**B-T**	**CAR**	**CHA**	**DIX**	**FIS**	**HUM**	**M-L**	**PAY**	**SAL**	**SAW**	**TAR**	**TOI**	**UIN**	**W-C**
MAMMALS																
Black-footed ferret 3/11/67 *Mustela nigripes*			o													o
Sierra Nevada bighorn sheep *Ovis canadensis* sierra January 3, 2000														X		
BIRDS																
Southwestern willow flycatcher 2/27/95 *Empidonax traillii extimus* ED 3/29/95									X					?		
Whooping crane 3/11/67 *Grus americana*			X										?			
REPTILES AND AMPHIBIANS																
Sierra Nevada Yellow-legged Frog 06/30/2014 *Rana sierrae*														X		
INSECTS																
Mt. Charleston Blue Butterfly 10/21/2013 *Icaricia shasta charlestonensis*														X		
FISH																
June sucker 3/31/86 *Chasmistes liorus*															o	o
Bonytail chub 4/23/80 *Gila elegans*	o		o			o	o		o						o	o
Humpback chub 3/11/67 *Gila cypha*	o		o			o	o		o						o	o
Colorado pike minnow 3/11/67 *Ptychocheilus lucius*	o		o			o	o		o						o	o
Kendall Warm Springs dace 10/13/70 *Rhinichthys osculus*			X													

ENDANGERED	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Sockeye salmon, (Snake River0 11/20/91 *Oncorhynchus nerka* (CH 12/28/98)					+					+	+	X				
Razorback sucker 10/23/91 *Xyrauchen texanus* (ED 11/22/91)	o		o			o	o		o						o	o
Sturgeon, pallid *Scaphirhynchus albus*			o													
PLANTS																
San Rafael cactus *Pediocactus despainii*							X									
Clay phacelia 09/28/78 *Phacelia argillacea*									?						X	
THREATENED	**ASH**	**BOI**	**B-T**	**CAR**	**CHA**	**DIX**	**FIS**	**HUM**	**M-L**	**PAY**	**SAL**	**SAW**	**TAR**	**TOI**	**UIN**	**W-C**
MAMMALS																
Canada lynx 4/15/00 *Lynx canadensis*	X	X	X							X		X	X		?	?
Grizzly bear 9/21/2009 *Ursus arctos horribilis*			X										X			
Gray wolf (Wyoming Rocky Mountain DPS 10J Experimental Population) *Canis lupus*			X	X									X			X
Utah prairie dog 6/04/73 *Cynomys parvidens*						X	X									
Northern Idaho ground squirrel 3/24/00 *Spermophilus brunneus*		X								X						
BIRDS																
Mexican spotted owl 3/16/93 *Strix occidentalis lucida (ED 4/15/93)*						X	X		X							
Yellow-billed cuckoo 11/03/2014 *Coccyzus americanus*	X	X	X		?	?	?	X	X	X	?	X	X	X	X	X
REPTILES AND AMPHIBIANS																
Desert tortoise 8/04/89 *Gopherus agassizii*														X		
Yosemite toad 6/30/2014 *Anaxyrus canorus*														X		
FISH																
Steelhead trout (Snake River summer) *Oncorhynchus mykiss*		X			X					X	X	X				

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

THREATENED	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Chinook salmon, Snake River sprg/smr *Oncorhynchus tshawytscha 4/22/92* (ED 5/22/92)		X			X					X	X	X				
Chinook salmon, Snake River fall *Oncorhynchus tshawytscha 4/22/92* (ED 5/22/92)										X						
Greenback cutthroat trout *Oncorhynchus clarki stomiua*									X							
Railroad Valley springfish 3/31/86 *Crenichthys nevadae*														X		
Lahontan cutthroat trout 10/13/70 *Oncorhynchus clarki henshawi*								X						X		
Columbia River bull trout 6/10/98 *Salvelinus confluentus*		X			X			X		X	X	X				
Paiute cutthroat trout 3/11/67 *Oncorhynchus clarki seleniris*														X		
PLANTS																
Deseret milkvetch 10/20/99 *Astragalus desereticus*									?						?	
Heliotrope milkvetch 11/6/87 *Astragalus limnocharis var.montii (A. montii)*									X							
Slick-spot peppergrass 10/08/09 *Lepidium papilliferum*		?														
Winkler cactus *Pediocactus winkleri*									?							
Maguire's primrose 8/21/85 *Primula cusickiana var. maguirei (P. maguirei)*																X
Last chance townsendia 8/21/85 *Townsendia aprica*						X	X									
Ute ladies' tresses orchid 1/17/92 *Spiranthes diluvialis* (2/18/92)		?		?	?		?				?	?	X		X	?
Webber ivesia 7/3/2014 *Ivesia webberi*														X		
PROPOSED	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
North American wolverine Gulo gulo (luscus)	X	X	X	X	X					X	X	X	X	X		X

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

CANDIDATE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Sierra Nevada red fox *Vulpes vulpes necator*														X		
Whitebark Pine *Pinus albicaulis*		X	X		X			X		X	X	X	X	X		

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
MAMMALS																
Bighorn Sheep *Ovis canadensis* - Includes Rocky Mountain bighorn sheep (*O. c. canadensis*), California bighorn sheep (*O. c. californiana*), and desert bighorn sheep (*O. c. nelsoni*) (7/29/2009)	X	X	X		X		X	X	X	X	X	X	X	X	X	X
Gray wolf (Rocky Mountain DPS) *Canis lupus*		X		X	X					X	X	X	X			X
Pygmy rabbit *Brachylagus idahoensis*				X	X	X	X	X			X	X	X	X		
Spotted bat *Euderma maculatum*	X	X	X	X	X	X	X	X	X	X	X	X	?	X	X	X
Fisher *Martes pennanti*		X	X		X					X	X	X	?		X	
Southern Idaho Ground Squirrel *Spermophilus brunneus endemicus*		X								X						
Townsend's Western Big-Eared Bat *Corynorhinus townsendii townsendii*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BIRDS																
Bald eagle *Haliaeetus leucocephalus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Boreal owl *Aegolius funereus*	X	X	X	X	X					X	X	X	X			X
Greater sage-grouse *Centrocercus urophasianus*	X	X	X	X	X	X	X	X	X	?	X	X	X	X	X	X
Greater sage-grouse Bi-State DPS *Centrocercus urophasianus*														X		
Trumpeter swan *Cygnus buccinator*			X	X									X			
Peregrine falcon 3/20/84 *Falco peregrinus anatum*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Common loon *Gavia immer*		X	X		+					?	+	X	X			
Harlequin duck *Histrionicus histrionicus*			X	X	?+					X	?+		X			
Mountain quail *Oreortyx pictus*		X						X		X		X		X		
Flammulated owl *Otus flammeolus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
White-headed woodpecker *Picoides albolarvatus*		X								X		X		X		
Three-toed woodpecker *Picoides tridactylus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Great gray owl *Strix nebulosa*	X	X	X	X	X					X	X	X	X	X		X
California spotted owl *Strix occidentalis occidentalis*														X		
Columbian sharp-tailed grouse *Tympanuchus phasianellus columbianus*		X		X				X		X		X	X			X
Northern goshawk *Accipiter gentilis*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
REPTILES AND AMPHIBIANS																
Columbia spotted frog *Rana luteiventris*	?	X	X	X	X			X	X	X	X	X	X	X	X	X
Boreal Toad *Bufo boreas*	X		X	X		X	X		X				X		X	X
FISH																
Wood River sculpin *Cottus leiopomus*												X				
Westslope cutthroat trout *Oncorhynchus clarki lewisi*		X	X		X					X	X	X				
Colorado River cutthroat trout *Oncorhynchus clarki pleuriticus*	X		X			X	X		X						X	X
Bonneville cutthroat trout *Oncorhynchus clarki utah*			X	X		X	X	X	X						X	X
Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri*			X	X								X	X			
Northern Leatherside Chub *Lepidomeda copei*			X	X								X	X			X
Southern Leatherside Chub *Lepidomeda aliciae*						X	X		X						X	
Big Lost River Whitefish *Prosopium williamsoni*					X											
INSECTS																
Spring Mountain Checkerspot *Chlosyne acastus robusta*														X		
Dark Blue														X		

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Euphilotes ancilla purpura																
Morand's Checkerspot *Euphydryas anicia morandi*														X		
PLANTS																
Pink agoseris *Agoseris lackschewitzii*			X								X		X			
Wonderland Alice flower Aliciella (=*Gilia) caespitosa*						X	X									
Chatterley Onion *Allium geyeri var. chatterleyi*									X							
Swamp onion *Allium madidum*										X						
Tolmie's onion *Allium tolmiei* var. *persimile*		X								X						
Candystick *Allotropa virgata*										X						
Sweet-flowered rock jasmine *Androsace chamaejasme ssp. carinata*			X						X				X			
Charleston angelica *Angelica scabrida*														X		
Wheeler's angelica *Angelica wheeleri*															X	X
Meadow pussytoes *Antennaria arcuata*								X								
Charleston pussytoes *Antennaria soliceps*														X		
Link Trail columbine *Aquilegia flavescens var. rubicunda*									X							
Graham columbine *Aquilegia grahamii*	X															
Rosy King's sandwort *Arenaria kingii* ssp. *rosea*														X		
Petiolate wormwood *Artemisia campestris ssp. borealis var. petiolata*	X															
Eastwood milkweed *Asclepias eastwoodiana*								X						X		
Clokey milkvetch *Astragalus aequalis*														X		

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Lost River milkvetch *Astragalus amnis-amissi*					X											
Goose Creek milkvetch *Astragalus anserinus*												?				
Lemhi milkvetch *Astragalus aquilonius*					X							?				
Bicknell milkvetch *Astragalus consobrinus*							X		?							
Meadow milkvetch *Astragalus diversifolius var. diversifolius*			X		X								X			
Dana milkvetch *Astragalus henrimontanensis*						X										
Isely's milkvetch *Astragalus iselyi*									X							
Starvling milkvetch *Astragalus jejunus var. jejunus*			X	X												
Long Valley milkvetch *Astragalus johannis-howellii*														X		
Broad-pod freckled milkvetch *Astragalus lentiginosus var. latus*								X								
Navajo Lake milkvetch *Astragalus limnocharis* var. *limnocharis*						X										
Table Cliff milkvetch *Astragalus limnocharis* var. *tabulaeus*						X										
Lee Canyon milkvetch *Astragalus oophorus* var. *clokeyanus*														X		
Lavin's egg milkvetch *Astragalus oophorus* var. *lavinii*														X		
Payson's milkvetch *Astragalus paysonii*			X							X			?			
Spring Mountain milkvetch *Astragalus remotus*														X		
Lamoille Canyon milkvetch *Astragalus robbinsii* var. *occidentalis*								X								
Toquima milkvetch *Astragalus toquimanus*														X		
Currant milkvetch *Astragalus uncialis*								X								

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
White Cloud milkvetch *Astragalus vexilliflexus* var. *nubilus*					X					X		X				
Guard milkvetch *Astragalus zionis var. vigulus*						X										
Bodie Hills rockcress Boechera (=*Arabis) bodiensis*														X		
Grouse Creek rockcress Boechera (=*Arabis) falcatoria*								X								
Spring Mountains rockcress Boechera (=*Arabis) nevadensis*														X		
Washoe tall rockcress Boechera (=*Arabis) rectissima* var. *simulans*														X		
Galena Creek rockcress Boechera (=*Arabis) rigidissima* var. *demota*														X		
Ophir rockcress Boechera (=*Arabis) ophira*														X		
Tiehm rockcress Boechera (=*Arabis) tiehmii*														X		
Upswept moonwort *Botrychium ascendens*														X		
Dainty moonwort *Botrychium crenulatum*	X												X	X	X	
Slender moonwort *Botrychium lineare*	X							?		?		X		X	?	X
Paradox moonwort *Botrychium paradoxum*						X										
Little grape fern *Botrychium simplex*												X				
Moosewort *Botrychium tunux*														X		
Beautiful Bryum *Bryum calobryoides*		X										X				
Cascade reedgrass *Calamagrostis tweedyi*										X						
Cusick camas *Camassia cusickii*										X						
Seaside sedge *Carex incurviformis*			X		X											

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Black and purple sedge *Carex luzulina var. atropurpurea*			X													
Tioga Pass sedge *Carex tiogana*														X		
Aquarius paintbrush *Castilleja aquariensis*						X										
Christ's Indian paintbrush *Castilleja christii*												X				
Tushar paintbrush *Castilleja parvula* var. *parvula*						X	X									
Reveal paintbrush *Castilleja parvula* var. *revealii*						X										
Centennial rabbitbrush *Chrysothamnus parryi* ssp. *montanus*													X			
Flexible alpine collomia *Collomia debilis var. camporum*											X					
Wasatch fitweed *Corydalis caseana spp. brachycarpa*															X	X
Creutzfeldt-flower cryptanth *Cryptantha creutzfeldtii*									X							
Yellow-white catseye *Cryptantha ochroleuca*						X										
Bodie Hills draba *Cusickiella quadricostata*														X		
Pinnate spring-parsley *Cymopterus beckii*						X			X							
Davis' wavewing *Cymopterus davisii*												X				
Douglas' biscuitroot *Cymopterus douglassii*					X						X	X				
Goodrich biscuitroot *Cymopterus goodrichii*														X		
Cedar Breaks biscuitroot *Cymopterus minimus*						X										
Brownie ladyslipper *Cypripedium fasciculatum*	X															X
Lesser yellow Lady's slipper *Cypripedium parviflorum (Cypripedium calceolus*																X

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
var. parviflorum)																
Wyoming tansymustard *Descurainia torulosa*			X													
Wasatch shooting star *Dodecatheon utahense*																X
Idaho douglasia *Douglasia idahoensis*		X								?		?				
Abajo peak draba *Draba abajoensis*									X							
Arid draba *Draba arida*														X		
Star draba *Draba asterophora* var. *asterophora*														X		
Wasatch Draba *Draba brachystylis*														X	?	X
Burke's draba *Draba burkei*																X
Rockcress draba *Draba globosa (=D. densifolia var. apiculata)*	X		X		X							X			X	X
Jaeger draba *Draba jaegeri*														X		
Maguire draba *Draba maguirei*																X
Serpentine draba *Draba oreibata* var. *serpentina*								?						X		
Charleston draba *Draba paucifructa*														X		
Pennell draba *Draba pennellii*								X								
Mt. Belknap draba *Draba ramulosa*							X									
Santaquin draba *Draba santaquinensis*															X	
Creeping draba *Draba sobolifera*						X	X									
Stanley's whitlow-grass *Draba trichocarpa*					X							X				
Nevada willowherb							X							X		

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Epilobium nevadense																
Spring Mountain goldenweed *Ericameria compacta (=Haplopappus compactus)*														X		
Pine Valley goldenweed *Ericameria crispa (=Haplopappus crispus)*						X										
Narrow-leaf goldenweed *Ericameria discoidea var. linearis (=Haplopappus macronema var.linearis)*			X													
Abajo daisy *Erigeron abajoensis*									X							
Carrington daisy *Erigeron carringtonae*									X							
Snake Mountain erigeron *Erigeron cavernensis*								X								
Cronquist daisy *Erigeron cronquistii*																X
Garrett's fleabane *Erigeron garrettii*															X	X
Kachina daisy *Erigeron kachinensis*									X							
Woolly daisy *Erigeron lanatus*			X													
Maguire daisy *Erigeron maguirei*							X									
LaSal daisy *Erigeron mancus*									X							
Untermann daisy *Erigeron untermannii*	X															
Widtsoe buckwheat *Eriogonum aretioides*						X										
Elsinore buckwheat *Eriogonum batemanii* var. *ostlundii*							X									
Desert buckwheat *Eriogonum brevicaule var. desertorum*												X				
Welsh buckwheat *Eriogonum capistratum var. welshii*					X											
Sunflower Flat buckwheat								X								

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Eriogonum douglasii var. elkoense																
Toiyabe buckwheat *Eriogonum esmeraldense var. toiyabense*														X		
Clokey buckwheat *Eriogonum heermannii var. clokeyi*														X		
Lewis's buckwheat *Eriogonum lewisii*								X								
Logan buckwheat *Eriogonum loganum (=E. brevicaule* var. *loganum)*																X
Guardian buckwheat *Eriogonum meledonum*					X							X				
Altered andesite buckwheat *Eriogonum robustum*														X		
Clokey greasebush *Glossopetalon clokeyi*														X		
Smooth dwarf greasebrush *Glossopetalon pungens var. glabra (=G.pungens)*														X		
Puzzling halimolobos *Halimolobos perplexa* var. *perplexa*										X						
Canyon sweetvetch *Hedysarum occidentale* var. *canone*									X							
Jones goldenaster *Heterotheca jonesii*						X										
Sierra Valley ivesia *Ivesia aperta* var. *aperta*														X		
Dog Valley ivesia *Ivesia aperta* var. *canina*														X		
Charleston ivesia *Ivesia cryptocaulis*														X		
Jaeger ivesia *Ivesia jaegeri*														X		
Plumas ivesia *Ivesia sericoleuca*														?		
Utah ivesia *Ivesia utahensis*															X	X
Wasatch jamesia															X	X

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Jamesia americana var. macrocalyx																
Zion jamesia *Jamesia americana var. zionis*						X										
Basin jamesia *Jamesia tetrapetala*								X								
Grimes lathyrus *Lathyrus grimesii*								X								
Wasatch pepperwort *Lepidium montanum* var. *alpinum*															?	X
Neeses' peppergrass *Lepedium montanum* var. *neeseae*						X										
Hazel's prickly phlox *Leptodactylon pungens* ssp. *hazeliae*										X						
Garrett bladderpod *Lesquerella garrettii*															X	X
Hitchcock bladderpod *Lesquerella hitchcockii var. hitchcockii*														X		
Payson bladderpod *Lesquerella paysonii*			X	X									X			
Maguire lewisia *Lewisia maguirei*								X								
Sacajawea's bitterroot *Lewisia sacajaweana*		X			X					X	X	?				
Canyonlands lomatium *Lomatium latilobum*									X							
Three-ranked hump-moss *Meesia triquetra*														X		
Goodrich stickleaf *Mentzelia goodrichii*	X															
Bank monkeyflower *Mimulus clivicola*										X						
Fish Lake naiad *Najas caespitosa*							X									
Idaho pennycress *Noccaea idahoensis var. aileeniae (=Thlaspi aileeniae)*					X							X				
Shevock rockmoss *Orthotrichum shevockii*														X		

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Spjut's brittle-moss *Orthotrichum spjutii*														X		
Challis crazyweed *Oxytropis besseyi* var. *salmonensis*					X											
Beaver Mountain groundsel *Packera (=Senecio) castoreus*							X									
Podunk groundsel *Packera (=Senecio) malmstenii*						X										
Arctic poppy *Papaver radicatum* var. *pygmaeum*	X															X
Naked-stemmed parrya *Parrya nudicaulis*			X													
Paria breadroot *Pediomelum pariense*						X										
Stemless beardtongue *Penstemon acaulis* var. *acaulis*	X															
Dune penstemon *Penstemon arenarius*														?		
Red Canyon beardtongue *Penstemon bracteatus*						X										
Cache beardtongue *Penstemon compactus*				X												X
Elegant penstemon *Penstemon concinnus*								?								
Idaho penstemon *Penstemon idahoensis*												X				
Charleston beardtongue *Penstemon leiophyllus* var. *keckii*														X		
Lemhi penstemon *Penstemon lemhiensis*											X					
Mt. Moriah penstemon *Penstemon moriahensis*								X								
Little penstemon *Penstemon parvus*						X	X									
Pinyon penstemon *Penstemon pinorum*						X										
Bashful penstemon *Penstemon pudicus*								X								

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Rhizome beardtongue *Penstemon rhizomatosus*								X								
Wassuk beardtongue *Penstemon rubicundus*														X		
Jaeger beardtongue *Penstemon thompsoniae ssp. jaegeri*														X		
Ward beardtongue *Penstemon wardii*							X									
Inconspicuous phacelia *Phacelia inconspicua*								?								
Small-flower phacelia *Phacelia minutissima*		X						X				?				
Mono phacelia *Phacelia monoensis*														X		
Salmon twin bladderpod *Physaria didymocarpa* var. *lyrata*											X		X			
Creeping twinpod *Physaria integrifolia v. monticola*			X													
Whitebark Pine *Pinus albicaulis*		X	X		X			X		X	X	X	X	X		
Altered andesite popcorn flower *Plagiobothrys glomeratus*														X		
Marsh's bluegrass *Poa abbreviata ssp. marshii*					*X*			*X*			*X*	*X*		*X*		
White Mountain skypilot *Polemonium chartaceum*														X		
Williams combleaf *Polyctenium williamsii*														X		
Angell cinquefoil *Potentilla angelliae*						X										
Cottam cinquefoil *Potentilla cottamii*												X				X
Sagebrush cinquefoil *Potentilla johnstonii*								X								
Alkali primrose *Primula alcalina*													X			
Ruby Mountain primrose *Primula capillaris*								X								

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Nevada primrose *Primula cusickiana var. nevadensis (=P. nevadensis)*								X								
Greenland primrose *Primula egaliksensis*			X													
Bugleg goldenweed Pyrrocoma (=*Haplopappus) insecticruris*		X										X				
Radiate goldenweed *Pyrrocoma radiata (=Haplopappus radiatus)*										X						
Bartons' blackberry *Rubus bartonianus*										X						
Arizona willow *Salix arizonica*						X	X		X							
Weber's saussurea *Saussurea weberi*			X													
Tobias' saxifrage *Saxifraga bryophora* var. *tobiasiae*										X						
Tolmie's saxifrage *Saxifraga tolmiei* var. *ledifolia*										X						
Musinea groundsel *Senecio musiniensis*									X							
Mono ragwort *Senecio pattersonensis*														X		
Clokey silene *Silene clokeyi*														X		
Nachlinger silene *Silene nachlingerae*								X								
Maguire campion *Silene petersonii*						X	?		X							
Railroad Valley globemallow *Sphaeralcea caespitosa var. williamsiae*								X								
Rock-tansy *Sphaeromeria capitata*						X										
Low sphaeromeria *Sphaeromeria compacta*														X		
Masonic Mountain jewelflower *Streptanthus oliganthus*														X		
Soft aster			X													

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

SENSITIVE	ASH	BOI	B-T	CAR	CHA	DIX	FIS	HUM	M-L	PAY	SAL	SAW	TAR	TOI	UIN	W-C
Symphyotrichum molle (=Aster mollis)																
Charleston kittentails *Synthyris ranunculina*														X		
Caespitose greenthread *Thelesperma caespitosum*	X															
Uinta green thread *Thelesperma pubescens*																X
Bicknell thelesperma *Thelesperma subnudum* var. *alpinum*						X	X									
Wavy-leaf thelypody *Thelypodium repandum*					X											
Alpine goldenweed *Tonestus (=Haplopappus) alpinus*														X		
Barneby woody aster *Tonestus (=Aster) kingii* var. *barnebyana*							X								X	
Sevier townsendia *Townsendia jonesii* var. *lutea*							X									
Charleston ground daisy *Townsendia jonesii* var. *tumulosa*														X		
Short-slyle tofieldia *Triantha occidentalis ssp. brevistyla*										X						
Currant Summit clover Trifolium *andinum var. podocephalum*								X								
Leiberg's clover *Trifolium leibergii*								X								
Rollins clover *Trifolium macilentum var. rollinsii*														X		
Charleston violet *Viola charlestonensis*														X		
Smith violet *Viola franksmithii*																X
Lithion violet *Viola lithion*								X								
Idaho range lichen *Xanthoparmelia idahoensis*											X					

x=known species/habitat; ?=suspected/potential habitatt; *=wild/naturally reproducing; +=migration; o=offsite; r= reintroduced populations; ED=Effective dates

ASH - Ashley	CHA - Challis	M-L - Manti-LaSal	TAR - Targhee
BOI - Boise	DIX - Dixie	PAY - Payette	TOI - Toiyabe
B-T - Bridger-Teton	FIS - Fishlake	SAL - Salmon	UIN - Uinta
CAR - Caribou	HUM - Humboldt	SAW - Sawtooth	W-C - Wasatch-Cache

KEY: X = known distribution species and/or habitat ? = suspected or potential habitat * = wild and naturally reproducing stocks + = migration corridors only o = offsite impacts (e.g. downstream) r = reintroduced Central Idaho & Yellowstone populations, covered under ESA Section 10(j), and declared experimental non-essential populations, and thus are treated like "proposed" species ## = no longer meet "sensitive"criteria (personal communication with Forest botanists and Dr. Duane Atwood), but no official list revision yet Dates are dates the Final Rule was published in the *Federal Register;* ED = Effective dates are about 30 days later if not listed.	***This list was compiled from the following sources:*** *R-4 Vertebrate Sensitive Species List* (August 13, 1990) *R-4 Sensitive Plant List* (April 29, 1994) *Endangered and Threatened Wildlife and Plants,* USDA-U.S. Fish & Wildlife Service (August 20, 1994) *Northern Goshawk - Listed as a Sensitive Species in R4* (October 31, 1991) *Miscellaneous Federal Registers*

APPENDIX B: Utah Species of Concern

APPENDIX C: US Forest Service TEPS Distribution

CHAPTER 4

LAND USE AND AIR QUALITY

During the 2017 Paleontology Resource Appraisal of the 4 Right area the Castlegate and Price River formations were determined to have little potential for the preservation of vertebrate fossils. Based on reports from local mines the general rarity of significant vertebrate fossil particularly in the Castlegate Sandstone supports the lack of potential to expose or damage paleontological resources due to escarpment subsidence impacts. (Paleontology Resource Appraisal 2017, Appendix 4-2).

Because the Mine has no plans to cause surface disturbance within the project area, a Class III cultural resource inventory was only required by the USFS in areas with a high potential for subsidence where cultural resources existed and could be adversely impacted. Historically, the areas include canyon walls and their associated rims. The inventory was conducted in portions of Sections 27 and 34. Two new sites were recorded adjacent to the 4 Right panel in Section 27 (42SV3786 and 42SV3787) neither was considered to be eligible to be listed by SHPO as recommended by the USFS. The cultural resource inventory and SHPO concurrence letter agreeing with USFS in not listing the new sites are located in Appendix 4-2 (Confidential). Two isolated objects were also located in Section 34 during the inventory. There are no known cultural and paleontological resources above the 4 Right 4 East panel and within the potential subsidence angle-of-draw.

South Fork Lease Modification

A cultural resource inventory was conducted in the South Fork Lease Modification (SFLM) area in 2018 by Tetra Tech (See Appendix 4-2). No significant cultural sites were found that would be eligible for inclusion on the NRHP. Tetra Tech recommends that mining within the SFLM area will have no effect on historic properties.

South Fork of Quitchupah Area of 2R2S Block "A" and 3R2S Block "B"

Cultural and Historic Information. Cultural resource information and maps identifying cultural and historical study areas are located in Appendix 4-2 in the Confidential folder of the M&RP. Canyon Environmental conducted an evaluation of the South Fork of Quitchupah in and adjacent to the 2R2S Block "A" panel Area.

CHAPTER 5

ENGINEERING

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.

South Fork Lease Modification

The proposed lease modifications are of the existing leases U-63214 (Quitchupah Tract) and UTU-84102 (Greens Hollow Tract). These leases were issued to the permittee in 1989 and 2017 respectively. The proposed mine plan can be found on Plate 5-7. No surface disturbance or facilities are anticipated within this area. Mining will occur only in the Upper Hiawatha coal seam and the overburden associated with the SFLM ranges from approximately 1,250 feet to 2,650 feet. Is it projected that less than 5 feet of subsidence will occur. No significant escarpments are found in the area.

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

CHAPTER 6

GEOLOGY

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.

South Fork Lease Modification

The lease modifications are located on the southeastern slopes of White Mountain in the southern region of the Wasatch Plateau. The general stratigraphy in this area includes the Starpoint, Blackhawk, Castlegate, Price River and North Horn formations. Mining will occur in the Upper Hiawatha coal seam and the overburden ranges from approximately 1,250 feet to 2,650 feet. No significant escarpments are found in the area.

Drill hole locations in the SFLM area can be found on Plate 6-1. Drill logs and chemical analyses for exploration in the SFLM area can be found in Appendix 6-2 (Drilling data is confidential as explained in section 6.2.4). As expected, lithological and chemical composition found in this area is consistent with findings for the Greens Hollow Lease. These findings can be found in sections 6.2.4.1 and 6.2.4.3.

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.

CHAPTER 7

HYDROLOGY

Table 7-11

SUFCO 2017 DRILLHOLE INFORMATION- 4RIGHT 4 EAST PANEL AREA								
Drill Hole ID	Date Completed	UTM Z12 WGS 84 Utah State Plane SLB Nad 27				Collar	TD (ft)	Water Encountered
		EAST	NORTH	EAST	NORTH	Elev (ft)		
17-34-1	8/14/17	469641.30	4311077.10	2042787.07	223975.43	8620.15	1018	No water encountered drill with no circulation
17-34-2	8/9/17	470248.20	4311437.40	2044772.46	225168.69	8659.34	1037	No water encountered drill with no circulation

South Fork Lease Modification

Eleven water monitoring locations associated with the South Fork Lease Modification (SFLM) area are listed in Table 7-12 below and have been added to the current monitoring program (See Table 7-2 and Plate 7-10). Seven of these are designated as protected sources in the SFLM Final Decision Notice/FONSI signed by the Forest Service in October of 2018. Data has been collected from nine out of the eleven locations since 2013. The other two locations were added at the divisions (UDOGM) request. The Quitchupah and Muddy Creek CHIA was completed in 2018. Appendix 7-29 of the Sufco permit contains the PHC for the SFLM area.

Table 7-12
South Fork Lease Modification - Water Monitoring Locations

Associated Lease	Water Monitoring Location	Source Type	Elev. (ft)	UTM NAD27		Associated Water Rights
				Easting	Northing	
Greens Hollow	Divide Spring	Spring	8,845	461297	4314348	-
	94-110	Spring	9,224	461800	4315754	94-110
	99	Spring	9,352	461609	4315684	-
	A Spring	Spring	8,520	460639	4313578	-
	B Spring	Spring	8,520	460661	4313547	-
	Skutumpah Spring	Spring	8,400	460903	4313360	-
	S. Fork Quitchupah Creek Upper[1]	Surface Water	8,867	461215	4314550	94-1403
	S. Fork Quitchupah Creek Lower[1]	Surface Water	8,470	462143	4313794	94-1403
	Skutumpah Creek Upper[1]	Surface Water	8,757	461013	4314367	63-3395
Quitchupah	Hansen Seep	Spring	8,399	462514	4313461	94-1411
	94-1397[1]	Spring	8,450	462889	4312695	94-1397

1. Not Listed in EA

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
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
In-mine Well (Proposed)	A	Screened in Starpoint Sandstone

Streams	Protocol	Comments
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
M-STR1	C,1	Cowboy Creek
M-STR4	C,1	Cowboy Creek
M-STR6	C,8	Top Greens Canyon

TABLE 7-2 (Continued) Water Monitoring Program

Streams	Protocol	Comments
Muddy ABF	C,8	Lower Muddy Creek
U-Mud	C,8	Confluence North & South Fork Muddy
Cowboy Top	C,2	Top of Cowboy Creek
Cowboy Middle	C,2	Mid segment of Cowboy Creek
Cowboy Bottom	C,2	Bottom of Cowboy Creek
SP60 Creek	C,2	Creek adjacent to Monitoring point SP60
CPC Upper	C,2	Top of Tributary to North Fork Quitchupah
CPC Middle	C,2	Mid segment of Tributary to North Fork Quitchupah
CPC Lower	C,2	Just above North Fork confluence
North Fork Upper	C,2	Top of North Fork Quitchupah at lease edge
North Fork Middle	C,2	Mid segment of North Fork Quitchupah just above CPC confluence
ULGH	C,2	Upper Left Fork Greens Hollow Creek
URGH	C,2	Upper Right Fork Greens Hollow Creek
GH at Road	C,2	Greens Hollow Creek at road crossing
Muddy Creek below Horse	C,2	Muddy Crk below confluence with Horse Crk
Muddy Creek above Horse	C,2	Muddy Crk above confluence with Horse Crk
Horse Creek	C,2	Horse Creek at confluence with Muddy Creek
S. Fork Quitchupah Creek Upper	C,2	Upper S. Fork Quitchupah Creek
S. Fork Quitchupah Creek Lower	C,2	Lower S. Fork Quitchupah Creek
Skutumpah Creek Upper	C,2	Upper Reaches of Skutumpah Creek

Springs	Protocol	Comments
SUFCO 001	D,3	Blackhawk Formation
SUFCO 047	D,4	Star Point Sandstone
SUFCO 057A	D,3	North Horn Formation
SUFCO 089	E,3	Castlegate Sandstone
GW-8	D,5	Price River Formation
GW-9	D,5	Price River Formation
GW-13	D,3	North Horn Formation
GW-20	D,5	Castlegate Sandstone

TABLE 7-2 (Continued) Water Monitoring Program

Springs	Protocol	Comments
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
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

TABLE 7-2 (Continued) Water Monitoring Program

Springs	Protocol	Comments
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
Wedge Spring	H,3	Castlegate Sandstone
Amanda Spring	H,3	Castlegate Sandstone
94-113 Seep	H,3	Price River Formation
Divide Spring	D,4	North Horn Formation
A Spring	D,4	Price River Formation
B Spring	D,4	Price River Formation
Skutumpah Spring	D,4	Price River Formation
Spring 99	D,4	North Horn Formation
94-110 Spring	D,4	North Horn Formation
Hansen Seep	D,4	Price River Formation
94-1397	D,4	Price River Formation

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

APPENDIX 7-29

PHC for the South Fork Lease Modifications

Investigation of Groundwater and Surface-Water Systems in the South Fork Lease Modification Area; Probable Hydrologic Consequences of Coal Mining

6 March 2019

Canyon Fuel Company, LLC
Sufco Mine
Salina, Utah

PETERSEN HYDROLOGIC
CONSULTANTS IN HYDROGEOLOGY

Investigation of Groundwater and Surface-Water Systems in the South Fork Lease Modification Area; Probable Hydrologic Consequences of Coal Mining

6 March 2019

Canyon Fuel Company, LLC
Sufco Mine
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Appendices

1.0 INTRODUCTION

The Canyon Fuel Company, LLC (CFC) Sufco Mine surface facilities are located approximately 25 miles east of Salina, Utah and about 9 miles west of Emery, Utah in the Wasatch Plateau coal mining district (Figure 1). The Sufco Mine produces bituminous coal using longwall mining techniques. The mine has been in operation since 1941.

CFC proposes to extend their existing mining operations westward into the South Fork Lease Modification Area (SFLMA), which is contiguous with the existing Sufco Mine permit area (Figures 1 and 2). Access to the SFLMA mining areas will be made using the existing mine portals and surface facilities in Convulsion Canyon. No new surface breakouts or surface facilities are proposed in association with mining at the SFLMA.

This report presents the groundwater and surface-water baseline data for the SFLMA and also a characterization of groundwater and surface-water systems. This document also includes a description of the probable hydrologic consequences (PHC) of the proposed coal mining and reclamation activities at the SFLMA. This document is written in support of the Hydrology section (Chapter 7) of the Mining and Reclamation Plan (MRP) for the Canyon Fuel Company, LLC, Sufco Mine (C0410002).

2.0 METHODS OF INVESTIGATION

The hydrology and hydrogeology of the SFLMA and adjacent areas has been evaluated based on an analysis of: 1) solute compositions of groundwaters and surface waters, 2) surface water and groundwater discharge data, and 3) geologic information. Specific methods of investigation are described below.

Maps and reports

Existing published and unpublished hydrologic, hydrogeologic, and geologic maps were obtained and reviewed. Several investigations of the hydrogeology and hydrology of the Sufco Mine permit and adjacent areas have been completed prior to this investigation. The USGS, in cooperation with the BLM (Thiros and Cordy, 1991), described the hydrology and potential effects of mining in the Quitchupah and Pines Tract. Mayo and Associates, LC (1997; 1999) described surface water and groundwater systems and mining-related hydrologic impacts at the SUFCO Mine permit and adjacent area. Petersen Hydrologic, LLC (2017) performed an investigation of groundwater and surface-water systems in the Greens Hollow Tract, which is contiguous with the SFLMA.

Collection of water quality and flow data

In anticipation of permitting at the SFLMA, Petersen Hydrologic, LLC performed baseline monitoring of springs and streams in and adjacent to the SFLMA beginning in 2013 and continuing through 2018. Petersen Hydrologic personnel have also monitored springs, streams, and wells in nearby areas at the Sufco Mine as part of operational and baseline

monitoring activities since 2000. Cirrus Ecological Solutions, LC of Logan, Utah performed baseline monitoring of springs and streams in areas that are adjacent to the SFLMA from 2001-2005 in conjunction with NEPA permitting for the Greens Hollow Tract. The Sufco Mine has also commissioned ongoing monitoring of streams, springs, and wells in nearby Sufco Mine areas since the early 1980s (38 years of continuous hydrologic monitoring).

As part of these activities, discharge rates and field water quality parameters were measured (including water temperature, pH, specific conductance, and dissolved oxygen). Spring and seep locations were determined in the field using hand-held GPS units.

The specific methods of study utilized by Petersen Hydrologic personnel to collect groundwater and surface-water quantity and quality data in the SFLMA (2013-2018) are described below.

Discharge Measurements

Discharge measurements for springs were typically performed using a calibrated container and a stopwatch. Generally, spring discharge measurements were performed by damming and diverting the spring discharge through a pipe. Using an appropriately sized container, time-to-fill measurements were typically performed at least 3 times at each location. An average time-to-fill value was used to calculate the reported discharge measurement. In instances where the discharge rates could not reasonably be measured because of very low flow rates or diffuse flow through areas of low relief, discharge rates were approximated (i.e. providing “less than” values).

Discharge measurements on streams were typically performed using a Marsh-McBirney brand electromagnetic current velocity meter and wading rod using methods described by the United States Geological Survey (1995). In some circumstances, discharge measurements in streams were performed using a pipe and a calibrated container.

Discharge Temperature Measurements

Temperature measurements were performed using a Taylor brand electronic digital thermometer. Temperature measurements on streams were performed in actively flowing, shaded areas where possible. Discharge temperature measurements at springs were performed as close to the spring discharge locations as possible.

Specific Conductance Measurements

Specific conductance measurements were performed using an Extech brand model EC400 conductivity meter or a Hanna brand conductivity meter, both with automatic temperature compensation. The instruments were regularly calibrated using traceable ASTM conductivity standard solutions.

pH Measurements

pH Measurements were performed using an Oakton brand Acorn 6 model electronic pH meter with automatic temperature compensation, an Oakton model pH Testr 30 with automatic temperature compensation, or a Hanna brand pHep 5 pH meter with automatic

temperature compensation. The instruments were regularly calibrated using traceable ASTM pH standard solutions.

Dissolved Oxygen

Dissolved oxygen measurements were performed using a YSI brand Model 55 dissolved oxygen meter. The meter utilizes a replaceable membrane and was regularly calibrated.

Water Quality Laboratory Measurements

Water quality laboratory analyses were performed by SGS Minerals Services of Huntington, Utah and Chemtech-Ford Analytical Laboratories of Sandy, Utah.

3.0 PHYSIOGRAPHIC SETTING

The Sufco Mine is situated in the Wasatch Plateau region of central Utah. The SFLMA is contiguous with the western borders of the existing Sufco Mine lease area (Figure 1). The SFLMA includes sloping mountainous terrain between Duncan Mountain and White Mountain uplands that are situated east of the adjacent Skutumpah Creek lowland areas. To the west of the SFLMA, White Mountain rises precipitously to elevations exceeding 10,800 feet. Topographic relief within the SFLMA is about 940 feet, ranging from about 8,400 feet along the Skutumpah Creek valley to about 9,340 feet along the White Mountain slopes in the northern portion of the SFLMA.

The upland plateau areas roll gently and are vegetated primarily with sagebrush, grasslands, and isolated stands of conifers. The mountainous regions are vegetated primarily with conifer and aspen forests on north-facing slopes and mountain bushes and grasslands on the adjacent mountainous areas.

4.0 CLIMATE

Precipitation in the vicinity of the Sufco Mine area is dependent on elevation. Annual precipitation in the vicinity ranges from 12 inches in the lower elevations to more than 20 inches in the higher elevations (Thiros and Cordy, 1991). Localized thunderstorms occur from July through November and contribute about half of the total annual precipitation (Thiros and Cordy, 1991). Mean monthly temperatures measured at the Emery 15 SW weather station, located about seven miles southeast of the study area are below freezing from November to March.

A National Weather Service weather station (Salina 24E) is operated at the Sufco Mine surface facilities. This weather station is operated year-round and records precipitation amounts as direct rainfall and as snow-water equivalent. A plot of yearly precipitation at the Salina 24E station for the period 1984 to 2018 as percentages of the station average is presented in Figure 3A. It is apparent from Figure 3A that during the period of baseline

monitoring at the SFLMA the annual precipitation at the Sufco Mine area has varied substantially. Notably, the 2010-2011 and 2016-2017 water years were unusually wet while the most recent 2017-2018 water year was unusually dry (receiving only 55% of the normal annual precipitation).

Climatic conditions in the region are also illustrated in a plot of the Palmer Hydrologic Drought Index (PHDI) for Utah Region 4 (Figure 3). The PHDI is a monthly value generated by the National Climatic Data Center using a variety of hydrologic parameters that indicates wet and dry spells. The PHDI is calculated from several hydrologic parameters including precipitation, temperature, evapotranspiration, soil water recharge, soil water loss, and runoff. Consequently, it is a useful tool for evaluating the relationship between climate and groundwater and surface water discharge data.

It is apparent in Figure 3 that from late-2000 through mid-2001 the region was experiencing a period of mild to moderate wetness. Beginning in mid-2001 the region began to transition to a notable period of drought that persisted until late-2004. The region then rapidly transitioned to a period of extreme wetness that peaked in mid-2005. The four-year period from 2006 through 2009 was characterized by generally dry conditions with mild to moderate drought prevailing. By mid-2010 the region was transitioning to a period of extreme wetness that peaked in mid-2011 and continued through the end of 2011. By early 2012, the region had returned to dry conditions with varying drought intensity. Drought conditions have prevailed in Region 4 from 2012 through 2018. Locally, as measured at the Salina 24E station at the Sufco Mine, although Region 4 experienced continuing drought

conditions during 2017, a wetter than normal period occurred locally at the Sufco Mine area during 2017 (Figure 3a). (It is notable in the discharge hydrographs presented in Appendix B that many spring discharge rates responded to this local wet condition during the 2016-2017 water year).

It is worthy of mentioning that, as reflected by both the precipitation data from the Salina 24E weather station (Figure 3A) and the regional PHDI data (Figure 3), a particularly severe period of extreme drought occurred in the region during 2018. The annual precipitation measured at the Salina 24E station during the 2017-2018 water-year was the lowest of any year on record since the station began operations in 1984. Further, the drought intensity during this period (as indicated by the PHDI index value for Utah Region 4 during September of 2018) was the second most intense drought period the region has experienced over the period of PHDI record (1895-2018). (The most intense drought condition ever reported for PHDI Region 4 during this 124-year period occurred during July and August of 2002).

5.0 GEOLOGY

Two Cretaceous- to Tertiary-age bedrock formations crop out in the SFLMA. These include, in descending order, the North Horn Formation and Price River Formation. Additionally, the Flagstaff Limestone is present near the top of White Mountain northeast of the SFLMA. These geologic formations are shown on a geologic map in Figure 4. The Castlegate

Sandstone and the Blackhawk Formation are present in the subsurface beneath the SFLMA. These geologic formations are described below.

Flagstaff Limestone

The Flagstaff Limestone is present east of the SFLMA where it forms the conspicuous white cap rock on White Mountain. The Flagstaff Limestone consists of freshwater limestone with some interbedded sandstone, shale, and volcanic ash. The formation is commonly light gray to white in color where it is exposed in the mountainous regions west of the SFLMA.

North Horn Formation

The North Horn Formation is exposed at the land surface over almost all of the SFLMA (Figure 4). It consists of variegated (mainly shades of red) shales with minor sandstone, conglomerate, and freshwater limestone (Doelling, 1972). It is estimated to be about 1,490 feet thick in the area, although no drilling in the area has penetrated both the upper and lower contacts of the formation. The lower contact of the formation is transitional with the underlying Price River Formation. The formation is vulnerable to mass movement, slope failures, and landslides (USFS, 2005).

Price River Formation

The Price River Formation is exposed at the land surface along the stream valleys of the South Fork of Quitchupah Creek and Skutumpah Creek to the east and west of the SFLMA, respectively (Figure 4). It consists of gray to white gritty sandstone, interbedded with shale and conglomerate deposited in a fluvial environment. The unit forms ledges and slopes

below the North Horn Formation due to interbedding of resistant sandstones with less resistant shales and claystones. The formation is reported to be approximately 550 feet thick in the Sufco Mine area.

While individual fluvial sandstones (paleochannels) in the Price River Formation are capable of transmitting water, groundwater is typically not transmitted over large vertical or horizontal distances in the formation. This is because of the lenticular geometry of the sandstone units and the interbedded low-permeability shales and claystone layers present in the formation that encase permeable units.

Castlegate Sandstone

The Castlegate Sandstone is present in the subsurface beneath the overlying Price River Formation. It does not crop out in the SFLMA or adjacent area. The Castlegate Sandstone is a cliff-forming unit that is about 200 feet thick in the Sufco Mine area. It is predominately massively bedded, coarse-grained sandstone with some interbeds of shale, siltstone, and conglomerate.

Blackhawk Formation

The Blackhawk Formation, which is present beneath the Castlegate Sandstone in the SFLMA, contains the mineable coal deposits within the Sufco Mine area. It consists of lenticular, discontinuous beds of sandstone, siltstone, mudstone, shale, and coal. The thickness of the Blackhawk Formation in the region is about 800 feet.

The Upper Hiawatha Coal seam of the Blackhawk Formation is underlain in the region by a sequence of shaley lagoonal deposits, ranging in thickness from 2 to 29 feet, which includes the Lower Hiawatha Coal Seam (Mayo and Associates, 1997).

While individual fluvial sandstones (paleochannels) in the Blackhawk Formation are capable of transmitting water, groundwater is typically not transmitted over large vertical or horizontal distances in the formation. This is because of the lenticular geometry of the sandstone units and the interbedded low-permeability shales and claystone layers present in the formation that encase permeable units. It is for this reason that persistent inflows of groundwater from saturated sandstone channels in the mine roof usually do not occur. Rather, because the sandstone channels are usually not in good hydraulic communication with overlying recharge areas, discharge from the sandstone channels in the mine roof typically wane gradually after first being intercepted as the volume of groundwater in storage in the sandstone unit diminishes over time and appreciable recharge to the sandstone unit does not occur.

Structure

In the Acord Lakes area an approximately north-south trending normal fault has been mapped along the eastern edge of the valley that has created a closed basin with at least 200 feet of vertical offset (Figure 4; Thiros and Cordy, 1991). Additional approximately north-south trending faults are believed to be present in areas to the west of the SFLMA.

Rock units in the area strike roughly 40°E and dip 1 to 2° (about 250 feet per mile) to the northwest. Local dips of the coal seam may range up to 10 degrees in areas where underlying paleochannels caused significant differential compaction.

6.0 PRESENTATION OF DATA

Baseline hydrologic monitoring location details are listed on Table 1. Information presented in Table 1 includes monitoring site geographic coordinates, elevations, associated geologic formations, spring development, and information on water usage. Baseline monitoring locations are plotted on Figure 2. A plot of the PHDI for Utah Region 4 is presented in Figure 3. A bar graph depicting the yearly precipitation averages measured at the Salina 24E weather station at the Sufco Mine is presented in Figure 3A. Discharge and water-quality data for springs and streams in the study area, including field and laboratory water quality measurements are presented in Table 2. Average discharge rate and water quality characteristics are summarized in Table 3. Supplemental chemical data for groundwaters and surface waters at the SFLMA are provided in Appendix A. A geologic map of the SFLMA and adjacent area is presented in Figure 4. Surface water drainages are shown on Figure 5. Stiff diagrams (1951) depicting the solute geochemical compositions of groundwaters and surface waters in the SFLMA are presented in Figure 6. Discharge hydrographs and graphs of important water quality parameters for springs and streams monitored for the SFLMA are presented in Appendix B.

7.0 GROUNDWATER AND SURFACE-WATER INFORMATION

Baseline hydrologic information for groundwaters and surface waters in the SFLMA is presented in Tables 1, 2, and 3. The information in Table 2 provides information on seasonal variation in water quality and water quality in the permit and adjacent area. Monitoring site locations are shown on Figure 2 and monitoring site details are listed on Table 1.

Groundwater discharge within the SFLMA and adjacent area occurs from the North Horn and Price River Formations. Of the 24 baseline monitoring springs listed in Table 1, 14 of these springs discharge from the North Horn Formation and 10 springs discharge from the Price River Formation.

The analysis of groundwater systems in the SFLMA is based largely on a regional model of active and inactive groundwater flow described below (Mayo et al., 2003). In 2003, Mayo et al. (2003) authored a peer-reviewed professional paper that presented the findings of a comprehensive, multi-year investigation of groundwater flow patterns in the mountainous terrain of Utah's Wasatch Plateau and Book Cliffs coal mining districts. This investigation describes a conceptual model of active and inactive groundwater flow regimes in the Utah coal mining districts that is directly applicable to groundwater flow regimes in the SFLMA and adjacent areas at the Sufco Mine. The Mayo investigation was based on analysis of a large volume of geologic, hydrogeologic, and hydrologic data from the study area. This

included analysis of discharge data from 123 springs for which long-term discharge data were available, 1,930 sets of major ion water sample analyses, Carbon-14 and tritium analyses from 132 sampling locations, and δ^2H and $\delta^{18}O$ analyses from 329 sampling locations. Much of the hydrologic data as well as information on historical mining practices discussed in the Mayo investigation was obtained specifically from the Sufco Mine area.

Groundwater systems in the SFLMA are associated with one of two fundamental types of groundwater flow regime. These two regimes are described by a fairly simple conceptual model that includes "active" and "inactive" groundwater flow regimes (Mayo et. al, 2003). The operation of these two regimes is fundamentally a consequence of the vertical and horizontal heterogeneity and discontinuity rock strata in the region. A discussion of the active- and inactive-zone groundwater regimes is presented below.

Active-Zone Groundwater Systems

Active zone groundwater systems are characterized as having good hydraulic communication with groundwater or surface-water recharge sources and having active groundwater flow from recharge to discharge areas. Thus, they are dependent on annual recharge events and are affected by short-term climatic variability.

Discharge hydrographs for springs in the study area are presented in Appendix B. It is apparent in the spring hydrographs of Appendix B and the discharge data presented in Table 2 that springs exhibit seasonal variations in discharge rates and also respond rapidly to short-term climatic variability. This supports the conclusion that these springs discharge from

active-zone groundwater systems, and are not related to the deep, inactive-zone groundwater systems that are encountered in the underground workings of the Sufco coal mine (discussed below).

Active-zone groundwater systems exist primarily where 1) there is adequate precipitation to facilitate groundwater recharge, 2) there is sufficient storage capacity in the near surface soils, porous rock units, and/or shallow, fractured bedrock horizons to sustain groundwater discharge for significant periods, and 3) there is a competent, impermeable perching layer present in the subsurface that prohibits the downward migration of groundwater. Downward migration of active-zone groundwaters into deeper horizons is prevented by the presence of low permeability bedrock horizons that are widely present in the North Horn, Price River, and Blackhawk formations in the study area, creating perched groundwater conditions. The perched groundwater systems, being constrained largely by surface topography, are usually of limited aerial extent. (i.e., groundwater discharge locations are commonly near recharge locations).

Inactive-Zone Groundwater Systems

Inactive-zone groundwater systems are characterized by old groundwater (commonly from about 2,000 to 19,000 years in the Wasatch Plateau coal mining district) and a general lack of hydraulic communication with the ground surface or active recharge sources (Mayo et. al, 2003). This condition is the result of the lack of recharge potential to deeper groundwater systems, either vertically or horizontally, because of 1) the abundance of low-permeability rocks in the rock sequence, and 2) the lenticular, discontinuous nature of the interbedded

more permeable horizons that limits the extent of potential groundwater movement. Inactive-zone groundwater systems are not influenced by either annual recharge events or by short-term climatic variability. This is evidenced by the lack of seasonal or climatic discharge responses of groundwater inflows into the Sufco Mine. Discussions of lower Blackhawk Formation groundwater systems and the lack of seasonal or climatic discharge responses (including graphs of roof drip and mine water discharge rates) are provided by Mayo and Associates (1997) and Mayo et al. (2003). All groundwater inflows into the Sufco Mine have been from inactive-zone systems, as evidenced by the radiocarbon ages of the waters and the lack of tritium in in-mine groundwaters (Petersen Hydrologic, 2017), and the lack of seasonal or climatic response in discharge rates.

Inactive-zone groundwaters in the Blackhawk Formation in the study area are not part of a regionally continuous aquifer. Groundwater in the inactive zone occurs primarily in isolated partitions created by the discontinuous nature of bedrock hydrostratigraphic horizons. Because these partitions are isolated both vertically and horizontally by low-permeable strata, lateral migration of groundwater in the deep Blackhawk Formation is limited. Historically, mining operations in the Sufco Mine have encountered groundwater in some portions of the mine, while other nearby locations have been dry. This condition demonstrates the limited groundwater recharge potential and the limited potential for lateral groundwater migration in the lenticular rock bodies of the Blackhawk Formation.

Stiff diagrams depicting the solute chemical composition of groundwaters and surface waters in the South Fork Lease Modification Area and surrounding region are shown on Figure 6.

Stiff diagrams are a useful analytical tool that allows the graphical representation of water solute compositions. The shape of the Stiff diagram is a reflection of the geochemical type, while the size of the diagram is related to the total dissolved solids concentration of the water.

Groundwaters discharging from springs and flowing in streams in the South Fork Lease Modification area commonly acquire their solute compositions through a series of well-documented chemical reactions. These are summarized below.

Carbon dioxide gas is produced naturally in the soil at concentrations greatly exceeding atmospheric concentrations by root-zone respiration and also by the decay of organic matter. Recharge water (rain and snow melt), upon entering the soil mantle, reacts with CO_2 to produce carbonic acid according to:

$$CO_2 + H_2O = H_2CO_{3\ \text{(carbonic acid)}} \qquad \text{(Equation 1)}$$

The produced carbonic acid subsequently dissociates into hydrogen ions (acid) and bicarbonate according to:

$$H_2CO_3 = H^+ + HCO_3^- \qquad \text{(Equation 2)}$$

The H^+ produced from Equation 2 reacts with carbonate minerals that are pervasive in the rocks of the Wasatch Plateau coal field, yielding calcium and magnesium ions and additional bicarbonate ions to the water according to:

$$CaCO_{3\ (calcite)} + H^+ = Ca^{2+} + HCO_3^- \quad \text{(Equation 3)}$$

and

$$CaMg(CO_3)_{2\ (dolomite)} + 2H^+ = Ca^{2+} + Mg^{2+} + 2\ HCO_3^- \quad \text{(Equation 4)}$$

Because of the limited solubility of calcite and dolomite in the absence of an additional source of CO_2, waters acquiring their solute compositions through the geochemical evolutionary pathway described in Equations 1 through 4 typically have relatively low TDS concentrations.

Groundwaters from formations containing soluble evaporite minerals often acquire a different solute geochemical type, and dissolved solids concentrations that are sometimes appreciably greater than that typically resulting from geochemical evolutionary pathway as described by equations 1-4 above. Surface waters flowing over sediments containing soluble evaporite minerals may also acquire elevated TDS concentrations and changed solute geochemical type. The geochemical reactions often responsible for these changes in chemical composition include:

$$CaSO_4 \cdot 2H_2O_{\ (gypsum)} = Ca^{2+} + SO_4^{2-} + 2H_2O \quad \text{(Equation 5)}$$

$$NaCl_{\ (halite)} = Na^+ + Cl^- \quad \text{(Equation 6)}$$

Waters rich in Ca^{2+} resulting from the dissolution of gypsum (Equation 5) may undergo ion exchange on clay minerals, resulting in an increase in Na^+ concentrations at the expense of exchanged Ca^{2+} ions according to:

$$Ca^{2+} + \text{Na-clay} = 2Na^{+} + \text{Ca-Clay} \qquad \text{(Equation 7)}$$

Ion exchange may also occur on zeolite minerals such as the sodium zeolite analcime according to:

$$2NaAlSi_2O_6 \cdot H_2O + Ca^{2+} = Ca(AlSi_2O6)_2 \cdot H_2O + 2Na^{+} \qquad \text{(Equation 8)}$$

Ratios of sodium to chloride in groundwaters and surface waters in the SFLMA exceed unity for all samples for which solute chemical data are available. The average sodium concentrations exceed the chloride concentrations by more than 10 times when expressed as milliequivalents per liter. This indicates that most of the sodium contained in groundwaters and surface waters is likely acquired through ion exchange reactions described in Equation 7 (and possibly Equation 8) above. If halite (NaCl) dissolution (Equation 6) was the primary source, it would be anticipated that the ratios of chloride to sodium would be near unity.

Groundwaters discharging at springs in the SFLMA are generally of low to moderate TDS concentration. TDS concentrations average 473 mg/L for the North Horn Formation springs and a somewhat greater 668 mg/L for the Price River Formation springs (Table 3). The solute chemical compositions of springs in both the North Horn and Price River formations include waters of the calcium-magnesium-bicarbonate type. It is evident in Figure 6 that sodium concentrations of groundwaters discharging from both of these geologic formations are sometimes elevated in varying degrees. This geochemical evolution likely begins according to equations 1,2,3 and 4 as groundwaters acquire a calcium-magnesium-

bicarbonate chemical composition as meteoric recharge waters recharge the through the ground surface and interact with CO_2 gas in the soil zone and subsequently with the pervasive carbonate minerals that are present in the region (with varying ratios of calcium to magnesium). Sodium concentrations may then become elevated as the waters interact to varying degrees with exchangeable clays along the groundwater flow path and ion exchange occurs (Equation 7). From this reaction, sodium concentrations are increased at the expense of corresponding decreases in calcium and/or magnesium concentrations. Where increased sulfate concentrations are apparent in groundwaters in the SFLMA, these sulfate concentrations are most likely derived from reactions with gypsum mineral along the groundwater flow path according to Equation 5. Oxidation of sulfide minerals along groundwater flow paths could also potentially contribute to sulfate concentrations in groundwaters in the SFLMA.

Stream flows in the SFLMA can increase precipitously during the springtime snowmelt event and during torrential thunderstorm events. During the high-flow snow-melt period, surface-water systems in the SFLMA commonly have relatively low TDS concentrations (Table 2). This results from a large influx of low-TDS snow melt waters to the water course. During the low-flow season, after the wintertime snowpack has waned, stream flows are typically much lower than during the spring time snowmelt event. At these times, the discharge in the stream is commonly dominated by discharge from the surrounding groundwater systems to the stream (i.e. baseflow conditions). Consequently, the TDS (and specific conductance) values for stream discharges occurring during baseflow conditions are commonly higher than those that occur during the high-flow snowmelt season (See TDS and specific conductance

values in Table 2). As an example of this occurrence, it is noted that specific conductance values for the South Fork of Quitchupah Creek as monitored at site Sufco 006A just east of the SFLMA have ranged from around 500 to more than 1100 uS/cm under seasonal flow conditions. This may reflect the variable component of snowmelt seasonally and also in response to drought conditions. This condition reflects a seasonal increase of more than 100% in the salinity of the water. The increased salinity of the water in this circumstance is reflective of the influence of groundwater contributions to the stream from the North Horn and/or Price River formations along the stream course. Similar conditions are observed under seasonal conditions throughout the Sufco Mine and adjacent areas.

It is important to note that, as reflected in the Stiff diagrams plotted in Figure 6 and from the solute chemical compositions listed in Table 2, the solute geochemical types of groundwaters vary appreciably over the SFLMA and adjacent area (See data in Table 2). Considerable chemical variability is present spatially between springs distributed over the study area (Figure 6). This observation suggests the likelihood that groundwaters discharging to springs in the tract area are sourced by local, active-zone groundwater systems that are appreciably influenced by variability in the local hydrogeochemical environment. In other words, if the springs in the SFLMA were discharging from a single, large-scale, regional type groundwater system (i.e. appreciable flow over long distances with groundwater flow potentially through multiple stratigraphic units), it would be anticipated that groundwater discharging from such a hypothetical system would have a more consistent and uniform chemical composition and distribution. That this is not the case strongly suggests that shallow groundwater flow within the region occurs as isolated, poorly interconnected groundwater systems (i.e. rather than a

large regional aquifer; i.e. active-zone groundwater systems). The notion of local groundwater flow conditions at the springs (i.e. shallow groundwater flow with groundwater recharge and groundwater discharge locations being near each other) is also supported by the active-zone characteristics of the spring discharges, including rapid response to seasonal and climatic recharge variability (see spring and stream hydrographs in Appendix B).

Surface-water drainages in the SFLMA and adjacent areas are shown on Figure 5. The land surface within the SFLMA includes portions of the North Fork of Quitchupah Creek drainage, the South Fork of Quitchupah Creek drainage, and the Skutumpah Creek drainage. Surface waters at the SFLMA have been monitored at stations "North Fork Upper", "SP60 Creek", and "North Fork Middle" in the North Fork of Quitchupah Creek drainage, stations "South Fork Upper" and "Sufco 006A" on the South Fork of Quitchupah Creek, and at stations "Skutumpah Creek Upper" and "Skutumpah Creek Middle" on the Skutumpah Creek drainage (Figure 5). Additionally, long-term discharge and water quality monitoring data has been collected at downstream locations on the South Fork and North Fork of Quitchupah Creek at stations Sufco 006 and Sufco 007, respectively. Information for these sites is available at the Utah Division of Oil, Gas and Mining on-line Coal Water Quality Database at https://linux1.ogm.utah.gov/cgi-bin/appx-ogm.cgi.

It should be noted that the surface-water stream that emanates from the upland areas along White Mountain supports stream flow to both the South Fork of Quitchupah Creek and Skutumpah Creek. There is a crude diversion in the stream channel just above the South Fork Upper and Skutumpah Creek Upper monitoring sites. An annotated photograph

showing this diversion is presented in Figure 7. The diversion is located in the south-central portion of Section 15, T. 21 S., R. 4 E. The diversion location is also shown on Figure 2. Surface water is diverted manually at the diversion into the South Fork or Skutumpah surface-water drainages by arranging loose rocks at the diversion to achieve the desired proportions of the flow to each drainage. Historical records detailing the timing and quantities of water diverted at this crude diversion have not been located (and may not exist).

Additionally, a United States Forest Service diversion for stock watering use is present higher in the drainage.

8.0 PROBABLE HYDROLOGIC CONSEQUENCES DETERMINATION

The following section describes the Determination of Probable Hydrologic Consequences of Coal Mining in the SFLMA.

728.100 Quality and quantity of surface water and groundwater under seasonal flow conditions

Information on quantity and quality of surface-water and groundwater under seasonal flow conditions for the SFLMA and adjacent area is presented in Tables 1 and 2. Additional information on groundwater and surface-water quality and quantity in adjacent areas at the Sufco Mine has been submitted electronically to the Utah Division of Oil, Gas and Mining through the on-line coal water quality database (UDOGM, 2019).

728.200 Baseline hydrologic information

Baseline monitoring of springs and streams, including laboratory water quality analyses, were performed in the SFLMA and surrounding areas during both high-flow and low-flow conditions from 2013 to 2018. The results of baseline monitoring at the SFLMA and adjacent areas are provided in Table 2.

728.310 Whether adverse impacts may occur to the hydrologic balance

The hydrologic balance is the sum of the flow interactions between surface waters and groundwaters and between various groundwater flow systems. This section describes the

potential for adverse impacts to the hydrologic balance as a result of coal mining activities in the SFLMA and adjacent area.

The potential for the establishment of hydrodynamic communication between the shallow groundwater systems that support spring and seep discharges in the SFLMA and the deep groundwater systems that are routinely intercepted within the mine workings at the Sufco Mine is considered remote. It is considered highly unlikely that surface waters or shallow groundwaters could migrate from the near surface into the underlying mine workings where the depth of cover exceeds 1,000 feet (which includes all proposed mining areas in the SFLMA). This is because The Price River and North Horn Formations are known to contain abundant, relatively thick shale and claystone layers (Mayo and Associates, 1997, 1999). These low-permeability layers inhibit the vertical migration of groundwater into deeper strata. Additionally, the Mesa Verde Group shales and claystones in the region are known to contain hydrophyllic clays which are of low permeability and swell when wetted to effectively seal subsidence cracking. Clays in the North Horn and Price River Formations have been determined to contain about 24 percent smectite clay which swells when wetted, effectively sealing fractures and stopping the downward flow of water (DOGM, 2005).

Because of the thickness of the overburden in proposed SFLMA mining areas, while surface cracking in these formations can occur as a result of subsidence, the presence of uncompromised shale or claystone layers beneath the subsidence cracked zone prevents further downward migration of groundwater into deeper formations. Near-surface tension cracks typically extend less than about 50 feet below the land surface (MSHA 2009).

Additionally, unconsolidated soils and weathered shales and clays are known to be present in North Horn- and Price River-derived sediments regionally. In areas where these formations are present near the surface and where tension cracking may occur, the tension cracks would likely remain open for only short periods of time. This is because the weathered or unconsolidated clayey or shaley sediments derived from these formations are typically plastic in nature and of low-permeability. These materials, through infilling or in-place swelling, tend to rapidly heal all but the largest tension cracks, minimizing impacts to local groundwater flow regimes.

It is noted here that while some impacts to shallow groundwater systems in the brittle Castlegate Sandstone have occurred in the region, no such shallow Castlegate Sandstone groundwater systems are present within the SFLMA (Figure 4). Consequently, no such impacts will occur within the SFLMA.

The Price River Formation and North Horn Formation are present at the surface in almost all of the proposed mining area at the SFLMA. Groundwater flow in these formations occurs primarily in sandstone units that are interbedded with thick sequences of low-permeability shale that generally deform plastically rather than in a brittle manner in response to subsidence mining. Additionally, swelling clays have been identified in the overburden that swell when wetted (USFS, 2014). Accordingly, significant impacts to groundwater systems in these formations are not anticipated. Rather, it is anticipated that groundwater flow conditions within the Price River Formation and North Horn Formation will generally be maintained during mining, as has been the previous experience elsewhere in mining

operations at the Sufco Mine and other mining operations in the Wasatch Plateau coal mining district. Swelling clays that can seal fractured zones in the Blackhawk Formation overburden above mining areas are also known to be present in the Sufco Mine area. Chempet Research Corporation (1989) found that Blackhawk Formation claystone layers contain up to 58% montmorillonite.

At any coal mine, subsidence-related interruption and deformation of strata above longwall-mined areas has the potential to alter the pre-mining groundwater flow conditions. The potential for this impact to affect groundwater and surface-water resources in the SFLMA is low. Subsidence of the land surface overlying coal mining areas is a commonly observed phenomenon in the Utah coal mining environment. Surface subsidence can occur where the rock strata overlying mined-out areas sags into the voids left by the extraction of the coal. The United States Mine Safety and Health Administration (MSHA 2009) describes zones of disturbance of geologic strata over mine workings. These zones include:

- Floor heave – Upward thrust of the floor in the mine working area.
- Caved zone – Caving of the overburden directly over a mine void and bulking of the caved material leading to support of overlying strata generally extending to a height of 3 to 10 times the extraction thickness. Assuming an extraction thickness of 10 feet, the caved zone would extend from 30 to 100 feet above the mining interval.
- Fractured zone – A zone of vertical fracturing and bed separations. Overburden in this zone moves vertically in large blocks along existing joints and new vertical

fractures. Typically this zone extends no more than 24 times the extraction thickness above the mine, but can reach 30 times the extraction thickness. Assuming an extraction thickness of 10 feet, the Fractured Zone would be anticipated to extend no more than 240 feet above the mine, possibly reaching 300 feet above the mine level.

- Main roof – This zone, which is sometimes subdivided into the Dilated Zone and the Constrained Zone, is an area of no significant increase in vertical hydraulic conductivity. This zone has been characterized as extending above the Fractured Zone up to 60 times the extraction thickness. Assuming a coal extraction thickness of 10 feet, the Main roof zone would extend for 600 feet above the mine level.

- Surface zone – Surface cracks are typically present in this zone and are generally limited to areas placed in tension by subsidence. Cracks can be created in dry clayey soil and joints can open in massive sandstones. Such cracks can extend downward to a depth of 50 feet.

Similarly, in order to estimate the height overlying mining areas to which subsidence-induced fracturing may extend, and to project minimum overburden thickness required to protect hydrologic resources, the Society for Mining, Metallurgy, and Exploration (SME, 2011) has developed empirical relationships between the thickness of the extracted coal seam and the upward fracture propagation distances (see SME Chapter 10.6, "Mine Subsidence"). Utilizing these relationships, the Mining Engineers Handbook recommends that a minimum vertical distance between the mine and an overlying water body with the potential for causing catastrophic damage should be a minimum of 60 times the coal mining height. The same

minimum vertical separation distance is recommended for protection of aquifers overlying total extraction mining areas. Based on these considerations, it is considered unlikely that impacts to groundwater aquifers, springs, seeps and streams will occur as a result of upwardly propagating fracturing in areas where the overburden exceeds 600 feet. Because mining in the SFLMA will occur in areas where the overburden exceeds 1,000 feet, subsidence-related impacts to shallow groundwater systems that support springs and provide baseflow to streams are not anticipated. The presence of a thick zone of unfractured, low-permeability bedrock prevents the downward migration of active-zone groundwaters into the deeper subsurface. Sealing of subsidence cracks by clays in the Blackhawk Formation is expected to minimize long-term effects of subsidence on the hydrologic systems (DOGM, 2013).

Previous experience at the Sufco Mine suggests that the surface tension fractures commonly extend to about 50 feet or less below the land surface. Thus, in the SFLMA, a sequence of several hundred feet of unfractured rocks will likely exist between the bottom of the shallow tension cracks near the surface and the top of the fractured zone above longwall mined regions. This sequence of low-permeability rock prevents the downward migration of active-zone groundwaters into the deeper subsurface. The presence of hydrophyllic clays in the fine-grained rocks of the Sufco Mine area effectively seal fractures that may form in the subsurface, preventing appreciable downward migration of groundwater.

Impacts to groundwater systems in the Star Point Sandstone, which underlie the coal seams to be mined in the Blackhawk Formation, are not anticipated. As discussed above, the Upper

Hiawatha Coal seam is underlain by shaley lagoonal sediments that include the Lower Hiawatha Coal seam, which would isolate the Upper Hiawatha coal seam from the underlying Star Point Sandstone. Mayo and Associates (1997) indicate that there is no known or suspected hydrologic connection between in-mine groundwaters and groundwaters discharging from the Star Point Sandstone at the Sufco Mine. We concur that this conclusion is likely correct.

728.320 Whether acid-forming or toxic-forming materials are present that could result in the contamination of surface water or groundwater supplies

Acid- and toxic-forming materials in soil and rock disturbed by mining have the potential to impact groundwater and surface water quality. Mine discharge water from the Sufco Mine is routinely monitored for indicators of increased acidity (iron, manganese, and pH) and toxic materials. Although the concentrations of iron in mine discharge water are occasionally elevated relative to springs in the region, mine discharge waters rarely exceed permitted discharge limits.

No new topsoil or waste rock piles are planned as a consequence of mining in the SFLMA and no impact from acid- or toxic-forming materials is anticipated.

With the exception of modest quantities of pyrite or similar sulfide minerals, no significant quantities of any acid- or toxic-forming materials are believed to be present in the SFLMA. Iron pyrite, marcasite, and other iron sulfide minerals are common in western coal mines. The oxidation of pyrite and marcasite, when exposed to water and oxygen, releases H^+ ions

(acid) into the mine water. The acid produced from pyrite and marcasite oxidation temporarily lowers the pH of the water. However, the acid produced from pyrite oxidation is rapidly consumed by reactions with the carbonate minerals which are pervasive in the rocks associated with the coal fields of the Wasatch Plateau. Thus, acid mine discharge generally does not occur. The iron released into the water from pyrite and marcasite oxidation is readily precipitated as iron-hydroxide when it contacts oxygenated water.

Thus, the potential for acid-forming or toxic-forming materials to result in contamination of surface-water or groundwater supplies is believed to be negligible.

728.331 What impact the proposed coal mining and reclamation operation will have on sediment yield from the disturbed areas

The sediment load of streams can be impacted by increased sediment yield from disturbed areas and from land that has undergone subsidence. Canyon Fuel Company has implemented a rigorous sediment control program that is designed to minimize the sediment yield from disturbed areas. This includes the use of sediment control fences, re-vegetation of previously disturbed areas, and the diversion of surface waters around disturbed areas. Runoff from disturbed areas is collected near its source and diverted into sediment control ponds for retention and settlement of suspended solids before it is discharged to natural drainages. Because mining areas at the SFLMA will be accessed through the existing Sufco Mine, the potential for additional impacts at the disturbed surface facilities resulting from coal mining in the SFLMA is minimal.

Where differential subsidence of the land surface occurs in stream drainages, there is the potential for the temporary increase of sediment yield in these drainages. This potential impact is primarily the result of subsidence-induced gradient changes along areas of differential subsidence. However, this effect is generally expected to be short lived. This is because the channel substrate in areas of increased stream gradients is down-cut while sediment is being deposited in areas of decreased stream gradients and the stream gradually returns to equilibrium with its channel substrate.

728.332 What impact the proposed coal mining and reclamation operation will have on acidity, total suspended and dissolved solids and other important water quality parameters of local impact

As discussed previously, impacts to groundwater systems that support springs and seeps and provide baseflow to streams in the SFLMA are not anticipated. Thus, detrimental impacts to important water quality parameters such as acidity, total suspended solids, and total dissolved solids in creeks and springs in the SFLMA are generally considered unlikely.

Fuels, greases, and oils are stored and used in the Sufco Mine permit area. There is the potential for spillage of these substances during equipment maintenance and operations, during filling of storage tanks and vehicle tanks, and from leakage from potentially leaking storage tanks. However, because the SFLMA will be accessed through the existing Sufco

Mine, the potential for increased releases of these materials as a result of mining activities in the SFLMA is considered minimal.

The Sufco Mine has previously implemented a rigorous spill prevention plan that is designed to minimize the potential for spillage of these substances and to ensure that any potential spills that may occur are promptly cleaned up. This plan will continue to be followed during mining in the SFLMA. Because the SFLMA will be accessed from the permitted existing surface facilities area (including equipment maintenance and fueling areas and chemical storage areas), there should be no additional potential for spillage as a result of mining in the SFLMA.

The discharge of Sufco Mine water to surface water drainages will have an impact on the water quality of receiving waters. The nature and magnitude of this impact is related to the relative quality of the receiving water and the mine discharge water. If the mine discharge water is of poorer quality than the receiving water, then the quality of the receiving water will be degraded proportionally. If the mine discharge water is of better quality than the receiving water, the quality of the receiving water will be improved. Historically, the discharge water from the Sufco Mine has generally been of relatively good quality and has usually met the beneficial use standards of the receiving water (DOGM, 2018).

Based on the fact that the geologic conditions at the SFLMA are generally similar to those in the adjacent existing Sufco Mine permit area, it is anticipated that the character of groundwater inflows in terms of both quality and quantity will likely be similar to those that

currently occur in the existing Sufco Mine. Consequently, no impacts to important water quality parameters above those that may occur under current conditions at the existing Sufco Mine area are anticipated as a result of mining in the SFLMA. The discharge of Sufco Mine water is regulated under a UPDES permit issued from the Utah Division of Water Quality.

728.333 What impact the proposed coal mining and reclamation operation will have on flooding or streamflow alteration

Other than the presence of the Acord Lakes area normal fault (which is situated outside of proposed mining areas (west of the SFLMA), there are no known geologic features in the SFLMA that are substantively different than those that have been encountered in nearby mining areas at the Sufco Mine. Mining practices to be utilized in mining the SFLMA will also be similar to those currently implemented at the Sufco Mine. Accordingly, there is no reason to anticipate that discharge rates from the Sufco Mine during mining at the SFLMA will be of a significantly different magnitude than what is occurring during Sufco Mine operations. Thus, no significant increase to the flooding or streamflow alteration potential of Sufco Mine discharge water to Quitchupah Creek is anticipated above that currently occurring as a result of mining in the SFLMA.

728.334 What impact the proposed coal mining and reclamation operation will have on groundwater and surface-water availability

As discussed previously, impacts to the shallow North Horn Formation and Price River Formation groundwater systems that support springs and seeps in the area and provide

baseflow discharge to streams are not anticipated. Impacts to stream discharge rates are also not anticipated. Therefore, the availability of these groundwaters and surface water resources will likely not be impacted.

728.350

728.351 Whether the underground coal mining and reclamation activities may result in contamination, diminution or interruption of State-appropriated water

As discussed above, the shallow, perched Price River and North Horn Formation groundwaters that support springs and seeps and provide baseflow discharge to perennial streams in the SFLMA are believed to be isolated from the deep groundwater systems that are routinely encountered during underground mining activities at the Sufco Mine. Accordingly, the potential for contamination, diminution, or interruption of groundwater systems resulting from the draining of overlying shallow groundwaters into deep horizons (or the mine workings) is considered remote. The deep groundwater systems that will likely be encountered during mining in the SFLMA include primarily perched systems associated with sandstone channels in the Blackhawk Formation beneath the SFLMA (Mayo and Associates, 1997;1999). While deep Blackhawk Formation groundwater systems will be intercepted and dewatered during mining activities, there are no known uses or State appropriations of these waters.

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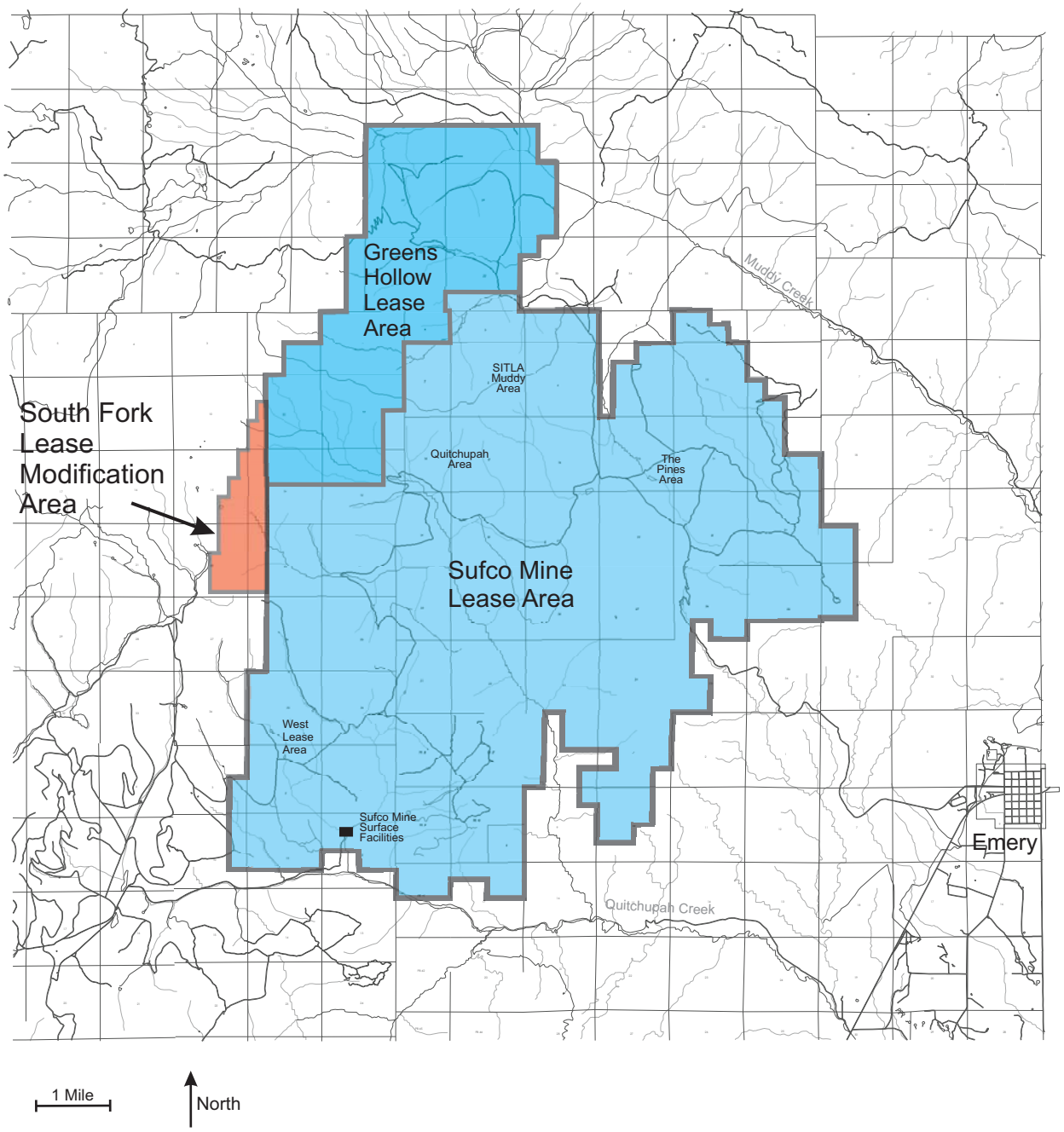
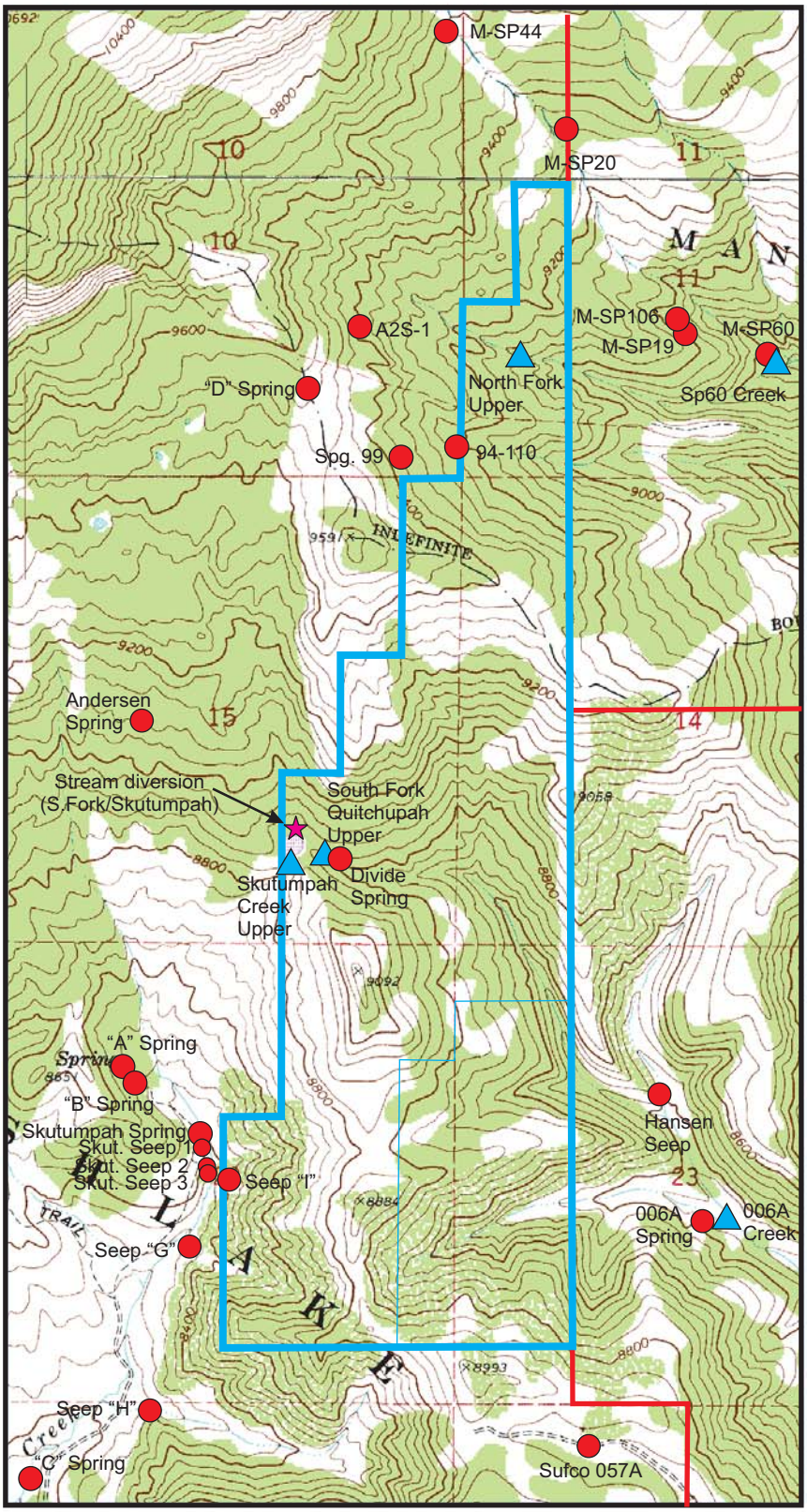
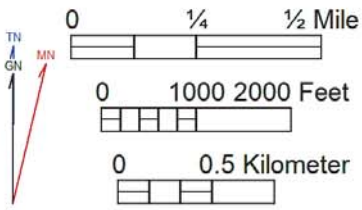


Figure 1 Location of the South Fork Lease Modification Area at the Sufco Mine.



Skutumpah Creek Middle
located on Skutumpah Creek
approximately 0.33 miles downstream
of C Spring at Horse Hollow confluence



Legend

- Spring baseline monitoring location
- Stream baseline monitoring location

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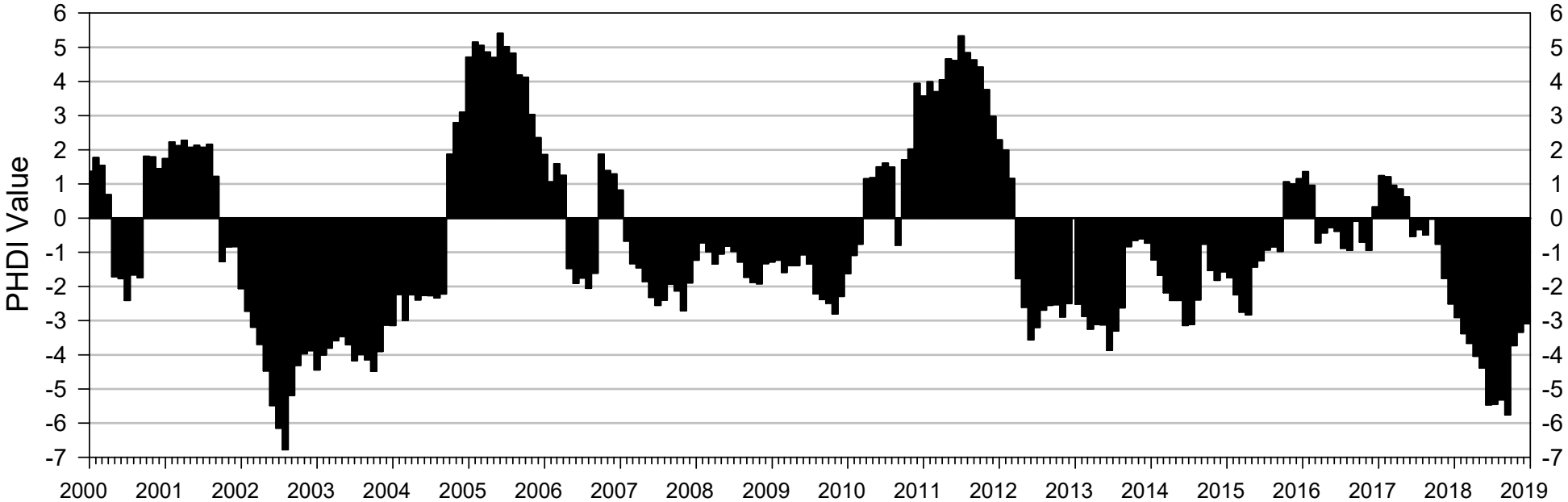
Drawing date: 21 Nov 2018
Revision:
Scale: Reference bar File: Fig2.cdr

Figure 2
Baseline monitoring locations for the South Fork Lease Modification area.



-1 to -2 Mild Drought
-2 to -3 Moderate Drought
-3 to -4 Severe Drought
-4 to -5 Extreme Drought

1 to 2 Mild Wet Spell
2 to 3 Moderate Wet Spell
3 to 4 Severe Wet Spell
4 to 5 Extreme Wet Spell

Figure 3 Plot of Palmer Hydrologic Drought Index for Utah Region 4.

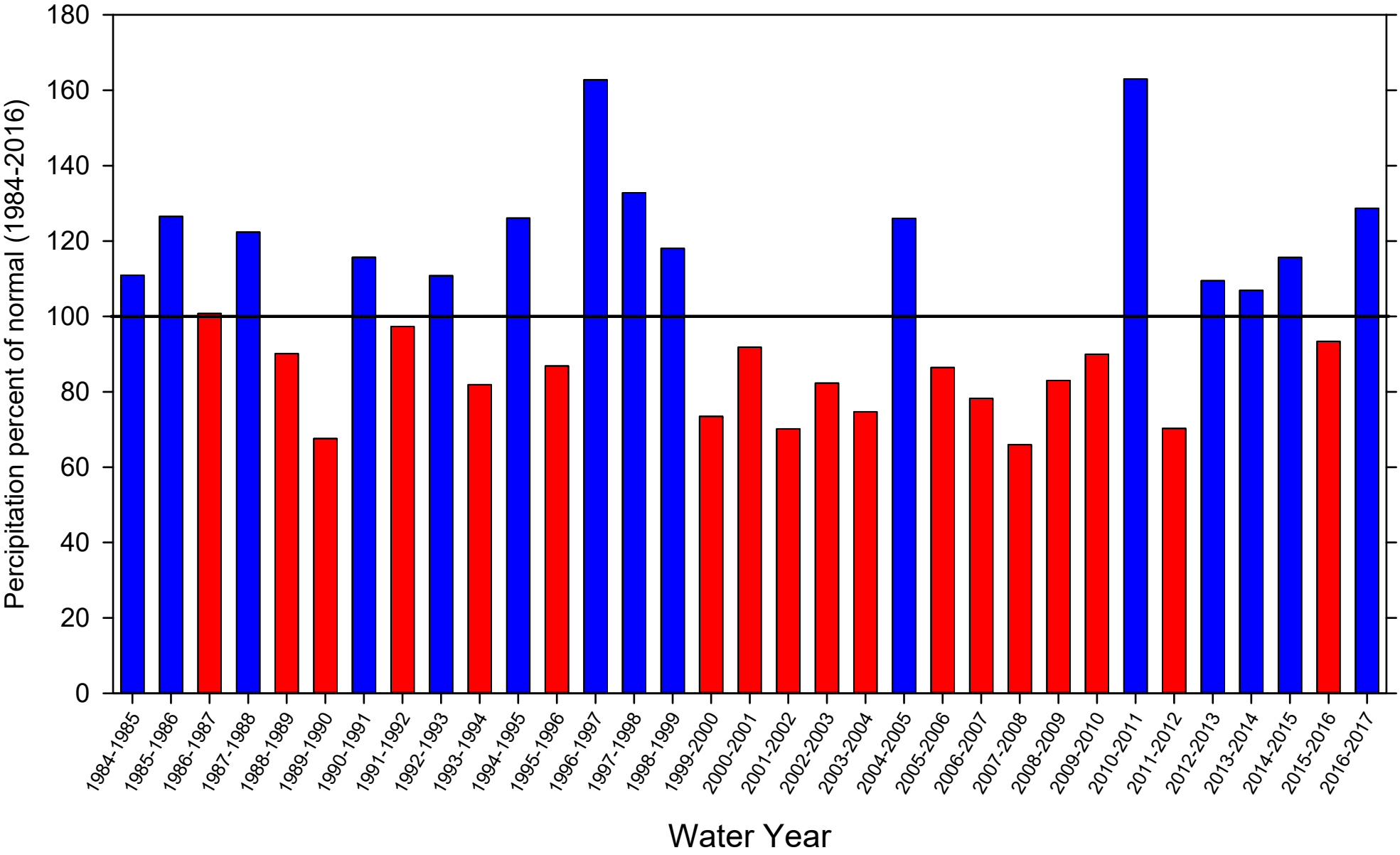
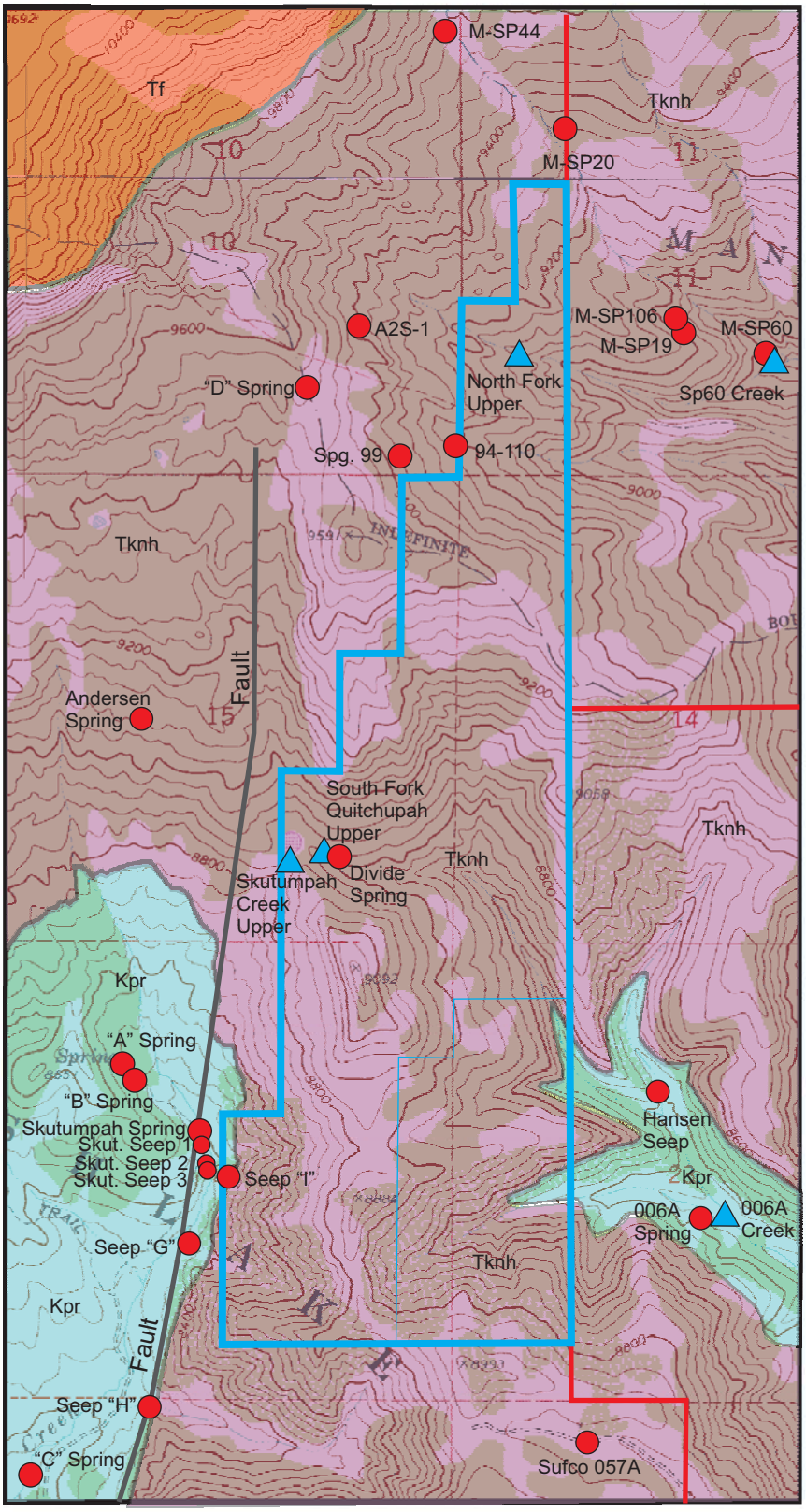
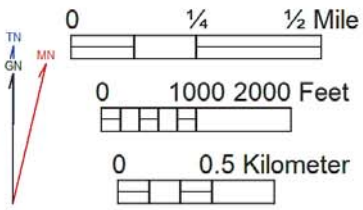


Figure 3A Salina 24E Sufco Mine Weather Station Precipitation.



Legend

Tf	Flagstaff Limestone
Tknh	North Horn Formation
Kpr	Price River Formation



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Drawing date: 6 Mar 2019
Revision:
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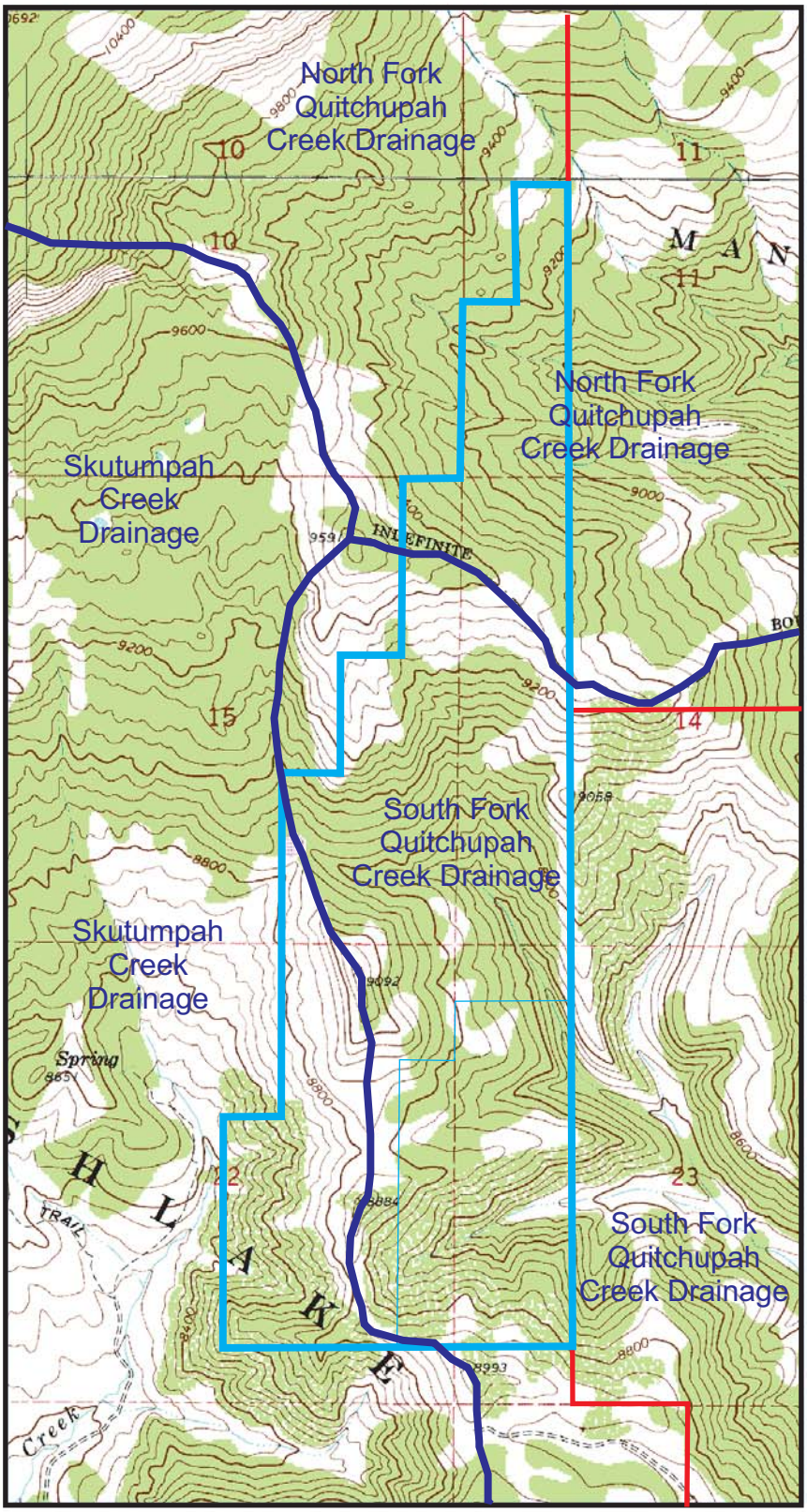
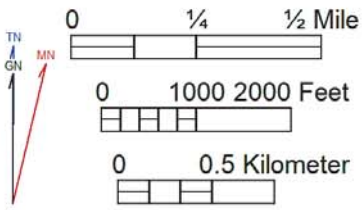
Figure 4
Geologic map of the South Fork Lease Modification Area.





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Drawing date: 21 Nov 2018
Revision:
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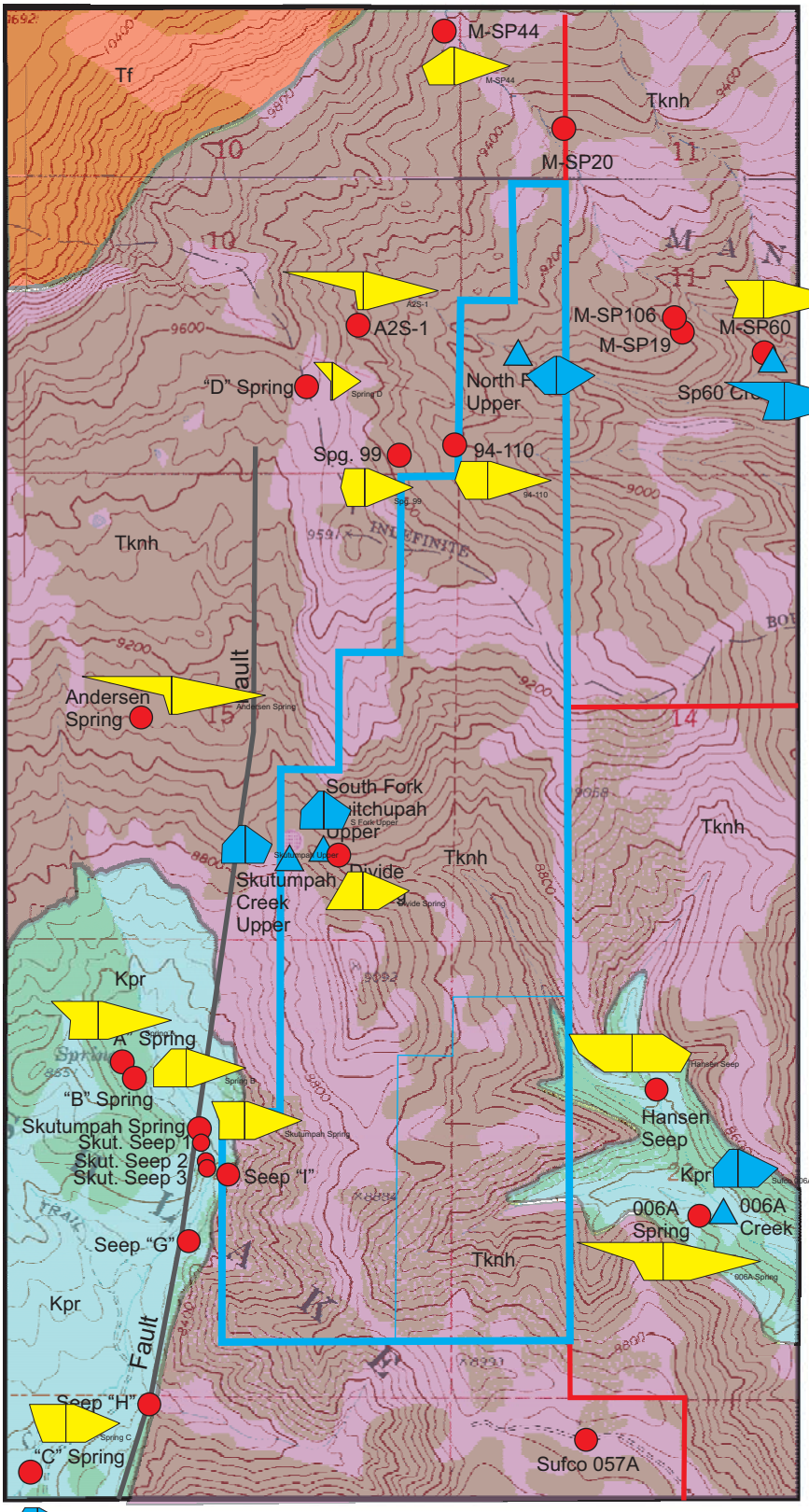
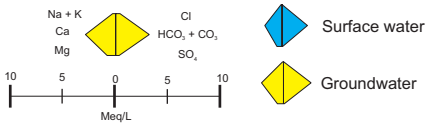
Figure 5
Surface-water drainages in the South Fork Lease Modification area.

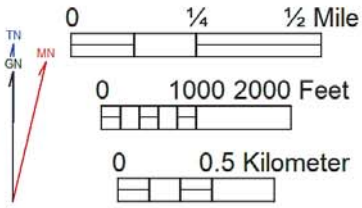




Legend

- Spring baseline monitoring location
- Stream baseline monitoring location

Skutumpah Creek Middle located on Skutumpah Creek approximately 0.33 miles downstream of C Spring at Horse Hollow confluence



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Drawn by: E. Petersen
Drawing date: 6 Mar 2019
Revision:
Scale: Reference bar File: Fig6.cdr

Figure 6
Stiff diagrams depicting solute chemical compositions of groundwaters and surface waters in the South Fork Lease Modification area.

Image taken on 21 July 2018

Figure 7 Crude surface-water diversion in the south-central portion of Section 15, T.21S., R.4E. See Figure 2 for diversion location. Surface water on the left is routed to Skutumpah Creek. Surface water on the right is routed to the South Fork of Quitchupah Creek.

Table 1 Monitoring site details.

Site ID	Location - UTM, NAD27		Elevation (ft.)	Water use	Development
Groundwater					
North Horn Formation Springs					
94-110 Spring	461800	4315754	9,224	Wildlife/Stockwatering use	Steel trough (not functioning)
A2S-1	461387	4316234	9,460	Wildlife/Stockwatering use	None
Andersen Spring	460701	4314798	9,090	Wildlife/Stockwatering use	Steel/aluminum troughs
Divide Spring	461297	4314348	8,840	Wildlife/Stockwatering use	None
M-SP19	462644	4316124	8,968	Wildlife/Stockwatering use	None
M-SP20	462191	4316826	9,395	Wildlife/Stockwatering use	None
M-SP44	461759	4317150	9,599	Wildlife/Stockwatering use	None
M-SP60	462887	4316092	8,801	Wildlife/Stockwatering use	None
M-SP106	462626	4316155	8,997	Wildlife/Stockwatering use	None
Seep D	461296	4315975	9,541	Wildlife/Stockwatering use	None
Seep H	460741	4312420	8,254	Wildlife/Stockwatering use	None
Seep I	460956	4313213	8,373	Wildlife/Stockwatering use	None
Spg. 99	461609	4315684	9,352	Wildlife/Stockwatering use	None
Sufco 057A	461907	4312329	8,900	Wildlife/Stockwatering use	Steel trough
Price River Formation Springs					
006A Spring	462827	4312962	8,330	Wildlife/Stockwatering use	None
Hansen Seep	462514	4313461	8,399	Wildlife/Stockwatering use	None
Spring A	460639	4313578	8,520	Wildlife/Stockwatering use	None
Spring B	460661	4313547	8,520	Wildlife/Stockwatering use	None
Spring C	460327	4312155	8,156	Wildlife/Stockwatering use	None
Seep G	460896	4312983	8,358	Wildlife/Stockwatering use	None
Skutumpah Spring	460903	4313360	8,400	Wildlife/Stockwatering use	None
Skutumpah Seep 1	460921	4313322	8,398	Wildlife/Stockwatering use	None
Skutumpah Seep 2	460931	4313241	8,379	Wildlife/Stockwatering use	None
Skutumpah Seep 3	460936	4313202	8,362	Wildlife/Stockwatering use	None

Site ID	Location - UTM, NAD27		Elevation (ft.)	Water use	Development
Surface Water					
South Fork Quitchupah Creek					
South Fork Quitchupah Upper	461329	4314316	8,840	---	None
006A Creek	462900	4312941	8,320	---	None
North Fork Quitchupah Creek					
North Fork Upper	462185	4316005	8,990	---	None
SP60 Creek	462887	4316092	8,801	---	None
Skutumpah Creek					
Skutumpah Creek Upper	461235	4314290	8,840	---	None
Skutumpah Creek Middle	459870	4311909	8,120	---	None

Table 2 Discharge and water quality data for groundwaters and surface waters in the South Fork Lease Modification area.

Note: Additional water quality parameters for groundwaters and surface waters is presented in Appendix A.

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
Groundwater																								
006A Spring	28-Jun-2010	0.28	5.3	7.39	1302	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	15-Sep-2010	0.19	6.5	7.29	1255	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	1-Nov-2010	0.27	5.6	7.17	1227	---	832	---	0.59	0.012	63.2	24.8	205	3.4	605	<1	151	37	---	---	---	---	---	---
006A Spring	17-Jun-2011	0.44	4.5	7.66	1261	---	796	---	0.14	<0.005	59.3	23.4	206	3.3	644	<1	150	38	---	---	---	---	---	---
006A Spring	21-Sep-2011	0.302	6.5	7.47	1277	---	816	---	0.09	<0.005	59.6	23.3	190	3.4	713	<1	135	36	---	---	---	---	---	---
006A Spring	12-Oct-2011	0.366	6.1	7.68	1298	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	1-Jun-2012	0.39	4.4	7.36	1263	---	800	---	0.29	<0.005	62.1	24.8	207	3.4	629	<1	137	37	---	---	---	---	---	---
006A Spring	12-Sep-2012	0.18	7.1	7.56	1216	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	1-Nov-2012	0.29	6.1	7.5	1247	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	27-Jun-2013	0.19	6.5	7.61	1271	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	26-Sep-2013	0.203	7.1	7.65	1246	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	23-Oct-2013	0.303	4.7	7.6	1210	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	28-May-2014	0.495	4	7.57	1267	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	23-Sep-2014	0.373	6.6	7.44	1254	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	28-Oct-2014	0.439	5.6	7.53	1273	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	23-Jun-2015	0.493	8.5	7.48	1293	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	21-Sep-2015	0.36	6.7	7.49	1174	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	8-Nov-2015	0.4	5.1	7.53	1221	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	28-Jun-2016	0.376	6	7.37	1247	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	25-Sep-2016	0.292	6.8	7.48	1250	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	11-Nov-2016	0.379	5.8	7.47	1237	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	28-Jun-2017	0.512	5.7	7.60	1221	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	28-Aug-2017	0.403	7.5	7.49	1215	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	10-Nov-2017	0.355	5.7	7.58	1161	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	9-Jun-2018	0.24	5.0	7.44	1247	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	8-Aug-2018	0.304	7.4	7.46	1192	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	26-Oct-2018	0.213	6.0	7.49	1254	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	11-Nov-2013	0.115	5.2	7.59	724	---	428	94	0.99	0.006	64.2	26.1	58.7	1.3	404	6	9	10	0.2	0.2	---	<0.2	<0.1	0.32
94-110	30-Jun-2014	0.299	6.1	7.52	744	---	445	---	0.22	0.008	67	28	56	1.48	398	<5	8	10	0.32	<0.05	---	<0.1	<0.05	<0.05
94-110	25-Sep-2014	0.205	9.2	7.6	775	---	468	15	<0.05	<0.002	70.64	27.85	59.09	1.22	395	<5	8	11	0.24	<0.05	1.47	<0.1	<0.05	<0.05
94-110	12-Nov-2014	0.181	4.4	7.54	777	---	427	91	0.31	0.019	67.26	27.66	60.22	1.28	408	<5	8	11	0.27	<0.05	0.27	<0.1	<0.05	<0.05
94-110	29-Jul-2015	0.253	7.1	7.47	756	---	411	10	0.13	0.005	70.31	30.18	59.92	1.2	390	<5	9	11	0.29	<0.05	0.37	<0.1	<0.05	<0.05
94-110	9-Nov-2015	0.179	5.9	7.50	758	---	444	17	0.19	0.007	69.2	28.33	63.93	1.47	412	<5	8	11	0.31	<0.05	3.08	0.2	<0.05	<0.05
94-110	9-Jul-2016	0.192	7.3	7.48	748	---	439	18	0.13	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	14-Nov-2016	0.126	5.9	7.62	771	---	482	14	<0.05	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	29-Jul-2017	0.335	7.1	7.46	726	---	466	6	0.13	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	18-Oct-2017	0.229	6.2	7.54	745	---	Lab Issue	Lab Issue	0.08	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	21-Jul-2018	0.077	8.6	7.66	763	---	451	24	0.13	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	27-Oct-2018	0.105	5.9	7.58	793	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
A2S-1	11-Nov-2013	Seep	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	30-Jun-2014	0.106	9.5	7.98	832	---	511	NM	0.86	0.031	18	8	174	1.78	499.878	<5	16	14	0.18	<0.05	NM	<0.1	<0.05	0.08
A2S-1	25-Sep-2014	0.029	12.9	7.97	882	---	584	137	0.66	0.156	17.85	7.44	181	1.24	534.016	<5	19	14	0.24	<0.05	1.02	<0.1	<0.05	0.17
A2S-1	11-Nov-2014	0.063	5.9	7.97	909	---	480	357	2.03	0.074	17.92	6.96	205.8	1.34	535.235	20	19	14	0.31	<0.05	0.31	<0.1	<0.05	<0.05
A2S-1	29-Jul-2015	0.062	12.1	7.37	832	---	540	158	2.03	0.094	18.83	8.22	185.1	1.43	513.289	<5	46	3	<0.05	<0.05	3.37	0.2	<0.05	0.13
A2S-1	9-Nov-2015	0.045	7.2	8.03	902	---	660	372	2.54	0.246	18.02	7.3	193.8	2.16	484	<5	19	15	0.35	0.13	3.37	0.6	<0.05	5.69
A2S-1	9-Jul-2016	0.100	11.9	7.99	819	---	518	59	0.63	0.019	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	14-Nov-2016	0.054	8.3	8.24	878	---	558	78	3.07	0.082	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	29-Jul-2017	0.097	12.7	8.01	782	---	544	142	0.8	0.04	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	18-Oct-2017	0.076	9.2	8.07	829	---	221	294	9.61	0.519	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	21-Jul-2018	<0.05	14.5	8.06	893	---	576	31	1.36	0.039	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Andersen Spring	19-Jul-2017	<0.1	13.4	9.51	953	---	530	330	3.20	0.653	5.01	21.27	242.5	2.78	435	48	35	4	<0.05	<0.05	---	---	0.06	---
Andersen Spring	18-Oct-2017	<0.01	7.4	9.56	935	---	412	---	39.6	3.702	17.13	3.08	214.2	5.88	606	<5	30	6	0.1	<0.05	---	---	---	0.79
Andersen Spring	21-Jul-2018	Seep	13.9	9.45	915	---	640	204	2.75	0.175	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	1-Jul-2014	1.63	7.4	7.59	743	---	429	---	<0.05	<0.002	55	43	43	1.33	330	<5	81	8	0.05	<0.05	---	<0.1	<0.05	<0.05
Divide Spring	25-Sep-2014	Damp	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	11-Nov-2014	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	29-Jul-2015	0.268	7.9	7.78	703	---	419	<5	<0.05	0.002	54.48	47.41	35.97	1.23	300	<5	79	7	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Divide Spring	9-Nov-2015	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	9-Jul-2016	2.36	10.7	7.52	720	---	460	300	0.07	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	14-Nov-2016	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	29-Jul-2017	0.56	8.4	7.51	679	---	374	12	0.31	0.017	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	18-Oct-2017	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	21-Jul-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	27-Oct-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hansen Seep	23-Apr-2012	0.356	11.3	7.63	1489	---	974	82	1.06	0.279	127	38.4	158	2.9	501	<1	228	118	<0.1	<0.1	---	0.2	0.02	0.05
Hansen Seep	12-Sep-2012	0.108	13.7	7.79	1370	---	948	---	0.27	0.19	117	38.2	163	2.9	505	<1	225	116	---	---	---	---	---	---
Hansen Seep	1-Nov-2012	0.03	7.5	7.39	1484	---	896	44	0.64	0.479	97.7	36.3	156	3.2	509	<1	220	121	<0.5	<0.5	---	<0.2	0.02	0.08
Hansen Seep	27-Jun-2013	<0.1	14.9	7.41	1461	---	960	672	---	1.32	186	37.7	155	3.3	504	<1	269	142	<0.1	<0.1	---	<0.2	0.08	0.41
Hansen Seep	26-Sep-2013	0.284	8.4	7.85	1452	---	904	6	0.14	0.06	114	36.5	150	2.8	467	<1	254	127	<0.1	<0.1	---	0.2	---	0.05
Hansen Seep	23-Oct-2013	0.242	5.0	7.57	1418	---	924	13	0.13	0.065	86.7	36.7	152	2.3	478	<1	250	120	<0.1	<0.1	---	<0.2	0.05	0.05
Hansen Seep	28-May-2014	0.266	8.8	7.68	1431	---	908	---	<0.05	0.216	110.7	36.44	145.7	2.94	379	<5	214	102	0.05	<0.05	---	<0.1	<0.05	<0.05
Hansen Seep	17-Sep-2014	0.196	10.9	7.64	4590		915	49	0.92	0.389	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hansen Seep	28-Oct-2014	0.226	6.1	7.44	1473	---	928	50	0.37	0.228	113	35.82	151.4	2.66	383	<5	247	114	<0.05	<0.05	---	<0.1	<0.05	0.08
Hansen Seep	8-Aug-2018	<0.05	13.8	7.49	1408	---	928	202	1.23	0.539	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hansen Seep	26-Oct-2018	0.152	6.7	7.31	1450	---	966	26	1.36	0.561	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	11-Jul-2001	2.26	10.4	8.24	508	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	3-Oct-2001	1.976	6.1	7.83	443	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	2-May-2002	3.031	5.1	8.28	456	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	27-Sep-2002	2.114	5.8	7.94	457	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	21-May-2003	2.866	5.2	7.86	449	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
M-SP19	8-Oct-2003	2.555	6.1	8.21	480	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	5-Jun-2004	3.128	6.5	8.23	851	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	27-Jun-2015	2.56	5.7	7.97	873	---	522	40	0.36	0.044	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	29-Sep-2015	1.73	6.3	8.04	824	---	523	12	0.27	0.004	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	7-Nov-2015	1.95	6	7.98	829	---	519	16	0.11	0.004	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	23-Jun-2016	2.53	6	8.00	835	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	26-Sep-2016	1.738	6.4	8.00	845	---	533	25	0.49	0.009	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	6-Nov-2016	2.05	6.3	8.07	840	---	509	<5	<.05	<.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	30-Jun-2017	4.49	6.1	8.05	818	---	514	12	0.06	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	28-Sep-2017	3.28	6.3	8.01	822	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	10-Nov-2017	3.11	6.2	8.01	813	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	19-Jun-2018	2.98	5.9	8.00	847	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	25-Sep-2018	1.43	6.2	7.96	843	---	481	<5	<0.05	0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	14-Nov-2018	2.21	6.4	8.02	868	---	536	124	0.81	0.042	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	11-Jul-2001	3.507	14.2	7.84	486	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	3-Oct-2001	0.909	12.1	7.85	435	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	2-May-2002	0.814	10.5	7.97	432	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	28-Sep-2002	0.706	7.4	7.79	435	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	22-May-2003	1.041	7.6	7.59	420	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	8-Oct-2003	0.781	11	8.31	494	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	5-Jun-2004	8.621	10.8	7.92	814	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	25-Jun-2015	5.24	8.3	7.78	824	---	468	13	0.15	0.016	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	26-Sep-2015	1.04	7.5	7.38	769	---	505	87	0.37	0.049	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	1-Nov-2015	1.21	6.8	7.69	763	---	453	23	0.85	0.042	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	26-Jun-2016	1.9	6.6	7.41	775	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	27-Sep-2016	0.98	7	7.56	781	---	484	13	0.11	0.004	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	26-Oct-2016	0.98	7.8	7.79	770	---	440	7	0.13	0.013	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	29-Jun-2017	8.06	7.4	7.61	736	---	432	7	0.23	0.032	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	28-Sep-2017	0.523	8.0	7.63	870	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	9-Nov-2017	1.44	7.1	7.57	745	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	27-Jun-2018	0.784	6.4	7.37	752	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	14-Sep-2018	0.647	6.4	7.51	658	---	441	103	1.29	0.067	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	6-Nov-2018	0.949	7.4	7.65	752	---	452	85	1.14	0.057	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	3-Oct-2001	0.561	9.2	7.52	314	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	2-May-2002	2.018	4.8	7.66	269	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	28-Sep-2002	0.196	10.3	7.66	376	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	22-May-2003	13.03	6.1	7.65	276	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	24-Sep-2003	0.197	12.1	7.93	721	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	5-Jun-2004	4.9	5.4	7.65	542	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	29-Jun-2014	3.18	5.9	7.64	554	---	313	---	<0.05	<0.002	66.00	33.00	15.00	0.48	345.038	<5	19	1			0.34	<0.1	<0.05	<0.05
M-SP44	18-Sep-2014	0.588	8.7	7.78	610	---	340	26	0.22	0.010	64.82	23.48	27.48	0.58	360.888	<5	25	2	0.24	<0.05		<0.1	<0.05	<0.05
M-SP44	31-Oct-2014	0.595	8.2	7.58	611	---	358	27	0.12	0.010	63.52	24.9	26.29	0.69	370.641	<5	26	2	0.06	<0.05	<0.05	0.1	<0.05	<0.05
M-SP44	25-Jun-2015	4.21	6	7.67	570	---	348	37	0.34	0.046	68.47	32.10	9.94	0.57	362.107	<5	14	1	0.16	<0.05	0.14	<0.1	<0.05	<0.05

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
M-SP44	26-Sep-2015	0.493	9.2	7.54	581	---	367	---	0.12	0.006	63.37	26.32	30.97	<0.14	362.107	<5	18	1	0.06	<0.05	0.29	0.3	<0.05	<0.05
M-SP44	1-Nov-2015	0.45	8.3	7.59	594	---	365	14	0.13	0.005	65.95	25.55	35.83	0.64	375.518	<5	26	2	0.12	<0.05	0.86	0.9	0.06	<0.05
M-SP44	26-Jun-2016	3.74	6.3	7.52	547	---	348	37	0.34	0.046	68.47	32.1	9.94	0.57	362	<5	14	1	0.16	<0.05	0.14	<0.1	<0.05	
M-SP44	27-Sep-2016	0.53	8.9	7.55	593	---	372	35	0.25	0.019	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	26-Oct-2016	0.495	8.6	7.65	597	---	330	41	0.61	0.022	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	29-Jun-2017	5.35	6.3	7.55	532	---	295	28	0.1	0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	29-Sep-2017	0.76	8.5	7.56	569	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	9-Nov-2017	0.55	7.9	7.63	560	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	27-Jun-2018	0.284	8.3	7.40	593	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	14-Sep-2018	0.031	12.8	7.41	638	---	203	220	5.07	0.657	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	3-Nov-2018	0.162	8.1	7.63	641	---	389	33	0.62	0.019	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	2-May-2002	0.888	5.7	7.64	403	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	27-Sep-2002	0.728	8	7.52	512	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	21-May-2003	0.761	6.5	7.63	491	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	8-Oct-2003	0.6	7.8	7.63	428	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	4-Jun-2004	0.676	9.6	7.79	943	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	30-Jun-2014	0.72	11.5	7.68	931	---	513		0.08	0.007	54.00	40.00	89.00	2.00	535.235	<5	27	39	0.18	<0.05	---	<0.1	<0.05	<0.05
M-SP60	23-Sep-2014	0.57	8.4	7.67	935	---	527	<5	0.05	<0.002	57.42	43.29	94.13	1.69	510.851	<5	26	39	0.13	<0.05	---	<0.1	<0.05	<0.05
M-SP60	6-Nov-2014	0.56	6.9	7.61	932	---	507	13	<0.05	0.002	61.05	41.92	95.59	1.74	513.289	<5	26	39	0.13	<0.05	<0.05	<0.1	<0.05	<0.05
M-SP60	27-Jun-2015	0.545	6.9	7.61	960	---	536	---	0.14	0.017	52.96	43.64	92.22	1.76	507.193	<5	26	39	0.11	<0.05	2.76	<0.1	<0.05	<0.05
M-SP60	29-Sep-2015	0.348	8.5	7.8	876	---	552	23	0.55	0.043	53.87	41.74	98.2	1.81	518.166	<5	25	36	0.17	0.39	1.36	0.3	<0.05	<0.05
M-SP60	7-Nov-2015	0.39	6.7	7.47	893	---	535	93	0.58	0.039	54.05	39.98	93.24	1.68	530.358	<5	25	38	0.3	0.32	1.41	0.1	<0.05	0.08
M-SP60	23-Jun-2016	0.424	7.4	7.72	889	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	26-Sep-2016	0.33	8.3	7.51	909	---	549	20	0.07	0.003	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	6-Nov-2016	0.299	7.3	7.83	896	---	513	6	<.05	<.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	30-Jun-2017	0.584	7.4	7.69	858	---	466	<5	<0.05	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	28-Sep-2017	0.523	8.0	7.63	870	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	10-Nov-2017	0.423	6.7	7.69	863	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	27-Jun-2018	0.472	7	7.67	912	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	25-Sep-2018	0.365	8.6	7.65	903	---	496	<5	0.09	0.009	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	14-Nov-2018	0.369	6.4	7.67	904	---	500	<5	<0.05	0.003	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	21-May-2003	0.685	4.7	7.84	451	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	8-Oct-2003	1.095	7.3	7.68	430	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	5-Jun-2004	0.476	7.6	7.7	878	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	27-Jun-2015	0.345	6.1	7.67	884	---	539	32	0.32	0.017	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	29-Sep-2015	0.339	7	7.65	824	---	519	52	0.51	0.018	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	7-Nov-2015	0.325	5.5	7.64	834	---	543	229	1.92	0.089	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	23-Jun-2016	0.377	6.2	7.74	849	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	26-Sep-2016	0.340	6.8	7.74	860	---	539	75	1.41	0.049	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	6-Nov-2016	0.334	6	7.78	863	---	496	27	1.96	0.049	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	30-Jun-2017	0.383	6.2	7.66	846	---	495	30	0.27	0.006	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	28-Sep-2017	0.342	6.7	7.63	851	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	10-Nov-2017	0.349	5.3	7.78	831	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
M-SP106	19-Jun-2018	0.321	5.8	7.74	870	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	25-Sep-2018	0.301	6.9	7.67	853	---	507	49	0.96	0.028	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	14-Nov-2018	0.311	5.5	7.76	884	---	517	102	0.91	0.085	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	8-Nov-2013	1.47	6.7	7.47	882	---	488	20	0.13	<0.005	55	36.5	88.7	1.5	414	9	47	15	<0.01	<0.01	---	<0.2	<0.01	0.04
Spring A	31-Jul-2014	1.76	6.4	7.5	946	---	547	---	0.13	0.006	68.98	32.16	99.19	2.25	365	<5	103	30	---	---	0.4	<0.1	<0.05	<0.05
Spring A	21-Nov-2014	1.42	6.2	7.54	944	---	576	<5	0.07	0.005	58.45	35.53	100.4	1.61	458	<5	47	15	0.06	<0.05	3.16	<0.1	<0.05	<0.05
Spring A	31-Jul-2015	1.60	6.7	7.52	904	---	595	---	<0.05	<0.002	58.42	38.63	110.5	1.55	454	<5	48	15	0.09	<0.05	0.13	<0.1	<0.05	<0.05
Spring A	14-Nov-2015	0.83	6.8	7.45	997	---	595	8	<0.05	<0.002	58.6	37.69	112.8	2.07	472	<5	50	15	0.11	<0.05	3.5	<0.1	<0.05	<0.05
Spring A	23-Jul-2016	1.010	7.0	7.58	953	---	653	69	0.98	0.019	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	15-Nov-2016	1.060	7.0	7.51	947	---	575	10	0.23	0.009	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	28-Jul-2017	2.21	6.9	7.57	911		520	<5	0.12	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	12-Dec-2017	1.5	6.2	7.57	914	---	567	12	0.35	0.012	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	3-Jul-2018	0.688	6.4	7.49	937	---	567	14	0.30	0.01	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	27-Oct-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	8-Nov-2013	4.31	6.4	7.5	717	---	396	16	0.14	<0.005	72.1	40.5	26.1	1.4	367	4	30	3	<0.1	<0.1	<0.1	<0.2	<0.01	0.02
Spring B	31-Jul-2014	5.37	6	7.54	754	---	455	---	<0.05	<0.002	77.48	42.9	34.67	1.48	391	<5	33	4	---	---	0.15	<0.1	<0.05	<0.05
Spring B	21-Nov-2014	0.77	5.3	7.59	782	---	441	8	0.09	<0.002	71.69	40.52	34.61	1.28	383	<5	32	5	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Spring B	31-Jul-2015	6.02	6.1	7.52	738	---	436	---	<0.05	<0.002	72.84	44.01	33.12	1.41	379	<5	31	3	<0.05	<0.05	0.13	<0.1	<0.05	<0.05
Spring B	14-Nov-2015	0.34	6.2	7.48	717	---	422	38	0.38	0.007	69.01	41.84	35.53	1.63	385	<5	32	4	<0.05	<0.05	1.12	<0.1	<0.05	0.07
Spring B	23-Jul-2016	3.04	6.5	7.59	733	---	416	19	<0.05	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	15-Nov-2016	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	28-Jul-2017	4.46	6.4	7.58	713	---	408	<5	0.06	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	12-Dec-2017	0.42	5.8	7.59	744	---	452	38	0.61	0.014	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	3-Jul-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	27-Oct-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	8-Nov-2013	1.95	7.8	7.45	916	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	31-Jul-2014	3.32	7.1	7.51	919	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	21-Nov-2014	2.29	7.4	7.54	937	---	566	6	<0.05	<0.002	65.16	30.08	87.40	2.09	348	<5	100	31	0.16	<0.05	3.28	<0.1	<0.05	<0.05
Spring "C"	31-Jul-2015	2.38	7.4	7.41	919	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	15-Nov-2015	1.57	7.9	7.48	921	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	23-Jul-2016	1.78	7.6	7.59	919	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	15-Nov-2016	1.26	8.2	7.48	947	---	586	72	0.51	0.008														
Spring "C"	28-Jul-2017	1.14	7.6	7.59	873	---	512	122	1.42	0.070	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	12-Dec-2017	1.73	7.6	7.48	914	---	592	54	0.55	0.010	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	3-Jul-2018	2.22	7.0	7.43	917	---	560	14	0.29	0.006	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	11-Nov-2013	0.545	7.7	9.44	235	---	133	848	26.6	1.48	3.4	2.3	43.3	2.8	171	7	3	2	---	---	---	---	---	---
Spring "D"	30-Jun-2014	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	25-Sep-2014	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	29-Jul-2015	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	9-Nov-2015	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	9-Jul-2016	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
Spring "D"	14-Nov-2016	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	29-Jul-2017	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	18-Oct-2017	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	21-Jul-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	23-Jul-2016	0.152	12.0	7.54	1406	---	844	260	1.77	0.08	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	15-Nov-2016	0.176	1.7	7.55	1374	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	28-Jul-2017	0.24	16.3	7.60	1329	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	12-Dec-2017	<0.05	1.1	8.06	1486	---	980	576	3.37	0.149	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	3-Jul-2018	0.109	11.5	7.50	1339	---	875	32	0.62	0.047	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "H"	15-Nov-2016	<0.05	4.3	8.34	1356	---	668	50	0.60	0.035	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "H"	28-Jul-2017	0.13	10.3	8.35	1054	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "H"	12-Dec-2017	<0.05	2.0	8.30	1314	---	892	32	0.68	0.036	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "H"	3-Jul-2018	0.124	10	8.54	1074	---	688	69	1.68	0.045	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep '"I"	28-Jul-2017	2.54	6.7	7.57	1063	---	662	6	<0.05	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep '"I"	12-Dec-2017	2.25	7.4	7.57	1086	---	721	6	0.14	0.005	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep '"I"	3-Jul-2018	2.21	6.3	7.49	1120	---	692	<5	<0.05	0.004	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	8-Nov-2013	<0.05	4.1	7.9	861	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	31-Jul-2014	<0.1	13.6	7.66	912	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	21-Nov-2014	<0.05	2.3	7.98	679	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	31-Jul-2015	<0.5	11.5	7.44	833	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	9-Nov-2015	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	23-Jul-2016	<0.05	14.6	7.49	870	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	15-Nov-2016	<0.05	6.6	7.62	812	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	28-Jul-2017	<0.1	13.2	7.79	920	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	12-Dec-2017	<0.01	0.4	8.21	1002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	3-Jul-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	8-Nov-2013	<0.05	7.5	7.49	769	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	31-Jul-2014	0.197	10.2	7.87	747	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	21-Nov-2014	0.24	4.2	7.87	801	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	31-Jul-2015	0.14	8.5	7.5	770	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	9-Nov-2015	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	23-Jul-2016	0.151	8.9	7.89	756	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	15-Nov-2016	0.101	8.5	7.73	768	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	28-Jul-2017	0.176	8.2	7.78	759	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	12-Dec-2017	0.205	7.8	7.67	760	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	3-Jul-2018	0.138	8.9	7.59	752	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	8-Nov-2013	<0.05	3.6	7.61	740	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	31-Jul-2014	<0.1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	21-Nov-2014	<0.05	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
Skutumpah Seep 3	31-Jul-2015	<0.05	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	9-Nov-2015	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	23-Jul-2016	<0.01	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	15-Nov-2016	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	28-Jul-2017	<0.01	16.9	7.61	772	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	3-Jul-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Spring	8-Nov-2013	12.2	7	7.53	785	---	428	50	0.29	0.011	61.8	33.8	74.8	1.4	386	5	50	12	---	---	<0.1	<0.2	<0.01	0.02
Skutumpah Spring	31-Jul-2014	14.9	6.6	7.59	805	---	547	---	0.13	0.006	68.98	32.16	99.19	2.25	365	<5	103	30	---	---	0.4	<0.1	<0.05	<0.05
Skutumpah Spring	21-Nov-2014	13.4	6.8	7.63	819	---	503	12	0.08	0.002	55.62	30.42	75.36	1.2	371	<5	49	11	0.08	<0.05	<0.05	<0.1	<0.05	0.1
Skutumpah Spring	31-Jul-2015	14.00	6.7	7.39	786	---	472	---	<0.05	<0.002	53.45	33.52	81.39	1.23	373	<5	49	11	0.06	<0.05	0.22	<0.1	<0.05	<0.05
Skutumpah Spring	14-Nov-2015	13.20	17.0	7.50	777	---	445	12	<0.05	<0.002	53.75	32.85	79.38	1.23	371	<5	50	11	0.13	<0.05	3.65	<0.1	<0.05	<0.05
Skutumpah Spring	23-Jul-2016	13.30	7.0	7.59	785	---	470	11	<0.05	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Spring	15-Nov-2016	12.00	7.2	7.58	793	---	500	<5	<0.05	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Spring	28-Jul-2017	14.10	7.0	7.63	786	---	436	8	<0.05	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Spring	12-Dec-2017	11.8	7.1	7.61	782	---	491	<5	<0.05	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Spring	3-Jul-2018	11.4	6.7	7.49	801	---	473	<5	<0.05	0.003	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Spring	27-Oct-2018	10.3	7.1	7.52	808	---	448	<5	<0.05	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	25-Sep-2014	0.251	10.6	7.48	676	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	11-Nov-2014	0.2	5	7.61	660	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	29-Jul-2015	0.34	8.3	7.38	584	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	9-Nov-2015	0.23	5.5	7.51	620	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	9-Jul-2016	0.27	8.2	7.74	560	---	310	44	1.01	0.075	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	14-Nov-2016	0.13	5.5	7.79	637	---	370	30	0.2	0.013	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	29-Jul-2017	0.465	8.5	7.56	615	---	384	<5	0.07	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	18-Oct-2017	0.185	6.2	7.68	627	---	183	14	0.41	0.028	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	21-Jul-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	27-Oct-2018	<0.05	3.5	7.57	682	---	284	630	2.15	0.100	50.86	22.7	45.89	4.49	313	<5	11	14	<0.05	<0.05	---	0.1	---	0.17
Sufco 057A	26-Jun-2004	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	1-Sep-2004	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	15-Oct-2004	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	13-Jun-2005	1.52	16.6	7.56	431	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	30-Sep-2005	0.004	18.2	7.55	706	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	24-Oct-2005	0.018	11.3	7.65	544	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	26-Jun-2006	0.6	18.1	6.37	586	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	13-Sep-2006	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	4-Nov-2006	0.031	6.5	7.66	482	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	25-Jun-2007	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	19-Sep-2007	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	29-Oct-2007	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	12-Jun-2008	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	15-Sep-2008	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	21-Oct-2008	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
Sufco 057A	19-Jun-2009	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	17-Sep-2009	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	19-Nov-2009	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	10-May-2010	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	6-Aug-2010	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	1-Nov-2010	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	28-Jun-2011	1.39	12.6	7.5	498	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	23-Sep-2011	< .25	11.6	7.6	560	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Oct-2011	< .5	6.1	7.43	528	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Jun-2012	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	26-Sep-2012	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	8-Nov-2012	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	28-Jun-2013	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	24-Sep-2013	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Oct-2013	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	11-Jun-2014	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	24-Sep-2014	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	11-Nov-2014	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	21-Jun-2015	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	22-Sep-2015	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	9-Nov-2015	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	26-Jun-2016	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Sep-2016	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	4-Nov-2016	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	25-Jun-2017	< .1	12.9	7.88	614	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	16-Aug-2017	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	17-Oct-2017	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	9-Jun-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	21-Sep-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Oct-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Surface Water																								
South Fork Q. Upr.	11-Nov-2013	128	4.6	8.63	514	10	328	4	0.05	0.05	52.8	32.1	11.8	1.1	218	12	97	2	0.4	<0.1	---	<0.2	<0.01	<0.01
South Fork Q. Upr.	1-Jul-2014	731	12.5	8.61	515	8.3	322	19	0.27	0.27	52	30	9	1.16	187	6	88	2	0.37	<0.05	---	<0.1	<0.05	<0.05
South Fork Q. Upr.	25-Sep-2014	151	13.6	8.72	518	8.05	350	8	<0.05	<0.05	50.55	31.26	11.14	1.14	175	<5	97	2	0.23	<0.05	0.15	<0.1	<0.05	<0.05
South Fork Q. Upr.	11-Nov-2014	11.8	0.1	8.43	593	10.14	372	13	0.12	0.12	56.1	32.43	12.22	1.12	202	<5	102	2	0.36	<0.05	0.36	<0.1	<0.05	<0.05
South Fork Q. Upr.	29-Jul-2015	411	13.4	8.77	497	8.1	302	24	0.16	0.16	48.34	32.62	10.65	1.01	172	<5	87	2	0.31	<0.05	2.28	<0.1	<0.05	1.99
South Fork Q. Upr.	9-Nov-2015	70	0.3	8.42	503	10.02	309	17	0.14	0.14	48.04	30.89	11.95	1.17	177	<5	95	2	0.42	<0.05	1	0.2	<0.05	<0.05
South Fork Q. Upr.	9-Jul-2016	455	14.7	8.69	507	8.03	331	17	0.28	0.28	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Q. Upr.	14-Nov-2016	4.4	4.7	8.33	611	10.05	394	23	0.12	0.12	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Q. Upr.	29-Jul-2017	354	14.7	8.66	485	7.85	300	14	0.23	0.23	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Q. Upr.	18-Oct-2017	27	7.6	8.60	512	8.75	169	11	<0.05	<0.05	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Q. Upr.	21-Jul-2018	35	14.8	8.6	536	7.45	342	19	0.35	0.35	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Q. Upr.	27-Oct-2018	46	8.2	8.27	647	9.08	390	<5	0.07	0.004	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
SP60 Creek	30-Jun-2014	1.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SP60 Creek	30-Jun-2017	37.5	14.5	8.64	545	8.11	293	12	0.06	<0.002	39.56	31.21	45.88	1.46	258	16	19	6	<0.05	<0.05	0.37	<0.1	<0.05	<0.05
SP60 Creek	28-Sep-2017	15.7	6.9	8.67	635	8.97	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SP60 Creek	10-Nov-2017	10.7	0.7	8.54	737	11.28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SP60 Creek	19-Jun-2018	0.299	9.6	8.04	794	7.29	456	6	0.09	0.008	54.46	33.14	80.33	1.89	427	<5	24	14	---	---	---	---	---	---
SP60 Creek	25-Sep-2018	0.308	9.8	8.70	841	7.68	506	12	0.28	0.007	33.1	27.84	144.3	2.46	435	21	23	17	---	---	---	---	---	---
SP60 Creek	14-Nov-2018	Dry	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	11-Nov-2013	59	4.5	8.42	547	10.04	316	11	0.13	<0.005	51.8	31.7	11.6	1.1	221	10	95	2	0.4	<0.1	---	<0.2	<0.01	0.01
Skutumpah Ck. Upr.	2-Jul-2014	81	16.5	8.24	549	7.3	305	39	0.53	0.014	36	27	34	2.56	211	22	46	8	<0.05	<0.05	---	<0.1	<0.05	0.06
Skutumpah Ck. Upr.	25-Sep-2014	7.8	15.5	8.48	527	8.39	345	6	0.35	0.031	52.37	31.57	11.3	1.13	182	<5	97	2	0.14	<0.05	2.07	<0.1	<0.05	<0.05
Skutumpah Ck. Upr.	11-Nov-2014	129	0.9	8.56	570	10.36	351	12	0.07	0.006	54.42	31.8	12.2	1.1	183	6	102	2	0.42	<0.05	0.42	<0.1	<0.05	<0.05
Skutumpah Ck. Upr.	29-Jul-2015	27	13.4	8.52	505	7.76	314	42	0.35	0.016	49.68	33.38	10.47	1.05	183	<5	88	2	0.29	<0.05	0.21	<0.1	<0.05	0.05
Skutumpah Ck. Upr.	9-Nov-2015	67	0.3	8.45	505	10.06	328	21	0.14	0.01	48.44	30.47	13.88	1.16	173	<5	94	2	0.4	<0.05	0.31	0.2	<0.05	0.05
Skutumpah Ck. Upr.	9-Jul-2016	75	15.3	8.65	509	7.81	323	38	0.57	0.016	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	14-Nov-2016	101	5.8	8.57	540	9.89	357	22	0.22	0.007	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	29-Jul-2017	75	14.9	8.59	490	7.51	302	30	0.36	0.015	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	18-Oct-2017	98	8.1	8.6	514	8.58	165	20	0.07	<0.002	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	21-Jul-2018	31	14.8	8.59	534	7.44	332	42	0.62	0.016	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	27-Oct-2018	46	10.5	8.5	581	9.09	353	<5	0.17	0.005	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	8-Nov-2013	156	1.2	8.78	624	10.24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	1-Jul-2014	130	18.6	8.59	587	7.27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	21-Nov-2014	186	0.2	8.67	661	10.37	396	64	1.08	0.019	51.87	29.01	29.89	1.09	232	<5	95	6	0.30	<0.05	<0.05	<0.1	<0.05	0.06
Skut. Creek Middle	31-Jul-2015	33	17.5	8.57	666	7.42	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	14-Nov-2015	68	0.3	8.36	634	10.38	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	23-Jul-2016	40	22.9	8.72	603	6.80	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	15-Nov-2016	117	5.8	8.70	608	9.42	376	23	0.54	0.009	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	28-Jul-2017	17	16.6	8.70	564	7.60	370	86	1.22	0.034	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	12-Dec-2017	48	0.4	8.50	688	10.85	431	55	0.68	0.021	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	3-Jul-2018	22	19.9	8.64	661	7.49	416	11	0.35	0.010	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	19-Oct-2009	75	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Jun-2010	500	16.8	8.51	538	7.31	360	---	1.27	0.072	56.93	32.42	12.89	1.54	224	4.8	95	2	---	---	---	---	---	---
Sufco 006A	15-Sep-2010	50.8	11.7	8.44	529	7.33	366	---	0.58	0.023	48.3	29	16.1	2.6	296	2.4	99	4	---	---	---	---	---	---
Sufco 006A	1-Nov-2010	82.2	3.4	8.22	560	9.38	362	---	0.72	0.039	53.5	29.8	17.8	1.3	306	1.2	101	4	---	---	---	---	---	---
Sufco 006A	17-Jun-2011	1109	9.5	8.77	512	7.86	312	---	0.58	0.035	56.1	30.1	13.2	1	326	2.4	68	4	---	---	---	---	---	---
Sufco 006A	21-Sep-2011	296	11.7	8.68	624	7.53	348	---	0.78	0.031	47.5	28.8	12	1.1	250	4.8	86	3	---	---	---	---	---	---
Sufco 006A	12-Oct-2011	186	7.9	8.6	558	8.72	342	---	0.32	0.019	54	31.6	15.3	1.3	256	2.0	86	4	---	---	---	---	---	---
Sufco 006A	1-Jun-2012	0.949	14.3	8.5	1182	7.5	776	46	0.74	0.016	64.7	37	138	2.5	513	4.2	183	47	---	---	---	---	---	---
Sufco 006A	12-Sep-2012	59.5	11.8	8.56	547	8.62	356	18	0.13	0.014	45.2	28.8	18	1.4	251	4.2	103	4	---	---	---	---	---	---
Sufco 006A	1-Nov-2012	56	3.9	8.56	578	9.85	324	27	0.22	0.014	52.7	31	20.4	1.3	251	4	101	5	---	---	---	---	---	---
Sufco 006A	27-Jun-2013	136	17.2	8.56	551	7.96	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	16-Sep-2013	210	13	8.52	609	7.88	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Field Measurements					Baseline Lab Parameters				Major Ions								Nutrients					
		Q	T	pH	Cond.	Dis. Ox.	TDS	TSS	Fe-T	Mn-T	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl	NO3	NO2	NO3+NO2	NH3	O-PO4	T-Phos
Site ID	Date	gpm	°C	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
Sufco 006A	23-Oct-2013	118	4	8.56	604	10.78	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-May-2014	576	12.4	8.56	569	7.56	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	17-Sep-2014	126	12.7	8.67	547	8.18	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Oct-2014	2.86	2.4	8.61	1123	10.08	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	23-Jun-2015	168	8.7	8.7	573	7.37	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	23-Sep-2015	113	11.7	8.59	518	8.22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	8-Nov-2015	28.6	0.2	8.37	640	10.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Jun-2016	339	18.5	8.51	536	7.16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	25-Sep-2016	122	9.2	8.68	536	9.24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	11-Nov-2016	2.7	2.7	8.56	962	9.56	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Jun-2017	321	12.5	8.62	510	8.04	321	140	0.95	0.042	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Aug-2017	117	15.0	8.61	509	7.48	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	2-Nov-2017	13.3	6.3	8.47	660	8.98	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	9-Jun-2018	6.98	19.4	8.42	819	6.50	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	8-Aug-2018	12.2	18.7	8.25	602	6.84	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	26-Oct-2018	2.0	4.6	8.13	932	10.27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
North Fork Upper	30-Jun-2017	718	11.5	8.64	329	8.54	183	10	<0.05	0.002	58.66	13.44	2.47	0.64	261	21	15	<1	0.09	<0.05	1.46	<0.1	<0.05	<0.05
North Fork Upper	28-Sep-2017	128	6.0	8.53	345	8.93	211	6	<0.05	<0.002	50.39	12.15	2.69	0.73	157	6	22	1	0.12	<0.05	3.63	<0.1	---	<0.05
North Fork Upper	10-Nov-2017	106	0.4	8.53	358	11.90	206	13	0.08	0.004	54.37	13.14	5.91	0.71	210	<5	22	1	0.15	<0.05	1.47	<0.1	---	<0.05
North Fork Upper	19-Jun-2018	94	12.4	8.53	353	7.72	207	<5	<0.05	0.003	52.00	13.42	4.01	0.60	166	8	27	<1	---	---	---	---	---	---
North Fork Upper	25-Sep-2018	39	7.8	8.54	340	8.32	183	6	0.08	0.004	51.53	11.75	3.71	0.57	150	6	24	<1	---	---	---	---	---	---
North Fork Upper	14-Nov-2018	37	0.6	8.28	478	10.93	249	14	0.16	0.008	61.84	14.90	7.04	0.74	194	<5	41	1	---	---	---	---	---	---

Table 3 Average discharge rates and water quality characteristics for springs and streams.

	Q	T	pH	Cond.	TDS	TSS	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl
	gpm	°C	Mg/L	uS/cm	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L
North Horn Formation Springs														
94-110	0.19	6.6	7.55	757	446	---	68.1	28.0	59.6	1.3	401	<5	8.3	10.7
A2S-1	0.06	10.4	7.97	856	519	---	18.1	7.6	187.9	1.6	513	<5	23.8	12.0
Andersen Spring	<0.05	11.6	9.51	934	527	---	11.1	12.2	228.4	4.3	521	24	32.5	5.0
Divide Spring	0.44	8.6	7.60	711	421	---	54.7	45.2	39.5	1.3	315	<5	80.0	7.5
M-SP19	2.53	6.3	8.04	721	517	---	---	---	---	---	---	<5	---	---
M-SP20	2.11	8.4	7.70	669	459	---	---	---	---	---	---	<5	---	---
M-SP44	2.02	8.1	7.61	538	336	---	65.8	28.2	22.2	0.6	363	<5	20.3	1.4
M-SP60	0.53	7.7	7.66	815	518	---	55.6	41.8	93.7	1.8	519	<5	25.8	38.3
M-SP106	0.42	6.2	7.71	801	519	---	---	---	---	---	---	<5	---	---
Spring D	0.05	7.7	9.44	235	133	---	3.4	2.3	43.3	2.8	171	7	3.0	2.0
Seep H	0.06	6.7	8.38	1200	749	---	---	---	---	---	---	<5	---	---
Seep I	2.33	6.8	7.54	1090	692	---	---	---	---	---	---	<5	---	---
Spg. 99	0.21	6.8	7.59	629	306	---	50.9	22.7	45.9	4.5	313	<5	11.0	14.0
Sufco 057A	<0.1	12.7	7.47	550	---	---	---	---	---	---	---	<5	---	---
Average:	**0.78**	**8.2**	**7.98**	**750**	**473**	---	**41.0**	**23.5**	**90.1**	**2.3**	**389**	**<5**	**25.6**	**11.4**
Price River Formation Springs														
006A Spring	0.33	6.0	7.49	1244	811	---	61.1	24.1	202.0	3.4	648	<5	143.3	37.0
Hansen Seep	0.17	9.7	7.56	1444	932	---	118.5	37.0	153.9	2.9	466	<5	238.4	120.0
Spring A	1.23	6.6	7.52	934	568	---	59.9	36.1	102.3	1.8	433	<5	59.0	18.0
Spring B	2.25	6.1	7.55	737	428	---	72.6	42.0	32.8	1.4	381	<5	31.6	3.8
Spring C	1.96	7.6	7.50	918	563	---	65.2	30.1	87.4	2.1	348	<5	100.0	31.0
Seep G	0.14	8.5	7.65	1387	900	---	---	---	---	---	---	<5	---	---
Skutumpah Seep 1	<0.05	8.3	7.76	861	---	---	---	---	---	---	---	<5	---	---
Skutumpah Seep 2	0.13	8.1	7.71	765	---	---	---	---	---	---	---	<5	---	---
Skutumpah Seep 3	<0.05	10.3	7.61	756	---	---	---	---	---	---	---	<5	---	---
Skutumpah Spring	12.78	7.8	7.55	793	474	---	58.7	32.6	82.0	1.5	373	<5	60.2	15.0
Average:	**1.90**	**7.9**	**7.59**	**984**	**668**	---	**72.7**	**33.6**	**110.1**	**2.2**	**441**	**<5**	**105.4**	**37.5**

	Q	T	pH	Cond.	TDS	TSS	Ca-D	Mg-D	Na-D	K-D	HCO3	CO3	SO4	Cl
	gpm	°C	Mg/L	uS/cm	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L (caco3)	Mg/L (caco3)	Mg/L	Mg/L
Surface Water averages														
South Fork Quitchupah Upper	202	9.1	8.56	537	326	15	51.3	31.6	11.1	1.1	189	<5	94.3	2.0
SP60 Creek	9	8.3	8.52	710	418	10	42.4	30.7	90.2	1.9	373	12.3	22.0	12.3
Skutumpah Creek Upper	66	10.0	8.51	531	316	26	48.8	31.0	15.6	1.4	192	6.3	87.0	3.0
Skutumpah Creek Middle	82	10.3	8.62	630	398	48	51.9	29.0	29.9	1.1	232	<5	95.0	6.0
Sufco 006A (South Fork Quitch.)	173	10.4	8.53	645	387	58	53.2	30.9	29.3	1.6	297	<5	102.4	8.6
North Fork Quitchupah Upper	187	6.5	8.51	367	207	10	54.8	13.1	4.3	0.7	190	6.8	25.2	1.0

Appendix A

Additional baseline water quality data for groundwaters and surface waters in the South Fork Lease Modification Area.

Appendix A Additional water quality information for groundwaters and surface waters in the South Fork Lease Modification Area.

		Other parameters							Trace metal constituents																	
		Hard.	Acidity	O&G	Tot. Alk.	Anions	Cations	Balance	Hg	Al-T	AL-D	As-D	B-D	Ba-D	Cd-D	Cr-D	Cu-D	Fe-D	Pb-D	Mn-D	Mo-D	Ni-D	Se-T	Se-D	Ag-D	Zn-D
		Mg/L (caco3)	Mg/L	Mg/L	Mg/L (caco3)	Meq/L	Meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Groundwater																										
006A Spring	28-Jun-2010	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	15-Sep-2010	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	1-Nov-2010	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	17-Jun-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	21-Sep-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	12-Oct-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	1-Jun-2012	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	12-Sep-2012	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	1-Nov-2012	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	27-Jun-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	26-Sep-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	23-Oct-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	28-May-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	23-Sep-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	28-Oct-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	23-Jun-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	21-Sep-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	8-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	28-Jun-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	25-Sep-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	11-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	6/28/2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	8/28/2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	11/10/2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	6/9/2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	8/8/2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
006A Spring	10/26/2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	11-Nov-2013	268	<5	---	342	7.3	7.9	4.3	<0.0002	1.7	<0.05	<0.05	<0.05	0.306	<0.005	<0.005	<0.005	<0.02	<0.02	0.028	<0.01	<0.005	0.26	0.08	<0.005	<0.01
94-110	30-Jun-2014	282	<5	---	398	8.41	8.11	-1.84	<0.0002	0.39	<0.03	<0.01	0.04	0.314	<0.001	<0.001	<0.01	<0.03	<0.01	0.002	<0.005	0.001	<0.02	<0.02	<0.002	<0.004
94-110	25-Sep-2014	291	15	---	395	8.39	8.42	0.19	<0.0002	0.13	<0.03	<0.01	0.04	0.378	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
94-110	12-Nov-2014	282	11	---	408	8.64	8.28	-2.09	<0.0002	0.8	<0.03	<0.01	0.03	0.351	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
94-110	29-Jul-2015	300	15	<5	390	8.28	8.63	2.04	<0.0002	0.34	<0.03	<0.01	0.05	0.372	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	0.03	<0.02	<0.002	0.012
94-110	9-Nov-2015	289	5	---	412	8.72	8.6	-0.69	<0.0002	0.45	0.24	<0.01	0.04	0.354	<0.001	<0.001	<0.01	0.09	<0.01	<0.002	<0.005	0.001	0.02	<0.02	<0.002	0.011
94-110	9-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	14-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	29-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	18-Oct-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	21-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
94-110	27-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	11-Nov-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	30-Jun-2014	77	<5	---	410	---	---	---	---	2.13	<0.03	<0.01	0.05	---	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	---	0.001	<0.02	<0.02	---	<0.004
A2S-1	25-Sep-2014	75	<5	---	438	---	---	---	---	1.16	0.26	<0.01	0.07	---	<0.001	<0.001	<0.01	0.11	<0.01	0.003	---	<0.001	<0.02	<0.02	---	<0.004
A2S-1	11-Nov-2014	73	<5	---	459	---	---	---	---	4.17	<0.03	<0.01	0.06	---	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	---	<0.001	<0.02	<0.02	---	<0.004

		Other parameters							Trace metal constituents																		
		Hard.	Acidity	O&G	Tot. Alk.	Anions	Cations	Balance	Hg	Al-T	AL-D	As-D	B-D	Ba-D	Cd-D	Cr-D	Cu-D	Fe-D	Pb-D	Mn-D	Mo-D	Ni-D	Se-T	Se-D	Ag-D	Zn-D
		Mg/L (caco3)	Mg/L	Mg/L	Mg/L (caco3)	Meq/L	Meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
A2S-1	29-Jul-2015	81	<5	---	421	---	---	---	---	3.93	<0.03	<0.01	0.07	---	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	---	<0.001	<0.02	<0.02	---	0.014
A2S-1	9-Nov-2015	75	<5	---	487	---	---	---	---	4.24	4.24	<0.01	0.07	---	<0.001	<0.001	<0.01	0.28	<0.01	0.246	---	0.001	<0.02	<0.02	---	0.009
A2S-1	9-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	14-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	29-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	10/18/2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
A2S-1	7/21/2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Andersen Spring	19-Jul-2017	17	---	---	483	---	---	---	---	---	0.37	0.02	0.12	---	<0.001	<0.001	<0.01	0.23	<0.01	---	0.006	0.001	---	<0.02	---	---
Andersen Spring	18-Oct-2017	55	56	---	---	12.93	10.58	<-10	---	---	0.08	0.03	0.15	---	<0.001	---	<0.01	0.68	<0.01	---	0.008	---	---	0.03	---	<0.004
Andersen Spring	21-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	1-Jul-2014	312	11	---	330	8.5	8.15	-2.1	<0.0002	0.04	<0.03	<0.01	0.06	0.183	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	0.001	<0.02	<0.02	<0.002	<0.004
Divide Spring	25-Sep-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	11-Nov-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	29-Jul-2015	331	8	---	300	7.85	8.22	2.26	<0.0002	0.06	<0.03	<0.01	0.07	0.217	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	0.03	<0.02	<0.002	<0.004
Divide Spring	9-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	9-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	14-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	29-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	18-Oct-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	21-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Divide Spring	27-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hansen Seep	23-Apr-2012	475	<5	---	411	16.3	16.5	0.6	<0.0002	1.7	0.4	<0.05	0.11	0.114	<0.005	<0.005	<0.005	0.48	<0.02	0.279	<0.01	<0.005	0.02	0.02	<0.005	<0.01
Hansen Seep	12-Sep-2012	449	<5	---	414	16.2	16.1	-0.3	<0.0002	0.2	0.2	<0.05	0.11	0.106	<0.005	<0.005	<0.005	<0.02	<0.02	<0.005	<0.01	<0.005	0.04	0.04	<0.005	<0.01
Hansen Seep	1-Nov-2012	393	<10	---	417	16.3	15.1	-3.7	0.0002	0.6	<0.05	<0.05	0.09	0.087	<0.005	<0.005	<0.005	<0.02	<0.02	0.181	<0.01	<0.005	0.05	0.02	<0.005	<0.01
Hansen Seep	27-Jun-2013	360	<5	---	413	17.8	14	-12	<0.0002	12.6	<0.05	<0.05	0.12	0.078	<0.005	81.9	<0.005	<0.02	<0.02	<0.005	<0.01	<0.005	<0.02	0.03	<0.005	<0.01
Hansen Seep	26-Sep-2013	435	<5	---	383	16.5	15.3	-3.9	<0.0002	0.2	<0.05	<0.05	0.09	0.114	<0.005	<0.005	<0.005	<0.02	0.02	0.041	<0.01	<0.005	0.02	<0.02	<0.005	<0.01
Hansen Seep	23-Oct-2013	368	<5	---	392	16.4	14	-7.9	<0.0002	0.2	<0.05	<0.05	0.09	0.082	<0.005	<0.005	<0.005	<0.2	<0.02	<0.005	<0.1	<0.005	0.03	<0.005	<0.005	<0.01
Hansen Seep	28-May-2014	426	10	---	379	14.92	14.94	0.07	<0.0002	0.11	<0.03	<0.01	0.09	0.104	<0.001	<0.001	<0.01	<0.03	<0.01	0.216	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Hansen Seep	17-Sep-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hansen Seep	28-Oct-2014	430	17	---	383	16	15.24	-2.45	<0.0002	0.33	<0.03	<0.01	0.07	0.125	<0.001	<0.001	<0.01	<0.03	<0.01	0.081	<0.005	<0.001	<0.02	<0.02	<0.002	0.01
Hansen Seep	8-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hansen Seep	26-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	11-Jul-2001	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	3-Oct-2001	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	2-May-2002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	27-Sep-2002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	21-May-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	8-Oct-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	5-Jun-2004	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	27-Jun-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	29-Sep-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	7-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	23-Jun-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	26-Sep-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	6-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Other parameters							Trace metal constituents																		
		Hard.	Acidity	O&G	Tot. Alk.	Anions	Cations	Balance	Hg	Al-T	AL-D	As-D	B-D	Ba-D	Cd-D	Cr-D	Cu-D	Fe-D	Pb-D	Mn-D	Mo-D	Ni-D	Se-T	Se-D	Ag-D	Zn-D
		Mg/L (caco3)	Mg/L	Mg/L	Mg/L (caco3)	Meq/L	Meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
M-SP19	30-Jun-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	28-Sep-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	10-Nov-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	19-Jun-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	25-Sep-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP19	14-Nov-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	11-Jul-2001	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	3-Oct-2001	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	2-May-2002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	28-Sep-2002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	22-May-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	8-Oct-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	5-Jun-2004	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	25-Jun-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	26-Sep-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	1-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	26-Jun-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	27-Sep-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	26-Oct-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	29-Jun-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	28-Sep-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	9-Nov-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	27-Jun-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	14-Sep-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP20	6-Nov-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	3-Oct-2001	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	2-May-2002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	28-Sep-2002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	22-May-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	24-Sep-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	5-Jun-2004	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	29-Jun-2014	298	8	---	283	---	---	---	<0.0002	<0.03	<0.03	<0.01	0.02	---	<0.001	<0.001	<0.01	<0.03	---	<0.002	---	0.001	<0.02	<0.02	---	<0.004
M-SP44	18-Sep-2014	259	<5	---	296	---	---	---	<0.0002	0.33	<0.03	<0.01	0.02	---	<0.001	<0.001	<0.01	<0.03	---	<0.002	---	<0.001	<0.02	<0.02	---	<0.004
M-SP44	31-Oct-2014	261	12	---	304	---	---	---	<0.0002	0.24	<0.03	<0.01	<0.01	---	<0.001	<0.001	<0.01	<0.03	---	0.002	---	<0.001	<0.02	<0.02	---	<0.004
M-SP44	25-Jun-2015	303	7	---	297	---	---	---	<0.0002	0.48	<0.03	<0.01	0.02	---	<0.001	<0.001	<0.01	<0.03	---	<0.002	---	<0.001	<0.02	<0.02	---	0.004
M-SP44	26-Sep-2015	267	5	---	297	---	---	---	<0.0002	0.2	<0.03	<0.01	0.02	---	<0.001	<0.001	<0.01	<0.03	---	<0.002	---	0.002	<0.02	<0.02	---	<0.004
M-SP44	1-Nov-2015	270	<5	---	308	---	---	---	<0.0002	0.21	<0.03	<0.01	0.02	---	<0.001	<0.001	<0.01	<0.03	---	<0.002	---	<0.001	<0.02	<0.02	---	<0.004
M-SP44	26-Jun-2016	303	7	---	297	---	---	---	<0.0002	0.48	<0.03	<0.01	0.02	---	<0.001	<0.001	<0.01	<0.03	---	<0.002	---	<0.001	<0.02	<0.02	---	0.004
M-SP44	27-Sep-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	26-Oct-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	29-Jun-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	29-Sep-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	9-Nov-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	27-Jun-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	14-Sep-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP44	3-Nov-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Other parameters							Trace metal constituents																		
		Hard.	Acidity	O&G	Tot. Alk.	Anions	Cations	Balance	Hg	Al-T	AL-D	As-D	B-D	Ba-D	Cd-D	Cr-D	Cu-D	Fe-D	Pb-D	Mn-D	Mo-D	Ni-D	Se-T	Se-D	Ag-D	Zn-D
		Mg/L (caco3)	Mg/L	Mg/L	Mg/L (caco3)	Meq/L	Meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
M-SP60	2-May-2002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	27-Sep-2002	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	21-May-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	8-Oct-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	4-Jun-2004	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	30-Jun-2014	299	<5	---	439	---	---	---	<0.0002	0.14	<0.03	<0.01	0.07	---	<0.001	<0.001	<0.01	<0.03	<0.01	---	---	0.001	<0.02	<0.02	---	<0.004
M-SP60	23-Sep-2014	322	<5	---	419	---	---	---	<0.0002	0.03	0.03	<0.01	0.07	---	<0.001	<0.001	<0.01	<0.03	<0.01	---	---	---	<0.02	<0.02	---	<0.004
M-SP60	6-Nov-2014	325	8	---	421	---	---	---	<0.0002	0.05	<0.03	<0.01	0.12	---	<0.001	<0.001	<0.01	<0.03	<0.01	---	---	0.001	<0.02	<0.02	---	0.009
M-SP60	27-Jun-2015	312	<5	---	416	---	---	---	<0.0002	0.23	<0.03	<0.01	0.05	---	<0.001	0.009	<0.01	0.04	<0.01	---	---	0.002	<0.02	<0.02	---	0.096
M-SP60	29-Sep-2015	306	<5	---	425	---	---	---	<0.0002	0.91	0.03	<0.01	0.07	---	<0.001	<0.001	<0.01	<0.03	<0.01	---	---	<0.001	0.03	0.03	---	<0.004
M-SP60	7-Nov-2015	300	<5	---	435	---	---	---	<0.0002	0.89	<0.03	<0.01	0.06	---	<0.001	<0.001	<0.01	<0.03	<0.01	---	---	0.001	0.03	0.03	---	<0.004
M-SP60	23-Jun-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	26-Sep-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	6-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	30-Jun-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	28-Sep-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	10-Nov-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	27-Jun-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	25-Sep-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP60	14-Nov-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	21-May-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	8-Oct-2003	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	5-Jun-2004	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	27-Jun-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	29-Sep-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	7-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	23-Jun-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	26-Sep-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	6-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	30-Jun-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	28-Sep-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	10-Nov-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	19-Jun-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	25-Sep-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
M-SP106	14-Nov-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	8-Nov-2013	288	<5	---	355	8.5	9.6	6.4	<0.0002	0.20	<0.05	<0.05	0.06	0.153	<0.005	<0.005	<0.005	<0.02	<0.02	<0.005	<0.01	<0.005	0.17	0.07	<0.005	<0.01
Spring A	31-Jul-2014	305	6	---	365	10.28	10.46	0.89	<0.0002	0.24	<0.03	<0.01	0.07	0.06	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Spring A	21-Nov-2014	292	10	---	458	10.56	10.25	-1.49	<0.0002	0.06	<0.03	<0.01	0.07	0.169	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Spring A	31-Jul-2015	305	<5	---	454	10.5	10.94	2.03	<0.0002	0.11	<0.03	<0.01	0.09	0.173	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	0.005	<0.001	0.02	<0.02	<0.002	0.007
Spring A	14-Nov-2015	302	5	---	472	10.89	10.99	0.25	<0.0002	0.09	<0.03	<0.01	0.08	0.168	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	0.03	<0.02	<0.002	<0.004
Spring A	23-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring A	27-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Other parameters							Trace metal constituents																		
		Hard.	Acidity	O&G	Tot. Alk.	Anions	Cations	Balance	Hg	Al-T	AL-D	As-D	B-D	Ba-D	Cd-D	Cr-D	Cu-D	Fe-D	Pb-D	Mn-D	Mo-D	Ni-D	Se-T	Se-D	Ag-D	Zn-D
		Mg/L (caco3)	Mg/L	Mg/L	Mg/L (caco3)	Meq/L	Meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Spring B	8-Nov-2013	347	<5	---	307	6.9	8.1	8.3	<0.0002	0.2	<0.05	<0.05	<0.05	0.241	<0.005	<0.005	<0.005	<0.02	<0.02	<0.005	<0.01	<0.005	0.26	0.07	<0.005	<0.01
Spring B	31-Jul-2014	370	<5	---	391	8.61	8.94	1.87	<0.0002	0.08	<0.03	<0.01	0.03	0.28	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	0.002	0.009
Spring B	21-Nov-2014	346	<5	---	383	8.45	8.45	0.02	<0.0002	0.14	<0.03	<0.01	0.03	0.265	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Spring B	31-Jul-2015	363	<5	---	379	8.32	8.73	2.44	<0.0002	0.05	<0.03	<0.01	0.05	0.266	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	0.03	<0.02	<0.002	<0.004
Spring B	14-Nov-2015	345	<5	---	385	8.48	8.47	-0.02	<0.0002	0.63	<0.03	<0.01	0.04	0.247	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	0.03	<0.02	<0.002	<0.004
Spring B	23-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring B	27-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	8-Nov-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	31-Jul-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	21-Nov-2014	287	9	---	348	9.91	9.58	-1.70	<0.0002	0.03	<0.03	<0.01	0.07	0.059	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Spring "C"	31-Jul-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	14-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	23-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "C"	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	11-Nov-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	30-Jun-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	25-Sep-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	29-Jul-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	9-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	9-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	14-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	29-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	18-Oct-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spring "D"	21-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	23-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "G"	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "H"	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "H"	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "H"	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep "H"	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep '"I"	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep '"I"	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seep '"I"	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Other parameters							Trace metal constituents																		
		Hard.	Acidity	O&G	Tot. Alk.	Anions	Cations	Balance	Hg	Al-T	AL-D	As-D	B-D	Ba-D	Cd-D	Cr-D	Cu-D	Fe-D	Pb-D	Mn-D	Mo-D	Ni-D	Se-T	Se-D	Ag-D	Zn-D
		Mg/L (caco3)	Mg/L	Mg/L	Mg/L (caco3)	Meq/L	Meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Skutumpah Seep 1	8-Nov-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	31-Jul-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	21-Nov-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	31-Jul-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	9-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	23-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 1	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	8-Nov-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	31-Jul-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	21-Nov-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	31-Jul-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	9-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	23-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 2	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	8-Nov-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	31-Jul-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	21-Nov-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	31-Jul-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	9-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	23-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Seep 3	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Sp.	8-Nov-2013	282	<5	---	326	7.9	8.9	6.2	<0.0002	0.3	<0.05	<0.05	<0.05	0.148	<0.005	<0.005	<0.005	<0.02	<0.02	<0.005	<0.01	<0.005	0.21	0.07	<0.005	<0.01
Skutumpah Sp.	31-Jul-2014	305	6	---	365	10.28	10.46	0.89	<0.0002	0.24	<0.03	<0.01	0.07	0.06	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	0.002	<0.004
Skutumpah Sp.	21-Nov-2014	264	7	---	371	8.75	8.59	-0.95	<0.0002	0.12	<0.03	<0.01	0.05	0.157	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Skutumpah Sp.	31-Jul-2015	271	6	---	373	8.79	9	1.19	<0.0002	<0.03	<0.03	<0.01	0.07	0.163	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Skutumpah Sp.	14-Nov-2015	270	6	---	371	8.77	8.87	0.56	<0.0002	0.07	<0.03	<0.01	0.06	0.15	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	0.03	<0.02	<0.002	<0.004
Skutumpah Sp.	23-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Sp.	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Sp.	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Sp.	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Sp.	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Sp.	27-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	25-Sep-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	11-Nov-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	29-Jul-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	9-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	9-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Other parameters							Trace metal constituents																		
		Hard.	Acidity	O&G	Tot. Alk.	Anions	Cations	Balance	Hg	Al-T	AL-D	As-D	B-D	Ba-D	Cd-D	Cr-D	Cu-D	Fe-D	Pb-D	Mn-D	Mo-D	Ni-D	Se-T	Se-D	Ag-D	Zn-D
		Mg/L (caco3)	Mg/L	Mg/L	Mg/L (caco3)	Meq/L	Meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Spg. 99	14-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	29-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	18-Oct-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	21-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spg. 99	27-Oct-2018	220	<5	---	313	6.88	6.52	-2.73	---	---	0.06	<0.01	0.04	---	<0.001	---	<0.01	0.04	<0.01	0.012	0.009	---	---	<0.02	---	<0.004
Sufco 057A	26-Jun-2004	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	1-Sep-2004	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	15-Oct-2004	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	13-Jun-2005	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	30-Sep-2005	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	24-Oct-2005	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	26-Jun-2006	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	13-Sep-2006	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	4-Nov-2006	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	25-Jun-2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	19-Sep-2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	29-Oct-2007	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	12-Jun-2008	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	15-Sep-2008	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	21-Oct-2008	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	19-Jun-2009	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	17-Sep-2009	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	19-Nov-2009	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	10-May-2010	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	6-Aug-2010	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	1-Nov-2010	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	28-Jun-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	23-Sep-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Oct-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Jun-2012	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	26-Sep-2012	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	8-Nov-2012	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	28-Jun-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	24-Sep-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Oct-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	11-Jun-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	24-Sep-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	11-Nov-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	21-Jun-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	22-Sep-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	9-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	26-Jun-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Sep-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	4-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	25-Jun-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	16-Aug-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	17-Oct-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	9-Jun-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Other parameters							Trace metal constituents																		
		Hard.	Acidity	O&G	Tot. Alk.	Anions	Cations	Balance	Hg	Al-T	AL-D	As-D	B-D	Ba-D	Cd-D	Cr-D	Cu-D	Fe-D	Pb-D	Mn-D	Mo-D	Ni-D	Se-T	Se-D	Ag-D	Zn-D
		Mg/L (caco3)	Mg/L	Mg/L	Mg/L (caco3)	Meq/L	Meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sufco 057A	21-Sep-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 057A	27-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Surface Water																											
South Fork Upr.	11-Nov-2013	264	<5	<5	199	6	5.8	-1.9	<0.0002	0.05	<0.05	<0.05	<0.05	0.093	<0.005	<0.005	<0.005	<0.02	<0.02	<0.005	<0.01	<0.005	0.22	0.07	<0.005	<0.01
South Fork Upr.	1-Jul-2014	253	<5	<5	193	5.74	5.48	-2.3	<0.0002	0.5	<0.03	<0.01	0.03	0.097	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	0.002	<0.02	<0.02	<0.002	<0.004
South Fork Upr.	25-Sep-2014	255	<5	<5	175	5.57	5.61	0.33	<0.0002	0.07	<0.03	<0.01	0.04	0.104	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
South Fork Upr.	11-Nov-2014	274	<5	<5	202	6.22	6.03	-1.56	<0.0002	0.21	<0.03	<0.01	0.03	0.093	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
South Fork Upr.	29-Jul-2015	255	<5	<5	172	5.3	5.58	2.58	<0.0002	0.27	<0.03	<0.01	0.04	0.098	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	0.03	<0.02	<0.002	0.005
South Fork Upr.	9-Nov-2015	247	<5	---	177	5.55	5.49	-0.58	<0.0002	0.23	<0.03	<0.01	0.03	0.088	<0.001	<0.001	<0.01	<0.03	<0.01	0.003	<0.005	<0.001	0.02	<0.02	<0.002	<0.004
South Fork Upr.	9-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Upr.	14-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Upr.	29-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Upr.	18-Oct-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Upr.	21-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Fork Upr.	27-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SP60 Creek	30-Jun-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SP60 Creek	30-Jun-2017	227	<5	<5	273	6.03	6.57	<10.00	<0.0002	---	<0.03	<0.01	0.05	---	<0.001	---	<0.01	<0.03	<0.01	<0.002	0.008	---	---	---	---	<0.004
SP60 Creek	28-Sep-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SP60 Creek	10-Nov-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SP60 Creek	19-Jun-2018	272	<5	<5	427	9.43	8.99	-2.42	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SP60 Creek	25-Sep-2018	197	<5	<5	456	10.08	10.28	0.99	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SP60 Creek	14-Nov-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	11-Nov-2013	260	<5	<6	198	6	5.7	-2.2	<0.0002	0.2	<0.05	<0.05	<0.05	0.093	51.8	<0.005	<0.005	<0.02	<0.02	<0.005	<0.01	<0.005	0.21	0.07	<0.005	<0.01
Skutumpah Ck. Upr.	2-Jul-2014	203	<5	<5	232	5.82	5.57	-2.24	<0.0002	1.03	<0.03	<0.01	0.04	0.14	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	0.002	<0.02	<0.02	<0.002	<0.004
Skutumpah Ck. Upr.	25-Sep-2014	261	<5	5.71	182	0.16	<5	5.73	<0.0002	0.26	<0.03	<0.01	0.04	0.108	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	0.02	<0.02	<0.002	<0.004
Skutumpah Ck. Upr.	11-Nov-2014	267	<5	<5	189	5.96	5.89	-0.54	<0.0002	0.1	<0.03	<0.01	0.03	0.092	<0.001	<0.001	<0.01	<0.03	<0.01	0.003	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Skutumpah Ck. Upr.	29-Jul-2015	262	<5	NM	183	5.53	5.71	1.54	<0.0002	0.52	<0.03	<0.01	0.04	0.103	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Skutumpah Ck. Upr.	9-Nov-2015	246	<5	NM	173	5.48	5.56	0.73	<0.0002	0.2	<0.03	<0.01	0.03	0.091	<0.001	<0.001	<0.01	<0.03	<0.01	0.003	<0.005	<0.001	0.02	<0.02	<0.002	0.015
Skutumpah Ck. Upr.	9-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	14-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	29-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	18-Oct-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	21-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skutumpah Ck. Upr.	27-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	8-Nov-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	1-Jul-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	21-Nov-2014	249	<5	<5	232	6.8	6.3	-3.79	<0.0002	2.22	<0.03	<0.01	0.03	0.104	<0.001	<0.001	<0.01	<0.03	<0.01	<0.002	<0.005	<0.001	<0.02	<0.02	<0.002	<0.004
Skut. Creek Middle	31-Jul-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	14-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	23-Jul-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	15-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	28-Jul-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	12-Dec-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Skut. Creek Middle	3-Jul-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

		Other parameters							Trace metal constituents																		
		Hard.	Acidity	O&G	Tot. Alk.	Anions	Cations	Balance	Hg	Al-T	AL-D	As-D	B-D	Ba-D	Cd-D	Cr-D	Cu-D	Fe-D	Pb-D	Mn-D	Mo-D	Ni-D	Se-T	Se-D	Ag-D	Zn-D
		Mg/L (caco3)	Mg/L	Mg/L	Mg/L (caco3)	Meq/L	Meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sufco 006A	19-Oct-2009	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Jun-2010	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	15-Sep-2010	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	1-Nov-2010	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	17-Jun-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	21-Sep-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	12-Oct-2011	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	1-Jun-2012	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	12-Sep-2012	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	1-Nov-2012	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	27-Jun-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	16-Sep-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	23-Oct-2013	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-May-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	17-Sep-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Oct-2014	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	23-Jun-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	23-Sep-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	8-Nov-2015	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Jun-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	25-Sep-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	11-Nov-2016	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Jun-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	28-Aug-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	2-Nov-2017	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	9-Jun-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	8-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sufco 006A	26-Oct-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
North Fork Upper	30-Jun-2017	202	<5	<5	282	5.97	4.16	<10.00	---	---	<0.03	<0.01	0.02	---	<0.001	---	<0.01	<0.03	<0.01	<0.002	0.007	---	---	---	---	<0.004
North Fork Upper	28-Sep-2017	176	<5	---	164	3.76	3.65	-1.46	---	---	<0.03	0.01	0.02	---	<0.001	---	<0.01	<0.03	<0.01	<0.002	0.008	---	---	0.04	---	<0.004
North Fork Upper	10-Nov-2017	190	<5	---	214	4.76	4.07	-7.86	---	---	<0.03	<0.01	0.02	---	<0.001	---	<0.01	<0.03	<0.01	<0.002	0.010	---	---	0.03	---	<0.004
North Fork Upper	19-Jun-2018	185	<5	<5	174	4.06	3.89	-2.11	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
North Fork Upper	25-Sep-2018	177	<5	<5	156	3.64	3.70	0.94	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
North Fork Upper	14-Nov-2018	216	<5	<5	194	4.78	4.66	-1.29	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Appendix B

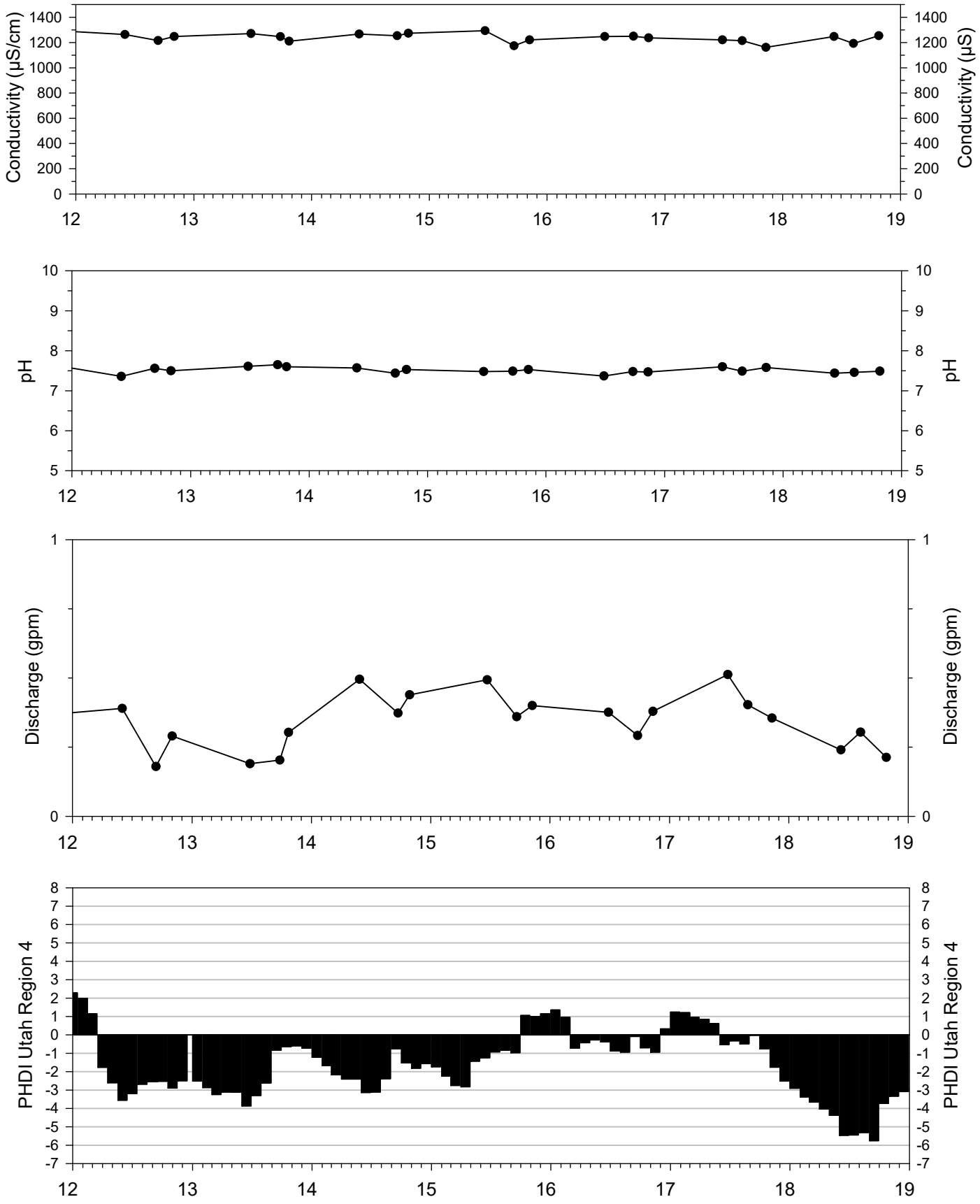
Plots of discharge rates and

water-quality parameters for

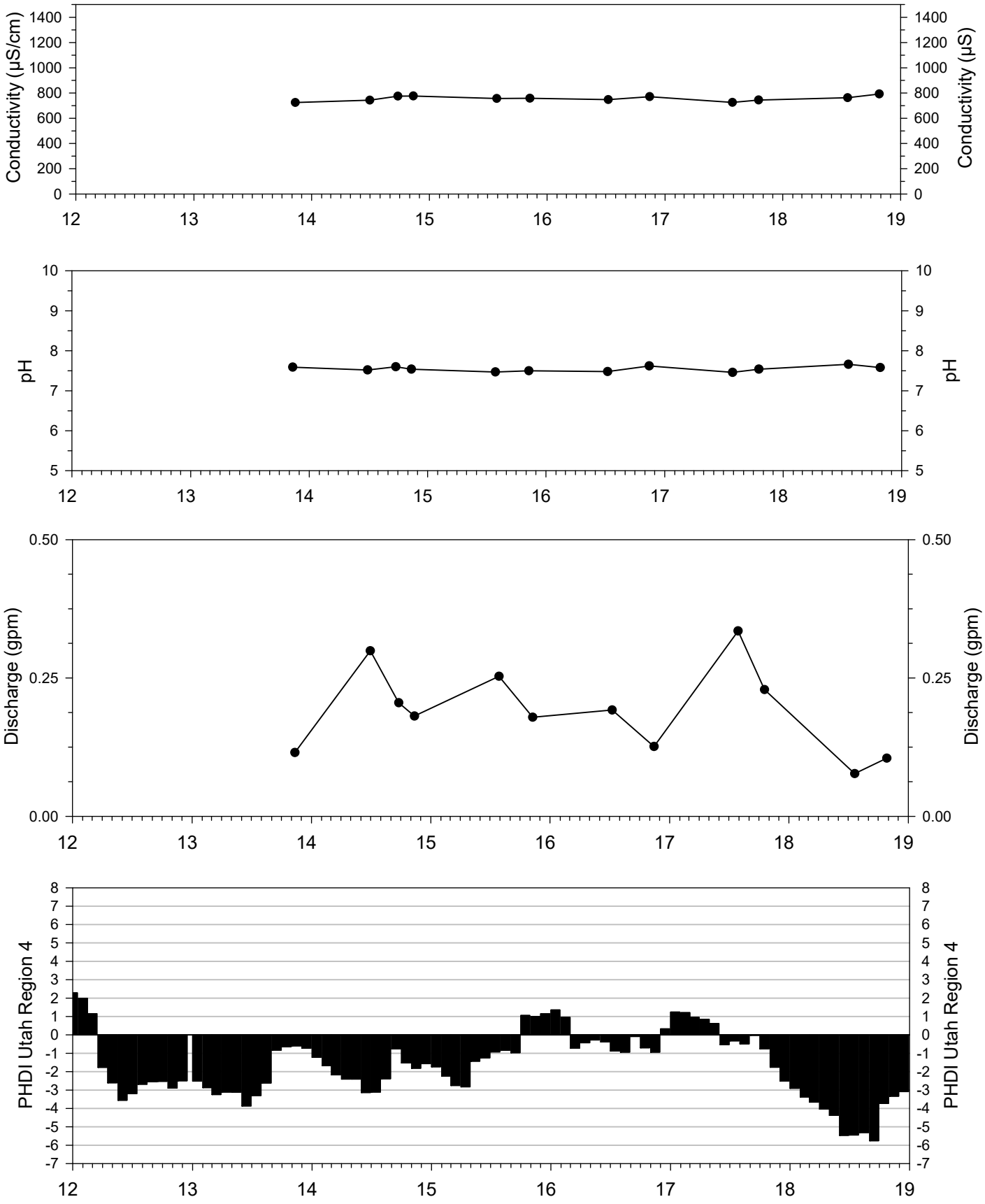
springs and streams in the

South Fork Lease Modification Area

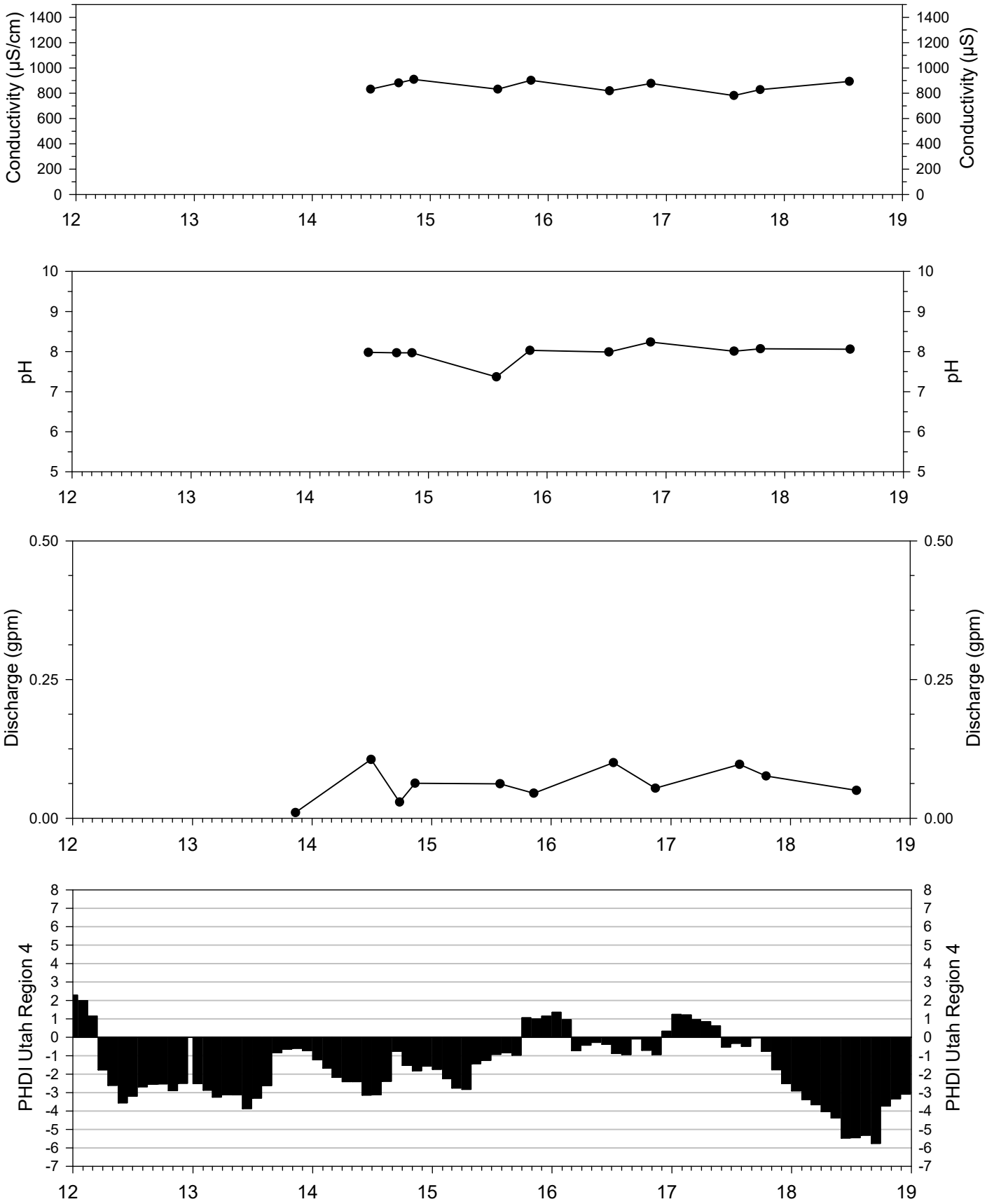
006A Spring


Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4
12
13
14
15
16
17
18
19

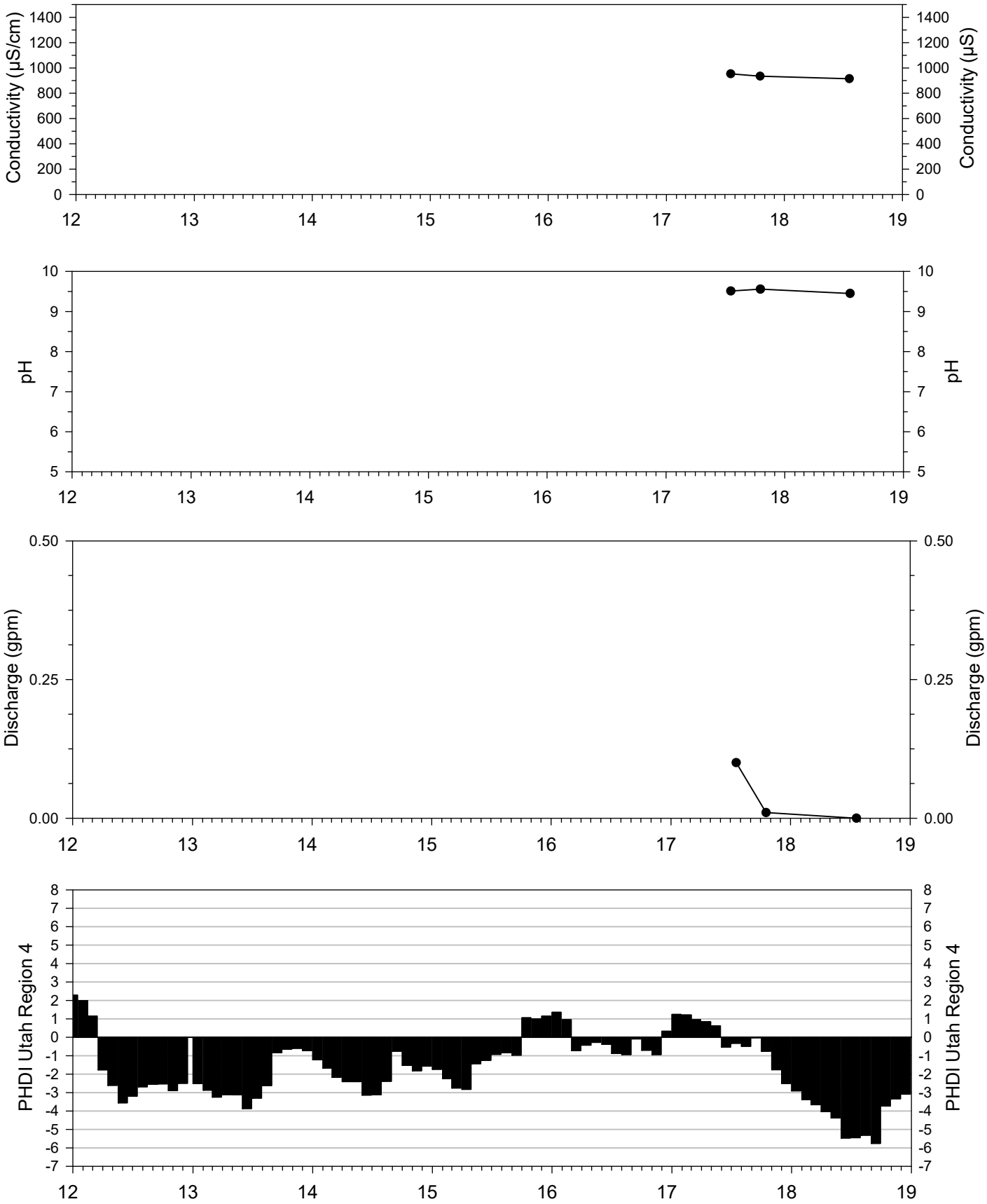
Spring 94-110



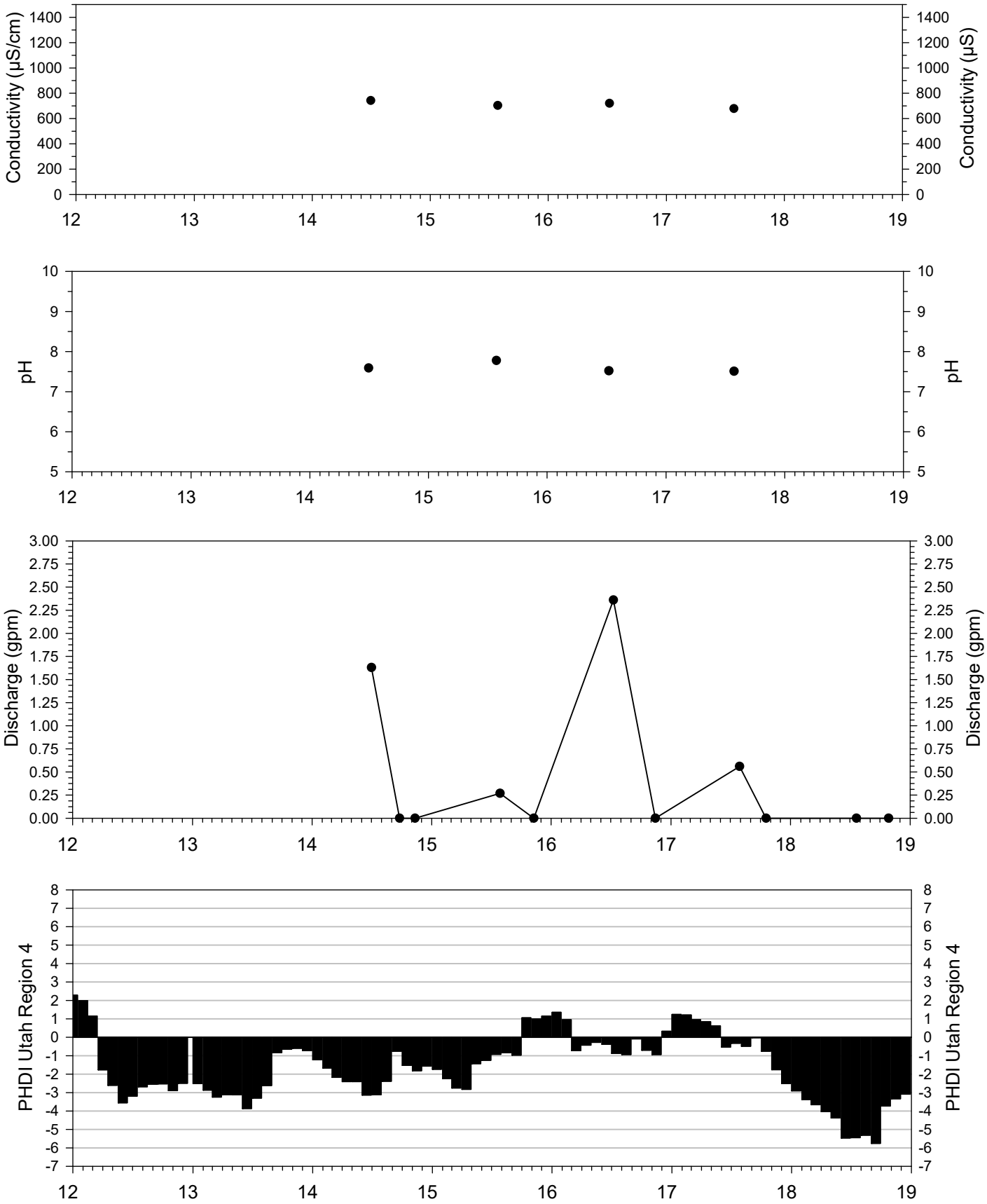
Spring A2S-1


Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4

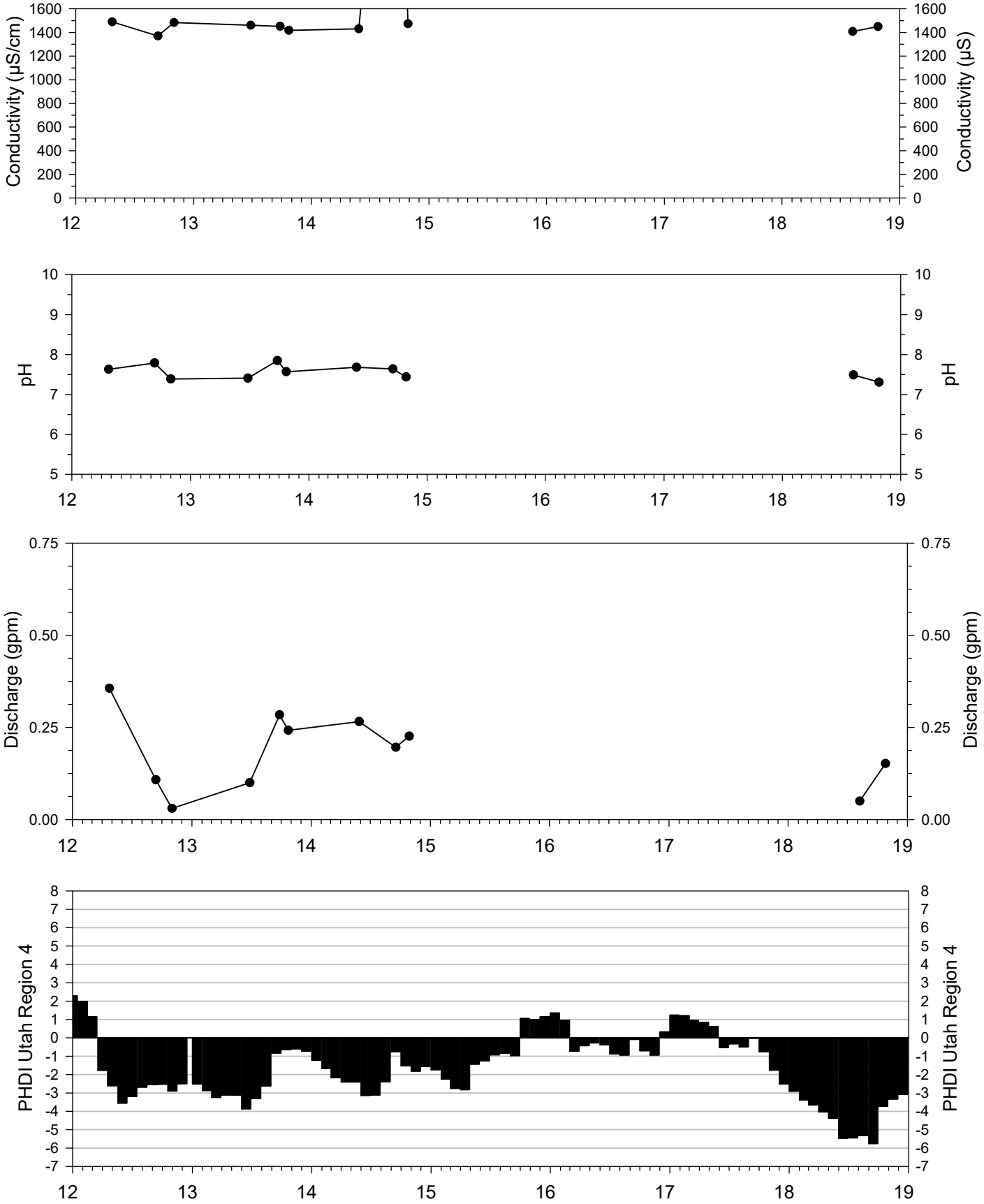
Andersen Spring



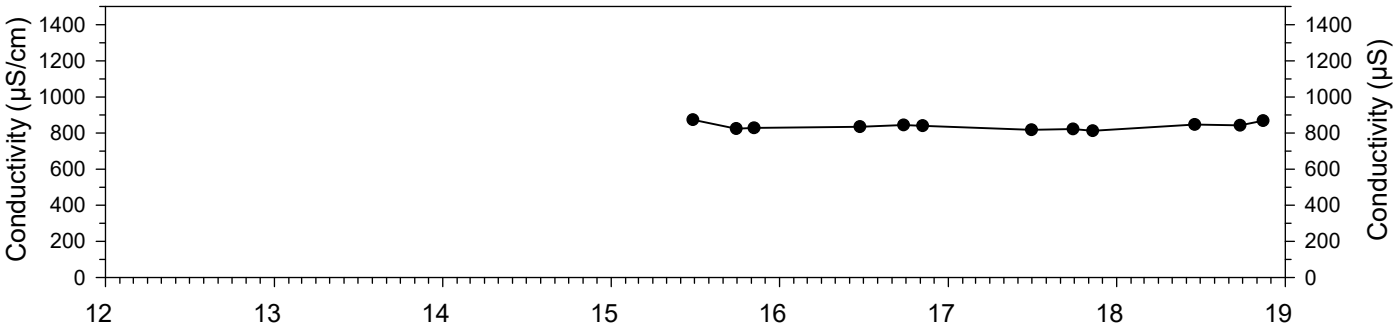
Divide Spring

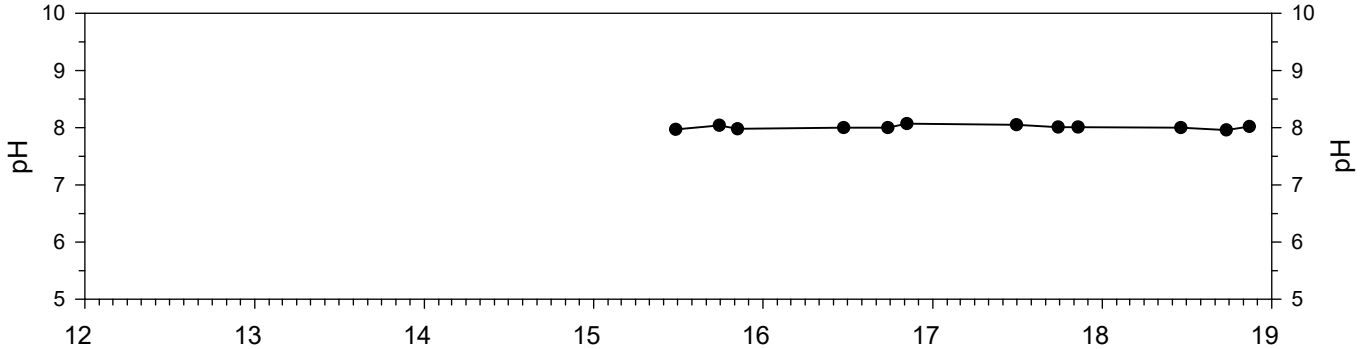


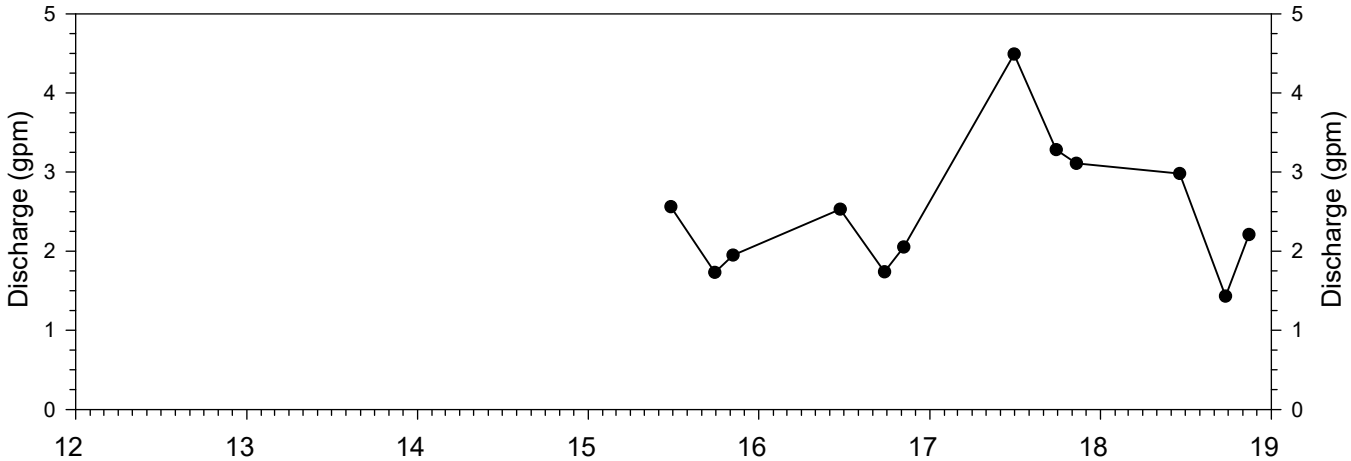
Hansen Seep

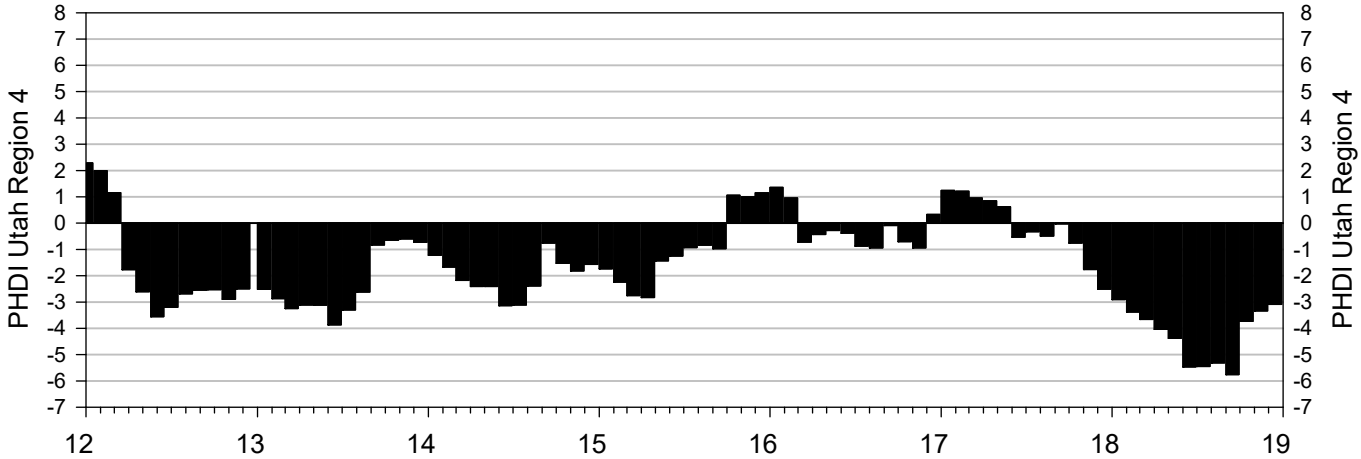

Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4

Spring M-SP19

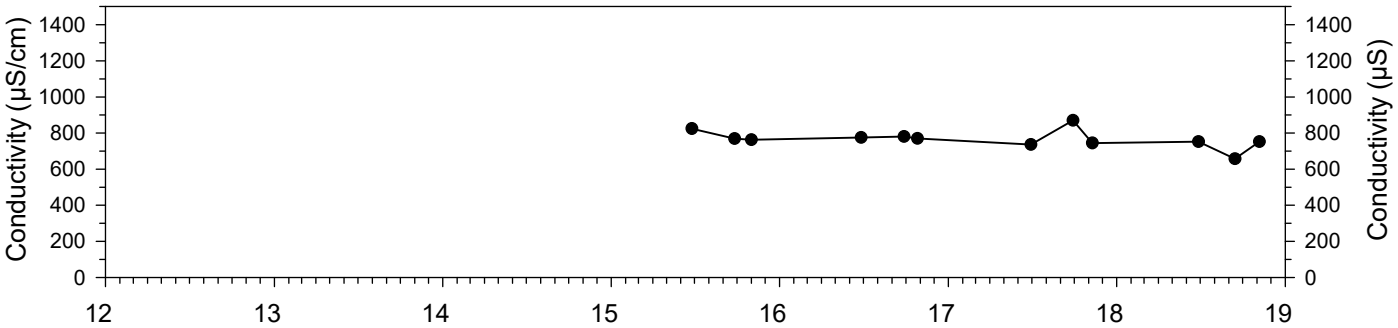


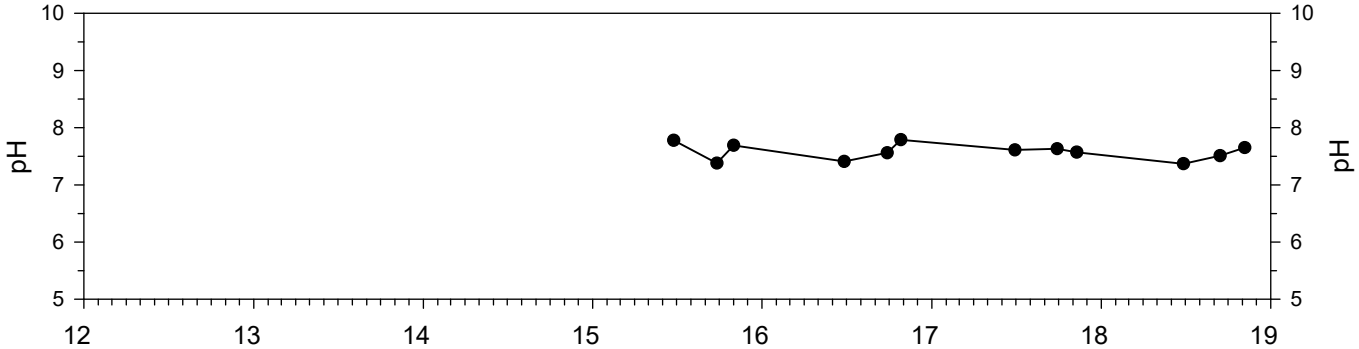


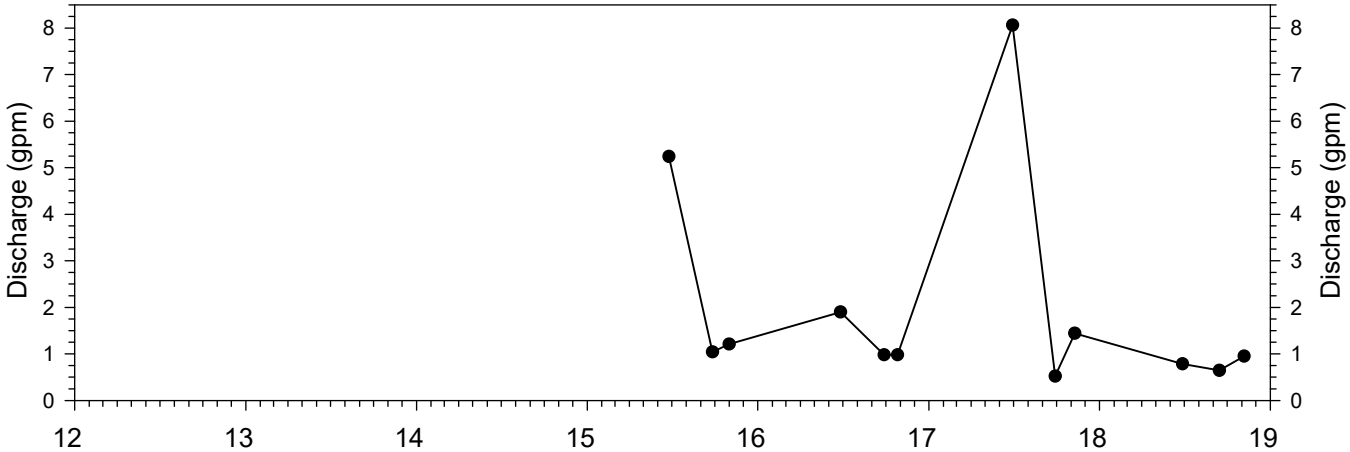


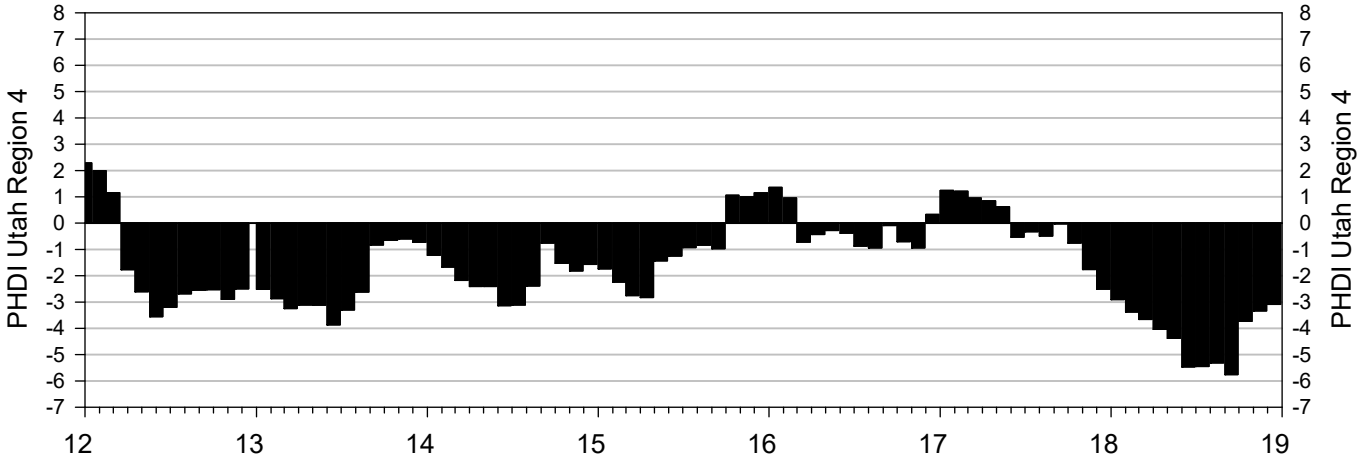


Spring M-SP20

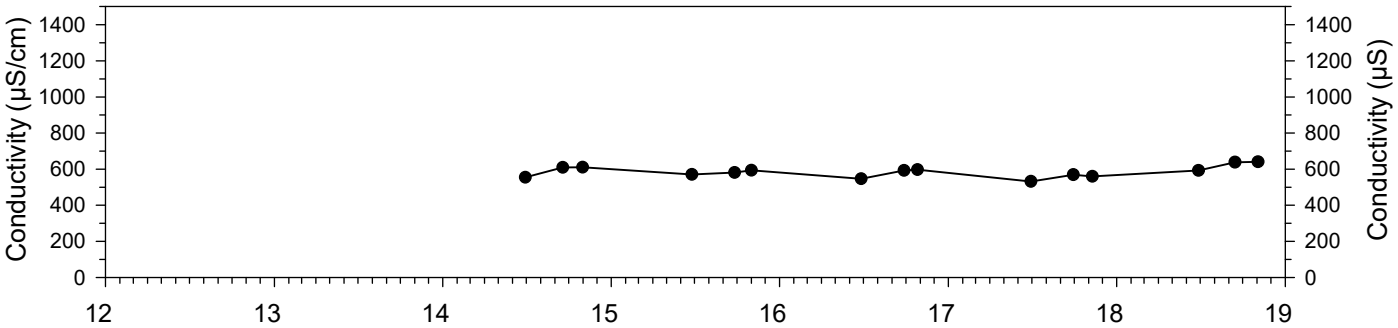


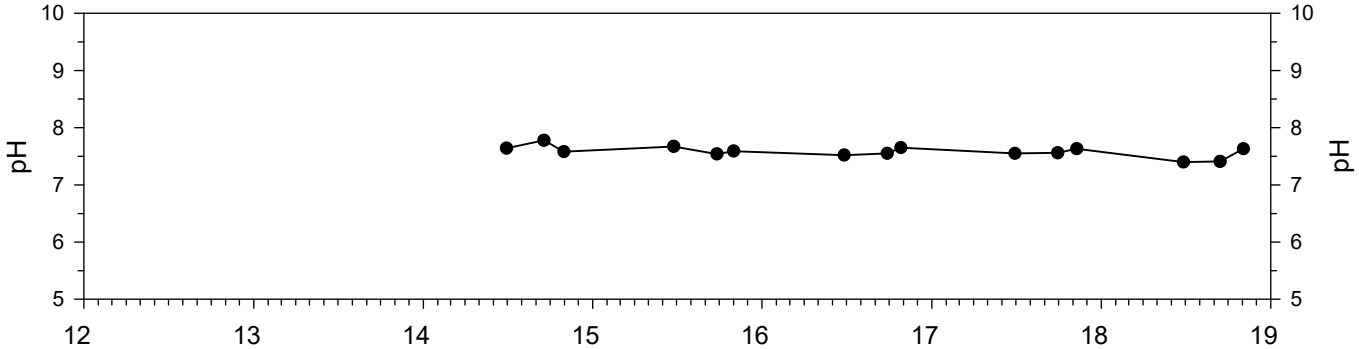


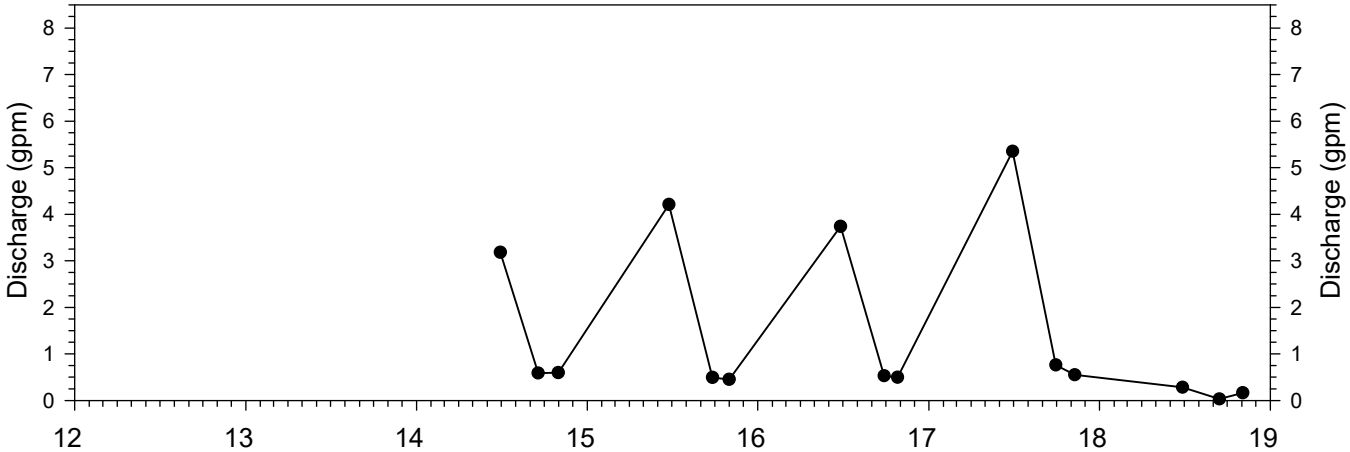


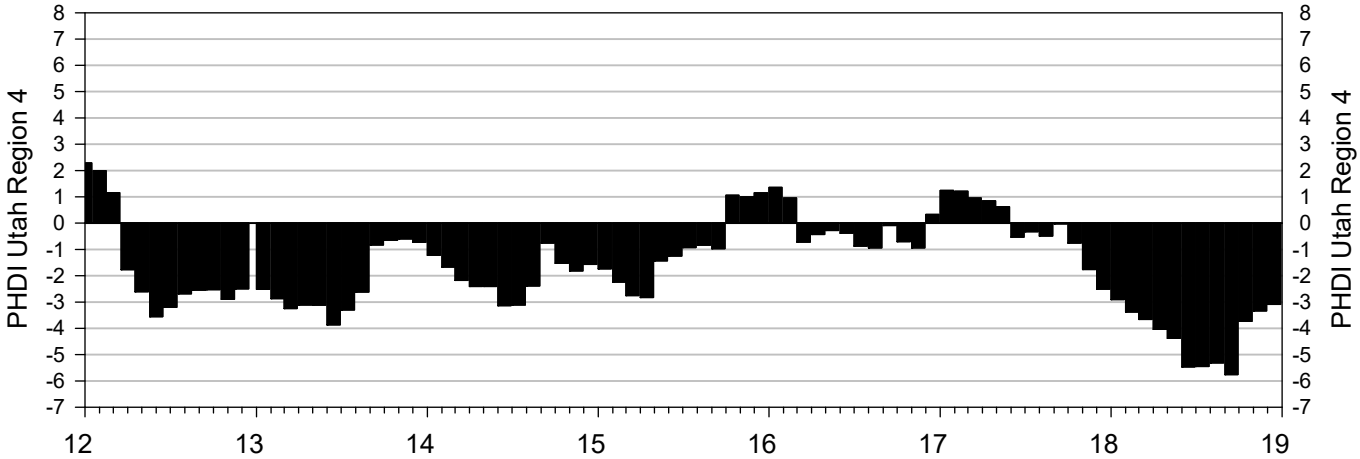


Spring M-SP44

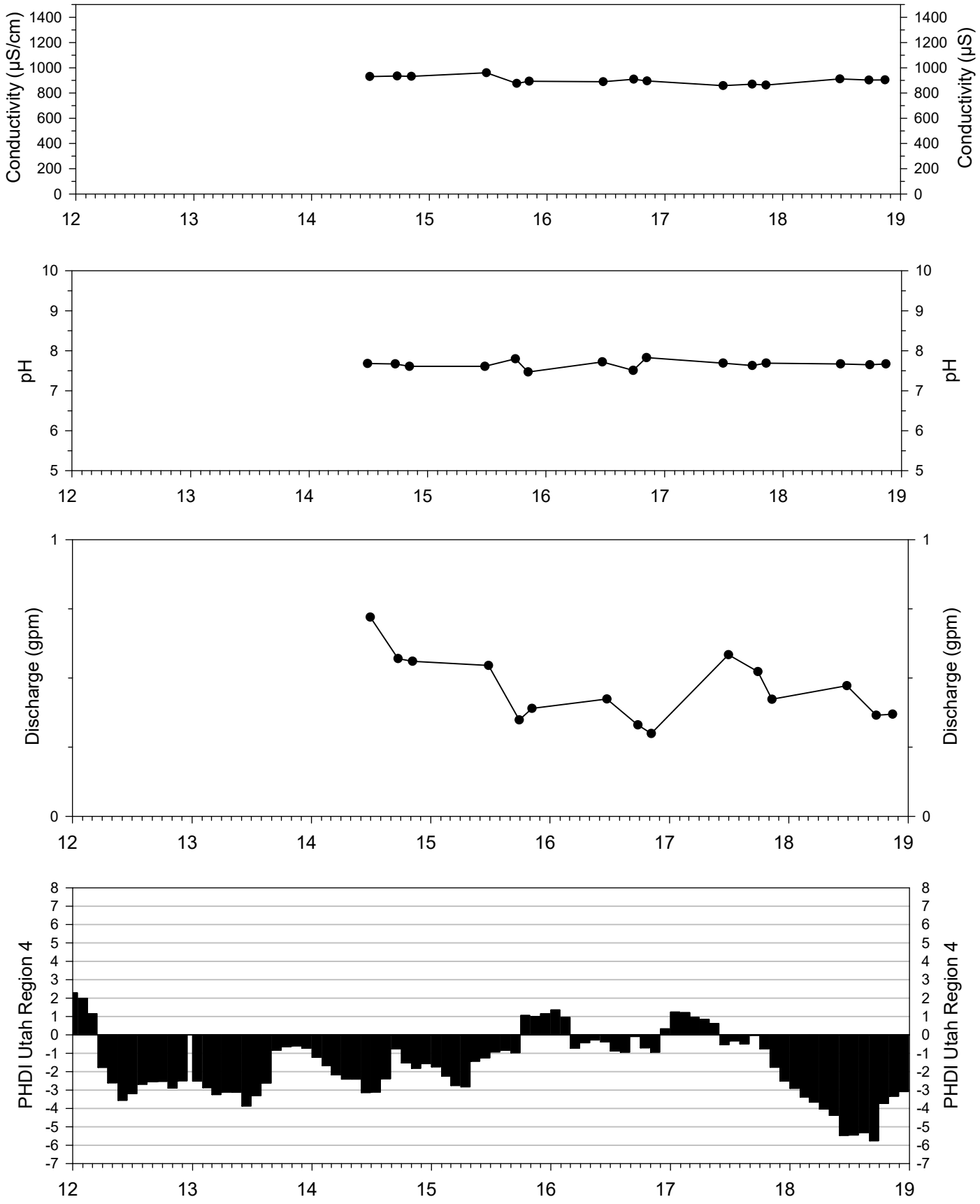




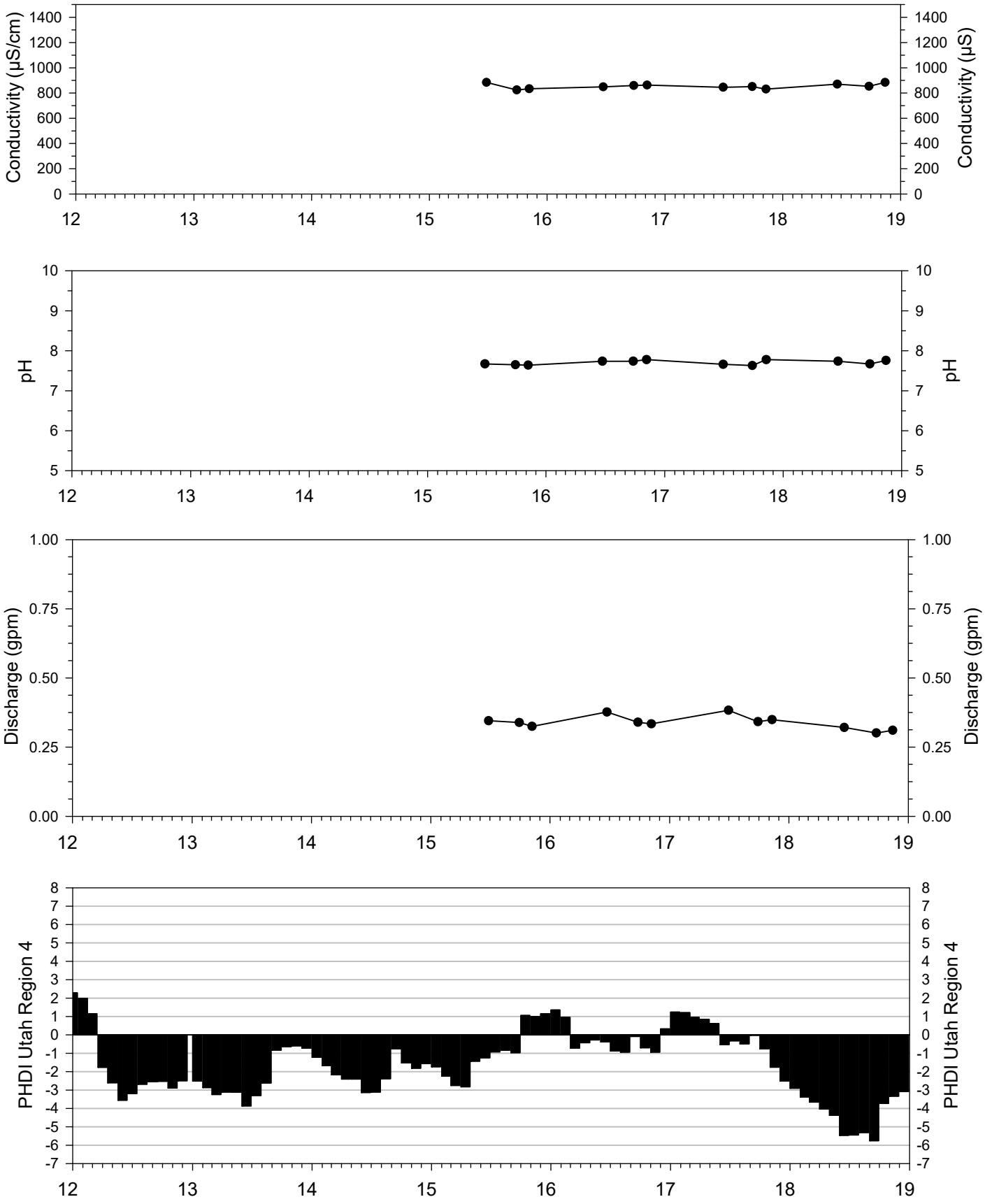




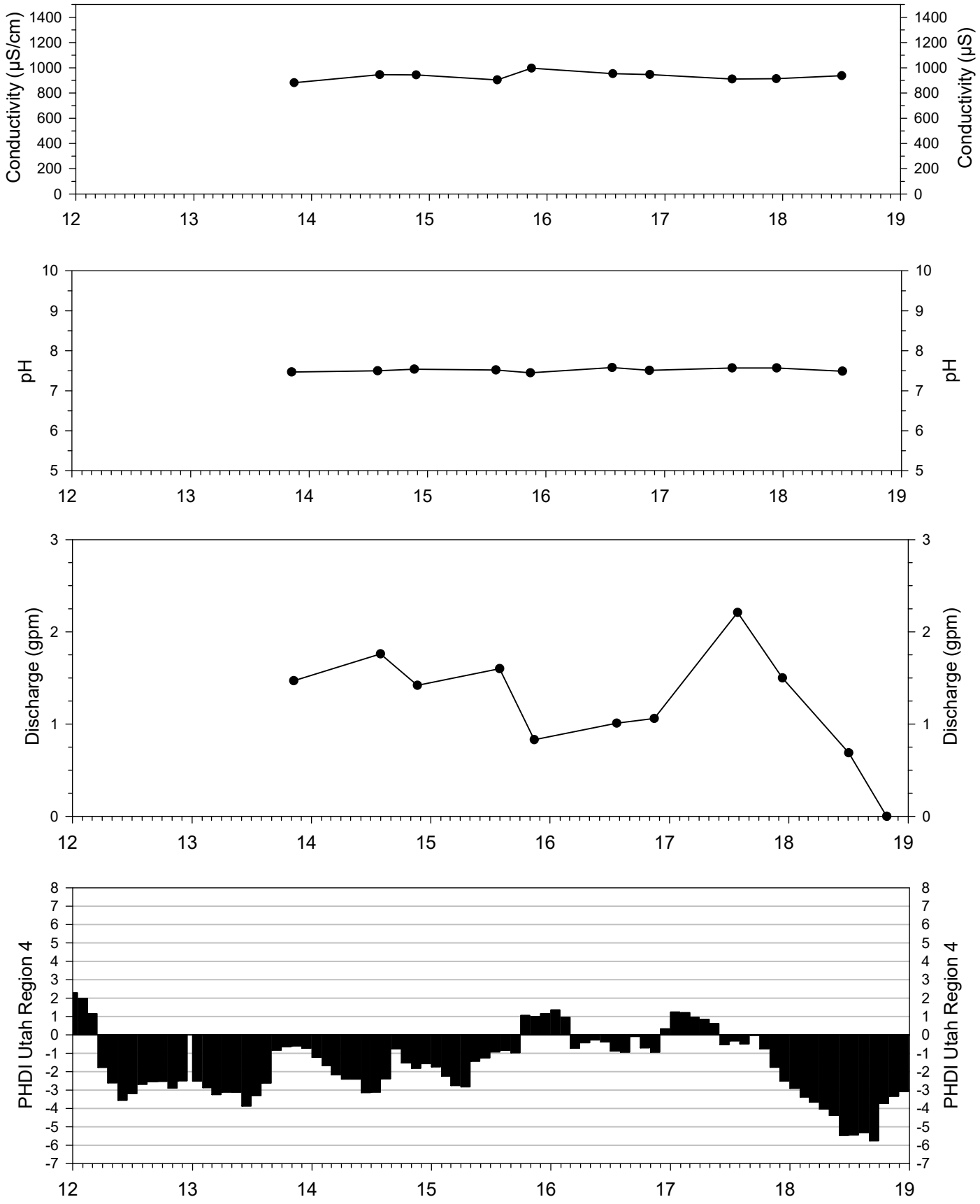
Spring M-SP60



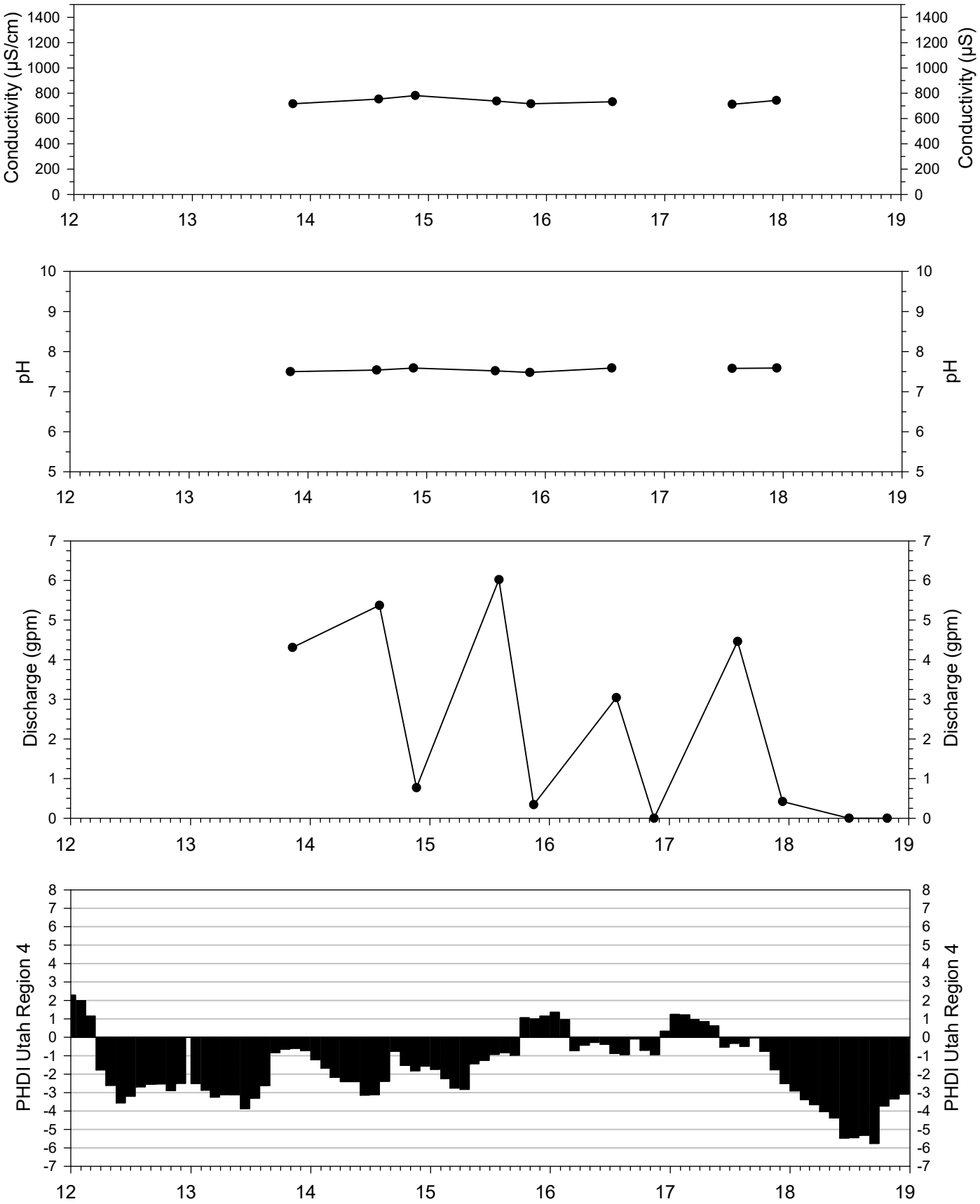
Spring M-SP106



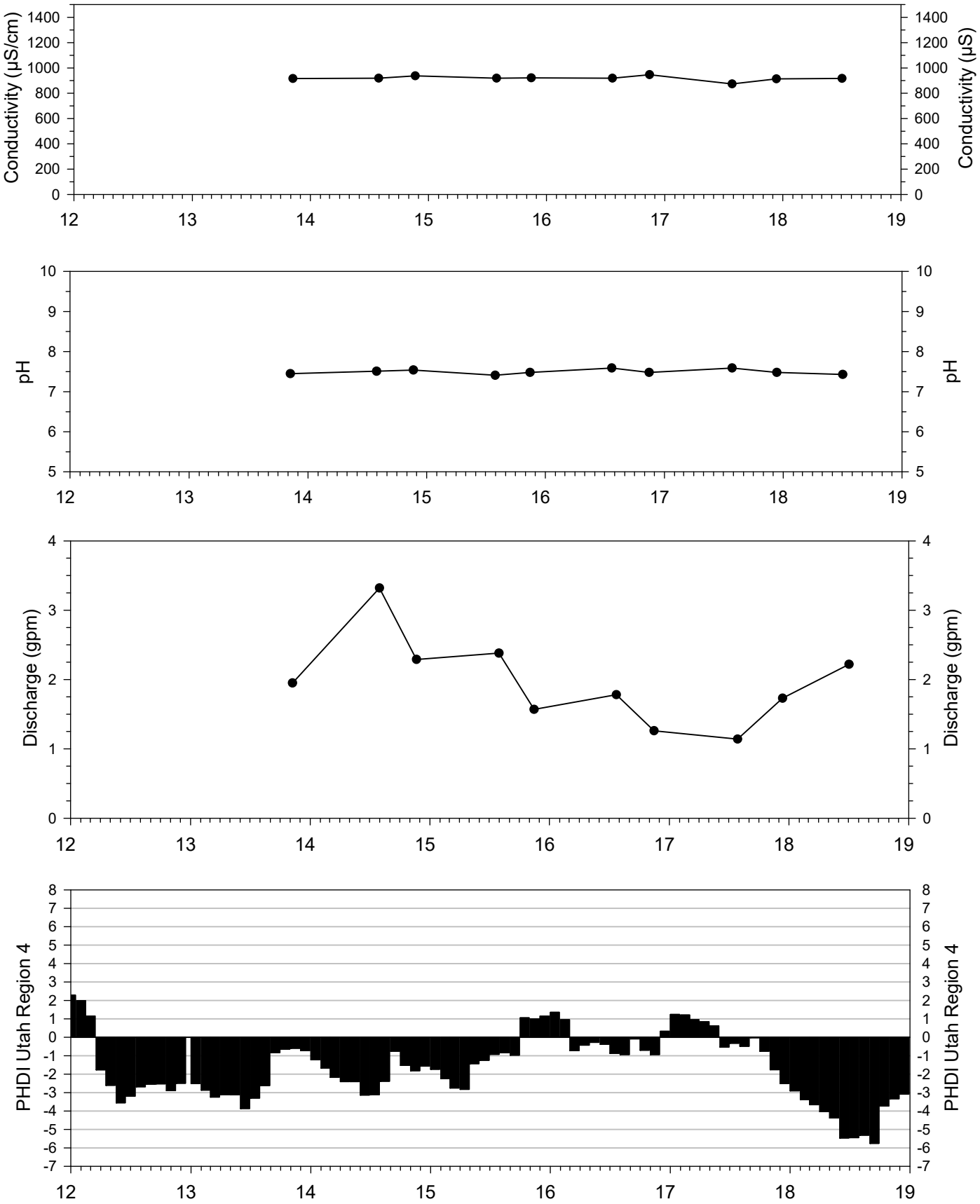
Spring A


Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4

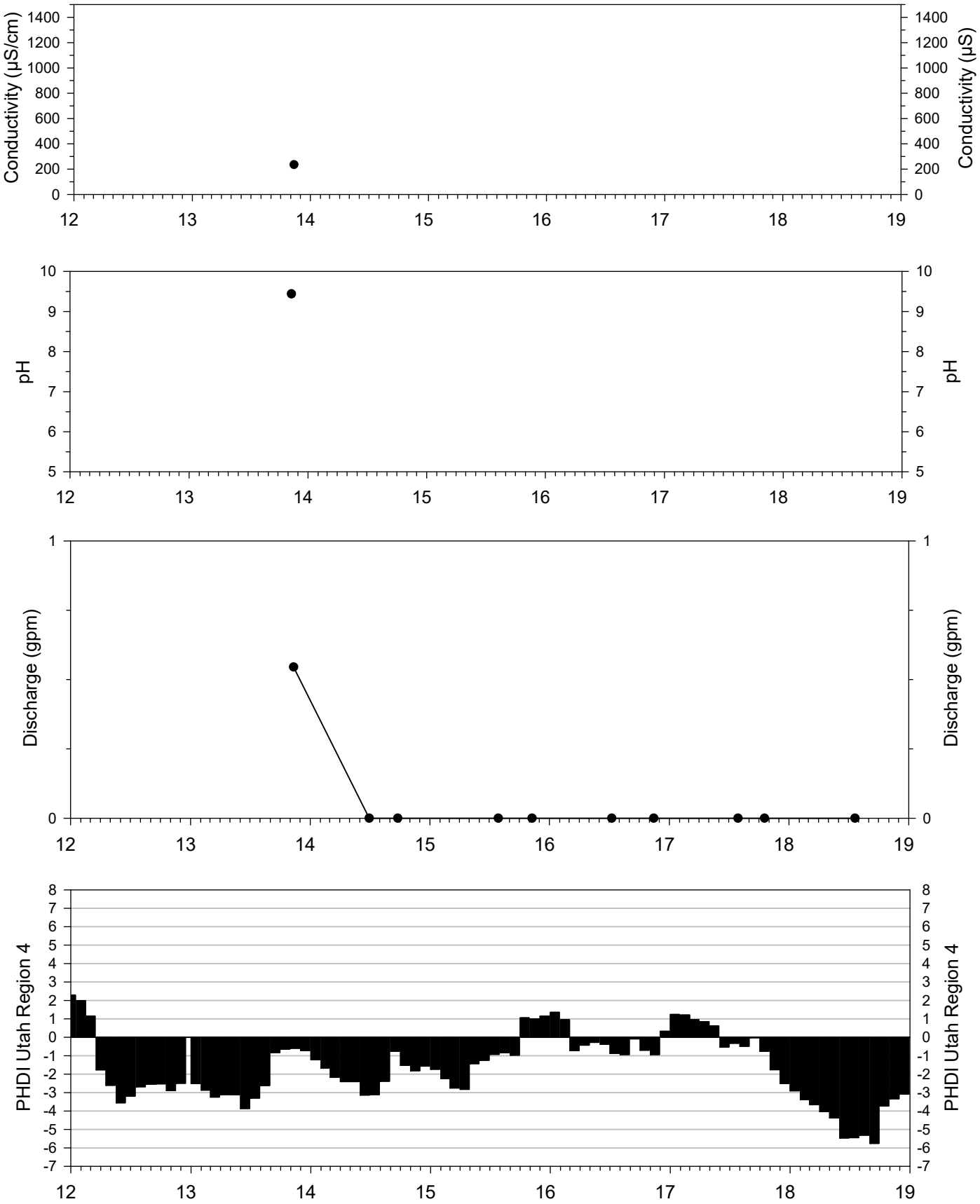
Spring B


Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4

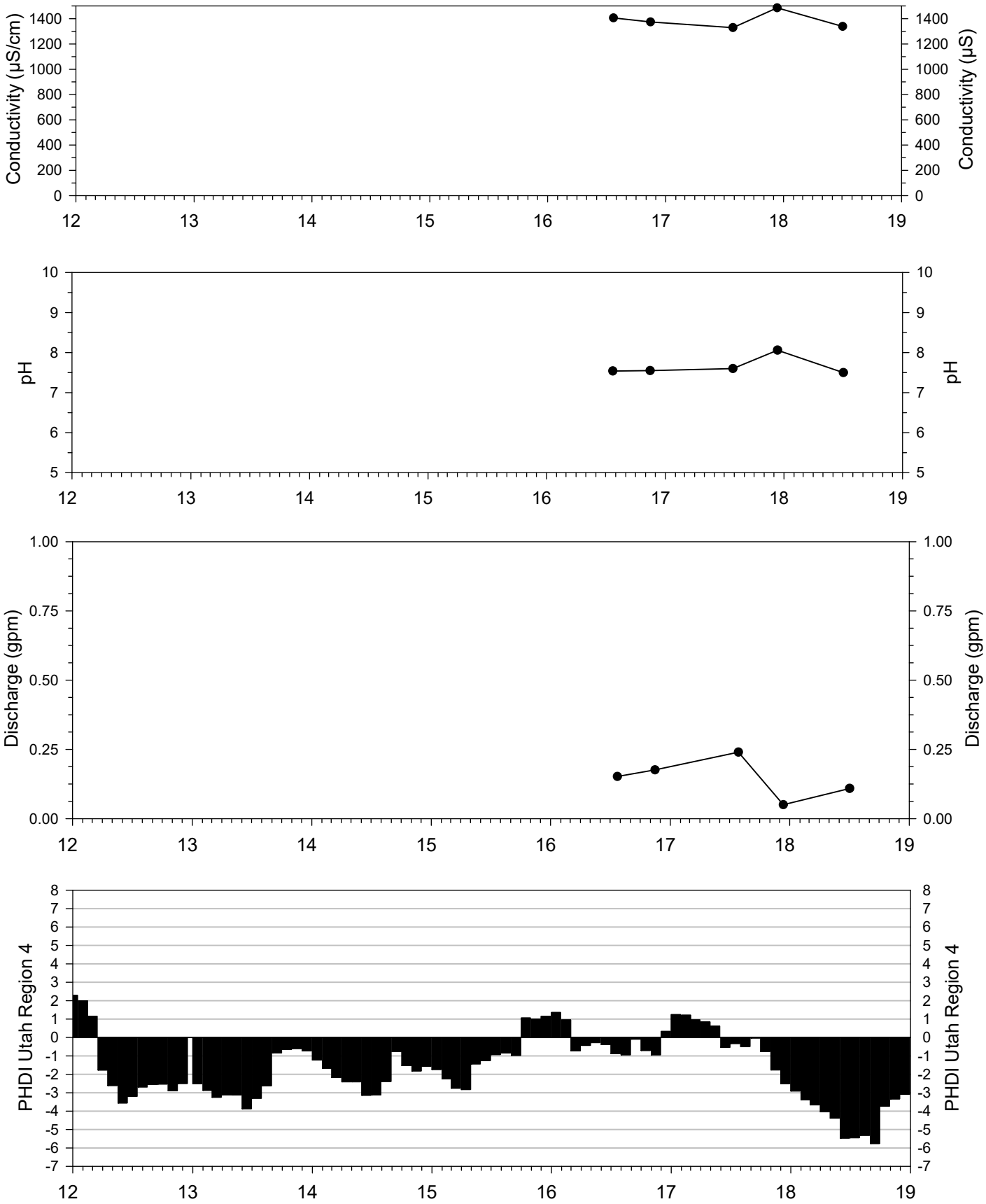
Spring C


Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4

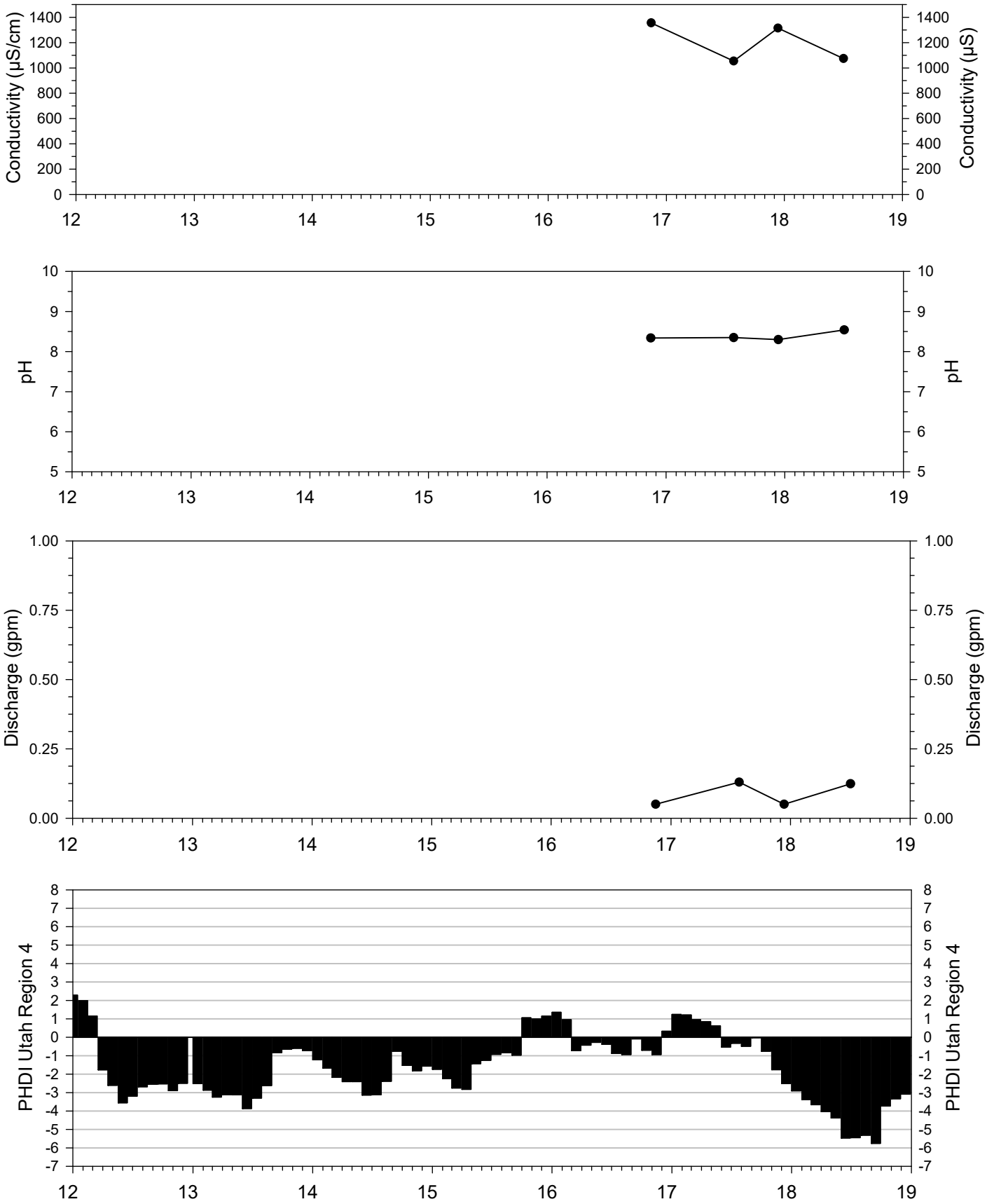
Spring D


Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4

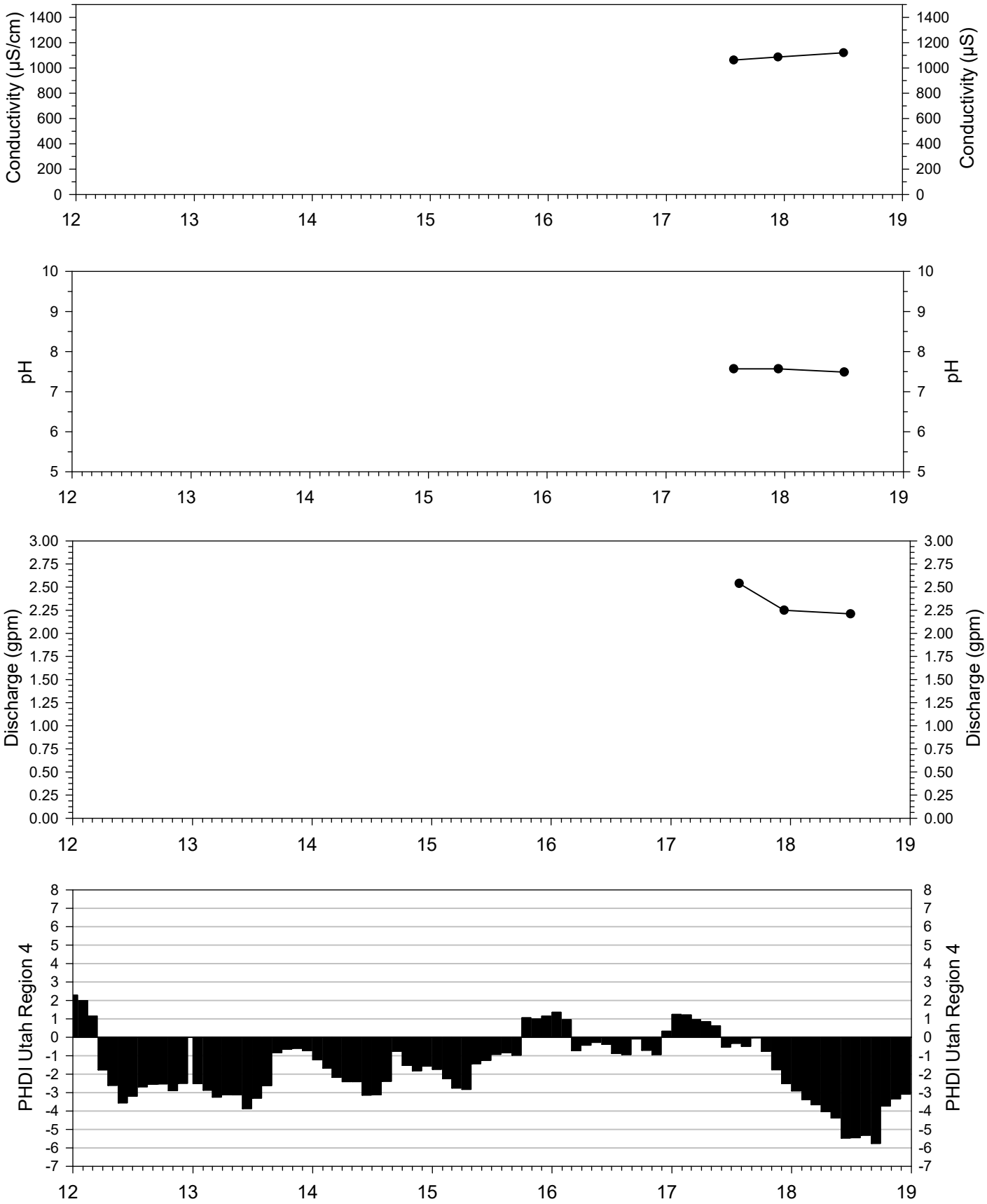
Seep G


Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4

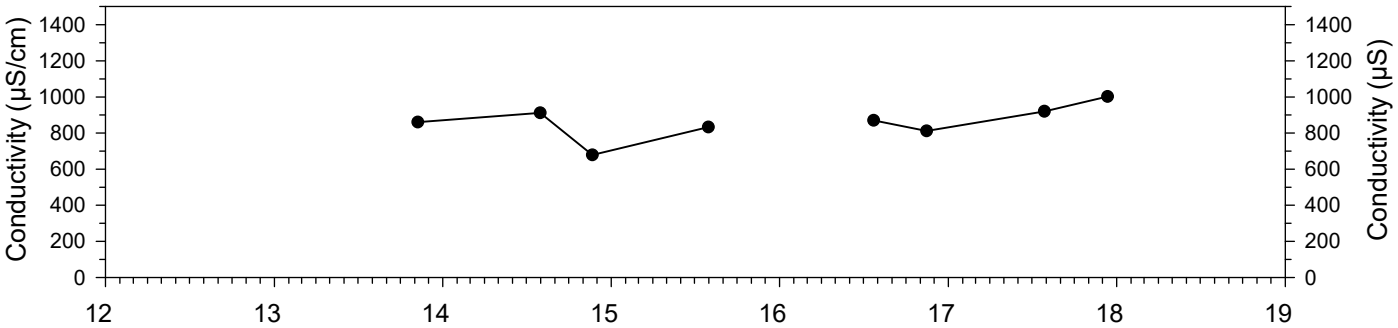
Seep H

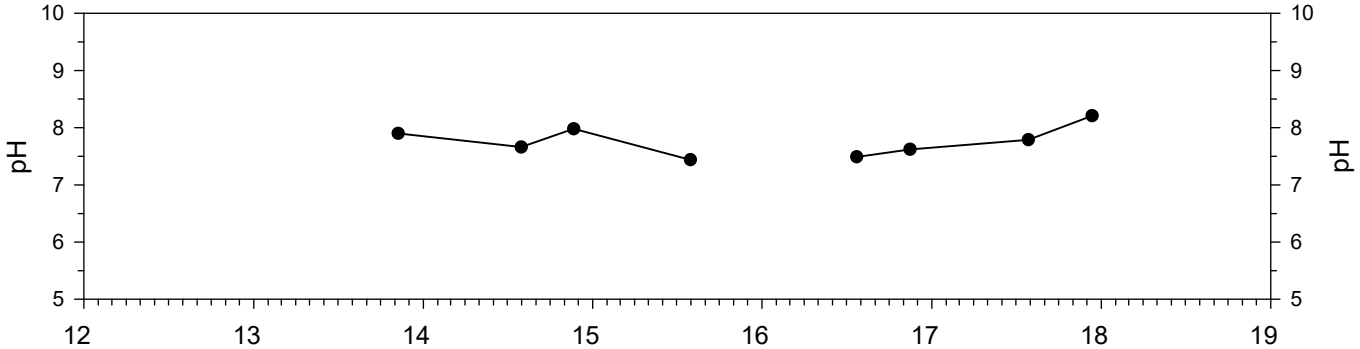

Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4

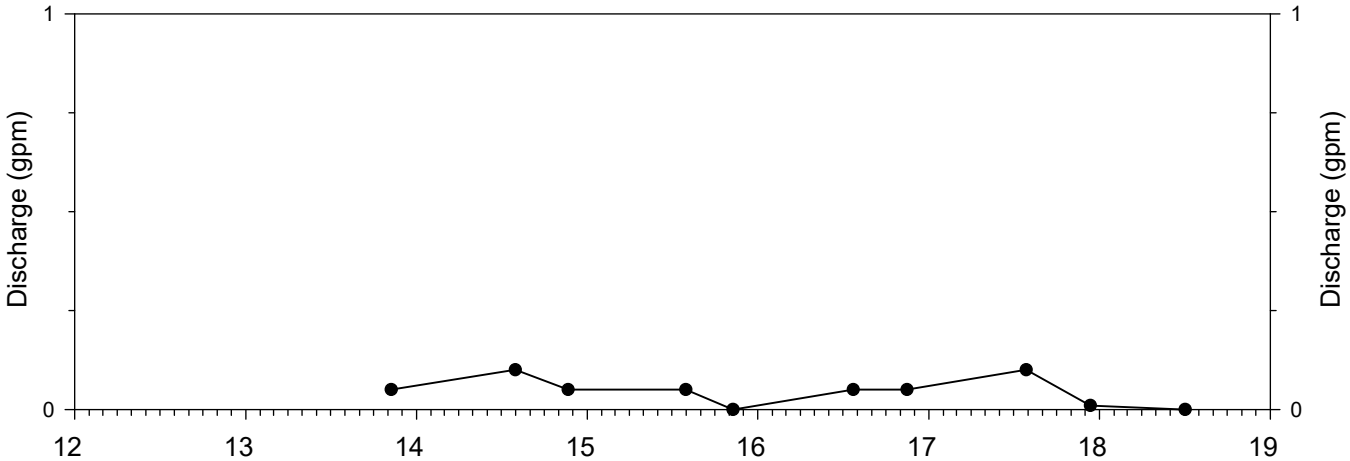
Seep I

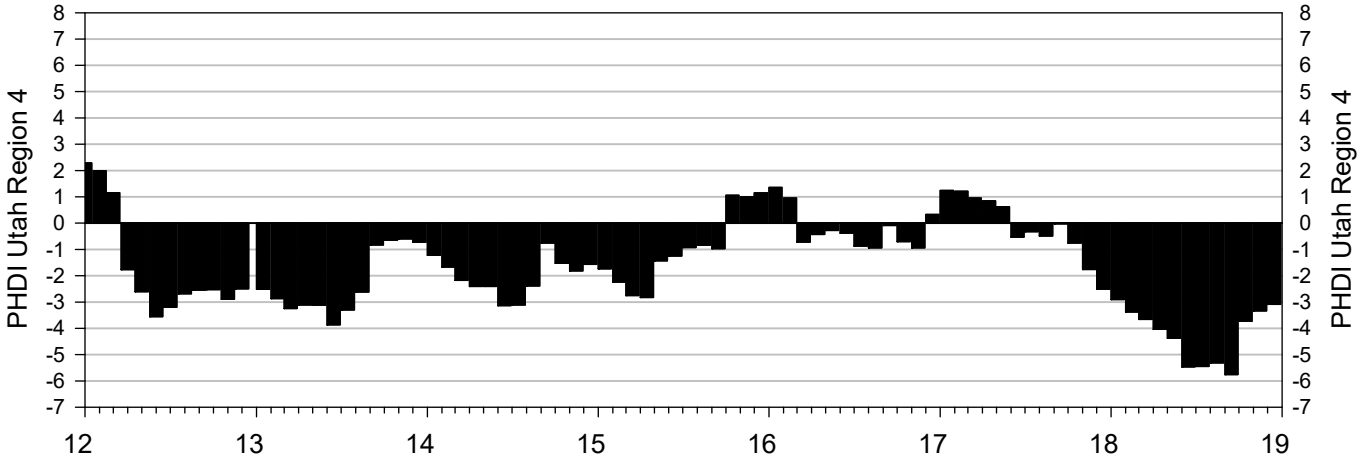

Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4
12
13
14
15
16
17
18
19

Skutumpah Seep 1









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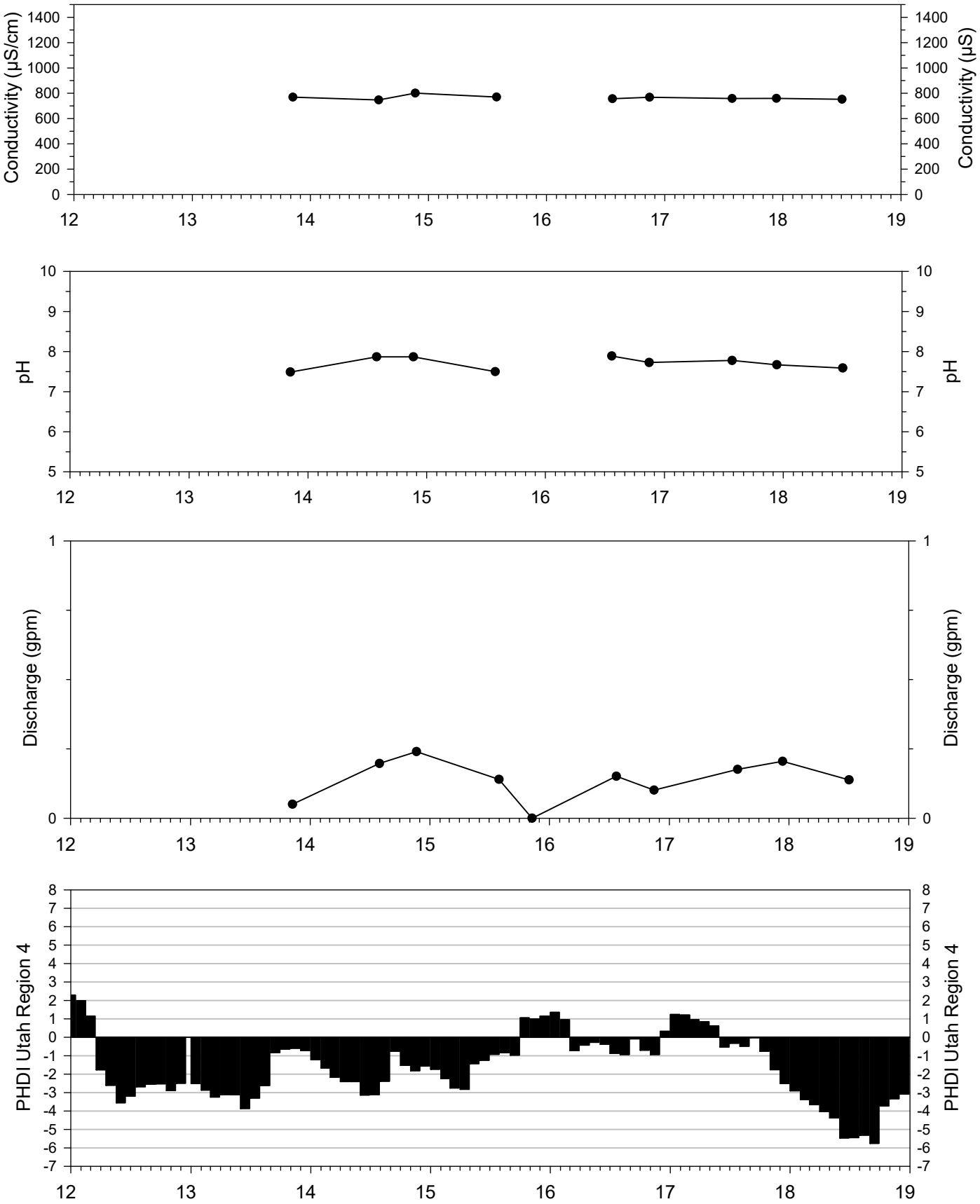

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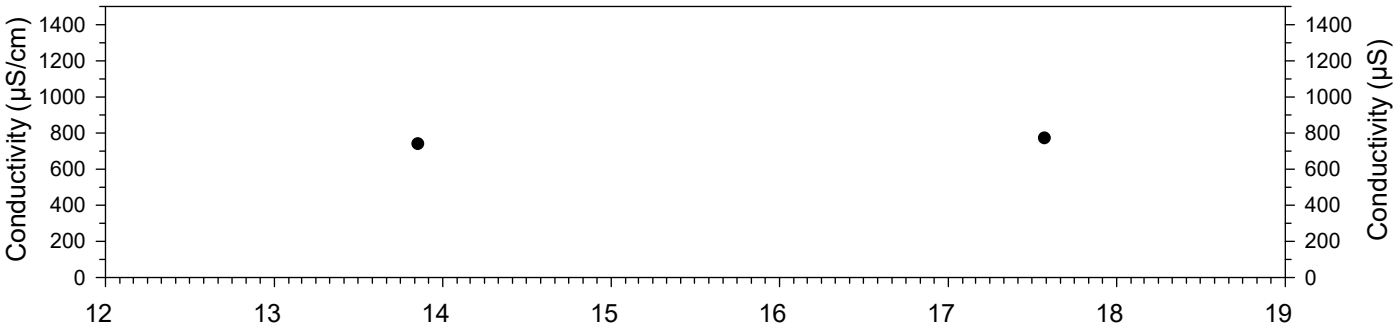
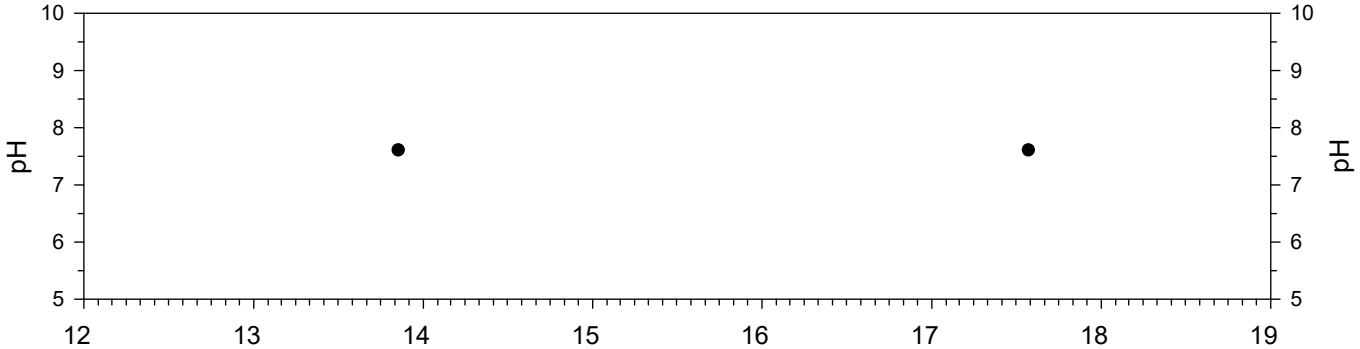
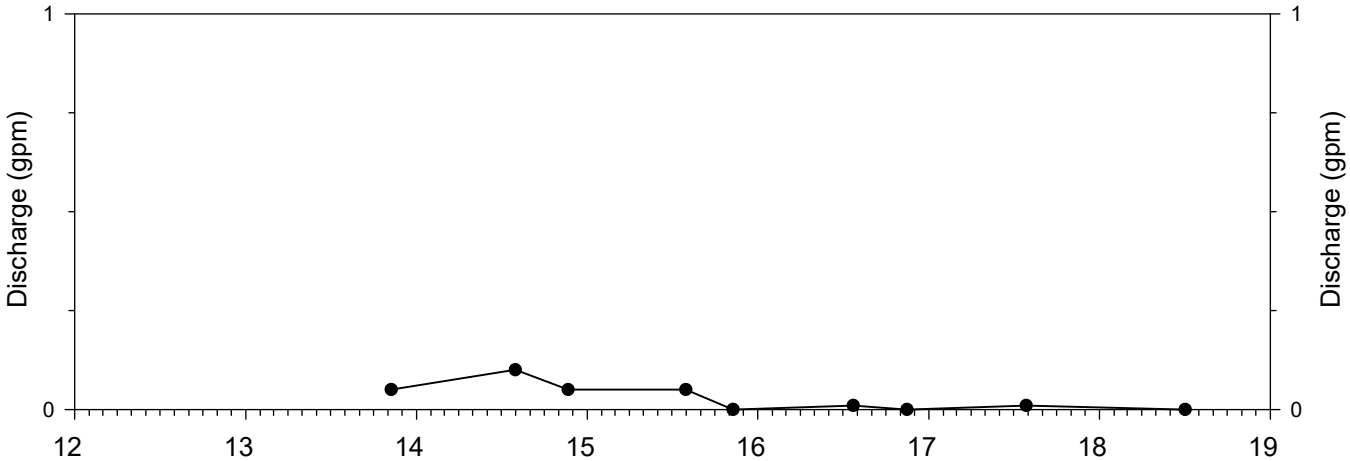
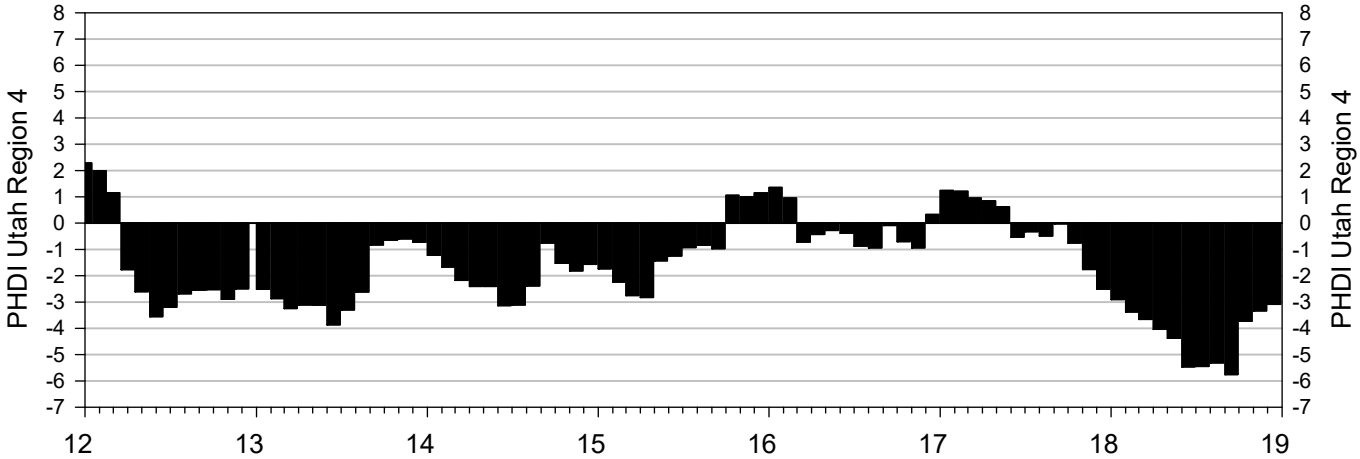
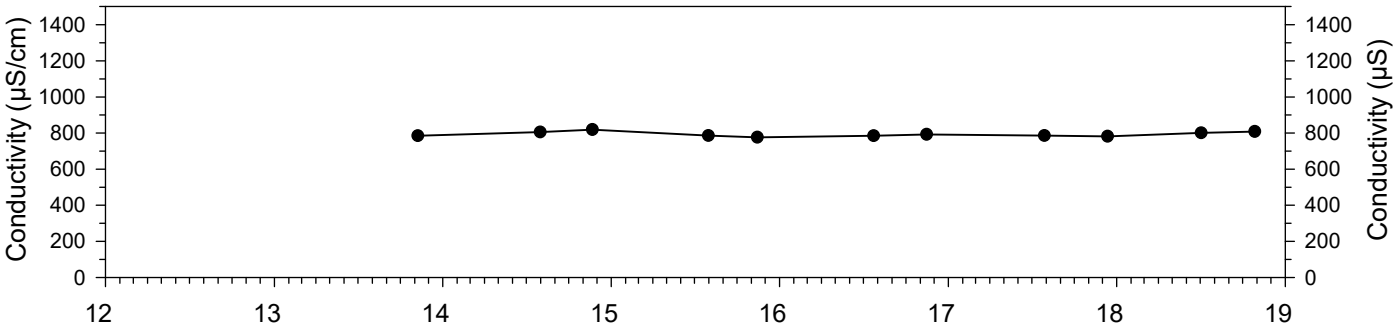


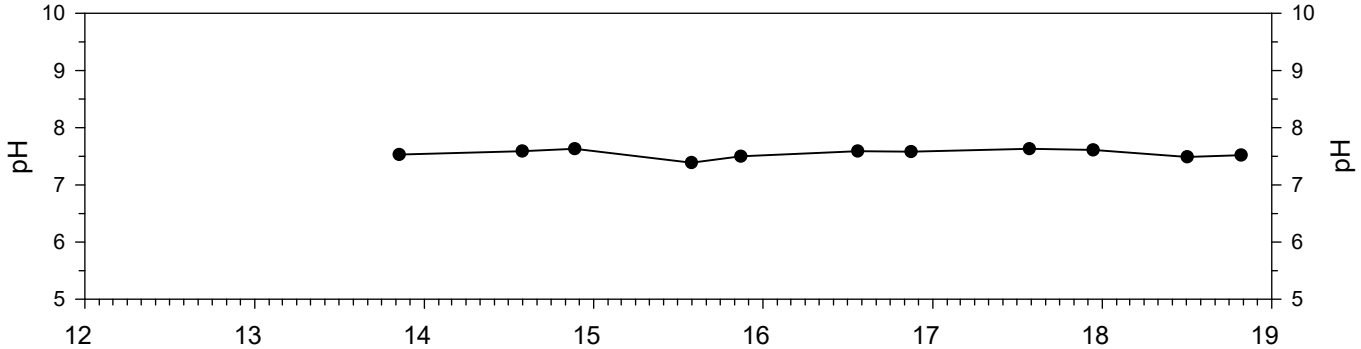


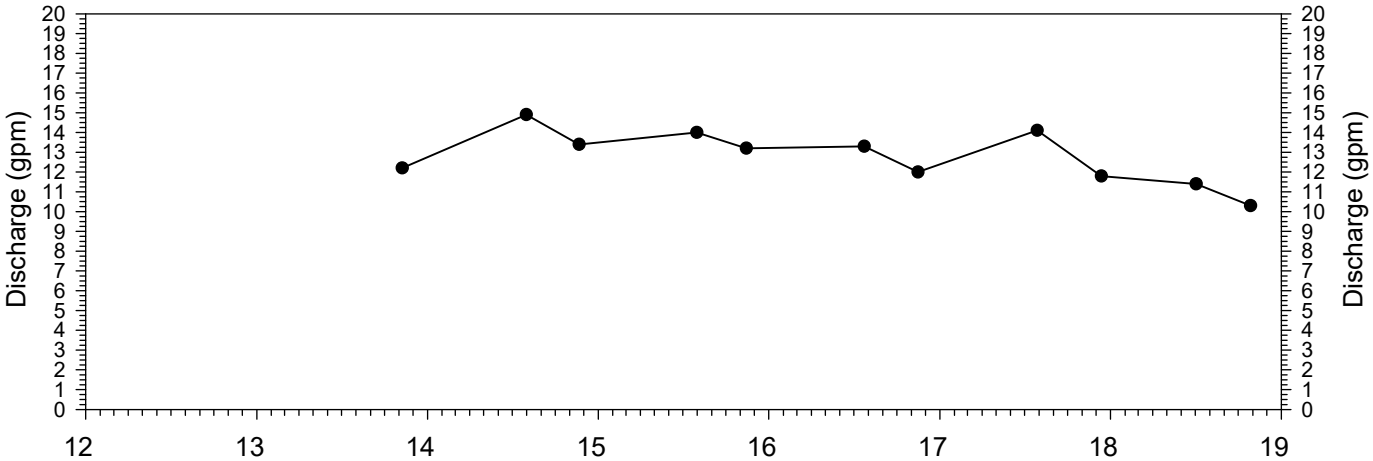


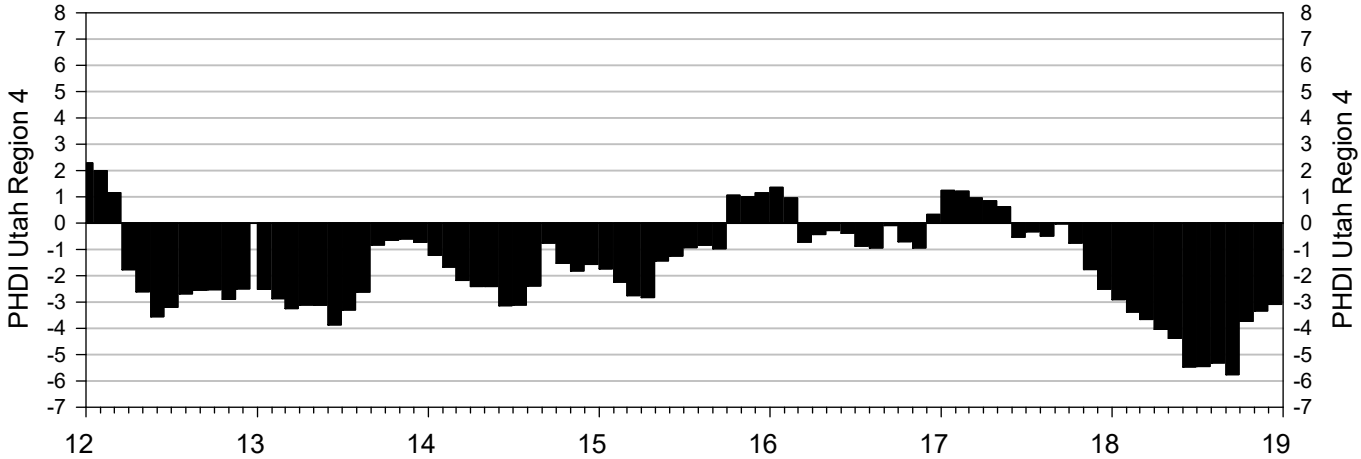


Skutumpah Spring

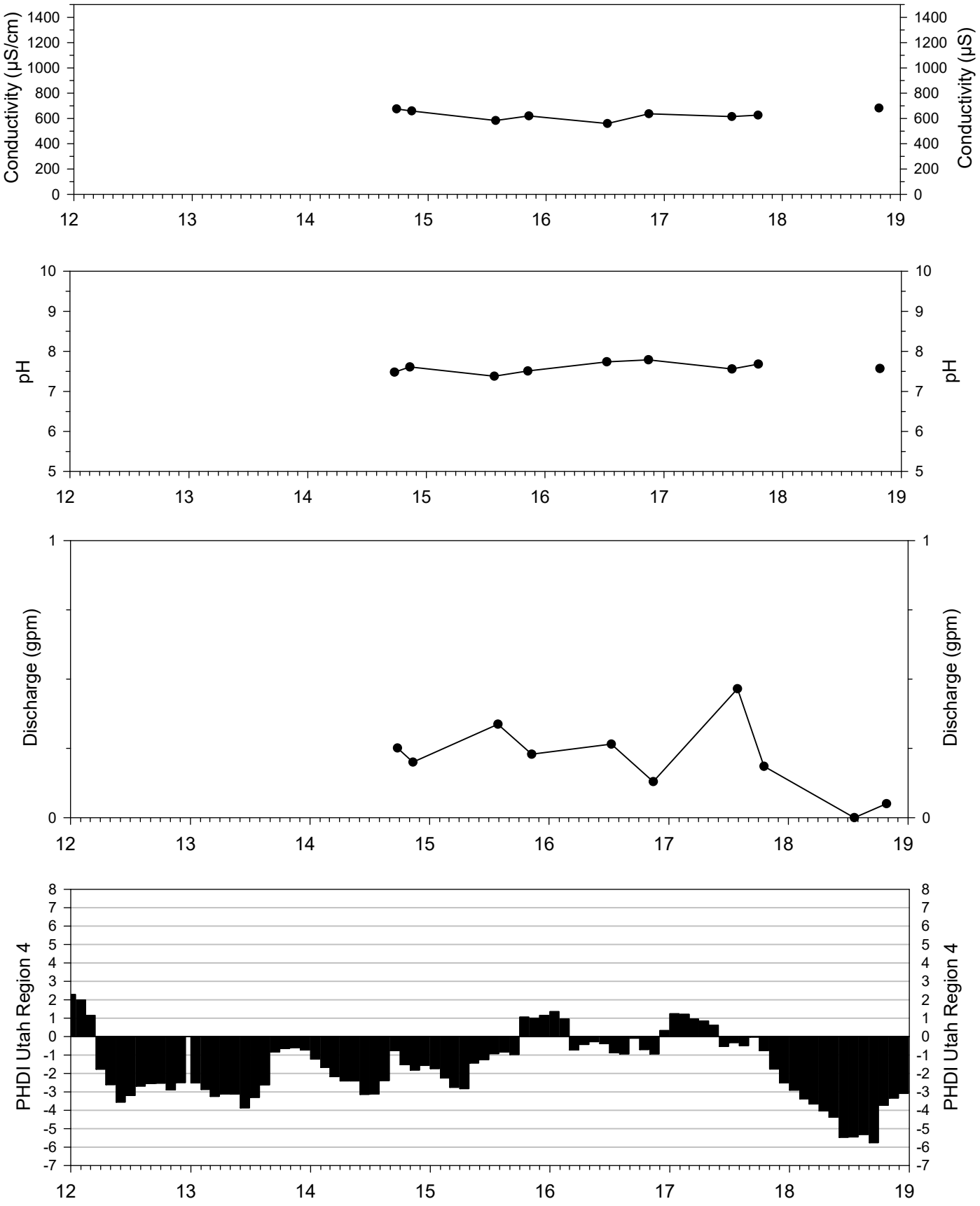




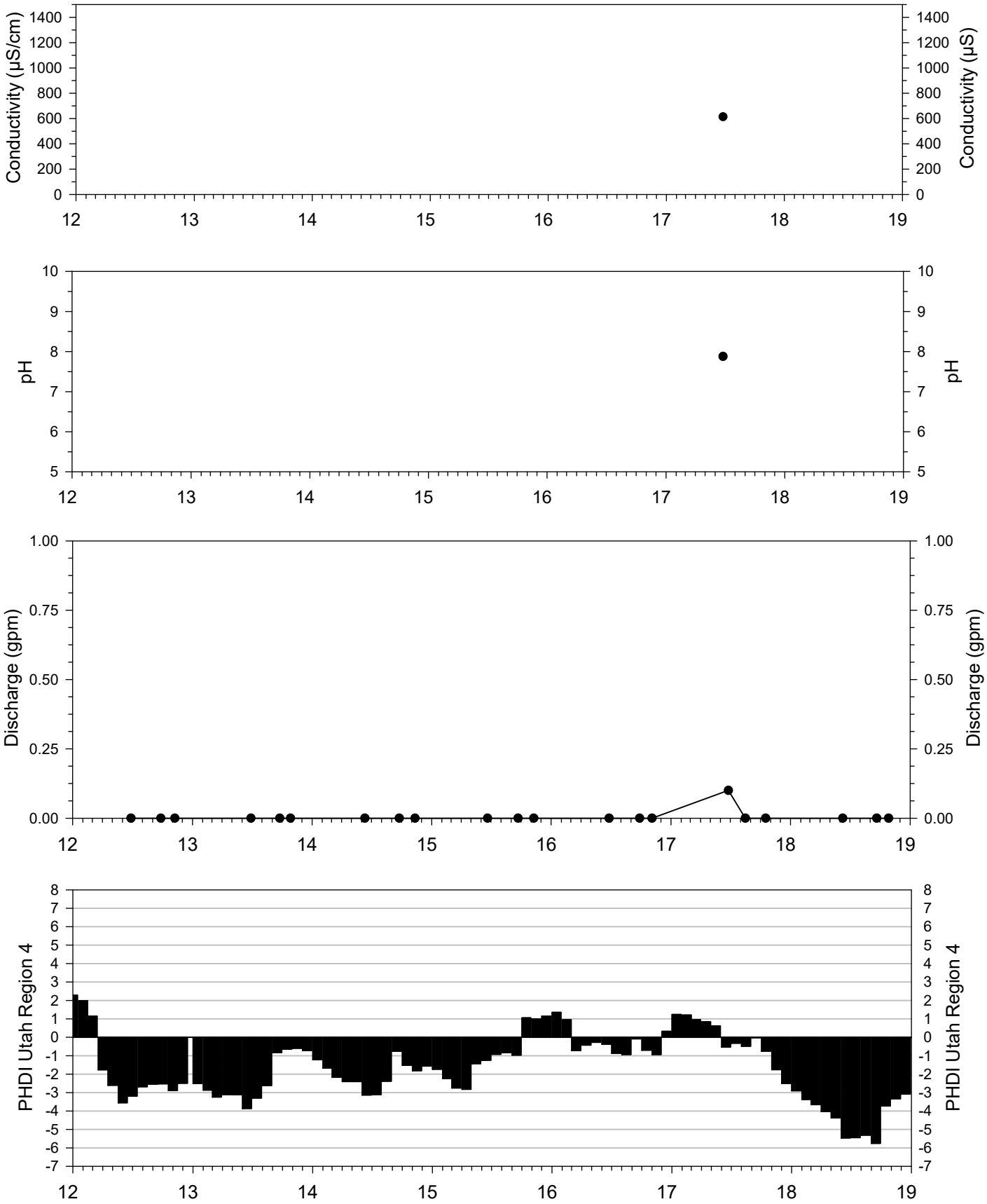




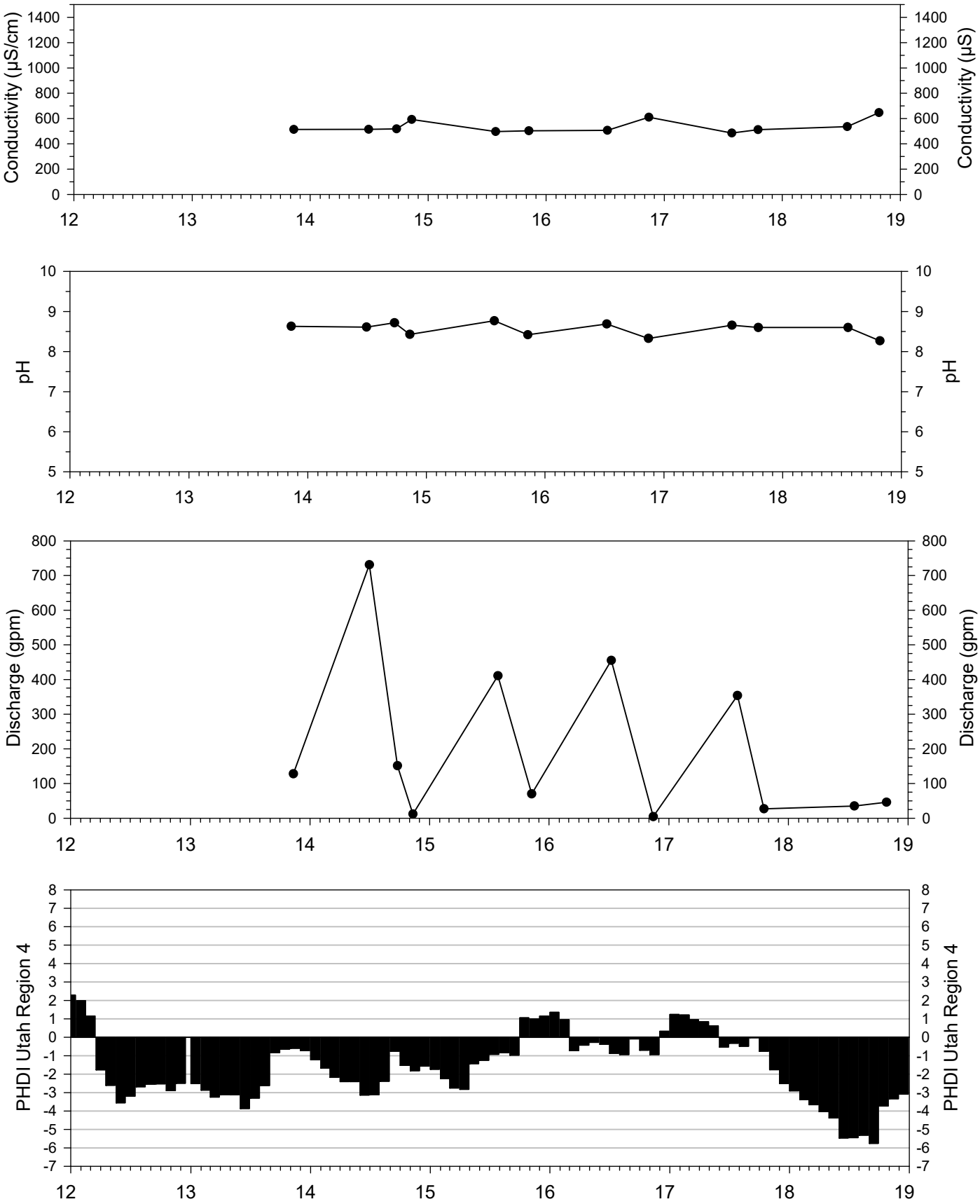
Spg. 99


Conductivity (µS/cm)
Conductivity (µS)
pH
Discharge (gpm)
PHDI Utah Region 4

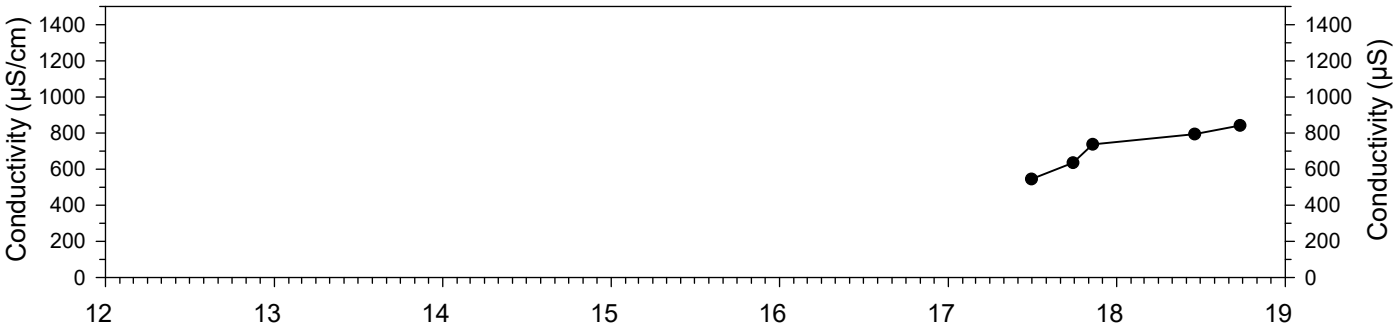
Spring Sufco 057A

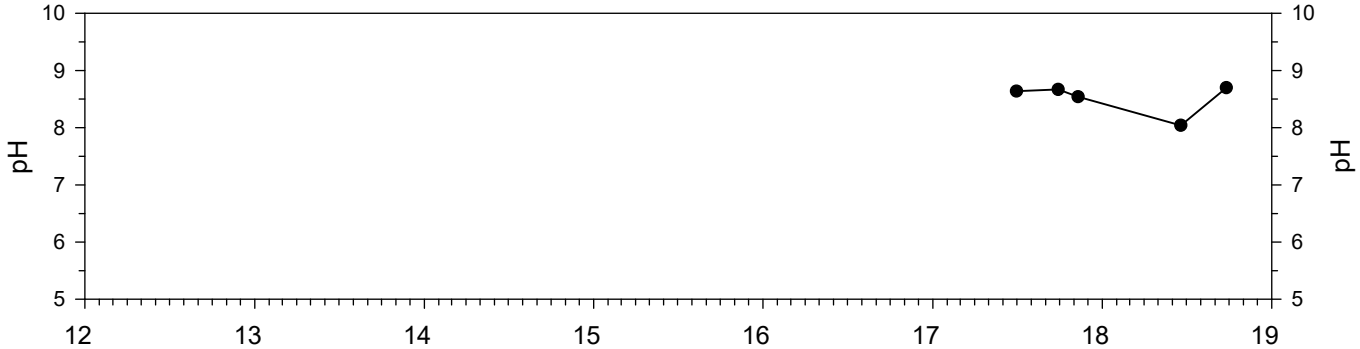


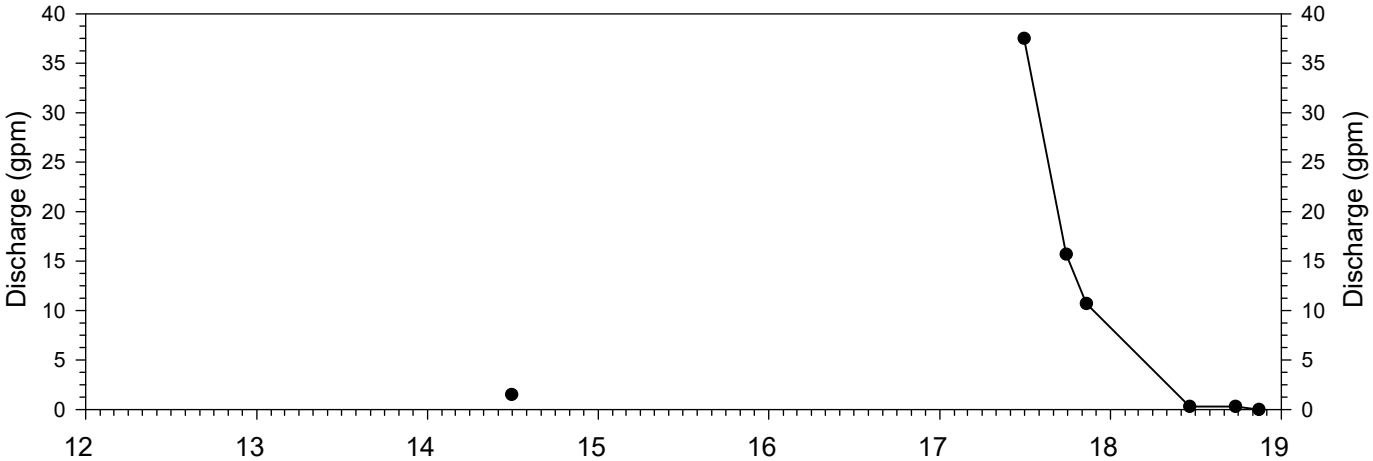
S. Fork Quitch. Creek Upper

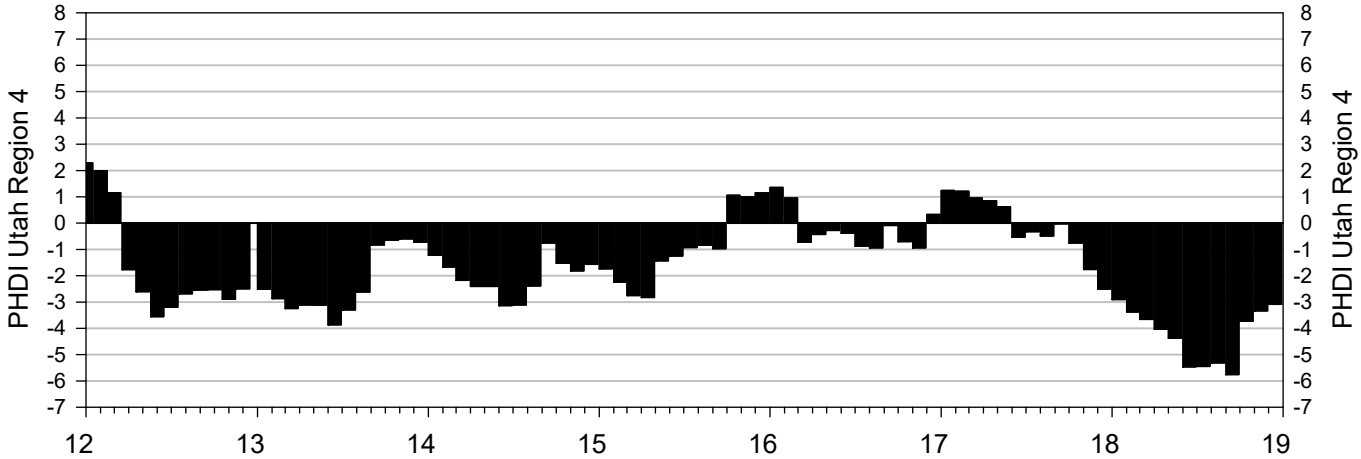


SP60 Creek

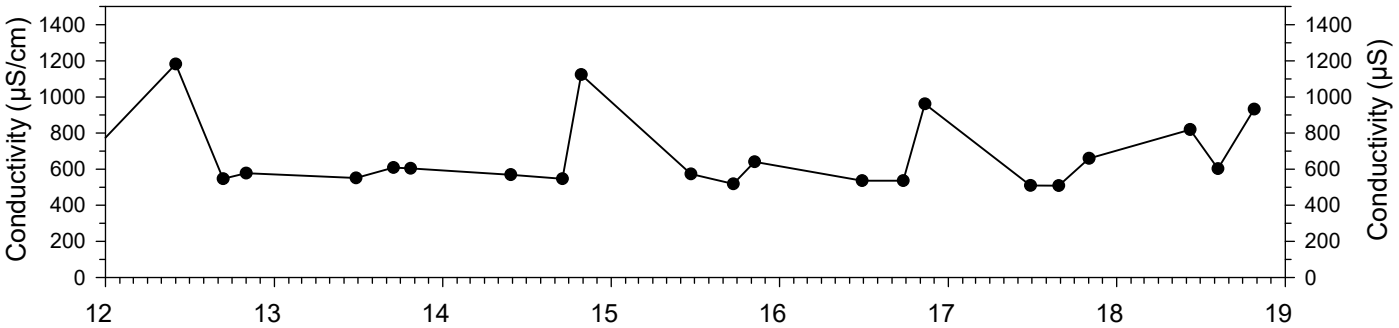

Conductivity (µS/cm)
Conductivity (µS)
0
200
400
600
800
1000
1200
1400
12
13
14
15
16
17
18
19

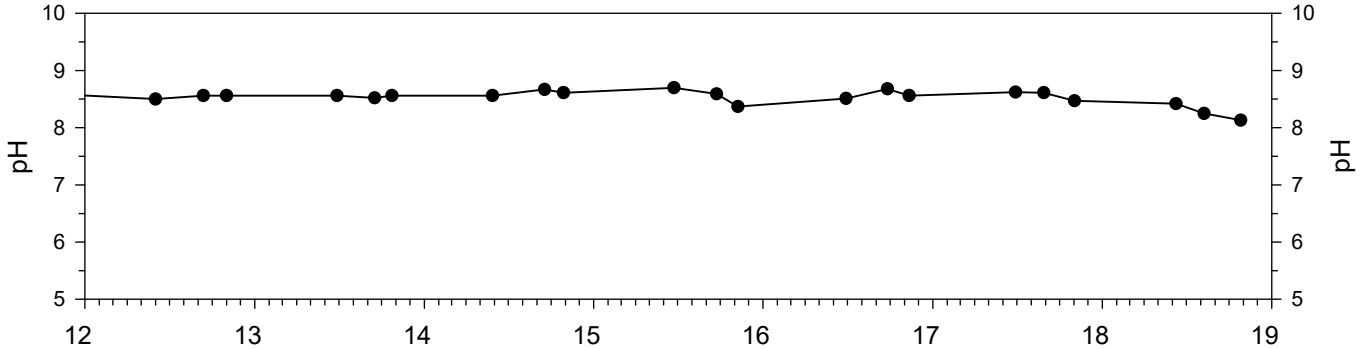

pH
5
6
7
8
9
10
12
13
14
15
16
17
18
19

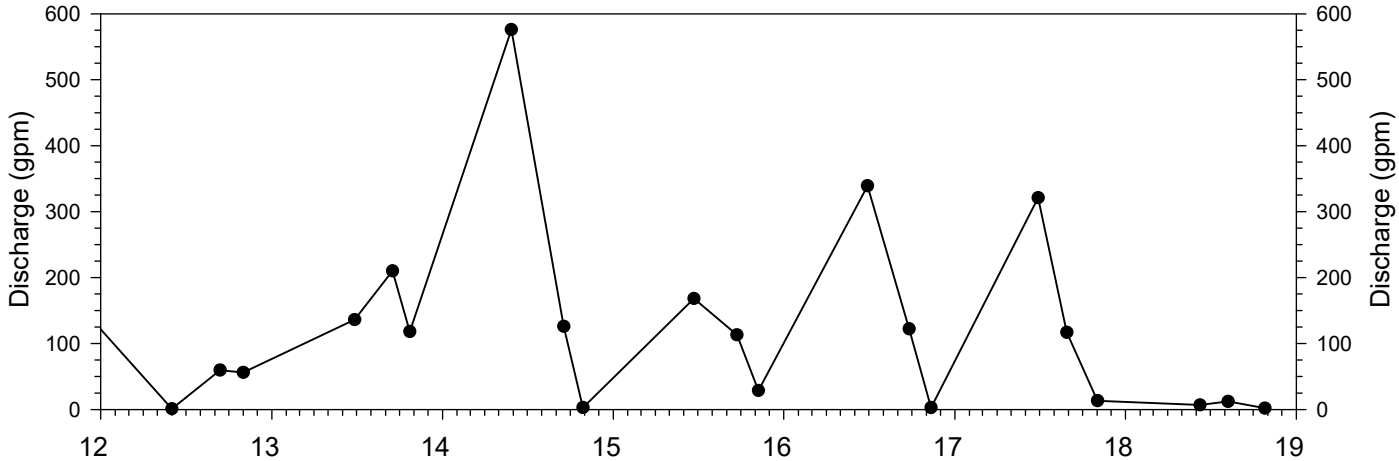

Discharge (gpm)
0
5
10
15
20
25
30
35
40
12
13
14
15
16
17
18
19

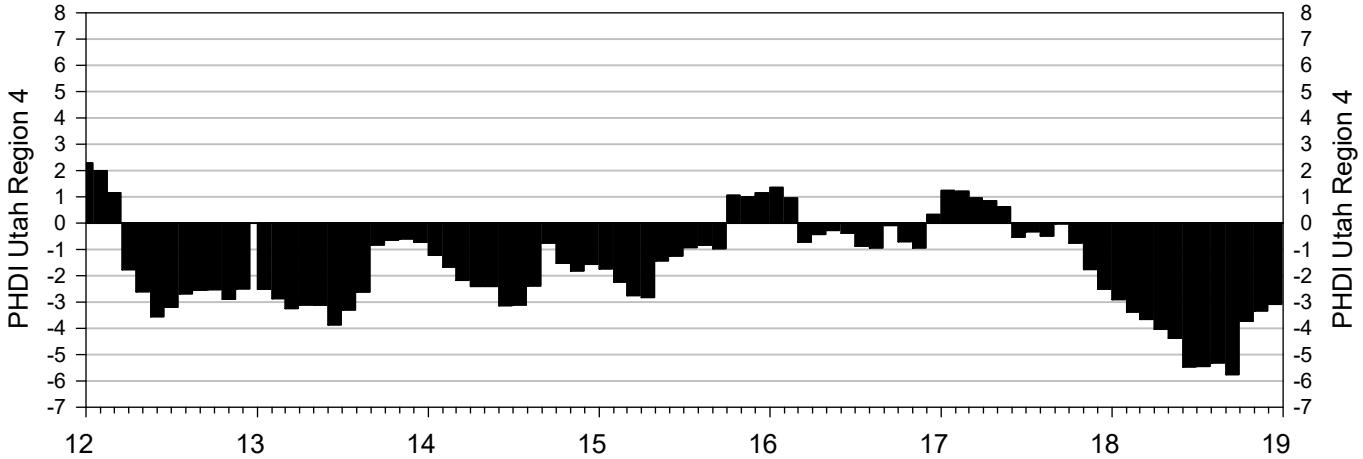

PHDI Utah Region 4
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
12
13
14
15
16
17
18
19

Sufco 006A (Quitchupah) Creek

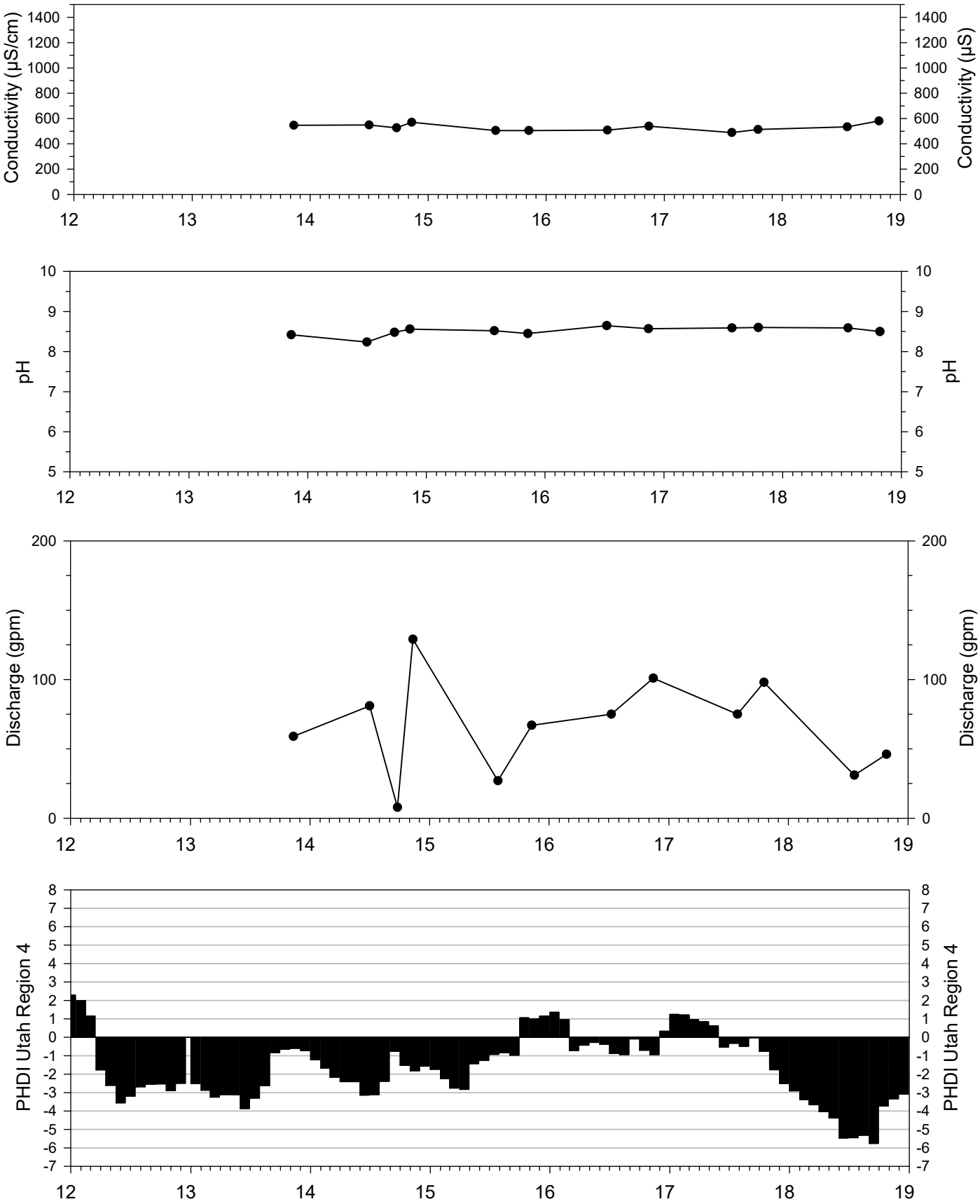




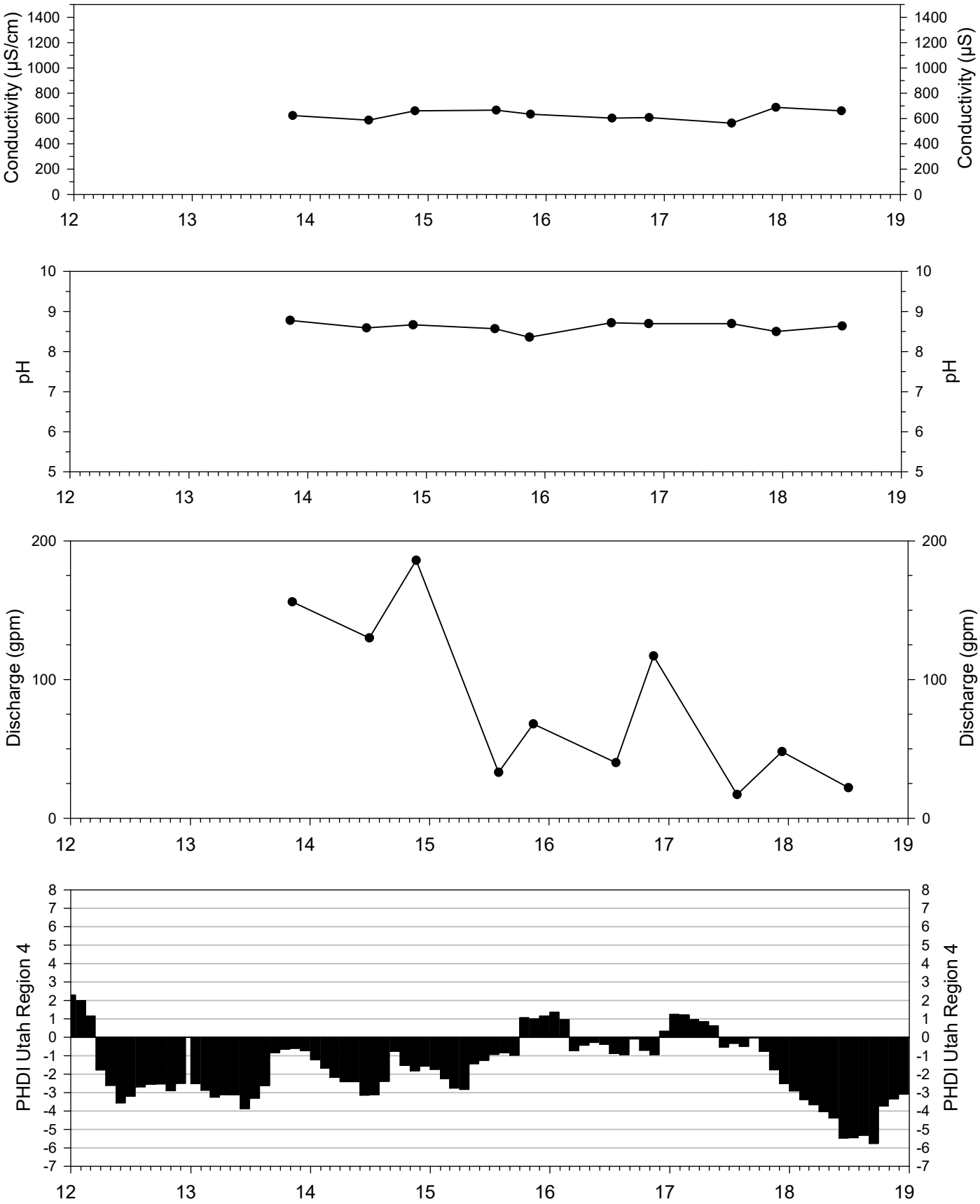




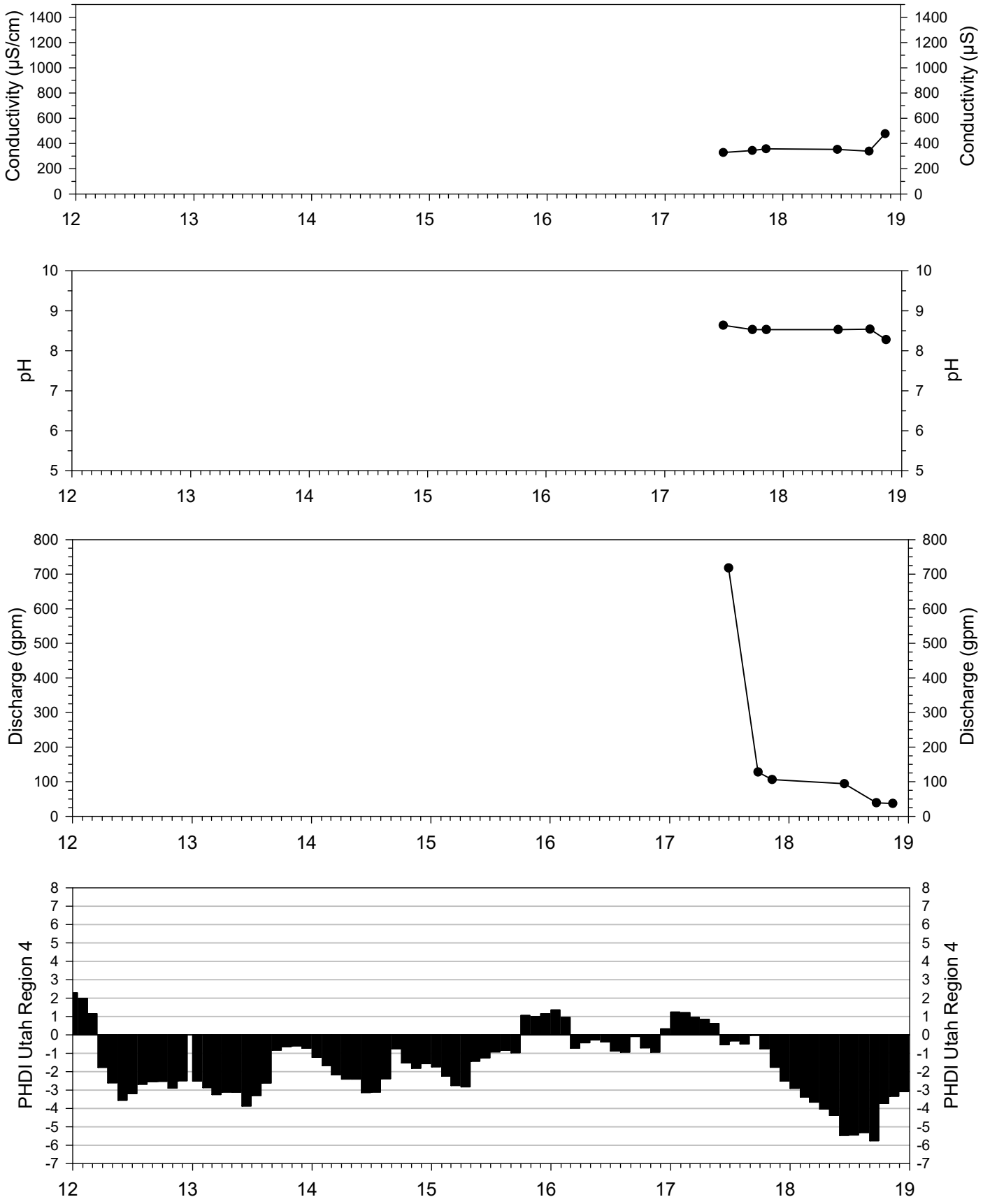
Skutumpah Creek Upper

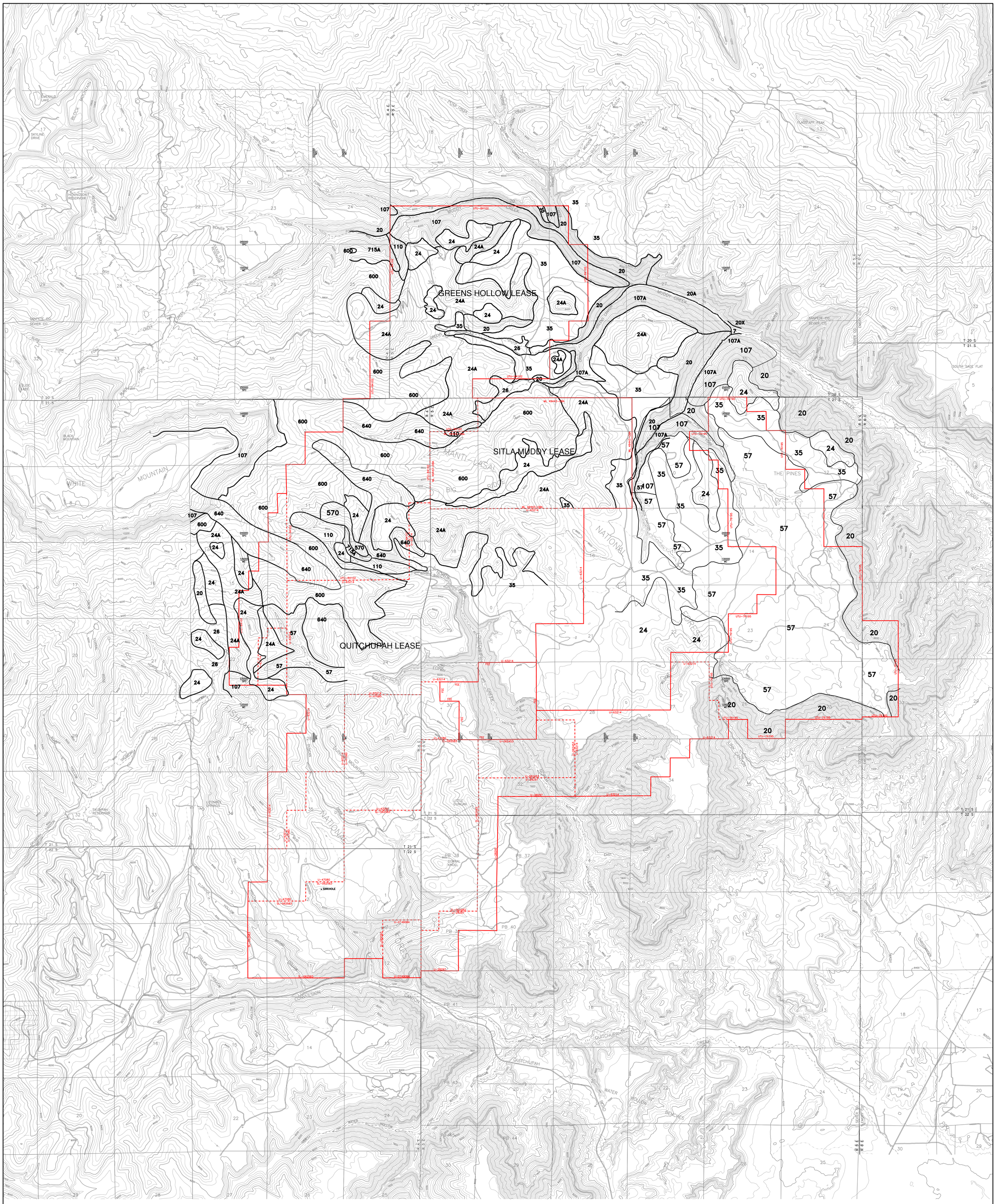


Skutumpah Creek Middle



North Fork Quitch. Upper





EXPLANATION

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

SOIL TYPES

7	SHUPERT–WINETTI FAMILIES
20	STRYCH–PATHEAD–WIGGLER FAMILIES
20A	ANDOK–STRYCH–WIGGLER FAMILIES
20X	ANDOK–WELRING FAMILIES
24	RABBITEX–REPP FAMILIES
24A	WHETROCK–DETRA FAMILIES
26	MARA–RABBITEX FAMILIES
35	DETRA FAMILY
57	FALCON FAMILY
107	BUNDO–SCOUT–UINTA FAMILIES
107A	CIRCLEVILLE–SCOUT–PANGUITCH FAMILIES
110	CASTINO–ELWOOD FAMILIES
600	FAIM–CLAYBURN–CASTINO FAMILIES
640	KILDOR FAMILY
715A	CROYDON–MORTENSON FAMILIES
570	LUCKY STAR–PRITCHETT FAMILIES

SOURCE:
COAL TRACT EVALUATIONS ON THE MANTI–LA SAL NATIONAL FOREST
MUDDY TRACT SOILS MAP
MARCH 2004
CIRRUS ECOLOGICAL SOLUTIONS, LC
965 SOUTH 100 WEST, SUITE 200
LOGAN, UTAH 84321
NATIONAL FORESTS SOIL SURVEY DATA
UTM NAD 83 ZONE 12N METERS 2013–2014

PROFESSIONAL ENGINEER No. 9073281 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

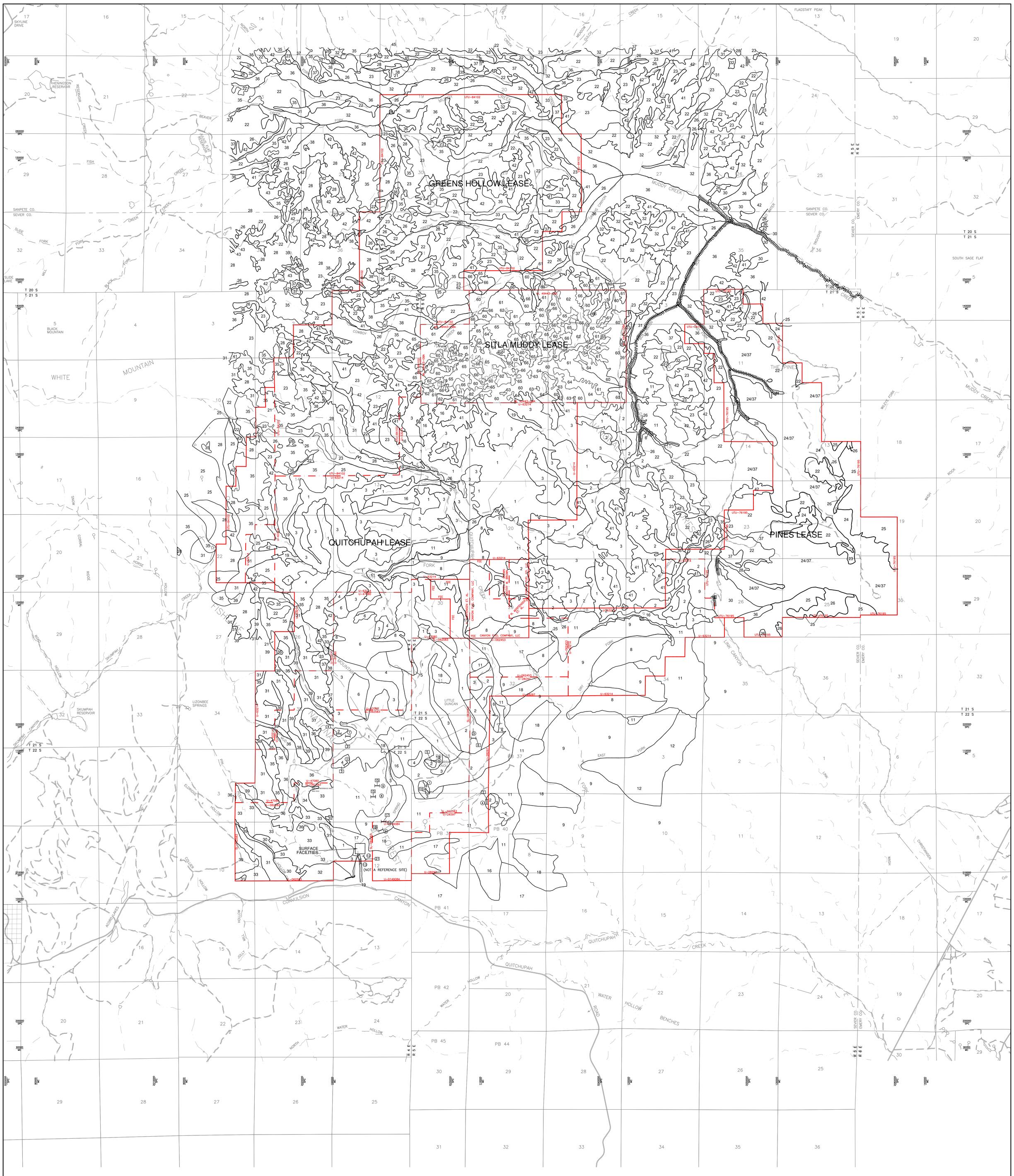
NO.	DATE	REQ. BY	DWG. BY	REMARKS
1	05/08/2007	M.L.D.	B.D.H.	
2	03/02/2015	V.M.	T.R.B.	ADDED 70 ACRE R.O.W. AREA FOR 5 WEST
3	04/26/2016	V.M.	J.G.C.	ADD GREENS HOLLOW & SOUTH FORK LEASE
				BOUNDARIES
4	12/14/2016	V.M.	J.G.C.	REMOVED SOUTH FORK LEASE BOUNDARY
5	04/12/2017	V.M.	B.R.	GREENS HOLLOW

_12MR-SUFMP1.ctb

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

SOIL TYPES
SITLA MUDDY & GREENS HOLLOW TRACT

PEN TBL:	SCALE: 1" = 2000'	DATE: 4/3/2019	DRAWN BY: B.D.H.	ENGINEER:	CHECKED BY: M.L.D.	SHEET NO.
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 2-3.dwg				PLATE 2–3



QUITCHUPAH LEASE PLANT COMMUNITIES

SOURCE:
SOUTHERN UTAH FUEL COMPANY
CONVULSION CANYON AND QUITCHUPAH TRACTS
VEGETATION MAP
EPS, INC. 129 NORTH 1000 EAST
OREM, UTAH 84057
1 OCTOBER 1991

1. SAGEBRUSH–GRASS
2. GRASS–BLACK SAGEBRUSH
3. MOUNTAIN BRUSH (OAK–SERVICEBERRY MOUNTAIN MAHOGANY, ETC.)
4. ASPEN
5. ASPEN–OAK
6. ASPEN–DOUGLAS FIR–LIMBER PINE
7. MOUNTAIN MAHOGANY–OAK–PONDEROSA PINE
8. DOUGLAS FIR–SPRUCE–LIMBER PINE
9. PINYON–JUNIPER–MOUNTAIN MAHOGANY
10. LIMBER PINE
11. PONDEROSA PINE–MOUNTAIN MAHOGANY–MANZANITA
12. PINYON–JUNIPER–DOUGLAS FIR
13. WIREGRASS–FOXTAIL–HAPLOPAPPUS
14. DOUGLAS FIR–SPRUCE–LIMBER PINE–ASPEN
15. LIMBER PINE–MOUNTAIN MAHOGANY–SERVICEBERRY
16. MOUNTAIN MAHOGANY
17. PINYON–JUNIPER
18. DOUGLAS FIR & OTHER
19. RIPARIAN
20. PONDEROSA PINE–DOUGLAS FIR–ASPEN–SERVICEBERRY

LEASE PLAN COMMUNITIES

SOURCE:
FISHLAKE NATIONAL FOREST VEGETATION GROUPS
MANTI–LA SAL NATIONAL FOREST
FES FIGURE 3–10 VEGETATION TYPES
JANUARY 1999
MANTI–LA SAL NATIONAL FOREST
FEIS, FIGURE 4–6 DECEMBER 2011

21. GRASSLAND PERENNIAL FORBS
22. SAGEBRUSH
23. MOUNTAIN BRUSH – SHRUBS
24. CONIFER TIMBER
25. MIXED CONIFER
26. BARREN GROUND
27. ASPEN – DECIDOUS FOREST
28. ASPEN – MIXED CONIFER
29. COTTONWOOD – BRUSH
30. PINYON – JUNIPER
31. GAMBEL OAK – OAK BRUSH
32. MOUNTAIN MAHOGANY
33. JUNIPER – MAHOGANY – WOODLAND
34. PONDEROSA PINE
35. ASPEN
36. FIR FOREST
37. PINE FOREST
38. HIGH MOUNTAIN BRUSH
39. RIPARIAN – WETLANDS – MEADOW
40. MANZANITA
41. PERENNIAL FORB LAND (ELEVATION MID–LOW)
42. PERENNIAL GRASSLAND (LOW ELEVATION)
43. PERENNIAL GRASSLAND (MID ELEVATION)
44. INTERMITTENT WET – DRY MEADOW
45. WILLOW – DOMINATED RIPARIAN

SITLA MUDDY LEASE PLANT COMMUNITIES

SOURCE:
MT NEBO SCIENTIFIC, INC.
RESEARCH & CONSULTING
330 EAST 400 SOUTH, SUITE 6
SPRINGVILLE, UTAH 84663
PATRICK D. COLLINS Ph.D. JANUARY 30, 2008

60. SAGEBRUSH/GRASS
61. MOUNTAIN BRUSH
62. MOUNTAIN HERBLANDS
63. OAK BRUSH
64. PINYON–JUNIPER
65. ASPEN
66. CONIFER

EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- 100000 MC — MINE COORDINATES
- 2020000 SPC — STATE PLANE COORDINATES
- VEGETATION SAMPLE SITE
- 22 — SOIL SAMPLE SITE
- 12 — VEGETATION SAMPLE NUMBER
- RIPARIAN AREAS
- * — SINK HOLE REFERENCE AREA

2000 0 2000

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

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

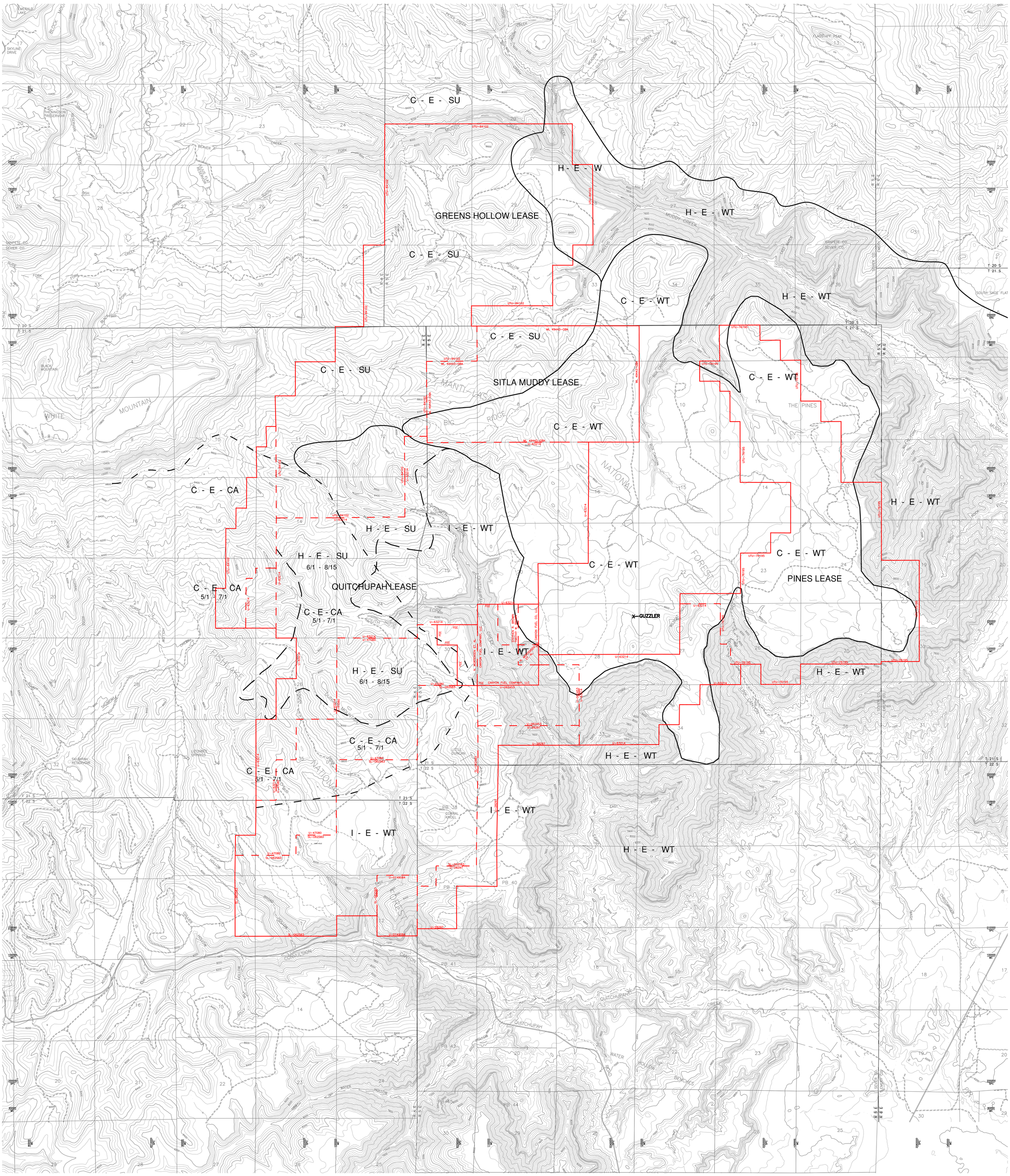
REVISIONS

NO.	DATE	REQ. BY	DWG. BY	REMARKS
9	03/02/2015	V.M.	T.R.B.	ADDED 70 ACRE R.O.W. AREA FOR 5 WEST
10	07/13/2016	V.M.	J.G.C.	ADD GREENS HOLLOW & SOUTH FORK LEASE BOUNDARIES
11	12/14/2016	V.M.	J.G.C.	REMOVED 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

PLANT COMMUNITIES AND SAMPLING AREA

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_15ndnl-SUFDNPL.ctb	1" = 2,000'	4/3/2019	B.D.H.		M.L.D.	PLATE 3–1
SHT SET: #### / PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 3–1.dwg					



EXPLANATION

	SUFCO EXTERIOR LEASE BOUNDARY
	SUFCO INTERIOR LEASE BOUNDARY
100000 MC	MINE COORDINATES
2020000 SPC	STATE PLANE COORDINATES
C - E - CA	CRITICAL ELK CALVING AREA
C - E - SU	CRITICAL ELK SUMMER RANGE
C - E - WT	CRITICAL ELK WINTER RANGE
H - E - SU	HIGH PRIORITY ELK SUMMER RANGE
H - E - WT	HIGH PRIORITY ELK WINTER RANGE
I - E - WT	LIMITED USE ELK WINTER RANGE
	CRITICAL ELK CALVING AREA BOUNDARY (WEST OF BOUNDARY LINE)
	HIGH PRIORITY SUMMER RANGE BOUNDARY
	HIGH PRIORITY WINTER RANGE BOUNDARY
5/1 – 7/1	PERIOD OF HEAVIEST RANGE USE
X	GUZZLER

SOURCES:

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 ELK RANGES MAP
   CHRIS COLT, FEB. 27, 1999
3. SITLA MUDDY TRACT
   COAL TRACT EVALUATIONS ON THE MANTI–LA SAL NATIONAL FOREST
   MUDDY TRACT ELK RANGE
   MARCH 2004
   CIRRUS ECOLOGICAL SOLUTIONS, LC
   965 SOUTH 100 WEST, SUITE 200
   LOGAN, UTAH 84321

PROFESSIONAL ENGINEER
No. 9073281
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

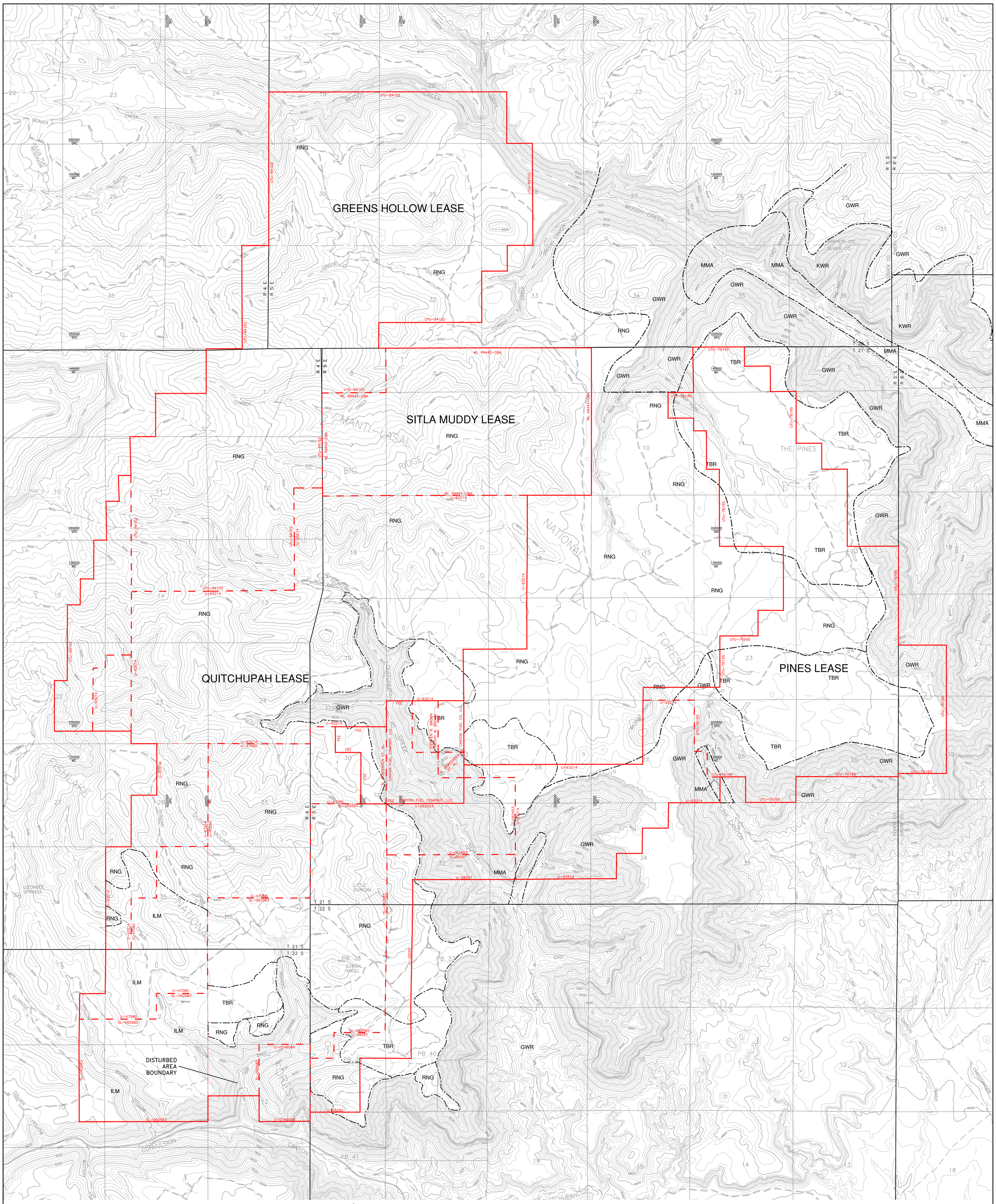
REVISIONS

NO.	DATE	REQ. BY	DWG. BY	REMARKS
7	03/02/15	V.M.	T.R.B	ADDED 7 ACRE R.O.W AREA FOR 5 WEST BOUNDARY
8	07/25/16	V.M.	T.R.B	ADD GREEN HOLLOW AND SOUTH FORK LEASE BOUNDARY
9	12/14/16	V.M.	T.L.M	REMOVE SOUTH FORK LEASE BOUNDARY
10	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

ELK RANGE

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_1Stdnt-SUFDP1.ctb	1" = 2,000'	4/4/2019	A.D.D.		BB	PLATE 3–2
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 3–2.dwg				



SITLA MUDDY TRACT

FOREST MANAGEMENT UNITS

—·—·—	FOREST MANAGEMENT UNIT BOUNDARY
GWR	GENERAL BIG GAME WINTER RANGE
TBR	LIMITED TIMBERING, INCLUDES GRAZING
RNG	RANGELAND/GRAZING
MMA	LEASABLE MINERAL DEVELOPMENT
ILM	INTERMEDIATE LOGGING MANAGEMENT
MMA	LEASABLE MINERAL DEVELOPMENT

SOURCE:
SOUTHERN UTAH FUEL COMPANY
CONVULSION CANYON AND QUITCHUPAH TRACTS
FOREST MANAGEMENT UNITS MAP
EPS, INC. 129 NORTH 1000 EAST
OREM, UTAH 84057
1 OCTOBER 1991

EXPLANATION

———	SUFCO EXTERIOR LEASE BOUNDARY
— · —	SUFCO INTERIOR LEASE BOUNDARY
100000 MC	MINE COORDINATES
2020000 SPC	STATE PLANE COORDINATES

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

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

1000 0 1000

REVISIONS

NO.	DATE	REQ. BY	DWG. BY	REMARKS
6	06/11/10	M.L.D.	K.B.B.	
7	07/14/16	V.M.	J.G.C.	ADD GREEN HPLLOW & SOUTH FORK LEASE BOUNDARY
8	12/15/16	V.M.	T.L.M.	REMOVE SOUTH FORK LEASE BOUNDARY
9	04/12/2017	V.M.	B.R.	GREENS HOLLOW

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597 South SR 24 – Salina, UT 84654
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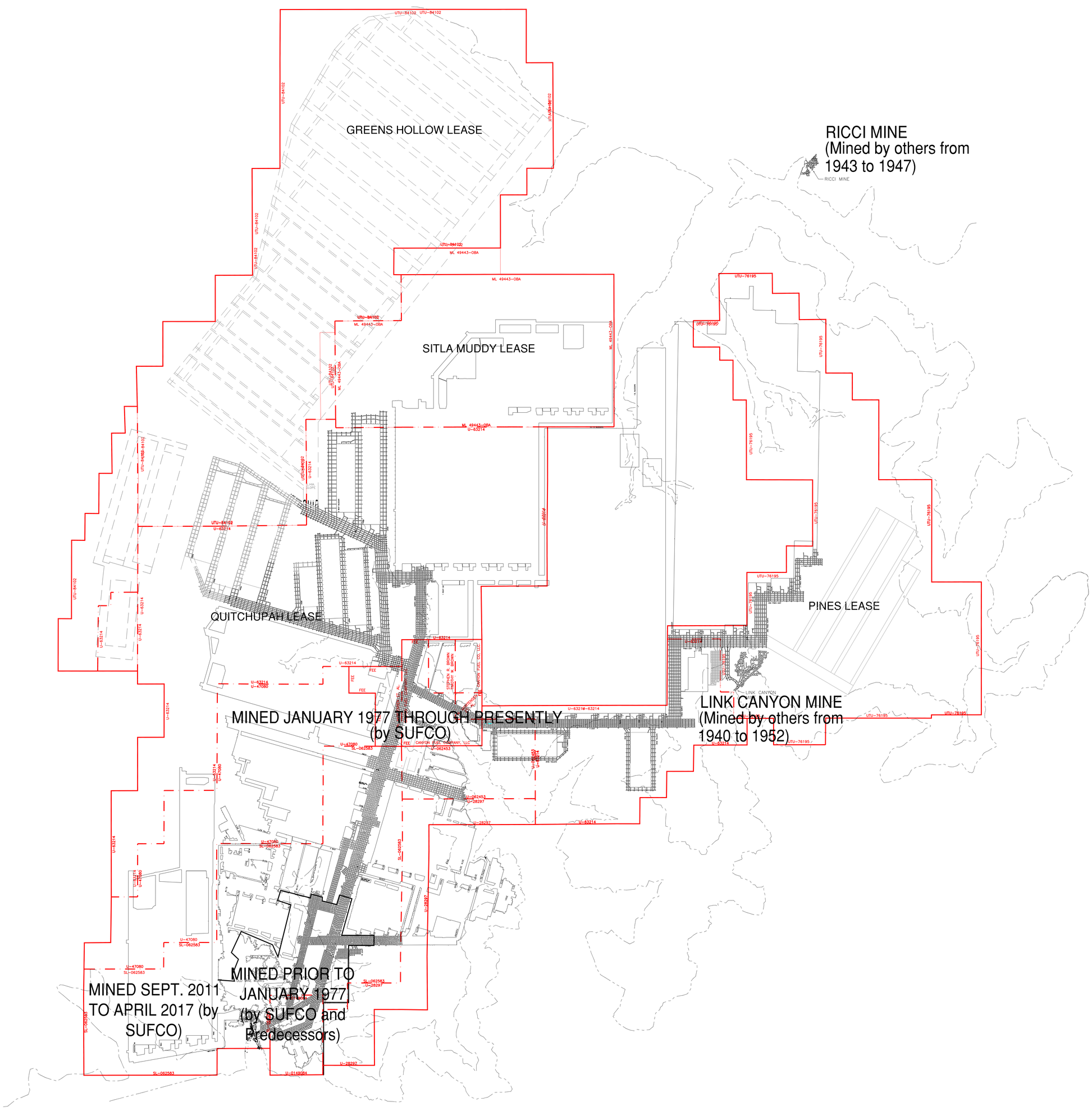
(435) 286-4499 Fax

LAND USES – SITLA MUDDY AND GREENS HOLLOW TRACT

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_15ndnf-SUFDNP1.ctb	1" = 1,500'	3/28/2018	A.D.D.		J.D.B.	PLATE 4-1C
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 4-1C.dwg				



EXPLANATION

MINED AREA BOUNDARY
OUTCROP
ESCARPMENT
EXTERIROR LEASE BOUNDARY
INTERIOR LEASE BOUNDARY

PROFESSIONAL ENGINEER
No. 9073281
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
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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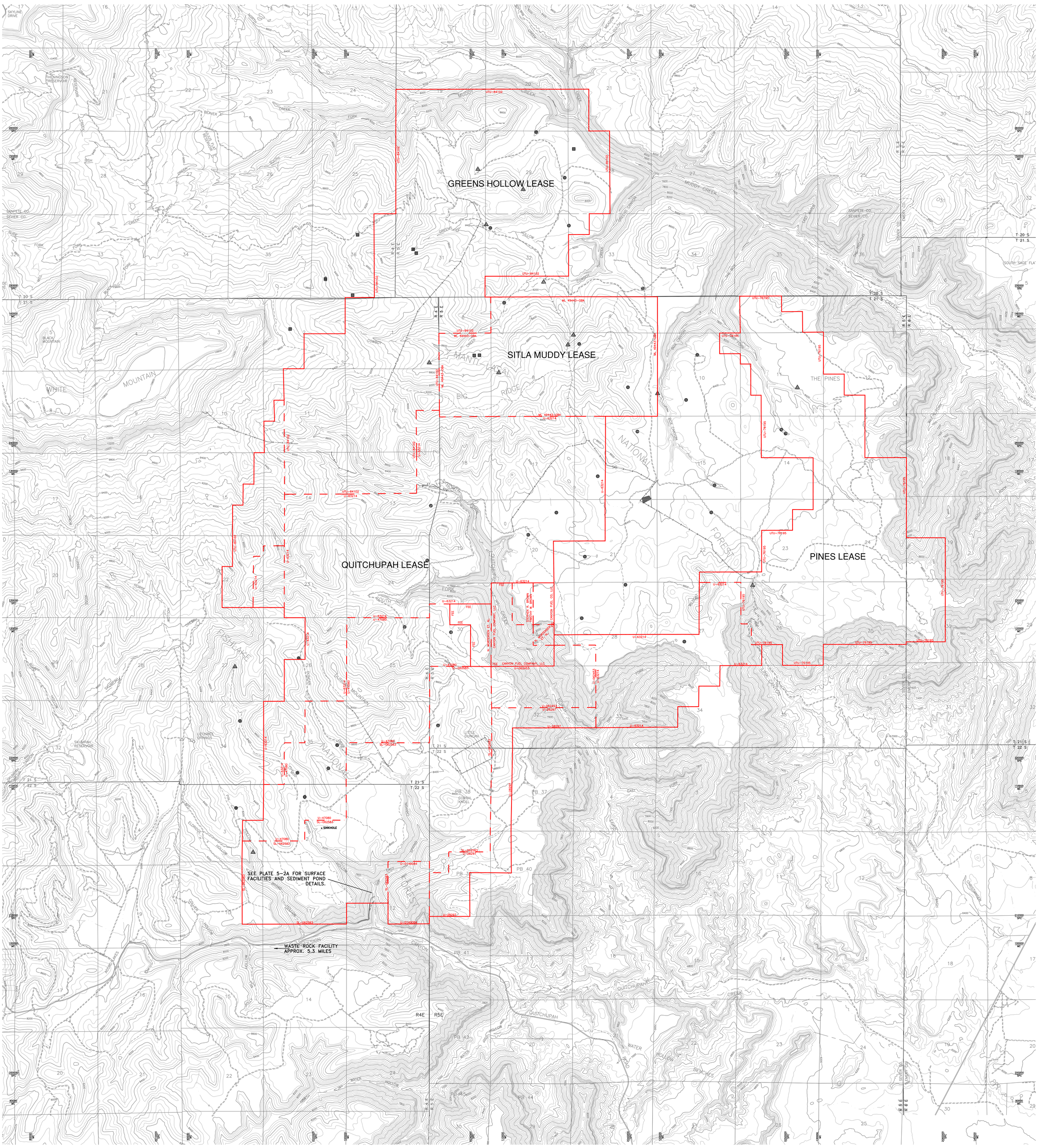
PREVIOUSLY MINED AREAS

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_15ndnh-SUFDNP1.ctb	1" = 2,000'	4/3/2019	A.D.D.			PLATE 5-1
SHT SET: #### / PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 5-1.dwg					



EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- MINE COORDINATES
- STATE PLANE COORDINATES
- RUNOFF POND
- NATURAL POND
- STOCK WATERING TROUGH
- TRAIL
- UNIMPROVED ROAD
- IMPROVED ROAD
- FENCE

PROFESSIONAL ENGINEER No. 9073281 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
6	03/02/15	V.M.	T.R.B.	ADDED 70 ACRE R.O.W. AREA FOR 5 WEST BOUNDARY
7	07/13/16	V.M.	J.G.C.	ADD GREENS HOLLOW & SOUTH FORK LEASE
8	12/15/16	V.M.	T.L.M.	REMOVE SOUTH FORK LEASE BOUNDARY
9	4/13/2017	V.M.	B.R.	GREENS HOLLOW

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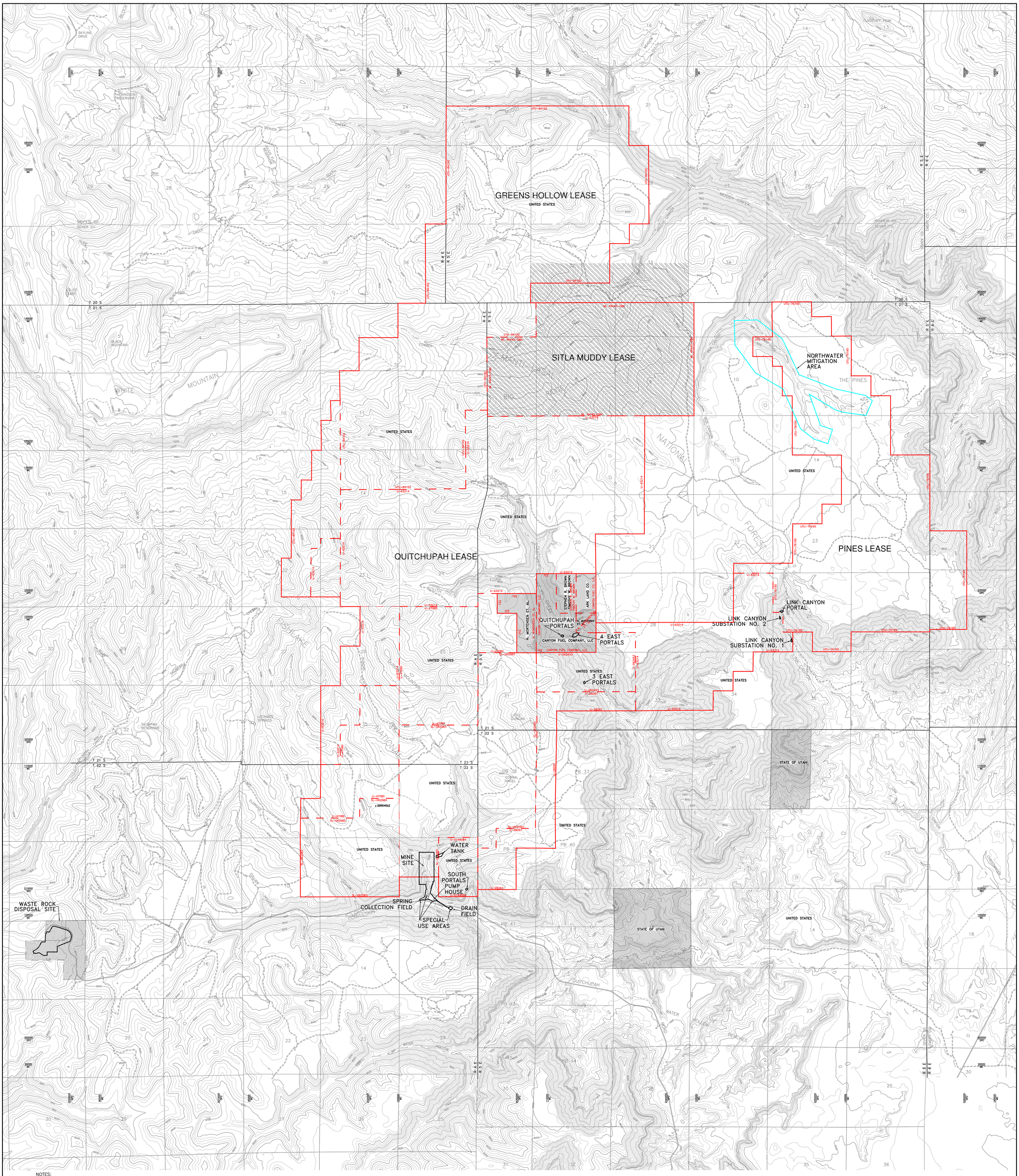
EXISTING SURFACE AND SUBSURFACE FACILITIES AND FEATURES

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO:
_1Shdnd-SUFDN1.ctb	1" = 2,000'	4/4/2019	A.D.D.		J.D.B.	PLATE 5-5
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 5-5.dwg				



NOTES:

1. "LEASE AREA" INCLUDES ALL FEDERAL COAL LEASES, STATE COAL LEASES, FEE LANDS AND U.S.F.S. SPECIAL USE PERMIT (SUP) AREAS SHOWN ON THIS MAP.
2. SEE VOLUME 3 REGARDING OWNERSHIP AT WASTE ROCK DISPOSAL SITE.
3. SEE PLATE 5-2A REGARDING MINESITE AREA DETAIL.
4. SEE PLATE 5-2B REGARDING U.S.F.S. SPECIAL USE AREA DETAIL.
5. SEE PLATE 5-2C REGARDING PORTAL AREA DETAIL.
6. SEE PLATE 5-2D REGARDING LINK CANYON SUBSTATION NO. 1 AREA DETAIL.
7. SEE PLATE 5-2E REGARDING LINK CANYON SUBSTATION NO. 2 AREA DETAIL.
8. SEE PLATE 5-2F REGARDING LINK CANYON PORTAL AREA DETAIL.

EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- DISTURBED BOUNDARY
- SPECIAL USE PERMIT BOUNDARY
- 100000 MC — MINE COORDINATES
- 2020000 SPC — STATE PLANE COORDINATES

LEASE AREA

16,954.56	ACRES	FEDERAL COAL LEASES
2,294.19	ACRES	UTAH STATE COAL LEASES
640.00	ACRES	FEE COAL LEASES
240.00	ACRES	WASTE ROCK DISPOSAL SITE
28.50	ACRES	U.S.F.S. SPECIAL USE PERMITS
70.00	ACRES	B.L.M. RIGHT-OF-WAY
20,227.25	ACRES	TOTAL LEASE AREA

ADJACENT AREA

1. BIOLOGY ADJACENT AREA IS A 0.5 MILE BUFFER AROUND ALL SURFACE DISTURBANCES.
2. SEE CHIA FOR HYDROLOGIC ADJACENT AREA BOUNDARY.

LAND AND MINERAL OWNERSHIP

LAND	MINERAL
UNITED STATES	STATE OF UTAH
UNITED STATES	UNITED STATES
VARIOUS OWNERS (AS SHOWN)	CANYON FUEL COMPANY, LLC
STATE OF UTAH	UNITED STATES
U.S.F.S. SPECIAL USE AREA	UNITED STATES

PROFESSIONAL ENGINEER No. 9073281 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
20	03/02/15	T.R.B.	J.G.C.	ADDED 70 ACRE R.O.W AREA FOR 5 WEST
21	07/14/16	V.M.	J.G.C.	ADD GREENS HOLLOW & SOUTH FROK LEASE BOUNDARY
22	12/14/16	V.M.	T.L.M.	REMOVE SOUTH FORK LEASE BOUNDARY
23	02/28/17	V.M.	B.R.	UPATED WASTE ROCK PERMIT BOUNDARY
24	04/13/2017	V.M.	B.R.	GREENS HOLLOW

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LAND OWNERSHIP, LEASE, AND PERMIT AREA MAP

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_1Sndrd-SUFDNP1.ctb	1" = 2,000'	4/19/2018	JMB/TRB	J.S	VM	PLATE 5-6
SHT SET: #### / PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 5-6.dwg					

GREENS HOLLOW LEASE

SITLA MUDDY LEASE

QUITCHUPAH LEASE

PINES LEASE

FUTURE LOWER HIAWATHA POINT OF ACCESS FROM UPPER HIAWATHA

RICCI MINE

LINK CANYON MINE

OLD MINE WORKS

EXPLANATION

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

MINING LEGEND

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

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1500 0 1500

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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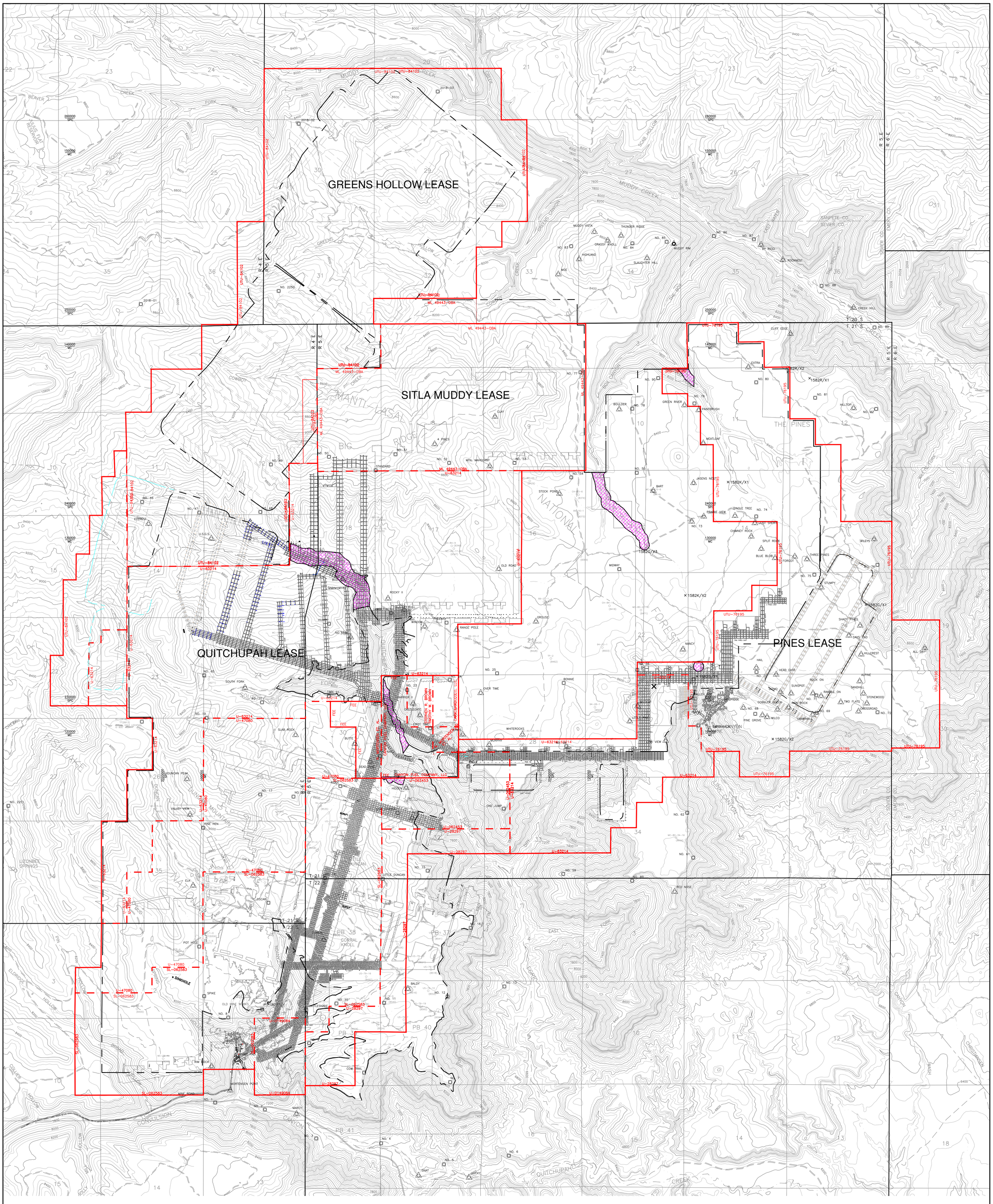
SUFCO MINE PLAN 5 YEAR PROJECTION

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_15mdrs-SUFDP1.ctb	1" = 1,500'	03/01/2000	B.D.H.	JDB	BB	PLATE 5-7
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 5-7.dwg				



EXPLANATION

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

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

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

1000 0 1000

REVISIONS

NO.	DATE	REQ. BY	DWG. BY	REMARKS
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	10/31/2019	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
8	8/7/2019	V.M.	J.G.C.	ADDED ARCH SITE

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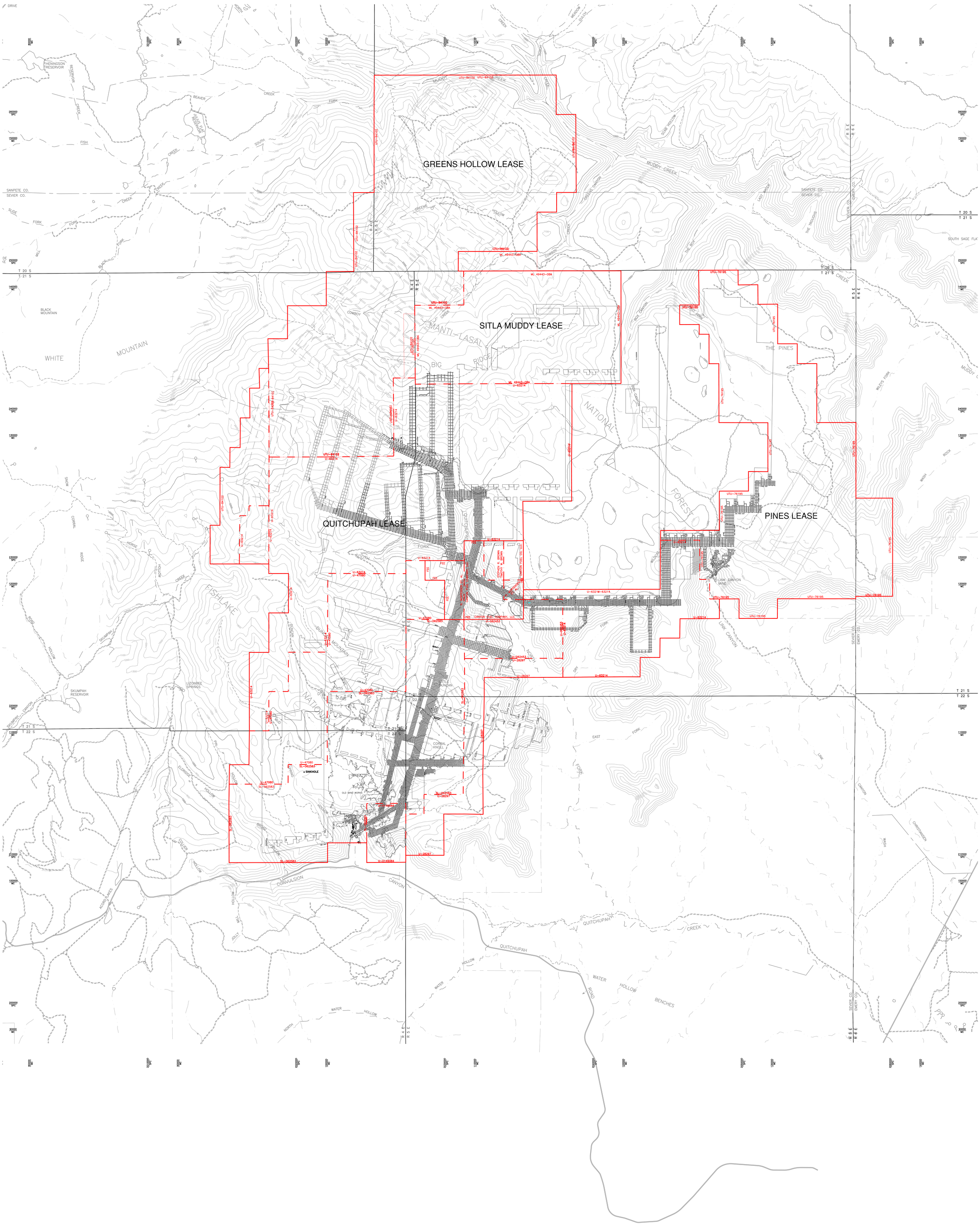
POTENTIAL SUBSIDENCE LIMITS

SCALE:	DATE:	DRAWN BY:	ENGINEER:	SHEET NO.
1" = 1000'	08/13/09	JMB		PLATE 5-10
CHECKED BY: WKS	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 5-10.dwg			



EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- 100000 MC — MINE COORDINATES
- 200000 SPC — STATE PLANE COORDINATES

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

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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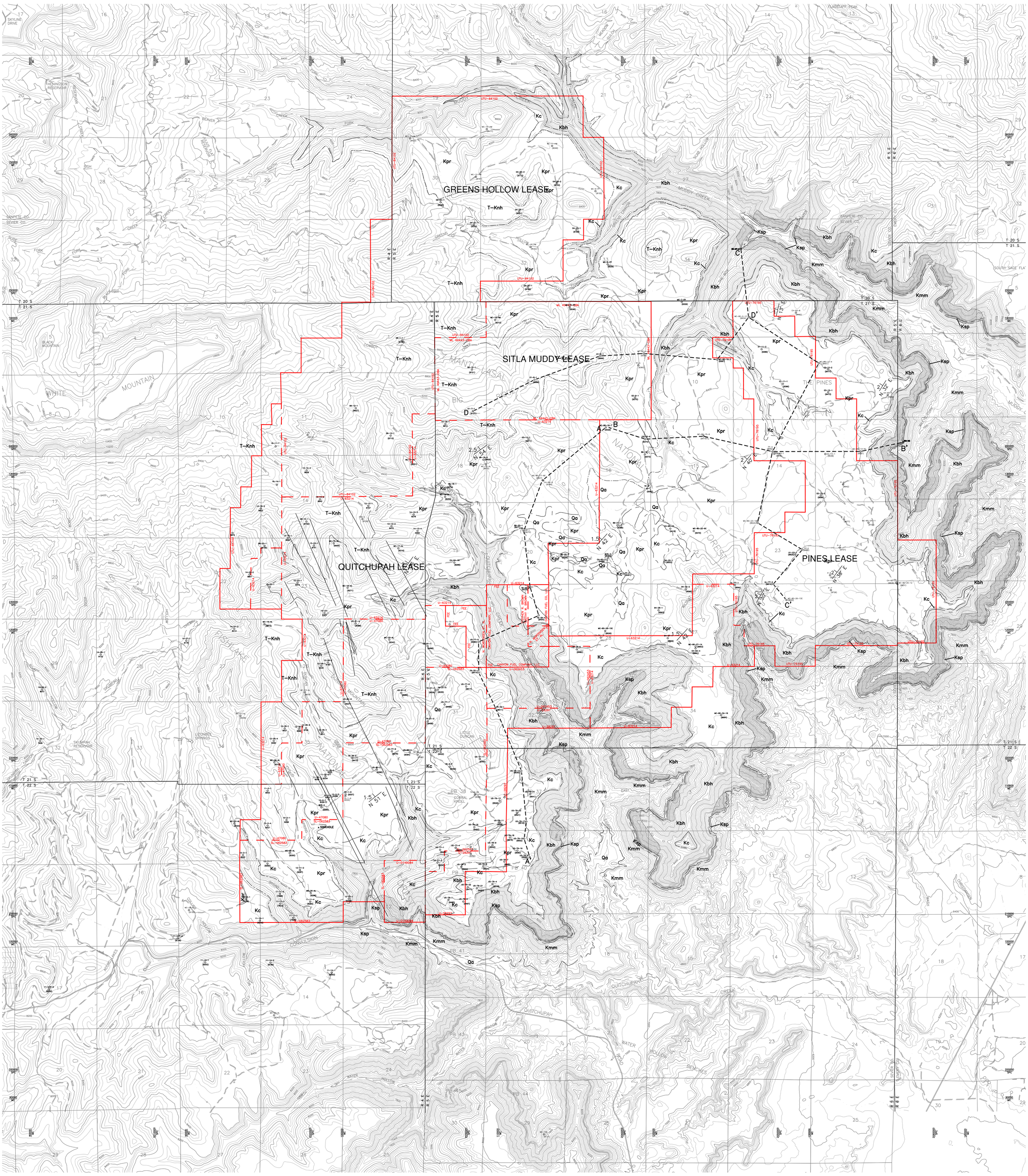
OVERBURDEN ISOPACH MAP

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO:
_1Shdnl-SUFDNP1.ctb	1" = 2,000'	01/20/2005	BDH/TRB	BB	BB	PLATE 5-11
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 5-11.dwg				

BBsurnell, 4/4/2019 10:47 AM



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

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

EXPLANATION

- UPPER HIAWATHA COAL SEAM OUTCROP
- EXTERIOR LEASE BOUNDARY
- INTERIOR LEASE BOUNDARY
- 1000000 MC — MINE BASE COORDINATES
- 2020000 SPC — STATE PLANE COORDINATES
- US–79–2 (8497) — DRILLHOLE LOCATION AND NUMBER, DRILLHOLE SURFACE ELEVATION
- 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

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

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2000 0 2000

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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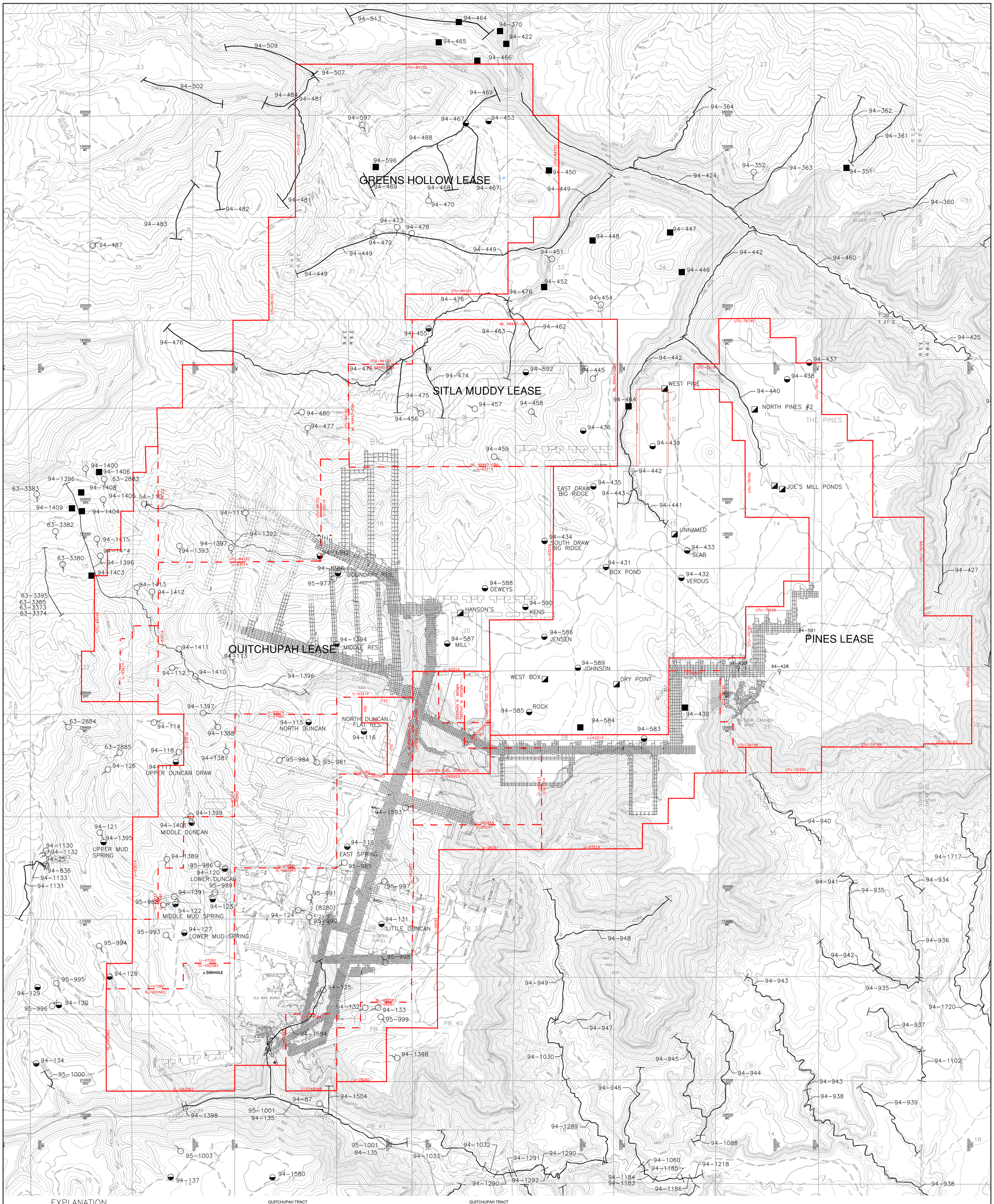
GEOLOGY & DRILL HOLE LOCATION MAP

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_10ndnb-SUFDNF1.ctb	1" = 2,000'	3/5/2015	KJW/TRB	JDB	BB	PLATE 6–1
SHT SET: #### / PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 6-1.dwg					

BBurnett; 4/4/2019 12:10 PM



EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- 100000 MC / 2020000 SPC — MINE COORDINATES / 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

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

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1500 0 1500

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

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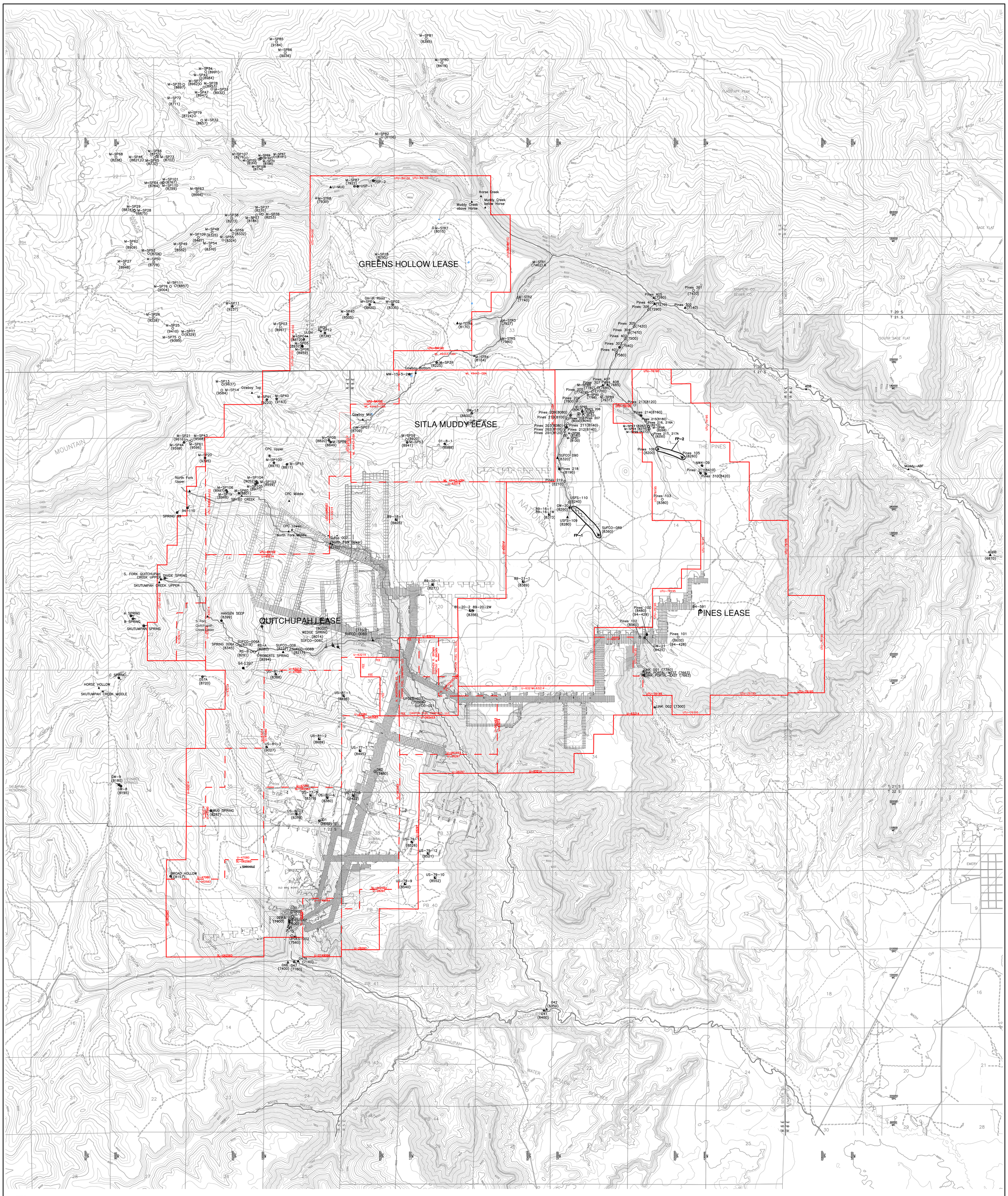
SURFACE AND GROUNDWATER RIGHTS-QUITCHUPAH TRACT

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_1Shdnl-SUFENP1.ctb	1" = 1,500'	07/13/2016	J.G.C	V.M.	V.M.	PLATE 7-2
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 7-2.dwg				

BBurnett 4/4/2019 12:37 PM



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	△	HISTORIC STREAM	⬡	UPDES MONITORING POINT
	SUFCO MINE INTERIOR LEASE BOUNDARY	▲	STREAM MONITORING	Ⓤ	IN MINE MONITORING SITE
100000 MC	MINE COORDINATES	◪	HISTORIC MONITORING WELL	(7600)	ELEVATION OF SITE
20200000 SPC	STATE PLANE COORDINATES	⊕	MONITORING WELL SITE		PERENNIAL FLOW LOCATION MONITORING POINT
		○	HISTORIC SPRING MONITORING SITE		PERENNIAL FLOWS
		●	SPRING MONITORING		SPRING NOT MONITORED

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

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

1000 0 1000

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 AND BELOW
26	1/15/2019	V.M.	J.G.C.	ADDED MONITORING POINT NW4-09

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

HYDROLOGIC MONITORING STATIONS

PEN TBL:		SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_15ndnf-SUFENP1.ctb		1" = 1,000'	10/26/2006	JMB/TRB	J.D.B.	BB	PLATE 7-3
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 7-3.dwg					

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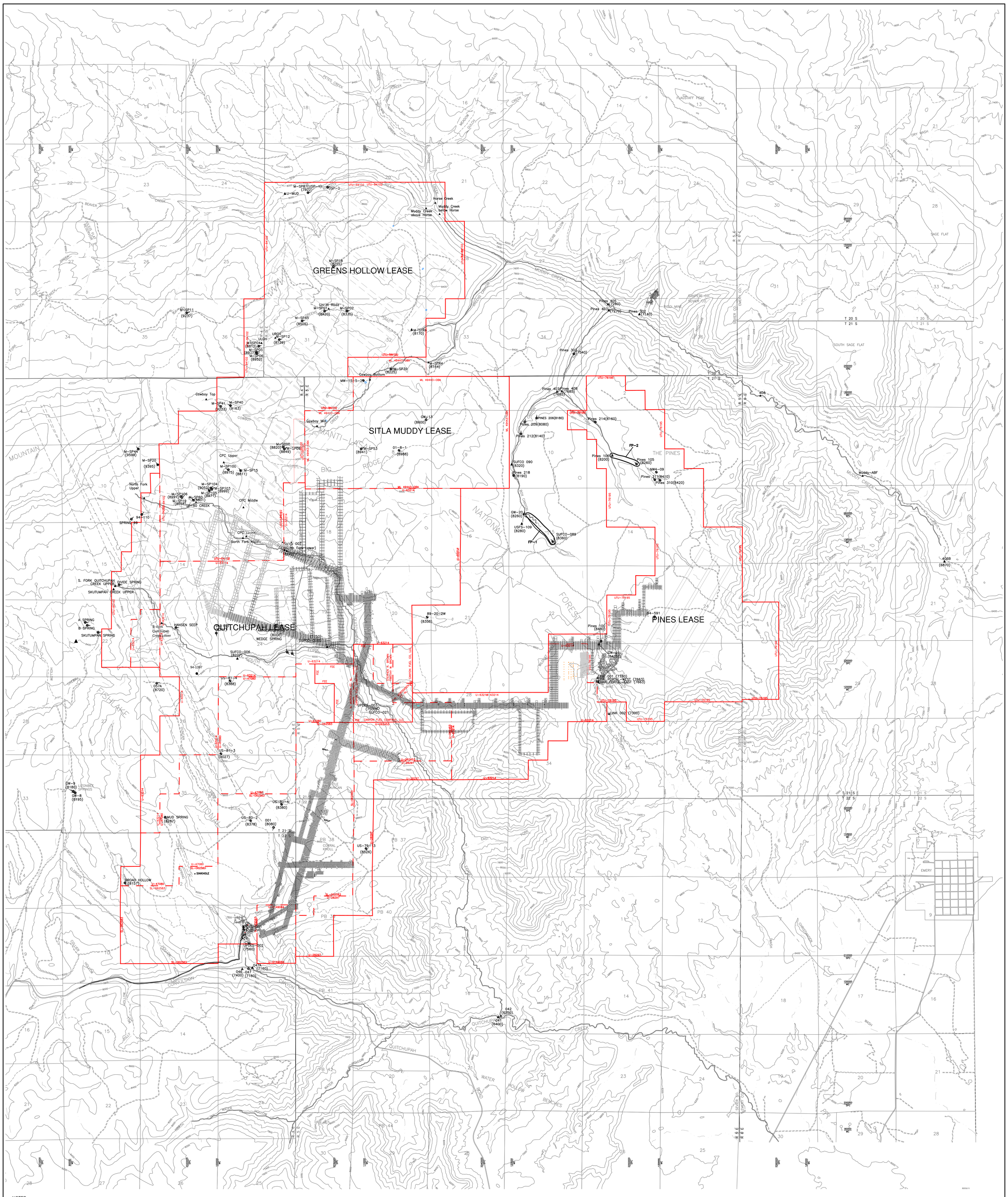

NOTES:

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

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

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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

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OPERATIONAL HYDROLOGIC MONITORING STATIONS

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO:
_1Shdnl-SUFDP1.ctb	1" = 1,000'	8/15/2017	B.T.N.	J.D.B.	B.B.	PLATE 7-10
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 7-10.dwg				

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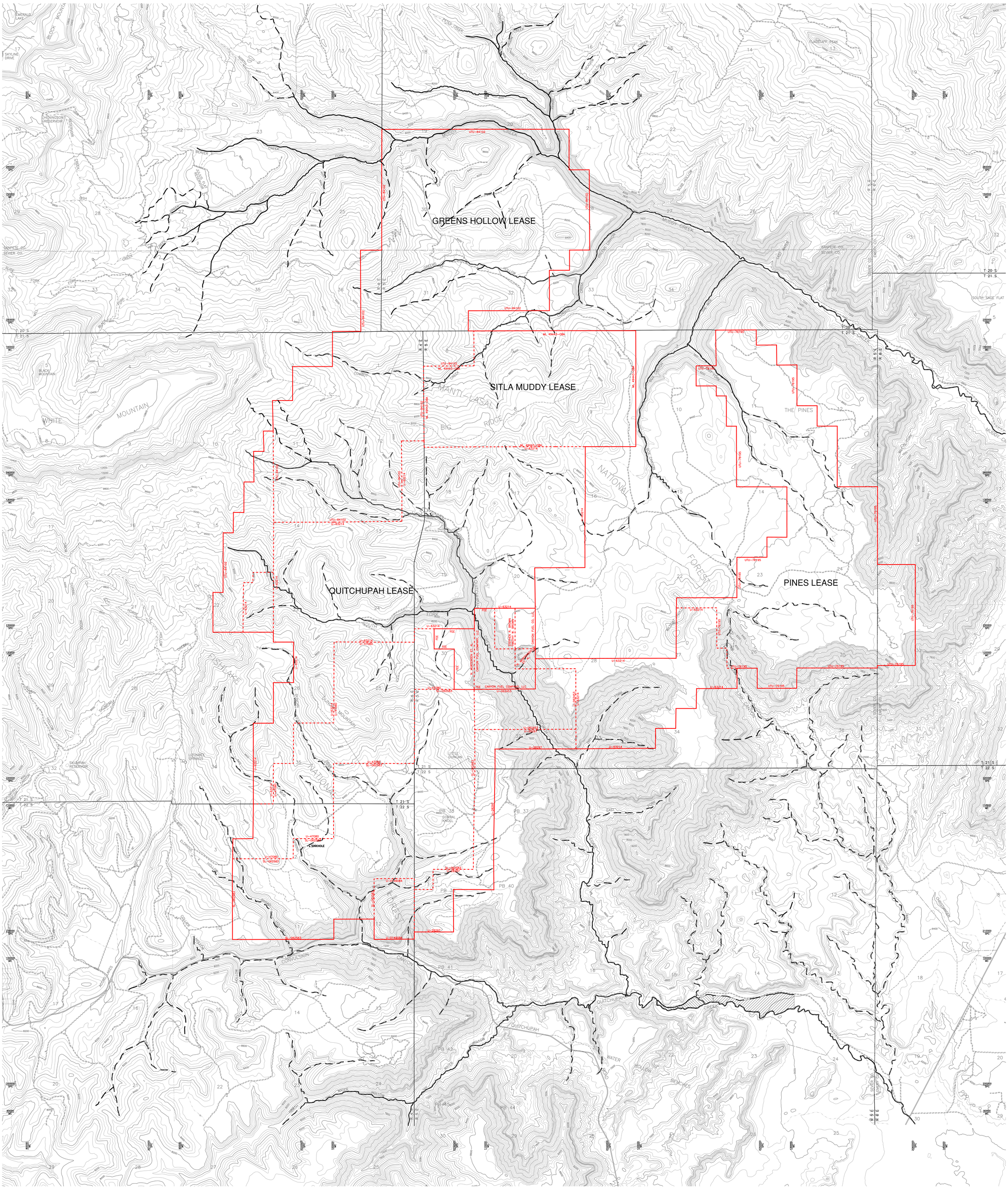

EXPLANATION

- SUFCO EXTERIOR LEASE BOUNDARY
- SUFCO INTERIOR LEASE BOUNDARY
- 100000 MC — MINE COORDINATES
- 2020000 SPC — STATE PLANE COORDINATES
- EPHEMERAL OR INTERMITTANT FLOWS
- PERENNIAL FLOWS
- IRRIGATION DITCH
- POTENTIALLY FLOOD IRRIGATED
- FLOOD IRRIGATED

SOURCES:

1. QUITCHUPAH TRACT
   HYDROMETRICS, INC.
   SOUTHERN UTAH FUEL COMPANY'S
   HYDROLOGICAL RESPONSE TO OSM'S APPARENT
   COMPLETENESS REVIEW, NOV. 1, 1980
2. PINES TRACT
   MANTI–LA SAL NATIONAL FOREST–PINES TRACT PROJECT
   FINAL ENVIRONMENTAL IMPACT STATEMENT (FEIS)
   FIGURE 3–11 SPRINGS, SEEPS, AND RIPARIAN AREAS
   JANUARY 1999
   USDA FOREST SERVICE, REGION FOUR
   MANTI–LA SAL NATIONAL FOREST
   EMERY AND SEVIER COUNTIES, UTAH

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

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2000 0 2000

REVISIONS

NO.	DATE	REQ. BY	DWG. BY	REMARKS
1	2/18/1999	M.L.D.	A.D.D.	
2	03/01/2000	W.K.S.	A.D.D.	
3	5/8/2007	M.L.D.	A.D.D.	
4	03/02/2015	V.M.	T.R.B.	ADDED 70 ACRE R.O.W. AREA FOR 5 WEST
5	07/13/2016	V.M.	J.G.C.	ADD GREENS HOLLOW & SOUTH FORK LEASE BOUNDARIES
6	12/15/2016	V.M.	T.L.M.	REMOVED SOUTH FORK BOUNDARY
7	04/12/2017	V.M.	J.G.C.	GREENS HOLLOW

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ALLUVIAL VALLEY FLOOR CHARACTERISTICS DETERMINATION

PEN TBL:		SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
JSmith-SUFDP1.ctb		1" = 2,000'	4/4/2019	ADD/TRB	JDB	BB	PLATE 9–1
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\PLATES\PLATE 9-1.dwg					