CHAPTER 1
GENERAL CONTENTS
## TABLE OF CONTENTS (December 20, 1991)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>1-1</td>
</tr>
<tr>
<td>Minimum Requirements for Legal, Financial, Compliance and Related Information</td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>1-1</td>
</tr>
<tr>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>1-1</td>
</tr>
<tr>
<td>Identification of Interests</td>
<td></td>
</tr>
<tr>
<td>112.100</td>
<td>1-1</td>
</tr>
<tr>
<td>Business Entity</td>
<td></td>
</tr>
<tr>
<td>112.200</td>
<td>1-1</td>
</tr>
<tr>
<td>Applicant and Operator</td>
<td></td>
</tr>
<tr>
<td>112.300</td>
<td>1-1</td>
</tr>
<tr>
<td>Control Persons</td>
<td></td>
</tr>
<tr>
<td>112.400</td>
<td>1-2</td>
</tr>
<tr>
<td>Coal Mining and Reclamation Operation Permit Applications Previous, Current or Pending</td>
<td></td>
</tr>
<tr>
<td>112.500</td>
<td>1-4</td>
</tr>
<tr>
<td>Legal or Equitable Owner of the Surface and Mineral Properties to be Mined</td>
<td></td>
</tr>
<tr>
<td>112.600</td>
<td>1-6</td>
</tr>
<tr>
<td>Owners of Record of Property Contiguous to Proposed Permit Area</td>
<td></td>
</tr>
<tr>
<td>112.700</td>
<td>1-7</td>
</tr>
<tr>
<td>MSHA Numbers</td>
<td></td>
</tr>
<tr>
<td>112.800</td>
<td>1-7</td>
</tr>
<tr>
<td>Interest in Contiguous Lands</td>
<td></td>
</tr>
<tr>
<td>112.900</td>
<td>1-7</td>
</tr>
<tr>
<td>Certification of Submitted Information</td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>1-7</td>
</tr>
<tr>
<td>Violation Information</td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>1-7</td>
</tr>
<tr>
<td>Right-of-Entry Information</td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>1-14</td>
</tr>
<tr>
<td>Status of Unsuitability Claims</td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>1-14</td>
</tr>
<tr>
<td>Permit Term</td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>1-17</td>
</tr>
<tr>
<td>Insurance Certificate and Proof of Publication</td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>1-17</td>
</tr>
<tr>
<td>Filing Fee</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>1-17</td>
</tr>
<tr>
<td>Permit Application Format and Contents</td>
<td></td>
</tr>
<tr>
<td>130</td>
<td>1-17</td>
</tr>
<tr>
<td>Reporting and Technical Data</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>1-19</td>
</tr>
<tr>
<td>Maps and Plans</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>1-19</td>
</tr>
<tr>
<td>Completeness</td>
<td></td>
</tr>
</tbody>
</table>
LIST OF APPENDICES
(Appendices appear in Volume 4)

Appendix
1-1 Legal Right-of-Entry Documents
1-2 Lease Documents
1-3 Newspaper Advertisement
1-4 Filing Fee Receipt
CHAPTER 1
GENERAL CONTENTS

110 Minimum Requirements for Legal, Financial, Compliance and Related Information

111 Introduction

For information pertaining to this section(s) refer to the General Chapter 1 binder for Canyon Fuel Company, LLC prepared for the Dugout Canyon Mine, Soldier Canyon Mine, SUFCO Mine, Skyline Mines, Banning Loadout and other operations.

112 Identification of Interests

112.100 Business Entity

For information pertaining to this section(s) refer to the General Chapter 1 binder for Canyon Fuel Company, LLC prepared for the Dugout Canyon Mine, Soldier Canyon Mine, SUFCO Mine, Skyline Mines, Banning Loadout and other operations.

112.200 Applicant and Operator

For information pertaining to this section(s) refer to the General Chapter 1 binder for Canyon Fuel Company, LLC prepared for the Dugout Canyon Mine, Soldier Canyon Mine, SUFCO Mine, Skyline Mines, Banning Loadout and other operations.

112.300 Control Persons

For information pertaining to this section(s) refer to the General Chapter 1 binder for Canyon Fuel Company, LLC prepared for the Dugout Canyon Mine, Soldier Canyon Mine, SUFCO Mine, Skyline Mines, Banning Loadout and other operations.
112.400 Coal Mining and Reclamation Operation Permit Applications
Previous, Current or Pending

The following list describes permits held by Canyon Fuel Company, LLC, pending applications for permits, and permits recognized as necessary in the future for which no application has been filed. Identification numbers of applications or permits are contained in the following list. Many of the agencies listed, however, have review responsibility only and may not have submitted a numbered permit.

<table>
<thead>
<tr>
<th>Permit</th>
<th>Issuing Authority</th>
<th>Approval Status/ Identification No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining and Reclamation Permit C/041/002</td>
<td>State of Utah Department of Natural Resources Division of Oil, Gas and Mining</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Department of Interior U.S. Geological Survey and Office of Surface Mining</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Department of Agriculture U.S. Forest Service Fishlake National Forest and Manti La Sal National Forest</td>
<td></td>
</tr>
<tr>
<td>U.P.D.E.S. Permit UT-0022918</td>
<td>Environmental Protection Agency and Utah D.E.Q.</td>
<td>Approved</td>
</tr>
<tr>
<td>Disposal for Water Discharge</td>
<td>Utah Department of Health</td>
<td>Approved</td>
</tr>
<tr>
<td>Business License</td>
<td>Sevier County</td>
<td>Approved</td>
</tr>
<tr>
<td>Mine Health and Safety Permits 42-00089</td>
<td>Mine Safety and Health Administration - Utah</td>
<td>Approved</td>
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<tr>
<td>ID No. 1211-UT-09-00089-01</td>
<td>Mine Safety and Health Administration</td>
<td>Waste Rock Disposal Area Construction Plan</td>
</tr>
<tr>
<td>Radio Permits</td>
<td>Federal Communications Commission</td>
<td>Approved</td>
</tr>
</tbody>
</table>
A table of the Canyon Fuel Company, LLC mining permits and operations is located in General Chapter 1.

SUFCO Mine C/041/002

The issuing authority for the Canyon Fuel Company, LLC permits is the UDOGM.

Operations held by Canyon Fuel Company, LLC and corporate structure are presented on Figure 1-1 in the General Chapter 1 for Canyon Fuel Company, LLC. Facility names, mailing addresses and permit numbers for these operations are provided in either Table 1-1 and/or Table 1-2. For additional information refer to the General Chapter 1 binder for Canyon Fuel Company, LLC.
112.500 Legal or Equitable Owner of the Surface and Mineral Properties

Owner of the surface under Federal Coal Leases U-062453, SL-062583, U-0149084, U-047080, U-063214, U-28297, UTU-76195, UTU-84102 and State of Utah Coal Lease ML 49443-OBA is:

- United States of America
  Department of Agriculture
  U.S. Forest Service
  Fishlake National Forest
  115 East 900 North
  Richfield, Utah 84701

- United States of America
  Department of Agriculture
  U.S. Forest Service
  Manti-La Sal Forest
  599 West Price River Drive
  Price, Utah 84501

- United States of America
  Department of Interior
  Bureau of Land Management
  Price Coal Office
  125 South 600 West
  Price, Utah 84501

Lessee for the Federal Coal Leases and State of Utah Coal Lease is:

Canyon Fuel Company, LLC
225 North 5th Street, 9th Floor
Grand Junction, CO 81501
Telephone: (970) 263-5130
The Bureau of Land Management owns the mineral rights for the Federal Coal Leases and the State of Utah owns the mineral rights for the State Coal Lease.

United States of America
Department of Interior
Bureau of Land Management
Price Coal Office
125 South 600 West
Price, Utah 84501

State of Utah
School and Institutional Trust Lands Administration
675 East 500 South, Suite 500
Salt Lake City, Utah 84102-2818

The Applicant owns 640 acres of coal within the lease area. Surface ownership of these acres is listed below:

Neal J. Mortensen
c/o UNELCO, Inc.
Aurora, Utah 84620

Roger E. Nielsen and Ruth Nielsen
515 East 240 North
Salina, Utah 84654

Canyon Fuel Company, LLC
225 North 5th Street, 9th Floor
Grand Junction, CO 81501
Telephone: (970) 263-5130

A property ownership map of the permit area and adjacent area is presented as Plate 5-6. The Greens Hollow Lease tract contains approximately 79 acres of Fishlake National Forest, the remainder of the tract's surface is managed by the Manti-La Sal Forest.

No area within the lands to be affected by surface operations and facilities or within the area of coal to be mined is under a real estate contract.
Coal mining and reclamation operations are listed on Table 1-1 and the corporate structures is presented on Figure 1-1 in the General Chapter 1 binder.

112.600 Owners of Record of Property Contiguous to Proposed Permit Area

The following list contains the names and addresses of all owners of surface lands contiguous to the permit boundary:

United States of America
Department of Agriculture
U.S. Forest Service
Fishlake National Forest
115 East 900 North
Richfield, Utah 84701

United States of America
Department of Agriculture
U.S. Forest Service
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

State of Utah
School and Institutional Trust Lands Administration
675 East 500 South, Suite 500
Salt Lake City, Utah 84102-2818

United States of America
Department of Interior
Bureau of Land Management
Price Coal Office
125 South 600 West
Price, Utah 84501

The following list contains the names and addresses of the owners of mineral acreage contiguous to the permit boundary:

State of Utah
School and Institutional Trust Lands Administration
675 East 500 South, Suite 500
Salt Lake City, Utah 84102-2818
112.700 MSHA Numbers


112.800 Interest in Contiguous Lands

The applicant owns or controls, directly or indirectly, no legal or equitable interest in any lands contiguous to the permit area.

112.900 Certification of Submitted Information

Canyon Fuel Company, LLC hereby attests that the information contained in this permit document is true and correct to the best of their knowledge.

113 Violation Information

For violation information refer to Table 1-2 in the General Chapter 1 binder for Canyon Fuel Company, LLC prepared for the operations.

114 Right-of-Entry Information

Copies of documents granting the legal right to enter and begin underground coal mining activities have not changed with the acquisition. They can be found in Appendix 1.1 Mining and Reclamation Plan for the SUFCO Mine, which is unmodified by this Notice of Change in Ownership and Control Information.
Canyon Fuel Company, LLC
SUFCO Mine

Mineral Leasing Act of 1920 and the leases themselves. Copies of Federal Coal Leases U-47080, U-28297, U-62453, U-149084, U-63214, UTU-76195, UTU-91108 (ROW), SL-062583, UTU-84102 and State of Utah Coal Lease ML 49443-OBA which grant the right to enter and conduct underground mining operations on the leased premises are presented in Appendix 1-2 Mining and Reclamation Plan for the SUFCO Mine. Appendix 1-2 is unmodified by this Notice of Change in Ownership and Control Information.

Federal Coal Lease SL-062583 grants the right to use lands for the construction and utilization of surface facilities necessary for underground coal mining.

BLM Lease UTU-84102 is in the process of being issued to Sufco. Once the lease/tract is issued to Canyon Fuel Company, LLC a copy of the documents will be incorporated into Appendix 1-2.

The legal description of the SUFCO coal leases:

Federal Coal Lease U-28297 - (716.51 acres +/-) - Approved January 1979

T. 21 S., R. 5 E., SLM, Utah
Sec. 32, lot 1, N1/2S1/2
Sec. 33, NW1/4SW1/4

T. 22 S., R. 5 E., SLM, Utah
Sec. 5, W1/2W1/2;
Sec. 7, S1/2NE1 /4, E1/2SW1/4, W1/2SE1/4;
Sec. 8, W1/2NW1/4.

Federal Coal Lease U-062453 - (480 acres +/-) - Approved March 1962

T. 21 S., R. 5 E., SLM, Utah
Sec. 28, SW1/4SW1/4
Sec. 29, SE1/4SE1/4
Sec. 32, N1/2
Sec. 33, W1/2NW1/4

Federal Coal Lease U-0149084 - (240 acres +/-) - Approved June 1966
T. 22 S., R. 4 E., SLM, Utah
Sec. 12, NE1/4 and N1/2SE1/4

Federal Coal Lease SL-062583 - (3,079.83 acres +/-) - Approved September 1941
T. 21 S., R. 4 E., SLM, Utah
Sec. 36, S1/2
T. 21 S., R. 5 E., SLM, Utah
Sec. 31, all;
T. 22 S., R. 4 E., SLM, Utah
Sec. 1, lots 1 to 4, S1/2N1/2, S1/2
Sec. 2, SE1/4, S1/2SW1/4;
Sec. 3, SE1/4SE1/4;
Sec. 10, E1/2NE1/4, NE1/4SE1/4;
Sec. 11, N1/2, N1/2S1/2;
Sec. 12, NW1/4
T. 22 S., R. 5 E., SLM, Utah
Sec. 6, all;
Sec. 7, N1/2NE1/4, E1/2NW1/4

Federal Coal Lease U-47080 - (1,953.73 acres +/-) - Approved October 1981
T. 21 S., R. 4 E., SLM, Utah
Sec. 25, all;
Sec. 35, E1/2, E1/2SW1/4;
Sec. 36, N1/2.
T. 21 S., R. 5 E., SLM, Utah
Sec. 30, lots 2-4, W1/2SE1/4
Canyon Fuel Company, LLC  
SUFCO Mine  

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 - (6336.34 acres +/-) - Approved July 1989  

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

T. 21 S., R. 5 E., SLM
Sec. 2, lots 3-4, S1/2SW1/4, SW1/4SE1/4
Sec. 10, NE1/4NE1/4
Sec. 11, NE1/4, SE1/4, NW1/4NW1/4, NE1/4NW14,
SE1/4NW1/4, N1/2SW1/4NW1/4, SW1/4SW1/4NW1/4,
E1/2SW1/4, E1/2NW1/4SW1/4, SE1/4SW1/4NW1/4
Sec. 12, S1/2SW1/4, NW1/4SW1/4
Sec. 13, NW1/4, S1/2
Sec. 14, NE1/4, E1/2NW1/4, E1/2E1/2SE1/4
Sec. 22, S1/2S1/2SE1/4
Sec. 23, SE1/4, E1/2SW1/4, S1/2SW1/4SW1/4, S1/2SE1/4NW1/4,
SE1/4NW1/4NE1/4, S1/2NE1/4NE1/4, NE1/4NE1/4NE1/4,
S1/2SW1/4NE1/4, NE1/4SW1/4NE1/4, SE1/4NE1/4
Sec. 24, all
Sec. 25, N1/2, N1/2S1/2
Sec. 26, N1/2, NE1/4SW1/4, E1/2NW1/4SW1/4, SE1/4

T. 21 S., R. 6 E., SLM
Sec. 19, lots 3-4, E1/2SW1/4
Sec. 30, lots 1-3, E1/2NW1/4, NE1/4SW1/4

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

T. 20 S., R. 4 E., SLM
Sec. 36, lot 4, E1/2NE1/4, NE1/4SE1/4

T. 20 S., R. 5 E., SLM
Sec. 19, lots 5-8, E1/2SW1/4, SE1/4
Sec. 20, S1/2
Sec. 21, W1/2SW1/4
Sec. 28, W1/2
Canyon Fuel Company, LLC
SUFCO Mine

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

BLM Right-of-Way UTU-91108 (70 Acres +/-) - Approved June 4, 2015
T. 21 S., R. 4 E., SLB&M
Sec. 1, E1/2SE1/4SE1/4, SE1/4NE1/4SE1/4
Sec. 12, E1/2E1/2NE1/4

State of Utah Coal Lease ML 49443-OBA - (2,294.19 acres +/-) - Approved October 2004
Modified June 2015, February 2017

T. 20 S., R. 5 E., SLB&M
Sec. 32: S1/2S1/2

T. 21 S., R. 5 E., SLB&M
Sec. 4: lots 1-4, S1/2S1/2
Sec. 5: lots 1-4, S1/2S1/2
Sec. 7: lots 1-4, NE1/4, SE1/4,
Sec. 8: All
Sec. 9: All
Canyon Fuel Company, LLC acquired the right to entry on these properties in the merger described in Section 111 herein above.

In addition, the SUFCO Mine permit area includes certain fee lands owned by Canyon Fuel Company, LLC as follows:

T. 21 S., R. 5 E., SLB&M, Utah
   Sec. 29, SW1/4, NW1/4, W1/2NE1/4, W1/2SE1/4
   Sec. 30, S1/2NE1/4, E1/2SE1/4
   containing 640.00 acres +/-

T. 22 S., R. 4 E., SLB&M, Utah
   Sec. 18, NE1/4, SE1/4NW1/4, NE1/4SE1/4
   containing 240 acres +/-

The name of the owner of these fee lands changed from Coastal States Energy Company to Canyon Fuel Company, LLC as a result of the merger transaction described in Section 111 herein above.

The SUFCO Mine also uses certain Forest Service lands in its operation for a spring collection system, pumphouse, water transmission line, sanitary discharge line, sanitary drainfield, access road to the sediment pond, and 25 KV powerline. These USFS special use permit areas are shown on Plate 5-6 through portions of:

T. 22 S., R. 4 E., SLB&M, Utah
   Sec. 12, S1/2
   containing 28.5 acres

The name of the permittee changed from Southern Utah Fuel Company to Canyon Fuel Company, LLC pursuant to the merger described in Section 111 herein above.

The total lease area includes 23,129.95 acres of Federal coal leases, 70 acres of BLM R-O-W, 2,294.19 acres of State of Utah coal leases, 640 acres of fee coal leases, the 240...
acres waste rock disposal site and 28.5 acres under U.S. Forest Service special use permit for a total of 26,402.64 acres.

115 Status of Unsuitability Claims

To the best knowledge of Canyon Fuel Company, LLC, no portion of the area to be permitted is designated, or under study for being designated, unsuitable for mining.

Since the SUFCO Mine was in production before passage of the Surface Mining Control and Reclamation Act of 1977, the unsuitability criteria were not applied to the existing surface facilities.

Canyon Fuel Company, LLC does not propose to conduct coal mining or reclamation operations within 300 feet of any occupied dwelling. Coal mining and reclamation operations have been or will be conducted within 100 feet of a public road, see Section 5.2.1.1 for details. Forest Service approval to conduct coal mining and reclamation operations within 100 feet of the Link Canyon forest service road is located in Appendix 1-1 and the newspaper advertisement for public comment is located in Appendix 1-3.

116 Permit Term

The following information is presented to identify permit term requirements and stipulations. Canyon Fuel Company will be operating the SUFCO Mine with continuous miner and longwall mining methods. The estimated number of total surface acres to be affected over the entire mining operation is 96.42 acres +/-.

<table>
<thead>
<tr>
<th>PERMITTED DISTURBED AREA BOUNDARY</th>
<th>ACTUAL AREA CURRENTLY DISTURBED TO BE RECLAIMED</th>
<th>SITE DESCRIPTION</th>
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<tr>
<td>30.210</td>
<td>17.405</td>
<td>Mine Site, East Spring Canyon</td>
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<tr>
<td>0.967</td>
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<td>Spring Collection Field, Convulsion Cyn.</td>
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<td>0.220</td>
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<td>Pump House, Convulsion Canyon</td>
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Canyon Fuel Company, LLC  
SUFCO Mine

Mining and Reclamation Plan  
September 2018

<table>
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<th></th>
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<th>Description</th>
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<td>0.784</td>
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<td>0.193</td>
<td>Water Tank, East Spring Canyon</td>
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<tr>
<td>0.286</td>
<td>0.017</td>
<td>3 East Portals</td>
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<td>1.774</td>
<td>0.70</td>
<td>4 East Portals</td>
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<td>0.302</td>
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<td>South Portals</td>
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<td>Quitchupah Portals</td>
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<td>Sinkhole</td>
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<td>Waste Rock Disposal Site*</td>
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<td>96.416</td>
<td>54.125</td>
<td>Totals Acres +/-</td>
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</table>

*Includes acreage from pre-expansion disturbance and Phases 1 thru 4 construction disturbance and seeding for Phase 5.

The legal description of the SUFCO permit area:

Mine Site Facility, Water Tank, South Portals, Spring Collection Field, Pump House, Pipeline, Leachfield (Approximately 64.40 acres +/- )

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

Section 12: A Portion of the following:
E1/2NW1/4, SW1/4NW1/4NE1/4, S1/2

Portals - 3 East, 4 East, Quitchupah and Link Canyon, Link Canyon Substation No. 1 and No. 2 (Approximately 3.368 acres +/- )

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

Section 26: A Portion of the following:
SE1/4SW1/4SW1/4NW1/4, E1/2NW1/4NW1/4SW1/4
SE1/4NE1/4SW1/4SW1/4

Section 29: A Portion of the following:
NW1/4NW1/4SW1/4SE1/4, NE1/4NW1/4SE1/4SW1/4
NE1/4NE1/4SE1/4SW1/4

Section 32: A Portion of the following:
NE1/4SW1/4SW1/4NE1/4

Waste Rock Disposal Site (Approximately 81.25 acres +/- )

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

Section 18*: S1/2NW1/4NE1/4, S1/2NW1/4NE1/4,
S1/2S1/2NW1/4NE1/4, S1/2NW1/4NW1/4NE1/4, S1/2SW1/4NE1/4NW1/4NE1/4,
W1/2SW1/4NE1/4NE1/4, W1/2E1/2SW1/4NE1/4NE1/4, S1/2SW1/4NW1/4NE1/4NE1/4,
S1/2N1/2SW1/4NW1/4NE1/4NE1/4, SW1/4SE1/4NW1/4NE1/4NE1/4,
W1/2E1/2SW1/4NE1/4NE1/4, NW1/4NW1/4SW1/4NE1/4, W1/2NE1/4SW1/4NE1/4,
NW1/4SW1/4SW1/4NE1/4, N1/2NE1/4SW1/4SW1/4NE1/4, SW1/4NE1/4NE1/4SW1/4NE1/4,
N1/2NE1/4NE1/4SW1/4NE1/4, N1/2NW1/4SE1/4SW1/4NE1/4, NE1/4NE1/4SE1/4NW1/4,
NE1/4NW1/4NE1/4SE1/4NW1/4, S1/2NE1/4SE1/4NW1/4, S1/2SE1/4NW1/4SE1/4NW1/4,
NE1/4SW1/4SE1/4 NW1/4, N1/2SE1/4SE1/4 NW1/4

* Excluding county/state road(s) and the features associated with the road(s) such as right-of-way, turn-offs and drainage controls such as ditches, culverts, etc.

North Water Mitigation Area (Approximately 542.260 acres +/-)
T. 21 S., R. 5 E., SLBM, Utah
Section 2: A Portion of the following:
    SW1/4SW1/4SW1/4
Section 3: A Portion of the following:
    S1/2SE1/4
Section 10: A Portion of the following:
    NE1/4, N1/2NE1/4SE1/4
Section 11: A Portion of the following:
    W1/2NW1/4, W1/2SE1/4 NW1/4, E1/2SW1/4, E1/2NW1/4 SW1/4, S1/2SE1/4, NW1/4SE1/4, S1/2NE1/4SE1/4
Section 12: A Portion of the following:
    W1/2SW1/4
Section 14: A Portion of the following:
    W1/2NE1/4, NE1/4 NW1/4

Sinkhole (Approximately 0.45 acres +/-)
T. 22 S., R. 4 E.
Section 2 Portion of the SW1/4NE1/4

PERMITTED AREA BOUNDARIES

<table>
<thead>
<tr>
<th>SITE DESCRIPTION</th>
<th>PERMITTED AREA BOUNDARIES</th>
</tr>
</thead>
<tbody>
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<td>Link Canyon Substation No. 2</td>
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<td>Link Canyon Portal</td>
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<tr>
<td>Sinkhole</td>
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</tr>
</tbody>
</table>

691.728 acres +/- TOTAL

The permit area boundary, which is shown on Plate 5-6, includes portions of Federal
coal leases, fee coal leases, the waste rock disposal site and U.S. Forest Service special use permit areas for a total of 691.728 acres +/-.

117 Insurance and Proof of Publication

Certificates of Insurance issued to Canyon Fuel Company, LLC are located in the General Chapter 1 binder as prepared for the operations and on file with the Division.

The newspaper advertisement appears in Appendix 1-3. Verification of the advertisement appearing in the appropriate newspapers will be added to Appendix 1-3 and submitted to the Division no later than 4 weeks after publication.

118 Filing Fee

A photocopy of the receipt is presented in Appendix 1-4 as proof of payment of the permit filing fee.

120 Permit Application Format and Contents

The permit application contains clear, concise, current information, in the format required by the UDOGM.

130 Reporting of Technical Data

All technical data submitted in the permit application is accompanied by the names of persons or organizations that collected and analyzed the data. The technical data also contains the dates of collection and analysis of the data, and descriptions of the method used to collect and analyze data. A professional qualified in the subject, planed or directed the technical analyses.
3 Right 4 East Panel(s)

Mining of this panel(s) will straddle Leases U-63214 and U-62453 which are referred to as the Quitchupah Tract throughout the M&RP in text, appendices and on drawings. Both leases were issued to the permittee in 1989, the tract was originally delineated in 1982. The mine plan is shown on Plate 5-7, mining will occur only in the Upper Hiawatha coal seam. Overburden is approximately 900 feet or more. An environmental assessment was prepared for Lease U-63214 in 1988 and an EIS for the Quitchupah Tract in 1983, a variety of information from these assessments are included in the existing M&RP.

A helicopter survey to locate raptors and migratory bird species was conducted in 1982 and 1988 by UDWR, USFWS, BLM, and USFS. In 1988 ten golden eagle nests were located within the lease boundary, two were active, two were tended and the remaining six were inactive. One active nest and two inactive nests were located in Section 33. Bald eagles annually visit the area during the winter. No other TES species are known to inhabit the tract.

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

Greens Hollow Lease

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

The maps submitted in this permit application correspond to the format required by the regulations.

Those portions in the mine plan area in which underground coal mining activities occurred before August 3, 1997, and from August 3, 1977 to May 3, 1978 are presented on Plate 5-1.

150 Completeness

CFC believes the information in the permit application for its operations to be complete and correct. Reference the Mining and Reclamation Plans for the Dugout Canyon Mine, Soldier Canyon Mine, Sufco Mine, Gordon Creek Mines, Skyline Mine, Fossil Rock Mine and Banning Loadout operations for additional site specific information.

REFERENCES:

CHAPTER 2

SOILS
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.10 Introduction</td>
<td>2-1</td>
</tr>
<tr>
<td>2.20 Environmental Description</td>
<td>2-2</td>
</tr>
<tr>
<td>2.2.1 Prime Farmland Investigation</td>
<td>2-2</td>
</tr>
<tr>
<td>2.2.2 Soil Survey</td>
<td>2-2</td>
</tr>
<tr>
<td>2.2.2.1 Soils Map</td>
<td>2-3</td>
</tr>
<tr>
<td>2.2.2.2 Soil Identification</td>
<td>2-3</td>
</tr>
<tr>
<td>2.2.2.3 Soil Description</td>
<td>2-4</td>
</tr>
<tr>
<td>2.2.2.4 Soil Productivity</td>
<td>2-9</td>
</tr>
<tr>
<td>2.2.3 Prime Farmland Soil Characterization</td>
<td>2-10</td>
</tr>
<tr>
<td>2.2.4 Substitute Topsoil</td>
<td>2-10</td>
</tr>
<tr>
<td>2.30 Operation Plan</td>
<td>2-11</td>
</tr>
<tr>
<td>2.3.1 General Requirements</td>
<td>2-11</td>
</tr>
<tr>
<td>2.3.1.1 Removing and Storing Soil Methods</td>
<td>2-11</td>
</tr>
<tr>
<td>2.3.1.2 Suitability of Topsoil Substitutes/Supplements</td>
<td>2-18</td>
</tr>
<tr>
<td>2.3.1.3 Testing of Topsoil Handling and Reclamation Procedures Regarding Revegetation</td>
<td>2-18</td>
</tr>
<tr>
<td>2.3.1.4 Construction, Modification, Use, and Maintenance of Topsoil Storage Piles</td>
<td>2-19</td>
</tr>
<tr>
<td>2.3.2 Topsoil and Subsoil Removal</td>
<td>2-21</td>
</tr>
<tr>
<td>2.3.2.1 Topsoil Removal and Segregation</td>
<td>2-21</td>
</tr>
<tr>
<td>2.3.2.2 Poor Topsoil</td>
<td>2-21</td>
</tr>
<tr>
<td>2.3.2.3 Thin Topsoil</td>
<td>2-21</td>
</tr>
<tr>
<td>2.3.2.4 Minor Disturbances Not Requiring Topsoil Removal</td>
<td>2-21</td>
</tr>
<tr>
<td>2.3.2.5 Subsoil Segregation</td>
<td>2-22</td>
</tr>
<tr>
<td>2.3.2.6 Timing</td>
<td>2-22</td>
</tr>
<tr>
<td>2.3.2.7 Topsoil and Subsoil Removal Under Adverse Conditions</td>
<td>2-22</td>
</tr>
<tr>
<td>2.3.3 Topsoil Substitutes and Supplements</td>
<td>2-23</td>
</tr>
<tr>
<td>2.3.3.1 Overburden Materials Supplementing and/or Replacing Topsoil</td>
<td>2-23</td>
</tr>
<tr>
<td>2.3.3.2 Suitability of Topsoil Substitutes and Supplements</td>
<td>2-23</td>
</tr>
<tr>
<td>2.3.3.3 Physical and Chemical Analyses</td>
<td>2-23</td>
</tr>
<tr>
<td>2.3.3.4 Testing of Substitute Topsoil</td>
<td>2-24</td>
</tr>
<tr>
<td>2.3.4 Topsoil Storage</td>
<td>2-24</td>
</tr>
</tbody>
</table>
2.3.4.1 Topsoil Stockpiling ........................................... 2-24
2.3.4.2 Stockpiled Topsoil ........................................... 2-24
2.3.4.3 Topsoil Stockpile Relocation ............................. 2-25

2.40 Reclamation Plan .................................................. 2-26
2.4.1 General Requirements ........................................... 2-26
2.4.2 Soil Redistribution ............................................... 2-26
2.4.2.1 Soil Redistribution Practices .............................. 2-26
2.4.2.2 Regrading ..................................................... 2-27
2.4.2.3 Topsoil Redistribution on Impoundments and Roads .......................... 2-28
2.4.3 Soil Nutrients and Amendments ............................... 2-28
2.4.4 Soil Stabilization .................................................. 2-28
2.4.4.1 Protection and Stabilization of Surface Areas .......... 2-28
2.4.4.2 Mulch Application ............................................ 2-28
2.4.4.3 Rills and Gullies ............................................ 2-29

2.50 Performance Standards ........................................... 2-30
2.5.1 Topsoil, Subsoil, and Topsoil Supplements Management ........................................... 2-30
2.5.2 Stockpiled Topsoil and Subsoil ................................ 2-30

References ............................................................... 2-30

LIST OF PLATES
Plate
2-1 Native Soil Types Present in SUFCO Mine Disturbed Area & Surrounding Area
2-2 Soil Types Pines Tract
2-3 Soil Types SITLA Muddy Tract

INTEGRATED

JAN 1 2 2018

Div. of Oil, Gas & Mining

2-iii
LIST OF APPENDICES
(Appendices appear in Volume 4)

Appendix
2-1  Prime Farmland Determination Documents
2-2  Report of Studies of Vegetation and Soils for SUFCO Mine
2-3  Water and Soil Data Report
2-4  Submittal of Drainage Plan and Slope Stability for Reclamation for Convulsion Canyon Mine, Sergent, Hauskins & Beckwith
2-5  Final Reclamation Cut and Fill Quantities
2-6  Link Canyon Substation Soils Investigation
2-7  Quitchupah Tract Supplemental Environmental Assessment 1989 and Environmental Assessment for Costal States Energy Company, Coal Lease Application U-63214 Quitchupah Tract
2-8  Pines Tract Soils Types
2-9  Link Canyon Portal Vegetation, Aquatic Fauna, and Soil Investigations
2-10 Muddy Tract Soils Types
CHAPTER 2
SOILS

2.10 Introduction
This chapter and Volume 3 of this M&RP contains all pertinent information relating to identification, management, and reclamation activities associated with the soil resources present in the disturbed area of the SUFCO Mine.

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

2.20 Environmental Description
The SUFCO Mine area lies in central Utah at the southern end of the Wasatch Plateau. Topography is dominated by plateaus separated by deeply incised canyons. Canyon walls are generally composed of laterally continuous (several thousand feet) ledge-forming sandstones, interbedded with slope forming shales and siltstones. Topography in the SUFCO Mine area ranges from 6500 to about 9,000 feet above sea level. Soils are generally not cultivated due to their thin nature, shortage of irrigation water, and a short growing season. Residual and colluvial soils are present at the SUFCO Mine surface facilities area. These soils have formed from residual sandstone and shale particles that mixed as they migrated down slope. Soils are usually very shallow, consisting predominantly of sand and silty sand loams which have high percolation rates. The soils are highly susceptible to wind erosion. The inherent erosion hazard from water is low. Rock outcrops consist of alternating layers of sandstone and shale. Subordinate amounts of coal
and limestone are also present. The landscape is steep and rocky with massive sandstone ledges, and siltstone/shale slopes. Surface and subsurface layers are often rocky.

### 2.2.1 Prime Farmland Investigation

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

### 2.2.2 Soil Survey

A Level I soil survey of the entire SUFCO Mine disturbed area, including the Link Canyon Substations Nos. 1 and 2, has been conducted. Soil survey data are presented in Appendix 2-2 for the majority of the permit area, Appendix 2-6 for the Link Canyon Substation areas, and are herein summarized in Sections 2.2.2.1 through 2.2.2.3. Survey data includes the following information: taxonomic classification, horizon name and depth, dry and moist color, texture (percent sand, silt, and clay), class, structure, percent rock fragments and organic matter, pH, effervescence, EC, and solubility of calcium, magnesium, and sodium (Appendices 2-2 and 2-6). A cross-reference list of map unit, soil taxonomic classification, and sample site appears in pages 17 through 19 of Appendix 2-2.

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

An Order 2 soil survey has been completed for the Link Canyon Substation No. 1 disturbed area and is included in Appendix 2-2. Additionally, an Order 1 soil survey was conducted of the substation Nos. 1 and 2 pad areas and the results are included in Appendix 2-6.
An Order 3 soil survey has been conducted for the Pines Tract and the results are included in Appendix 2-8. (Plate 2-2)

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

2.2.2.1 Soils Map

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

2.2.2.2 Soil Identification

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

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

2.2.2.3 Soil Description

Soil Type O

Soil type O is found at the north end of the disturbed area, in the area of the confluence of the Mud Spring Hollow and East Spring Canyon drainages (Plate 2-1). The taxonomic classifications of Soil O are that of a loamy-skeletal, mixed, frigid Ustic Torriorthent. This soil is found on slopes with grades of 60 percent or greater; consists of well-drained soils that have formed from residuum and
Colluvium; and supports Pinyon, Juniper, and Mountain Mahogany vegetative growth. The water holding capacity is 3.5 inches.

The A soil horizon ranges from 0 to 2 inches in depth and is a sandy clay loam composed of about 52% sand, 22% silt, and 26% clay. The dominant color is a pale brown (10YR 6/3) when dry, and a dark grayish brown (10YR 4/2) when moist. Rock fragments (predominantly gravel) account for 15% by volume of this horizon. A pH of 7.66, EC of 740 mmhos/cm, and organic matter values of 2.22% are present. Solubility values (ppm) of Ca, Mg, and Na, are 116.3, 14.4, and 6.7, respectively.

The AC soil horizon ranges from 2 to 12 inches in depth and is a sandy clay loam composed of approximately 50% sand, 18% silt, and 32% clay. Predominant color is a yellowish brown (10YR 5/4) dry, and a dark grayish brown (10YR 4/2) wet. Rock fragments make up about 45% (15% gravel, 10% cobbles, 20% stones) of the AC horizon by volume. A pH of 7.73, an EC of 940 mmhos/cm, and an organic matter percent of 2.2% are common. Solubility values (ppm) of Ca, Mg, and Na, are 150, 18, and 6, respectively.

The C soil horizon ranges in depth from 12 to 31 inches. This horizon is also a sandy clay loam composed of 45% sand, 23% silt, and 32% clay. Soil color is light yellowish brown (2.5Y 6/4) when wet. Rock fragments account for 30% (20% gravel, 5% cobbles, 5% stones) of the C soil horizon by volume. A pH value of 7.92, EC of 560 mmhos/cm, and an organic matter percent of 0.54 are present. Solubility values (ppm) of Ca, Mg, and Na, are 83, 12, and 9, respectively. Bedrock is encountered at a depth of 31 inches.

Soil Type W

Soil type W is found along the western edge of the disturbed area on an east facing slope with a grade of 60% or more (Plate 2-1). The taxonomic classifications of Soil W are that of a loamy-skeletal, mixed, frigid Typic Xerothent. Soil W supports vegetation consisting of sage-grass and mountain brush in this area. This soil consists of excessively well drained soils that have formed in residuum and colluvium. Rock outcrops comprise 30% of the mapped area containing soil type W.
The A1 soil horizon occurs from the surface to a depth of 4 inches. This surface soil horizon is a sandy clay loam composed of 53% sand, 21% silt, and 26% clay; rock fragments compose about 80% (40% gravels, 40% cobbles) of its volume. The A1 horizon has a brown to dark brown color (10YR 4/3) when moist. A pH value of 7.5, EC of 3300 mmhos/cm, and a percent organic matter of 1.54 are present. The solubilities of Ca, Mg, and Na, are 430, 118, and 42 ppm, respectively.

The A1 soil is underlain by a brown to dark brown (10YR 4/3) C soil horizon. The C soil occurs between depths of 4 to greater than 60 inches. It is also a sandy clay loam with sand, silt, and clay percentages of 53, 21, and 26, respectively. Rock fragments compose about 45% by volume (25% gravel, 10% cobbles, 10% stones) of this soil horizon. Solubilities of Ca, Mg, and Na are identical to those in the A1 horizon.

**Soil Type T**

Soil type T is found in the south-central region of the disturbed area and encompasses the original drainage channel of the East Spring Canyon (Plate 2-1). This unit consists of excessively well-drained soils that have formed in colluvium and residuum. Slopes range in excess of 60%. Soil T is classified as a loamy-skeletal, mixed, frigid, Calcixerollic Xerochrept. Rock outcrops comprise 30% of the mapped area containing soil type T. The water holding capacity of the soil is 4 inches. Soil T supports pinyon pine, juniper, and wild rye vegetation.

The surficial A1 soil horizon ranges in depth from 0 to 2 inches. This horizon is a sandy clay loam, composed of 45% sand, 23% silt, and 32% clay. Soil color is yellowish brown (10YR 5/4) when moist. Rock fragments account for only 5% (gravel) by volume. A pH value of 7.57, EC of 1110 mmhos/cm, and an organic matter percent of 5.57% are present. Solubility values (ppm) of Ca, Mg, and Na, are 149, 29, and 8, respectively.

The B1 horizon, a clay loam, occurs between depths of 2 to 12 inches, and is composed of 37% sand, 29% silt, and 34% clay. Rock fragments compose 55% (10% gravel, 5% cobbles, 40% stone) by volume of this soil resource. When moist the B1 horizon is brown to dark brown (10YR 4/3) in color. Geochemical tests reveal a pH of 7.45, an EC of 1340 mmhos/cm, and an organic
matter percent of 4.07. Solubility values of Ca, Mg, and Na, are 182, 35, and 7.4 ppm, respectively.

The underlying B2 soil horizon ranges from depths of 12 to 24 inches, and is brown (10YR 5/3) in color. It is a clay loam composed of 35% sand, 27% silt, and 38% clay. Rock fragments account for 45% (40% gravel, 5% cobble) by volume of this soil horizon. PH value of 7.66, an EC of 820 mmhos/cm, and organic matter values of 2.63 are present. Ca, Mg, and Na solubility concentrations are 99, 20, and 9 ppm, respectively.

The basal yellowish brown (10YR 5/4) C soil horizon occurs from 24 to 58 inches below ground level. Soil C is also a clay loam, with sand comprising 37%, silt 27%, and clay 35%. Rock fragments make up 50% of this soil horizon, with stones accounting for 40%, gravel 5%, and cobbles 5%. Solubility concentrations of Ca, Mg, and Na are 220, 80, and 37 ppm, respectively.

Soil Type X
Soil X lies along the eastern edge and in the north-central region of the disturbed area (Plate 2-1). This soil is a complex consisting of two soil types: (1) a clayey-skeletal, mixed, frigid, shallow Lithic Calcixeroll, and (2) a fine, mixed, frigid Mollic Haploxeralf. The former soil comprises approximately 70% of the soil cover in this region, the latter soil type accounts for about 20%, with about 10% of the area covered with rock outcrop. Both soil types support pinyon pine and juniper trees.

The Lithic Calcixeroll soil is composed of A1, AC, and Cca soil horizons. The A1 horizon occurs from the surface to a depth of 4 inches below the surface and is dark brown (7.5YR 3/2). It is a clay loam composed of 43% sand, 29% silt, and 28% clay. Rock fragments (gravel) comprise 25% by volume this horizon. An organic matter content of 7%, pH value of 7.44, and an EC of 1280 mmhos/cm are present. Soluble concentrations of Ca, Mg, and Na are 205, 27, and 6.6 ppm, respectively.

The AC soil horizon occurs between 4 to 8 inches below ground level, and is predominately a clay composed of 33% sand, 25% silt, and 42% clay. Its color when moist is dark brown (7.5YR 3/2). Gravel makes up 20% of this horizon, by volume. Organic matter accounts for about 5% of this
horizon. PH and EC values of 7.9 and 510 mmhos/cm are present. Ca, Mg, and Na soluble concentrations are 73, 19, and 3 ppm, respectively.

The underlying Cca soil horizon extends from 8 inches to depths of about 17 inches, where bedrock is encountered. The Cca horizon is a reddish brown clay. Clay comprises 42% of this horizon; subordinate amounts of sand (35%) and silt (23%) are also present. Rock fragments account for 55% (40% gravel, 15% cobbles) of this zone. EC values of 380 mmhos/cm, along with a pH of 7.97, and an organic matter percent of only 1.21% are present. Soluble concentrations for Ca, Mg, and Na are 10, 10, and 6 ppm, respectively.

The Mollic Haploxeralf soil is characterized by an A, AC, and Cca soil horizons. The surficial A horizon extends to 5 inches below ground level, and is a very dark brown (10YR 2/2) sandy clay loam. It is typically composed of 59% sand, 15% silt, and 26% clay. Gravel accounts for only 5% by volume of this horizon. Percent organic matter is about 7%. A pH of 7.63 and an EC of 1620 mmhos/cm are present. The soluble concentrations (ppm) of Ca, Mg, and Na are 168, 72, and 26, respectively.

The underlying AC soil zone occurs between 5 to 14 inches below the surface, and is a pale brown (10YR 6/3) clay. Clay is the dominant constituent comprising 44% of this zone, silt (39%) and sand (17%) are also present. Rock fragments make up 20% (5% gravel, 15% cobbles) of this horizon, by volume. An organic matter value of 3.8%, a pH level of 7.48, and an EC of 6340 mmhos/cm characterize this soil horizon. Solubilities of Ca, Mg, and Na are 517, 279, and 317 ppm, respectively.

The basal soil horizon, Cca, a light brownish gray clay, typically extends to depths of 34 inches where bedrock is encountered. Cca is composed of 52% clay, 37% silt, and 11% sand. Rock fragments comprise 40% (10% gravel, 20% cobbles, 10% stones) of this horizon. Percent organic matter is only 1.7. PH and EC values are 7.87 and 9590 mmhos/cm, respectively.
Overflow Pond Soils
A general description of the soils located in the Overflow Pond area will be provided in Appendix 2-2.

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

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

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

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

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

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.
Electrical conductivity and other analytical data for soils of the disturbed area, soil types O, W, T, and X, are found in Tables 51, 56, 53, 57, and 58, of Appendix 2-2, respectively. These data reveal a high percentage of rock fragments which may limit fertility for both topsoil and subsoil. Vegetation associated with these soils regarding soil productivity are presented (as recommended by the Soil Conservation Service) in Appendix 2-2 and discussed in Chapter 3 of the Mining Reclamation Plan (MR&P).

2.2.3 Prime Farmland Soil Characterization

No prime farmland exists in the permit area (see Section 2.2.1).

2.2.4 Substitute Topsoil

During final reclamation suitable growth medium/substitute topsoil will be collected at potential locations such as the upper sediment pond dam, the fill slope above the upper sediment pond and soil resources used to construct the original surface pad. The applicant has no sound method for calculating the quantity of growth medium/substitute topsoil available from these potential locations. The preconstruction topography is poor or non-existent and a record of the quantity of material used for the construction of these locations is not available. A random composite sample will be taken for approximately every 2,000 tons as the soil is collected to determine suitability as growth medium/substitute topsoil. The soil resources will be supplemented as described in Section 2.4.3.
2.30 Operation Plan

2.3.1 General Requirements

2.3.1.1 Removing and Storing Soil Methods

The SUFCO Mine has been in operation since 1941. At the time the main facilities in East Spring Canyon were constructed, no topsoil was segregated and saved. Topsoil and other fill material was used in construction of the surface facilities pad. However, soils removed from the Link Canyon Substation No. 1 area are to be stored in the outslope of the substation pad. Additionally, the soils removed from the Link Canyon Substation No. 2 area will be stored in a small stockpile adjacent to the substation pad. The mix of topsoil and subsoil will be used as substitute topsoil at the time of reclamation. Soils removed from the Link Canyon Mine Portal area will be stored in a topsoil pile located south of the disturbed portal pad area out of the floodplain (Plate 5-2F). The majority of the portal area has been previously disturbed and only thin topsoil layers exist in portions of the disturbed area. Topsoil will be carefully removed with efforts made to minimize the amount of subsoil salvaged since most of the subsoils are not suitable as substitute topsoil or growth media.

The methods described herein are followed when removing and storing soil resources that necessitate removal as a result of construction of new surface operations.

Soil salvage will take place in two lifts where possible. The first lift will include the A horizon material to be stockpiled in one location and the second lift will include the remaining B and C horizons, excluding material with a coarse fragment content of over 50 percent. The latter would be stockpiled in a third, but adjacent location. These stockpiles will be graded to gradual slopes (3h:1v) and seeded to promote surface stabilization.
Where topsoil thicknesses of less than 6 inches are encountered, the topsoil and underlying unconsolidated materials (up to 6 inches total) will be removed and stockpiled together; the entire mixture will be treated as topsoil in compliance with R645-201-234.300.

In the Link Canyon Substation No. 1 disturbed area, the A and C horizons will be removed together from the topsoil salvage area and stored on the pad outslope as a single soil resource. A 3 inch wide non-biodegradable polyethylene underground warning tape marker flagging will be utilized on an eight foot centerline square grid pattern to mark the proximity of the original, undisturbed topsoil surface area beneath the side-cast materials to help prevent surface damage during reclamation and excavation of the side-cast topsoil. The maximum projected volume of topsoil salvage based on the soil survey depth of 20 inches and the projected topsoil salvage area of 0.08 acres is 224 cubic yards. The projected original, undisturbed topsoil surface area that will be marked with flagging tape (0.10 acres) and the projected cut Topsoil salvage area (0.08 acres) are delineated by the Cut and Fill Boundary line as shown on Plate 5-20. The salvaged topsoil will be removed as a separate layer, segregated and placed on the south end of the pad outslope. The remaining excavated material in the deeper cuts will be used as fill material for the access road and the north end of the substation pad.

The soil to be removed at the Link Canyon Substation No. 2 will include the A horizons and a portion of the C horizon. As described in Appendix 2-6, six mapped soil units exist in the No. 2 pad area. Following is an estimated volume of soil to be salvaged and placed in the topsoil storage pile based on the area of each soil unit and average depth of salvage for each unit area. The actual total volume of soil stored may differ from the total provided below and is dependant upon conditions found during construction.

<table>
<thead>
<tr>
<th>Soil Map Unit</th>
<th>Estimated Thickness (ave)</th>
<th>Mapped Area</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>24-inches</td>
<td>612 sf</td>
<td>24 CY</td>
</tr>
<tr>
<td>B</td>
<td>8-inches</td>
<td>579 sf</td>
<td>14 CY</td>
</tr>
<tr>
<td>C</td>
<td>6-inches</td>
<td>473 sf</td>
<td>9 CY</td>
</tr>
<tr>
<td>D</td>
<td>36-inches</td>
<td>600 sf (approx.)</td>
<td>67 CY</td>
</tr>
<tr>
<td>E</td>
<td>8-inches</td>
<td>28 sf</td>
<td>1 CY</td>
</tr>
<tr>
<td>F</td>
<td>5-inches</td>
<td>198 sf</td>
<td>3 CY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td>118 CY</td>
</tr>
</tbody>
</table>
The A and C horizons will be removed together from the topsoil salvage area and stored in the pile as a single soil resource. Type D soils, the overcast from the east side of the trolley road, will be recovered prior to construction of the substation pad. All available suitable soils encountered during site construction will be salvaged and stored for final reclamation. A person qualified to make soil salvaging determinations will be on site during construction.

Six soil types and waste coal were identified by Dan Larsen (EIS) during his investigation of the soils in the Link Canyon Mine Portal disturbed area. The soil types and thicknesses of salvageable topsoil are listed below:

<table>
<thead>
<tr>
<th>Soil</th>
<th>Map Unit</th>
<th>Approx. Thickness</th>
<th>Mapped Area (approx.)</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC</td>
<td>Waste Coal</td>
<td>0 inches</td>
<td>250 sf</td>
<td>0 CY</td>
</tr>
<tr>
<td>DR</td>
<td>Disturbed old access road</td>
<td>6 inches</td>
<td>1300 sf</td>
<td>24 CY</td>
</tr>
<tr>
<td>CU</td>
<td>Calcic Ustochrepts</td>
<td>6 inches</td>
<td>800 sf</td>
<td>15 CY</td>
</tr>
<tr>
<td>TUE</td>
<td>Typic Ustochrepts, eroded, carbonatic</td>
<td>4 inches</td>
<td>200 sf</td>
<td>3 CY</td>
</tr>
<tr>
<td>TUL</td>
<td>Typic Ustochrepts, light colored</td>
<td>6 inches</td>
<td>20 sf</td>
<td>1 CY</td>
</tr>
<tr>
<td>VS</td>
<td>Very stoney and bouldery area</td>
<td>0 inches</td>
<td>100 sf</td>
<td>0 CY</td>
</tr>
<tr>
<td>RP</td>
<td>Riparian sites</td>
<td>6 inches</td>
<td>2000</td>
<td>37 CY</td>
</tr>
</tbody>
</table>

All available suitable soils encountered during portal site construction will be salvaged and stored for final reclamation (Plate 5-2F). A person qualified to make soil salvaging determinations will be on site during construction. The volume of topsoil salvaged was 38 cubic yards. The location of the topsoil pile is shown on the revised As-Built Plate 5-2F. The remaining excavated material will be used as fill material for the access road and the portal pad. A tracked vehicle, such as a trackhoe, will be used to remove the initial topsoil layers from the access road and pad area. As the site is constructed and space becomes available, a rubber-tired vehicle, such as a front end loader or backhoe, may be used to remove soils. During the topsoil removal process, a moisture level of at least 15% will be maintained in the soils to reduce dust and loss of the resource. Maintaining soil...
moisture may be accomplished using a water truck equipped with pumps and hoses and personnel assigned to spraying the dry soils prior to and during salvage operations.

The sewer leach field for the mine site buildings will be expanded and two new water holding tanks will be buried in place at the existing pump house in the Fall of 2001. In both cases, the soils at these two locations have been disturbed in the past. A field investigation conducted
of the site in October 2001 found that top soil was not present at either site. Following is a description of the plan to salvage and replace the subsoils at the two locations.

The additional leach field laterals will require a disturbance of approximately 60 by 70 feet, or 4200 square feet. The soils in the planned disturbed area no longer had a topsoil layer. The upper most layer of soil was approximately 1- to 3-inches thick and consisted of a grayish brown loose, sandy and silty loam with some fine to coarse gravels. It appeared to be a remnant of a C horizon prior to surface disturbance. The soils had been left undisturbed long enough for some vegetation to grow and vegetative litter, in small concentrations, was present. Underlying the C horizon remnant was a C2 horizon that consisted of brown very gravelly sand. The gravel was fine to coarse and large sandstone cobbles were present. The soils were dry.

It is anticipated that the upper 1- to 3-inches of the soils will be removed from the area prior to disturbance. During soil removal operation, a field supervisor will be at the location to monitor the removal of the soils. The total depth of soil removal will be based upon the color change between the upper most and underlying layer and the use of a tape measure. For calculation purposes, the upper layer of soils was assumed to average 2-inches. Therefore, the total material removed prior to excavating the lateral trenches is:

\[ 4200 \text{ sq ft} \times 0.17 \text{ ft} = 714 \text{ cubic feet or approximately 26 cubic yards}. \]

The 26 yards of salvaged soils will be removed and placed temporarily on the top of the existing leach field immediately adjacent to and southeast of the new lateral locations. The remaining material, C2 horizon, will be excavated from the trenches and temporarily stored adjacent to the excavation but not mixed with the 26 cubic yards of salvaged soil. After the laterals are placed, the excavated C2 material will be replaced in the trench and any remaining material will be evenly spread over the disturbed trench area. The salvaged 26 cubic yards of soils will then be spread over the disturbed area. The surface will be left in a roughened state to reduce erosion. Reseeding of the area will take place as soon as practical.

The location of the new water tanks was near the bottom of the drainage. The soils in the immediate area of the two new water tanks consisted of at least four feet of sand with lenses of very fine silt. The upper 0- to 3-inches of the sand occasionally contained some vegetative.
material. However, this material did not significantly differ from the underlying four feet of sand. The soil also contained occasional lenses of fine gravel. It is anticipated that the coarseness of the material would increase with depth (i.e., a coarsening downward sequence often associated with high energy stream deposits).

No soil salvage is anticipated at this location since previous disturbance has essentially removed the uppermost layers of salvage value. During construction of the pits in which the new tanks will be placed, the sand removed from the pits will be placed to one side, the tanks put in place, and the pits backfilled with the removed sand. It is anticipated the sand removed from the pits will be used as bedding material. The remaining sand will be spread over the disturbed area and also used to supplement the existing surface runoff control berms already in the tank area.

A 300,000 gallon fire water tank will be constructed in the fall of 2001 north of the mine site substation which is located on the hill side above the portals and mine buildings. Construction of the tank will require the removal of soils and weathered bedrock. The soils in the area consist of soils Type X as described in Section 2.2.2.3 of this chapter. A profile of the exposed soil in a cut adjacent to the substation and within the tank area was measured and described. The identified A1 horizon extended from 1.5- to 7.5-inches below ground surface. The area had an average of 1.5 inches of vegetative litter from sage brush, pinyon, and junipers. The AC horizon extended from a depth of 7.5- to 12.0-inches below the surface. The Cca horizon extended from a depth of 12.0-inches to approximately 42-inches. Underlying this unit was weathered bedrock of sandstone and siltstone. A copy of the field log data sheet is included in Appendix 2-2.

Salvaged soil volumes for the disturbance related to construction of the fire water tank are based on the measured thicknesses described above of the A1 (topsoil) horizon, underlying AC and Cca horizons (subsoils), and the cut and fill calculations provided on Figure 5-OE of Chapter 5 of this permit. The A1 horizon in the area appeared to have a maximum thickness of 6-inches. As described previously in this section, where the topsoil is less than 6-inches thick, a lift of 6-inches of topsoil and subsoil will be taken and stockpiled as topsoil. The removal of the first 6-inches of soil will be observed and measured in the field by the site construction supervisor or a trained representative. The total area where soil salvage will be performed is approximately 0.07 acres (3,049 sq ft). Based on this area, the following volumes of salvaged soils were estimated:

A1 or topsoil - maximum thickness 0.5 ft.
The volume of salvagable topsoil varied from the volume originally calculated due to large sandstone boulders present in the cut area and reduced the salvageable topsoil significantly, from the estimate ~56 cu yds to 8.2 cu yds.

AC and Cca horizon - average thickness of approximately 3 ft
3 ft X 3,049 sq ft = 9,147 cu ft (~339 cu yds)*

The topsoil will be removed first and transported for storage at the waste rock storage site. It will be signed and stored separately from other piles located at the site. The subsoils will be removed to a depth of 42-inches or to the boundary with the weathered bedrock. Approximately 109 cu yds of subsoil and weathered bedrock will be used as fill material at the water tank site. The remaining subsoils will be transported to the waste rock site and stored with the subsoils removed previously from the minesite. Storage of the topsoil and subsoil piles will be done in accordance with Section 2.3.1.4 of this M&RP.

The topsoil removed from construction of the overflow pond and overflow pond access road will be stockpiled on a stable surface southwest of the overflow pond, see Plate 7-4A. According to Plate 2-1 the overflow pond site consists of type T soil. The A horizon is 0 to 2 inches in depth and the B horizon is 2-12 inches in depth. The topsoil stockpile will be segregated between A and B horizons. Much of the site of the overflow pond is on steep hill sides where topsoil is less then 6 inches deep. Assuming an average of 12 inches of removal the following quantities have been calculated:

0.167 ft X 49,950 sq ft = 8,342 cu ft (~309 cy) horizon A
0.833 ft X 49,950 sq ft = 41,608 cu ft (~1,541 cy) horizon B
Total 309 cy + 1,541 cy = 1,850 cy

A site specific soil survey will be completed for the Overflow Pond prior to disturbance and this information will be utilized in determining topsoil salvage depth. During topsoil removal observations and measurements in the field will be conducted by the site construction supervisor or a trained representative. Actual volume of topsoil removed and stockpiled for the Overflow Pond was 1,488 cubic yards.

During the topsoil removal operation for the temporary access road for the construction of the bypass culvert portion of the overflow pond, the total depth of soil removal will be based upon the
color change between the upper most and underlying layer and the use of a tape measure. For calculation purposes, the upper layer of soils was assumed to average 12-inches. Therefore, the total material removed prior to excavating the bypass culvert trench is:

\[13000 \text{ sq ft} \times 1.0 \text{ ft} = 13000 \text{ cubic feet or approximately 482 cubic yards.}\]

The 482 yards of salvaged soils will be removed and placed adjacent to the new bypass culvert trench location. The remaining material, C2 horizon, will be excavated from the trench and temporarily stored adjacent to the excavation but not mixed with the 482 cubic yards of salvaged soil. After the culvert is placed, the excavated C2 material will be replaced in the trench and any remaining material will be evenly spread over the disturbed trench area. The salvaged 482 cubic yards of soils will then be spread over the disturbed area. The surface will be left in a roughened state to reduce erosion. Reseeding of the area followed the completion of construction in 2010.

2RWL Sinkhole - In October 2016 a sinkhole in the SW1/4 NE1/4 of Section 2, Township 22 South, Range 4 East was reshaped. Temporary access to the hole was made from FR007 to the hole, topsoil was removed from the perimeter of the existing hole and stockpiled for immediate replacement. Approximately 1,000 cubic yards was stockpiled, with the depth of topsoil on the perimeter ranging from 8 to 30 inches. The hole was graded to approximately 2.5:1 slopes thus reducing the depth of the hole from approximately 40' to 26'. Approximately 6 - 8" of topsoil was replaced over the sinkhole area, the area was pocked with a bucket approximately 42" in width. The access corridor, sinkhole and immediate areas were seeded. For additional information refer to Sections 3.2.2.2, 5.2.1.1 and 5.4.1.1. The sinkhole is located within the area of the West Lease Modifications permitted in 2011.

2.3.1.2 Suitability of Topsoil Substitutes/Supplements

See Section 2.3.3.2

2.3.1.3 Testing of Topsoil Handling and Reclamation Procedures Regarding Revegetation

The Applicant will exercise care to guard against erosion during and after application of topsoil and will employ the necessary measures to ensure the stability of topsoil on graded slopes. Erosion
control measures will include surface roughing and erosion mat placement on slope areas thought to be unstable. The Applicant will fill, regrade, or otherwise stabilize any rills or gullies deeper than nine (9) inches which form in areas which have been regraded and topsoiled. The areas adjacent to any rills or gullies which have been filled, regraded or otherwise stabilized, will be reseeded or stabilized accordingly.

Methods used to evaluate success of revegetation and stabilization appear in page 37 of Appendix 2-2. Erosion monitor pins will be placed on the slopes at the time of reseeding. Locations of the erosion pins will be obtained via a random number generator. The pin locations will be surveyed and revegetation analyses conducted annually following completion of reseeding, until the release of the bond.

2.3.1.4 Construction, Modification, Use, and Maintenance of Topsoil Storage Piles
The topsoil storage piles (Plate 2-1) at the SUFCO Mine in East Spring Canyon area consist of small amounts of topsoil, from the substation pad (27 cubic yards) and the area where the sediment pond (1,200 cubic yards) was constructed. The topsoil materials were segregated and stockpiled. The stockpiled materials were selectively placed in small area exemption areas within the permit area on stable surface areas below the sediment pond (0.105 acres) and on the south end of the substation pad (0.02 acre). The topsoil small area exemption stockpiles are isolated with no means of access from the main surface area to protect the topsoil from contaminants and unnecessary compaction that would interfere with vegetation. A topsoil storage sign was installed at the base of each stockpile. The stockpiles were protected from wind and water erosion by being revegetated with a quick growing vegetative cover (proposed seed mix minus the shrubs and trees) and by installing silt fence below the stockpiles to help trap sediment coming off the stockpile. This topsoil will not be moved or disturbed until required for redistribution during final reclamation.

Topsoil from the Overflow Pond will be placed in a topsoil pile located southwest of the overflow pond area. This storage area will be protected with berms and/or silt fences, a three-strand barbed wire fence, and revegetated with a quick growing vegetative cover (standard seed mix in section 3.4.1.2 minus the shrubs and trees) to control erosion. The surface of the topsoil pile will be pitted to reduce runoff and erosion. This soil will not be moved or disturbed until it is required.
for redistribution during final reclamation. A figure of the surveyed topsoil stockpile and estimated quantity of soil stored in the pile is included in Appendix 2-2. Plate 5-2B shows the as-built features associated with the overflow pond.

Topsoil from the Link Canyon Substation No. 1 will be placed and stored on the outslope of the pad. This storage area will be protected with berms and/or silt fences, a three-strand barbwire fence, and revegetated to control erosion. This soil will not be moved or disturbed until it is required for redistribution during final reclamation.

Soil from the Link Canyon Substation No. 2 will be placed in a soil stock pile located at the south end of the pad area. The storage area will be protected with berms and/or silt fences, a three strand barbwire fence, and revegetated to control erosion. This soil will not be moved or disturbed until it is required for redistribution during final reclamation.

Soil from the Link Canyon Mine Portal area will be placed in a topsoil pile located south of the disturbed portal pad area out of the floodplain (Plate 5-2F). The storage area will be protected by installing a topsoil storage sign at the base of the pile, berms and/or silt fences, a three strand barbwire fence, and protected from wind and water erosion by surface pitting the stockpile to retain moisture and reduce erosion and by being revegetated with a quick growing vegetative cover (standard seed mix in section 3.4.1.2 minus the shrubs and trees) to control erosion. This soil will not be moved or disturbed until it is required for redistribution during final reclamation. The surface of the topsoil pile will be pitted to reduce runoff and erosion. Vegetation removed during site construction, such as sage brush and other woody plants, will be placed on top of the pile.

Excess subsoil associated with construction of a run of mine coal stockpile and the West Lease portal tunnel development is stored at SUFCO Mine's waste rock disposal site. At the mine site the substation binwall has approximately 2,160 cubic yards of subsoil material and 5,300 cubic yards of road base, with the additional 11,747 cubic yards of subsoil material (Soil Nail Wall/West Lease/run of mine stockpile) being stored at the waste rock site there is a total of 19,207 cubic yards (approximate) that will be available for use as subsoil material during final reclamation of the mine site facilities. Reference Appendix 2-3 for the analyses of the subsoil being stored at the waste rock site to be used during reclamation of the mine site.

Approximately 487 cyds of subsoil was removed during the stabilization construction of a soil nail wall located behind the Warehouse Annex Building.
Immediately adjacent to the subsoil pile at the waste rock site is stored 756.3 cubic yards of topsoil collected from beneath the footprint of the subsoil pile. This total represents the removal of approximately 12" of topsoil prior to placement of the subsoil. Section 3.1.6 of Volume 3 of this M&amp;RP contains more information pertaining to the soils stored at the waste rock disposal site.

2.3.2 Topsoil and Subsoil Removal

2.3.2.1 Topsoil Removal and Segregation
All topsoil thicker than 6 inches will be removed as a separate layer from the subsoil, segregated, and stockpiled separately. Topsoil less than 6 inches thick will be removed according to Section 2.3.2.3. However, in the areas of the Link Canyon Substation Nos. 1 and 2 pads, all soil will be removed and stored in one area as a single soil resource. At substation pad No. 1, the maximum projected volume of topsoil salvage based on the soil survey depth of 20 inches and the projected topsoil salvage area of 0.08 acres is 224 cubic yards. The salvaged topsoil will be removed as a separate layer, segregated and placed on the south end of the pad outslope. The remaining excavated material in the deeper cuts will be used as fill material for the access road and the north end of the substation pad. At substation No. 2, the volume of soil projected to be removed is 118 CY.

2.3.2.2 Poor Topsoil
Topsoil that is of an insufficient quantity, or of poor quality (for sustaining vegetation) will be removed as a separate layer and segregated. Such operations will be done with approval of the UDOGM, and in compliance with R645-301-233.100 (Section 2.3.3.1).

2.3.2.3 Thin Topsoil
Topsoil to be removed that is less than 6 inches thick will be removed with the immediately underlying unconsolidated materials (up to a total of 6 inches). This material mixture will be treated as topsoil and stockpiled together without any horizon segregation.

2.3.2.4 Minor Disturbances Not Requiring Topsoil Removal
Small Structures. Topsoil will not be removed prior to construction resulting in only minor disturbances as described in R645-301-232.400. Such construction activity includes work on small structures such as power poles, signs, fence lines, and other small structures which do not significantly disturb the site.

Vegetation. SUFCO Mine will not remove topsoil for minor disturbances where such activity will not destroy vegetation or cause erosion.

2.3.2.5 Subsoil Segregation
Due to the poor quality of the subsoil, the B and C soil horizons will not be individually segregated and stockpiled. The topsoil will be segregated and stockpiled separately from the subsoil (B & C horizons) except in the area of the Link Canyon Substations Nos. 1 and 2, and Link Canyon Mine Portal. These soils will be salvaged as specified in Section 2.3.2.1

2.3.2.6 Timing
Where possible, soil removal will take place after all vegetation has been removed that could interfere with soil salvage. Surface disturbance activities will take place after the soil has been removed.

2.3.2.7 Topsoil and Subsoil Removal Under Adverse Conditions
In areas of surface disturbance, topsoil and subsoil will be each removed separately and segregated, except where natural conditions render operations hazardous.

Conventional Machines. In localities where steep grades, adverse terrains, severe rockiness, limited depth of soils, or other adverse conditions exist that render soil removal and segregation activities using conventional machines hazardous, soils will not be salvaged and stockpiled.

Substitute Topsoil. Importing of substitute topsoil is not expected to be required. The applicant will evaluate importation of topsoil with the regulatory authority if deemed necessary based upon revegetation success.
2.3.3 Topsoil Substitutes and Supplements

2.3.3.1 Overburden Materials Supplementing and/or Replacing Topsoil
Selected overburden materials may be used as a supplement to topsoil during reclamation operations. If overburden materials are used, the operator commits to demonstrating, to the UDOGM prior to topsoil emplacement, that the resultant soil is equal to or more suitable than the original soil in supporting revegetation efforts.

2.3.3.2 Suitability of Topsoil Substitutes and Supplements
At the time (1941) the Convulsion Canyon operations began and surface facilities were constructed, no topsoil was segregated and saved. Topsoil and other fill material was used in construction of the surface facilities pad. This material will be excavated and used as a topsoil substitute after recontouring of the site during reclamation. The total quantity of this topsoil substitute required for a 6-inch soil layer will come from within the present mine facility pad fill and from slopes at the mine which are restored during the active life of the mine. A random composite sample will be taken for every 2000 tons as the topsoil is collected. Topsoil will be collected into a pile for storage during the recontouring process and spread over the disturbed area prior to preparation for seeding.

2.3.3.3 Physical and Chemical Analyses
Physical and chemical analyses of the soil material will be conducted during collection operations to determine if/what supplemental fertilizer is needed. The material has already been tested where it is exposed and a report describing its vegetation potential appears in Appendix 2-3.

The applicant will utilize the proposed topsoil subsequent to approval by the regulatory authorities.

Certification of Reclamation Topsoil Suitability. The suitability of the substitute topsoil shall be certified by an approved laboratory in accordance with at least one of the following: Soil Conservation Service (SCS) published data, SCS technical guides, state agricultural agency,
2.3.3.4 Testing of Substitute Topsoil

Only the substitute topsoil used in lieu of, or in conjunction with, on-site overburden and topsoil will be tested as described in Section 2.3.3.3.

2.3.4 Topsoil Storage

2.3.4.1 Topsoil Stockpiling

Topsoil removed will be stockpiled for later use in reclamation operations when it is impractical to promptly redistribute the topsoil on regraded areas.

Presently, the topsoil storage piles at the SUFCO Mine are of the small amounts of topsoil removed from the substation and sediment pond areas (Section 2.3.1.4).

2.3.4.2 Stockpiled Topsoil

Stable Stockpile Site. Stockpiled materials will be placed on a stable site within the permit area. The topsoil pile containing the topsoil removed from the sediment pond site was stockpiled in a small area exemption pile on a stable surface area (0.105 acres) below the sediment pond (Section 2.3.1.4). Topsoil removed for the construction of the overflow pond is stockpiled southwest of the overflow pond, see Plate 7-4A, in a small area exemption pile on a stable surface area (0.141 acres) The topsoil pile containing the soil removed from the substation area (0.02 acres) is located in a small area exemption pile on the south side of the substation. Topsoil removed from the Link Canyon Substation No. 1 will be located on the outslope below the pad as shown on Plate 5-2D. Topsoil removed from the Link Canyon Substation No. 2 will be stored in the soil stockpile as shown on Plate 5-2E. Topsoil removed from the Link Canyon Mine Portal area will be stored in the soil stockpile as shown on Plate 5-2F.
Protection from Contaminants and Compaction. Stockpiled topsoil shall be protected from contaminants and unnecessary compaction. To protect the topsoil from contaminants and unnecessary compaction that could interfere with vegetation, the sediment pond topsoil and the substation stockpiles are isolated with no means of access from the main surface area (Section 2.3.1.4). A topsoil storage sign was installed at the base of both stockpiles and will be placed on the Link Canyon Substations Nos. 1 and 2 and Link Canyon Mine Portal storage areas.

Wind and Water Erosion Protection. All topsoil stockpiles will be protected from wind and water erosion by prompt establishment and maintenance of a vegetative cover (standard seed mix in section 3.4.1.2 minus the shrubs and trees). The sediment pond and substation topsoil stockpiles are protected from wind and water erosion by the establishment of a protective vegetative cover. The Link Canyon Portal topsoil pile will be protected by adding vegetative material removed during site construction. Grasses native to the area will be planted either through seeding or by obtaining and planting plugs from nearby undisturbed sites. A silt fence was installed below the stockpiles to help trap sediment runoff from the stockpiles.

Topsoil Redistribution. All stockpiled topsoil will not be moved until redistributed during reclamation operations unless approved by the UDOGM.

2.3.4.3 Topsoil Stockpile Relocation

Stockpiled topsoil in jeopardy of being detrimentally affected in terms of its quantity and quality by mine operations may be temporarily redistributed after approval from the UDOGM.

Host Site. Topsoil relocation may occur provided that such action does not permanently adversely affect topsoil of the host site.

Topsoil Suitability. Topsoil relocation may occur provided the topsoil is retained in a condition more suitable for redistribution than if stockpiled.
2.40 Reclamation Plan

2.4.1 General Requirements
Topsoil redistribution, amendments, and stabilization are discussed in Sections 2.4.2, 2.4.3, and 2.4.4, respectively. Refer to Sections 2.3.1.1 and 3.2.2.2 for information pertaining to the reclamation of the 2RWL Sinkhole which is within the West Lease Modification Areas permitted in 2011.

2.4.2 Soil Redistribution

2.4.2.1 Soil Redistribution Practices
In addition to the redistribution practices discussed herein, the following action will be taken. Within the disturbed areas the contaminated surface soil layer will be removed and stored during the final reclamation process. The contaminating gravels, crushed stone, and other contaminates will be buried along with the structure foundations.

Soil Thickness. Topsoil will be distributed on all areas with slopes less than 1h:1.5v that are to be reclaimed. Topsoil redistribution procedures will ensure an approximate uniform thickness of six inches. During this time period, the topsoil will be allowed to settle and attain equilibrium with its natural environment. This procedure will be followed for all areas in which facilities such as road beds, mine pads, and building sites are to be abandoned.

Compaction. To prevent compaction of topsoil, soil moving equipment will refrain from unnecessary operation over spread topsoil. Front-end-loaders and other wheel mounted equipment may be used to transport and dump topsoil. However, to minimize compaction, only track-mounted equipment (example bulldozer) will be used to spread the topsoil. The topsoil will be disced or ripped, surface roughened, pitted, and/or deep gouged prior to seeding to help alleviate soil compaction, increase soil stability, and to increase water harvesting.

In the 300,000 gallon fire water tank area, the concrete foundation of the water tank will be broken up and placed against the base of the cutslope. The fill material used to create the foundation pad will be used first to backfill the tank area. The remainder of the fill necessary for reclamation will be obtained from the subsoil stock pile at the waste rock site. Finally, the topsoils will be returned to the site for distribution. The thickness of the redistributed topsoil should roughly equal six inches, the thickness originally removed.
Erosion. Procedures will be exercised to ensure the stability of topsoil on graded slopes to guard against erosion during and after topsoil application. Erosion control measures will include surface roughing, pitting, deep gouging, and/or placement of organic matting on slope areas thought to be unstable.

2.4.2.2 Regrading
Since the mine is over 55 years old, there are no private or public topographic maps which can be used to accurately determine the original geometric configuration of the canyon. Prior to topsoil redistribution, the disturbed area will be regraded to agree with final reclamation topography (Chapter 5 and Plate 5-3).

The postmining topography was designed by Sergent, Hauskins & Beckwith's (SH&B) (Appendix 2-4). The cut and fill quantities are 74,734 and 71,173 yards, respectively (Appendix 2-5). These values supersede those presented in Appendix 2-4.
On slopes less than 1.5h:1v, regraded land will be scarified by a ripper-equipped tractor or with other suitable equipment. The surface will be ripped to a suitable depth to reduce surface compaction, provide a roughened surface to assure topsoil adherence, and promote root penetration.

2.4.2.3 Topsoil Redistribution on Impoundments and Roads
This regulation does not apply as the sedimentation pond and dam will be dismantled and reclaimed with the other surface disturbed areas. Similarly, reclamation of abandoned roads will also follow the same technique as for other disturbed areas.

2.4.3 Soil Nutrients and Amendments
Soil nutrients and amendments will be applied to the redistributed soil as necessary, to establish the vegetative cover. Soils will be analyzed prior to redistributing, following the Division’s Guidelines for Management of Topsoil and Overburden, to determine what fertilizers and amendments will promote successful revegetation and the appropriate application rates.

2.4.4 Soil Stabilization

2.4.4.1 Protection and Stabilization of Surface Areas
All reclaimed areas will be stabilized to control erosion by application of mulch and regrading of rills and gullies.

The Link Canyon Substations Nos. 1 and 2 and Portal area reclaimed pads, access roads, and affected slopes will be pitted or deep gouged and have the large rocks and boulders and slash previously removed spread out over the surface to help increase soil stability and will be fenced to prevent damage from cattle grazing during reclamation.

2.4.4.2 Mulch Application
Mulch will be applied to all areas that have been regraded and covered with soil to stabilize the topsoil. For further discussion of revegetation practices to be utilized see Chapter 3.
2.4.4.3 Rills and Gullies

Postmining Land Use and Revegetation. Rills and gullies that disrupt the postmining land use or reestablishment of vegetative cover will be regraded, the topsoil replaced, and reseeded.

Water Quality. Rills and gullies that contribute to the degradation of stream quality will be regraded, receive new topsoil, and be revegetated.
2.50 Performance Standards

2.5.1 Topsoil, Subsoil, and Topsoil Supplements Management
All topsoil, subsoil, and topsoil supplements shall be managed as outlined in Sections 2.30 and 2.40.

2.5.2 Stockpiled Topsoil and Subsoil
All stockpiled topsoil and subsoil will be managed according to plans outlined in Sections 2.30 and 2.40.

REFERENCES:

# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.10 Introduction</td>
<td>3-1</td>
</tr>
<tr>
<td>3.1.1 Vegetative, Fish and Wildlife Resources</td>
<td>3-2</td>
</tr>
<tr>
<td>3.1.2 Potential Impact to Vegetative, Fish and Wildlife Resources</td>
<td>3-2</td>
</tr>
<tr>
<td>3.1.3 Description of Reclamation Plan</td>
<td>3-2</td>
</tr>
<tr>
<td>3.20 Environmental Description</td>
<td>3-2</td>
</tr>
<tr>
<td>3.2.1 Vegetation Information</td>
<td>3-2</td>
</tr>
<tr>
<td>3.2.1.1 Plant Communities Within the Proposed Permit Area</td>
<td>3-2</td>
</tr>
<tr>
<td>3.2.1.2 Land Productivity Prior to Mining</td>
<td>3-4</td>
</tr>
<tr>
<td>3.2.2 Fish and Wildlife Information</td>
<td>3-5</td>
</tr>
<tr>
<td>3.2.2.1 Level of Detail</td>
<td>3-5</td>
</tr>
<tr>
<td>3.2.2.2 Site-specific Resource Information</td>
<td>3-5</td>
</tr>
<tr>
<td>3.2.2.3 Fish and Wildlife Service Review</td>
<td>3-28</td>
</tr>
<tr>
<td>3.2.3 Maps and Aerial Photographs</td>
<td>3-28</td>
</tr>
<tr>
<td>3.2.3.1 Location and Boundary of Proposed Reference Area</td>
<td>3-28</td>
</tr>
<tr>
<td>3.2.3.2 Elevations and Locations of Monitoring Stations</td>
<td>3-28</td>
</tr>
<tr>
<td>3.2.3.3 Facilities for Protection and Enhancement</td>
<td>3-28</td>
</tr>
<tr>
<td>3.2.3.4 Vegetation Type and Plant Communities</td>
<td>3-28</td>
</tr>
<tr>
<td>3.30 Operation Plan</td>
<td>3-34</td>
</tr>
<tr>
<td>3.3.1 Measures Taken to Disturb the Smallest Practicable Area</td>
<td>3-34</td>
</tr>
<tr>
<td>3.3.2 Description of Anticipated Impact of Subsidence</td>
<td>3-34</td>
</tr>
<tr>
<td>3.3.3 Plan to Minimize Disturbances and Adverse Impacts</td>
<td>3-35</td>
</tr>
<tr>
<td>3.3.3.1 Minimized Disturbance to Endangered or Threatened Species</td>
<td>3-41</td>
</tr>
<tr>
<td>3.3.3.2 Species and Habitats</td>
<td>3-41</td>
</tr>
<tr>
<td>3.3.3.3 Protective Measures</td>
<td>3-41</td>
</tr>
<tr>
<td>3.40 Reclamation Plan</td>
<td>3-50</td>
</tr>
<tr>
<td>3.4.1 Revegetation</td>
<td>3-50</td>
</tr>
<tr>
<td>3.4.1.1 Schedule and Timetable</td>
<td>3-50</td>
</tr>
<tr>
<td>3.4.1.2 Descriptions</td>
<td>3-51</td>
</tr>
<tr>
<td>3.4.1.3 Greenhouse Studies, Field Trials or Other Equivalent Studies</td>
<td>3-57</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4.2 Fish and Wildlife</td>
<td>3-58</td>
</tr>
<tr>
<td>3.4.2.1 Enhancement Measures</td>
<td>3-58</td>
</tr>
<tr>
<td>3.4.2.2 Plants Used for Wildlife Habitat</td>
<td>3-58</td>
</tr>
<tr>
<td>3.4.2.3 Cropland</td>
<td>3-59</td>
</tr>
<tr>
<td>3.4.2.4 Residential, Public Service and Industrial Land Use</td>
<td>3-59</td>
</tr>
<tr>
<td>3.50 Performance Standards</td>
<td>3-60</td>
</tr>
<tr>
<td>3.5.1 General Requirements</td>
<td>3-60</td>
</tr>
<tr>
<td>3.5.2 Contemporaneous Reclamation</td>
<td>3-60</td>
</tr>
<tr>
<td>3.5.3 Revegetation: General Requirements</td>
<td>3-60</td>
</tr>
<tr>
<td>3.5.3.1 Vegetative Cover</td>
<td>3-60</td>
</tr>
<tr>
<td>3.5.3.2 Reestablished Plant Species</td>
<td>3-61</td>
</tr>
<tr>
<td>3.5.3.3 Vegetative Exception</td>
<td>3-62</td>
</tr>
<tr>
<td>3.5.3.4 Cropland</td>
<td>3-62</td>
</tr>
<tr>
<td>3.5.4 Revegetation: Timing</td>
<td>3-62</td>
</tr>
<tr>
<td>3.5.5 Revegetation: Mulching and Other Soil Stabilizing Practices</td>
<td>3-62</td>
</tr>
<tr>
<td>3.5.6 Revegetation: Standards for Success</td>
<td>3-63</td>
</tr>
<tr>
<td>3.5.6.1 Success of Revegetation</td>
<td>3-63</td>
</tr>
<tr>
<td>3.5.6.2 Standards for Success</td>
<td>3-64</td>
</tr>
<tr>
<td>3.5.6.3 Siltation Structure Maintenance</td>
<td>3-65</td>
</tr>
<tr>
<td>3.5.6.4 Removal of Siltation Structures</td>
<td>3-65</td>
</tr>
<tr>
<td>3.5.7 Revegetation: Extended Responsibility Period</td>
<td>3-65</td>
</tr>
<tr>
<td>3.5.7.1 Extended Period Begins</td>
<td>3-65</td>
</tr>
<tr>
<td>3.5.7.2 Vegetative Parameters</td>
<td>3-65</td>
</tr>
<tr>
<td>3.5.7.3 Husbandry Practices</td>
<td>3-65</td>
</tr>
<tr>
<td>3.5.8 Protection of Fish, Wildlife and Related Environmental Values</td>
<td>3-65</td>
</tr>
<tr>
<td>3.5.8.1 Existence of Endangered or Threatened Species</td>
<td>3-66</td>
</tr>
<tr>
<td>3.5.8.2 Bald and Golden Eagles</td>
<td>3-66</td>
</tr>
<tr>
<td>3.5.8.3 Taking of Endangered or Threatened Species</td>
<td>3-66</td>
</tr>
<tr>
<td>3.5.8.4 Replacement of Wetland and Riparian Vegetation</td>
<td>3-66</td>
</tr>
<tr>
<td>3.5.8.5 Manmade Wildlife Protection Measure</td>
<td>3-67</td>
</tr>
</tbody>
</table>

References | 3-67 |

*Div. of Oil, Gas & Mining*
### LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>USDA-FS Region 4 Sensitive Species</td>
</tr>
<tr>
<td>3-3</td>
<td>USDA-FS Region 4 Sensitive Species</td>
</tr>
<tr>
<td>3-2</td>
<td>Native Utah Wildlife Species of Special Interest</td>
</tr>
<tr>
<td>3-1</td>
<td>Federally Listed and Proposed Endangered Species in Utah</td>
</tr>
</tbody>
</table>

### LIST OF PLATES

<table>
<thead>
<tr>
<th>Plate</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>Plant Communities and Reference Areas</td>
</tr>
<tr>
<td>3-2</td>
<td>Elk Range</td>
</tr>
<tr>
<td>3-3</td>
<td>Deer Range &amp; Raptor Nests</td>
</tr>
</tbody>
</table>
LIST OF APPENDICES
(Appendices appear in Volume 5)

Appendix

3-1  Report of 1983 Field Investigations

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

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

3-4  Raptor and General Avifauna Studies

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

3-6  Vegetation Information Guidelines, Appendix A

3-7  Power Line Correspondence

3-8  Bat Survey for the SUFCO Mine

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

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

3-11 Muddy Creek Technical Report-Wildlife

3-12 Mexican Spotted Owl Survey Muddy Tract

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

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

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

3-16 Greens Hollow Tract
CHAPTER 3

BIOLOGY

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

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

EPS - Report of Studies of Vegetation and Soils for SUFCO Mine - 1980 (Appendix 2-2)
AQU - Aquatic Resource Inventory of Southern Utah Fuel Company Permit Area - 1980 (Appendix 3-2)
WIL - Wildlife Assessment of the Southern Utah Fuel Company Mining Property and Adjacent Areas - 1980 (Appendix 3-3)
RAP - Raptor and General Avifauna Studies - 1980 (Appendix 3-4)
FSW - Fauna of Southeastern Utah and Life Requisites Regarding their Ecosystems - 1990 (Appendix 3-5)
VWP - Vegetation and Wildlife of the Pines Tract Project - 1999 (Appendix 3-9).

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

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

3.1.1 Vegetative, Fish and Wildlife Resources
Vegetative, fish and wildlife resource conditions in and adjacent to the SUFCO Mine are discussed in Section 3.20.

3.1.2 Potential Impact to Vegetative, Fish and Wildlife Resources
Potential impact to vegetative, fish and wildlife resources and the associated mitigation plan are presented in Sections 3.30 and 3.40 of this application.

3.1.3 Description of Reclamation Plan
The reclamation plan used to restore the vegetative, fish and wildlife resources to a condition suitable for the postmining land use is presented in Section 3.40.

3.20 Environmental Description

3.2.1 Vegetation Information
This section contains the environmental descriptions for the vegetation for the permit and adjacent areas.

3.2.1.1 Plant Communities Within the Proposed Permit Area
"Vegetation changes from one landform to another. On the benches landform, there is a combination of sagebrush-grass community and ponderosa pine stands. Intermixed are patches of low quality Quaking Aspen, Mountain Mahogany, and Manzanita brush. Ground cover is composed of several native grasses, forbs, and low brush species. Density is generally good.

The steep slopes and scarp faces landform is sparsely vegetated. Pinyon, Juniper, and Mountain Mahogany are scattered over the landform. The site is very harsh and ground vegetation is limited to light quantities of native grasses and forbs in cracks and shelves where soil can accumulate. Composition includes a few drought resistant grasses, annual forbs, Mountain Mahogany and other brush.

Narrow stringers in canyon bottoms are the most productive in the area. Vegetation is primarily native grass, low brush and forbs growing together to form a heavy sod. Brush types include
willow, rose, rabbit brush, sand brush and others. Carex grows in some of the wetter spots. Only an occasional tree occurs in the bottoms.

The rolling hills landform is covered by an occasional small patch of trees which include Ponderosa pine, Douglas-fir, Alpine-fir, Spruce and Aspen. More common are brush species including oak, snowberry, and sagebrush. Grasses and forbs are very sparse and include several native species." (Blumer, 1979)

The plant communities identified within the proposed permit area are (see Plate 3-1):

- Sagebrush-grass
- Grass-black sagebrush
- Mountain Brush (oak, serviceberry, mountain mahogany, etc.)
- Aspen
- Aspen-oak
- Aspen-Douglas fir-limber pine
- Mountain mahogany-oak-ponderosa pine
- Douglas fir-spruce-limber pine
- Pinyon-juniper-mountain mahogany
- Limber pine
- Ponderosa pine-mountain mahogany-manzanita
- Pinyon-juniper-Douglas fir
- Wiregrass-foxtail-haplopappus
- Douglas fir-spruce-limber pine-aspen
- Limber pine-mountain mahogany-serviceberry
- Mountain mahogany
- Pinyon-juniper
- Douglas fir & other
- Riparian
- Ponderosa pine-douglas fir-aspen-serviceberry
- Grassland-perennial forbs
- Sagebrush
- Mountain brush
- Conifer timber
- Mixed
- Barren ground
Aspen-deciduous forest
Additional plant communities are designated on Plate 3-1.

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

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

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

3.2.1.2 Land Productivity Prior to Mining
The land productivity of the mine area was not measured in 1941 when mining began. However, Appendix 2-2 contains a consultant study (EPS, pgs. 45 - 78) compiled in 1980, which states total cover, production pounds per acre and species within the permit area. Additional information was presented in INV Report, August 12, 1983 (Appendix 3-1).
3.2.2 Fish and Wildlife Information
A summary of the fish and wildlife resource information for the permit and adjacent areas is contained in Sections 3.2.2.1 through 3.2.2.3. As mentioned above, a wildlife report was included with a vegetation report in 1999 (VWP) for the proposed mine expansion called the Pines Tract Project. Fish and wildlife resources in the SITLA Muddy tract are as described in Sections 3.2.2.1 through 3.2.2.3 and in the "Muddy Creek Summary Report - Wildlife" prepared by Cirrus and included as Appendix 3-11. Fish and wildlife resources within the West Coal Lease Modifications and the area of the 2016 sinkhole repair are summarized in Appendix 3-13 and Section 3.2.2.2. A description of the potential impacts and mitigation of impacts of mining on fish and wildlife is included in Section 3.3.3.3 of this permit.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Raptors
Only one nest, that of a Cooper’s Hawk, was found in 1980 (Appendix 3-4). The one Cooper's Hawk nest found was in an area seemingly less favorable than surrounding canyons. Quitchupah Canyon appeared to be prime habitat, but no nests were found.

Golden Eagles were seen on nearly every survey day during the 1980 survey by Clayton White of Brigham Young University (Appendix 3-4). The presence of two adults accompanied by a juvenile suggest their nearby breeding, however no nests were located.

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

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

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

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

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

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

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

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

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

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

A helicopter survey to locate raptors and migratory bird species was conducted in 1982 and 1988 by UDWR, USFWS, BLM, and USFS. In 1988 ten golden eagle nests were located within the...
Quitchupah lease boundary, two were active, two were tended and the remaining six were inactive. One active nest and two inactive nests were located in Section 33 (Dry Fork Canyon) during these surveys. During a conversation with Jeff Jewkes it was reported that the raptor nests in the canyon located in Section 33 were surveyed in 2014, 2015 and 2016 by the DWR. One of the three nests in the canyon was active in 2015, and the same nest appeared tended in 2014 and 2016. The other nests were inactive during the three-year survey period. The nests in Dry Canyon were re-surveyed in 2017, in April, May and June, during the surveys the nests were inactive. An application for a “nest take permit” for nests 793, 794 and 795 was submitted to the USFWS prior to the mining of the 3 Right 4 East panel. An e-mail from the USFWS is included in Appendix 3-15, documenting the schedule of review and the potential date of issuance of the “nest take permit.” The permittee’s intention is to be given permission by the USFWS permit to take the nests, provide and have an approved mitigation plan for the taking of the nests. The permittee will have the obligation of following the requirements of the USFWS permit. The location of the three nests is shown on confidential raptor nest drawing within Appendix 3-15 of this M&RP. Once the “nest take permit” has been granted the Manti-La Sal biologist and the UDOGM biologist will be informed of the requirements and stipulations associated with the “nest take permit” and will be provided a copy. In 2017 during the raporters surveys of the mine area, including the 3R4E and 4R4E mining panels, the Raptor Survey Guidelines (DOGM, 2010) were followed. The active mining areas with the potential to subside are surveyed in or before the first year of mining and until subsidence movement, as determined by the mine’s annual subsidence survey, has ceased. Subsidence survey data is provided to DOGM annually for their files.

Other than golden eagles, no TES species are known to inhabit the area of the panel. According to the DWR in a 1989 assessment the southern portion of the lease area is considered crucial winter range for deer and elk.

Although no surface facilities are planned for construction above the 3 Right 4 East underground panel, as requested by the Manti-La Sal Forest Biologist and Forest Service Supervisor the following standard has been included in the requirements pertaining exclusively to the lands above the 3 Right 4th East underground panel. “To protect sage-grouse habitat, locate new appurtenant surface facilities outside priority habitat management areas, unless no technically feasible alternative exists. If new appurtenant surface facilities cannot be located outside of priority habitat management areas, locate them with and existing disturbed areas, if possible. If location with and existing disturbed area is not possible, the construct new facilities to minimize disturbed area while meeting mine safety standards and requirements in the established mine-plan approval process.
and locate the facilities in an area least harmful to greater sage-grouse habitat based on vegetation topography, or other habitat features. (Greater Sage-grouse Record of Decision, GRSG-M-CML-ST-093)"

4 Right 4 East Panel - Vegetation Information

At approximately 11:30 am on April 24, 2017 a walking survey of the surface above and immediately adjacent to the panel was conducted by a qualified CFC employee. Vegetation types were documented within the potential subsidence impact area above the 4R4E panel and adjacent areas (See the 4R4E Projected Subsidence Map in Appendix 6-4). The vegetation types found during the survey include pinyon-juniper, sagebrush/grass, and mountain sagebrush types of the desert shrub biome. These findings coincide with data found in an environmental assessment and a supplemental environmental assessment complete in 1988 and 1989 respectively. Appendix 2-7 contains the aforementioned EA and supplemental EA associated with the Quitchupah Lease. Refer to Plates 5-6 and 5-7 of the M&RP for information regarding the location of both the Quitchupah Lease and the 4R4E panel. The findings of the walking survey also coincide with data shown on Plate 3-1.

4 Right 4 East Panel - Raptor Information

The 4R4E panel is located in Sections 27 and 34, Township 21 South, Range 5 East. It is located in Dry Fork Canyon perpendicular and west of the North Fork of Quitchupah Creek. A helicopter survey to locate raptors and migratory bird species was conducted in 1982 and 1988 by UDWR, USFWS, BLM, and USFS. In 1988 ten golden eagle nests were located within the Quitchupah lease boundary, two were active, two were tended and the remaining six were inactive. There were no nest located within a 0.5 mile radius around the current location of the 4R4E panel during these surveys. The nests in Dry Fork Canyon were re-surveyed in April, May and June of 2017. Four inactive Golden Eagle nests were found (793GoEa, 794GoEa, 795GoEa, 315GoEa) within a 1.5 mile radius around the 4R4E panel. These surveys show that there are no active or inactive nest within 0.25 miles from the area of potential subsidence above the 4Right 4 East panel (See the 4R4E Projected Subsidence Map in Appendix 6-4). The permittee will perform raptor surveys before, during and after mining as required by the Division. These reports will be submitted annually to the Division. The 2017 raptor survey reports are found in Appendix 3-4 and 3-15. Areas surveyed in these reports designated for the 3 Right 4 East panel also apply to the 4 Right 4 East panel.
4 Right 4 East Panel - Elk & Mule Deer
The 4R4E panel is located in the southern portion of the Quitchupah Lease (See Plated 5-6 and 5-7 of the M&RP). The panel is located just outside of within what is considered crucial or critical winter range for deer and elk. The escarpment in the southeastern portion of the tract which lies between Quitchupah Canyon and Link Canyon is known as an elk migration route, providing access to and from the winter range from the plateau top (See Plates 3-2 and 3-3 of the M&RP). The permittee is obligated to monitor and mitigate subsidence that poses a risk to livestock and wildlife as soon as feasibly possible. This will be done according to the subsidence monitoring plan (See Section 5.2.5.1) and migration commitments (See Sections 3.3.3.3 and 3.4.1.2) within the MRP. An effort will be made by the permittee to monitor subsidence between 60 and 90 days following completion of the 4R4E longwall panel or as soon as access is feasible. The permittee recognizes that this time constraint commitment only applies to the 4R4E panel.

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

4 Right 4 East Panel - Seed Mix Information
Should a seed mix be required to be used on soil filled subsidence cracks the seed mix previously used for the sinkhole repair and reclamation project will be used. See Section 3.4.1.2 for information regarding the sinkhole project seed mix. Soils used to fill subsidence cracks which receive seed will not receive mulch or fertilizer. Refer to Section 5.2.5.2 (Correction of Material Damage) for additional information.

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

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

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

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

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

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

Although the potential area of impact is not critical to the continued existence and perpetuation of the herd, it is important to maintenance of current population levels, and portions of the entire lease 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 question do not always winter on the rims nor the plateau but in the lower elevation areas to the southeast. This observation was substantiated by a conversation with a local forest ranger out of Richfield. The amount of snow is probably the determinant, with the elk wintering wherever there is available forage from the rim to the low brush areas in the southeast.

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

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

3 Right 4 East Panel(s)

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

Mule Deer

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

During the summer the mule deer generally utilize all of the habitats near watering areas. The most heavily used communities were the sage, mountain brush and the composite of aspen,
Canyon Fuel Company, LLC                    Mining and Reclamation Plan
SUFCO Mine                                               November 8, 2018

mountain mahogany, manzanita and ponderosa. This is as expected since there is considerably more browse in these communities than in the others sampled.

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

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

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

**Bobcat**
The mine and adjacent areas provide substantial value habitats for bobcats, who were evidenced, by sightings and tracks, to occupy or use all terrestrial habitats on the entire area of potential impact. Sensitive periods would be late February when parturition occurs, May and June when young bobcats are first exploring and learning to hunt. Bobcats are not as secretive as cougar, making them less likely to avoid the high human disturbance areas and making them more vulnerable to open human harassment and illegal killing. Since this is an ongoing mining operation, pressures on bobcats should be unchanged.

**Black Bear**
Bear tracks were observed in Broad Hollow, but Forest Service personnel indicated to us that most of the bear sightings occurred on White Mountain. At best black bear are not abundant nor are they active year round. Sensitive periods in the life cycle of the black bear are February and March when the cubs are born and when they accompany their mother on initial foraging expeditions during early summer. Since parturition occurs within the winter den and since disturbance in the black bear habitat will be limited to subsidence, this sensitive period will be little impacted by the proposed action.

**Mountain Cottontail**
The entire mine area provides substantial value, and year long habitats for cottontail rabbits. The young are born between April and July which is considered a sensitive period, but the proposed actions will in all probability not seriously alter the reproductive potential of the population. Hunting pressure will likely not increase, nor will illegal kills. However, this would not matter since hunted rabbit populations are more healthy and stable than non-hunted populations. Subsidence could potentially cause death from caving burrows and disrupt reproduction for a short time.

**Snowshoe Hare**
The snowshoe hare is present in and dependent upon the limited spruce-fir vegetation habitat of the mine area year round. The sensitive period for reproduction is from April 1 to August 15. Subsidence will not impact the above ground dweller as it does subterranean inhabitants. Little change in snowshoe hare populations will result from the proposed actions. Hunting pressure, legal and illegal, will be the most influential activity of man upon snowshoe hares, but will be of little far reaching impact.

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

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

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

**Threatened and Endangered Plant and Wildlife Species.** Passage of the Endangered Species Act of 1973 (Public Law 23-20S) provided the legal basis for establishment of lists of endangered and threatened plant species. Such lists were prepared under direction of the Smithsonian Institution, and were published subsequently in the Federal Register (40: 2782 427924, 1975; and 41: 2452 4 24572, 1976). The region under investigation was included in a report on threatened and endangered species of the Central Coal lands of Utah (Welsh 1976). An inventory of endangered wildlife species performed in 1989 by the Division of Wildlife Resources recorded no species within the proposed permit area (conversation with Pamela Hill, DWR, Cedar City, 1991). Table 3-1 provides a list of Federally listed Threatened and Endangered Species that have been identified in the Utah counties in which Sufco lies. However, this list does not necessarily indicate these species are found within the mine permit boundaries.

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

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

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

**Table 3-1**

| Federally Listed and Proposed Endangered Species in Utah |
| Sevier, Sanpete and Emery Counties |
| November 1, 2017 |

**Plants**
- Barneby Reed-Mustard: *Schoenocrambe barnebyi*
- Heliotrope Milk-Vetch: *Astragalus montii*
- Jones Cycladenia: *Cycladenis humilis var. jonesii*
- Last Chance Townsendia: *Townsendia aprica*
- Wright Fishhook Cactus: *Sclerocactus wrightiae*
- Winkler Pincushion Cactus: *Pediocactus winkleri*
- Despain Pincushion Cactus: *Pediocactus despainii*

**Mammals**
- Utah Prairie Dog: *Cynomys parvidens*
- Canada Lynx: *Lynx canadensis*

**Birds**
- Mexican Spotted Owl: *Strix occidentalis lucida*
- Western Yellow-billed Cuckoo: *Coccyzus americanus*

**Fish**
- Bonytail Chub: *Gila elegans*
- Colorado Pikeminnow: *Ptychocheilus lucius*
- Humpback Chub: *Gila cypha*
- Razorback Sucker: *Xyrauchen texanus*

**Amphibians & Reptiles & Snails**
- None listed in the Counties

**Status**

<table>
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<th>Present</th>
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<td>NP</td>
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E - Endangered  T - Threatened  Extirpated - No longer occur in Utah  C - Candidate  NP - Not Present (BLM, USFWS, FSEIS)  P - Present (BLM, FSEIS)

For additional information contact: U. S. Fish and Wildlife Service, Telephone: (801) 975-3300
Habitats of Unusually High Value. The area of potential impact contains a variety of important habitats for several species that are considered of "high interest" to various management agencies because these species are of economic or recreational value. There are ten recognizable vegetation habitats from a faunal standpoint: chaparral (ponderosa pine, curl-leaf mountain mahogany, manzanita, aspen), spruce-fir (englemann spruce, douglas fir, sub-alpine fir, white-fir), aspen, sagebrush, mountain brush (oak, curl-leaf mountain mahogany, smooth-leaf mountain mahogany, service berry sagebrush), streamside, pinyon-juniper, ponderosa pine, grass, and scotch pine-spruce. Conifer, aspen, high sage and meadow areas on Duncan Mountain are used as summer range and calving areas for elk and summer range for mule deer. Ponderosa pine along ridge tops are heavily used by elk during the late winter, early spring and occasionally during the summer. The cliff areas harbor mountain lion, bobcat and bear. Mountain brush habitats are heavily utilized by deer and elk during the winter and spring. Deer and elk winter on the lower elevation areas, particularly in the vegetation communities traversed by the access road (WIL, pgs. 2-3, Appendix 3-3).

Literature and field data were summarized for all terrestrial vertebrates of concern, and the species categorized to determine habitat affinities and high interest species status. These results are reported in tabular form (WIL, Tables 3 through 5, Appendix 3-3). They are listed according to their various ecological classifications. All species whose ranges appear to overlap any or all of the potential area of impact are listed. Generally speaking, the project area could potentially be inhabited by 64 mammalian, 8 amphibian and 14 reptilian species (Wasatch Plateau, Appendix 3-5). Some of these are considered high interest species for the habitats and local area of concern.

Since the immediate area of the mine portal, access roads, loading and storage facilities has already been lost as habitat, concern will be given to revegetation with species that will not only benefit, but promote wildlife.

The cliffs in Quitchupah Canyon are habitat for cougar. The observed animals seem to use them for denning activities. Therefore care has been taken to avoid placement of portal openings where there are caves or other natural denning sites. There are a limited number of trails going from the
plateau area through the cliffs to the valley floor to the southeast. It appears that these trails are important to elk migration from summer to winter range, and therefore construction of ventilation portals has not been allowed to interrupt this limited number of access routes.

No endangered or threatened mammal species occur within the mine boundary as recorded in a study performed by H. Duane Smith and Clyde L. Pritchett (WIL, Appendix 3-3).

A peregrine falcon eyrie existed in 1997 about one half mile from the site but during aerial surveys conducted in 1998 and 1999 no falcons were sighted. Discussion about threatened, endangered or otherwise sensitive plant and animal species of the Pines Tract Project area is given in Appendix 3-9.

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

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

**Species of High Federal or State Interest.** The species of interest to the state of Utah are listed on Table 3-2. The species are divided into eight categories (extinct, extirpated, endangered, threatened, declining populations, limited distribution, declining populations/limited distribution and conservation). The Western Bluebird classified as sensitive, appears to be restricted to the Ponderosa Pine as a nesting bird. It can be locally common and its habitat is widespread over the state. It therefore does not represent any special problem in the lease area.

**Sensitive Species of High Federal Interest.** The species of interest to the federal Forest Service are listed on Table 3-3. The species are all sensitive as determined by the FS MLS Sensitive Species List and have the potential to occur within the permit area.

The Link Trail Columbine is the only Forest Service Region 4 sensitive species known to exist on the mine areas called the Pines Tract and Muddy Tract. SUFCO monitors populations of the Link Trail Columbine within the East Fork of the Box Canyon where it has been determined that mining might negatively affect the populations within the permit area. A discussion about threatened, endangered or otherwise sensitive plant and animal species of the Pines Tract Project area and Muddy tract is given in Appendices 3-9 and 3-11.

**150-Acre Incidental Boundary Change.** Sensitive species listed in Table 3-3 may be found within the boundary area. Species of most concern are the Link Trail columbine, Northern Goshawk, Northern Three-Toed Woodpecker, Flammulated Owl, and the Spotted Bat.

- Link Trail columbine - No populations have been found within the 150 acre IBC area. The boundary area is located on a plateau. Adjacent to the boundary area is Box Canyon that has suitable habit for this vegetation. A survey of the canyon will be conducted to locate representative populations of the columbine. The location of the populations of the columbine will be recorded using a topographic map and a GPS survey will be used to verify the coordinates. Photographs of the colonies will be
taken during the survey. The survey will be conducted during the growing season to ensure as many colonies as reasonably possible are located.

- **Northern Goshawk** - No populations have been found within the 150 IBC boundary area. The Goshawk requires wooded areas for nesting and the vegetative cover of the area is generally sagebrush with few trees.

- **Northern Three-Toed Woodpecker** - The woodpecker is likely to use the general area but no populations have been found within the 150 acre IBC. The woodpecker requires forests containing spruce, fir, aspen, pine, and tamarack for nesting. The vegetative cover of the area is sagebrush with few trees.

- **Flammulated Owl** - The owl has been seen in the general area but no populations have been found within the 150 acre IBC area. The owl prefers mature ponderosa pine or Douglas fir forests with open canopies. Nests are made in large diameter dead trees with cavities. Vegetative cover of the 150 acre IBC area is sagebrush with few ponderosa pines and Douglas fir.

- **Spotted Bat** - The bat has been seen in both Muddy and Box Canyons. These canyons are in close proximity to the 150 acre IBC but no populations have been found within the 150 acre IBC area. The spotted bat usually roosts in rock crevices high on steep cliff faces but will inhabit Ponderosa pine, desert shrub, and pinyon-juniper stands. Few steep cliff faces are located within the 150 acres but are adjacent to the area. The 150 acres is part of a plateau and the vegetation is mainly Ponderosa pine, desert shrub, and pinyon-juniper stands.

**Link Canyon Mine Portals.** A few of the Sensitive species listed in Table 3-3 may be found within the portal area. The disturbed area associated with the re-opened portal is less than one acre and is included in an area previously disturbed by mining activities. No sensitive plants species were found in the area by Zobell (2000) or Mt. Nebo Scientific (2002) nor have mammals included in Table 3-3 been found in the portal area. Previous bat surveys indicated Spotted Bats are not present in the portal area. No access to the mines appear to be available to bats as the portals were completely closed by rubble in the 1980’s. No Bald Eagle nests are known to occur in the area. A Peregrine Falcon eyrie was reported two miles to the east of the site in 1998 and 2001 but the eyrie was inactive in 1999, 2000 and 2002. Because the flow of water from the portals is minimal (one gallon per minute or less), fish are not found at this location. A survey specifically conducted for endangered mollusks was conducted in the portal area in June 2002. It is unlikely any endangered
snails are present in the general area because of its isolated location and since the source of water only became available after the mine closed in the 1950's. Amphibians have not been reported in the area, possibly for the same reasons as those listed previously for the mollusks.

**East Fork Of Box Canyon.** Sufco intends to undermine portions of the East Fork of Box Canyon beginning in the Fall of 2003 through 2005 as they extract coal from the 3LPE and 4LPE longwall panels. Prior to the initiation of undermining and subsidence, a pre-subsidence qualitative evaluation of vegetation and channel conditions will be conducted in the East Fork of Box Canyon from the Joe's Mill Ponds downstream to a location above the west gate roads associated with the 3LPE panel. The survey will consist of video taping the condition of the stream channel paying particular note to surface flows and ground water discharge, vegetation types and conditions, animal species in the area including documenting the absence or presence of macroinvertebrates in the stream channel by filming the turning over of rocks or debris, general soil conditions, and the general geomorphology of the area. A qualified botanist will be used to identify and report in the video tape the major representative plant species along the stream channel. This will include riparian and spring locations found along the stream channel. Major hanging gardens will be identified and discussed. The general stream morphology will be discussed in the video including the width and depth of pools, height of natural drops, existing joints, cracks, and fractures, locations where flows naturally diminish or increase, etc.

A video tape will be made of the same portion of the East Fork at the same time of the year on the third year following undermining during September of 2008. A comparison will be made of the two tapes using the parameters described above and any changes due to mining activities will be noted. The tapes will be submitted to the Division as part of the Annual Report; the Fall 2003 video tape will be submitted with the 2003 Annual Report and the comparison tape will be submitted with the 2008 Annual Report.

Fourteen sites have been identified and established during the qualitative pre-subsidence survey for use in a quantitative evaluation of site-specific vegetative and hydrologic conditions (See Chapter 7 Section 7.3.1.2) The site locations have been mapped and identified in the field with...
stakes and flagging. The sites include each of the springs found within the portion of the East Fork to be subsided and the Joe's Mill pond area.

A survey of the identified stream and spring monitoring sites will include a concentrated study of vegetative communities associated with the stream and spring sites. The vegetative survey of the East Fork will be conducted following the USFS and D.L. Rosgen stream channel survey protocol. The condition of the riparian vegetation flanking the channel at each of the sites will be described and the hillsides above the channels will also be monitored for changes in morphology. Maps of the surveyed areas will be prepared. The survey will be conducted before subsidence begins in the effected areas of Box Canyon Creek and will be repeated in 2004, 2005, 2006, and 2008.

The conditions of the vegetation at the spring sites will be monitored for the same parameters as the stream sites. The source and discharge area will be included in the survey. Photographs will be obtained at each of the monitoring stations of the vegetative communities along the stream channel, hillsides above the site, and at the spring locations. Permanent photo points will be established to allow for repeatability of photographing the vegetation.

Qualitative surveys of the vegetation at each monitoring station will be conducted twice per year, once at the beginning of the growing season and again at the end of the season, for the first three years as mining is commenced in the East Fork and then in the fifth year following undermining. The surveys will include observations of the conditions, types, notable changes, etc., of the vegetation in the Joe's Mill pond area vegetation and along stream banks and spring locations identified as monitoring sites.

Erosion of the hillsides will be monitored during the twice yearly qualitative vegetation survey using a numerical ranking system to identify the degree of erosion. The ranking system will be as follows:

4-Extreme erosion  
        deeply incised rills and gullies with unstable, actively slumping walls and loose material moving rapidly to the rill or gully floor, freshly exposed plant roots, no remaining topsoil, no vegetative litter, little to no vegetative cover.
Canyon Fuel Company, LLC
SUFCO Mine

3-High erosion  incised rills and gullies slightly unstable slopes, only occasional slumps of the rill or gully wall, some plant roots exposed, little to no topsoil remaining, little to no vegetative litter, poor vegetative cover.

2-Moderate erosion small rills, no gullies, moderately stable slopes, very little to no exposed roots, most of the topsoil remains, moderate vegetative cover.

1-Slight erosion occasional small rills, no significant channeling in the soils, no exposed roots, topsoil remains, most vegetative litter in place, good vegetative cover.

0-No erosion  Appears relatively undisturbed, essentially no rills, vegetative litter in-place, healthy vegetative cover.

Photographic evidence of the state of erosion will be obtained each year at the East Fork monitoring sites for annual comparative and evaluation purposes. The climatic and overall vegetative conditions of the area will be noted. Particular attention will be paid to the effects of grazing on the vegetation and soils with respect to changes in the rank of erosion.

As part of the quantitative evaluation of the East Fork of Box Canyon, the locations of populations of the Link Canyon Columbine will be identified, mapped, and locations staked. The number of individuals in the populations will be counted or accurately estimated. All other populations of Threatened and Endangered and Sensitive Species found in the area of concern will be identified. The population location will be mapped, if appropriate, and the number of individuals will be recorded. The surveys of the TEC and Sensitive Species, if found, will be repeated in 2004, 2005, 2006, and 2008.
Canyon Fuel Company, LLC  
SUFCO Mine  

Mining and Reclamation Plan  
December 20, 1991 (R 07/12)

A low level, colored infrared aerial survey will be conducted of the East Fork of Box Canyon in 2003 and in 2008. The survey will include the stream and spring monitoring points. The results of the survey will be reported to the Division in the mine’s Annual Report in the year following the survey.

The vegetative, erosion, and colored infrared survey reports will be submitted to the Division as part of the annual report according to the schedule provided below. Two copies of the reports will be sent to the Division so that they may forward one copy to the Manti-LaSal National Forest.

1. 2003 Baseline Vegetation Report to be submitted with the mine’s 2004 Annual Report. Also includes baseline colored infrared aerial photos and report of the monitored stream and spring areas within the East Fork of Box Canyon.

2. Both 2004 Quantitative and Qualitative Vegetation Reports for the 1st year data collected following undermining will be submitted in the 2005 Annual Report.

3. 2005 Qualitative Vegetation Reports for the 2nd year following undermining will be submitted in the 2006 Annual Report. The Qualitative surveys only will be conducted.

4. 2006 Quantitative and Qualitative Vegetation Reports for the 3rd year following undermining will be submitted in the 2007 Annual Report.

5. 2008 Quantitative and Qualitative Vegetation Reports for the 5th year following undermining will be submitted in the 2009 Annual Report. Also includes the colored infrared aerial photos and report of the monitored stream and spring areas within the East Fork of Box Canyon.

If substantiated mining-induced changes occur in the vegetation within the affected areas of the East Fork of Box Canyon, a revegetation/enhancement mitigation plan will be created and submitted to the Division. The permittee understands that the mitigation plan will be approved only after the Division consults with the USFS on the proposed plan.

In addition to the East Fork of Box Canyon vegetative monitoring and mitigation plan, Sufco will implement a hydrologic monitoring plan as well as a stream channel subsidence crack mitigation plan. These plans are discussed in greater detail in Section 7.3.1.2 and Section 5.2.5.1 of this M&RP. Mitigation of cracks, if they occur, in the bottom of the stream channel requires the placement of bentonite grout to stop the diversion of surface flows. If mitigation is required during the critical elk and deer time periods of November 1st through April 1st and May 1st through July 1st.
or during the raptor nesting and rearing season of February 1st through August 31st, the Division will be contacted and the mitigation plans reviewed with the appropriate regulatory personnel. Mitigation work will be performed in such a manner as to minimize disturbance to wildlife.

A baseline macroinvertebrate survey was performed on the East Fork of the Box Canyon on October 20, 2003 by Dr. Dennis K. Shiozawa with assistance from Patrick Collins of Mt. Nebo Scientific. Ms. Katherine Foster of the Manti-LaSal National Forest was also present during the survey. Locations of the macroinvertebrate populations survey were determined based on the stream channel floor conditions, availability of water, and potential repeatability of the survey. Sites in the area of EFB-4 were not acceptable to Dr. Shiozawa since the channel floor was not stable and consisted of loose sand. The current environmental conditions, specifically the channel floor configuration, would likely be changing naturally over time and with every significant precipitation event. These naturally occurring changes would make repeating the survey in these types of locations very difficult at best. Additionally, the loose sands that formed the channel floor are abrasive and very detrimental to macroinvertebrate life. The movement of sand through the system as a result of a precipitation event could easily significantly diminish or destroy populations. Therefore, four locations were selected in the area of and upstream of site EFB-11. These locations appeared to have the most stable channel floor, bed rock, and repeatability of the survey at these locations would be possible.

The survey consisted of obtaining two sample sets from each site. The organisms captured at each site will be identified to the species level. The number of organisms per unit of measure were counted and recorded. Two copies of the results of this baseline survey will be submitted to the Division with the 2004 Annual Report. A second and third survey will be performed in 2004 and 2005 following undermining and two copies of the results will be submitted to the Division with the 2005 and 2006 Annual Reports.

A copy of the October 2003 "Monitoring and Mitigation Plan for Mining Under the East Fork of Box Canyon" prepared by the Division and reviewed and accepted by the Forest with some modifications has been included in Appendix 3-10. The preceding paragraphs have been prepared based on this plan. Sufco will meet all of the monitoring and mitigation responsibilities described in the plan as it pertains to the undermining of the East Fork of Box Canyon.
2RWL Sinkhole Area - Inventory information associated with the area of the emergency sinkhole repaired in October 2016 is included in Appendix 3-13 and Confidential Appendix 4-2. When the West Coal Lease Modification Environmental Assessment UT-070-08-083 was prepared in 2009 by the BLM and Fishlake National Forest the area of the sinkhole was included as part of Lease U-47080. A copy of the assessment (EA) was incorporated into Appendix 3-13 of the permit on February 1, 2011. The following is a summary of the biology information from the aforementioned EA.

- No federally listed or candidate plant or wildlife species, or their critical habitats, have been identified in the area covered by the EA. Forest Service sensitive species in the area may include spotted bat, Townsends big-eared bat and greater sage grouse. Refer to Table 3-3 in environmental assessment in Appendix 3-13 for additional explanation.

- The area lies within Forest Service Management Area 4B, the management emphasis is on the habitat needs of one or more management indicator species.

- The drainages in the area support limited areas of wetlands. The wetlands would continue to be subject to natural impacts and ongoing grazing. Due the limited extent, spotty distribution and low quality riparian and aquatic habitat, potential for adverse effects was expected to be low.

- Subsidence could effect cliff-nesting species, however nesting sites sites are not limited and new habitat would offset potential loss.

- Based on the Forest Service vegetation mapping (2007) the vegetation in the effected area is sage/perennial grass.

- In upper Mud Spring Hollow (north of sinkhole) the spring was developed for livestock watering, but was dry in July 2008 and was disconnected and dilapidated in 2009. The seasonal wetland hydrology continued to support the sedges and rushes in 2008. The determination of wetland boundaries in the 2007 vegetation mapping is exaggerated in this area according to the EA. Impacts to springs associated with the wetland is expected to decrease with increasing overburden depth.

- The assesment of wildlife impacts was based on a site visit in July 2008, review of NEPA and other pertinent documents (Cirrus 2008a). Information on management indicator species (MIS) was provided by Fishlake National Forest (Rodriguez et al 2006). Refer to Tables 3-3 and 3-4 of EA for additional information.

- In the Southern Rockies/Colorado Plateau Bird Conservation Region 16 there are 29 species of concern which could occur in the area. Three were most likely species were part of the Cirrus reported Biological Evaluation (2008). They were determined to be unaffected because habitat is either not present or would not be affected.

- Livestock grazing has occured on the area since the late 1800's and the area is currently grazed under the Forest Service Quitchupah Cattle and Horse Allotment. The area of Coal Lease U-47080
was also a part of an Environmental Assessment in 1981 as part of the lease application package.

3.2.2.3 Fish and Wildlife Service Review
If requested, the applicant authorizes the release of information pertaining to Section 3.2.2 and 3.3.3 to the U.S. Fish and Wildlife Service Regional and Field office for their review.

3.2.3 Maps and Aerial Photographs
The lease area was mapped by use of a mosaic of aerial photographs and assured by ground inspection. Vegetation sampling locations/reference areas are shown on Plate 3-1.

Greens Hollow. To the best of the applicants knowledge there are no reference areas, monitoring stations for fish and wildlife, habitat features, facilities used to protect and enhance fish/wildlife within the Greens Hollow Lease area. Land Uses for the Greens Hollow Lease are shown on Plate 4-1C.

3.2.3.1 Location and Boundary of Proposed Reference Area
The locations of the vegetative reference areas are found on Plate 3-1. Area 13 shown on Plate 3-1 is to be used as a mapping unit only and not a reference area or validation site. Site 12 will be used as the reference area for the minesite sedimentation pond area.

3.2.3.2 Elevations and Locations of Monitoring Stations
Raptor nest locations and elk and deer range are shown on Plate 3-2 and 3-3. The permit area contains no fish monitoring stations.

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

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

3.2.3.4 Vegetation Type and Plant Communities
Vegetative types and plant communities are outlined on Plate 3-1 of this application.
# Table 3-2

**Utah Sensitive Species List- Sevier, Sanpete and Emery Counties**

**November 1, 2017**

<table>
<thead>
<tr>
<th><strong>Mammals</strong></th>
<th><strong>State Status</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown (Grizzly) Bear- Historically</td>
<td>Ursus arctos</td>
</tr>
<tr>
<td>Black-footed Ferret- Unconfirmed</td>
<td>Mustela nigripes</td>
</tr>
<tr>
<td>Utah Prairie Dog</td>
<td>Cynomys parvidens</td>
</tr>
<tr>
<td>Fringed Myotis</td>
<td>Myotis thysanodes</td>
</tr>
<tr>
<td>Big Free-tailed Bat</td>
<td>Nyctinomops macrotis</td>
</tr>
<tr>
<td>Townsend's Big-eared Bat</td>
<td>Plecotus townsendii</td>
</tr>
<tr>
<td>Canada Lynx - Possibly/Historically</td>
<td>Lynx canadensis</td>
</tr>
<tr>
<td>Kit Fox</td>
<td>Vulpes macrotis</td>
</tr>
<tr>
<td>White-tailed Prairie-dog</td>
<td>Cynomys leucurus</td>
</tr>
<tr>
<td>Pygmy Rabbit</td>
<td>Brachylagus idahoensis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Birds</strong></th>
<th><strong>State Status</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bald Eagle</td>
<td>Haliaeetus leucocephalus</td>
</tr>
<tr>
<td>Ferruginous Hawk</td>
<td>Buteo regalis</td>
</tr>
<tr>
<td>Northern Goshawk</td>
<td>Accipiter gentilis</td>
</tr>
<tr>
<td>Burrowing Owl</td>
<td>Athene cunicularia</td>
</tr>
<tr>
<td>Short-eared Owl</td>
<td>Asio flammeus</td>
</tr>
<tr>
<td>American White Pelican</td>
<td>Pelecanus erythrorhynchos</td>
</tr>
<tr>
<td>Three-toed Woodpecker</td>
<td>Picoides tridactylus</td>
</tr>
<tr>
<td>Greater Sage-Grouse</td>
<td>Centrocercus urophasianus</td>
</tr>
<tr>
<td>Long-billed Curlew</td>
<td>Numenius americanus</td>
</tr>
<tr>
<td>Black Swift</td>
<td>Cypseloides niger</td>
</tr>
<tr>
<td>Lewis’s Woodpecker</td>
<td>Melanerpes lewis</td>
</tr>
<tr>
<td>Grasshopper Sparrow</td>
<td>Ammodramus savannarum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Fish</strong></th>
<th><strong>State Status</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonytail</td>
<td>Gila elegans</td>
</tr>
</tbody>
</table>
Humpback Chub  
Gila cypha  
S-ESA (E)  
Razorback Sucker  
Xyrauchen texanus  
S-ESA (E)  
Roundtail Chub  
Gila robusta  
CS (E)  
Flannelmouth Sucker  
Catostomus latipinnis  
CS (E)  
Bluehead Sucker  
Catostomus discobolus  
CS (E, S)  
Colorado River Cutthroat Trout  
Oncorhynchus clarki pleuriticus  
CS (E, S, SV)  
Bonneville Cutthroat Trout  
Oncorhynchus clarki utah  
CS (S, SV)  
Colorado Pikeminnow  
Ptychocheilus lucius  
S-ESA (E)  
Southern Leatherside Chub  
Lepicormeda aliciae  
SPC (S, SV)  

Reptiles and Amphibians  
Western (Boreal) Toad  
Bufo boreas  
SPC (E, S, SV)  
Great Plains Toad  
Bufo cognatus  
SPC (E)  
Columbia Spotted Frog  
Rana luteiventris  
CS (S)  

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

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

Key to State Status Field (Table 3-2)  
Symbol  
Definition  
S-ESA  
Federally-listed or candidate species under the Endangered Species Act.  
SPC  
Wildlife species of concern.  
CS  
Species receiving special management under a Conservation Agreement in order to preclude the need for Federal listing.  
E  
Emery County List  
S  
Sanpete County List  

INCORPORATED  
MAY 07 2019  
Div. of Oil, Gas & Mining
Table 3-3
USDA-FS Region 4 Sensitive Species - Fishlake and Manti-LaSal
February 2013 Update (June 2016)

<table>
<thead>
<tr>
<th>Plants</th>
<th>Status</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link Trail Columbine*</td>
<td>Aquilegia flavescens var. rubicunda</td>
<td>K</td>
</tr>
<tr>
<td>Cruetzfeldt-flower Cryptanth*</td>
<td>Cryptantha creutzfeldii</td>
<td>K</td>
</tr>
<tr>
<td>Carrington Daisy*</td>
<td>Erigeron carringtoniae</td>
<td>K</td>
</tr>
<tr>
<td>Canyon Sweetvetch*</td>
<td>Hedysarum occidentale var. canone</td>
<td>K</td>
</tr>
<tr>
<td>Maquire Campion*</td>
<td>Silene petersonii</td>
<td>K/P</td>
</tr>
<tr>
<td>Musinea Groundsel</td>
<td>Senecio musinensis</td>
<td>K</td>
</tr>
<tr>
<td>Arizona Willow*</td>
<td>Salix arizonica</td>
<td>K</td>
</tr>
<tr>
<td>Wonderland Alice Flower*</td>
<td>Aliciella caespitosa</td>
<td>K</td>
</tr>
<tr>
<td>Chatterley Onion*</td>
<td>Allium geyeri var. chatterleyi</td>
<td>K</td>
</tr>
<tr>
<td>Sweet-flower Rock Jasmine*</td>
<td>Androsace chamaejasme ssp. Carinata</td>
<td>K</td>
</tr>
<tr>
<td>Bicknell Milkvetch*</td>
<td>Astragalus consobrinus</td>
<td>K/P</td>
</tr>
<tr>
<td>Isely's Milkvetch*</td>
<td>Astragalus iselyi</td>
<td>K</td>
</tr>
<tr>
<td>Desert Milkvetch*</td>
<td>Astragalus desereticus</td>
<td>K</td>
</tr>
<tr>
<td>Tushar Paintbrush*</td>
<td>Castilleja parvula var. parvula</td>
<td>K</td>
</tr>
<tr>
<td>Pinnate Spring-parsley*</td>
<td>Cymopterus beckii</td>
<td>K</td>
</tr>
<tr>
<td>Abajo Peak Draba*</td>
<td>Draba abajoensis</td>
<td>K</td>
</tr>
<tr>
<td>Mt. Belknap Draba*</td>
<td>Draba ramulosa</td>
<td>K</td>
</tr>
<tr>
<td>Creeping Draba*</td>
<td>Draba sobolifera</td>
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</tr>
<tr>
<td>Nevada Willowherb*</td>
<td>Epilobium nevadense</td>
<td>K</td>
</tr>
<tr>
<td>Abajo Daisy*</td>
<td>Erigeron abajoensis</td>
<td>K</td>
</tr>
<tr>
<td>Kachina Daisy*</td>
<td>Erigeron kachinensis</td>
<td>K</td>
</tr>
<tr>
<td>Maquire Daisy*</td>
<td>Erigeron maquirei</td>
<td>K</td>
</tr>
<tr>
<td>LaSal Daisy*</td>
<td>Erigeron mancus</td>
<td>K</td>
</tr>
<tr>
<td>Elsinore Buckwheat*</td>
<td>Eriogonum batemanii var. ostlundii</td>
<td>K</td>
</tr>
<tr>
<td>Canyonlands Lomatium*</td>
<td>Lomatium latilobum</td>
<td>K</td>
</tr>
</tbody>
</table>

3-31
<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Scientific Name</th>
<th>K</th>
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<tbody>
<tr>
<td>Fish Lake Naiad*</td>
<td>Nafas caespitosa</td>
<td>K</td>
<td>NP</td>
</tr>
<tr>
<td>Beaver Mountain Groundsel*</td>
<td>Packera castoreus</td>
<td>K</td>
<td>NP</td>
</tr>
<tr>
<td>Little Penstemon*</td>
<td>Penstemon parvus</td>
<td>K</td>
<td>NP</td>
</tr>
<tr>
<td>Ward Beardtongue Penstemon*</td>
<td>Penstemon wardii</td>
<td>K</td>
<td>NP</td>
</tr>
<tr>
<td>Bicknell Thelesperma*</td>
<td>Thelesperma subnudum var. alpinum</td>
<td>K</td>
<td>NP</td>
</tr>
<tr>
<td>Barneby Woody Aster*</td>
<td>Tonestus kingii var. barnebyana</td>
<td>K</td>
<td>NP</td>
</tr>
<tr>
<td>Sevier Townsendia*</td>
<td>Townsendia jonesii var. lutea</td>
<td>K</td>
<td>NP</td>
</tr>
<tr>
<td>Sañ Rafael Cactus*</td>
<td>Pediocactus despainii</td>
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<tr>
<td>Clay Phacelia*</td>
<td>Phacelia argillacea</td>
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<td>NP</td>
</tr>
<tr>
<td>Last Chance Townsendia*</td>
<td>Townsendia aprica</td>
<td>K</td>
<td>NP</td>
</tr>
<tr>
<td>Ute Ladies'Tresses Orchid*</td>
<td>Spiranthes diluvalis</td>
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<td>NP</td>
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<tr>
<td>Heliotrope Milk-Vetch*</td>
<td>Astragalus montii</td>
<td>P</td>
<td>NP</td>
</tr>
<tr>
<td>Winkler Cactus*</td>
<td>Pediocactus winkleri</td>
<td>K</td>
<td>NP</td>
</tr>
<tr>
<td>Desert Milk-Vetch*</td>
<td>Astragalus desereticus</td>
<td>K</td>
<td>NP</td>
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**Mammals**

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<tr>
<td>Townsend’s Western Big-eared Bat*</td>
<td>Corynothinus townsedii townsedii</td>
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<td>Spotted Bat*</td>
<td>Euderma maculatum</td>
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<td>Bighorn Sheep*</td>
<td>Ovis canadensis</td>
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<td>NP</td>
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<td>Pygmy Rabbit*</td>
<td>Brachylagus idahoensis</td>
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<tr>
<td>Utah Prairie Dog*</td>
<td>Cynomys parvidens</td>
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**Birds**

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<tr>
<td>Flammulated Owl*</td>
<td>Otus flammelolus</td>
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<td>Northern Three-toed Woodpecker*</td>
<td>Picoides tridactylus</td>
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<tr>
<td>Bald Eagle*</td>
<td>Haliaeetus leucocephalus</td>
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<td>Greater Sage-grouse*</td>
<td>Centrocercus urophasianus</td>
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<td>Falco peregrinus anatum</td>
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<td>P</td>
</tr>
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<td>Yellow-billed Cuckoo*</td>
<td>Coccyzus americanus</td>
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<td>Southwestern Willow Flycatcher*</td>
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<tr>
<td>Mexican Spotted Owl*</td>
<td>Strix occidentalis lucida</td>
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</tbody>
</table>

3-32

INCORPORATED
MAY 07 2019
Div. of Oil, Gas & Mining
Canyon Fuel Company, LLC  
SUFCO Mine  

Mining and Reclamation Plan  
November 8, 2018

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

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

K - Known distribution species and or habitat  
P - Suspected species or potential habitat  
NP- Not Present (BLM FSEIS)

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

3.3.1 Measures Taken to Disturb the Smallest Practicable Area

No vegetative disturbance is anticipated beyond that encountered during exploratory drilling, portal site construction or that created by subsidence. New operational facilities are kept to a minimum. Only facilities required to maintain the coal operation or satisfy environmental or safety requirements are built.

Revegetation methods to be used to temporarily stabilize are described according to degree of slope angle and accessibility. Interim stabilization is discussed in Section 3.5.2.

The seed mixture (see Section 3.4.1) will be used to revegetate areas disturbed by mining and all associated activities. The climate of the area was reviewed to assess the need for drought-tolerance in the species selected for the seed mixture. The vegetation report (Appendix 2-2) was evaluated to determine seed mixture constituents in light of production, cover, and diversity requirements. The soils report was reviewed to select species adapted to the soil’s physical and chemical condition. Plant species were selected on the basis of wildlife needs and requirements. In addition, the operations plan was reviewed to determine the need for species with quick establishment, rapid spreading and high erosion control potentials.

3.3.2 Description of Anticipated Impacts of Subsidence

Surface disturbance associated with certain mining operations and techniques can be extremely detrimental to terrestrial and aquatic vertebrates, but the longwall technique used within the SUFCO Mine minimizes much of the impact. Since no overburden is removed, the major problem is surface subsidence. The acreage that will be undermined may subside up to a maximum of 70 percent of the thickness of the mined coal. Similarly mined areas in comparable habitats in New Mexico have experienced less than 12 percent subsidence with little or no visible disturbance. The existing mined area has subsided and shows minor surface fissures. It is probable that the integrity of the above ground terrestrial vertebrate communities will generally remain status quo, with occurrence of occasional fractures and minor slippages that will not be detrimental to vegetation or wildlife.
Credibility to this statement comes from the lack of detectable differences in terrestrial vertebrates in comparable habitats in expansion areas.

Subterranean changes, however, are not currently fully understood. There is the possibility that when subsidence occurs, it will disrupt burrow systems and underground aquifers. The loss of the burrow system will destroy the home and habitat of fossorial mammals, reptiles and amphibians and possibly cause death to some species in the immediate area at the time of collapse. If subsidence were to occur simultaneously and non-uniformly over the entire area of concern, this would be a major problem not only for the prey species, but particularly for predators dependent upon the prey base. However, since subsidence will occur systematically and in small areas at a given time, only localized populations will be impacted and only for a short while. Reproductive potential coupled with dispersal will facilitate almost immediate recovery and negate the temporary population reduction. There are no threatened nor endangered species present in the area, so none will be impacted. It has also been observed that burrowing mammals frequently make new dwellings along subsidence induced fractures.

The question of underground aquifer disruption is not easily dismissed. The geology and hydrological system in this area has been studied for several years. Surface waters and habitats are significant resources to elk and deer during the late summer months when water becomes the limiting resource to habitat utilization. Alteration of the groundwater resources would be serious, not to the perpetuation of the population and herds as an entity, but to harvestable productivity. Such habitat loss would also be detrimental to amphibians and aquatic dependent reptiles.

3.3.3 Plan to Minimize Disturbances and Adverse Impacts
In new mine operations it is easy to suggest, provide and implement mitigative measures. But in the case of the SUFCO Mine, preconstruction design and associated mitigation does not apply nor can it be implemented without major additions or modifications. The mine has been operating approximately 55 years, and little can or should now be done to change the design of the portal facilities to lessen the impacts. Any significant change now would increase impacts. Any species inhabiting and utilizing the area of concern have likely habituated to the present facilities and
consequently adjusted their behavior including migration so that change would be more impacting than status quo.

Construction of additional ventilation portals could potentially cause problems. These portals will be opened to the outside from the underground mine entries. Chainlink fence is placed over the portal opening, to protect wildlife from harm. These portals will be placed so that no major big game migration trails are interrupted and no caves or natural cougar denning or resting ledges are destroyed.

Noise, created from operation of the mine, is not expected to increase in the existing areas of disturbance associated with the mining activity, not even with the addition of any ventilation intake portals along the cliffs. These portals are only for intake air. The present exhaust fans are at the mine site and at the 4 East Portal in Quitchupah Canyon.

Appendix 3-16 contains a sound monitoring report conducted by Tetra Tech, Inc in 2008. The monitoring was conducted to collect baseline data in association with the potential development and operation of a ventilation shaft near Quitchupah Canyon. The data was collected around an existing ventilation fan and at selected sensitive resource location such as Forest System Roads, and Greater Sage-grouse leks. The collected sound level data will be used to determine measures which could reduce sound related impacts associated with the operation of the proposed ventilation fan.

Sound level measurements taken within the resource locations ranged between 27.6 dBA and 70.3 dBA. Sounds from the existing fan were discernable at the leks and forest service roads, however most were at or near the background sound levels. Refer to Table 1 for average, minimum and maximum levels at each location.

Efforts have already been made to minimize wildlife loss and/or harassment associated with operation of the mine. Speed limits are set and posted on the county controlled access road to the mine to alert drivers to the presence of wildlife. Although the danger of road strikes is more harmful to wildlife than transportation vehicles, there is the potential for loss of human life and equipment.
damage. Therefore avoiding collisions has become a practical company policy. Wildlife crossing areas or sites of limited visibility are adequately marked. The applicant has instituted the use of a commuter bus to reduce traffic and emissions on the access road from Salina, Utah to the mine. SUFCO prohibits the discharge of firearms by employees on the road in East Spring Canyon (portal site). In conjunction with this restriction, the Applicant has initiated an employee education program to reduce harassment and disturbance of wildlife during sensitive stages in their life history.

Perhaps the most promising mitigation action is that of enhancement or maintenance of wildlife habitat. Enhancing wildlife habitat away from the mine area will improve habitat, possibly increase wildlife numbers, and attract wildlife away from impacted areas. Since much of the area is public domain, wildlife habitat enhancement is a viable management tool. However, any such effort should be carefully coordinated among appropriate regulatory agencies. Some examples of these measures include:

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

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

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

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

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

1. Mining Consumption

Water used underground to mine coal:
2.29% moisture added to coal by cutting and dust suppression operations
Projected 2005 tonnage of coal mined 7,605,685 tons
Projected 5-year average tonnage of coal mined 7,510,217 tons
Tons water/year (based on projected 5 yr average) 171,984 tons
Pounds water/yr 343,967,939 pounds
Gallons/year (8.337 lbs/gal of water) 41,257,999 gallons
Acre feet/year 126.62 ac-ft

2. Ventilation Consumption

33,068 gallons/day (05/02 ventilation survey)
33,068 gallons/day x 365 days/year = 12,069,820 gallons/year = 37.05 ac-ft/year

3. Coal Producing Consumption

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

4. Sediment Pond Evaporation

Mine Site Pond 0.236 acres (surface area)
Evaporation 18.1 in/yr
18.1 in/yr = 1.508 ft/yr
1.508 ft/yr x 0.236 acres = 0.356 ac-ft/yr

Waste Rock Pond 0.219 acres (surface area)
Evaporation 18.1 in/yr
18.1 in/yr = 1.508 ft/yr
1.508 ft/yr x 0.236 acres = 0.330 ac-ft/yr

INCORPORATED APR 19 2018
Total Annual Pond Evaporation = 0.686 ac-ft/yr

5. Subsidence Effects on Springs and Seeps

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

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

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

6. Alluvial Well Pumpage

Sufco does not pump water from an alluvial well.

7. Alluvial Aquifer Abstractions into Mine

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

8. Deep Aquifer Pumpage

Sufco does not pump from deep aquifers.

9. Postmining Inflow to Workings

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

10. Coal Moisture Loss

8.34% inherent moisture - source Sufco Geologist

Projected Tonnage 2005 = 7,605,685 tons

Tons water/yr = 634,314 tons

Pounds water/yr = 1,268,628,258 pounds

Gallons water/yr = 152,168,437 = 466.9 ac-ft/yr

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

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

Mine Discharge:
2004 Average 4,948,260gpd = 1,806,114,900 gal/yr = 5544.3 ac-ft/yr.
Consumption Volume from items 1 - 11 above = 179.1 ac-ft/yr
Total mining operations net water gain/loss = 5365.2 ac-ft/yr gain.

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

The applicant will apply all methods necessary to minimize disturbances or any adverse effects to species listed on Tables 3-1 and 3-2. Potentially adverse impact on wildlife and related environmental values will be avoided or minimized through the implementation of mitigation measures. The Applicant will operate and maintain all transportation systems and support facilities under its control in a manner that minimizes impacts.

3.3.3.2 Species and Habitats

All species and habitats within the permit area will be protected to the best of the applicants ability. Wildlife habitat protection will be considered in the construction of all future facilities. For additional information, see Section 3.3.3.3.

3.3.3.3 Protective Measures

The county access road traverses known deer winter range where deer feed along and readily cross the road making them vulnerable to the coal hauling trucks. Although deer can habituate to traffic thus reducing road strikes, more deaths occur than are desirable.

In the construction of the ventilation portals along canyon walls consideration is given to potential cougar denning and resting sites. When portals are opened to the outside from the underground mine and not from the outside in, little actual habitat is lost to the wildlife of the area.

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

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

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

Subsidence induced seismicity has not been noted to have an adverse impact on livestock or wildlife in the existing mined portions of the Sufco permit area. It is not anticipated the impact to wildlife and livestock due to mining induced seismicity will change or increase as the permit area is expanded into new lease areas.

Areas with suitable habitat for raptor nesting that have a potential to be disturbed by subsidence caused by mining will be surveyed using aerial or ground surveys prior to mining. Raptor nests that have a potential to be disturbed by subsidence will be evaluated with the Division of Oil Gas and Mining and with DWR/FWS if required. Following the evaluation an appropriate plan of action will be developed on a case by case basis. The applicant will obtain any permits necessary for disturbance of the nest if this is the course of action decided upon.

A summary of the information reported in the raptor survey (annual) and the survey will be provided to the Division within three months following the receipt and review of the survey by the permittee. The summary will include a drawing correlating the surveyed nest locations with the areas of potential subsidence anticipated at the time of report submittal.
The Link Canyon Substation No. 1 pad area has an old historic golden eagle nest (#31) that was not found during the 1997 Raptor Survey and a tended falcon scrape (#33) within the buffer zone. These two nests will not be disturbed with the planned mining activity. To protect these nests during the construction of the Substation No. 1 pad the nests will be avoided, and the timing of the construction activity will be after the nesting period of August 15, 1998.

In Link Canyon during the 1998 Raptor Survey a new tended golden eagle nest was found (#321) and the other old historic golden eagle nest sites (#31, and #32) and the falcon scrape (#33) were not found.

In Link Canyon during the 1999 Raptor Survey the golden eagle nest (#321) was inactive and the other old historic golden eagle nest sites (#31, and #32) and the falcon scrape (#33) were not found. Golden eagle site #32 was renumbered in the 1999 survey as #799 and the old historic site #31 shown next to the Link Canyon road and Substation No. 1 pad was deleted.

To protect these nests during the construction of the Substation No. 2 pad the nests will be avoided. The timing of the construction activity started on October 15, 1999 with the construction of a small 20'x30' pad for drilling the power cable boreholes out from within the mine, casing the boreholes, and pulling power cables into the boreholes. The construction of the proposed Substation No. 2 pad and substation will be started right after the drilling and power cables are completed in February, weather permitting. Construction activities began before and continues into the nesting season, any birds wanting to use these old nests in the area would be able to choose if they can tolerate the disturbance. These nests will be monitored during the construction period to see if they are being used.

After the Link Canyon Substation is in place very little mining activity will occur in the area with only emergency maintenance and monthly electrical inspections required. This maintenance and inspection activity will be similar to general public access on the road. Minor maintenance and monthly inspections will only require a pickup truck, ATV or snowmobile going up the canyon for access to the substation. Any major maintenance requiring heavy construction equipment will require
monitoring from December 1 to April 15 for big game winter range and from January 1 to August 15 for raptors and will require a clearance from the DWR and USFS.

Construction associated with the reopening of the western Link Canyon Mine portal, will require minimizing activities that disturb big game from December 1 to April 15. Construction activities from January 1 to August 15 will require a clearance from the DWR and US Fish and Wildlife Service because of potential disturbance to nesting raptors. This proposed project is located in a MMA (Minerals Management Area) in the Manti-La Sal forest plan (Figure 3-15, Management Area Direction, Manti-La Sal National Forest Pines Tract Project, Final Environmental Impact Statement, January 1999). A GWR (General Big-Game Winter Range) Management Unit is located adjacent to the MMA Management Unit. Although this direction does not apply to the adjacent MMA Management Unit where the current proposal is located, the Manti-La Sal National Forest Record of Decision considered this management direction. Direction for operations in adjacent GWR Management Units calls for minimizing potential conflicts. The current proposal will have negligible effects to wintering big game because there will be very little activity at the site following the initial short-term construction activity (pages 14-15, Manti-La Sal National Forest, SUFCO Mine Link Canyon Portal Record of Decision, Oct. 10, 2002). The area will be surveyed for raptor nests. If any are found within the prescribed buffer zone, they will be monitored for activity and work at the portal site will occur following the same guidelines as those described for the Link Canyon Substation.

Mining within the SITLA Muddy Tract will be limited to underground activities; no surface disturbance, other than exploration drilling, is anticipated in this area. Exploration drilling is typically handled by the Division under a separate permit application process. No known raptor nests are known to exist within the SITLA Muddy tract where subsidence will occur. However, if future raptor monitoring finds any raptor nest that has a potential to be disturbed by subsidence, the nest and potential damage will be evaluated with DWR and FWS. An appropriate plan of action will be developed on a case by case basis. The Division of Oil Gas and Mining will be informed in advance when such an evaluation is necessary. The applicant will obtain any permits necessary for disturbance of the nest if this is the course of action decided upon.
Generally, vegetation within the lease and permit areas outside of disturbed areas is protected from mining related impacts, such as subsidence, by the depth of overburden and depth of soil. Experience in mining the Pines and Quitchupah leases has shown that upland vegetation does not appear to be significantly affected by subsidence. Cracks that form in the soil tend to heal quickly and the majority of the vegetation in the area of surface cracks does not appear to be suffering from undue stress. The only cases of damage to vegetation related to mining appears to occur when subsidence cracks form in areas where a brittle sandstone body is near the surface with little soil cover and a crack either visibly bifurcates a plants root system or opens wide enough for soils and small plants to fall into. In a few locations, tree roots have been weakened by surface cracks and have resulted in the trees toppling shortly after the cracking occurs. This impact appears to be typically limited to areas near a canyon rim such as in the West and East Forks of Box Canyon. In areas where there are at least a few feet of soils over bedrock, such as in the previously mined portions of the Quitchupah Lease, this phenomenon has not been observed. Significant impacts to upland vegetation from subsidence are not anticipated in the SITLA Muddy Tract since most of the tract area has a relatively thick mantle of soils.

The depth of overburden in the SITLA Muddy Tract ranges from 900 to nearly 2200 feet. Areas projected to be undermined are covered by a minimum of 1000 feet to a maximum of 2100 feet. Most of the vegetation in the tract is found to be growing in the Price River and the North Horn Formations where the depth of cover is at least 1000 feet. Where these formations are exposed to mining induced subsidence in the Sufco area, the formations tend to react more plastic than brittle and subsidence crack formation is often muted. Subsidence cracks in thick soils and heavily weathered bedrock near the ground surface will frequently heal or fill in a relatively short period of time. Because of the depth and type of cover, Sufco anticipates there will be little impact to upland vegetation due to the subsidence. Subsidence cracks that form that are determined to be a safety hazard will be mitigated as discussed previously in this section.

The applicant has implemented a program to monitor the effect of subsidence on the vegetative communities. The applicant uses color infrared photography (CIR) to document changes to vegetation. This CIR coverage was begun in 1987 and will be updated at least every 5 years thru 2018.
The riparian vegetation within upper Box Canyon adjacent to the 150 acre lease modification is of special concern to the permitting agencies and the permittee. Because of this concern, SUFCO commits to monitoring the effects of subsidence on the riparian vegetation within the upper Box Canyon by including this area within the color infrared photography monitoring program described in the preceding paragraph. Previous infrared surveys have included most of the 150 acre lease modification area and upper Box Canyon. These previous surveys will be used to provide baseline data for the monitoring of subsidence effects, if they occur, on the riparian vegetation within the area. This data will be reviewed by qualified personnel to make determinations concerning the effects of subsidence on the riparian vegetation.

A survey will be conducted to locate representative populations of vegetation growing within bedding planes and fractures in the walls of Box Canyon. The location of the populations will be recorded using a topographic map and a GPS survey will be used to verify the coordinates. Photographs of the vegetation will be taken during the survey. The survey will be conducted during the growing season through 2013, when the survey was discontinued. This survey may coincide with the survey for the Link Trail Columbine as discussed previously in this chapter. A report of this survey will be included in the SUFCO annual report through 2012, a summary of the reports including the information gathered in 2013 is located in Appendix 3-10.

The applicant has implemented a program to monitor surface flowing water to determine diminished flows resulting from mine-related subsidence. The plan is incorporated as part of the overall surface water monitoring program. Monitoring with respect to wildlife watering sources has been discussed in Appendix 7-2. The applicant will cooperate with regulatory agencies to develop and provide alternative water sources for wildlife if mine-related subsidence disturbs the present sources.

In areas where wetlands and habitats of unusually high value for fish and wildlife exist, more intensive water and subsidence monitoring may occur when deemed necessary by the permittee, Division, and/or landowner/manager. This type of monitoring has already taken place in the East Fork of Box Canyon in the Pines Tract area and is described in detail in Chapter 5 Section 5.2.5.1 and Chapter 7 Section 7.3.1.2. Only two short segments of Cowboy Creek are within the SITLA Muddy Tract. Both segments are located on the eastern portion of the tract. One segment is located in the northeast 1/4 of Section 7, T21 S, R 5 E and the other is in the eastern 1/4 of Section 5 Section 7, T 21 S, R 5 E. Both of these segments of stream are perennial and contain riparian vegetation in the channel bottom and on the banks of the channel. Additionally, there are several low flow springs within the SITLA Muddy Tract supporting riparian vegetation. The locations of
these springs are identified on Plate 7-3. The riparian vegetation associated with Cowboy Creek and the springs is identified on Plate 3-1.

As discussed in the SITLA Muddy Tract PHC (Appendix 7-20), springs in the area occur within the North Horn and Price River Formations. The springs typically occur on the down gradient end of a perched aquifer where the beds containing the water are truncated by surface topography. Most of the springs occur in areas where overburden depths are approximately 1500 feet or greater. Sufco has undermined a few springs where the cover was greater than 800 feet, most of them occurring in the East Fork of Box Canyon. A few of the springs that discharged at or near the Blackhawk Formation - Castlegate Sandstone contact moved down-gradient. The remainder that discharge from the Castlegate Sandstone where the overburden is greater than 800 feet do not appear to have been significantly impacted by subsidence (PHC Appendix 7-20 and personal communication with Erik Petersen of Petersen Hydrologic, Inc., Lehi, Utah, October 2005). Based on this experience, Sufco believes undermining the springs supporting associated riparian vegetation in the SITLA Muddy Tract will not significantly impact the vegetation.

Sufco has undermined a portion of the East Fork of Box Canyon where the flow is perennial. In the segment of the stream supported the Blackhawk Formation, subsidence related cracking of the brittle sandstone and silty sandstone beds did result in a temporary diversion of surface water into the subsurface. However, it was observed the water resurfaced down-gradient where the channel down cut through the brittle sandstone layers and encountered more plastic siltstones and shales. Mine personnel successfully repaired the channel floor with bentonite and native soils and restored the flow to the surface. Subsequent spring runoff also appears to have aided in natural repairing of the channel floor. Initial annual monitoring of the vegetation in the lower East Fork of the Box Canyon, begun in late 2003 and early 2004, has indicated the riparian vegetation adjacent to the stream channel does not appear to have been significantly impacted by subsidence.

Based on the experience to date (Fall 2005) of undermining the East Fork of Box Canyon, subsidence of the short segments of Cowboy Creek present in the SITLA Muddy tract is not anticipated to adversely impact the perennial vegetation associated with the creek. The overburden between the coal seam to be mined and the stream channel in the tract is between 1100 and 1600 feet. The underlying formations contain rock types that would be expected to easily heal surface cracks that form beneath the stream channel. Additionally, the alluvium within the stream channel supporting riparian vegetation is derived from the fine-grained rocks of the Price River and North Horn formations. This alluvium is expected to naturally readily fill fractures.
may occur in the channel substrate thus limiting the loss of flow, if any, supporting the riparian vegetation.

Though not anticipated, short segments of Cowboy Creek could be subsided in the SITLA Muddy Tract. If this is anticipated to occur, Sufco, with the approval of the Division and concurrence of the Forest, will instigate a vegetation monitoring and mitigation plan similar to the plan implemented prior to the undermining of the East Fork of Box Canyon. If mitigation of surface cracks is required, methods similar to those proposed and implemented in the East Fork of Box Canyon as described in Chapter 5 Section 5.2.5.1 and Chapter 7 Section 7.3.1.8 will be used.

South Fork of Quitchupah - The monitoring and mitigation plan for undermining the South Fork of Quitchupah 2R2S Block “A” and 3R2S Block “B” is located in Appendix 3-14. Appendix 3-14 contains a Threatened, Endangered and Sensitive survey prepared by Mt. Nebo Scientific and an assessment of the macroinvertebrates in the South Fork of Quitchupah Creek. The macroinvertebrate assessment was prepared by Dennis K. Shiozawa, Ph.D., which contains the results of a series of benthic samples taken to determine the diversity of the invertebrate community in the South Fork of Quitchupah Creek. In 2016 a summary monitoring report (Appendix 3-14) for the upper reaches (sites Q01 - Q09) of the riparian plant community was compiled for of the South Fork of Quitchupah Creek. The report summarizes the data gathered from 2012 thru 2015. The riparian vegetation sample stations in the South Fork were chosen by a team of experts from various agencies (see methods section within the reports). The stations included both control and sampling sites, control being outside the zone of subsidence and the sites being within. It should be noted that one control spring area was impacted in the Fall of 2015, it appears that the spring had been dug out to create a water hole for cattle, consequently the spring consists of a 6 foot diameter pool with almost no riparian vegetation and muddy banks. A second impact to the area was a control burn by the Forest Service on the slopes adjacent to the creek also in 2015-2016, due to the burn and verbal communications with the Division it was decided to end the sampling in 2016 in the upper reaches. According to the report summary “there seemed to be no clear differences in the riparian width trends for the control stations or the subsidence zone stations. Moreover, there were also no clear differences in the trends in the springs when compared channel sites in either the control or the subsidence zone stations. ------- suggesting that the subsidence from underground coal mining had little or no negative impact on the riparian plant communities that are supported along the South Fork Quitchupah Creek.” (Riparian Plant Community Monitoring in Selected Reaches of South Fork Quitchupah Creek: A Summary (2012-2015), Mt. Nebo Scientific, Inc.)
The 2R2S “A” panel/block contains Q01 - Q09, the 3R2S “B” panel/block contains Q10- Q11. The control sites not subject to impact by subsidence are Q01, 03,07,08,09, 11, the site with a potential of being impacted by subsidence are Q02, 04, 05, 06 and 10.

Sites Q10S and Q11C (lower reaches) will continue to be monitored through the Fall of 2016. They are in the deep canyon area of South Fork. An addendum to the Riparian Vegetation Monitoring Table is included in Appendix 3-14 as are the riparian vegetation monitoring reports for 2012 thru 2016, in addition a summary report was written in 2016.

The applicant will request that future power lines on the SUFCO Mine site be constructed per OSM and UDGOM regulations or with alternative guidelines approved by the regulatory authority. Additional information referencing power lines is located in Section 3.5.8.5.

Efforts will be taken to regulate the use of pesticides when needed. Before a pesticide is used, the type and concentration will be approved by the Regulatory Authority.

**3.40 Reclamation Plan**

The Reclamation Plan will include the seed mix and rate of seedlings per acre as well as stocking rates for shrub plantings, planting techniques, fertilization methods and amount and frequency of application. The fish (see Section 3.2.2) and wildlife plan for the permit area is outlined in Section 3.4.2.

**3.4.1 Revegetation**

The reclamation plan for final revegetation is included in this section for all lands disturbed by coal mining and reclamation operations.

The short-term goal of this revegetation plan is the immediate stabilization of the disturbed sites through erosion control. This objective will be achieved through controlled grading practices, proper seedbed preparation to encourage rapid plant establishment, inclusion of rapidly establishing species in the seed mixture to be planted and mulch applications.

The long-term goals are to establish useful, productive range and wildlife habitat. These goals will be attained through the selection and placement of desirable and productive plant species, and a commitment to monitor and maintain revegetated areas throughout the bond liability period.
3.4.1.1 Schedule and Timetable
The reclamation timetable and schedule is outlined in Figure 5-2.

The planting of seeds and seedlings will be undertaken at the most feasible time following disturbance activities. Planting will begin after the plant growth medium has been replaced. Grasses and forbs will be tentatively planned for planting in May or early June; shrubs and seedlings in late August through early October.

3.4.1.2 Descriptions
Species and Amounts of Seed. All revegetated areas will be planted with this standard seed mix: Revegetation of the mine portal and sedimentation pond area is to include the planting of 500 seedling shrubs and tree seedlings per acre, as listed below:

Shrubs and Trees Seedlings:
Bitterbrush 20%
Utah Serviceberry (15%)
Curlleaf mountain mahogany (15%)
Sagebrush 20%
Birch-leaf mountain mahogany (15%)
Woods Rose 15%

The bitterbrush seedlings could possibly be impacted by grazing deer during the first year following planting. If so, the seedlings will be replaced with another brush species.

The breakout areas (remote portals) will be reclaimed using the standard seed mix. Seeding will be done by broadcasting. Mulch and fertilization will be applied at the rates listed below under Mulching Techniques.

The riparian area of the Link Canyon Mine portals will be revegetated by planting the following seedlings:
Willow (Salix spp.) 50% River Birch 10%
Red Osier Dogwood 20 % Alder 10%
Woods Rose 10%
### General Pinyon-Juniper Seed Mixture for the SUFCO Mine

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Rate PLS/Ac</th>
<th>No. Seeds Per Ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TREE &amp; SHRUBS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amalanchier utahensis</td>
<td>Serviceberry</td>
<td>4.00</td>
<td>2.37</td>
</tr>
<tr>
<td>Artemisia tridentata</td>
<td>Big sagebrush</td>
<td>0.10</td>
<td>5.91</td>
</tr>
<tr>
<td>Atriplex canescens</td>
<td>Fourwing saltbush</td>
<td>2.00</td>
<td>2.53</td>
</tr>
<tr>
<td>Chrysothamnus nauseosus</td>
<td>Rubber rabbitbrush</td>
<td>0.30</td>
<td>2.75</td>
</tr>
<tr>
<td>Rosa woodsii</td>
<td>Wood’s Rose</td>
<td>1.00</td>
<td>1.04</td>
</tr>
<tr>
<td><strong>FORBS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achillea millefolium</td>
<td>Yarrow</td>
<td>0.05</td>
<td>3.18</td>
</tr>
<tr>
<td>Hedysarum boreale</td>
<td>Northern sweetvetch</td>
<td>4.00</td>
<td>3.09</td>
</tr>
<tr>
<td>Linum lewisii</td>
<td>Blue flax</td>
<td>1.00</td>
<td>6.38</td>
</tr>
<tr>
<td>Penstemon eatonii</td>
<td>Eaton penstemon</td>
<td>0.50</td>
<td>6.89</td>
</tr>
<tr>
<td>Penstemon palmeri</td>
<td>Palmer penstemon</td>
<td>0.50</td>
<td>7.00</td>
</tr>
<tr>
<td><strong>GRASSES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromus carinatus</td>
<td>Mountain brome</td>
<td>2.00</td>
<td>4.59</td>
</tr>
<tr>
<td>Elymus cinereus</td>
<td>Gt. Basin wildrye</td>
<td>2.00</td>
<td>4.36</td>
</tr>
<tr>
<td>Elymus smithii</td>
<td>Western wheatgrass</td>
<td>2.00</td>
<td>5.79</td>
</tr>
<tr>
<td>Elymus spicatus</td>
<td>Bluebunch wheatgrass</td>
<td>2.00</td>
<td>6.43</td>
</tr>
<tr>
<td>Elymus trachycaulus</td>
<td>Slender wheatgrass</td>
<td>1.50</td>
<td>5.51</td>
</tr>
<tr>
<td>Stipa hymenoides</td>
<td>Indian ricegrass</td>
<td>1.50</td>
<td>6.47</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td>24.45</td>
<td>74.29</td>
</tr>
</tbody>
</table>

* Elymus salinus should be added if commercially available.

** Rates based on broadcast seeding.

Note: seed amounts are pure live seed per acre
Willows intermixed with the remainder of the seedlings will be planted adjacent to the reclaimed channel and within the protective riprap. Willow cuttings from existing plants in the drainage will be cut and planted early in the first spring following reclamation construction activities. The slopes away from the channel will be reseeded with the standard seed mix at prescribed rates of application where coverage consists of at least 50 to 100 seeds per square foot. The seed mix for the Link Canyon Portal will not include alfalfa seed. Horsetail and clematis occur naturally in the area and will be allowed to invade the reclaimed area. Plugs of existing sedges in the eastern portal area will be obtained and transplanted to the reclaimed western portal.

Reclamation of the portal access road and portal area will include transplanting Creeping Oregon Grape. Creeping Oregon Grape will be transplanted to the topsoil pile during site construction and it is anticipated a portion of these plants will be used during reclamation of the access road.

3 Right 4 East Panel(s)

Pertaining exclusively to the potential subsidence disturbance associated with the 3 Right 4th East mining panel the following will apply:

* The mortality of ponderosa pines on the surface above the panel will be monitored during the annual subsidence survey while the panel is being mined and during the annual subsidence survey two years following the completion of mining.
* Should a seed mix be required to be used on soil filled subsidence cracks or to replace a ponderosa pine(s), the following seed mix will be used. Soils used to fill subsidence cracks which receive seed will not receive mulch or fertilizer.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Rate PLS/Ac</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TREE &amp; SHRUBS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artemisia tridentata</td>
<td>Big sagebrush</td>
<td>0.10</td>
</tr>
<tr>
<td>Pinus ponderosa</td>
<td>Ponderosa Pine</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>GRASSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromus carinatus</td>
<td>Mountain brome</td>
<td>2.00</td>
</tr>
<tr>
<td>Elymus smithii</td>
<td>Western wheatgrass</td>
<td>2.00</td>
</tr>
<tr>
<td>Elymus spicatus</td>
<td>Bluebunch wheatgrass</td>
<td>2.00</td>
</tr>
<tr>
<td>Elymus trachycaulus</td>
<td>Slender wheatgrass</td>
<td>1.50</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td>8.1</td>
</tr>
</tbody>
</table>
Refer to Section 5.2.5.2 (Correction of Material Damage) for additional information.

**2RWL Sinkhole Repair and Reclamation:** At the request of the Fishlake Forest the seed mix for reclamation of the site in 2016 included the following seed mix which was broadcast in October immediately following the placement of soil and pocking/gouging of the site. Mulch was not used to discourage impact from livestock and large mammal browsing the mulch on the reclaimed sinkhole area. Refer to Sections 5.2.1.1 and 5.4.1.1 of Chapter 5 for additional information.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>PLS lbs/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elymus trachycaulus</td>
<td>Slender Wheatgrass</td>
<td>3</td>
</tr>
<tr>
<td>Achnatherum nelsonii</td>
<td>Columbia needle grass</td>
<td>1</td>
</tr>
<tr>
<td>Elymus glaucus</td>
<td>Blue Wildrye</td>
<td>1</td>
</tr>
<tr>
<td>Aster glaucodes</td>
<td>Blueleaf Aster</td>
<td>0.25</td>
</tr>
<tr>
<td>Sanguisorbia minor</td>
<td>Small burnet</td>
<td>1</td>
</tr>
<tr>
<td>Lupinus argenteus</td>
<td>Silvery lupine</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>7.25</strong></td>
</tr>
</tbody>
</table>

“Natural colonization of native species is often allowed to occur on sites where the seeds of desirable plants exist in the soil seed bank or on adjacent lands. ... it may be the preferred management action on sites where native seed sources are available....” (USDA Forest Service Proceedings RMRS-P38.2005) There is an expectation that shrubs species in the area of sinkhole will invade the seeded area, since a shrub seed was not included in the seed mix recommended by the Forest Service. In addition, the topsoil from the sinkhole was stockpiled and replaced in a very short time and likely contains sagebrush and rabbit brush seed.

**Success Standards** (Part of Forest Service Quitchupah Grazing Allotment). Due to the disturbance associated with the sinkhole being so small and through consultation with the USFS and DOGM the density standard of shrubs/tree has been agreed upon to be zero (0) for the site (Email communication Appendix 3-13). To determine the success of the revegetation seeding (2016) in either 2021/2022 the ground cover and production of living plants on the revegetated area will be at least 60% of that of the 100’ square reference area immediately adjacent to the reclaimed sink hole on the northern edge of the reclaimed site (refer to Plate 3-1 and Appendix 3-13 for location). The reference area will be evaluated during the same year for comparison. If the vegetative cover and production is less than 60%, the site will be reseeded.

If a change in use is required due to the sinkhole acting as a pond, it will be repermitted if there...
is no change in the designated use of the sinkhole, in 2026 the ground cover and production of living plants on the revegetated area will be at least equal to that of the 100' square reference area to enable bond release. The reference area will be evaluated during the same year for comparison. If the production is not equal to the reference area the permittee will determine a course of action in consultation with biologists from the Fishlake National Forest and the Division.

Sinkhole Geology, Soils, Slope and Vegetation
The sinkhole is in an area where the geologic formations transition from the Castlegate Sandstone formation to the Price River formation. According the Ecological Site Description (NRCS) the site contains Rizno Skos soils and further describes the soil as follows. “The soils in this site are very shallow to shallow and well to excessively drained. These soils are typically eolian deposits over residuum derived dominantly from sandstone and interbedded shale. The soil temperature and moisture regimes are mesic and aridic respectively. Surface and subsurface textures are generally fine sands, fine sandy loams and loamy sands.”

The location of the sinkhole and reference area is relatively flat and slightly sloping to the west. Vegetation for the area on a large scale is shown on Plate 3-1, the qualified persons who did these studies are referenced on Plate 3-1. The information from Plate 3-1 has been enlarged on the figure included in Appendix 3-13. More specific description of the vegetation for the sinkhole and its immediately adjacent reference area is sagebrush, grasses and forbs with Ponderosa pines growing within a couple hundred feet of the western edge of the sinkhole and reference area site (see photos Appendix 3-13).

Method Used for Planting and Seeding. The entire disturbed area will be revegetated using various seeding methods such as hydroseeding, broadcasting or drilling. The best available economically feasible technology will be used at the time of seeding. The tree and shrub seedlings will be planted in clumps to maximize edge effect and provide more adequate cover for wildlife. At least five clumps per acre (consisting of 100 seedlings per clump) will be planted at intervals ensuring that 35 to 50 percent of each acre is covered.

Mulching Techniques. The mixture and application rate will be:

- 2000 lbs. of mulch per acre
- 100 lbs. of nitrogen per acre
- 100 lbs. of phosphorus per acre
The slopes and overfill areas will involve scarification and/or construction of small terraces on the slopes. The prepared slope will tend to hold moisture and to allow for places where plants can grow.

If hydro-seeding is used, first seed, tackifier and wood fiber mulch (400 lbs/acre) will be mixed in a water slurry and applied. The mulch acts as a buffer to protect the seed from damage while spraying and as a visual indicator to verify the area covered. Next, fertilizer, tackifier, and wood fiber mulch (2000 lbs/acre) will be mixed in a water slurry and applied. The seedlings of shrubs and trees will be placed through the hydro-mulch material.

The pond area should be reclaimed using similar methodology at the conclusion of the mining operation. See Section 3.5.5 for additional discussion.
Irrigation, Pest and Disease Control. Subsequent to treatment, both hand set plantings and hydromulch applications may be given supplemental irrigation, as needed, until plants are well established. No persistent pesticides will be used by the Applicant in the mine area unless previously approved by the UDOGM.

The Link Canyon Portal reclaimed area will be fenced with three-strand barb wire to keep grazing livestock out of the reseeded and reclaimed area.

Measures Proposed for Revegetation Success. Success of revegetation and stabilization of the portal yard and overfill areas will be evaluated during the middle of each growing season, when cover and composition studies are most feasible. The same statistical methods and sample adequacy levels used in establishing the reference areas will be used in monitoring percent cover and composition of revegetation attempts in disturbed areas in as much as possible. The Applicant will comply with the statistical confidence method required in R645-301-356.120. Erosion pins will be placed on slopes at the time of reseeding operations during final reclamation. A table of random numbers will be used to determine pin placement. Measurement of erosion pins will help determine revegetation success in holding soil and stabilizing slopes.

See Appendix 2-2 page 5 through 7 for the statistical methods and sample adequacy levels used to establish the reference areas.

3.4.1.3 Greenhouse Studies, Field Trials or Other Equivalent Studies

If the UDOGM requires additional testing for the purpose of demonstrating that reclamation as required by the State Program can be accomplished according to information given in the M&RP, the applicant will comply.
A field trial is to be established by Spring 1994 on the east side of the disturbed area in the vicinity of cross section C-C. The plot will be approximately .20 acres in size. Most of this slope will not be redisturbed during final reclamation and is similar to those that will be encountered in final reclamation.

The site will first be roughened by hand raking or some other method to help prepare the seed bed. The area will be broadcast seeded with the approve seed mix and recommended available fertilizer of 16 pounds nitrogen, 32 pounds phosphorus and 32 pounds potassium per acre. The seed and fertilizer will be hand raked into the prepared soil seed bed. The area will be mulched with noxious weed-free straw or hay at the minimum rate of 2,000 lbs. per acre. The straw will be anchored by hand with shovels and anchored with a plastic mesh. The plastic mesh will be anchored with wire staples. The area will then be planted with the approved available shrub seedlings. The percentage of shrub seedlings may vary due to availability, however, the area will be planted with a minimum density of 500 seedlings per acre.

3.4.2 Fish and Wildlife

The fish (see Section 3.2.2) and wildlife plan is a set of specifications and procedure to avoid potential adverse impact to wildlife and their habitat. Revegetation to sustain and improve wildlife habitat will be the primary concern of the applicant following the termination of mining operations. The plan is consistent with Sections 3.30 and 3.5.8.

3.4.2.1 Enhancement Measures

Range improvements within the lease area include 12 stockponds, 1 water trough, several miles of range fences, approximately 1,000 acres of sagebrush burning and spraying and approximately 600 acres of reseeding (USDA, 1988). A guzzler has been added to the area recently to provide a water source for wildlife. The guzzler is protected from livestock use (See Plate 3-3 for guzzler location).

3.4.2.2 Plants Used for Wildlife Habitat

The plant species in the reclamation seed mix are consistent with those presently grown in the
permit area (excluding yellow clover which is an introduced species). Section 3.4.1.2 contains the proposed reclamation seed and shrub mix.

Nutritional Value. The nutritional value will be consistent with that of vegetation in the surrounding areas.

Cover. The goal of the Applicant is to establish plant species which will provide sufficient cover for the fish and wildlife of the area. The Applicant will use rocks and dead trees and shrubs as part of the planting surface preparation to enhance the reclaimed area for wildlife habitat. Rock and brush piles will be constructed to make artificial habitat. Reshaping of the disturbed area will simulate the surrounding topography. See Section 3.4.1 for additional discussion.

Ability to Support and Enhance. The plant species have the ability to support and enhance the fish or wildlife habitat after the release of the performance bonds. Shrubs will be planted in clumps of no more than 1,000 per acre.

3.4.2.3 Cropland
Cropland is not a postmining land use.

3.4.2.4 Residential, Public Service and Industrial Land Use
No residential, industrial or public service use is planned at the present time for the permit area following the termination of mining.
3.50 Performance Standards

3.5.1 General Requirements
The Applicant commits to conduct all operations in accordance with the plans submitted in Sections R645-301-330 through R645-301-340 of the permit application.

3.5.2 Contemporaneous Reclamation
Reclamation of the pre-SMCRA coal slide areas south of the permit area as shown on Plate 5-2B was completed in 1981 in accordance with a USFS and OSM-approved plan.

The Applicant will revegetate areas for interim periods with grasses and forbs. An example of this type of interim reclamation would be an area in which erosion control is needed for the interim period before redisturbance. Sparse interim vegetation will aid in preventing soil erosion. Contemporaneous reclamation will not be done in areas the Mine Health and Safety Regulations require to be kept barren of vegetation (such as areas around mine ventilation openings).

Permit conditions will dictate the reclamation measures to be performed on land disturbed by such activities as exploratory drilling.

3.5.3 Revegetation: General Requirements
A vegetative cover will be established on all reclaimed areas to allow for postmining land use (primarily wildlife habitat). Water areas and surface areas of roads will not be revegetated. The vegetative cover will be in accordance with the approved permit and reclamation plan. All species of vegetation to be used in reclamation activities, whether planted by seed or seedlings, shall be approved by the appropriate governmental agencies.

3.5.3.1 Vegetative Cover
The seed mix proposed for revegetation is intended to provide vegetative cover that will be diverse, effective and permanent. The seed mixture was selected with respect to the climate,
potential seedbed quality, erosion control, drought tolerance and the mixture's ability for quick establishment and spreading.

Native Species. The vegetative mixture will be comprise of species native to the area, capable of achieving postmining land use an approved by the UDOGM. Only native species are recommended for revegetation of the mine portal and pond areas. Diversity of species should allow ultimate utilization of plants by wildlife and by domestic livestock. Both mine portal and pond areas are regarded as harsh environments and might require exceptional methodology before successful revegetation is realized.

The revegetative species will be purchased from suppliers who will certify their percentages of purity, germination, hard seed, and percentages of maximum weed seed contents.

Extent of Cover. The vegetative cover will be at least equal in extent to the natural vegetation of the reference areas.

Stabilizing. The vegetative cover mixture is capable of stabilizing the soil surface from erosion.

3.5.3.2 Reestablished Plant Species

Compatible. The reestablished plant species have been selected to insure their compatible with the approved postmining use.

Seasonal Characteristics. The revegetation plant species will have the same growing season as the original vegetation, or in this instance as the adjacent areas.

Self-generation. The reestablished plants are species capable of self-generation and plant succession.

Compatibility. The seed mix suggested for revegetation contains plants native to the area and compatible with the plants and animals species of the permit area.
Federal and Utah Laws or Regulations. The seed mixture purchased to revegetate the mine area will contain no poisonous or noxious plant. No species will be introduced in the area without being approved by the UDOGM.

3.5.3.3 Vegetative Exception
The applicant does not require vegetative exception at this time.

3.5.3.4 Cropland
The permit area contains no land designated as cropland for postmining land use.

3.5.4 Revegetation: Timing
The applicant will follow the recommended guidelines for revegetation as discussed in Section 3.4.1.1.

3.5.5 Revegetation: Mulching and Other Soil Stabilizing Practices
Hydromulching will be used on slopes 1.5:1 or steeper and will consist of chopped straw or fiber mixed with water and machine blown at the rate of 2,000 lbs/acre. Mulch mats may also be used on these steep slopes. Mulching and revegetation will not be attempted on sheer rock outcrops.

On slopes flatter than 1.5:1 mulch will be applied at the rate of 2,000 lbs/acre. Different mulches such as straw, hay and wood fiber may be used.

Suitable mulch and other soil stabilizing practices will be used on all areas that have been regraded and covered by topsoil or topsoil substitutes. The slopes will be scarified or small terraces will be constructed.

Slopes 1.5:1 or steeper will not hold topsoil; therefore, these slopes will be revegetated without the application of topsoil. Seeds for grasses and forbs will be incorporated in a water slurry with a tackifier and mulch material (400 lbs/acre) and applied. Fertilizer and the hydromulch
materials (2000 lbs/acre) will then be applied as a separate application. The shrub and tree seedlings will be placed through the hydromulch material.

The Applicant will exercise care to guard against erosion during and after application of topsoil and will employ the necessary measures to ensure the stability of topsoil on graded slopes.

Reclaimed slopes in the area of the Muddy Creek Breakout will be protected from erosion by the application of an erosion mat, such as an excelsior mat, stapled in place. The mat will be placed after the application of seed and fertilizer. Because of the limited area and steep slope associated with the breakout, the seed and fertilizer will be applied at the same rate as specified for hydromulching and hydroseeding.

3.5.6 Revegetation: Standards for Success
The standards for revegetation success are detailed in Section 3.4.1.2 and Appendix 2-2. Refer to Section 3.4.1.2 for subsection entitled "2RWL Sinkhole Area" for site specific success standards.

3.5.6.1 Success of Revegetation
The success standards for approval will be judged on the effectiveness of the vegetation for postmining land use, the extent of cover in comparison to the reference area, and the standards outlined in Section 3.5.3.

Sampling Techniques. The applicant will comply with the standards for success, statistically valid sampling techniques for measuring success, and the approved methods outlined in the UDOGM's currently approved "Vegetation Information Guidelines, Appendix A" (Appendix 3-6 contains guidelines that were in place).

Standards for Success. The sampling techniques for success will use a 90 percent statistical confidence interval as required by R645-301-356.120. The standards for success will include criteria representative of unmined lands in the area of the permit. Areas not achieving 90 percent of the cover in adjacent areas with similar vegetation will be reevaluated and augmentation reclamation measures will be made to successfully vegetate those areas.
3.5.6.2 Standards for Success

Standards of success will be applied in accordance with the approved postmining land use as described in this section.

Grazing Land or Pasture Land. The ground cover and production of living plants on the revegetated area will be at least equal to the reference area.

Cropland. There is no area designated as cropland within the permit area.

Fish and Wildlife Habitat. The success of revegetation for fish and wildlife habitat will be determined on the basis of tree and shrub stocking and vegetative ground cover. Minimum stocking and planting arrangements will be specified by the UDOGM on the basis of local and regional conditions. Trees and shrubs will be healthy and at least 80 percent will be in place at least eight growing seasons after reclamation to allow for the bond release. Ground cover success will not be less than that required to achieve the approved postmining land use. Refer to Section 3.4.1.2 for variance from shrub standard for the S2RWL Sinkhole.

Industrial, Commercial or Residential. The postmining land use for the permit area is not designated for industrial, commercial or residential use.

Previously Disturbed Areas. The SUFCO Mine has been in operation since 1941. Since 1977, interim revegetation has been done but there is no record of revegetation being done prior to 1977. The applicant will restore the vegetative ground cover to that of the surrounding area and the ground cover will be adequate to control erosion.

The Link Canyon Portals will be constructed in an area that was disturbed by pre-SMCRA mining activities. The portals in this area were closed in the 1950's. Two reference areas, a Pinyon-Juniper area and a riparian area, specific to these portals were created in July 2002. Success standards for the Link Canyon Portal area will be based on a comparison between the reference areas specific to the Link Canyon Portals and the reclaimed area applying the required statistical confidence method described above.
3.5.6.3 Siltation Structure Maintenance
Siltation structures will be maintained until removal is authorized by the UDOGM and the disturbed areas has been stabilized and revegetated. The structures will be removed not sooner than two years after the last augmented seeding. For additional details on siltation structures, see Section 5.4.2.

3.5.6.4 Removal of Siltation Structures
The land on which siltation structures are located will be revegetated in accordance with the reclamation plan Sections R645-301-353 and R645-301-357.

3.5.7 Revegetation: Extended Responsibility Period
The applicant will be responsible for the success of revegetation for a period of ten years following seeding, fertilization and irrigation of the reclaimed mine area.

3.5.7.1 Extended Period Begins
The period of extended responsibility will begin the year after the reseeding, fertilization, and irrigation have been completed.

3.5.7.2 Vegetative Parameters
Vegetation parameters will equal or exceed the approved success standard during the last two years of the responsibility period. The success standards are outlined in Sections 3.5.6.1 and 3.5.6.2 of this application.

3.5.7.3 Husbandry Practices
The Applicant will comply with UDOGM approved husbandry practices which will be normal conservation practices within the region of the mine. These practices may include disease, pest, and vermin control; and any pruning, reseeding and transplanting required.

3.5.8 Protection of Fish, Wildlife and Related Environmental Values
The Applicant will minimize disturbances and adverse impacts on fish, wildlife and their related environments as outlined in Section 3.3.3. The company will continue to educate their employees and habitat users about wildlife needs and their importance.

The intermittent flow of streams within the lease area does not support a population of game fish; therefore, there are no fisheries within the permit area to protect.

3.5.8.1 Existence of Endangered or Threatened Species
Coal mining will not be conducted where its operation might jeopardize the existence of any endangered or threatened species. The mining of coal will not result in the destruction or adverse modification of these species' critical habitat.

Any state or federally listed endangered or threatened species will be reported to the UDOGM upon its discovery. Mining operations will proceed in accordance with the UDOGM's stipulations. These stipulations also apply to reclamation operation at the SUFCO Mine.

Discussion of threatened and endangered species are presented in the following reports: WIL, pages 8 and 44, Appendix 3-3; RAP, pages 8-9, Appendix 3-4; and AQU, page 6, Appendix 3-5. A more current listing of threatened and endangered species are included in this M&RP as Table 3-1 and Table 3-2.

3.5.8.2 Bald and Golden Eagles
Coal mining and reclamation operations will be conducted in a manner protective of the bald or golden eagle. The applicant will promptly report any golden or bald eagle nests found within the permit boundaries and will proceed with operations in accordance with the UDOGM's stipulations.

3.5.8.3 Taking of Endangered or Threatened Species
The applicant understands that there is no permission implied by these regulations for taking of endangered or threatened species, their nests or eggs.
3.5.8.4 Replacement of Wetland and Riparian Vegetation
No riparian habitat has been disturbed.

3.5.8.5 Manmade Wildlife Protection Measure

Electric Power Lines. All power lines within the SUFCO Mine permit area were modified during the summer of 1981 to comply with the guidelines of REA Bulletin 61-10, "Power Line Contacts by Eagles and Other Large Birds". Various correspondence regarding the Applicant's modification of power lines is presented in Appendix 3-7. The locations of mine site power poles are shown on Plate 5-5.

Potential Barriers. The mine has been operating approximately 55 years and little should now be done to change the design of the portal facilities to lessen the impacts. The wildlife inhabiting and utilizing the area of concern have likely acclimated to the present facilities and consequently adjusted their behavior including migration so that a modification of the facilities to providing corridors would be more adverse than leaving the facilities as they are.

Pond Protection. Fences or other appropriate methods will be used to exclude wildlife from ponds containing hazardous concentrations of toxic-forming materials. However, at this time the applicant has no ponds containing hazardous concentrations of toxic-forming materials.

REFERENCES:


CHAPTER 4

LAND USE AND AIR QUALITY

INCORPORATED

FEB 01 2011

Div. of Oil, Gas & Mining
TABLE OF CONTENTS

Section                  Page
4.10 Land Use            4-1
  4.1.1 Environmental Description ........................................ 4-1
    4.1.1.1 Premining Land Use ............................................ 4-1
    4.1.1.2 Previous Mining Activity ..................................... 4-24
  4.1.2 Reclamation Plan ..................................................... 4-25
    4.1.2.1 Postmining Land Use Plan ..................................... 4-25
    4.1.2.2 Land Owner or Surface Manager Comments ...................... 4-28
    4.1.2.3 Suitability and Capability .................................... 4-28
    4.1.2.4 Performance Standards ....................................... 4-28
      4.1.3.1 Postmining Land Use ........................................ 4-28
      4.1.3.2 Determining Premining Uses of Land ....................... 4-28
      4.1.3.3 Criteria for Alternative Postmining Land Uses .......... 4-28
  4.1.4 Alternative Land Use .............................................. 4-28
4.20 Air Quality .......... 4-28
  4.2.1 Air Quality Standards ............................................. 4-29
  4.2.2 Compliance Efforts .............................................. 4-29
  4.2.3 Monitoring Program ................................................ 4-30
References .................. 4-31

LIST OF PLATES

   Plate                  Description
   4-1                    Land Uses
   4-1C                   Land Uses - Silla Muddy and Greens Hollow Tract

LIST OF APPENDICES
(Appendices appear in Volume 6)

Appendix
   4-1                    Utah Big Game Annual Report, 1991, Deer Herd Unit #43, Elk Herd Unit #14
   4-2                    Cultural and Historical Resources (Confidential)
   4-3                    Assessment of Particulate Emissions Report
   4-4                    Division of Air Quality Approval Order
   4-5                    Cultural Resource Memorandum of Agreement
   4-6                    Cultural Resource Documentation

INCORPORATED

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Div. of Oil, Gas & Mining
4.10 Land Use
This section of the permit application includes descriptions of the premining and proposed postmining land use(s).

Greens Hollow Lease
Much of the information presented for the permitting of the Greens Hollow Lease (GHL) was prepared with a conceptual mine plan assuming full extraction mining, associated subsidence and represents maximum impacts in the Bureau of Land Management's Environmental Impact Statement (FSEIS). The information in the text represents the permittees accepted obligations and commitments, the information provided in appendices from the (FSEIS) unless reference specifically is provided as background or baseline for the obligations and commitments within the text. The Sitla Muddy Tract/Lease should not be confused with the BLM Muddy Creek Tract/Lease of which the Greens Hollow Lease was once a part.

4.1.1 Environmental Description
A statement of the conditions and capabilities of the land to be affected by coal mining and reclamation operations follows in this section.

4.1.1.1 Premining Land Use
The surface lands within the lease and permit areas (except for 640 acres privately owned) are owned by the U.S. Government and are either parts of the Fishlake National Forest, the Manti-La Sal National Forest or lands administered by the Bureau of Land Management. These lands have been inventoried by the respective regulatory agencies who are responsible for the administration and use of these government lands. Federal comprehensive land use plans have been prepared by the U.S. Forest Service Offices.

Land Use Map. Plates 4-1 and 4-1C presents these Federal comprehensive land use plans information in the lease and permit areas.
Land Capability. The SUFCO Mine area's recreational use (excluding hunting) is approximately 427 days annually. Most of this use is dispersed among horseback riding, snowmobiling, hiking, camping, four wheeling and fuel wood gathering (Billy Dye, Ferron Ranger District; Bob Tuttle, Fishlake National Forest).

The major plant communities in the SUFCO Mine area are identified in Section 3.2.1.1.

The pinyon/juniper woodland occurs on steep unstable slopes and is considered unsuitable for grazing although it is grazed within the allotment. The vegetation condition within the pinyon/juniper woodland type was considered good. Forage production (mainly Indian rice-grass and bluebunch wheatgrass) is low. Arnold et al. (1964), Jameson and Dodd (1964), and Jameson (1971) found that as tree canopy increased, understory vegetation decreased. Phillips (1965) found that mature stands with a 74 per unit crown canopy produced 96 pounds of forage per acre while stands with 1-2 percent cover produced from 418-577 pounds per acre. Lewis et al. (1965-1967) found production values between 40 and 460 pounds per acre in stands sampled. Areas where trees had been removed produced as much as 900 pounds per acre. Canopy cover of pinyon and juniper in the SUFCO Mine Quitchupah lease area fairly dense and forage production in the type would generally be less than 100 lbs./acre in an average year. Assuming 50 percent utilization and 25 lbs./animal/day, it would take 15 acres to carry an animal for a month (WESTECH, 1978).

A large part of the flatter upland area is dominated by sagebrush/grassland. The U.S. Forest Service (unpublished, 1971) has mapped this area as suitable rangeland with vegetation condition. The sagebrush/grassland type within the SUFCO Mine Quitchupah lease area is the most desirable type for grazing, producing the most available forage per acre for livestock. It generally has lower vegetation condition than other types indicating it receives heavier grazing pressure. Three transects established in 1971 by the U.S. Forest Service on the SUFCO Mine Quitchupah lease area averaged 1100 lbs/acre (dry weight). Of this, about 940 lbs/acre was perennial grasses and sedges. The transects established, however, are in areas where shrub coverage is low and forage production would probably be lower for most of the sagebrush/grassland type where shrub coverage is higher. For this type, it would take 2-3 acres to carry an animal for a month. The U.S.
Forest Service estimates a carrying capacity of 0.5 animal units per month (AUM) per acre (B. Bass personal correspondence, 1979).

The aspen type is an important producer of forage for big game and domestic stock. A high percentage of the production is forbs which makes this type more desirable to big game and sheep. Mature aspen with a herbaceous understory in good to excellent condition will produce from 1,000 to 1,800 lbs/acre air dry forage (Lewis, 1971). The U.S. Forest Service estimates that in this area, aspen type produces 1,000 to 1,500 lbs/acre with 0.6 to 0.65 AUM/acre (M. Stubbs personal correspondence, 1979). Most of the aspen stands in the SUFCO Mine Quitchupah lease area serial with vegetation condition (U.S. Forest Service, unpublished, 1971).

The ponderosa pine, mountain shrub and coniferous forest types are generally lower forage producers although the extent of these types on the study area makes them an important component of the grazing system. Portions of these types, especially along the steep canyon walls, have been rated unsuitable for grazing and receive little grazing pressure due to limited accessibility to livestock. Areas of these types on more gentle slopes receive heavier grazing as indicated by lower vegetation condition. These areas provide some forage for livestock and are valuable forage producers for big game. Julander (1955) estimated forage production for mountain brush and oak types. He found that the mountain brush type produced 723 lbs/acre (green weight) of which 11 lbs/acre were grasses. He found that grasses are preferred forage for cattle and are selected as their key forage species. Where grasses were unavailable, however, cattle used forb and shrub species resulting in competition with big game species.

Valley bottoms receive little grazing pressure except in the vicinity of water sources where pressure is locally heavy. Valley bottoms are generally narrow and represent limited available forage. Steep slopes receive limited grazing pressure from livestock because of the steep inclines and lack of water. Flatter mesa tops and rolling terrain receive heavier pressure because of easier movement by livestock and more available forage. Grazing pressure is heaviest around water sources in these more accessible areas.
Very little of the SUFCO Mine area is in vegetation communities capable of producing timber products. The pinyon/juniper woodland community generally occurs on steep, unstable slopes making it undesirable for accessibility.

The coniferous forest type also occurs on steep slopes and generally in small stands. Economics of harvesting these stands would result in a high cost/benefit ratio. Other than very limited consumption for posts and poles, this type receives no use in the area as a timber producer. Christmas tree cutting, however, is higher in this community type than others in the area.

The ponderosa pine type is the only vegetation community receiving substantial use for timber production. This type generally occurs on flatter sandy sites and is readily accessible. Large, mature (250 + years) trees have been harvested on a selective basis. Pine regeneration in cut over stands is sparse and mountain mahogany and manzanita appear to be increasing in the understory. Within the SUFCO Mine Quitchupah lease area approximately 528 thousand board feet (MBF) have been harvested between 1977 and 1978 with average volumes of 1.3 average net volume/acre (M. Stubbs personal correspondence, 1979). Quaking aspen stands receive limited local pressure for posts and poles.

The vegetation communities supported in the Pines Tract area and SITLA Muddy Tract area are discussed in Chapter 3 of this M&RP.

**Land Use Description.** The leased areas lie within the Manti-La Sal and Fishlake National Forests and are subject to the Land and Resource Management plans prepared by the agency. These plans identify the principle use of the lease areas as rangeland with small areas set aside for timber harvesting and as general big game range. Recreation in the lease areas includes camping, firewood gathering, hunting, some snowmobiling, and sight seeing from late spring to late fall. Yearly recreation use is light, but during deer and elk hunts, use is extremely heavy.

There are no developed or inventoried recreation campgrounds on the lease areas. The mining operation will not impact any of these uses and will preserve the uses into the postmining period.
The timber on the lease areas are open grown Ponderosa pine. All commercial stands occur on the benches. Trees are of low quality because of the poor tree growing site. Cutting is limited to older over-matured trees and occurs infrequently. No adverse timber impacts are anticipated.

The aesthetic value of the area has been categorized by the U.S. Forest Service as follows: "The mesa rim and deep canyons can be seen as background from Emery (Dog Valley). They are classified as distinctive with variety. Activity from the proposal will not be visually evident from the valley. The lease area is seen as middle ground from a few remote spots on the Duncan Mountain Road. This scene area is presently classified in Sensitivity Level 2 (Average Sensitivity). The visual objective as recommended by the Land Use Plan is 2 (Modification). This permits activities to visually dominate the characteristic landscape. Very few people visit the area and those that do, come for something other than scenic attractions."

With the inclusion of the Pines Tract into the SUFCO lease and permit areas "changes in the existing landscape could include escarpment failures. This is not expected to change the visual character of the region."

A portion of the surface area is grazed by cattle under the Quitchupah Grazing Association allotment (Fishlake National Forest). The allotment covers approximately 43,156 acres, it presently supports 813 head of cattle from June 11 through September 30, for a total of 2,981 cow months (Bob Tuttle, Fishlake National Forest).

The Emery allotment (Manti-La Sal Forest) supports 1,300 head of cattle. This allotment is under an intensive rest-rotation management system, placing the cattle in the mine area for approximately one month a year. Several ranches in Emery County are dependent on the allotment. Structural range improvements include one watering trough (spring fed) and two cattle guards on the access route into the lease.

The number of hunters in the Salina Planning Unit increased 122 percent from 1969 to 1972 (U.S. Forest Service, 1976). In Deer Unit #43/45 (Salina) 9,383 hunters were recorded afield during the 1990 hunting season. The Fishlake Elk Herd Unit #14 hosted 4,027 hunters during the 1990
season. Additional hunter use information reported by the Utah Division of Wildlife Resources can be found in the Utah Big Game Annual Report for 1991 (Appendix 4-1).

**Pines Tract Area**

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

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

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

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

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

The existing land uses in the SITLA Muddy Tract area include: timber production, livestock grazing, wildlife habitat, recreation, transportation corridors and underground coal mining (SUFCO Mine). The roads/transportation corridors are generally single-lane native surface forest development and maintenance roads which are passable during the drier months of the year. The roads are classified by the Forest as Level 2 roads and generally no restrictions are placed on these roads for public use. The Forest does recommend the use of high clearance vehicles for most of the roads in the SITLA Muddy Tract area and to avoid use when the road surfaces are wet. However, if the permittee is using the roads for other than periodic monitoring, special use permits must be obtained from the Forest. Many of the forest development roads connect with local roads that access major highways.

In the late 1970s two Roadless Area Review and Evaluation (RARE) II areas within the SITLA Muddy Tract region were inventoried. Neither area was designated as wilderness, nor were they classified as roadless or semi-primitive recreation management areas under the 1986 Forest Plan Revision (Pines Tract Project EIS, 1999). Recent re-inventories (July 2004) of Roadless Areas by the Manti LaSal National Forest as part of their Forest Plan Revision to be completed by the end of 2006 have included nearly all of the SITLA Muddy Tract as potentially “roadless”. This designation excludes the existing Forest Development Roads 044, 2033, and 010 that lie within the eastern and northern portions of the SITLA Muddy Tract. Only a small segment of land west and north of the Main Fork of Box Canyon and western SITLA Muddy Tract boundary, east of Forest Road 044, and south of the southern boundary of sections 2, 3, and 4 of T 21 S., R 5 E., SLM is identified as not being included in the proposed roadless area. Currently, the Forest typically administers most of the areas identified as having “roadless” characteristics as though the areas were officially accepted as roadless. This action is being taken to preserve, where possible, unroaded characteristics of portions of the Forest.

The SITLA Muddy Tract area is part of the Emery C&H grazing allotment. The SITLA Muddy Tract unit supports 1,387 head of cattle during the early grazing season. Three ponds for livestock and wildlife use have been developed in the SITLA Muddy Tract area. The limited amount of perennial
water within the analysis area reduces the potential for many species of fish to be present. However, Muddy Creek and the lower portion of Box Canyon Creek support fish populations.

There are no oil or gas leases associated with the SITLA Muddy Tract area.

3 Right 4 East Panel(s)

In the area of the Quitchupah lease two major cultural resource surveys were competed, one in 1977 (AERC) and one in 1983 by Centuries Research, Incorporated. The nature of the cultural resources found indicates that the area was used very lightly in prehistoric times, and mostly for flaking and hunting.

In 1992 a cultural survey (UT-92-AF-381) was performed by AERC on the north canyon rim above North Fork Quitchupah Creek. Three sites were identified, one in each of two adjoining sections and one straddling the section line of the two. According to SHPO and National Register of Historic Place, these sites have not been listed with the National Register (Beth Karpinski, Archeologist, Tetra Tech, December 15, 2016). The sites are north of the 3R4E panel(s), but lie over existing mains.

Cultural and paleontological resources above the 3 Right 4 East panel and within the potential subsidence angle-of-draw will be surveyed and the reported findings will be submitted to the Manti-La Sal Forest Archeologist for processing for clearance. A copy in the reports are located in confidential Appendix 4-2. Due to heavier snows in 2016/2017 the survey will be delayed until the area can be accessed. Longwall mining of this panel will not be started until the archeological clearances have been obtained.

During the 2017 Class III cultural survey two of the previously recorded sites were re-inventoried, one was determined to be eligible (42SV2310), the other was not eligible (42SV2309). Improved GPS equipment has placed the eligible site over the mine entries with the potential for 8" of subsidence. "The site does not have any architectural or unique features...The site is stable with no significant impact or threats currently facing it.....The observed surface scatter is the result of...eroding...anchored lee side dune." The recommendation as eligible is due to the "potential for
intact buried cultural deposits” (Tetra Tech, June 23, 2017, Appendix 4-2). Two additional sites were found and two IOs were located, none of these sites were determined to be eligible during this survey.

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).

Land uses include mining, firewood collection, livestock grazing, wildlife habitat, watershed, exploration and recreation. These uses existed in the early 1900’s and would be expected to continue without disruption by continued mining in the lease tract.

**Greens Hollow Tract**

The area is not proximate to local communities and the access to the area is time consuming. Overall recreational use is light compared to other areas of the Forest, there are no small reservoirs or collector roads. Seasonal use begins in May and end following hunting season in October. Approximately 24 miles of forest road are used by OHV’s 4WD’s and conventional vehicles.

Noise levels vary in the tract area from, recreational vehicles, wood cutting and the mines exhaust fan. A noise study was conducted, sound levels ranged from 32.8 dBA to 70.3 dBA. Higher sound level measurement taken at various monitoring locations could be a result of wind gusts. Appendix 3-15 contains a copy of Sound Study Report prepared by Tetra Tech.

The majority of the tract falls with the Emery Cattle and Horse Grazing Allotment (9,107 acres) on the Manti-La Sal National Forest. A small parcel on the north is on the Ferron Cattle and Horse Grazing Allotment (203 acres) also on the Manti-La Sal Forest. On the southern end of are tract on the Fishlake National Forest lies the Quitchupah Cattle and Horse Grazing Allotment (1,714 acres). The limiting factor for the allotments is stock water, spring-fed troughs provide the most reliable sources of stock water, with developed stock ponds and natural pond providing a less reliable source. Refer to Appendix 4-6 for figure showing range allotments.
Documented land uses for the Greens Hollow Tract include:
Livestock grazing, spring development and other water improvements (guzzler, etc), habitat improvement, prescribed burns, sage grouse brood rearing habitat, forest service road development, mining, recreation timber operations and private land access, dispersed camping and hunting, exploration drilling, and geophysical surveys. Underground room and pillar mining at the Ricci Mine was done in the area on the north slope of Muddy Creek.

The tract contains two Inventoried Roadless Areas (IRAs), the Muddy Creek-Nelson Mountain IRA is on the Manti and the White Mountain IRA on both the Fishlake and Manti. Five percent of the Muddy Creek IRA is in the tract and 10% of the White Mountain IRA is within the tract. The Wildcat Knoll IRA (0.6%) is within the extended analysis area. Activities on the IRAs are subject to restrictions specified in the USFS 2001 Roadless Rule.

The Paiute Indian Tribe, Navajo Nation and Ute Indian Tribe were consulted; no sacred sites were identified in the course of the tribal consultation (FESEIS).

**Cultural and Historic Resources Information.** Cultural resource information and maps identifying cultural and historical study areas are located in Appendix 4-2. An intensive cultural resource evaluation of five coal exploration well locations has been conducted on the Quitchupah Lease by Dr. Richard Hauck of AERC (see Appendix 4-2). As part of this evaluation he also made a record search at the State Historic Preservation office and the National Register of Historic Places. No sites were found that would be affected by the drilling activity. A ten percent cultural resource potential survey was completed by Les Sikle, Forest Archaeologist, Manti-La Sal National Forest. A copy of his report is included in Appendix 4-2 along with the Utah State Historical Society's concurrence letter.

An intensive cultural resource evaluation of a proposed breakout, substation and power line in the Link Canyon Locality conducted by Dr. Richard Hauck of AERC is included in Appendix 4-2. No cultural or paleontological resources were observed within the proposed Link Canyon development area during the archaeological survey.
A cultural resource evaluation of the Link Canyon Mine portals area in Link Canyon was conducted by John Senulis of Senco-Phoenix. A copy of his report is included in Appendix 4-2. The conclusion of his evaluation of the portal site was that no cultural or paleontological resources are present. Many of his conclusions were based on work previously performed in the immediate portal area and surrounding areas by Dames and Moore, AERC, JBR, and the BLM.

There are no cemeteries, public parks, historic places, or areas within the boundaries of any units of the National System of Trails or the Wild and Scenic Rivers System located in areas to be affected by the SUFCO Mine (See Appendix 4-6 for a description). The Applicant agrees, however, to notify the regulatory authority and the Utah State Historical Society of previously unidentified cultural resources discovered in the course of mining operations. The Applicant also agrees to have any such cultural resources evaluated in terms of National Register of Historic Places eligibility criteria. Protection of eligible cultural resources will be in accordance with regulatory authority and Utah SHPO requirements. The Applicant will also instruct its employees that it is a violation of federal and state laws to collect individual artifacts or to otherwise disturb cultural resources.

150 Acre Incidental Boundary Change

Cultural and Historic Information. Cultural resource information and maps identifying cultural and historical study areas are located in Appendix 4-2. Dr. Richard Hauck of AERC conducted an intensive evaluation of the 150 acre IBC. Four new sites were discovered and recorded during the evaluation. All the sites are located on or near the east rim of Box Canyon. The sites include two significant rock shelters (42SV 2492 and 42SV 2495), a significant ceramic scatter (42SV 2493), and a non-significant kill-butchering locus (42SV 2494).

Site 42 SV 2492 - The site consists of a rock shelter. This site is considered to be a significant resource and excellent potential for National Register classification. The site is 15 meter wide with a sandstone arched roof and is susceptible to surface subsidence.

Site 42 SV 2493 - The site consists of ceramic scatter occupying an area of 20 to 30 meters on the bedrock top at the canyon rim. This site is considered to be a significant resource.
and has the potential for National Register classification. This site is not considered to be at-risk or susceptible to surface subsidence.

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

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

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

Pines Tract Area

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

Information concerning the potential of specific sites as to being either in the subsidence zone or out of the zone or being evaluated or unevaluated is contained in the Memorandum of Agreement between Federal and State agencies.
The monitoring, treatment plans and mitigation of the cultural resource sites will be in accordance with the Memorandum of Agreement (MOA) 00-MU-11041000-017, and any amendment to it, between the USFS - Manti-La Sal, USHPO, the Advisory Council on Historic Places, UDOGM, and the SUFCO Mine located in Appendix 4-5.

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

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

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

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

**Muddy Creek Coal Tract Area**

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

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

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

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

<table>
<thead>
<tr>
<th>Site #</th>
<th>Site Type</th>
<th>Evaluation (Cirrus Ecological Solutions, LC)</th>
<th>Undermined/potential for impact by mining</th>
<th>Date Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>42SV2584*</td>
<td>LS, RS,C</td>
<td>Significant</td>
<td>No/Not expected</td>
<td>1966(PI 1976)</td>
</tr>
<tr>
<td>42SV2596</td>
<td>LS, RS</td>
<td>Non-significant</td>
<td>No/Not expected</td>
<td>1966(PI 1976)</td>
</tr>
<tr>
<td>42SV2597</td>
<td>LS</td>
<td>Non-significant</td>
<td>No/Not expected</td>
<td>1966</td>
</tr>
<tr>
<td>42SV2554</td>
<td>LS</td>
<td>Significant</td>
<td>No/Not expected</td>
<td>1966</td>
</tr>
<tr>
<td>42SV2492</td>
<td>LS</td>
<td>Non-significant</td>
<td>No/Not expected</td>
<td>1966</td>
</tr>
</tbody>
</table>

LS - Lithic Scatter  RS- Rock Shelter  C-Ceramics

* Re-recorded on IMACS form, lumped ML#s 2281 and 2282 with this.

Site 42SV2584 and 42SV2596 lie within the boundary of the SITLA lease expansion (Section 32, T 20 S, R 5 E). According to a report prepared for the Manti-La Sal Forest by Cirrus Ecological Solutions, LC, site 42SV2584 is considered significant, while 42SV2596 is considered non-significant. In the current Sufco five year mine plan no mining is planned beneath either location and they do not lie within the angle-of-draw (Plate 5-10A), therefore no impact is anticipated to
either site. Should the mine plan change where the eligible site could be impacted, the permittee will coordinate with DOGM and the USFS prior to mining.

Sites 42SV2584 and 42SV2596 were reevaluated by USFS archeologist in 2015. On 11/20/15, SHPO concurred with the USFS recommendation that site 42SV2584 be determined eligible and 42SV2596 be determined not eligible. A copy of the SHPO concurrence letter is located in Appendix 4-2 (Confidential) of the M&RP.

**West Coal Lease Modification Areas**

**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. EarthTouch, Inc. conducted an intensive evaluation of the West Coal Lease Modification Areas.

The results of the cultural resource inventory for the project resulted in the identification of 15 cultural resource sites, which included three previously recorded sites (42SV1301, 42SV1386 and 42SV2688), and 12 new sites (42SV3207-3215 and 42SV3246-3248). Overall, the identified cultural resource sites consist of small- to moderate-sized lithic scatters and small rock shelters/overhangs, some with associated pictographs. Of the 15 sites identified within the West Coal Lease Modification Areas, six sites are recommended eligible for the National Register of Historic Places. These sites include 42SV3209, 42SV3211, 42SV3212, 42SV3213, 42SV3247 and 42SV3248 which consist of small rock shelters and rock shelters with pictographs. Site 42SV3209 will be the only site undermined under the present mine plan. This shelter is more of a terrace overhang that extends 6 meters long, with a 1.5 meter overhang or width.

**2RWL Sinkhole -** In 2016 an additional cultural resource review/inventory was performed by Tetra Tech a consulting firm, for the area of the sinkhole. The inventory included information from the EarthTouch report previously mentioned and from other previously prepared reports. A copy of the inventory results have been included in Appendix 4-2. Within the inventory area, no cultural resources had been recorded. Thus, no impacted were anticipated during the repair of the sinkhole. Clearance for the repair of the sinkhole was give by SHPO from documentation prepared by Tetra Tech and Jessica Montcalm of the Division of Oil, Gas and Mining. The area of the sinkhole is part of the West Lease Modification Area previously permitted in 2011. An E&ME prepared for the West Lease Modification is located in Appendix 3-13.
hole is part of the West Lease Modification Area previously permitted in 2011. An EA prepared for the West Lease Modification is located in Appendix 3-13.

3 Right 4 East - Quitchupah Tract
In 1989 more than 960 acres of the tract had been surveyed for cultural resources. The survey indicated that the area was used lightly in prehistoric times (Environmental Assessment, Coal Lease U63214, October 1988). The U.S. Forest Service and State Historic Preservation Officer determined that mining induced subsidence will have minimal impact on cultural resources (UDOGM Environmental Assessment, October 27, 1989).

4 Right 4 East - Quitchupah Tract
In the area of the Quitchupah lease two major cultural resource surveys were completed, one in 1977 (AERC) and one in 1983 by Centuries Research, Incorporated. The nature of the cultural resources found indicates that the area was used very lightly in prehistoric times, and mostly for flaking and hunting (Environmental Assessment, Coal Lease U-63214, October 1988). The U.S. Forest Service and State Historic Preservation Officer determined that mining induced subsidence will have minimal impact on cultural resources (UDOGM Environmental Assessment, October 27, 1989).

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 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.

The results of the cultural resource inventory for the project resulted in the identification of 4 cultural resource sites, which included one previously recorded site (42SV2690), and 3 new sites (42SV3462, 42SV3463 and 42S3464). Overall, the identified cultural resource sites consist of lithic scatters and a small rock shelter/overhang. Of the 4 sites identified within the South Fork of Quitchupah Area, two sites are recommended eligible for the National Register of Historic Places.

These sites include 42SV2690 which consists of a lithic scatter and 42SV3464 which consists of a lithic scatter associated with a small rock shelter. Both sites will be undermined under the present mine plan. This shelter is more of a terrace overhang that measures approximately 1.5 meters high and 4 meters wide at the opening and extends 1.5 meters beneath the rock to a tapered edge. The shelter shows signs of modern disturbance and it appears that some of the fill material has been disturbed by minor looting activities.

A cultural resource investigation plan for the 42SV3464 rock shelter was requested and approved between the U.S. Forest Service, Utah State Historic Preservation Office (SHPO), EnviroWest, LLC and Canyon Fuel Company, LLC since the shelter appeared to have been disturbed. Testing of the rock shelter for significance was conducted by EnviroWest and Fishlake National Forest Archaeologist in the fall of 2012. While the site was initially evaluated as being eligible for listing
in the National Register of Historic Places, subsequent testing has found it to be ineligible for listing due to disturbance. A copy of the cultural resource investigation testing report and the Determination of Significance and Effect form are located in Appendix 4-2 in the Confidential folder of the M&RP. No further testing of the 42SV2690 lithic scatter was required.

South Fork of Quitchupah Canyon - 2013 Inventory (October 2014)
During July and August 2013 a file search of archeological/cultural resource records and a pedestrian inventory of the study area was performed by EnviroWest LLC. The report is located in Appendix 4-2, Confidential Folder (2013). During the pedestrian inventory five new cultural resource sites were documented, three consisted of lithic scatters located on the bench area and two rock shelters in the canyon. The lithic scatters were recommended by EnviroWest LLC as ineligible for listing in the National Register of Historic Places (NRHP), whereas the two rock shelters were recommended to be eligible for listing in the NRHP. Upon consideration of the EnviroWest LLC report recommendations and a mine plan prepared by Sufco showing several panels to be mined to the north of 3R2S panel a “Determination of Significance and Effect” was prepared by Forest Service Archeologist Charmaine Thompson and signed by SHPO representative in 2013 showing a finding of “adverse effect”, Appendix 4-2, Confidential (2013).

Due to a change in Sufco’s mine plan and further evaluations by an engineer and geologist it was determined the potential for impact to either shelter by subsidence associated with mining was unlikely. A drawing included in Appendix 4-2, Tension Cracks(2 South) illustrates the location of the shelters in proximity to the 3R2S panel and showed surveyed surface cracks as a result of mining in the 2R2S panel. Evaluation of the cracks from past mining(2R2S, Pines) illustrates that surface cracking associated with subsidence primarily occurs within the mined panel area and well within the anticipated angle of draw of subsidence. Therefore, it is believed that the information and maps provided in Appendix 4-2 demonstrate that the two shelters 42SV3550 and 42SV3551 should not be affected by the mining.

The additional information was provided to Manti-La Sal Forest Service Archeologist Charmaine Thompson. During a second review of the information pertaining to mining activities in relation to the two shelters (Forest Service Project - ML-13-1452, Appendix 4-2) and a visit to the study area,
Ms. Thompson revised her earlier determination to be “no adverse effect” to the shelters listed in the report. Ms. Thompson’s evaluation letter and determination were forwarded to the Utah State Historical Society, with a request for concurrence with the decision of “no adverse effect”, concurrence was given by Chris Merritt, Senior Preservation Specialist. The documentation of the decision and concurrence is located in Confidential Appendix 4-2.

**Greens Hollow Tract**
The first archaeological survey of the tract area occurred in 2008, and additional survey was conducted in 2009. Twenty-nine heritage resource inventories (including the two previously mentioned) were completed within one mile of the Greens Hollow tract analysis area between 1977 and 2009. Twenty-seven were in association with mining. Over 1,820 acres have been surveyed within the maximum area of potential subsidence. The surveys are highly variable with significantly less surveys being performed in the steeper or more rugged terrain.

To protect the archeological sites, the canyons within the study area were excluded from mining, which reduced the archaeological sites to five with only one of the five being recommended as eligible for inclusion in the NRHP. Refer to Appendix 4-2 and Confidential Plate 5-10C for information associated with the sites.

Paleontological resources are expected to exist in the formations within the Green Hollow tract, however no surveys have been conducted. The resources are likely to be of the unprotected variety according to the “Heritage Resource” report in Appendix 4-2.

The Greens Hollow Tract Lease area was originally part of the Muddy Creek Tract (not the same as the SITLA Muddy Tract), reports and documents referring to the Muddy Creek Tract in this chapter text and appendices are applicable to the Greens Hollow Tract. The connection of the two tracts is presented in the Final Supplemental environmental Impact Statement for the Greens Hollow Federal Coal Lease Tract Section 1.2.6.

Site specific archeological/paleontological resources studies will be performed on the Greens Hollow Lease area as required for surface disturbance associated with mining. The location of
inventoried cultural sites are shown on drawings within their respective reports contained in Appendix 4-2 and Plate 5-10C. Memorandum of Agreement (MOA) between Manti-La Sal Forest and Utah State Historic Preservation Officer, Attachment D, Page 7 states “The is one identified National Register eligible site within the area of subsidence mining that might be adversely affected by subsidence mining. 42SV3224 is on the very edge of this area which make it unlikely that mining would occur under it. However, it is in an area with little overburden, which make it more likely that if subsidence mining does occur, surface cracking of the kind that could affect the site is more likely to occur. .......... In general, surface cracks that do not bisect features or buried deposits will be considered to have no adverse effect on that site. The results of subsidence that will be considered to produce an adverse effect to a given site are cracks through features or buried deposits or cracks near features that cause potential new channels for water that would, in turn, bisect or otherwise damage features or buried deposits.” Since there are several different reports for the Greens Hollow area a table has been prepared listing the cultural resource sites existing within the lease area and within the estimated subsidence angle of draw. Surface construction of a power line and shafts were evaluated in the MOA, EIS and other reports, the reports designated mitigation requirements, however the permittee does not currently plan construction, road modification or surface disturbance, therefore mitigation obligations are not required currently.

<table>
<thead>
<tr>
<th>Site /SHPO #</th>
<th>Brief Description</th>
<th>Mitigation/Monitoring /Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>42sp504</td>
<td>Scatter</td>
<td>Outside, NA</td>
</tr>
<tr>
<td>42sv1484</td>
<td>Scatter and trash</td>
<td>Outside, NA</td>
</tr>
<tr>
<td>42sv2589</td>
<td>Scatter w shelter</td>
<td>Non Subsidence Zone, Outside</td>
</tr>
<tr>
<td>42sv2586</td>
<td>Scatter w camp</td>
<td>Non Subsidence Zone, Outside, NA</td>
</tr>
<tr>
<td>42sv2584</td>
<td>Scatter w shelter; ceramics</td>
<td>Non Subsidence Zone, Outside</td>
</tr>
<tr>
<td>42sv2949</td>
<td>Scatter and tools</td>
<td>Non Subsidence Zone, Outside, NA</td>
</tr>
<tr>
<td>42sv3224 **</td>
<td>Scatter, hearth and tools</td>
<td>Non Subsidence Zone, Outside, NA</td>
</tr>
<tr>
<td>42sv3226</td>
<td>Scatter</td>
<td>Non Subsidence Zone, Outside, NA</td>
</tr>
<tr>
<td>42sv1578/2341</td>
<td>Multicomponent</td>
<td>Outside, NA</td>
</tr>
</tbody>
</table>

Notes:

NA - Not Applicable/required
Outside - outside area of influence by subsidence, no surface disturbance/construction
Non Subsidence Zone - If any mining, first mining only, no long wall mining
** - Recommended for inclusion in the National Register of Historic Places, however to date not included
An extended version of this table containing non-eligible NRHP sites is provided in Appendix 4-2 along with the Cultural Resource Sites Greens Hollow EIS drawing showing the location of both eligible and non-eligible sites and the long-wall mine plan.

Memorandum of Agreement (MOA) between Manti-La Sal Forest and Utah State Historic Preservation Officer, Attachment D, Page 7 states “The is one identified National Register eligible site within the area of subsidence mining that might be adversely affected by subsidence mining. 42SV3224 is on the very edge of this area which make it unlikely that mining would occur under it. However, it is in an area with little overburden, which make it more likely that if subsidence mining does occur, surface cracking of the kind that could affect the site is more likely to occur. In general, surface cracks that do not bisect features or buried deposits will be considered to have no adverse effect on that site. The results of subsidence that will be considered to produce an adverse effect to a given site are cracks through features or buried deposits or cracks near features that cause potential new channels for water that would, in turn, bisect or otherwise damage features or buried deposits.” Site 42SV3224 is not within the Greens Hollow Lease (UTU-84102), it is located within Lease U-63214.

The following steps/requirements apply only to sites 42SV3224, 42SV2584 and 42SV2589 listed in Appendix D, Step 1 of the MOA as quoted below and to no other archeological sites: “The following steps will be done to establish the presence or absence of potential effects to sites from subsidence mining. These are based on the nature of the known sites and on the types of subsidence effects that have been noted in nearby areas of existing subsidence mining (particularly in The Pines Tract). These will be done within the context of the same research design used to guide treatment of sites within the road right of way that has been reviewed by the Utah SHPO and interested Tribes.

1) Create detailed, base-line maps and photographic records of 42SV3224, 42SV2584 and 42SV2589 before subsidence mining begins. The goal of this documentation is to establish the presence of natural rills and other natural surface features that might be mistaken for surface cracks resulting from subsidence. These maps would include any features (such as hearths) that might be adversely affected by any cracking near or through those features and provide a more detailed record of the location and nature of surface artifacts than is o
the existing site forms.

2) Monitor each site once a year while mining is occurring under the area of those sites.

3) If surface cracking or buckling is found, each crack will be examined in relationship to the existing detailed site map. If surface artifacts are found to be missing or displaced, this will be noted in the monitoring notes. Loss or displacement of documented artifacts will be considered to be of no adverse effect to the site.

4) Each crack will be examined for the presence or absence of subsurface deposits, including the use of trowels or shovels to establish clean profiles. These exposed sediments will be documented for the presence or absence of buried artifacts, soil stains or features. If no such artifacts, deposits, or features are found, than the crack will be considered to be of no adverse effect to the site. Damage to such materials by surface cracking will be considered an adverse effect and the following steps will be implemented.

a) All buried artifacts, soil stains, or features found within subsidence cracks will be documented using sub-meter GPS units and standard archaeological documentation procedures.

b) Any decision to expand excavation of these features will be guided by the research design and may include 1 x 1 meter units that expose more or all of features such as hearths.

c) Once the goals of the research design are reached, excavations of material exposed in that particular subsidence crack will cease and the adverse effect of that crack will be considered to be mitigated. The results of the excavations will then be analyzed and reported to SHPO in a report that meets professional standards.

5) If cracking or buckling that resulted from subsidence mining is found at any of the rock shelters at sites 42SV2584 and 42SV2589, then this will be considered an adverse effect that requires additional consultation with the Utah SHPO and interested Tribes and amendment of this agreement as described in Stipulation VIII of the Memorandum of Agreement.

Greens Hollow Federal Coal Lease Tract (UTU-84102) MOA Stipulation VIII: “8) A monitoring plan will be developed that monitors potential project effects at sites within the project area and immediately adjacent to roads that area improved as a result of the project. This plan will meet four goals. The first is to have archaeologists on scene during initial layout of the south vent shaft construction footprint in order to ensure full avoidance of sites 42SV2949 and 42SV3224. The
second is to monitor the site within the area of subsidence mining that might be affected by surface cracking (42SV3224). The third goal is to monitor area sites for indications of illegal artifact collecting and looting. The fourth is to monitoring the two sites containing rock shelter sites with the area of no subsidence mining (42SV2584 and 42SV2589) in order to ensure that no effects from subsidence occur.”

The MOA for the Greens Hollow Lease lists three sites of concern 42SV3224, 42SV2484 and 42SV2589. Per the first step:

“1) Create detailed, base-line maps and photographic records of 42SV3224, 42SV2584 and 42SV2589 before subsidence mining begins.”

Site forms prepared for the sites and on files with the Manti-La Sal Forest constitute baseline maps and photos for these sites, the first step is considered complete as identified per a e-mail communications with Charmaine Thompson, Heritage Program Leader Manti La Sal Forest on March 1, 2018.

When the area below or immediately adjacent to the sites has been mined, the second step will be undertaken. Mining will occur beneath 42SV3224 but not under sites 42SV2584 and 42SV2589 since both are “within the area of no subsidence mining” in accordance with Lease UTU-84102. Step 2 if required will be postponed in the winter, until the snow is off the ground. Per the aforementioned e-mail communication with Charmaine Thompson, mine personnel will notify DOGM and USFS approximately six months from when mining immediately adjacent or beneath the three sites is completed.

The mining adjacent to sites 42SV2584 and 42SV2589 will occur sometime after the year 2025. The mining beneath 42SV3224 was completed in February 2018, a site visit will be arranged in 2018 in accordance with Step 2. Representatives from Suco mine, DOGM and the Forest Service heritage staff will survey the three sites for the effects of subsidence. Once it is established whether or not the sites have been affected by subsidence, either the monitoring will cease due to no effect or a contract archeologist will be enlisted by the mine to complete a research design, complete limited documentation/possible small scale excavation procedures and prepare a report of the results of those findings(Steps 3 - 4). Should there be effects of subsidence at sites 42SV2484 and 42SV2589, the mine with the assistance from the Forest Service archeologist will do additional consultation with SHPO, the Tribes and other affected parties as defined at the time.
of consultation to resolve the effects (Step 5). Once it has been determined that subsidence has ceased in the area immediately adjacent to sites 42SV2584 and 42SV2589 and at site 42SV3224 monitoring indicates "no effect" further monitoring will cease. The inventory forms for these sites are located in Appendix 4-2.

In accordance with previous commitments the mine has made in previous sections of this M&RP, protection of eligible cultural resources will be in accordance with regulatory authority and Utah SHPO requirements. The Applicant will also instruct its employees that it is a violation of federal and state laws to collect individual artifacts or to otherwise disturb cultural resources.

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

4.1.1.2 Previous Mining Activity
Portions of the mine plan area were mined prior to the filing of this permit application. SUFCO Mine began a small operation mining the Upper Hiawatha Coal seam in 1941. There was no previous mining activity prior to the 1941 SUFCO operation.

From 1941 through 1974, the coal was removed by conventional mining techniques. From 1974 through 1978, both conventional and continuous mining methods were used. From 1978 until October 1985, all mining used continuous mining methods. Since October 1985 both continuous mining and longwall mining methods have been used. The portion of the seam mined by conventional methods was only partially extracted leaving all pillars for support. The majority of the mining done has been full extraction. All longwall mining is full extraction.

The quantity of coal mined prior to this permit application was approximately 37,058,100 tons. The earlier workings are shown on Plate 5-1 as an integral part of the mining operation.

Use of the land preceding mining was primarily grazing. The area also supported limited timbering in the Ponderosa stands and hunting.
4.1.2 Reclamation Plan

4.1.2.1 Postmining Land Use Plan
All uses of the land immediately prior to mining and the capability of the land to support prior alternate uses will remain equally available throughout the life of the mine without impact from underground mining except on insignificant levels. The infinitesimal effect of underground mining on surface use is accounted for as follows:

1. Isolated facilities in use for duration of the mine, including portal and associated buildings, comprise only 48.432 of the 27,605.17 acres under consideration, which is too small to adversely affect general land use.

2. Gradual and even subsidence over most of the lease and permit areas is too imperceptible to affect general land use. The ultimate subsidence affect over the lease will be "uniform." As a qualification, there probably will be an uneven arching effect on the surface over the full-extraction mining areas during actual mining operations which will stabilize in uniform subsidence once the entire area has been mined. The total subsidence effect should be minor so as to not affect general land use.

The Applicant intends that the postmining land uses will be consistent with the land use plans prepared by the Forest Service. Final reclamation activities such as grading and seeding as detailed within this M&RP will be completed in a manner to provide uses of the lands consistent with those uses required by the U.S. Forest Service land use plans. Retention of pre-SMCRA highwalls is discussed in Section 5.5.3.6.

The SUFCO Mine lease areas are predominantly U.S. Forest Service land managed under the multiple use and sustained yield concepts. Present management emphasizes livestock grazing, wildlife, timber and watershed development.

The land use plans for the lease areas developed by the U.S. Forest Service includes eight different management prescriptions (U.S. Forest Service 1986):
Management prescription MMA. Emphasis is on leaseable minerals development. Land surface is to be made available for existing and potential major mineral developments. In units where mineral development is pending, renewable resource activities strive to be compatible with the management goals of adjacent management units. Long-term investments, such as timber planting, generally are not made. However, short-term investments, such as range and wildlife revegetation projects, may be made on these units. As the developments are removed and restoration is completed, these areas may be changed to other appropriate management units.

Management prescription TBR. Emphasis is on wood-fiber production and harvest. The harvest methods by Forest cover type are single tree and group selection and shelterwood in Englemann spruce-subalpine fir, Douglas-fir, ponderosa pine, mixed conifers, and clear cutting in aspen. Wildlife habitat diversity may be enhanced by vegetative manipulation. Livestock grazing may be permitted. Water yield could be altered through vegetation management, as well as decrease evapotranspiration and maximize snow retention in small openings on low energy slopes. Dispersed recreation opportunities vary between semi-primitive non-motorized and roaded natural appearing.

Management prescription RNG. Emphasis is on production of forage and cover for domestic livestock and wildlife. Intensive grazing management systems are generally favored. Nonstructural restoration practices include a full spectrum of treatments such as plowing, seeding, cutting, chaining, burning, spraying with herbicides, crushing, pitting, furrowing, and fertilization. Dispersed recreation opportunities vary between semi-primitive non-motorized and roaded natural appearing. Management activities are evident, but harmonize with the natural setting.

Management prescription GWR. Management emphasis is on providing general big-game winter range. These are areas wildlife traditionally use. Treatments of various types are applied to increase forage production and plant species composition. This may include chaining, cutting, prescribed burning, seeding,
spraying, planting, and other treatments. Selected browse species are regenerated to maintain a variety of age classes. Permanent roads and special uses may be permitted. Short-term or temporary roads are obliterated and rehabilitated within one year after intended use. Motorized use is managed as appropriate to prevent unacceptable stress on big-game animals during the primary use season.

e. Management prescription 4B. Management emphasis is on habitat for management indicator species. The goal is to optimize habitat capability, and thus numbers of the species. Investments in other compatible resource uses may occur but will be secondary to habitat requirements. Recreation and other human activities are regulated to favor the needs of the designated species. Roaded-natural recreation opportunities are provided along forest arterial and collector roads. Local roads and trails are either open or closed to public motorized travel. Management activities may dominate in foreground and middleground, but harmonize and blend with the natural setting.

f. Management prescription 6B. Management emphasis is on livestock grazing. Intensive range resource management is applied. Condition is improved through use of vegetation and soil restoration practices, improved livestock management, and regulation of other resource activities. Dispersed recreational opportunities vary between semi-primitive non-motorized and roaded natural. Management activities are evident but harmonize and blend with the natural setting.

g. Management prescription 9F. Management emphasis is on improving watershed condition. This will be achieved by protection, seeding, cultural treatment or any combination of other methods that will accomplish the objectives. Management activities in the foreground, middleground, and background may dominate, but should be designed to harmonize and blend with the natural setting to the extent possible. Motorized travel is prohibited except for over-snow machines and for designated routes.

h. Management prescription KWR. Management emphasis is on providing key big-game winter range. These areas are essential to wildlife. Motorized use is
managed as appropriate to prevent unacceptable stress on big-game animals during the primary use season.

4.1.2.2 Land Owner or Surface Manager Comments
Surface owner approval of the Applicant's proposed postmining land use will be confirmed by the approval of this Mining and Reclamation Plan by the respective Forest Service units for those federal lands that they administer. The private landowner comments concerning the postmining land use are contained in the UNELCO letter in Appendix 1-1.

4.1.2.3 Suitability and Capability
Final fills will not contain excess spoils.

4.1.3 Performance Standards
The performance standards for the areas to be reclaimed for postmining land use are contained in this section.

4.1.3.1 Postmining Land Use
The proposed postmining land uses will be identical to the premining land uses and the land will be capable of supporting such land uses.

4.1.3.2 Determining Premining Uses of Land
The Applicant plans for the same postmining land uses as existed before the operation began.

4.1.3.3 Criteria for Alternative Postmining Land Uses
No alternative postmining land uses have been planned.

4.1.4 Alternative Land Use
No alternative postmining land uses have been planned.

4.20 Air Quality
This section includes descriptions of plans to comply with the Clean Air Act and applicable Utah or federal statutes and regulations pertaining to air quality standards.
4.2.1 Air Quality Standards

SUFCO Mine's mining activities are being conducted in compliance with the requirements of the Clean Air Act and the Utah Air Quality Regulations.

4.2.2 Compliance Efforts

The state of air quality control of the SUFCO Mine is generally excellent except the control of fugitive dust in the product loadout area. Watering of this area is done in accordance with stipulations in the Air Quality Permit.

a. Access road - The access road is paved and free of mud and potholes. Access to the road is limited by the surrounding terrain which leaves it free of carried-on mud or dirt by vehicles. Emissions from the access road are minimal.

b. Service area - Fugitive Emissions. The service area is compact and efficient in size and layout. The area in front of the portal and office building as well as the area in front of the shop is paved. Traffic to and from the mine is limited by the small parking area available (approximately 25 car capacity). Personnel are transported to and from the work site by company bus and van pools. Dust emissions caused by personnel and mining support operations are minimal in spite of the partially unpaved parking area. The SUFCO Mine currently employs approximately 234 people. Based-on an average round trip of 62 miles per day, 3.0 million miles of personal car transportation is saved annually by the use of company transportation. This represents an extremely significant limitation of vehicular emissions.

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

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

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

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

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

**Greens Hollow.** The are no anticipated impacts to air quality associated with the addition of the Greens Hollow Lease or current plans to modify the existing Air Quality Approval Order. Sufco will continue to be considered a "Minor Source" by the Utah Department of Environmental Quality and the mining of the Greens Hollow Lease is not a significant acid rain source (FSEIS, 2015). The demand for coal from the Sufco mine is established, the addition of the coal in the Greens Hollow Lease extends the supply of coal for years. Coal production and therefore trucking is intended to remain within the limits of the existing Air Quality Approval Order (Review production quantities in Section 5.2.3). Should mining changes require a revision, the Air Quality Approval Order will be updated at that time.

**4.2.3 Monitoring Program**
The UDOGM does not require an air monitoring program for the SUFCO underground mine at this time. The mine currently operates under Division of Air Quality Approval Order DAQE-
REFERENCES:


# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.10 Introduction</td>
<td>5-1</td>
</tr>
<tr>
<td>5.1.1 General Requirements</td>
<td>5-1</td>
</tr>
<tr>
<td>5.1.2 Certification</td>
<td>5-1</td>
</tr>
<tr>
<td>5.1.2.1 Cross Sections and Maps</td>
<td>5-2</td>
</tr>
<tr>
<td>5.1.2.2 Plans and Engineering Designs</td>
<td>5-3</td>
</tr>
<tr>
<td>5.1.3 Compliance with MSHA Regulations and MSHA Approvals</td>
<td>5-4</td>
</tr>
<tr>
<td>5.1.3.1 Coal Processing Waste Dams and Embankments</td>
<td>5-4</td>
</tr>
<tr>
<td>5.1.3.2 Impoundments and Sedimentation Ponds</td>
<td>5-4</td>
</tr>
<tr>
<td>5.1.3.3 Underground Development Waste, Coal Processing Waste, and Excess Spoil</td>
<td>5-4</td>
</tr>
<tr>
<td>5.1.3.4 Refuse Piles</td>
<td>5-4</td>
</tr>
<tr>
<td>5.1.3.5 Underground Openings to the Surface</td>
<td>5-5</td>
</tr>
<tr>
<td>5.1.3.6 Discharge to Underground Mines</td>
<td>5-5</td>
</tr>
<tr>
<td>5.1.3.7 Surface Coal Mining and Reclamation Activities</td>
<td>5-5</td>
</tr>
<tr>
<td>5.1.3.8 Coal Mine Waste Fires</td>
<td>5-5</td>
</tr>
<tr>
<td>5.1.4 Inspections</td>
<td>5-5</td>
</tr>
<tr>
<td>5.1.4.1 Excess Spoil</td>
<td>5-5</td>
</tr>
<tr>
<td>5.1.4.2 Refuse Piles</td>
<td>5-5</td>
</tr>
<tr>
<td>5.1.4.3 Impoundments</td>
<td>5-6</td>
</tr>
<tr>
<td>5.1.5 Reporting and Emergency Procedures</td>
<td>5-7</td>
</tr>
<tr>
<td>5.1.5.1 Slides</td>
<td>5-7</td>
</tr>
<tr>
<td>5.1.5.2 Impoundment Hazards</td>
<td>5-7</td>
</tr>
<tr>
<td>5.1.5.3 Temporary Cessation of Operations</td>
<td>5-7</td>
</tr>
<tr>
<td>5.20 Operation Plan</td>
<td>5-8</td>
</tr>
<tr>
<td>5.2.1 General</td>
<td>5-8</td>
</tr>
<tr>
<td>5.2.1.1 Cross Sections and Maps</td>
<td>5-8</td>
</tr>
<tr>
<td>5.2.1.2 Signs and Markers</td>
<td>5-13</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS (Continued)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2.2 Coal Recovery</td>
<td>5-14</td>
</tr>
<tr>
<td>5.2.3 Mining Methods</td>
<td>5-18</td>
</tr>
<tr>
<td>5.2.4 Blasting and Explosives</td>
<td>5-20</td>
</tr>
<tr>
<td>5.2.5 Subsidence</td>
<td>5-21</td>
</tr>
<tr>
<td>5.2.5.1 Subsidence Control Plan</td>
<td>5-25</td>
</tr>
<tr>
<td>5.2.5.2 Subsidence Control</td>
<td>5-39F</td>
</tr>
<tr>
<td>5.2.5.3 Public Notice of Proposed Mining</td>
<td>5-42</td>
</tr>
<tr>
<td>5.2.6 Mine Facilities</td>
<td>5-42</td>
</tr>
<tr>
<td>5.2.6.1 Mine Structures and Facilities</td>
<td>5-43</td>
</tr>
<tr>
<td>5.2.6.2 Utility Installation and Support Facilities</td>
<td>5-43</td>
</tr>
<tr>
<td>5.2.7 Transportation Facilities</td>
<td>5-47</td>
</tr>
<tr>
<td>5.2.7.1 Road Classification</td>
<td>5-47</td>
</tr>
<tr>
<td>5.2.7.2 Description of Transportation Facilities</td>
<td>5-48</td>
</tr>
<tr>
<td>5.2.8 Handling and Disposal of Coal, Excess Spoil, and Coal Mine Waste</td>
<td>5-51</td>
</tr>
<tr>
<td>5.2.8.1 Coal Handling and Transportation</td>
<td>5-51</td>
</tr>
<tr>
<td>5.2.8.2 Overburden</td>
<td>5-51</td>
</tr>
<tr>
<td>5.2.8.3 Spoil, Coal Processing Waste, Non-Coal Waste, and Mine Waste</td>
<td>5-51</td>
</tr>
<tr>
<td>5.2.8.4 Dams, Embankments, and Impoundments</td>
<td>5-54</td>
</tr>
<tr>
<td>5.2.9 Management of Mine Openings</td>
<td>5-54</td>
</tr>
<tr>
<td>5.3.0 Operational Design Criteria and Plans</td>
<td>5-56</td>
</tr>
<tr>
<td>5.3.1 General</td>
<td>5-56</td>
</tr>
<tr>
<td>5.3.2 Sediment Control</td>
<td>5-56</td>
</tr>
<tr>
<td>5.3.3 Impoundments</td>
<td>5-56</td>
</tr>
<tr>
<td>5.3.3.1 Slope Stability</td>
<td>5-57</td>
</tr>
<tr>
<td>5.3.3.2 Foundation Considerations</td>
<td>5-57</td>
</tr>
<tr>
<td>5.3.3.3 Slope Protection</td>
<td>5-57</td>
</tr>
<tr>
<td>5.3.3.4 Embankment Faces</td>
<td>5-58</td>
</tr>
<tr>
<td>5.3.3.5 Highwalls</td>
<td>5-58</td>
</tr>
</tbody>
</table>
**TABLE OF CONTENTS (Continued)**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3.3.6 MSHA Criteria</td>
<td>5-58</td>
</tr>
<tr>
<td>5.3.3.7 Pond Operation and Maintenance Plans</td>
<td>5-58</td>
</tr>
<tr>
<td>5.3.4 Roads</td>
<td>5-59</td>
</tr>
<tr>
<td>5.3.4.1 Location, Design, Construction, Reconstruction, Use,</td>
<td></td>
</tr>
<tr>
<td>Maintenance, and Reclamation</td>
<td>5-59</td>
</tr>
<tr>
<td>5.3.4.2 Environmental Protection and Safety</td>
<td>5-60</td>
</tr>
<tr>
<td>5.3.4.3 Primary Roads</td>
<td>5-60</td>
</tr>
<tr>
<td>5.3.5 Spoil</td>
<td>5-61</td>
</tr>
<tr>
<td>5.3.6 Coal Mine Waste</td>
<td>5-61</td>
</tr>
<tr>
<td>5.3.6.1 Design</td>
<td>5-62</td>
</tr>
<tr>
<td>5.3.6.2 Waste Emplacement</td>
<td>5-62</td>
</tr>
<tr>
<td>5.3.6.3 Excess Spoil Fills</td>
<td>5-62</td>
</tr>
<tr>
<td>5.3.6.4 Impounding Structures Constructed of Coal Mine Waste</td>
<td>5-62</td>
</tr>
<tr>
<td>5.3.6.5 Disposal of Coal Mine Waste in Special Areas</td>
<td>5-62</td>
</tr>
<tr>
<td>5.3.6.6 Underground Development Waste</td>
<td>5-62</td>
</tr>
<tr>
<td>5.3.6.7 Coal Processing Waste</td>
<td>5-63</td>
</tr>
<tr>
<td>5.3.6.8 Coal Processing Waste Banks, Dams, and Embankments</td>
<td>5-63</td>
</tr>
<tr>
<td>5.3.6.9 Refuse Piles</td>
<td>5-63</td>
</tr>
<tr>
<td>5.3.7 Regraded Slopes</td>
<td>5-63</td>
</tr>
<tr>
<td>5.3.7.1 Division Approval</td>
<td>5-63</td>
</tr>
<tr>
<td>5.3.7.2 Regrading of Settled and Revegetated Fills</td>
<td>5-64</td>
</tr>
<tr>
<td>5.40 Reclamation Plan</td>
<td>5-65</td>
</tr>
<tr>
<td>5.4.1 General</td>
<td>5-65</td>
</tr>
<tr>
<td>5.4.1.1 Commitment</td>
<td>5-65</td>
</tr>
<tr>
<td>5.4.1.2 Surface Coal Mining and Reclamation Activities</td>
<td>5-65</td>
</tr>
<tr>
<td>5.4.1.3 Underground Coal Mining and Reclamation Activities</td>
<td>5-65</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS (Continued)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4.1.4 Environmental Protection Performance Standards</td>
<td>5-65</td>
</tr>
<tr>
<td>5.4.2 Narratives, Maps, and Plans</td>
<td>5-65</td>
</tr>
<tr>
<td>5.4.2.1 Reclamation Timetable</td>
<td>5-65</td>
</tr>
<tr>
<td>5.4.2.2 Plan for Backfilling, Soil Stabilization, Compacting, and Grading</td>
<td>5-65</td>
</tr>
<tr>
<td>5.4.2.3 Final Surface Configuration Maps and Cross Sections</td>
<td>5-74</td>
</tr>
<tr>
<td>5.4.2.4 Removal of Temporary Structures</td>
<td>5-75</td>
</tr>
<tr>
<td>5.4.2.5 Removal of Sedimentation Ponds</td>
<td>5-75</td>
</tr>
<tr>
<td>5.4.2.6 Roads</td>
<td>5-75</td>
</tr>
<tr>
<td>5.4.2.7 Final Abandonment of Mine Openings and Disposal Areas</td>
<td>5-76</td>
</tr>
<tr>
<td>5.4.2.8 Estimated Cost of Reclamation</td>
<td>5-77</td>
</tr>
<tr>
<td>5.50 Reclamation Design Criteria and Plans</td>
<td>5-78</td>
</tr>
<tr>
<td>5.5.1 Casing and Sealing of Underground Openings</td>
<td>5-78</td>
</tr>
<tr>
<td>5.5.2 Permanent Features</td>
<td>5-78</td>
</tr>
<tr>
<td>5.5.2.1 Small Depressions</td>
<td>5-78</td>
</tr>
<tr>
<td>5.5.2.2 Permanent Impoundments</td>
<td>5-78</td>
</tr>
<tr>
<td>5.5.3 Backfilling and Grading</td>
<td>5-78</td>
</tr>
<tr>
<td>5.5.3.1 Disturbed Area Backfilling and Grading</td>
<td>5-78</td>
</tr>
<tr>
<td>5.5.3.2 Spoil and Waste</td>
<td>5-79</td>
</tr>
<tr>
<td>5.5.3.3 Exposed Coal Seams, Acid- and Toxic-Forming Materials, and Combustible Materials</td>
<td>5-80</td>
</tr>
<tr>
<td>5.5.3.4 Cut-and-Fill Terraces</td>
<td>5-80</td>
</tr>
<tr>
<td>5.5.3.5 Highwalls From Previously Mined Areas</td>
<td>5-80</td>
</tr>
<tr>
<td>5.5.3.6 Approximate Original Contour</td>
<td>5-81</td>
</tr>
<tr>
<td>5.5.3.7 Backfilling and Grading - Thin Overburden</td>
<td>5-81</td>
</tr>
<tr>
<td>5.5.3.8 Backfilling and Grading - Thick Overburden</td>
<td>5-81</td>
</tr>
<tr>
<td>5.5.3.9 Regrading of Settled and Revegetated Fills</td>
<td>5-81</td>
</tr>
<tr>
<td>5.60 Performance Standards</td>
<td>5-82</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table                  Page
5-1  List of Major Equipment ................................................... 5-21
5-2  Subsidence Control Point Survey Data .................................... 5-31
5-3  Minimum Support Pillar Requirements .................................... 5-41
5-4  Description of Existing Structures ....................................... 5-44
5-5  Reclamation Channel Design Summary .................................... 5-73

LIST OF FIGURES

Figure                  Page
5-0A  14L4E Draw Angle Study .................................................. 5-24
5-0B  6 East Draw Angle Study ................................................... 5-25
5-0C  Tipple Building Modification - Location Exhibit ....................... Appendix 5-11
5-0D  Tipple Building Modification - Sump Details ......................... Appendix 5-11
5-0E  Proposed 300,000 Gallon Fire Water Tank Pad Detail ................ 5-15A
5-1  Coal Flow Diagram ........................................................... 5-52
5-2  Reclamation Timetable ....................................................... 5-66
5-3  Straw-Bale Dike & Silt Fence Installation Procedures ................ 5-70
LIST OF PLATES

Plate

5-1 Previously Mined Areas
5-2A Detail of East Spring Canyon Surface Facilities
5-2B Extended East Spring Canyon Surface Facilities
5-2C Detail of Portal Surface Facilities
5-2D Detail of Link Canyon Surface Facilities
5-2E Detail of Link Canyon Surface Facilities No. 2
5-2F Detail of Link Canyon Portal Facilities
5-3A Post-Reclamation Surface Configuration
5-3B Extended Post-Reclamation Surface Configuration
5-4 Post-Reclamation Cross Sections
5-5 Existing Surface and Subsurface Facilities and Features
5-6 Land Ownership and Permit Area Map
5-7 Upper Hiawatha Mine Plan - 5 Year Projection
5-8 Lower Hiawatha Mine Plan - 5 Year Projection
5-9 Transportation Facility Cross Sections
5-10 Potential Subsidence Limits Sufco Mine
5-10C Potential Subsidence Limits - SITLA Muddy Tract & Greens Hollow Tract (Confidential)
5-11 Overburden Isopach Map
LIST OF APPENDICES
(Appendices appear in Volume 6)

Appendix

5-1 Primary Road Certification
5-2 Approximate Original Contour Variance Request
5-3 Sevier County Landfill Disposal Agreement
5-4 USFS Report Regarding Subsidence Tension Cracks
5-5 Experimental Coal Mining Program Approval
5-6 Leach Field Permit
5-7 Slope Stability Analysis
5-8 Access Road Stability Evaluation - Dames & Moore, 1981
5-9 Reclamation Bond Estimate
5-10 West Lease Portals Construction and Bonding Details
5-11 Upper Mine Yard Details
5-12 Office Parking Lot Details
5-13 2RWL Sinkhole
5-14 4R4E Panel Location
CHAPTER 5
ENGINEERING

5.10 Introduction
This chapter provides a discussion of general engineering aspects, an operation plan, a reclamation plan, design criteria, and performance standards related to the SUFCO Mine. The existing and proposed coal mining and reclamation activities associated with the mine have been or will be designed, located, constructed, maintained, and reclaimed in accordance with the operation and reclamation plans.

Greens Hollow Lease
Much of the information presented for the permitting of the Greens Hollow Lease (GHL) was prepared with a conceptual mine plan assuming full extraction mining, associated subsidence and represents maximum impacts in the Bureau of Land Management’s Environmental Impact Statement (FSEIS). The information in the text represents the permittees accepted obligations and commitments, the information provided in appendices from the (FSEIS) unless reference specifically is provided as background or baseline for the obligations and commitments within the text. The Greens Hollow Tract Lease area was originally part of the Muddy Creek Tract, reports and documents referring to the Muddy Creek Tract in this chapter text and appendices are applicable to the Greens Hollow Tract. The Muddy Creek Tract should not be confused with the SITLA Muddy Tract.

5.1.1 General Requirements
This permit application includes descriptions of the proposed coal mining and reclamation operations together with the appropriate maps, plans, and cross sections. Methods and calculations utilized to achieve compliance with the design criteria are also presented.

5.1.2 Certification
Where required by the regulations, cross sections and maps in this permit application have been prepared by or under the direction of, and certified by, qualified registered professional engineers or land surveyors. As appropriate, these persons were assisted by experts in the fields of hydrology, geology, biology, etc.
5.1.2.1 Cross Sections and Maps

Previously Mined Areas. A certified map showing the location of previously mined areas is provided as Plate 5-1.

Surface Facilities. Certified maps and cross sections concerning the disposal of underground development waste are provided in this M&RP, Volume 3. A certified map showing the location of non-coal (non-waste rock) waste storage, coal storage and loading areas, explosive storage and handling facilities, and topsoil stockpiles is provided as Plate 5-2A. An additional topsoil stockpile associated with the waste-rock disposal area is located as provided in Volume 3 of this M&RP.

Locations of sedimentation ponds are noted on Plate 5-2A, 5-2B and in Volume 3 of this M&RP. No water treatment facilities exist at the site other than the sewage leach field, sediment basin, and sedimentation ponds.

The following facilities or activities do not exist or occur within the permit area:

- Coal preparation plant,
- Coal cleaning,
- Coal processing waste banks, dams, or embankments,
- Disposal of non-coal (non-waste rock) waste other than durable rock-type construction materials such as cinder block, and
- Air pollution control facilities.

Hence, certified maps or cross sections of these facilities are not provided in this plan. The durable rock-type construction materials are disposed of in the waste-rock disposal area together with the mine development waste.

Surface Configurations. Certified maps and cross sections showing the final (post-reclamation) surface configuration of the East Spring Canyon disturbed area are provided on Plates 5-3A&B and 5-4. Cut and fill volumes for final reclamation are contained in Appendix 2-5. Information regarding the final surface configuration of the waste-rock disposal areas is provided in Volume 3 of this M&RP.
Hydrology. Certified maps and cross sections associated with the hydrology of the SUFCO Mine area are provided in Chapter 7.

Geology. Certified maps and cross sections associated with the geology of the SUFCO Mine area are provided in Chapter 6.

5.1.2.2 Plans and Engineering Designs

All plans and engineering designs presented in this M&RP were prepared by or under the direction of and certified by a qualified registered professional engineer.

Excess Spoil. No excess spoil will be generated from the permit area.

Durable Rock Fills. No durable rock fills will exist in the permit area.

Coal Mine Waste. The design of the waste-rock facility has been certified by a qualified registered professional engineer.

Impoundments. The only impoundments constructed for the mining and reclamation operation consist of sedimentation ponds. Each of these ponds was designed by a professional engineer using current, prudent, engineering practices. These designs were certified by a qualified registered professional engineer.

The existing impoundments within the permit area consist of the four structures constructed for sediment control purposes. These structures are:

- The concrete sediment trap located near the southern end of the mine yard.
- The primary sedimentation pond located immediately below the fill on which the existing mine facilities are constructed.
- The overflow pond located 800 feet downstream from the primary sedimentation pond.
- The sedimentation pond located at the waste rock disposal site.
All pertinent information regarding these sedimentation ponds is presented in Sections 7.3.2.2 and 7.4.2.2.

**Primary Roads.** The design and construction of the primary road associated with the mine has been certified by a professional engineer as meeting the requirements of R645-301-534.200 and R645-301-742.420. This certification is presented in Appendix 5-1.

**Variance From Approximate Original Contour.** The design for the proposed variance from the approximate original contour requirements of R645-301-270 has been certified by a professional engineer in conformance with professional standards established to assure the stability, drainage, and configuration necessary for the intended postmining use of the site. This certification is presented in Appendix 5-2.

### 5.1.3 Compliance with MSHA Regulations and MSHA Approvals

#### 5.1.3.1 Coal Processing Waste Dams and Embankments
No coal processing waste dams or embankments exist within the permit area.

#### 5.1.3.2 Impoundments and Sedimentation Ponds
No impoundments or sedimentation ponds in the permit area meet the size criteria of 30 CFR 77.216(a).

#### 5.1.3.3 Underground Development Waste, Coal Processing Waste, and Excess Spoil
No underground development waste, coal processing waste, or excess spoil is disposed of in underground mine workings in the permit area.

#### 5.1.3.4 Refuse Piles
The waste-rock disposal area has been designed and constructed to meet the requirements of 30 CFR 77.214 and 30 CFR 77.215. Details of this design are presented in the M&RP, Vol. 3.
5.1.3.5 Underground Openings to the Surface
Upon abandonment, each opening to the surface from the underground will be capped, sealed, backfilled, or otherwise properly managed in accordance with 30 CFR 75.1771. Details regarding final abandonment of mine openings are provided in Section 5.4.2.7.

5.1.3.6 Discharges to Underground Mines
No discharges occur from the surface to underground mine workings in the permit area.

5.1.3.7 Surface Coal Mining and Reclamation Activities
No surface coal mining and reclamation activities occur in the permit area.

5.1.3.8 Coal Mine Waste Fires
If any coal mine waste fires occur within the permit area, these will be reported immediately to MSHA and the UDOGM. Immediate remedial action will be taken as deemed necessary by SUFCO Mine to protect public health and safety as well as the environment. Following initial remedial efforts, a long-term plan will be formulated in discussion with MSHA and the UDOGM to extinguish any existing fires and prevent future fires.

5.1.4 Inspections

5.1.4.1 Excess Spoil
Excess spoil is not generated at the SUFCO Mine.

5.1.4.2 Refuse Piles
Regular inspections of the waste-rock area will be made during placement and compaction of the coal mine refuse materials. These inspections will be made by or under the direction of a registered professional engineer experienced in the construction of similar earth and water structures. These inspections will occur at least quarterly throughout placement of the waste materials and during the following critical periods of the phased construction of the site:

- Foundation preparation (including removal of organic material and topsoil),
- Installation of final surface drainage systems, and
The final graded and revegetated facility.

The frequency of the inspections will be increased if a danger or harm exists to public health and safety or to the environment. Inspections will continue until the waste-rock area has been finally graded and revegetated.

A certified report will be submitted by a registered professional engineer to the UDOGM within two weeks after each inspection. This report will indicate whether or not the waste-rock pile has been constructed and maintained as designed and in accordance with the approved plan and the R645 rules. The report will also include a discussion of any appearances of instability, structural weakness, and other hazardous conditions noted during the inspection. A copy of the inspection report will be maintained at the mine office.

5.1.4.3 Impoundments

Inspections of all sedimentation ponds associated with the SUFCO Mine will be made at least quarterly. A report of inspection will be prepared by a qualified individual and submitted to the UDOGM within two weeks after each inspection. No other mine-related impoundments exist in the permit area.

New impoundments that may be constructed in the future within the permit area will be inspected regularly during construction and upon completion of construction. These inspections will be made by or under the direction of a registered professional engineer experienced in the construction of similar earth and water structures. Inspections will continue until removal of the structure or release of the performance bond.

All sediment ponds associated with the SUFCO Mine will be inspected annually by a registered professional engineer. A certified report will be prepared by a registered professional engineer and submitted to the UDOGM within two weeks after each inspection. This report will indicate whether or not the impoundment has been constructed and maintained as designed and in accordance with the approved plan and the R645 rules. The report will also include a discussion of any appearances of instability, structural weakness or other hazardous conditions, depth and elevation.
of any impounded waters, existing storage capacity, and existing or required monitoring procedures and instrumentation, and any other aspects of the structure affecting stability, as noted during the inspection. A copy of the inspection report will be maintained at the mine office.

No impoundments currently exist within the permit area that are subject to 30 CFR 77.216. If impoundments subject to 30 CFR 77.216 are constructed in the future, these impoundments will be inspected on a weekly basis. These inspections will be performed in accordance with 30 CFR 77.216-3.

5.1.5 Reporting and Emergency Procedures

5.1.5.1 Slides
If a slide occurs within the permit area that may have a potential adverse effect on the public, property, health, safety, or the environment, SUFCO Mine will notify the UDOGM by the fastest available means following discovery of the slide and will comply with any remedial measures required by the UDOGM.

5.1.5.2 Impoundment Hazards
If any examination or inspection of an impoundment discloses that a potential hazard is associated with that impoundment that may have an adverse effect on the public, property, health, safety, or the environment, the person who examined the impoundment will promptly inform the UDOGM of the finding and of the emergency procedures formulated for public protection and remedial action. If adequate procedures cannot be formulated or implemented, the UDOGM will be notified immediately.

5.1.5.3 Temporary Cessation of Operations
Prior to a temporary cessation of operations within the permit area that will last for a period of 30 days or more or as soon as it is known that a temporary cessation will extend beyond 30 days, SUFCO Mine will submit to the UDOGM a notice of intention to cease or abandon operations. This notice will include the following:
o A statement of the exact number of surface acres and the horizontal and vertical extent of subsurface strata which have been affected by mining operations in the permit area prior to cessation of operations,

o A discussion of the extent and kind of reclamation activities which will have been accomplished prior to cessation of operations, and

o An identification of the backfilling, regrading, revegetation, environmental monitoring, underground opening closures, and water treatment activities that will continue during the temporary cessation.

During the temporary cessation, SUFCO Mine will support and maintain all surface access openings to underground operations. SUFCO Mine will also secure surface facilities in areas in which there are no current operations but where future operations are to be resumed under an approved permit.

5.20 Operation Plan

5.2.1 General

5.2.1.1 Cross Sections and Maps

Previously Mined Areas. Plate 5-1 shows the location and extent of known workings of active, inactive, or abandoned underground workings, including openings to the surface, within the permit and adjacent areas. No previously surface-mined areas exist within the permit area.

Existing Surface and Subsurface Facilities and Features. Plates 5-2A, 2B, 2C, 2D, 2E, 2F and 5-5 depicts the following information:

o All buildings in and within 1000 feet of the permit area, including an identification of the current use of the buildings,

o The location of surface and subsurface features within, passing through, or passing over the permit area, including major electric transmission lines and pipelines (no agricultural drainage tile fields exist within the permit area),

o Each public road located in or within 100 feet of the permit area,

o The location of the waste-rock disposal area, and
The location of each sedimentation pond within the permit area (there are no permanent water impoundments within the permit area).

The location and features of the repaired sinkhole are shown in Appendix 5-13.

Tipple Building was modified in 2008 to widen the tipple building sump to accommodate the use of a larger loader to collect coal fines when the Tipple Building is being cleaned. This allows a loader to collect the coal fines from the Tipple Building cleanup and put them on the coal storage pile preventing them from being washed through the mine yard. Design and cross sections of the Tipple Building Modification are provided on Figures 5-0C and 5-0D (Appendix 5-11).

To facilitate the separation of rock from coal, a rock chute will be attached to the Tipple Building, with a steel girder in a concrete pier (2' X 2' Approx.) atop a spread footing (3' X 3' X 1' Approx.) providing additional stability. The rock exiting the chute will drop into a rock bin constructed of precast 3'X3'x6' concrete blocks. The diagrams of the rock chute structure and rock bin are located in Appendix 5-11. The location of the rock chute footings and rock bin is used for coal storage, preparation and coal loading, making the salvage of topsoil or subsoil unlikely. Excavated material not of a quality to be placed in the coal pile will be hauled and placed with the waste rock.

Landowner, Right-of-Entry, and Public Interest. Plate 5-6 shows the boundaries of lands and the names of present owners of record of those lands, both surface and subsurface, included in or contiguous to the permit area. SUFCO Mine has a legal right to enter and begin coal mining operations on all of the lands within the permit area.

Coal mining and reclamation operations are conducted within 100 feet of the right-of-way line of a public road (except where mine access roads join that right-of-way) at the waste-rock disposal area. The measures to be used to ensure that the interests of the public and the affected landowners are protected by operations at the waste-rock disposal facility are outlined in the M&RP, Volume 3.

Coal mining and reclamation operations are conducted within 100 feet of the right-of-way line of the Link Canyon Road, a public-access dirt road. SUFCO Mine uses a portion of this road to...
access the mining operation's electrical system from the Link Canyon Portal. Mining activities are conducted within 100 feet of this road during maintenance and operation of the electrical substation. The interests of the public and the affected landowners will be protected with respect to this road by the following measures:

- Surface activities will be conducted in a manner that will not block the road,
- The portal area access road will be gated and the mine portal intake will be protected from unauthorized entry by the installation of steel sets and a locked chain-link gate. The key for the gate will be kept approximately 25 feet from the gate inside the mine. This permits emergency exit from the mine but prevents entrance from the outside,
- During initial construction of the facilities the public will be protected by posting warning signs on the road, talking to contractors, and by a temporary chain-link fence with warning sign during portal entrance construction when the contractor is not on site to prevent entrance to the portal, and
- Regular inspections of that portion of the road are conducted by mine personnel to ensure that erosion does not become a problem. In the event that material damage due to erosion as a result of mining activities is discovered on or along the side of this road, SUFCO Mine will repair this damage and implement additional runoff-control measures as needed.

The mine portals enter the ground beneath the East Side USFS Public Stock Trail, a public-access dirt road that is constructed on the east side of East Spring Canyon from the bottom of SUFCO Mine to the upper plateau. This road has historically been used to herd livestock between grazing allotments during seasonal changes. SUFCO Mine also uses portions of this road to access the mining operation's electrical and water supply systems. Mining activities are conducted within 100 feet of this road during maintenance and operation of the electrical substation and water supply system (adjacent to the road) and where the portals enter the ground (beneath the road). The interests of the public and the affected landowners will be protected with respect to this road by the following measures:
No subsidence or caving operations will be conducted to affect any portion of the right-of-way of this road within 100 feet of the underground entry system.

Surface activities will be conducted in a manner that will not block the road, and

Water bars have been constructed on that portion of the road bordering the disturbed area adjacent to the mine surface facilities. Regular inspections of that portion of the road are conducted by mine personnel to ensure that erosion does not become a problem. In the event that material damage due to erosion as a result of mining activities is discovered on or along the side of this road, SUFCO Mine will repair this damage and implement additional runoff-control measures as needed.

Subsidence from underground mining operations may affect public-access dirt roads throughout the lease and permit areas. As part of the subsidence monitoring program, these roads will be regularly inspected. If material damage occurs to these roads as a result of mine subsidence, the roads will be repaired by SUFCO Mine.

**Mining Sequence and Planned Subsidence.** The mine plan for the SUFCO Mine is presented in Plate 5-7 (Upper Hiawatha seam) and Plate 5-8 (Lower Hiawatha seam). These maps show the boundaries of all areas proposed to be affected over the estimated total life of the coal mining and reclamation operations, including the size, sequence, and timing of mining of subareas to be affected beyond the present permit term. No surface disturbances are currently anticipated within the permit area beyond that presented in this M&RP.

Plates 5-7 and 5-8 also shows the location and extent of underground workings in which planned-subsidence mining methods will be used as well as areas where measures will be taken to prevent, control, or minimize subsidence and subsidence-related damage. The location of the waste-rock disposal area in relation to the underground mine workings, is discussed in Volume 3 of this M&RP.

Pines East Panels located in the Pines Lease will be mined using the First Mining/Room & Pillar method, no subsidence is projected with this method. Due to no subsidence, monitoring is not planned for these panels.

**Land Surface Configuration.** Slope measurements for undisturbed areas adjacent to disturbed areas associated with the mine are shown on Plate 5-2A&B. Surface facilities at the site have been in existence since 1941. Pre-mining topographic maps do not exist. Therefore, the slope

5-11
measurements shown on Plate 5-2A&B are considered generally indicative of original land slopes in the vicinity of the mine.

2RWL Sinkhole - A mitigation plan for the repair of a sinkhole located on Lease U-47080 is located in Appendix 5-13. An Environmental Assessment UT-070-08-083 was prepared in January 2009 for the West Coal Lease Modification for the BLM and Fishlake National Forest where the sinkhole is located. A copy of the assessment if located in Appendix 3-13. The sinkhole is with the West Lease Modification Areas permitted in 2011.

The area of the sinkhole was undermined within Lease U-47080 in December 2015. The sinkhole feature has previously occurred naturally in the area, but this is the first hole to occur during longwall mining. It is suspected that mining-related subsidence triggered this collapse into an existing cavity within the fault zone close to the surface. Previously, exploration drilling has encountered voids that were interpreted as limited zones of open fractures.

The depth of overburden in the area is 890 feet, at that depth, at mid-panel, subsidence has the potential of 5 - 6 feet. The sinkhole was approximately 41' wide, 64' long and 40' deep. It was assumed in this case that there was a large open cavity near the surface, that opened when mining occurred in 2015. Refer to Section 5.20 for reclamation information.

Surface Facilities. Plates 5-2A,B,C,D,E,&F and Figure 5-0E shows the locations of the following surface facilities:

- Buildings, utility corridors, and facilities to be used,
- The area of disturbance at the mine mouth,
- Coal storage and loading facilities,
- Non-coal (non-waste rock) storage areas, and
- Explosive storage and handling facilities.
- Portal sites.
The remaining area of land to be affected by mining and reclamation operations is at the waste-rock site. The area of land to be affected at the waste-rock site is shown on maps provided in Volume 3 of this M&RP. The disturbed areas shown on Plates 5-2A,B,C,D,&E and the waste-rock area surface facility maps are the same as the land areas for which a performance bond or other guarantee has been posted.

Locations of topsoil stockpiles are shown on Plates 5-2A, 5-2B and in Volume 3 (Map 2). No coal processing waste banks, dams, or embankments exist in the permit area. Similarly, no spoil or coal preparation waste sites exist in the permit area. Sediment that is periodically removed from the sedimentation ponds will be disposed of at the waste-rock disposal site.

General refuse that is generated on site is stored at the location indicated on Plate 5-2A. This waste consists predominantly of old brattice cloth, ventilation tubing, broken timbers, wire, broken machinery parts, paper, cardboard, and miscellaneous garbage. This non-hazardous, non-toxic, non-coal, non-waste rock refuse is disposed of periodically at the Sevier County Landfill. The agreement with the Sevier County Landfill for disposal of this refuse is provided in Appendix 5-3.

Transportation Facilities. Roads that have been constructed, used, or maintained by SUFCO Mine in the permit area for the mining and reclamation operations are shown on Plate 5-2A&B. No rail systems or overland conveyor systems (other than the material-handling conveyors in the mine yard) are associated with the permit area. Drainage structures associated with the roads are presented in Section 7.5.2.2. Cross sections of the roads are provided on Plate 5-9.

5.2.1.2 Signs and Markers

Mine and Permit Identification Signs. Mine and permit identification signs have been placed at the locations shown on Plates 5-2A,B,D,E,&F. Each identification sign contains the following information:

- Mine name,
- Company name,
- Permanent program permit number as obtained from the UDOGM,
Canyon Fuel Company, LLC
SUFCO Mine

- MSHA identification number,
- EPA permit number, and
- Federal Coal Lease numbers pertinent to the operation.

These signs will be retained and maintained until after the release of all bonds for the permit area.

**Perimeter Markers.** Perimeter markers (disturbed area boundary) have been installed at the locations shown on Plates 5-2A,B,C,D,E,&F. These markers, consisting of red and yellow steel T-posts, delineate the areas affected by surface operations at the mine. Each perimeter marker can be seen from the ground connectively from another marker.

**Buffer Zone Markers.** Stream buffer zone markers have been placed at the three locations within the permit area where surface effects of mining activities approach perennial or intermittent stream channels. These locations are as follows:

- Quitchupah ventilation entries located adjacent to the North Fork of Quitchupah Creek in S 1/2 Sec. 29, T. 21 S., R. 5 E.
- The vicinity of the pump station and leach field near the confluence of East Spring Canyon and Quitchupah Creek in S 1/2 Sec. 12, T. 22 S., R. 4 E.
- The vicinity of the Link Canyon Portal in SW 1/4 NW 1/4 Sec. 26, T. 21 S., R. 5 E.

Each buffer zone marker has dimensions of 12 inches by 18 inches and is labeled "Stream Buffer Zone - No Disturbing Beyond This Point".

**Topsoil Markers.** Markers have been placed on all topsoil stockpiles. These markers are labeled "Topsoil Storage Area".

5.2.2 **Coal Recovery**

Current mining operations at the SUFCO Mine occur in the Upper Hiawatha Seam. Future mining operations are also planned to occur in the Lower Hiawatha Seam. The overall objective of mining operations in the lease and permit areas is to maximum coal recovery coupled with safety. Coal recovery at the mine has been and will continue to be maximized through the following efforts:
(Figure 5-0E)
Proposed 300,000 Gallon Fire Water Tank Pad Detail
PROPOSED 300,000 GALLON FIRE WATER TANK AND PUMP HOUSE PAD

PROPOSED 300,000 GALLON FIRE WATER TANK

PROPOSED PUMP HOUSE

CROSS SECTION A-A'

CROSS SECTION B-B'

VOLUMES
CUT: 489.31 CUBIC YARDS
FILL: 109.25 CUBIC YARDS

FIGURE 5-0E PROPOSED 300,000 GALLON FIRE WATER TANK PAD DETAIL

CANYON FUEL COMPANY, LLC
SUFCO Mine

DATE: OCT. 15, 2001
SCALE: 1" = 20'
DRAWN BY: BDH

FILENAME:
H:\DRAWINGS\MRP\PLATES\FIGURE5-0e
Pre-mining analysis of drill-hole data allows estimates to be made of the nature, depth, and thickness of the coal seam and associated partings. Using these data, the mine plan and mining methods are evaluated and amended as necessary to maximize coal recovery.

Experience gained during mining is used to amend future mine plans if coal recovery can be increased.

The mine converted from an exclusive room-and-pillar extraction method to a combination of room-and-pillar and longwall extraction methods in October 1985. As a result of this conversion, coal recovery at the mine increased from approximately 75 percent under exclusive room-and-pillar methods to 88 percent under the combined room-and-pillar and longwall methods.

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

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

Mining is not planned on parts of the extreme east and southeast portions of the Pines Tract Lease UTU-76195 as a result of poor quality and seam height. A parting located in the middle of the seam, will not allow mining to occur at the minimum height without putting quality at unacceptable levels. Much of the seam height in these areas is between 4-6 feet. Reserves are also lost to burn in these areas as a result of several promontories in the area which allow greater exposure of the outcrop to the atmosphere.
Mining is not planned on the northern portion of the SITLA Muddy Tract Lease ML 49443-OBA in the Upper Hiawatha Seam as a result of a sand channel and seam height that will not allow mining to occur.

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

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

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


The Greens Hollow "Plan of Operations" associate with the R2P2 has not been finalized, but once completed it will be filed with the BLM. The plan will contain detailed mine plans and reserve calculations for the Greens Hollow lease operated by Canyon Fuel Company, LLC SUFCO Mine. Reference Stipulation 22, page 5 (Appendix 1-1) in the Greens Hollow Lease for a discussion of requirements associated with mining and the R2P2.

5.2.3 Mining Methods
A combination of room-and-pilar and longwall mining methods are used in the SUFCO Mine. The use of these two mining methods has been selected to maximize coal recovery and enhance production rates within the specific geologic constraints of the lease area.

Room-and-Pillar Mining. Room-and-pillar mining is conducted at the SUFCO Mine using continuous miners for the following purposes:

- To develop the mains, submains, and panel entries,
- To extract panels where the cover is 1,500 feet or less,
- To partially extract coal in areas where surface features require protection, and
- To extract coal in areas where geological conditions or physical boundaries are not suitable for longwall mining.

Panel development under room-and-pillar mining methods is achieved by driving three panel entries from the main entries along side the designated panels. Each mining panel is then developed from these entries on the retreat. Pillars within panels that are not required to remain in place to protect long-term mine access or surface resources are also extracted upon retreat from an area to increase coal recovery.

Coal is transported from the continuous miner to the belt feeder by electric or diesel haulage units. Coal is conveyed out of the panel and on out of the mine by belt conveyors. Diesel-powered, rubber-tired tractors and service cars are used to transport personnel and materials from the portals to the working faces.
Pillars in developed entries will be left to protect adjacent panels.

**Longwall Mining.** Longwall mining is used for extraction of large, uniform blocks of coal where the panels are more than 2,500 feet in length and where a suitable longwall panel can be laid out. Coal thicknesses of up to 14 feet are mined in the SUFCO Mine using longwall methods. In areas where coal is thicker than the height capacity of the mining equipment, the unmined coal will be left on the bottom of the bed unless economic or safety conditions warrant otherwise.

The longwall mining system at the SUFCO Mine consists of three basic integrated sub-systems: self advancing roof support, shearer, and conveyance. Shield-type roof supports are used. Shield supports are generally considered more suitable for mining conditions such as those encountered at the SUFCO Mine and are designed for expansion, contraction, advancement, and movement in varying thicknesses of coal.

The longwall shearer at the SUFCO Mine utilizes a double-ended shearer system for efficiency and flexibility of operation. Such a system consists of two rotary cutting drums mounted on ranging arms which are pivoted to a common body containing the power and drive assemblies. An optimum-tip drive speed is associated with each drum-pick configuration and diameter to assure minimization of fines in the sheared coal. The conveyance system used in the mine has been designed to convey extracted coal along the 540 to 1000 foot faces.

**Anticipated Production.** Anticipated annual production of coal from the SUFCO Mine during the permit term is as follows:

2017 - 2021 coal production will range from 5.5 thru 6.3 million tons

**Major Equipment.** Major equipment in use at the SUFCO Mine is listed in Table 5-1. The same type of equipment or equivalent is expected to be used in the future.
5.2.4 Blasting and Explosives

Mining and reclamation activities at the SUFCO Mine generally does not require the use of blasting or explosives on the surface. Historically, the infrequent surface blasting conducted at the SUFCO Mine has been for construction projects and for removal of dislodged boulders that roll into the surface facility area. These blasts have been under the 5 pound exemption in most cases, and have been conducted under the direction of a certified blaster. Any future blasting associated with mining and reclamation activities that may be needed will be conducted in accordance with R645-301-524. All underground blasting activities at the mine are conducted under the direction of a MSHA certified blaster.

**TABLE 5-1**
List of Major Equipment

<table>
<thead>
<tr>
<th>Type of Machinery</th>
<th>Manufacturer</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting Machine</td>
<td>Joy</td>
<td>15RU</td>
</tr>
<tr>
<td>Continuous Miner</td>
<td>Joy</td>
<td>12CM-12</td>
</tr>
<tr>
<td>Coal Drills</td>
<td>Long-Airdox</td>
<td>RDF-24</td>
</tr>
<tr>
<td>Roof Bolters</td>
<td>Lee Norse, Fletcher</td>
<td>T1-43, HDDR-13</td>
</tr>
<tr>
<td>Roof Bolters</td>
<td>Secoma</td>
<td>PEC-22M-1BR-D4</td>
</tr>
<tr>
<td>Shuttle Cars</td>
<td>Wagner / Joy</td>
<td>MTT-F20-S18, MTT-F17-I45 / 10SC32</td>
</tr>
<tr>
<td>Front-End Loaders</td>
<td>Eimco</td>
<td>913, 915D, 915E</td>
</tr>
<tr>
<td>Front-End Loaders</td>
<td>Wagner</td>
<td>ST2D</td>
</tr>
<tr>
<td>Feeder Breakers</td>
<td>Stamler / McLanahan</td>
<td>14B / HV56</td>
</tr>
<tr>
<td>Feeder Breakers</td>
<td>Long-Airdox</td>
<td>R11</td>
</tr>
<tr>
<td>Compressors</td>
<td>Gardner-Denver</td>
<td>185 CFM</td>
</tr>
<tr>
<td>Rock Dusters</td>
<td>MSA</td>
<td>400</td>
</tr>
<tr>
<td>Mantrips</td>
<td>Getman / Dodge</td>
<td>R62 X PC / RAM 3500</td>
</tr>
<tr>
<td>Longwall Shearer</td>
<td>Joy</td>
<td>7LS</td>
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<tr>
<td>Longwall Shields</td>
<td>Joy</td>
<td>960 Ton</td>
</tr>
<tr>
<td>Stage Loader</td>
<td>MTA</td>
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</tbody>
</table>
SUFCO began operations which caused surface subsidence in June 1976. At that time, continuous miners were used to extract coal from pillars which were developed as part of a retreating panel. The panels were approximately 650 feet wide and varied in length up to 2,500 feet. The average mining height in this initial area of pillar extraction approached 11 feet and the extraction ratio averaged about 80 percent.

The resulting subsidence from the initial retreat mining averaged about 4 feet in plateau areas where the overburden was approximately 900 feet thick. In areas where panel boundaries were outside the escarpment created by (i.e., not overlain by) the Castlegate Sandstone, subsidence increased with the decreasing overburden thickness and the decreasing strength of the overlying rock. The maximum subsidence in this first area of pillar extraction was 8.5 feet in an area not overlain by the Castlegate Sandstone where the overburden thickness was only about 600 feet.

Longwall mining was introduced at the SUFCO Mine in October 1985, when a longwall system was added. Longwall panels have ranged in width from 540 feet to 1000 feet and up to 17,000 feet in length. Mining heights have varied from 8.5 feet to 13.5 feet with the longwall system.

Subsidence above the longwall panels has historically averaged about 4 feet. Overburden thickness above the longwall panels has typically been greater than above the room-and-pillar panels. The maximum subsidence caused by longwall mining to date has been 7 feet.

Several draw angle surveys have been performed at the mine over the past fourteen years. These surveys have been oriented both parallel and perpendicular to the long axis of the panel. Data collected over continuous-miner areas to date indicate that the average draw angle is 15 degrees. Individual measurements over continuous-miner areas have ranged from 10 to 21 degrees. New longwall draw angle data obtained in 1995 indicates an angle of 15 degrees for the longwall areas. Draw angle study completed in 1999 over 13L4E LW panel indicates 15 degrees is valid. Summary results of the LW panel studies are shown in Figures 5-0A and 5-0B.
(Figure 5-0A)

14L4E Draw Angle Study
(Figure 5-0B)
6 East Draw Angle Study
Tension cracks have occurred over most of the subsidence areas. These cracks tend to be most pronounced in areas where pillars have been extracted (as compared to areas overlying longwall panels). The lengths of the cracks vary from a few feet to nearly 200 feet. Most are oriented either parallel to the natural jointing pattern or parallel to the boundaries of the underground excavation. Cracks with the longest continuous length appear to be natural joints which have been intensified by subsidence action. Vertical displacement along the cracks is uncommon and horizontal displacement varies from hairline to several inches in width. Follow-up observations of individual tension cracks indicate that the cracks tend to close (either partially or fully) following initial development (see Appendix 5-4).

Monitoring data collected to date indicate that subsidence above the SUFCO Mine occurs rapidly after initial movement. Approximately 80 percent of maximum subsidence occurs within about four months. The remainder of subsidence occurs slowly over a period of a few years. These monitoring data have been presented and summarized annually in reports submitted to the UDOGM by SUFCO Mine. Refer to Appendix 5-13 for description of 2RWL repaired sinkhole, Section 5.2.1.1 and Section 5.4.1.1 provide additional information.

3 Right 4 East Panel(s)
Mining of this panel(s) will straddle Leases U-63214 and U-62453 which are referred to as the Quitchupah Tract throughout the M&RP in text, appendices and on drawings. Both leases were issued to the permittee in 1989, the tract was originally delineated in 1982. The mine plan is shown on Plate 5-7, mining will occur only in the Upper Hiawatha coal seam. Overburden is approximately 900 feet or more. An environmental assessment was prepared for Lease U-63214 in 1988 and an EIS for the Quitchupah Tract in 1983, a variety of information from these assessments are included in the existing M&RP.

4 Right 4 East Panel(s)
Mining of this panel will occur in Lease U-63214 which is referred to as the Quitchupah Tract throughout the M&RP in text, appendices and on drawings. This lease was issued to the permittee in 1989, the tract was originally delineated in 1982. See Appendix 5-14, Plate 5-6 and Plate 5-7 for the 4R4E mine plan, lease locations and mine timing respectively. Mining will occur only in the
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 panels 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 panels will be mined using the First Mining/Room & Pillar method, no subsidence is projected with this method. No surface disturbance, new surface facilities or infrastructure will be associated with the mining of the panels.

5.2.5.1 Subsidence Control Plan

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

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

State appropriated water supply locations within the Greens Hollow Lease and adjacent area are shown on the Water Rights Plate 7-2. The water rights information is provided in Appendix 7-1.
The water rights assigned within the Greens Hollow Lease and immediately adjacent belong to the USFS. According to water right records no manmade ponds or troughs are assigned state appropriated water supplies. Because of stipulations within the lease document, the M&RP and the conclusion of the PHC and CHIA is not anticipated that water resources will receive impacted and if they are they will be mitigated as discussed in Sections 5.2.5 and 7.3.1.8.

The underground workings mine plan is shown on Plates 5-7 and 5-8.

**Mining Methods.** As noted in Section 5.2.3, both room-and-pillar and longwall mining methods are used in the SUFCO Mine. The size, sequence, and timing for the development of the underground workings are shown on Plates 5-7 and 5-8.

**Physical Conditions Affecting Subsidence.** A detailed description of the physical conditions in the lease and permit areas that influence subsidence (i.e., overburden lithology and thickness, coal seam thickness, etc.) is provided in Chapter 6.

**Subsidence Control Measures.** Most of the land within the lease area will eventually be affected by subsidence. Anticipated areas of subsidence and those areas planned for protection from subsidence are shown on Plates 5-10& 5-10C. The primary areas where subsidence is not anticipated are the areas overlying the pre-1977 workings in Lease SL-062583 shown on Plate 5-1 (referred to herein as the "Old Mine") and certain lease areas underlying Quitchupah Canyon, Box Canyon, and Muddy Creek.

The "Old Mine" area was mined in such a manner that coal pillars were left for support throughout the entire workings. Since these pillars are large enough to support the overburden and further mining is not anticipated in these workings, the surface area above the workings should not experience any subsidence.

Where perennial streams are not undermined they will be protected from subsidence by establishing stream buffer corridors within the mine from which only limited coal recovery will occur. Support pillars will be left in these locations to preclude subsidence. Underground stream buffers will only be crossed to the extent necessary to allow access to reserves. This access will consist of entries and cross cuts with support pillars. Entries that cross through the underground stream buffer corridors with less than 300 feet of cover will be sealed and/or backfilled upon abandonment using the best available technology to prevent disturbance of the overlying streams.
Protected cultural resource sites will be designed to include a buffer zone to protect the area from the effects of subsidence caused by underground full extraction mining. The width of the corridor will be calculated as follows: the depth of overburden to the coal seam will first be established. This depth will be multiplied by tan 15° to obtain the distance underground mining needs to be away from the area to not cause subsidence effects. An additional 25 foot buffer will be added to this calculated distance to account for minor irregularities in the course of the stream or cultural resource site.

Surface structures overlying the area to be subsided consist of trails, unimproved dirt roads, fences, runoff catchment ponds, and streams. The applicant will repair any subsidence caused damage to these or other structures to the extent economically and technically feasible, and will comply with R645-301-525.160 and R645-301-525.230. Additional mediation and remedial measures are described in Section 5.2.5.2 Subsidence Control.

Monitoring within the lease area has shown that subsidence rarely exceeds 50 percent of the mining height where the overburden thickness is greater than 800 feet. This overburden thickness is generally achieved above the rim of the Castlegate Sandstone (see Plates 5-10& 5-10C). Topography above the Castlegate Sandstone is gently sloping while that within and below the sandstone outcrop contains cliffs and steep slopes. With the exception of the experimental mining practice described below, future subsidence is typically planned only for those areas above the rim of the Castlegate Sandstone where the overburden thickness exceeds 800 feet.

**Experimental Mining and Subsidence.** To protect the environmental resources associated with escarpments, SUFCO Mine currently has a general policy of precluding subsidence below the rim of the Castlegate Sandstone. This requires that significant quantities of coal remain unrecovered.

Pillars were extracted from room-and-pillar workings beneath two areas of escarpment. The location of these areas is shown on Plate 5-1. These areas involved a 5,000-foot section of escarpment on Federal lease (SL-062583) in East Spring Canyon (1977-78) and 2,000 feet of escarpment on Fee property (1983-88) on the east side of Quitchupah Canyon. The East Spring
Canyon escarpment is much less distinct than the Quitchupah Canyon escarpment due to the greater depth of Quitchupah Canyon.

Following pillar removal from the East Spring Canyon area, tension cracks were found around the perimeter of the canyon. Most of these cracks followed natural joints which were temporarily amplified by subsidence. There were no slope or cliff failures along the entire 5,000 feet of affected escarpment.

A similar pattern of tension cracks occurred above three room-and-pillar panels in Quitchupah Canyon. There were no slope failures, but one incidence of cliff spalling occurred.

Longwall mining was first implemented by SUFCO Mine in 1985 in areas that would not affect the escarpments. Observations during the next two years indicated that, unlike room-and-pillar extracted areas, subsidence in areas overlying longwall panels did not cause significant tension cracking that might result in massive slope failure if the cracking was to occur along the escarpments. With this in mind, and with the goal of both SUFCO Mine and the land management agencies being to maximize coal recovery while minimizing environmental impacts, an experimental project was requested by SUFCO Mine and approved by the UDOGM in 1987 (see Appendix 5-5). Under this program, a section of Quitchupah Canyon below the Castlegate Sandstone escarpment was included in the planned longwall subsidence zone. The purpose of this project was to determine whether or not an escarpment could be undermined by longwall mining with minimal or no surface effects.

Prior to mining in the experimental areas, a raptor survey was conducted of the cliff areas on both the west side of Quitchupah Canyon where the mining was to occur and the east side of the canyon opposite the mining section. A visual and photographic survey was also performed of the experimental area to document pre-mining conditions. Pre-mining subsidence monitoring stations were established above the experimental panels to provide future survey control. These stations were installed in high and low tension areas around the escarpment and near naturally-eroded blocks of sandstone that were standing independent of the cliff face.
Three longwall panels were completed in 1987 as part of the project. The area of proposed escarpment subsidence (the "Experimental Mining Practice" area) is shown on Plate 5-1. The north ends of two of the longwall panels extended beyond the escarpment toward the canyon. The third longwall panel was located entirely beyond the cliff beneath the canyon wall.

To date, monitoring efforts associated with the experimental mining practice have established that subsidence has occurred in a predictable manner varying from one foot to seven feet with minimal surface disturbance. One of the independent sandstone blocks fell from the escarpment during subsidence and a few tension cracks were created along the cliff face. No other visible signs of mining were found even though the surface elevations have dropped several feet in some areas of the experiment. Monitoring stations have moved horizontally from a few tenths of a foot to nearly three feet. Post-mining monitoring of the surface above the longwall panels is continuing. A report which describes the experimental project and its results in greater detail has been prepared for submittal to the UDOGM.

**Subsidence Monitoring.** In 1976 (i.e., prior to the onset of subsidence), SUFCO Mine began collecting baseline topographic data from the lease area using conventional survey methods. The use of conventional survey methods for subsidence monitoring continued until 1985 (i.e., at the beginning of longwall mining), when the lease area was flown to establish a set of baseline photography and a grid of surface elevations. Where possible, elevations were photogrammetrically determined from this baseline photography on an approximate 200-foot grid. These original horizontal and vertical data, together with the original conventional-survey data, serve as the comparative database for determining ground movement in subsequent years. A baseline was also established to monitor changes in vegetative cover with the use of color infrared aerial photography (CIR). The first baseline was done in 1987 for the existing leases. The baseline for the Quitchupah lease was flown in 1988 with CIR. The applicant will follow up with CIR coverage of the leases at least every five years. The CIR photographs are stored at the SUFCO Mine. CIR photography was taken in 1990, 1995, 1999, 2003 (East Fork Box Canyon only), and 2004. The next projected CIR flight dates will be in 2008, 2013, and 2018.
Additional aerial photography of the lease area is currently obtained on an annual basis. New elevations are then determined at each of the previously-selected horizontal coordinates and the differences between the original and the new elevation measurements are used to generate a subsidence contour map. This map and supporting narrative are submitted annually to the UDOGM in the form of a subsidence report. This subsidence report outlines the history of subsidence at SUFCO Mine as well as the status of subsidence during the previous year.

Numerous control points have been established within the lease area to assist in the subsidence surveys (see Plates 5-10& 5-10C). Current (2005) coordinates and elevations of these control points are provided in Table 5-2. Additional control points will be added as necessary when existing points become influenced by subsidence. Future points will typically consist of 3-foot lengths of No. 4 rebar embedded in concrete with a stamped brass cap for identification. Since geologic and mining uncertainties often force a change in planned mining sequences, future control points will be installed only after the mine panels are in their development phase.

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

A annual monitoring program was developed to analyze the subsidence cracks related to undermining of the West Fork of Box Canyon. Mining in the area in 1999 did produce visible fracturing at the surface on both the northwest and southeast walls of the canyon in this area. The monitoring program includes measuring the offset and/or width of portions of selected subsidence cracks. Similar data will also be collected from specified segments of subsidence cracks that have occurred away from the walls of the canyon and do not appear to be influenced by the lack of bedrock support created by the canyon. Information gathered from this monitoring program, along with previous studies that SUFCO has performed, will be used to predict the effects of subsidence within other areas of the Pines Tract and other areas of the
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<td>8783.19</td>
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<td>U.S.G.S.</td>
<td>130065.44</td>
<td>100407.72</td>
<td>8648.16</td>
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<tr>
<td>Valley View</td>
<td>115797.62</td>
<td>099307.50</td>
<td>9054.37</td>
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</table>
TABLE 5-2 (Continued)

Subsidence Control Point Survey Data

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Northing</th>
<th>Easting</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanwinkle</td>
<td>120967.82</td>
<td>131485.30</td>
<td>8738.62</td>
</tr>
<tr>
<td>Wasatch2</td>
<td>176502.69</td>
<td>091318.15</td>
<td>11130.23</td>
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<tr>
<td>White Rocks</td>
<td>119944.80</td>
<td>116486.58</td>
<td>8530.16</td>
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<tr>
<td>White Rocks II</td>
<td>119945.83</td>
<td>116485.02</td>
<td>8526.53</td>
</tr>
<tr>
<td>Wilco</td>
<td>120846.31</td>
<td>129130.30</td>
<td>8685.09</td>
</tr>
<tr>
<td>Wildcat</td>
<td>121403.85</td>
<td>122435.42</td>
<td>9030.03</td>
</tr>
<tr>
<td>Wileys</td>
<td>130032.60</td>
<td>134664.80</td>
<td>8652.51</td>
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<tr>
<td>Window</td>
<td>125525.90</td>
<td>111439.67</td>
<td>8290.13</td>
</tr>
</tbody>
</table>
mine where similar geomorphologic and geologic conditions occur. This program was developed and implemented by the Fall of 2000. Subsidence cracks in the area of the West Fork of Box Canyon were surveyed for their location. However, in the years 2000 through 2003 the width and/or offset of the cracks were not measured or the records were not kept. Width and/or offset measurements were made in the Fall of 2004 and will again be made in the Fall of 2005 and every year thereafter.

It is believed by the permittee that any change in the width of the cracks can easily be tracked on an annual basis rather than a semi-annual basis. The permittee has observed that most subsidence cracks that develop in the mining area do not change significantly after the first 4 to 6 months following their creation. The crack measurement records will be reported in the mines annual report.

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

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

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

It is anticipated that subsiding under portions of East Fork Box Canyon and South Fork Quitchupah will result in a slight flattening of the stream gradient, which will increase pooling of the stream through a stretch of several hundred feet of the stream. Cracks will also likely develop across the East Fork Box Canyon Creek directly above the longwall panels and along the gate roads. These crack zones will form shortly after undermining of the stream bed. They are anticipated to be.
2 inches or less in width with these cracks healing to some degree following formation. Details of the expected location of the cracks are given in Appendix 7-19. Because of the nature of the fine-grained sediments that form the stream channel floor in the South Fork of Quitchupah, surface cracks - if any form - are anticipated to be very narrow in width and would self heal rapidly. However, if cracks do develop in the channel floor and appear to be taking surface water from the creek, sealing of these cracks will be done with bentonite grout. Use of bentonite grout for the sealing of the cracks in the channel floor is discussed in Section 3 of the Pines Tract FEIS (1999) and in more detail in the following section.

East Fork of Box Canyon Subsidence Monitoring and Mitigation

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

Prior to the initiation of undermining and subsidence, a presubsidence survey will be conducted in the East Fork of Box Canyon from the Joe’s Mill Ponds downstream to a location above the west gate roads associated with the 3LPE panel. The survey will consist of video taping the condition of the stream channel paying particular note to surface flows and ground water discharge, vegetation types and conditions, animal life in the area including macroinvertebrates in the stream channel, soil conditions, and the general geomorphology of the area. A follow-up video survey will be made at the same time of year on the third year following undermining during September of 2008. A general comparison between the two tapes will be made to determine what, if any, effects to the parameters described above have occurred. The biological aspects of the video tape are discussed in greater detail in Section 3.2.2.2 while the monitoring of surface and ground water flows are discussed in Section 7.3.1.2.

The subsidence monitoring plan for the East Fork of Box Canyon will include frequent inspection of the stream channel during and after active subsidence. While mining is occurring under the
stream channel and within the 15-degree angle-of-draw above the active longwall face, that area of the channel will be inspected twice a week for subsidence cracks or other related features. As the longwall face advances and the 15-degree angle-of-draw area follows, the portions of the channel that now lie outside the 15-degree angle-of-draw will be monitored for subsidence features on an every two week basis for eight weeks. Following the eight week period, the features will be monitored on a quarterly basis for two years following the cessation of subsidence related effects, if any, due to mining. Table 7-5A in Chapter 7 lists the schedule for water and subsidence monitoring frequency.

Mitigation of cracks that would appear to interrupt or divert flows from the stream channel will be sealed immediately with bentonite. Sufco will use hand placement methods when sealing cracks with bentonite. The individual(s) conducting the survey will be equipped with an adequate volume of bentonite, in powder, granular, and/or chip form, to seal small cracks. The bentonite may be placed by pouring it directly into the crack and hydrating with stream water or, if in an actively flowing portion of the stream, temporarily diverting the flow around successive portions of the crack using native soils and placing the bentonite in the exposed section of the crack until the crack is sealed. Sealing of the lower portions of the channel walls may also be required if the crack occurs where the channel is defined by bedrock. If cracks are present in channel walls defined by soil, the soil cracks will be hand filled using a native soil/bentonite mix. The sealing of the channel floor and walls will be accomplished with hand tools such as shovel, picks, trowels, etc.

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

A weekly report will be submitted via e-mail to the Division detailing the results of the inspections. The reports will include, but not necessarily be limited to: a map illustrating the current location of the longwall face; descriptions and dates of field activities; noted changes in stream and local geomorphology; location, width, frequency of cracks; and a description of repairs, if any, conducted. If the prescribed inspections cannot be conducted, the reason for the missed inspection and a record of the attempt to conduct the inspection will be submitted to the Division in the weekly report. The Division will be notified immediately after mining-induced cracks, if any, are found in the East Fork stream channel and the steps taken or planned to be taken as mitigation. Thereafter, the Division will be advised of continuing mitigation efforts, if needed, in the weekly report.

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

South Fork of Quitchupah 2R2S Block "A" and 3R2S Block "B" Subsidence Monitoring and Mitigation

Portions of the South Fork of Quitchupah will be undermined and subsided as longwall panels 2R2S and 3R2S are extracted. A monitoring and mitigation plan (Appendix 3-14) that is more intensive than the general Mining and Reclamation Plan area has been proposed for monitoring surface and ground water flows, subsidence cracks and repair of the cracks in the portions of the South Fork of Quitchupah channel to be undermined. The subsidence portion of the monitoring and mitigation plan is discussed in detail in the following text.

Prior to the initiation of undermining and subsidence, a pre-subsidence survey of the stream channel will be conducted in the portion of South Fork of Quitchupah that flows over the 2R2S and 3R2S
panels and associated gate roads. The survey will consist of a gain/loss survey of flow within the stream channel paying particular attention to surface flows and ground water discharge, soil conditions, and the general channel geomorphology of the area. A similar study was performed in the past but all stream measurements were not conducted on the same date. The second gain/loss survey will be completed on a single day at or near base flow conditions late in the summer or early fall of 2011. The mine will attempt, as part of this second survey, to occupy the same monitoring sites in the panel area as those chosen in the initial survey. The monitoring of surface and ground water flows are discussed in greater detail in Section 7.3.1.2.

The subsidence monitoring plan for the South Fork of Quitchupah will include frequent inspection of the stream channel during and after active subsidence. While mining is occurring under the stream channel, and within the 15-degree angle-of-draw above the active longwall face, that area of the channel will be inspected semi-weekly for subsidence cracks or other related features. As the longwall face advances and the 15-degree angle-of-draw area follows, the portions of the channel that now lie outside the 15-degree angle-of-draw will be monitored for subsidence features on a quarterly basis for two years following the cessation of subsidence related effects, if any, due to mining.

Mitigation of cracks that interrupt or divert flows from the stream channel will be sealed immediately with an appropriate impermeable grout or, in some cases, native materials. Sufco will attempt to seal cracks with the least intrusive methods (typically hand placement of grout or native materials) first. The sealing material may be placed by pouring it directly into the crack or, if cracks occur in an actively flowing portion of the stream, the stream may be temporarily diverted using native materials (or a designed flume if necessary to maintain the flow) until the crack is sealed. If cracks are present in channel walls defined by soil, the soil cracks will be hand filled using a native soil/bentonite mix. The sealing of the channel floor and walls will be accomplished with hand tools such as shovel, picks, trowels, etc.

As a backup plan, in the unlikely event that cracks too large to be sealed through the efforts of one or two persons in one day do occur and it appears there is a danger of water being diverted from the
channel for an extended period of time, the stream will be temporarily diverted using native materials and a pipe to carry the flow over the crack to maintain the channel flow. Arrangements will be made to get a contractor to the site as soon as possible to repair the crack after consultation with the Forest Service.

There may be sections of the stream channel that may require more intensive mitigation efforts to restore surface flows in the creek. These efforts could include the drilling of closely spaced shallow boreholes in and adjacent to the stream channel and the injection of an acceptable impermeable grout into the alluvium or bedrock. The work will be accomplished either using hand tools or low impact equipment to minimize surface disturbance. Existing roads and turnouts will be used as staging areas to locate larger equipment and supplies. Any hoses or lines will be transported from the staging areas to the nearby work sites either by hand, the use of pack animals, or by helicopter. This work will be done with a contractor selected after consultation with the Forest Service.

Additionally, it may be required to remove loose rock from the channel floor, either where the channel flows across thin-bedded bedrock or where large rock have fallen into the channel and is impeding flows. In the instance of the former, past experience has shown this can occur in the upper Blackhawk Formation and is easily repaired by removing enough of the broken channel surface to again expose the stream flow. In the instance of the later, removal of large rocks could be accomplished by drilling and then fracturing the rock into smaller fragments more easily moved to locations were they are not impeding flow. This work may be completed using available pneumatic or hydraulic tools that do not require road or pad building disturbances. In the unlikely event that large boulders do need to be moved, pumps and tanks necessary to complete the work will be located in pre-disturbed areas, such as roads or turnouts, and hoses will be walked into the work area.

A copy of the "Monitoring and Mitigation Plan for Undermining the South Fork of Quitchupah 2R2S Block "A" and 3R2S Block "B" has been included in Appendix 3-14. The preceding paragraphs have been prepared based on this plan. Sufco will attempt to meet the monitoring and mitigation responsibilities described in the plan as it pertains to the undermining of the South Fork of Quitchupah 2R2S Block "A" and 3R2S Block "B" Refer to Chapter 3, Section 3.3.3.3 for additional information.
Sufco will conduct longwall mining operations in such a manner as to minimize surface disturbance while mining within the 15-degree angle-of-draw area that includes the South Fork stream channel. This will be accomplished by advancing the longwall on a schedule where mining will not be suspended for a period to exceed 48 hours.

A bi-weekly (once every two weeks) report on the impacts to stream flow and required mitigation, if any, will be submitted via e-mail to the Division and the forest detailing the results of the inspections while mining is occurring under the stream channel. The reports will include, but not necessarily be limited to: a map illustrating the current location of the longwall face; descriptions and dates of field activities; noted changes in stream and local geomorphology; location, width, frequency of cracks; and a description of repairs, if any, conducted. If the prescribed inspections cannot be conducted, the reason for the missed inspection and a record of the attempt to conduct the inspection will be submitted to the Division and the forest in the report. The Division and the forest will be notified immediately after mining-induced cracks, if any, are found in the South Fork stream channel and the steps taken or planned to be taken as mitigation. Thereafter, the Division and the forest will be advised of continuing mitigation efforts, if needed, in the report.

Though not anticipated, short segments of Cowboy Creek could be subsided in the SITLA Muddy Tract. If this is anticipated to occur, Sufco, will submit a plan for mitigation to address, if it occurs, adverse impacts to Cowboy Creek. With the approval of the Division and concurrence of the Forest, Sufco will instigate a flow monitoring plan similar to the plan implemented prior to the undermining of the East Fork of Box Canyon. If mitigation of surface cracks are required, methods similar to those proposed and implemented in the East Fork of Box Canyon as described above could be used.

Mining within the area of the East Fork of the Box Canyon, South Fork of Quitchupah and within the area of Cowboy Canyon in the SITLA Muddy Tract will be conducted in accordance with State and Federal rules and regulations and the requirements and stipulations presented in the BLM's Conditions of Approval of the Resource Recovery and Protection Plan (July 31, 2003) located in Appendix 1-2. A survey of the water quality and quantity of surface and groundwater, including State appropriated waters, within the SITLA Muddy Tract has been completed. The results of the area survey are included in the PHC for the SITLA Muddy Tract and included in Appendix 7-20. Ground and surface waters in the tract that have attached rights are listed in Appendix 7-1.

A discussion regarding the methods Sufco would employ to mitigate and replace an adversely affected State appropriated water supply is provided in Chapter 7, Section 7.3.1.8.
3 Right 4 East Panel(s)
Should cracks develop in the surface above the panel(s) the sealing of these cracks will be done with inert materials such as soil, rock, road base, etc. and seeded with the mix in Section 3. 4.1.2 (3 Right 4 East Panel(s)). A drawing showing the potential subsidence with the mining of the 3R4E panel is located in Appendix 6-4 (Confidential). Potential subsidence beneath the 42SV2310 archeological site could be 0 to 8 inches (Appendix 6-4 and 4-2). Refer to Section 5.2.5.2 (Correction of Material Damage) and Section 7.2.8.3 for additional information.

5.2.5.2 Subsidence Control

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

\[ SF = \frac{SD}{OS} \]  

where

- \( SF \) = safety factor against pillar failure (fraction)
- \( SD \) = support strength density (psi)
  \[ Y_c (1-ER) \]
- \( Y_c \) = average compressive yield strength of the coal (psi)
  = 3090 psi for the Upper Hiawatha seam
- \( ER \) = extraction ratio (fraction)
  \[ 1-(A_p/A_t) \]
- \( A_p \) = pillar area (ft²)
- \( A_t \) = area supported by pillar (ft²)
- \( OS \) = overburden stress (psi)
  \[ (d)(D_o)/144 \]
- \( d \) = overburden depth (ft)
- \( D_o \) = overburden density (lb/ft³)
  = 160 lb/ft³ for the lease area
Based on these equations and data, the support pillar designs summarized in Table 5-3 have been derived. This equation does not take into account either size effect or shape effects and is based on a one-dimensional stress field. Historically this equation has provided good results when used in areas where a number of uniform pillars are extracted. One area (5 North panels) of the mine experienced pillar failure when the area was flooded with water after mining of the panels had been completed. This particular area was mined using a double pass technique and the mining height was from 14 to 18 feet. The resulting pillars varied from 25 feet x 25 feet to 40 feet x 40 feet. The underlying floor was a weak mudstone that lost its cohesive strength when wet. When the 1R5N and 2R5N panels were flooded the underlying mudstone became saturated and lost its cohesive strength. This allowed the pillars in the area with SF < 2.5 to fail, because frictional confinement on the bottom of the pillar was lost. To prevent reoccurrence the Applicant will commit to not flood areas of the mine that have small pillars and a weak mudstone floor in areas where subsidence is to be prevented.

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

**Correction of Material Damage.** SUFCO Mine will try to plan mining operations so that no material damage occurs as a result of subsidence in the lease area. However, should material damage occur, SUFCO Mine will correct any material damage resulting from subsidence caused to surface lands to the extent technologically and economically feasible by restoring the land to a condition capable
## TABLE 5-3

Minimum Support Pillar Requirements

<table>
<thead>
<tr>
<th>Maximum Cover (feet)</th>
<th>Max. Allowable Ext. Ratio (percent)</th>
<th>Nominal Pillar Centers (feet)</th>
<th>Safety Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>67</td>
<td>45 X 45</td>
<td>9.29</td>
</tr>
<tr>
<td>200</td>
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<tr>
<td>700</td>
<td>53</td>
<td>60 X 60</td>
<td>1.86</td>
</tr>
<tr>
<td>800+</td>
<td>50</td>
<td>65 X 65</td>
<td>1.74</td>
</tr>
</tbody>
</table>
of maintaining the value and reasonably foreseeable uses which it was capable of supporting before the subsidence. In addition, SUFCO Mine will either correct material surface damage resulting from subsidence caused to any structure or facilities by repairing the damage or compensate the owner of such structures or facilities in the full amount of the diminution in value resulting from the subsidence.

Protection of Significant Surface Resources. None of the following exist within the area of potential subsidence associated with the SUFCO Mine:

- Public buildings or facilities,
- Churches, schools, and hospitals,
- Impoundments with a storage capacity of 20 acre-feet or more or bodies of water with a volume of 20 acre-feet or more,
- Aquifers or bodies of water that serve as a significant water source for any public water supply system, or
- Urbanized areas, cities, towns, or communities.

Hence, no special control measures are required to preclude subsidence impacts to these resources.

5.2.5.3 Public Notice of Proposed Mining

Should new lease areas be added to the SUFCO Mine, a public notice of proposed mining will be mailed to all owners and occupants of the affected surface property and structures above the proposed underground workings. This notification will include identification of specific areas in which mining will occur, dates that specific areas will be undermined, and the location or locations where SUFCO Mine’s subsidence control plan may be examined.

5.2.6 Mine Facilities

5.2.6.1 Mine Structures and Facilities
Most surface structures and facilities at the SUFCO Mine have been in place for at least 10 years. Locations of these facilities are noted on Plate 5-2A,B,&C. Locations of the Link Canyon Substation facility and the horizontal power boreholes are noted on Plate 5-2D.

Table 5-4 lists the existing structures at the mine surface and at the Link Canyon facility area, their approximate dates of construction, and their general construction materials. All structures are actively maintained and are in good functional condition. Because the structures were constructed specifically for use as mining facilities and have been actively used and maintained since construction, all are considered adequate to meet the requirements of R645-301. No modifications or reconstruction are required for the structures to meet the requirements of R645-301.

All structures and facilities will be removed following mining in accordance with the reclamation plan discussed in Section 5.40.

5.2.6.2 Utility Installation and Support Facilities

Utility Installations. All coal mining and reclamation operations will be conducted to minimize damage, destruction, or disruption of services provided by electric lines, telephone transmission stations, water lines, and sewer lines which pass over, under, or through the permit area. Areas where these utilities are located are within non-subsidence zones. No other utility installations exist in the permit area. All utility installations associated with the SUFCO Mine will be removed following mining in accordance with the reclamation plan discussed in Section 5.40.

Support Facilities. Support facilities at the SUFCO Mine will be operated in accordance with the permit issued for the mine. Support facilities will be located, maintained, and used in a manner that:

- Prevents or controls erosion and siltation, water pollution, and damage to public or private property,
### TABLE 5-4

Description of Existing Structures

<table>
<thead>
<tr>
<th>Structure</th>
<th>Construction Date</th>
<th>Construction Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulance Garage</td>
<td>Summer 2007</td>
<td>Pre-Engineered Steel</td>
</tr>
<tr>
<td>Belt Deicer Tank</td>
<td>Fall 1994</td>
<td>Steel</td>
</tr>
<tr>
<td>Bulk &amp; Used Oil Storage</td>
<td>Fall 1977 / Fall 2004</td>
<td>Steel &amp; Concrete</td>
</tr>
<tr>
<td>Cap Magazine</td>
<td>Summer 1982</td>
<td>Steel &amp; Wood</td>
</tr>
<tr>
<td>Chlorinator Building</td>
<td>Summer 1979</td>
<td>Steel</td>
</tr>
<tr>
<td>Covered Storage</td>
<td>Summer 1979</td>
<td>Concrete Block</td>
</tr>
<tr>
<td>Diesel Tank</td>
<td>Fall 1996</td>
<td>Steel &amp; Concrete</td>
</tr>
<tr>
<td>Drainage Culverts</td>
<td>Summer 1976</td>
<td>Steel</td>
</tr>
<tr>
<td>Electrical Building</td>
<td>Summer 1977</td>
<td>Concrete Block</td>
</tr>
<tr>
<td>Fan</td>
<td>Winter 1980</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Fans - Mine #1 West Lease</td>
<td>Fall 2012 &amp; Spring 2014</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Fire Water Tank - 300,000</td>
<td>Spring 2002</td>
<td>Steel &amp; Concrete</td>
</tr>
<tr>
<td>Fuel Dock</td>
<td>Summer 1976</td>
<td>Concrete</td>
</tr>
<tr>
<td>Guard House</td>
<td>Summer 1977</td>
<td>Wood</td>
</tr>
<tr>
<td>Load-Out Belt</td>
<td>Summer 1975</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Lower Stacker Coal Storage</td>
<td>Summer 1975</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Lump Coal Belt</td>
<td>Fall 2010</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Lump Coal Storage</td>
<td>Fall 1981, Fall 1982</td>
<td>Concrete</td>
</tr>
<tr>
<td>No. 1 Belt</td>
<td>Fall 1977</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Office Building</td>
<td>September 1973 / 1990 / 2006</td>
<td>Pre-Engineered Steel</td>
</tr>
<tr>
<td>Powder Magazine</td>
<td>Summer 1982</td>
<td>Steel and Wood</td>
</tr>
<tr>
<td>Pulley Racks</td>
<td>Summer 1991</td>
<td>Steel</td>
</tr>
<tr>
<td>Pump Houses</td>
<td>Summer 1967 and 1975</td>
<td>Wood Frame &amp; Metal</td>
</tr>
<tr>
<td>Rock Dust Bin</td>
<td>Fall 1976, Summer 1982</td>
<td>Structural Steel</td>
</tr>
</tbody>
</table>
### TABLE 5-4 (Continued)
Description of Existing Structures

<table>
<thead>
<tr>
<th>Structure</th>
<th>Construction Date</th>
<th>Construction Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROM Coal Storage</td>
<td>Winter 1988</td>
<td>Struct. Steel/Concrete</td>
</tr>
<tr>
<td>ROM MCC Building</td>
<td>Winter 1988</td>
<td>Concrete Block</td>
</tr>
<tr>
<td>Sampler Building</td>
<td>Fall 2003</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Sand &amp; Salt Storage</td>
<td>Fall 2010</td>
<td>Concrete</td>
</tr>
<tr>
<td>Seal Portals</td>
<td>At Reclamation</td>
<td>Concrete</td>
</tr>
<tr>
<td>Sediment Trap</td>
<td>Summer 1979</td>
<td>Concrete</td>
</tr>
<tr>
<td>Septic Tanks</td>
<td>Summer 1976 / Summer 2006</td>
<td>Steel / Concrete</td>
</tr>
<tr>
<td>Shelves</td>
<td>Summer 1990</td>
<td>Steel</td>
</tr>
<tr>
<td>Shop Garage</td>
<td>Summer 1989</td>
<td>Pre-Engineered Steel</td>
</tr>
<tr>
<td>Shop Office</td>
<td>Summer 1977</td>
<td>Wood</td>
</tr>
<tr>
<td>Side Release Tank</td>
<td>Fall 1997</td>
<td>Steel</td>
</tr>
<tr>
<td>Steam Cleaner Building</td>
<td>Fall 1981</td>
<td>Concrete</td>
</tr>
<tr>
<td>Stoker Belt</td>
<td>Fall 1977</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Stoker Bin</td>
<td>Fall 1977</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Stoker Coal Storage</td>
<td>Fall 1982</td>
<td>Concrete</td>
</tr>
<tr>
<td>Stoker Oil Tanks</td>
<td>Fall 1977 / Fall 2004</td>
<td>Steel &amp; Concrete</td>
</tr>
<tr>
<td>Storage Trailers</td>
<td>1975</td>
<td>Wood &amp; Aluminum</td>
</tr>
<tr>
<td>Substation - Lower</td>
<td>Fall 1991 / Fall 2006-2007</td>
<td>Steel /Concrete/ Binwall</td>
</tr>
<tr>
<td>Ticket Printers</td>
<td>Summer 1996</td>
<td>Steel</td>
</tr>
<tr>
<td>Tipple Building</td>
<td>Fall 1977 / Mod. Fall 2008</td>
<td>Struct. Steel &amp; Concrete</td>
</tr>
<tr>
<td>Tipple MCC Building</td>
<td>Summer 2005</td>
<td>Concrete Block</td>
</tr>
<tr>
<td>Tipple Office Building</td>
<td>Fall 1977</td>
<td>Concrete Block</td>
</tr>
<tr>
<td>Structure</td>
<td>Construction Date</td>
<td>Construction Materials</td>
</tr>
<tr>
<td>-------------------------</td>
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<tr>
<td>Transfer Building</td>
<td>Fall 1977</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Truck Loader Bin</td>
<td>Fall 2002</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Truck Scale</td>
<td>1975 / 1982 / 1996</td>
<td>Structural Steel</td>
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<tr>
<td>Warehouse and Shop</td>
<td>Summer 1976</td>
<td>Pre-Engineered Steel</td>
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<td>Warehouse Annex</td>
<td>Spring 2014</td>
<td>Pre-Engineered Steel</td>
</tr>
<tr>
<td>Water Tanks - Lower</td>
<td>Summer 1975/Summer 2002</td>
<td>Steel &amp; Plastic</td>
</tr>
<tr>
<td>Water Tank - Upper</td>
<td>Summer 1975</td>
<td>Steel</td>
</tr>
</tbody>
</table>

**Link Canyon Facilities**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Construction Date</th>
<th>Construction Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link Canyon Portals</td>
<td>Spring 2003</td>
<td>Steel</td>
</tr>
<tr>
<td>Link Canyon Substation</td>
<td>Summer 2000</td>
<td>Steel Skid</td>
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</tbody>
</table>

**Four East Facilities**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Construction Date</th>
<th>Construction Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan Generator Building</td>
<td>Fall 2003</td>
<td>Pre-Engineered Steel</td>
</tr>
<tr>
<td>4 East Fan</td>
<td>Spring 1996, Spring 2018*</td>
<td>Structural Steel</td>
</tr>
</tbody>
</table>

* Concrete foundation extension (Drawing located in Appendix 5-9)
To the extent possible, using the best technology currently available, minimizes damage to fish, wildlife, and related environmental values, and

Minimizes additional contributions of suspended solids to stream flow or runoff outside the permit area.

All support facilities will be removed following mining in accordance with the reclamation plan discussed in Section 5.40.

Water Pollution Control Facilities. Water pollution control facilities at the SUFCO Mine consist of the sedimentation ponds, the appurtenant structures associated with the sedimentation ponds, and the sewage disposal leach field. All water pollution control facilities will be removed following mining in accordance with the reclamation plan discussed in Section 5.40.

The sedimentation ponds and appurtenant structures have been constructed as discussed in Chapter 7 and are used and maintained as discussed in Section 5.3.3.7. Sanitary sewage is routed by gravity through a pipeline from the mine surface facility to the leach field at the location in Convulsion Canyon shown on Plate 5-2B. The sewage facilities were designed for a projected total employment of 300 to 330 persons. A special-use permit has been obtained from the U.S. Forest Service and an operational permit has been obtained from the Utah Department of Health for use of the leach field. Copies of these permits are provided in Appendix 5-6.

5.2.7 Transportation Facilities

5.2.7.1 Road Classification
The mine access road is a primary public road. The truck haul loop through the yard and across the scale is a primary haul road. The access road to the office building and the shop/warehouse complex is an ancillary road. The access roads to the Link Canyon Substation No. 1 and No. 2 and Link Canyon Portal are an ancillary road. All other roads in the vicinity of the mine are public roads, most of which pre-date the mine. These public roads are not used for transporting
coal and are only infrequently used by mine personnel for access to the water system, the electrical substations (East Side USFS Public Stock Trail and Link Canyon Road), for the performance of subsidence surveys, or for the collection of environmental monitoring data. These public roads are, therefore, classified as primary roads because they will be retained for an approved postmining land use after mine reclamation.

5.2.7.2 Description of Transportation Facilities

No surface conveyors (other than those in the mine yard immediately adjacent to the portals) or rail systems have been or will be constructed, used, or maintained within the permit area.

Conveyor Specifications. The conveyors within the surface facility complex are used to transport and stockpile coal. These conveyor locations are shown on Plate 5-2A. The No. 1 Belt, Loadout Belt, and ROM Belts are 54" covered rigid structure conveyor belts. The Stacker Conveyor and Stoker Belt are 42" covered rigid structure conveyor belts. The Reclaim Belts are 42" uncovered catenary conveyor belts. The lump coal conveyor is a 36" covered rigid structure conveyor belt.

Road Specifications. Cross sections and profiles of roads that are used or maintained by SUFCO Mine are provided on Plate 5-9 and 5-2D. Information regarding road drainage structures is presented in Chapter 7.

The mine access road is a county road that extends from Interstate Highway 70 to the mine (a distance of 9.95 miles). This road is classified as a collector road in the State collector system. It was upgraded from a dirt Forest Service road in 1977.

The Utah Department of Transportation (UDOT) coordinated the upgrade of the road under a contract between Coastal States Energy Company, Sevier County, and UDOT. Coastal States initially paid for the work and was later reimbursed by the state under provisions of the Resource Development Act of 1975.
The road has a 28-foot finished width. The reconstruction consisted of 17.5 inches of untreated base course followed by 2.5 inches of gravel sub-base. The first paving course was a 3-inch bituminous lift. This was followed by a 4.5-inch bituminous surface course. A seal coat with 0.75-inch chips provides the wear surface.

SUFCO Mine constructed an ancillary road in 1980 extending from the mine access road to the sedimentation pond. The purpose of this road was to permit access to the pond area during construction activities. The road was retained following pond construction to permit access during pond maintenance (sediment removal, etc.).

A cross section of the sedimentation-pond access road is provided on Plate 5-9. This dirt road has a width of 22 feet. The road slopes into the hillside, with a drainage ditch being present where the road meets the toe of the hill.

The truck loop road is a paved road about 20 feet in width. It is constructed across the yard area and has an adequate base to support the 4 to 12 inch of asphalt paving. The access road to the office and shop/warehouse complex is of varying width and has both asphalt and gravel sections. This road has berms along steep down slopes of adequate height to prevent vehicles from leaving the road and going down the slope. Drainage from both the truck loop road and the access road to the office and shop/warehouse complex is routed to the sediment trap and then to the sediment pond for treatment.

The East Side USFS Public Stock Trail is a U.S. Forest Service road that has been upgraded within the disturbed area boundary to allow occasional vehicular traffic to the substation and fire water tank above the office building. The upgrade portion of this road has water bars and riprap to minimize erosion. Chapter 7 discusses the design of these controls in detail.

The Link Canyon Substation No. 1 and No. 2 and Link Canyon Portal access roads are a graveled dirt road about 16 feet in width. The Link Canyon access roads have a ditch that runs next to the road to minimize erosion. A cross section of the Link Canyon Substation No. 1...
access road is provided on Plate 5-2D, cross section of the Link Canyon Substation No. 2 access road is provided on Plate 5-2E and cross section of the Link Canyon Portal access road is provided on Plate 5-2F. Chapter 7 discusses the design of these controls in detail.

The remaining roads used by SUFCO Mine are public roads that are owned and maintained by the U.S. Forest Service. These roads are generally unimproved dirt roads and are used for access to mine utilities as well as access to the lease area surfaces for the collection of monitoring data (environmental and subsidence data).

**Drainageway Alterations.** No alterations or relocations of natural drainageways are anticipated within the permit area to accommodate the needs of transportation systems.

**Road Maintenance.** The mine access road contract charges Coastal States with maintenance expenses above those received by Sevier County from Class B road funds. These Class B road funds are discretionary and are used by the county for salaries, equipment, and road maintenance projects on all Class B roads in the county. SUFCO Mine has been primarily responsible for road maintenance.

The mine access road is maintained to provide a safe and efficient transportation unit. Periodic repairs (including surface asphalt repair, ditch grading and repair, etc.) are made to the road as needed to keep the road in good working condition. SUFCO Mine provides primary maintenance of the mine access road (including snow removal and repair) from the edge of the permit area to the junction of the frontage road adjacent to Interstate Highway 70. The county and the State have both assisted in snow removal.

In the event that a catastrophic event occurs that causes damage to the mine access road, SUFCO Mine will repair that portion of the road that is present within the permit area as soon as practical after the damage has occurred. Furthermore, SUFCO Mine will cooperate with the county to promote rapid repair of that portion of the mine access road outside of the permit area as soon as practical following catastrophic damage.
The sedimentation-pond access road is maintained by SUFCO Mine as necessary to permit access to the pond during sediment removal. The truck loop road and the access road to the office and shop/warehouse complex are maintained by SUFCO Mine as necessary to provide a safe, smooth surface for vehicular traffic. The East Side road, Link Canyon Substation No. 2 access road and Link Canyon Portal access road are maintained as necessary within the disturbed area boundaries by SUFCO Mine to minimize erosion and allow occasional access to the substations. No sand or salt is applied within the disturbed area boundaries for snow and ice removal. The remaining roads in the lease area are maintained by the U.S. Forest Service. SUFCO Mine has committed to repair damage to these public roads if this damage results from mining activities (e.g., subsidence).

5.2.8 Handling and Disposal of Coal, Excess Spoil, and Coal Mine Waste

5.2.8.1 Coal Handling and Transportation
Coal is removed from the underground workings using the mining methods and conveyor system described in Section 5.2.3. A material flow diagram for the surface at the mine portal is provided in Figure 5-1.

Run-of-mine coal is brought out of the mine by conveyor belt to a transfer bin. From the transfer bin, the coal is fed either to a temporary storage silo or to the crushing and screening system. After crushing and screening, the coal is loaded onto trucks (either through the truck loadout tube or by front-end loader) and transported. Lump, stoker, and crushed coal circuits exist in the system.

5.2.8.2 Overburden
No overburden is removed, handled, stored, or transported within the permit area.

5.2.8.3 Spoil, Coal Processing Waste, Non-Coal Waste, and Mine Development Waste

Excess Spoil. No spoil is generated at the SUFCO Mine.
Coal Processing Waste. SUFCO Mine does not process their coal beyond crushing and screening. Thus, no coal processing waste is generated in the permit area.

Non-Coal Mine Waste. Non-coal (non-waste rock) waste generated in the permit area is temporarily stored in a protected concrete trash pit area near the guard house at the location shown on Plate 5-2A. Once a sufficient amount of this waste accumulates to justify removal (approximately 2 to 3 times per week), the non-coal waste is loaded onto a truck with a front-end loader and hauled to the Sevier County Landfill (see Section 5.2.1.1).

No non-coal (non-waste rock) waste is permanently disposed of within the permit area. No non-coal waste that is defined as hazardous under 40 CFR 261 is currently generated at the mine. If such waste is generated in the future, it will be handled in accordance with the requirements of Subtitle C of the Resource Conservation and Recovery Act and any implementing regulations.

Underground Development Waste. Complete descriptions of the construction, use, maintenance, and removal of the waste-rock disposal facility are provided in the M&RP Volume 3 of this M&RP. This facility has been designed to accept approximately 10,000 tons of waste material per year for a projected period of at least 20 years.

Minimization of Acid, Toxic, and Fire Hazards. Data presented in Volume 3 of this M&RP and in Chapter 6 indicate that no materials at the site are acid forming. These same documents indicates that the waste rock has the potential of being slightly toxic forming with respect to boron. Should an acid- or toxic-forming problem with the waste rock be identified during future sample collection, those materials so identified will be buried within 30 days after the material is exposed at the mine site.

The area used for temporary storage of debris generated at the mine is protected from the wind by walls on three sides. The access to the storage area is sloped inward to prevent water from running off the waste pile prior to removal. Because debris that is generated at the mine site
is only temporarily stored at the mine prior to off-site disposal, there is no significant potential for
this debris to spontaneously combust. Fire extinguishers are kept on mobile equipment in the
mine yard to extinguish any fires should combustion of the waste materials occur. Waste
materials that constitute a fire hazard (e.g., grease, lubricants, paints, and flammable liquids) will
be stored in such a manner as to minimize any fire hazard. Empty containers of such products
will only be stored temporarily at the mine-site prior to proper off site disposal.

5.2.8.4 Dams, Embankments, and Impoundments

No dams, embankments, or impoundments are used for the handling or disposal of coal,
overburden, excess spoil, or coal mine waste in the permit area.

5.2.9 Management of Mine Openings
Thirteen underground mine openings exist within the permit area. Locations of these portals are
shown on Plates 5-2A,C,&F. Six of these openings are located at the mine surface facilities in
East Spring Canyon and serve as primary pathways for ingress and egress of personnel and
machinery, removal of coal from the mine, and mine ventilation. The are located as follows:

- East Spring Canyon portals - 4 portals and 2 intakes
- 3 East portals - 2 intakes
- Quitchupah portals - 2 intakes
- 4 East portals - 1 intake and 1 portal
- Link Canyon Portal - 1 intake

These remaining (non-East Spring Canyon) openings are used for mine ventilation and
emergency egress. Each of these supplementary intakes is protected from unauthorized entry by
the installation of steel sets and a locked chain-link gate. The keys for the gates are kept
approximately 25 feet from the gates inside the mine. This permits emergency exit from the mine
but prevents entrance from the outside.
Each underground mine opening is protected from deterioration through the installation of steel portal liner, steel sets, and timbers. These protective measures are inspected weekly to ensure that they remain in good condition.

Any portals which become temporarily inactive in the permit area, but have a further projected useful service, will be protected through the installation of a lockable chain-link gate as described above to prevent unauthorized entry. Warning signs will be posted to identify the hazardous nature of the opening. These protection and warning devices will be periodically inspected and maintained in good operating condition during the period of temporary inactivity.
5.30 Operational Design Criteria and Plans

5.3.1 General
This application contains a general plan for each sedimentation pond within the permit area. No other water impoundments or coal processing waste banks, dams, or embankments exist in the permit area.

No minable coal exists beneath the sedimentation ponds. Thus, subsidence will not affect operation of the ponds.

5.3.2 Sediment Control
Sediment-control measures for the SUFCO Mine and Link Canyon facilities are described in detail in Section 7.3.2. The sedimentation structures at the portal facilities consist of a concrete sediment basin in the mine yard, a primary sedimentation pond at the bottom of the fill slope upon which the mine yard is constructed and an overflow pond 800 feet below the primary sedimentation pond. At the waste-rock disposal site, a sedimentation pond and a decant pond have been constructed. Runoff-control structures at the mine yard and the waste-rock disposal site have been designed to convey runoff in a non-erosive manner. Sediment-control measures at the Link Canyon facilities consists of containment berms, gravel and silt fencing.

In addition to the use of sedimentation ponds and properly designed runoff-control facilities, sediment yields in the permit area are minimized by:

- Disturbing the smallest practicable area during the construction or modification of surface facilities and

- Contemporaneously reclaiming areas suitable for such reclamation.

During construction of the new overflow pond sediment from the disturbed area will be controlled by the use of containment berms and silt fencing.

5.3.3 Impoundments
5.3.3.1 Slope Stability

The only impoundments that are constructed, used, or maintained by SUFCO Mine are the sedimentation ponds at the portal facilities and the waste-rock disposal site. A slope-stability analysis for the primary sedimentation pond is provided in Appendix 5-7. According to this analysis, the minimum safety factors for the primary pond embankment are 2.2 under static conditions and 1.4 under seismic conditions. A slope-stability analysis for the overflow pond is provided in Appendix 7-23. These safety factors exceed the minimum requirements of R645-301-533.100.

A slope-stability analysis for the waste-rock disposal site sedimentation pond is presented in Appendix 5-7. According to this analysis, the minimum safety factors for the waste-rock area pond embankment are 2.8 under static conditions and 1.5 under seismic conditions. These safety factors exceed the minimum requirements of R645-301-533.100.

5.3.3.2 Foundation Considerations

No conditions were encountered during construction of the sedimentation ponds that suggested that the foundations upon which the ponds were constructed would be unstable. The slope-stability analyses presented in Appendix 5-7 indicate that the pond foundations will be stable under operating conditions.

Prior to construction of each sedimentation pond, all vegetative matter and topsoil was removed from the foundation area. Stability of the ponds has been enhanced through the installation of cutoff trenches and antiseep collars. Detailed cross sections of the sedimentation ponds are presented on Plates 7-5, 7-5A and in Volume 3.

5.3.3.3 Slope Protection

The outslopes and inslopes of the sedimentation ponds were revegetated following construction to minimize surface erosion and protect the embankments against sudden drawdown.
The primary sediment pond has 2H:1V to 3H:1V inslopes (Plate 7-5). The overflow pond has 2H:1V to 3H:1V inslope (Plate 7-5A). The waste rock disposal site sedimentation pond has a 3H:1V inslope (Volume 3 of this M&RP). Surface erosion would be minimized by the flatness of the inslopes.

In the event of a storm, rapid drawdown in the primary sedimentation pond would be restricted to the vertical distance between the spillway and the peak water level, a distance of 0.20 ft (Plate 7-5). The maximum drawdown in the overflow pond during a storm event is 0.74 ft (Plate 7-5A). The maximum drawdown in the waste rock disposal site sedimentation pond during a storm event is 1.1 ft (Appendix II, Volume 3). Drawdown of this size is not significant and, given the flatness of the inslopes, is not of erosional concern.

During decant of the sedimentation ponds, flow is controlled and is unlikely to cause surface erosion.

5.3.3.4 Embankment Faces
Embankment inslopes and outslopes were revegetated following construction of the sedimentation ponds. Riprap was also placed on the upstream faces of the embankments near the discharge structures.

5.3.3.5 Highwalls
No highwalls are located below the water lines of the sedimentation ponds.

5.3.3.6 MSHA Criteria
No sedimentation ponds in the permit area meet the size criteria of 30 CFR 216(a).

5.3.3.7 Pond Operation and Maintenance Plans
Each sedimentation pond is designed in accordance with R645-301-740. Details of these designs are presented in Chapter 7 and in Volume 3.

The sedimentation ponds are operated as containment structures, with primary and emergency spillways to discharge water during a storm that exceeds the design capacity. Excess water following a runoff event is held in the ponds until the suspended sediment settles. Water is decanted in accordance with the discharge permit and 40 CFR 434 effluent limitations.

The decant devices for the three sedimentation ponds consist of an inverted section of 12-inch diameter iron pipe connected to iron pipe at the primary sediment pond, an inverted section of 24-inch CMP pipe connected to an 18-inch pipe at the overflow pond and an inverted section of 12-inch CMP connected to 12-inch CMP pipe at the Waste Rock Disposal Site. Outflow from the decant
devices is controlled by locked gate valves. Keys to the locks are maintained at the mine office. Details of the design of these decant devices are provided in Chapter 7.

Inspections of the sedimentation ponds are conducted on a quarterly basis (see Section 5.1.4.3). Maintenance that is required to keep the ponds in good working condition is performed as soon as practical following discovery of a maintenance need.

Sediment is removed from the ponds when it accumulates to 60 percent of the design sediment storage volume. This removed sediment is disposed of in the waste-rock disposal area.

5.3.4 Roads

5.3.4.1 Location, Design, Construction, Reconstruction, Use, Maintenance, and Reclamation

Control of Damage to Public or Private Property. All roads used by SUFCO Mine were designed in accordance with applicable county, UDOT, and U.S. Forest Service standards. By designing according to these standards, damage to public or private property has been minimized.

Road Surfacing. The surface of the mine access road consists of asphalt with a rock-chip wear surface (see Section 5.2.7.2). All ancillary roads are unimproved dirt roads. No acid- or toxic-forming materials have been used in the road surfaces.

Appendix 5-11 contains design drawing and information pertaining to the paving of an area in the upper mine yard and the repair and re-paving of the area between the shop/warehouse and the ambulance garage/Dodge Shop/steam bay/dog house and repaving of an area behind the shop/warehouse building. The areas to be paved will also have three segments of concrete ditch with drop drains. The drop drain will direct surface runoff into existing culverts, which discharge water into the sediment pond for treatment.

A fourth drop drain located in the left hand corner of the site plan drawing (Appendix 5-11) will collect water and direct the water through a drain pipe, inserted through a concrete wall to the lower yard. In the second phase of the paving and drainage installation the drain pipe through the concrete wall will be connected to a pipeline and connected to an existing pipeline. The water will proceed per the permitted drainage plan, through the yard to the sediment pond.

The design of the Type 2 junction box has a single inlet/outlet, the design of the Type 3 junction has multiple inlets/outlets, the dimensions are the same for either box see the Site Drainage Detail Sheet drawing G-9 in Appendix 5-11 for the dimensions.
Sufco Parking Lot (Constructed 1950's) - A plan has been provided in Appendix 5-12 for the replacement of the asphalt in parking area adjacent to the mine office building. After removal and prior to replacing the asphalt, the area will be re-graded to slope to the center of the parking area where an installed concrete waterway will assist in directing precipitation/water into structures in the permitted drainage plan to the sediment pond.

If necessary a grade ring will be added to the existing manhole to bring the manhole cover up to the grade of the replaced asphalt.

Due to the limited knowledge of the material beneath the existing asphalt there is uncertainty to whether existing material or acquired untreated base course will be used. Existing native material will be used for the construction base when it’s characteristics meet compaction standards, however when required untreated base course (0-8") will be used. Excess native material generated during the regrading of the parking lot area depending on its quality will be hauled to the waste rock site and either mixed with the waste or placed on the subsoil pile. The area to be re-paved ties into existing features on each end which will require the grade to be similar to the grade prior to the repaving and installation of the concrete waterway. The reclamation cut/fill calculations for this area should remain unchanged.

Slope Stability. The stability of the mine access road embankment has been evaluated where the road enters the permit area. Results of this evaluation are presented in Appendix 5-8. This analysis indicates that the access road embankment has a minimum safety factor of 1.7 under static conditions. This value exceeds the safety factor of 1.3 required by R645-301-534.130.

An evaluation of the stability of the sedimentation-pond access road embankment is presented in Appendix 5-8. This evaluation indicates that the minimum static safety factor of the sedimentation-pond road embankment is 1.7. This value also exceeds the safety factor of 1.3 required by R645-301-534.130.

All other roads in the lease area are owned and maintained by the U.S. Forest Service. No stability problems have been noted on these roads.

5.3.4.2 Environmental Protection and Safety
Safety and environmental protection were primary concerns during the design and reconstruction of the mine access road and construction of the sedimentation-pond access road. The grade, width, and surface materials used for the roads were selected to be appropriate for the planned duration and use of the roads.
5.3.4.3 Primary Roads

General. The only primary road (outside of the disturbed area boundary) used or maintained by SUFCO Mine is the mine access road. The extension of this primary road within the disturbed area boundary is known as the truck loop road. This road was designed and constructed in consultation with the U.S. Forest Service in a manner that provided protection to fish, wildlife, and related environmental values. The road is being maintained by SUFCO Mine to meet its design standards throughout the life of the mining and reclamation activities. Catastrophic events are repaired as soon as practical after the damage occurs.

The mine access road was designed and reconstructed and is used and maintained in a manner that prevents damage to public or private property. Only nonacid- and nontoxic-forming materials were used to surface the road. The road embankments have a minimum static safety factor in excess of 1.3. Any portion of the road within the permit area that is not to be retained for use under an approved post-mining land use will be reclaimed immediately after it is no longer needed for mining and reclamation operations.

Road Alignment. The reconstructed mine access road was located generally along the alignment of the former dirt road. The former road location had been in existence for many years and had not experienced major stability problems. Thus, the road is located on the most stable available surface, giving consideration also to safety and environmental protection.

Road Surfacing. The mine access road is surfaced with asphalt with a rock-chip wear surface. This surface was designed to account for the anticipated volume of traffic as well as the weight and speed of vehicles using the road. No problems have been encountered with the road surface since its construction in 1977.

Road Maintenance. The mine access road is maintained by SUFCO Mine in cooperation with the county and UDOT. As required, SUFCO Mine repairs the road surface, blades the adjacent drainage ditches, fills potholes, and resurfaces the road. Where necessary, minor reconstruction of road segments will occur, together with revegetation of road cuts and fills and removal of brush.

Road Culverts. All culverts along the mine access road were installed and are maintained in accordance with manufacturers recommendations. Thus, these culverts have sustained the vertical soil pressure, the passive resistance of the foundation, and the weight of vehicles using the road. No evidence of structural problems has been observed with the culverts.
5.3.5 Spoil
No spoil is generated in the permit area.

5.3.6 Coal Mine Waste
A detailed description of disposal of coal mine waste resulting from mining activities at the SUFCO Mine is provided in Volume 3 of this M&RP. That document is summarized in this section.

5.3.6.1 Design
The waste-rock disposal facility was designed with a minimum static safety factor of 2.62. This design and the associated evaluations were based on the results of detailed foundation and laboratory analyses of soils at the site of the disposal facility.

5.3.6.2 Waste Emplacement
Waste rock is placed at the disposal site in a manner that enhances the stability of the waste pile. The waste is placed in horizontal lifts that do not exceed three feet in thickness. The material is dumped from the haul trucks. Dozers are used to rework and initially compact the dumped material. Additional compaction of each lift is accomplished by routing the loaded haul trucks over the lift surface in such a manner as to cover the entire area uniformly. The waste rock is covered periodically to minimize public hazards and the potential for spontaneous combustion.

5.3.6.3 Excess Spoil Fills
No excess spoil fills exist in the permit area.

5.3.6.4 Impounding Structures Constructed of Coal Mine Waste
No impounding structures have been constructed of coal mine waste in the permit area.

5.3.6.5 Disposal of Coal Mine Waste in Special Areas
No coal mine waste is disposed of in special areas in the permit area.

5.3.6.6 Underground Development Waste
A detailed description of the geotechnical investigations, design, construction, operation, maintenance, and reclamation of the waste-rock disposal site is provided in Volume 3. This M&RP also contains:
A description of pre-disturbance soil resources at the waste-rock disposal site,

A description of plans for stockpiling topsoil at the waste-rock disposal site, and

A discussion of the suitability of the material for reclamation.

5.3.6.7 Coal Processing Waste
No coal processing waste is generated within the permit area.

5.3.6.8 Coal Processing Waste Banks, Dams, and Embankments
No coal processing waste banks, dams, or embankments exist within the permit area.

5.3.6.9 Refuse Piles
A detailed description of the waste-rock disposal site is provided in Volume 3 of this M&RP. This M&RP volume contains:

A description of pre-disturbance soils at the site and the suitability of the waste rock for reclamation,

Certification of the design and plans,

Compliance with applicable MSHA regulations,

A description of proposed inspection activities,

A description of the design, stability, operation, and reclamation of the waste-rock site, and

A discussion of runoff- and sediment-control plans associated with the site.

5.3.7 Regraded Slopes

5.3.7.1 Division Approval
No mining or reclamation activities are conducted in the permit area that require approval of the UDOGM for alternative specifications or for steep cut slopes due to the inability of SUFCO Mine to meet regulatory requirements for:
  o Protection of fish, wildlife, and related environmental values (R645-301-358),
  o Certification of the design of the mine access road (R645-301-512.250),
  o Road classification (R645-301-527.100),
  o Maintenance of roads to meet their design standards throughout their use or remediation of damage caused by catastrophic events (R645-301-527.230),
  o Location, design, construction, reconstruction, use, maintenance, or reclamation of roads in a manner that prevents damage to public or private property, utilizes nonacid- and nontoxic-forming substances in road surfacing, and achieves an acceptable static safety factor against slope failure (R645-301-534.100),
  o Design of roads to ensure environmental protection and safety (R645-301-534.200),
  o Design, location, surfacing, maintenance, and drainage of primary roads in a manner that allows continued use of the road (R645-301-534.300),
  o Retention of a road following reclamation that is not necessary as part of an approved post-mining land use (R645-301-542.600 and R645-301-762), and
  o Road drainage (R645-301-742.410, R645-301-742.420, and R645-301-752.200).

5.3.7.2 Regrading of Settled and Revegetated Fills
SUFCO Mine is requesting a variance from the approximate original contour requirements of R645-301-553.600. This request is presented in Appendix 5-2. The variance request is not based on the presence of settled and revegetated fills.
5.40 Reclamation Plan

5.4.1 General

5.4.1.1 Commitment
Upon the permanent cessation of coal mining and reclamation operations at the SUFCO Mine, SUFCO Mine will close, backfill, or otherwise permanently reclaim all affected areas in accordance with the R645 regulations and this reclamation plan.

2RWL Sinkhole - Mimicking natural sinkhole features in the area, the permittee accomplished the reclamation of the sinkhole with the following steps.
Temporary access to the hole was made from FR007 to the hole; topsoil was removed from the perimeter of the existing hole and stockpiled for immediate replacement; the sandstone on the interior of the hole was broken up and pushed towards the hole's center; the hole was graded to approximately 2.5:1 slopes, reducing the depth from approximately 40' to 26'; approximately 6 - 8" of topsoil was placed; the hole was pocked; and the hole, access corridor and immediate areas were seeded.

5.4.1.2 Surface Coal Mining and Reclamation Activities
No surface coal mining and reclamation activities are conducted in the permit area.

5.4.1.3 Underground Coal Mining and Reclamation Activities
All surface equipment, structures, or other facilities not required for continued underground mining activities and monitoring, unless approved by the UDOGM as suitable for the post-mining land use or environmental monitoring, will be removed and the affected lands reclaimed.

5.4.1.4 Environmental Protection Performance Standards
The plan presented herein is designed to meet the requirements of R645-301 and the environmental protection performance standards of the State Program.

5.4.2 Narratives, Maps, and Plans

5.4.2.1 Reclamation Timetable
A timetable for the completion of each major step in the reclamation plan is presented in Figure 5-2.

5.4.2.2 Plan for Backfilling, Soil Stabilization, Compacting, and Grading
The regrading plan for the waste rock disposal facility is presented in Volume 3. Regrading at the waste rock facility will occur on a continuing basis as the rock is emplaced.
<table>
<thead>
<tr>
<th>TASK</th>
<th>MONTHS FROM START OF RECLAMATION</th>
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<tbody>
<tr>
<td>REMOVE UNDERGROUND FACILITIES</td>
<td></td>
</tr>
<tr>
<td>SEAL MINE OPENINGS</td>
<td></td>
</tr>
<tr>
<td>DEMOLISH SURFACE STRUCTURES</td>
<td></td>
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<tr>
<td>REMOVE BUILDING FOUNDATIONS (AS NECESSARY)</td>
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<tr>
<td>EARTHWORK IN SOUTHERN SLOPE</td>
<td></td>
</tr>
<tr>
<td>REMOVE SEDIMENTATION POND</td>
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</tr>
<tr>
<td>INSTALL INTERIM SEDIMENT CONTROL</td>
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<tr>
<td>BACKFILLING AND COMPACTION</td>
<td></td>
</tr>
<tr>
<td>CONSTRUCT MAIN CHANNEL INLET</td>
<td></td>
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<tr>
<td>SEAL OR REMOVE CULVERTS</td>
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<tr>
<td>CONSTRUCT MAIN CHANNEL</td>
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<tr>
<td>CONSTRUCT WEST COLLECTOR CHANNEL</td>
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<tr>
<td>CONSTRUCT EAST COLLECTOR CHANNEL</td>
<td></td>
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<tr>
<td>CONSTRUCT TRIBUTARY CHANNELS</td>
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<tr>
<td>PLACE TOPSOIL</td>
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<td>REVEGETATE</td>
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<tr>
<td>RECLAIM ROADS</td>
<td></td>
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<tr>
<td>RECLAIM WASTE ROCK AREA</td>
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</tbody>
</table>

NOTE: SCHEDULE ASSUMES THAT WEATHER CONDITIONS WILL BE CONDUCIVE TO RECLAMATION ACTIVITIES.

FIGURE 5-2. RECLAMATION TIMETABLE
The regrading plan for all mine openings is presented in Section 5.4.2.7 of this M&RP.

The regrading plan for the 4E Fan facility area will be to reclaim it for its entire length. The pre-existing slopes for the 4E Fan facility area will be restored to the extent possible and in accordance with Approximate Original Contour regulations using all the fill material stored in the pad area. The slopes will be constructed using equipment small enough to be transported through the mine such as backhoes and dozers to move the soil. The surface of the replaced soil will be prepared for reseeding as specified in Section 2.4.2 of this M&RP. Soil compaction will be avoided as much as possible through limiting the number of equipment passes over a given area. The area will be reseeded in accordance with the methods described in Section 3.40 of the permit. Since the reclaimed acreage will be the same as the pad disturbed area, erosion controls for final reclamation will be placed in essentially the same location as shown on Plate 5-2C. The reclamation soil surface and vegetation will be monitored and maintained in accordance with this M&RP.

The regrading plan for the Link Canyon Portal and Link Canyon Substation No. 1 and No. 2 facility areas will be to reclaim them for their entire length. The pre-existing slopes for the Link Canyon Portal and Link Canyon Substation No. 1 and No. 2 facility areas will be restored to the extent possible and in accordance with Approximate Original Contour regulations using all the fill material stored in the three respective pad areas. The power cable and communication boreholes at Link Canyon Substation No. 2 will be capped, sealed, and plugged with concrete as described in section 7.6.5 of this M&RP. The marker flagging as described in Section 2.3.1.1 separating the original, undisturbed topsoil surface beneath the stockpiled topsoil will need to be located and used as a guide when removing the side cast materials stored on the outslope. The slopes will be constructed using equipment such as trackhoes and dozers to move the soil. Topsoil from the Link Canyon Portal topsoil storage pile, the Link Canyon Substation No. 1 outslope topsoil storage area and the Link Canyon Substation No. 2 topsoil storage pile will be redistributed over the newly restored slope as indicated in Section 2.4.2. The surface of the replaced soil and the original, undisturbed topsoil surface beneath the stockpiled topsoil will be prepared for reseeding as specified in Section 2.4.2 of this M&RP. Soil compaction will be avoided as much as possible through limiting the number of equipment passes over a given area. The area will be reseeded in accordance with the methods.
described in Section 3.40 of the permit. Since the reclaimed acreage will be the same as the pad disturbed area, erosion controls for final reclamation will be placed in essentially the same location as shown on Plates 5-2D, 5-2E, and 5-2F. The reclaimed pads, access roads, and affected slopes will be fenced with a three-strand barbwire fence to prevent damage from cattle grazing during reclamation. The reclamation soil surface and vegetation will be monitored and maintained in accordance with this M&RP.

The regrading plan for the East Spring Canyon facility is summarized below. Engineering calculations and design details associated with this regrading plan are presented in Appendix 2-4. The East Spring Canyon regrading plan was designed to meet the objectives of balancing cut and fill quantities, maintaining a geotechnically stable surface configuration, and controlling erosion. Major features of the East Spring Canyon regrading plan are:

- Reduction of the slope at the southern end of the mine-yard fill,
- Removal of the sedimentation pond dams and implementation of interim sediment-control measures,
- Backfilling to remove highwalls and cut slopes to the extent possible within the objectives noted above (cut and fill balance, site stability, and erosion control),
- Construction of an armored embankment at the inlet of the main reclamation channel, and
- Construction of reclamation diversion channels.

The estimated cut quantity for East Spring Canyon is approximately 74,734 cubic yards with an estimated fill of 71,173 cubic yards (see Appendix 2-4). The difference between these two quantities is anticipated to be balanced by compaction. Regrading activities will continue until the final surface configuration defined by Plates 5-3A&B and 5-4 has been achieved. Details regarding topsoil placement and revegetation following regrading are provided in Chapters 2 and 3, respectively.

The Warehouse Annex building will be constructed in an area which has existing drainage controls and the soil have been pre-disturbed (Plate 5-2A & 5-2B). The area will be leveled to allow access to the building by small equipment and delivery trucks.
A soil nail wall will be constructed to stabilize the slope directly behind the Annex building. The technique uses grouted tension-resisting steel elements drilled into an exposed soil face and grouted into place. Design details and drawings associated with the soil nail wall (shotcrete) and soil nails is located in Appendix 5-11. Sheet 1.2 illustrates the location of the wall and soil nails. As noted on Sheet 1.2 the exact length of the wall will need to be field-fit, thus on the illustration the location of soil nails extends beyond the end of the wall. Sheet No. 1.4 illustrates the soil material to be removed to facilitate the instillation of the wall and facilitate the insertion of the soil nails.

The soil nails will remain in the slope and covered with soil during reclamation, the shotcrete wall will be broken up and buried during reclamation. Bonding for the removal of the shotcrete wall has been provided in Appendix 5-9. The reclamation contours of the slope are shown on Plate 5-3B.

**Building and Utility Demolition.** Prior to significant regrading activities at the East Spring Canyon facility, existing buildings, walls, utilities, coal-handling facilities, and other above-ground structures will be removed from the area. To the extent possible, these structures and facilities will be salvaged. Those materials requiring off-site disposal will be placed in a licensed landfill. Final decisions regarding salvage or disposal of structures and equipment will be made just prior to reclamation following an assessment of the salvageability of the structures and equipment. If foundations and buried utilities will not interfere with regrading activities, they will be left in place for on-site burial. The water and sewer lines were installed and buried prior to Aug. 3, 1977 under a Special Use Permit with the Forest Service and will be left in place upon completion of mining activities.

**Southern Slope Regrading.** The present slope at the southern end of the mine yard will be cut from its existing continuous slope of approximately 1.4H:1V to a slope of 2.5H:1V in the center of the slope. The regraded slope will taper along the east and west sides of the slope to blend with the natural slopes. The recontoured slope will have 10-foot wide benches on 80-foot vertical centers to collect slope runoff and minimize the potential for erosion.

Proposed post-reclamation contours of the East Spring Canyon site are presented in Plate 5-3A&B. Analyses presented in Appendix 2-4 indicate that the fill under this configuration will have a minimum static safety factor against failure of 1.51.
reduce cut slopes in the mine yard and achieve the final surface configuration presented on Plate 5-3A&B.

**Primary Sedimentation Pond, Overflow Pond and Dam Removal and Interim Sediment Control.** The existing primary sedimentation pond at the base of the mine-yard fill slope will be removed to allow construction of the main reclamation stream channel. All of the fill material from the pond and the dam west of the reclamation channel will be removed. This material will be used as fill in the mine-yard area as needed to reduce final slope grades. The pond and dam fill material east of the reclamation channel will be cut back to a 2H:1V slope above the rock channel. The regrading plan for the overflow pond will be to reclaim the area for its entire length. The pre-existing slopes and channel for the overflow pond area will be restored to the extent possible and in accordance with Approximate Original Contour regulations using all the fill material stored in the dam. Topsoil from the overflow pond topsoil storage pile will be redistributed over the newly restored slopes. Removal of the primary sedimentation pond, overflow pond and dam will be accomplished using backhoes, loaders, dozers, and other appropriate earthmoving equipment.

Immediately following removal of the sedimentation pond and dam, silt fences will be installed for interim sediment control at the locations noted on Plate 5-3A&B to control erosion prior to revegetation success. Immediately following removal of the overflow pond and dam, silt fences will be installed for interim sediment control at locations below the area to control erosion prior to revegetation success. These silt fences will be installed as noted in Figure 5-3. In addition to silt fences, straw-bale dikes may be installed on a temporary basis as necessary to control localized erosion prior to the establishment of revegetation efforts. If installed, locations of the straw-bale dikes will be selected to reduce sediment contributions to runoff based on field observations. Straw-bale dikes will be installed as noted in Figure 5-3.

**Backfilling and Compaction.** All vegetation, organic matter, and debris will be cleared from areas to receive fill. The cut material from site regrading, sedimentation pond removal, and channel excavation will be placed as fill and graded to facilitate drainage from the mine site and contributing side areas. All fill placed during recontouring of the site will be compacted to at least 85 percent of maximum Proctor density (ASTM D698). Compaction will be accomplished using repeated passes of rubber-tired equipment, rollers, and other appropriate equipment.

Side hill embankments, where the width (including bench cuts) is too narrow to allow access
Straw-Bale Dike

Filter Fabric

Pursy toe of filter fabric in trench and back-fill

Flow

Source: Barfield et al. (1981)

Silt Fence

Incorporated Effective: Jun 15 2000

Utah Division Oil, Gas and Mining

Figure 5-3. Straw-Bale Dike & Silt Fence Installation Procedures
by compaction equipment, will be initially constructed by end dumping, but only to a width necessary to allow compaction equipment access. After this is achieved, the fill will be placed in lifts and compacted to at least 85 percent of maximum Proctor density. Lifts will be placed with a thickness when compacted of no more than 8 inches. Care will be taken to ensure that fill materials are not frozen during placement or compaction. Any areas that are damaged by freezing will be reconditioned, reshaped, and recompressed to at least 85 percent of maximum Proctor density. All fill placement and compaction activities will be overseen by an experienced engineer.

**Construction of Main Channel Inlet.** The main reclamation channel to be constructed at the site will convey water from East Spring Canyon and Mud Spring Hollow above the mine to East Spring Canyon below the mine. The proposed location of this channel is shown on Plate 5-3A&B. Details regarding channel design are provided in Appendix 2-4.

Deposition of naturally-occurring sediment will occur where East Spring Canyon and Mud Spring Hollow enter the main reclamation channel due to abrupt changes in channel gradient (12 to 17 percent in the natural channels and 2 to 10 percent in the reclamation channel). Therefore, the inlet section for the reclamation channel was designed to provide for sediment accumulation. This inlet will also direct flows from the two undisturbed canyons to the reclamation channel.

The sedimentation area of the inlet section will be constructed by excavating all fill from the section down to undisturbed native materials. The minimum depth of excavation will be 7 feet even if this excavation must occur in bedrock. The excavated bank of the inlet section will be reinforced with riprap where this bank occurs on fill. No reinforcing will be used where the excavated bank occurs in bedrock. The reinforced bank will be keyed into bedrock to prevent underflow via piping. Bank reinforcing will consist of riprap underlain by filter fabric as detailed in Appendix 2-4.

During excavation of the inlet section, the existing bypass culverts for East Spring Canyon and Mud Spring Hollow will be removed.
Construction of Reclamation Channels. Reclamation channels will be constructed at the locations shown on Plate 5-3A&B. The main reclamation channel will be constructed along the east side of the existing fill into bedrock. East and west collector channels will be constructed to capture runoff from undisturbed areas and convey this runoff to the main channel. Intercept channels will also be placed on the southern slope following regrading to minimize erosion of the slope. Details regarding the design and construction of these channels are provided in Appendix 2-4. A summary of the reclamation channel design parameters is presented in Table 5-5.

The main reclamation channel downstream from the inlet will consist of trapezoidal sections cut into bedrock. Bottom widths on these sections will range from 10 to 17.5 feet, with side slopes varying from 1H:1V to 0.75H:1V. The narrower width and steeper side slope will occur where the bottom gradient of the channel is steepest.

All existing fill will be removed from the alignment of the main reclamation channel to ensure that the channel bottoms in bedrock. During this excavation, sections of the channel may be cut deeper than is desirable to maintain the necessary gradient (see Table 5-5). In such areas, coarse rock from the channel excavation will be used to fill undesirable depressions. This rock fill will then be covered with 12 inches of grout meeting the specifications described in Section 5.4.8 of Appendix 2-4.

The main reclamation channel will discharge into the existing stilling basin downstream from the sedimentation pond. No modification of the existing stream channel will occur downstream from the stilling basin.

The west collector channel will be excavated primarily into bedrock at the western edge of the existing mine site. This channel will collect runoff from undisturbed areas west of the site and convey this runoff across the site to the stilling basin downstream from the existing
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<th>Side Slope (H:V)</th>
<th>Bottom Width (ft)</th>
<th>Bank Height (ft)</th>
<th>Design Velocity (ft/s)</th>
<th>Design Flow Depth (ft)</th>
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**Main Channel**

**West Collector Channel**

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**East Collector Channel**

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sedimentation pond. The channel will consist of trapezoidal sections with bottom widths and depths of 2 to 3 feet. The downstream portion of this channel will be constructed in bedrock where it flows down the slope to the main reclamation channel.

The northern portion of the west collector channel will cross fill. At this location, a triangular channel will be constructed, consisting of riprap underlain by filter fabric. Riprap specifications and other details regarding the design and construction of the west collector channel are provided in Appendix 2-4.

A tributary of the west collector channel will be constructed along the top of the regraded southern slope. This tributary will preclude runoff from flowing down the slope, thereby also precluding excessive erosion of the slope. The tributary will be triangular in shape and constructed of riprap overlying filter fabric as noted in Appendix 2-4.

The east collector channel will be cut into bedrock at the head of the existing cut slope along the east side of the mine site. This channel will have two outlets, conveying runoff from undisturbed areas to the main reclamation channel and to the stilling basin downstream from the sedimentation pond. The channel will consist of trapezoidal sections with bottom widths and depths of 2 to 3 feet. Details regarding the design and construction of the east collector channel are provided in Appendix 2-4. The downstream portion of this channel will be constructed in bedrock where it flows down the slope to the main reclamation channel.

Two intercept channels will be constructed on the regraded southern slope. The purpose of these channels will be to reduce the effective slope length, thus minimizing the potential for erosion of the slope. The channels will be constructed on benches that are placed to divide the slope into thirds (see Plate 5-3A&B). The intercept channels will be triangular and lined with riprap and filter fabric. They will discharge to the main reclamation channel. Details regarding the design and construction of the intercept channels are provided in Appendix 2-4.

5.4.2.3 Final Surface Configuration Maps and Cross Sections
Final surface configuration maps and cross sections for the East Spring Canyon site are provided on Plates 5-3A&B and 5-4, respectively. The primary access road to the mine yard will be removed at the permit boundary. Existing public access roads within the lease area will remain following reclamation. No facilities related to the coal mining operations will remain in the permit area following reclamation. Information regarding the final surface configuration of the waste-rock disposal site is provided in Volume 3. Final surface configuration maps and cross sections for the 4E Fan facility, Link Canyon Substation facility and all out-by mine portals are provided on Plates 5-2C, 5-2D, 5-2E and 5-2F, respectively.

5.4.2.4 Removal of Temporary Structures
All surface structures associated with the mining operation will be removed as outlined in Section 5.4.2.2. A description ensuring that all structures and sedimentation ponds have been removed will be provided to the UDOGM before seeking bond release or abandoning the permit area.

5.4.2.5 Removal of Sedimentation Ponds
Information regarding removal of primary sedimentation ponds and overflow pond associated with the SUFCO Mine is provided in Section 5.4.2.2 for the East Spring Canyon facility and in Volume 3 of this M&RP for the waste rock disposal site. The timetable for removal of the minesite ponds is indicted in Figure 5-2.

5.4.2.6 Roads
The primary mine access road will be reclaimed beginning at the guard shack at the entry to the mine yard. This road will be regraded by removing any remaining asphalt, removing fill from beneath the road to the natural ground surface, and placing the fill against the adjacent cut slope. Placement and compaction of the backfill material will be as indicated in Section 5.2.4.2.

Proposed reclamation contours following closure of the mine access road are presented in Plate 5-3A&B. The roadside culvert referred to as Pipe No. 5 (see Chapter 7) that exists immediately south of the guard shack will be retained for runoff control along the unreclaimed portion of the road.
Recontouring of the road surface near the guard shack will result in closure of the road to traffic. In addition, "Dead End" signs that meet UDOT specifications will be placed in the center of the access road where regrading begins and on the access road in Sec. 11, T. 22 S., R. 4 E., where the Convulsion Canyon road departs from the access road to the mine.

The sedimentation pond access road will be reclaimed for its entire length. This road will be regraded by removing fill from beneath the road to the natural ground surface and placing the fill against the adjacent cut slope. Placement and compaction of the backfill material will be as indicated in Section 5.2.4.2. Proposed reclamation contours following closure of the sedimentation pond access road are presented in Plate 5-3A&B. This road will be closed to traffic following reclamation by virtue of its non-existence.

The Link Canyon Portal and Link Canyon Substation No. 1 and No. 2 access roads will be reclaimed for their entire length the same way as the Link Canyon Portal and Link Canyon Substation No. 1 and No. 2 facility areas as described in Section 5.4.2.2 of this M&RP. Original contours of the Link Canyon Portal access road are presented on Plate 5-2F. Original contours of the Link Canyon Substation No. 1 and No. 2 access roads are presented on Plates 5-2D and 5-2E. These roads will be closed to traffic following reclamation by virtue of their non-existence.

Following regrading of the roads, topsoil will be applied to the regraded surfaces and the area will be revegetated. Topsoiling and revegetation activities are discussed in Chapters 2 and 3, respectively.

5.4.2.7 Final Abandonment of Mine Openings and Disposal Areas

Abandonment of Openings. All mine openings will be sealed at least 25 feet inside the mine opening. Prior to installation of the seal, all loose material will be removed from the roof, floor, and rib of the mine within three feet of the seal area. The seal will then be constructed using solid concrete blocks (average minimum compressive strength of 1,800 psi) with nominal dimensions of 6 inches high, 8 inches wide, and 16 inches long. Mortar will consist of one part cement, three parts sand, and no more than seven gallons of water per sack of cement.
The seal will be recessed at least 16 inches deep into each rib and 12 inches deep into the floor. No recess will be made into the roof. In the bottom course, each block will be laid with its long axis parallel to the rib. The long axis in succeedingly higher courses will be perpendicular to the long axis of the blocks in the preceding course. An interlaced pilaster will be constructed in the center.

The seals will have a thickness of approximately 16 inches. Following seal construction, the entries will be backfilled from the seal to the outside surface with soil that is sloped at the surface to match the final slope at the entry. Due to the location of some entries that do not have surface access, such as the 4E Fan facility, the entries will be backfilled from inside the mine before the seal construction. Due to safety reasons, some entries that are completely cribbed off due to bad roof conditions, such as the 3E Portals and Quitchupah Portals, will need to be backfilled with the use of explosives to blast the cribs and roof rock down to fill the entry before the seal construction. The surface soil will then be raked and revegetated with the approved seed mixture.

Alternatively, a cast in place MSHA approved seal will be installed with a minimum thickness of 3 feet and with a minimum compressive strength of 200 psi.

**Disposal of Excess Spoil.** No excess spoil is generated in the permit area.

**Disposal of Coal Mine Waste.** All coal mine waste generated at the SUFCO Mine is disposed of at the waste-rock disposal site. Information regarding disposal practices and reclamation plans for this facility is provided in Volume 3.

**Disposal of Non-Coal Mine Wastes.** All non-coal (non-waste rock) waste generated from mining and reclamation operations is disposed of as outlined in Sections 5.2.1.1 and 5.2.8.3. Following cessation of mining activities, non-coal mine waste that is still temporarily stored at the site will be removed and disposed of in the Sevier County Landfill. Non-coal waste that is generated during the course of reclamation (i.e., as a result of building demolition) will likewise be disposed of at an off-site location (either the Sevier County Landfill or an alternative state-approved solid-waste disposal area).
5.4.2.8 Estimated Cost of Reclamation

The estimated cost to reclaim the SUFCO Mine surface facilities is provided in Appendix 5-9. The paving project for the upper mine yard has been included in the reclamation bond.
5.50 Reclamation Design Criteria and Plans

5.5.1 Casing and Sealing of Underground Openings
Each underground opening to the mine will be sealed and backfilled when no longer needed for monitoring or other use approved by the UDOGM upon a finding of no adverse environmental or health and safety effects. Permanent closure measures will be as described in Section 5.4.2.7. This closure method has been designed to prevent access to the mine workings by people, livestock, fish and wildlife, and machinery. The closures have also been designed to keep water from flowing from the mine workings to prevent acid or other toxic drainage from entering ground and surface waters.

5.5.2 Permanent Features

5.5.2.1 Small Depressions
During final grading and spreading of topsoil, small depressions will be left in the soil. The purpose of these depressions will be to retain moisture, minimize erosion, and assist revegetation.

5.5.2.2 Permanent Impoundments
No permanent impoundments will be left following reclamation.

5.5.3 Backfilling and Grading
Plans for backfilling and grading of the site upon reclamation have been presented in Section 5.4.2.2. This plan was designed to comply with the applicable requirements of R645-301-500 and R645-301-700. As indicated in Section 5.4.2.2, backfilling and grading operations will be conducted in a controlled manner.
5.5.3.1 Disturbed Area Backfilling and Grading

Approximate Original Contour. The pre-SMCRA cut slopes are shown as part of the pre-1977 disturbance on Plate 5-2B. The cut slopes to be retained are shown on Plate 1 of Appendix 5-2 as A-A', B-B', C-C' and D-D'. A study of the existing cliffs in the area (Appendix 5-2) shows that these cut slopes will approximate original contour.

Elimination of Highwalls, Spoil Piles, and Depressions. The backfilling and grading plan has been designed to eliminate highwalls at the site. No spoil piles exist. With the exception of the small depressions discussed in Section 5.5.2.1, the only depressions that will remain at the site following reclamation will be the inlet section of the main reclamation channel (which was designed as a sedimentation structure to prevent clogging and subsequent overtopping of the channel - see Section 5.4.2.2) and the stilling basin at the downstream end of the main reclamation channel (which is being retained to reduce the velocity of flows exiting the channel - see Section 5.4.2.2).

Slope Stability. Backfilled and regraded slopes have been designed to not exceed the angle of repose. Final reclamation slopes have been designed with a minimum static safety factor of 1.51 (see Section 5.4.2.2), thus preventing slides.

Erosion and Water Pollution. Temporary sediment-control measures will be implemented following backfilling and regrading as outlined in Section 5.4.2.2. As vegetation becomes established on the reclaimed surfaces, erosion potentials will be further minimized. By minimizing erosion, water pollution will also be precluded. Additional water-quality concerns do not exist at the site (see Chapter 7).

Post-Mining Land Use. The disturbed area will be backfilled and regraded in a manner that supports the approved post-mining land use.

5.5.3.2 Spoil and Waste

Spoil. No spoil is generated within the permit area.
Refuse Piles. Details regarding the design, operation, final surface configuration, and final grading of the waste-rock disposal site is provided in Volume 3. As noted in this M&RP, the waste-rock disposal site has been designed to achieve a long-term static safety factor of 2.62 which is more than twice the minimum acceptable static safety factor of 1.3 as required by R645-301-553.260.

Coal Processing Waste. No coal processing waste is generated within the permit area.

5.5.3.3 Exposed Coal Seams, Acid- and Toxic-Forming Materials, and Combustible Materials

Exposed Coal Seams. Coal seams that were exposed during mining will be covered with a minimum of four feet of nontoxic and noncombustible materials during final backfilling and grading. This cover material may consist of material removed during grading of the site (see Section 5.4.2.2), subsoil, and/or topsoil.

Acid- and Toxic-Forming Materials. No acid-forming materials exist at the site (see Section 5.2.8.3). Potentially toxic-forming materials are disposed of at the waste-rock disposal site in accordance with Volume 3 of this M&RP.

Combustible Materials. All combustible materials that are exposed, used, or produced during mining will be disposed of off site as outlined in Section 5.2.1.1.

5.5.3.4 Cut-and-Fill Terraces

As indicated in Section 5.4.2.2, two terraces will be cut into the southern mine-yard slope during final grading activities. The purpose of these terraces will be to control erosion and ensure stability of the final-graded slope.

5.5.3.5 Highwalls From Previously Mined Areas

Highwalls exist within the permit area that are the result of previous mining operations. These highwalls are the result of surface disturbance in East Spring Canyon by the operator prior to 1990.
5.5.3.6 Approximate Original Contour
The final reclamation surface is shown on Plate 5-3A&B. This configuration is based on using all available earth materials at the mine site, however several cut slopes will be left along the western edge of the existing pad area based on the following factors:

- The retained cut slopes are not significantly greater in height or length than the dimensions of existing cliffs and the surrounding area,
- The residual cut slopes are similar in structural composition to the pre-existing cliffs in the surrounding area and are compatible with the visual attributes of the area, and
- The residual cut slopes are compatible with the geomorphic processes of the area.

5.5.3.7 Backfilling and Grading - Thin Overburden
No surface coal mining and reclamation activities involving thin overburden occur within the permit area.

5.5.3.8 Backfilling and Grading - Thick Overburden
No surface coal mining and reclamation activities involving thick overburden occur within the permit area.

5.5.3.9 Regrading of Settled and Revegetated Fills
No regrading of settled and revegetated fills is anticipated in the permit area.
5.60 Performance Standards

Coal mining and reclamation operations at the SUFCO Mine will be conducted in accordance with the approved permit and the requirements of R645-301-510 through R645-301-553.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.10 Introduction</td>
<td>6-1</td>
</tr>
<tr>
<td>6.1.1 General Requirements</td>
<td>6-1</td>
</tr>
<tr>
<td>6.1.2 Certification</td>
<td>6-1</td>
</tr>
<tr>
<td>6.20 Environmental Description</td>
<td>6-2</td>
</tr>
<tr>
<td>6.2.1 General Requirements</td>
<td>6-2</td>
</tr>
<tr>
<td>6.2.2 Cross Sections, Maps and Plans</td>
<td>6-2</td>
</tr>
<tr>
<td>6.2.3 Geologic Determinations</td>
<td>6-4</td>
</tr>
<tr>
<td>6.2.4 Geologic Information</td>
<td>6-5</td>
</tr>
<tr>
<td>6.2.4.1 Regional Setting</td>
<td>6-5</td>
</tr>
<tr>
<td>6.2.4.2 Test Boring and Drillhole Data (overburden removed)</td>
<td>6-11</td>
</tr>
<tr>
<td>6.2.4.3 Test Boring and Drillhole Data (overburden not removed)</td>
<td>6-11</td>
</tr>
<tr>
<td>6.2.5 Additional Geologic Information</td>
<td>6-12</td>
</tr>
<tr>
<td>6.2.6 Sampling Waivers</td>
<td>6-13</td>
</tr>
<tr>
<td>6.2.7 Description of the Overburden Thickness and Lithology</td>
<td>6-13</td>
</tr>
<tr>
<td>6.30 Operation Plan</td>
<td>6-14</td>
</tr>
<tr>
<td>6.3.1 Casing and Sealing of Exploration Holes</td>
<td>6-14</td>
</tr>
<tr>
<td>6.3.2 Subsidence Monitoring</td>
<td>6-14</td>
</tr>
<tr>
<td>6.3.3 Exploration Drilling</td>
<td>6-15</td>
</tr>
<tr>
<td>6.3.4 Exploration Hole Reclamation</td>
<td>6-18</td>
</tr>
<tr>
<td>6.40 Performance Standards</td>
<td>6-19</td>
</tr>
<tr>
<td>6.4.1 Exploration and Drillholes</td>
<td>6-19</td>
</tr>
<tr>
<td>6.4.2 Monuments and Surface Markers of Subsidence Monitoring Points</td>
<td>6-19</td>
</tr>
<tr>
<td>6.4.3 Exploration Drilling</td>
<td>6-19</td>
</tr>
<tr>
<td>6.4.3.1 Exploration Activities</td>
<td>6-19</td>
</tr>
<tr>
<td>6.4.3.2 Soils</td>
<td>6-19</td>
</tr>
<tr>
<td>6.4.3.3 Biology</td>
<td>6-20</td>
</tr>
<tr>
<td>6.4.3.4 Hydrology</td>
<td>6-20</td>
</tr>
<tr>
<td>6.4.3.5 Archaeology</td>
<td>6-20</td>
</tr>
<tr>
<td>6.4.3.6 Acid or Toxic-Forming Materials</td>
<td>6-20</td>
</tr>
<tr>
<td>6.50 Reclamation</td>
<td>6-21</td>
</tr>
<tr>
<td>6.5.1 Wheel Tracks and Drill Sites</td>
<td>6-21</td>
</tr>
<tr>
<td>6.5.2 Permanent Casing and Sealing of Wells</td>
<td>6-21</td>
</tr>
</tbody>
</table>

References | 6-22 |
Canyon Fuel Company, LLC
SUFCO Mine

Mining and Reclamation Plan
December 2017

LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-1</td>
<td>Generalized Stratigraphic Section</td>
<td>6-3</td>
</tr>
<tr>
<td>6-2</td>
<td>Location and approximate setup of directional horizontal drill site within the permitted Sufco mine site area</td>
<td>6-17</td>
</tr>
<tr>
<td>6-3</td>
<td>Location and approximate setup of second directional horizontal drill site within the permitted Sufco mine site area</td>
<td>6-18</td>
</tr>
</tbody>
</table>

LIST OF PLATES

<table>
<thead>
<tr>
<th>Plate</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-1</td>
<td>Geology and Drillhole Location Map With Proposed Drill Holes</td>
</tr>
<tr>
<td>6-2</td>
<td>Geologic Cross Section A-A'</td>
</tr>
<tr>
<td>6-3</td>
<td>Geologic Cross Section B-B'</td>
</tr>
<tr>
<td>6-4</td>
<td>Geologic Cross Section C-C'</td>
</tr>
</tbody>
</table>

LIST OF APPENDICES

(Appendices appear in Volume 6)

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-1</td>
<td>Drill Logs (Confidential)</td>
</tr>
<tr>
<td>6-2</td>
<td>Chemical Analyses</td>
</tr>
<tr>
<td>6-3</td>
<td>Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining</td>
</tr>
<tr>
<td>6-4</td>
<td>3 Right 4 East and 4 Right 4 East Panels (Confidential)</td>
</tr>
<tr>
<td>6-5</td>
<td>Greens Hollow Lease</td>
</tr>
</tbody>
</table>

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APR 19 2018

Div. of Oil, Gas & Mining
6.10 Introduction
This chapter presents a description of the geologic resources in the area of the SUFCO Mine.

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

6.1.1 General Requirements
The geologic resources in the SUFCO Mine area are discussed in Sections 6.2.1 through 6.2.7 of this chapter. The plans for casing and sealing of exploration holes and for subsidence monitoring are addressed in Sections 6.3.1 through 6.3.2.

6.1.2 Certification
All maps, plans, and cross-sections presented in this chapter, required by the regulations, have been certified by a professional engineer.

6.20 Environmental Description
This section presents a description of the geologic resources in the area of the SUFCO Mine.

6.2.1 General Requirements
This section presents the regional and site-specific geologic information for the SUFCO Mine area. The site-specific geologic information for the nearby waste rock disposal site is contained in Volume 3, Part 2.2.

6.2.2 Cross Sections, Maps and Plans
Plate 6-1 presents the surficial geology of the site area, the coal outcrop lines and the strike and dip of the coal seam mined. Plate 6-1 also presents the locations of the drillholes in the mine area.
Elevations are given for the drillholes which were logged and sampled. These logs are presented in Appendix 6-1.

The geologic cross-sections, presented on Plate 6-2, 6-3, 6-4 and 6-5, displays the thickness of the coal seams together with their surrounding lithology and the lateral correlation of coal seams using the following drillholes, measured underground mine sections, and measured outcrop sections. (Figure 6-1 presents the generalized stratigraphic section for the mine area.)

<table>
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</tr>
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<tr>
<td>MC-80-16-7</td>
<td></td>
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<tr>
<td>MC-80-17-8C</td>
<td></td>
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<tr>
<td>TP-1</td>
<td></td>
</tr>
<tr>
<td>76-29-Y</td>
<td></td>
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<tr>
<td>2L4E (Underground)</td>
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</tr>
<tr>
<td>US-77-5</td>
<td></td>
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<tr>
<td>76-32-J</td>
<td></td>
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<tr>
<td>76-32-I</td>
<td></td>
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<tr>
<td>US-79-14</td>
<td></td>
</tr>
<tr>
<td>2R5E (Underground)</td>
<td></td>
</tr>
<tr>
<td>US-79-17</td>
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<td>US-79-10</td>
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<tr>
<td>01-8-1</td>
<td></td>
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<tr>
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<td>TP-4</td>
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</tr>
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<td></td>
</tr>
</tbody>
</table>

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

4 Right 4 East Panel(s)
The 4R4E panel is located within Lease U-63214 which is referred to as the Quitchupah Tract. This tract is located within the southern region of the Wasatch Plateau which lies with the Basin and Range-Colorado Plateau Province. The topography of the tract consists of a flat plateau that is deeply dissected by narrow canyons. The coal seams crop out in the southeastern portion of the tract along the steep escarpments of Quitchupah Canyon, Dry Fork Canyon, East Fork Canyon.
INTERBEDDED LIGHT GRAY CLAYSTONE AND SILTSTONE WITH SPARSE THIN SANDSTONE

INTERBEDDED GRAY SANDSTONE AND MOTTLED CLAYSTONE AND SILTSTONE

LIGHT GRAY, MEDIUM TO COARSE-GRAINED MASSIVE SANDSTONE, PARTLY CONGLOMERATIC

MEDIUM GRAY TO BLACK SILTY SHALE AND CLAYSTONE WITH INTERBEDDED FINE TO MEDIUM-GRAINED, GRAY MASSIVE SANDSTONE AND GRAY, THIN-BEDDED SILTSTONE, COAL SEAMS AT BASE

DUNCAN COAL SEAM

UPPER HIWATHA COAL SEAM

LOWER HIWATHA COAL SEAM

LIGHT GRAY, MEDIUM-GRAINED MASSIVE SANDSTONE

MEDIUM-GRAY CLAYSTONE WITH INTERBEDDED THIN, LIGHT GRAY, FINE-GRAINED SANDSTONE

BASE NOT EXPOSED

FIGURE 6-1. GENERALIZED STRATIGRAPHIC SECTION.
and Link Canyon, The 4R4E panel is located in Dry Fork Canyon. See Appendix 5-14, Plate 5-6 and Plate 5-7 for the 4R4E mine plan, lease locations and mine timing respectively. Mining will occur only in the Upper Hiawatha coal seam. Overburden ranges approximately from 300-900 feet. The projected subsidence across the 4R4E panel ranges from 1-5 feet and the projected average subsidence is approximately 2 feet. See the 4R4E Projected Subsidence Map in Appendix 6-4.

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

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

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

**6.2.3 Geologic Determinations**

The information required by UDOGM to make a determination of the acid or toxic forming characteristics of the site strata is presented in Section 6.2.4.3 of this M&RP.
The information required by UDOGM to make a determination as to whether the reclamation plan, described in Section 5.40, can be accomplished is presented in Section 6.2.4.

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

6.2.4 Geologic Information

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

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

Mancos Shale-Masuk Member
The Masuk Member of the Mancos Shale has been mapped throughout eastern Utah and western Colorado. The Masuk Member crops out along the entire eastern edge of the Wasatch Plateau and varies in thickness from 300 to 1,300 feet (Davis, and Doelling, 1976). It thins from north to south and from east to west. The Masuk is probably 500 to 600 feet thick in the North Fork of Quitchupah Canyon on the east side of the mine property.

The Masuk Member of the Mancos Shale is the lowest rock unit exposed and consists of blue-gray fissile claystone or silty claystone which weathered light blue-gray to light tan. The unit contains thin calcareous sandy or silty interbeds which increase in frequency toward the top of the unit. The interbeds are usually light tan to yellow, and in places their weathering gives the Masuk a light tan cast. The Member forms the lower slopes of the Convulsion and North Fork Quitchupah Canyons on the south and east sides of the mine property. It forms steep, barren, easily eroded slopes with occasional ledges of more resistant fine-grained sandstone, siltstone, or sandy claystone.
**Star Point Sandstone**

Exposures of the Star Point Sandstone form a broad, arcuate band crossing eastern Utah and extending into eastern Wyoming, where it is roughly correlative to the Shannon Sandstone of the Cody Shale, and into southwestern Colorado and northeastern New Mexico, where its equivalent is the Point Lookout Sandstone (McGookey, 1973). The Star Point in Utah is almost continuously exposed for about 100 miles along the eastern edge of the Wasatch Plateau (Spieker, 1931).

The unit ranges in thickness to more than 1,000 feet in the Pleasant Valley area in the northern part of the Wasatch Plateau. Eastward, it intertongues and grades with the Mancos Shale until it is absent as a unit near Sunnyside in the Bookcliffs. The unit thins southward along the Wasatch Plateau, and the lowermost units of the Star Point grade into the underlying Masuk Shale (Spieker, 1931). Near the SUFCO Mine property, Bucurel (1977) estimates the Star Point to be about 200 feet thick. The top of the Star Point is nearly planar in the mine area, with the exception of some intertonguing with the overlying Blackhawk Formation (Marley, 1980) in Convulsion Canyon, and again in the Link Canyon-Muddy Creek area northeast of the SUFCO Mine property.

The Star Point Sandstone is a tan to gray, fine- to medium-grained, friable, usually well sorted sandstone, with minor thin interbeds of siltstone or claystone. In places, the upper few feet are bleached white. Marley and Flores (1977) note that the Star Point contains trace fossils, and that siltstones and shales in the unit are intensely bioturbated. Marley et. al. (1979) state that the Star Point Sandstone is a coastal complex of distributary channel, delta front, and beach barrier sediments. The Star Point Sandstone in the mine area is a massive cliff-forming unit which created a nearly unbroken ledge along Convulsion Canyon and North Fork Quitchupah Canyons.

**Blackhawk Formation**

The Blackhawk Formation outcrops from Thousand Lakes Mountain in south central Utah along the Wasatch Plateau northward to the Bookcliffs, and eastward along the Bookcliffs to a few miles east of Thompson, Utah, in Grand County, where it pinches out. The unit is well exposed along the front of the Wasatch Plateau and in the canyons cutting the Plateau. In the mine area, it is well exposed in Convulsion and Quitchupah Canyons. The Blackhawk Formation varies in thickness from 400 feet, south of John’s Peak (Davis, and Doelling, 1976), to 1,750 feet in the Pleasant Valley area (Hintze, 1973) with a general thickening from east to west. On the SUFCO Mine property the Blackhawk varies in thickness from 700 to 830 feet, generally thickening northeastward.
The Blackhawk Formation consists of interbedded alluvial plain and marginal marine deposits of sandstone, siltstone, claystone and coal. Sandstone comprises up to 65 percent of the total thickness of the Blackhawk Formation. The fine- to medium-grained sandstones occur as thin to massively bedded paleochannel deposits. The paleochannels increase in frequency, thickness, and lateral extent upward in the formation. There is also a vertical repetition of erosional scours within the upper sandstones (Marley et. al., 1979). The sandstones grade laterally into siltstones and shale. Most of the coal seams in the Blackhawk occur in the lower 200 feet, with the thicker coal seams occurring in the lower 150 feet.

Three coal seams with thickness greater than five feet (the Upper Hiawatha Seam and two others of lesser importance; the Lower Hiawatha Seam and the Duncan Seam) are found in the Blackhawk Formation within the mine property (Figure 6-1). The Upper Hiawatha Seam is the only one of the three which is minable within most of the mine property boundary. This seam has a thickness of between 9 and 18 feet over most of the property but thins sufficiently due to a mid-seam parting in the southeastern portion of the property that it becomes unminable. The Lower Hiawatha Seam occurs in the interval between the Upper Hiawatha Seam and the Star Point Sandstone. It is 2 to 29 feet above the Star Point Sandstone. The interval between the two coal seams varies between 5.6 and 70 feet. The Lower Hiawatha Seam is thin and discontinuous, varying in thickness from 0 to 17.2 feet. The seam is rendered unminable over much of the property due to partings. The Lower Hiawatha seam is only considered to be mineable where the interburden between the Upper Hiawatha seam is greater than 30 feet. This condition and a sufficient mining height occurs only in the northwest corner of the SUFCO Mine property.

The third coal seam occurs 100 to 130 feet above the Upper Hiawatha and has been informally named the Duncan Seam by the SUFCO Mine. The Duncan seam occurs in a small portion of lease U-28297. Because it is of such limited lateral extent, it cannot be correlated with any coal seams in areas surrounding the SUFCO Mine property. It has a maximum thickness of ten feet and is not mineable because of its limited lateral extent. The unsplit area of the Duncan seam is of small extent, probably less than 50 acres. The Duncan zone may correlate with the Muddy coal seam which occurs north of the SITLA lease.

The Upper Member of the Blackhawk Formation generally forms a steep, irregular slope between the cliffs of the underlying Star Point Sandstone and the overlying Castlegate Sandstone. Ledges of sandstone up to 50 feet thick break the slope. In some exposures, the unit is nearly vertical where the Star Point below has sheared off and erosion has not brought the slope to equilibrium.
In Convulsion and Quitchupah Canyons, there are large areas of coal burn where the coal has burned naturally and baked the enveloping clays and sandstones to form a resistant reddish clinker layer. These areas are generally steeper than the surrounding slopes. Vegetative cover is generally sparse such that the Blackhawk strata can be easily seen except on some north-facing slopes where vegetation masks the unit.

**Castlegate Sandstone**
The Castlegate Sandstone extends across the eastern part of Utah, along part of the Bookcliffs and the entire length of the Wasatch Plateau (Spieker, 1931) but loses its character as a cliff-former south of Interstate Highway 70. It is correlative to the Cliffhouse Sandstone of southwestern Colorado and northern New Mexico (McGookey, 1973). In the Wasatch Plateau, its thickness varies from 50 to 500 feet (Spieker, 1931). It is thickest in Price River Canyon at the north end of the Wasatch Plateau. The Castlegate Sandstone is exposed along the rims of Convulsion and North Fork of Quitchupah Canyons. Its thickness varies across the SUFCO Mine property from about 120 to 260 feet with a general northwestward thickening.

The Castlegate Sandstone is a fluvial deposit composed mostly of sandstone, conglomeratic sandstone, pebble conglomerate, and gritstone lenses. There are some thin interbeds of siltstone and claystone, especially toward the base of the unit. The member forms much of the surface of Old Woman Plateau in the southern part of the mine property, and creates a nearly unbroken cliff along the canyons which flank the SUFCO Mine on the south and east.

**Price River Formation**
The Price River Formation is the uppermost member of the Mesa Verde Group and in the vicinity of the mine it caps the mesa which forms the Old Woman Plateau. The formation is reported to be approximately 550 feet thick in the mine area.

The Price River Formation consists of gray to white gritty sandstone, interbedded with subordinate shale and conglomerate. The formation is resistant to weathering and is a ledge and slope former due to interbedding of resistant sandstones with less resistant shales and claystones.

**North Horn Formation**
The North Horn Formation straddles the Cretaceous-Tertiary boundary. The maximum thickness of the North Horn within the lease area occurs on Big Ridge where it is estimated to be approximately 430 feet thick. A few seasonal springs are found in the North Horn.
Sandstone, other beds of the Price River Formation and the North Horn Formation constitute the cap rock in this area of the Wasatch Plateau.

According to Spieker (1931), the North Horn "consists in the central part of the Plateau predominantly of vari-colored shale, in which the combinations of various shades of red, purple, chocolate-brown, green, and gray are characteristic of the coloring of (correlative) rocks in the general region, but it contains many irregular beds of gray, brown, and cream-colored sandstone of various texture, and thin beds of fresh-water limestone, chiefly steel-gray and cream colored but in places also white, tan, and dark blue-gray. In the southwestern, central-eastern, and northern parts of the Plateau the member contains more sandstone. Beds of conglomerate occur in the member irregularly both as to horizon and locality."

Structure. The mine area lies midway between the Joe’s Valley-Paradise Fault Zone to the east and the Musinia Fault Zone to the west. Rock units in the mine area strike roughly N40°E and dip 1 to 2 degrees (about 250 feet per mile) to the northwest (Plate 6-1). Local dips may range up to 10 degrees in areas where paleochannels underlying the coal seam cause significant differential compaction. Such local structural variations cannot generally be predicted based on drilling due to the narrow width and sinuous character of these paleochannels found in the lower Blackhawk Formation.

Small displacement faults (apparent vertical displacement of about three feet or less) and some of greater displacement have been encountered and will be encountered as development of the SUFCO Mine progresses. These faults most commonly strike approximately N10° to 15°W and are near vertical. Joints occur parallel and normal to the fault trend.

Geomorphology. The Old Woman Plateau is a gently rolling plateau which is dissected by canyons incised by Quitchupah Creek and its tributaries (Plate 6-1). These canyons are steep-walled and adjacent plateau areas are capped by the Castlegate Sandstone. In the southern part of the mine area, there are areas on the plateau where the nearly flat-lying bedrock forms the surface of the plateau. This structural plain feature is common in the Colorado Plateau. There are also erosional remnants above the plateau surface such as Duncan Mountain and Little Duncan Mountain that are comprised of the Price River Formation and the North Horn Formation. Range terraces were developed on one of the slopes of Little Duncan Mountain during the 1930’s.
Tension cracks were developed during the 1970's near East Spring Canyon due to subsidence. These cracks are now mostly healed at the surface by the soil filling them in. Additional subsidence-related tensions cracks have formed within the Pines Lease. Those occurring in soil have healed over time, however, those occurring in the Castlegate Sandstone outcrop are still visible.

Quitchupah and Box Canyon Creeks are perennial and are supplied by springs and ephemeral streams.

**Surface and Groundwater Impact.** Surface and groundwater impact are discussed in Chapter 7 of this M&RP.

**Coal Geology.** The coal which is extracted from the SUFCO Mine occurs in the lower portion of the Blackhawk Formation of the Mesa Verde Group of rocks of Upper Cretaceous age. Doelling (1972) identifies the seam as being the Upper Ivie bed while the SUFCO Mine calls it the Upper Hiawatha. The Blackhawk is overlain by the Price River Formation, including the Castlegate Sandstone, and is underlain by the Star Point Sandstone, all being members of the Mesa Verde Group.

The Upper Hiawatha coal seam has quite uniform thickness from southwest to northeast as shown in the Cross-Sections (Plates 6-2, 6-3 and 6-4). North and west of section 7, T22S, R5E, the thickness is also uniform and averages approximately 15 feet. Drillhole information (Appendix 6-1) and Spieker (1931) indicate that the coal thins from Section 7 toward Convulsion Canyon to the southeast. Drillhole data show 6.3 feet of coal in Section 7.

The as-mined quality of the Upper Hiawatha coal seam averages 11,400 BTU, 9.4% ash, 9.5% moisture, 36% volatile matter and 44% fixed carbon.

The Duncan Coal Seam will not be mined as a part of the SUFCO Mine operations because it is discontinuous and has insufficient minable reserves. The Lower Hiawatha Coal Seam will only be mined in the western portion of the Quitchupah lease because this is the only area where the coal is thick enough to mine and there is sufficient interburden between the Upper and Lower Hiawatha seams to allow mining. The Lower Hiawatha seam may also occur in minable thickness at the northern edge of the SITLA lease but it is not currently under lease (only the Upper Hiawatha seam is under lease).
Greens Hollow - Both the Upper and Lower Hiawatha occur in the lease, the Lower Hiawatha seam has mineable coal thickness throughout the majority of the lease tract and the Upper has mineable thickness in a portion of the lease. The interburden between the Lower Hiawatha and the overlying Upper Hiawatha is considered too thin to mine both seams. Overburden in the area ranges from 1,000 to 2,500 feet. The anticipated mining height ranges from approximately 9 to 15 feet.

The rocks in the Greens Hollow area are sedimentary, with the exposed units being the Blackhawk, Castlegate Sandstone, Price River, North Horn and Flagstaff Limestone in ascending order. Refer to General Stratigraphy, Figure 1 and Geologic Fence Diagram, Map 2, in the Geology Technical Report found in Appendix 6-54. Subsurface units include Mancos Shale and Star Pont Sandstone. Much of the topography exhibits mass movement including landslides, slumps, rock falls, thin alluvium in canyon bottoms and incised moderate to deeply eroded stream channels.

Cross-Sections, Maps and Plans. The cross-sections and maps are discussed in Section 6.2.4 and are located at the end of this chapter. The applicant request's that this information remain confidential.

Drill Logs and Chemical Analyses. See Section 6.2.4.3 and Appendices 6-1 and 6-2. The applicant requests that this information remain confidential and that public access to these sections be limited to only persons with an interest which is or may be adversely affected as provided under Section 40-10-10(4) of the Act.

6.2.4.2 Test Boring and Drillhole Data (overburden removed)
SUFCO Mine does not plan to remove any overburden above the coal seam to be mined. Regulations related to overburden removal do not apply to this M&RP.

6.2.4.3 Test Boring and Drillhole Data (overburden not removed)
The drill logs and chemical analyses required by regulations R645-301-624.310 through R645-301-624.330 are presented in Appendices 6-1 and 6-2.

Lithologic Logs. Lithologic logs of drillholes are presented in Appendix 6-1. The applicant requests that this information be kept confidential and that public access to these sections be limited to only persons with an interest which is or may be adversely affected as provided under Section 40-10-10(4) of the Act.
Acid, Toxic, and Alkaline Chemical Analyses (above and below the coal seam). Chemical analyses for acid- and toxic-forming and alkalinity-producing materials from the waste rock disposal site and roof and floor rock material from drill cores is presented in Appendix 6-2. Using Table 2 in the Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining (Appendix 6-3), only two unacceptable values have been reported. Samples of material placed in the waste rock disposal site are taken regularly and analyzed quarterly and are considered to be representative of the coal, roof, floor, and partings. The boron concentration of the waste rock disposal site sample taken in the second quarter of 1991 exceeds the acceptable level of 5.0 ppm by only 0.44 ppm; therefore, this boron value is not of significant concern. Secondly, the SAR value of 19.30 for the Upper Hiawatha coal seam in drillhole 89-20-2 is unacceptable. However, as there have been no other unacceptable SAR values since this sample was taken, it is probably due to contamination, lab error or sampling error. Analytical results of all other samples are acceptable.

Acid, Toxic, and Alkaline Chemical Analyses (coal seam). The chemical analyses discussed above are also representative of the coal seam mined. Additionally, analyses of pyrite and sulfur forms have been performed on roof, parting, and floor samples taken from various core holes. The results of these analyses are reported in Appendix 6-2.

Properties of Rocks in Room and Pillar Areas. Room and pillar mining is now only used in the stream buffer zones and beneath escarpments to prevent subsidence. Pillars are not removed in these areas.

The clay content of floor and roof rock samples from two drill holes was determined analytically (see Appendix 6-2) but otherwise clay content is based on description of cores. The lithology of the stratum immediately below the minable coal varies from drillhole to drillhole. Therefore, the clay content will range from almost 100% (pure claystone) to less than 5% (submature or mature sandstone). Drillholes 74-36-5, 76-28-K, 76-29-Y, US-79-14, US-79-15 and US-81-4 penetrate the stratum immediately below the coal seam to be mined. Lithologic logs for these drillholes (which include lithotypes of the stratum immediately below the coal seam to be mined) are presented in Appendix 6-1. No engineering properties for the underlying claystone have been determined, because its friable nature makes it next to impossible to prepare samples.

6.2.5 Additional Geologic Information
It is not anticipated that any additional geologic data will need to be collected for this site.
6.2.6 Sampling Waivers
SUFCO Mine does not request a sampling waiver for this site.

6.2.7 Description of the Overburden Thickness and Lithology
Overburden thickness above the coal seam varies due to the plateau and canyon-type topography from approximately 600 to 1800 feet and averages about 900 feet. Stratigraphically, the overburden consists of the Upper Blackhawk Formation which contains the coal seams, the Castlegate Sandstone, the Price River Formation, and the North Horn Formation, as described in Section 6.2.4.1 of this M&RP.
6.30 Operation Plan

6.3.1 Casing and Sealing of Exploration Holes

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

6.3.2 Subsidence Monitoring

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

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

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

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

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

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

Some of the drill sites will be accessed using existing wheel tracks or over the existing surface and a few will require that new roads be built off of U. S. Forest Service roads or existing wheel tracks. Helicopter-supported drilling techniques will also be utilized at times to minimize surface impacts.

The drill sites will be approximately 80 feet by 100 feet in size. One half of the site will be for the drill rig and water truck while the other half will have 1 to 2 mud pits and temporary supply storage.

The applicant requests that any information from exploration drilling be kept confidential and that public access to any of the information be limited to only persons with an interest which is or may be adversely affected as provided under Section 40-10-10 (4) of the Act.

**Mine Yard Directional Horizontal Burn Drilling**

One horizontal directional exploration drillhole will be drilled from within the permitted Sufco minesite at a location shown on Figure 6-2. This drillhole will be drilled to determine coal burn location west of the Sufco minesite for mine planning purposes. The directional drillhole will be nominally 3.8 inch and will be drilled almost entirely within the Upper Hiawatha coal seam. Only minor excavation of existing mine yard fill material will occur on the existing permitted Sufco minesite. A small ditch and mudpit/sump will be constructed to contain drill water and fluids. Drill fluids will be recycled as much as possible. Drilling fluid additives will be minimal and nontoxic.
A mudpit/sump will be constructed to contain drill water and fluids. Drill fluids will be recycled as much as possible. Drilling fluid additives will be minimal and nontoxic. Excess fluids and cuttings will be hauled to an approved waste disposal site. The mudpit will be constructed in such a way as to allow easy access for cleaning and hauling away cuttings (Figure 6-2). Cuttings will be hauled to Sufco Mine's permitted waste rock site along the Sufco haul-road to the southwest. Drill water will be supplied by the existing minesite water system. Upon completion, the drill hole collar will be plugged with a cement or grout to a depth of approximately 100 ft. Drilling is planned to begin on approximately April 30, 2008, and be completed by June 30, 2008. Upon completion all equipment will be removed and the yard fill smoothed out. No surface or vegetation disturbance or change in runoff will occur since the work is being conducted on the permitted minesite.

Figure 6-2. Location and approximate setup of directional horizontal drill site within the permitted Sufco minesite area.
A second horizontal directional exploration drillhole will be drilled from within the permitted Sufco minesite at a location shown on Figure 6-3. This drillhole will be drilled to determine coal burn and coal temperature west of the Sufco minesite for mine planning purposes. The directional drillhole will be nominally 3.8 inch and will be drilled in strata above the upper Hiawatha seam and within the Upper Hiawatha coal seam. Only minor excavation of existing mine yard fill material will occur on the existing permitted Sufco minesite. A small ditch and mudpit/sump will be constructed to contain drill water and fluids. Drill fluids will be recycled as much as possible. Drilling fluid additives will be minimal and nontoxic. Excess fluids and cuttings will be hauled to an approved waste disposal site. The mudpit will be constructed in such a way as to allow easy access for cleaning and hauling away cuttings (Figure 6-3). Cuttings will be hauled to Sufco Mine's permitted waste rock site along the Sufco haul-road to the southwest. Drill water will be supplied by the existing minesite water system. The north side track will be cased into the old Convulsion Canyon Mine for monitoring of mine atmosphere. A valve will be installed at the collar to allow monitoring and atmospheric sampling. Upon completion of monitoring activities the drill hole collar will be plugged with a cement or grout to a depth of approximately 50 ft. Drilling is planned to begin on approximately December 9, 2009, and be completed by February 26, 2010. Upon completion all equipment will be removed and the yard fill smoothed out. No surface or vegetation disturbance or change in runoff will occur since the work is being conducted on the permitted minesite.
6.3.4 Exploration Hole Reclamation

The exploration holes will be filled with concrete or concrete/hole plug-abandonite slurry through their full depth after exploration activities are completed. Concrete will be used through all minable coal zones. This will be done by pumping concrete or slurry through the drill pipe which hangs 40-60 ft. off the bottom of the hole until the hole up to the drill pipe is filled. The drill pipe is then tripped-out another 40-60 ft. and more concrete or slurry is pumped into the hole. This process is repeated until the full depth of the hole is filled and good drill hole wall to concrete/hole plug-abandonite contact is assured.
6.40 Performance Standards

6.4.1 Exploration and Drillholes
The performance standards used in the casing and sealing of all exploration holes and drillholes are outlined in Section 7.6.5 of this M&RP.

6.4.2 Monuments and Surface Markers of Subsidence Monitoring Points
The performance standards used in the reclamation of all monuments and surface markers used as subsidence monitoring points are outlined in Section 5.2.5.

6.4.3 Exploration Drilling

6.4.3.1 Exploration Activities
During drill site preparation, drilling and reclamation, any trash or contamination that may result from these activities, will be removed from the site. Trash and contaminants will be disposed of in an approved disposal site.

No heavy equipment will be moved if the ground is soft and rutting potential exists. All travel will stay within a twelve-foot wide track. All drilling and related equipment will be promptly removed from the exploration area when no longer needed.

The applicant's representative will, while in the exploration area, have a copy of the Division Approval for Exploration within the permit area available for review.

6.4.3.2 Soils
Where topsoil and subsoil are removed for drill site construction the methods described in Chapter 2 Soils Section 2.3.1.1 will be followed. Soil will be salvaged to at least a 12 inch depth or the full soil depth from drill sites and constructed roads to consolidated material, whichever is less. Wheel tracks used to access drill sites are considered minor disturbance as described in R645-301-232.400 and will be treated as described in Chapter 2 Soils Section 2.3.2.4. Due to the
short time topsoil and subsoil will be stockpiled and the small amount stockpiled, it will not be vegetated. All topsoil and subsoil stockpiles will be completely surrounded by a properly constructed silt fence.

Soil from constructed roads will be salvaged by pushing it into a berm and protected by diverting water away from the berm. The soil in wheel tracks will be ripped then scarified prior to reseeding.

6.4.3.3 Biology
The performance standards described in Chapter 3 Biology Section 3.5 will be followed during drill site and wheel track reclamation. A raptor survey will be done in the Spring/early Summer of 2005 and the new information will be used to ensure that nesting sites are not disturbed during drilling. Exploration activities (drilling, dirt work and reclamation) will only occur between August 1 and December 1 unless otherwise approved by involved agencies. The mitigation requested by the U. S. Forest Service NEPA documentation for the loss of water from the North Fork of Quitchupah Creek will be satisfied. No trees having cavities which could be used by nesting migratory birds of high federal interest will be removed during the exploration activities.

6.4.3.4 Hydrology
The performance standards described in Chapter 7 Hydrology will be followed where applicable during the exploration period. Though sediment yield will be negligible, sediment from drill sites will be controlled by either a properly constructed silt fence located at the lowest point on each drill site or by diverting all run-off from each drill site into the mud pit. Sediment from topsoil and subsoil stockpiles will be controlled by a silt fence around their base.

Sedimentation control from newly built temporary roads will meet that described in R 742-410 while the roads are in use. Reclamation of those roads will follow that described in Chapter 7 Hydrology, Section 7.60, to ensure post-use sedimentation control.

6.4.3.5 Archaeology
An archaeological survey will be conducted prior to site preparation, drilling activities and use of wheel tracks for those areas which have not been previously surveyed. Should cultural or historical resources be found during these activities the activity will be stopped and the UDOGM notified.

6.4.3.6 Acid or Toxic-Forming Materials

No acid or toxic-forming materials have been encountered previously and thus are not expected to be encountered during this drilling program. The addition of suspended solids to streams will be negligible due to the small areas disturbed, the short life of the drilling program and sediment control measures that will be used.


Canyon Fuel Company, LLC
SUFCO Mine

Mining and Reclamation Plan
December 20, 1991 (R 01/06)

6.50 Reclamation

6.5.1 Wheel Tracks and Drill Sites

Wheel tracks will be reclaimed by ripping followed by scarifying the soil and reseeding. Drill sites will be reclaimed by first replacing the material excavated for the mudpits, distributing the soil, and lastly reseeding. The seed mix to be used is as follows (as approved by USFS during 2004 drilling):

<table>
<thead>
<tr>
<th>Seed Name</th>
<th>Pounds PLS/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Wheatgrass</td>
<td>2</td>
</tr>
<tr>
<td>Basin Wild Rye</td>
<td>1</td>
</tr>
<tr>
<td>Blue Bunch Wheatgrass</td>
<td>2</td>
</tr>
<tr>
<td>&quot;Paiute&quot; Orchardgrass</td>
<td>1</td>
</tr>
<tr>
<td>Intermediate Wheatgrass</td>
<td>2</td>
</tr>
<tr>
<td>Ladak Alfalfa</td>
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</tr>
<tr>
<td>Small Burnet</td>
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</tr>
<tr>
<td>Silvery Lupine</td>
<td>0.75</td>
</tr>
<tr>
<td>Mountain Aster</td>
<td>0.25</td>
</tr>
<tr>
<td>Elymus smithii</td>
<td></td>
</tr>
<tr>
<td>Elymus cinereus</td>
<td></td>
</tr>
<tr>
<td>Agropyron Spicatum</td>
<td></td>
</tr>
<tr>
<td>Dactylis glomeratus</td>
<td></td>
</tr>
<tr>
<td>Agropyron (elymus) intermedium</td>
<td></td>
</tr>
<tr>
<td>Medicago sativa Var Ladak</td>
<td></td>
</tr>
<tr>
<td>Sanguisorba minor</td>
<td></td>
</tr>
<tr>
<td>Lupinus argenteus</td>
<td></td>
</tr>
<tr>
<td>Aster adscendens</td>
<td></td>
</tr>
</tbody>
</table>

The seed mixture certificate will state seed germination test date, germination rate, and elevation, county and state of origin. The seed will be sold in compliance with the State Seed Act. U. S. Forest Service certified noxious weed free straw or hay will be used as mulch.

Revegetation success will be determined using the Erosion Condition Classification System developed by OSMRE and by comparison to established reference areas. The reference areas will be undisturbed areas of a similar vegetative type adjacent to the drill sites. Equipment used to reclaim wheel tracks, build roads and drill sites will be either a D-7 or D-8 size dozer or a road grader to fill mud pits, redistribute soils, and rip and scarify wheel tracks.

6.5.2 Permanent Casing and Sealing of Wells

All drill holes will be plugged with concrete as described in Chapter 7 Hydrology section 7.6.5. A permanent marker will be placed at the top of each drill hole bearing the drill hole number.
REFERENCES:


SUFCO Mine. Personal communication by Larry Trimble, field reconnaissance. Salina, Utah.

CHAPTER 7

HYDROLOGY
## TABLE OF CONTENTS (December 20, 1991)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.10 Introduction</td>
<td>7-1</td>
</tr>
<tr>
<td>7.1.1 General Requirements</td>
<td>7-1</td>
</tr>
<tr>
<td>7.1.2 Certification</td>
<td>7-1</td>
</tr>
<tr>
<td>7.1.3 Inspection</td>
<td>7-1</td>
</tr>
<tr>
<td>7.20 Environmental Description</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.1 General Requirements</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.2 Cross Sections and Maps</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.2.1 Location and Extent of Subsurface Water</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.2.2 Location of Surface Water Bodies</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.2.3 Locations of Monitoring Stations</td>
<td>7-2</td>
</tr>
<tr>
<td>7.2.2.4 Location and Depth of Water Wells</td>
<td>7-3</td>
</tr>
<tr>
<td>7.2.2.5 Surface Topography</td>
<td>7-3</td>
</tr>
<tr>
<td>7.2.3 Sampling and Analysis</td>
<td>7-3</td>
</tr>
<tr>
<td>7.2.4 Baseline Information</td>
<td>7-3</td>
</tr>
<tr>
<td>7.2.4.1 Groundwater Information</td>
<td>7-5</td>
</tr>
<tr>
<td>7.2.4.2 Surface Water Information</td>
<td>7-17</td>
</tr>
<tr>
<td>7.2.4.3 Geologic Information</td>
<td>7-24</td>
</tr>
<tr>
<td>7.2.4.4 Climatological Information</td>
<td>7-24</td>
</tr>
<tr>
<td>7.2.4.5 Supplemental Information</td>
<td>7-25</td>
</tr>
<tr>
<td>7.2.4.6 Survey of Renewable Resource Lands</td>
<td>7-25</td>
</tr>
<tr>
<td>7.2.4.7 Alluvial Valley Floor Requirements</td>
<td>7-25</td>
</tr>
<tr>
<td>7.2.5 Baseline Cumulative Impact Area Information</td>
<td>7-26</td>
</tr>
<tr>
<td>7.2.6 Modeling</td>
<td>7-26</td>
</tr>
<tr>
<td>7.2.7 Alternative Water Source Information</td>
<td>7-26</td>
</tr>
<tr>
<td>7.2.8 Probable Hydrologic Consequences</td>
<td>7-26</td>
</tr>
<tr>
<td>7.2.8.1 Potential Impacts to Surface and Groundwater</td>
<td>7-26</td>
</tr>
<tr>
<td>7.2.8.2 Baseline Hydrologic and Geologic Information</td>
<td>7-30</td>
</tr>
</tbody>
</table>
**TABLE OF CONTENTS (Continued)**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2.8.3 PHC Determination</td>
<td>7-30</td>
</tr>
<tr>
<td>7.2.9 Cumulative Hydrologic Impact Assessment (CHIA)</td>
<td>7-47</td>
</tr>
<tr>
<td>7.3.0 Operation Plan</td>
<td>7-48</td>
</tr>
<tr>
<td>7.3.1 General Requirements</td>
<td>7-48</td>
</tr>
<tr>
<td>7.3.1.1 Hydrologic-Balance Protection</td>
<td>7-48</td>
</tr>
<tr>
<td>7.3.1.2 Water Monitoring</td>
<td>7-49</td>
</tr>
<tr>
<td>7.3.1.3 Acid- and Toxic-Forming Materials</td>
<td>7-72</td>
</tr>
<tr>
<td>7.3.1.4 Transfer of Wells</td>
<td>7-72</td>
</tr>
<tr>
<td>7.3.1.5 Discharges</td>
<td>7-72</td>
</tr>
<tr>
<td>7.3.1.6 Stream Buffer Zones</td>
<td>7-73</td>
</tr>
<tr>
<td>7.3.1.7 Cross Sections and Maps</td>
<td>7-74</td>
</tr>
<tr>
<td>7.3.1.8 Water Rights and Replacement</td>
<td>7-74</td>
</tr>
<tr>
<td>7.3.2 Sediment Control Measures</td>
<td>7-75</td>
</tr>
<tr>
<td>7.3.2.1 Siltation Structures</td>
<td>7-76</td>
</tr>
<tr>
<td>7.3.2.2 Sedimentation Ponds</td>
<td>7-76</td>
</tr>
<tr>
<td>7.3.2.3 Diversions</td>
<td>7-78</td>
</tr>
<tr>
<td>7.3.2.4 Road Drainage</td>
<td>7-82</td>
</tr>
<tr>
<td>7.3.3 Impoundments</td>
<td>7-82</td>
</tr>
<tr>
<td>7.3.3.1 General Plans</td>
<td>7-82</td>
</tr>
<tr>
<td>7.3.3.2 Permanent and Temporary Impoundments</td>
<td>7-84</td>
</tr>
<tr>
<td>7.3.4 Discharge Structures</td>
<td>7-84</td>
</tr>
<tr>
<td>7.3.5 Disposal of Excess Spoil</td>
<td>7-84</td>
</tr>
<tr>
<td>7.3.6 Coal Mine Waste</td>
<td>7-84</td>
</tr>
<tr>
<td>7.3.7 Noncoal Mine Waste</td>
<td>7-84</td>
</tr>
<tr>
<td>7.3.8 Temporary Casing and Sealing of Wells</td>
<td>7-85</td>
</tr>
<tr>
<td>7.4.0 Design Criteria and Plans</td>
<td>7-85</td>
</tr>
<tr>
<td>7.4.1 General Requirements</td>
<td>7-85</td>
</tr>
</tbody>
</table>
**TABLE OF CONTENTS (Continued)**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.4.2 Sediment Control Measures</td>
<td>7-85</td>
</tr>
<tr>
<td>7.4.2.1 General Requirements</td>
<td>7-85</td>
</tr>
<tr>
<td>7.4.2.2 Siltation Structures</td>
<td>7-88</td>
</tr>
<tr>
<td>7.4.2.3 Diversions</td>
<td>7-106</td>
</tr>
<tr>
<td>7.4.2.4 Road Drainage</td>
<td>7-113</td>
</tr>
<tr>
<td>7.4.3 Impoundments</td>
<td>7-113</td>
</tr>
<tr>
<td>7.4.4 Discharge Structures</td>
<td>7-114</td>
</tr>
<tr>
<td>7.4.4.1 Erosion Protection</td>
<td>7-115</td>
</tr>
<tr>
<td>7.4.4.2 Design Standards</td>
<td>7-116</td>
</tr>
<tr>
<td>7.4.5 Disposal of Excess Spoil</td>
<td>7-116</td>
</tr>
<tr>
<td>7.4.6 Coal Mine Waste</td>
<td>7-116</td>
</tr>
<tr>
<td>7.4.6.1 General Requirements</td>
<td>7-116</td>
</tr>
<tr>
<td>7.4.6.2 Refuse Piles</td>
<td>7-117</td>
</tr>
<tr>
<td>7.4.6.3 Impounding Structures</td>
<td>7-117</td>
</tr>
<tr>
<td>7.4.6.4 Return of Coal Processing Waste to Abandon Underground Working</td>
<td>7-117</td>
</tr>
<tr>
<td>7.4.7 Disposal of Noncoal Mine Waste</td>
<td>7-117</td>
</tr>
<tr>
<td>7.4.8 Casing and Sealing of Wells</td>
<td>7-117</td>
</tr>
<tr>
<td>7.50 Performance Standards</td>
<td>7-118</td>
</tr>
<tr>
<td>7.5.1 Water Quality Standards and Effluent Limitations</td>
<td>7-118</td>
</tr>
<tr>
<td>7.5.2 Sediment Control Measures</td>
<td>7-118</td>
</tr>
<tr>
<td>7.5.2.1 Siltation Structures and Diversions</td>
<td>7-118</td>
</tr>
<tr>
<td>7.5.2.2 Road Drainage</td>
<td>7-118</td>
</tr>
<tr>
<td>7.5.3 Impoundments and Discharge Structures</td>
<td>7-119</td>
</tr>
<tr>
<td>7.5.4 Disposal of Excess Spoil, Coal Mine Waste and Noncoal Mine Waste</td>
<td>7-119</td>
</tr>
<tr>
<td>7.5.5 Casing and Sealing of Wells</td>
<td>7-119</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td>7.60 Reclamation</td>
<td>7-119</td>
</tr>
<tr>
<td>7.6.1 General Requirements</td>
<td>7-119</td>
</tr>
<tr>
<td>7.6.2 Roads</td>
<td>7-119</td>
</tr>
<tr>
<td>7.6.2.1 Restoring the Natural Drainage Patterns</td>
<td>7-119</td>
</tr>
<tr>
<td>7.6.2.2 Reshaping Cut and Fill Slopes</td>
<td>7-120</td>
</tr>
<tr>
<td>7.6.3 Siltation Structures</td>
<td>7-120</td>
</tr>
<tr>
<td>7.6.3.1 Maintenance of Siltation Structures</td>
<td>7-120</td>
</tr>
<tr>
<td>7.6.3.2 Removal of Siltation Structures</td>
<td>7-120</td>
</tr>
<tr>
<td>7.6.4 Structure Removal</td>
<td>7-120</td>
</tr>
<tr>
<td>7.6.5 Permanent Casing and Sealing of Wells</td>
<td>7-120</td>
</tr>
<tr>
<td>References</td>
<td>7-121</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Located Behind Tab Marked Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-1</td>
<td>Upper Price River Formation Hydrographs</td>
</tr>
<tr>
<td>7-2</td>
<td>Castlegate Sandstone Hydrographs</td>
</tr>
<tr>
<td>7-3</td>
<td>Blackhawk Formation Hydrographs</td>
</tr>
<tr>
<td>7-4</td>
<td>Surface Drainage Patterns</td>
</tr>
<tr>
<td>7-5</td>
<td>Streamflow Probability of Selected Streams</td>
</tr>
<tr>
<td>7-6</td>
<td>Mine Discharge and Coal Production Rates</td>
</tr>
<tr>
<td>7-7</td>
<td>Abandoned Mining Equipment Locations</td>
</tr>
<tr>
<td>7-8</td>
<td>East Fork Box Monitoring Locations</td>
</tr>
<tr>
<td>7-9</td>
<td>Monitoring Stations in the South Fork of Quitchupah Creek Area</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-1</td>
<td>Observation Well Completion Summary</td>
<td>7-4</td>
</tr>
<tr>
<td>7-1A</td>
<td>Flow Observations in Link Canyon Water Monitoring Sites</td>
<td>7-40</td>
</tr>
<tr>
<td>7-2</td>
<td>Water Monitoring Program</td>
<td>7-51</td>
</tr>
<tr>
<td>7-3</td>
<td>Field and Laboratory Measurement Protocol</td>
<td>7-55</td>
</tr>
<tr>
<td>7-4</td>
<td>Groundwater Operational Water Quality Parameters</td>
<td>7-56</td>
</tr>
<tr>
<td>7-5</td>
<td>Surface Water Operational Water Quality Parameters</td>
<td>7-56</td>
</tr>
<tr>
<td>7-5A</td>
<td>East Fork of Box Canyon Monitoring and Mitigation</td>
<td>7-65</td>
</tr>
<tr>
<td>7-6</td>
<td>Summary of Watershed Data</td>
<td>7-90</td>
</tr>
<tr>
<td>7-7</td>
<td>Stage-Capacity Curve for the Concrete Sediment Trap</td>
<td>7-94</td>
</tr>
<tr>
<td>7-8</td>
<td>Stage-Capacity Data for the Sedimentation Pond</td>
<td>7-95</td>
</tr>
<tr>
<td>7-8A</td>
<td>Stage-Capacity Data for the Overflow Pond</td>
<td>7-97</td>
</tr>
<tr>
<td>7-9</td>
<td>Summary of Diversion Ditches</td>
<td>7-102</td>
</tr>
<tr>
<td>7-10</td>
<td>Summary of Diversion Culverts</td>
<td>7-103</td>
</tr>
<tr>
<td>7-11</td>
<td>4R4E Panel Drillhole Data</td>
<td>7-16</td>
</tr>
</tbody>
</table>
LIST OF PLATES

Plate

7-1 (Revisions have eliminated this plate)
7-2 Surface and Groundwater Rights
7-3 Hydrologic Monitoring Stations
7-4 Sedimentation Pond Topography
7-4A Overflow Pond Topography
7-5 Sedimentation Pond Cross Sections
7-5A Overflow Pond Cross Sections and Details
7-5B Overflow Pond Details
7-6 East Spring Canyon Drainage Details
7-7 (Revisions have eliminated this plate)
7-8 Watersheds Draining to The East Spring Canyon Surface Facilities
7-9 Link Canyon Watershed
7-10 Operational Hydrologic Monitoring Stations (Greens Hollow)
7-10C 4R4E Drill Logs (CONFIDENTIAL)
7-11 4R4E Drillhole Location Map
LIST OF APPENDICES
(Appendices appear in Volumes 7, 8 and 9)

Appendix

7-1 Water Rights Data
7-2 Hydrometrics Reports
7-3 Groundwater Level Data
7-4 Water Quality Data Summaries
7-5 Climatological Data
7-6 Spill Prevention Control and Countermeasure Plan
7-7 UPDES Permit
7-8 1980 Valley Engineering, Inc. Report
7-9 1979 Merrick and Company Report
7-10 Hydrologic Design Methods
7-11 Runoff Calculations
7-12 Diversion Ditch Calculations
7-13 Diversion Culvert Calculations
7-14 Sedimentation Pond Calculations
7-15 Alternative Sediment Control Measures Calculations and Designs
LIST OF APPENDICES (Continued)
(Appendices appear in Volumes 7, 8 and 9)

7-16 Small Area Exemption Demonstration Calculations

7-17 Investigation of Surface and Groundwater Systems in the Vicinity of the SUFCO Mine, Sevier County, Utah: Probable Hydrologic Consequences of Coal Mining at the SUFCO Mine and Recommendations for Surface and Groundwater Monitoring

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

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

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

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

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

7-23 Overflow Pond Calculations

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

7-25 North Water Mitigation Plan

7-26 Probable Hydrologic Consequences of Longwall Coal Mining of 2R2S Block "A" at the Canyon Fuel Company, LLC Sufco Mine, Salina, Utah
LIST OF APPENDICES (Continued)
(Appendices appear in Volumes 7, 8 and 9)

7-27  Greens Hollow Tract

7-28  Probable Hydrologic Consequences - Greens Hollow Tract
CHAPTER 7
HYDROLOGY

7.10 Introduction

7.1.1 General Requirements
This chapter presents a description of:

- existing hydrologic resources within the permit and adjacent areas;
- proposed operations and the potential impacts to the hydrologic balance;
- methods of compliance with design criteria;
- applicable hydrologic performance standards; and
- hydrologic reclamation plans for the SUFCO Mine.

Greens Hollow Lease
Much of the information presented for the permitting of the Greens Hollow Lease (GHL) was prepared with a conceptual mine plan assuming full extraction mining, associated subsidence and represents maximum impacts in the Bureau of Land Management’s Environmental Impact Statement (FSEIS). The information in the text represents the permittees accepted obligations and commitments, the information provided in appendices from the (FSEIS) unless reference specifically is provided as background or baseline for the obligations and commitments within the text. The Greens Hollow Tract Lease area was originally part of the Muddy Creek Tract, reports and documents referring to the Muddy Creek Tract in this chapter text and appendices are applicable to the Greens Hollow Tract. The Muddy Creek Tract should not be confused with the SITLA Muddy Tract.

7.1.2 Certification
All maps, plans, and cross sections presented in this chapter have been certified by a qualified, registered professional engineer.

7.1.3 Inspection
Impoundments associated with the mining and reclamation operations will be inspected as described in Section 5.1.4.3 of this M&RP.
7.20 Environmental Description

7.2.1 General Requirements
This section presents a description of the premining hydrologic resources within the permit area and adjacent areas that may be affected or impacted by the proposed coal mining and reclamation operation.

7.2.2 Cross Sections and Maps

7.2.2.1 Location and Extent of Subsurface Water
Groundwater occurs in perched zones of limited areal extent within the leased area. The PHC studies conducted by Mayo and Associates (Appendix 7-17 and Appendix 7-18) have determined that none of the formations down through the Blackhawk support a continuous aquifer. According to Mayo's research all of the aquifers within the permit area and adjacent areas are perched and discontinuous so it is not possible to represent a potentiometric surface for the area.

Seasonal variations in well water levels are discussed in Section 7.2.4.1.

The PHC for the Greens Hollow Lease area is located in Appendix 7-28 and discusses subsurface water.

7.2.2.2 Location of Surface Water Bodies
A map showing the location of surface water bodies (such as streams, ponds, and springs) for which water rights exist or for which there are pending water rights applications is provided as Plate 7-2. A listing of water rights data (names, locations and ownership) is presented in Appendix 7-1. Other than for the indicated springs, no water rights exist for groundwater in the permit and adjacent areas.

7.2.2.3 Locations of Monitoring Stations
Surface water and groundwater monitoring stations associated with the SUFCO operation are located as shown on Plate 7-3. Approximate surface elevations of the monitoring stations are also indicated on Plate 7-3.
7.2.2.4 Location and Depth of Water Wells

No water-supply wells exist in the permit or adjacent areas. Groundwater monitoring wells in the area are located as shown on Plate 7-3. Depths of these wells and other completion details are summarized in Table 7-1.

Greens Hollow. Well MW-15-5-2 is located near Cowboy Creek (Plate 7-3). The well depth is approximately 295' deep. The well was drilled in 2015 has consistently been dry during monitoring.

An in-mine monitoring well will be drilled into the Starpoint Sandstone to below the coal seam during 2019. The well will be drilled as close to the Greens Hollow Lease boundary as possible with the location being determined by safety, access and etc. The well location will be added to Plate 7-3 and 7-10 once the well has been completed. The well’s drill log with depth and other relevant information will be added to Appendix 6-1 (confidential) and a description of the well’s groundwater quality will be included in Appendix 7-27 once the information is available. Observation wells that are monitored as part of the SUFCO hydrologic monitoring program are monitored three times per year.

7.2.2.5 Surface Topography

Surface topographic features in the permit and adjacent areas are shown on the base maps used for Plate 7-3.

7.2.3 Sampling and Analysis

All water samples collected for use in this M&RP have been analyzed according to methods in either the "Standard Methods for the Examination of Water and Wastewater" or 40 CFR parts 136 and 434. Where feasible, these same references have been used as the basis for sample collection.

7.2.4 Baseline Information

Surface water, groundwater, and climatic resource information is presented in this section to assist in determining the baseline hydrologic conditions which exist in the area of the mine. This information provides a basis to determine if mining operations have had, or can be expected to have, a significant impact on the hydrologic balance of the area.
TABLE 7-1
OBSERVATION WELL COMPLETION SUMMARY\(^{(a)}\)

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<tr>
<th>Well Number</th>
<th>Total Drilled Depth (ft)</th>
<th>Elev. Top of Casing (ft)</th>
<th>Total Depth Cased (ft)</th>
<th>Casing ID (in)</th>
<th>Length of Perf. (ft)</th>
<th>Formation Monitored(^{(b)})</th>
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<tr>
<td>US-77-7</td>
<td>1220</td>
<td>8495.7</td>
<td>Unknown</td>
<td>1.25</td>
<td>Unknown</td>
<td>Unknown</td>
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<tr>
<td>US-77-8</td>
<td>1140</td>
<td>8424.6</td>
<td>160</td>
<td>1.25</td>
<td>110</td>
<td>Kc</td>
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<tr>
<td>US-77-9</td>
<td>1140</td>
<td>8360.2</td>
<td>100</td>
<td>1.25</td>
<td>75</td>
<td>Lower Kc/Upper Kbh</td>
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<tr>
<td>US-79-9</td>
<td>970</td>
<td>8541.8</td>
<td>860</td>
<td>2.0</td>
<td>20</td>
<td>Upper Hiawatha Coal</td>
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<tr>
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<td>990</td>
<td>8553.8</td>
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<td>Upper Hiawatha Coal</td>
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<td>8523.1</td>
<td>860</td>
<td>2.0</td>
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<td>1014</td>
<td>8527.6</td>
<td>710</td>
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<td>US-80-2</td>
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<td>4.0</td>
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<tr>
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\(^{(a)}\) See Plate 7-3 for well locations

\(^{(b)}\) Kc = Castlegate Sandstone member of the Price River Formation. Kbh = Blackhawk Formation
7.2.4.1 Groundwater Information

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

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

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

AQUIFERS

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

North Horn Formation. The North Horn Formation crops out in the northwest portion of the lease area. This formation consists of interbedded shale, sandstone, and limestone. Data presented in Appendix 7-2 indicate that only one seep and one spring issue from the North Horn Formation within the lease area. Recharge occurs to outcrops of the North Horn Formation west of the lease
area (Thiros and Cordy, 1991). Thus, it may serve as an aquifer in some portions of the western adjacent area.

**Upper Price River Formation.** The upper Price River Formation consists of about 450 feet of interbedded sandstone and claystone. Within the area, the upper Price River Formation has not been identified as a significant aquifer. Thiros and Cordy (1991) estimated that combined recharge to the upper Price River Formation and the Castlegate Sandstone is limited to 1.2 percent of the total annual precipitation. As indicated in Appendix 7-2, a few isolated springs have been identified discharging from the sandstone lenses within the formation. No groundwater has been identified within this formation during the exploration drilling which has been conducted from the top of the plateau. As a result no monitoring or water supply wells have been completed in this formation within the mining area.

Five monitoring wells have been completed in a massive sandstone unit in the Price River Formation at the waste rock disposal site. Hydrographs of three representative wells (B-3, B-6, and B-8) are depicted in Figure 7-1. Seasonal fluctuations are typically less than one foot in wells B-3 and B-6, and less than three feet in B-8. All three wells display a general downward trend in water levels from spring to late summer (see also Appendix 7-4 and Waste Rock Volume).

**Castlegate Sandstone.** The Castlegate Sandstone consists of an estimated 120 to 260 feet of medium to coarse-grained sandstone with a few thin interbedded mudstones or shales near the base. The sandstone is conglomeratic, forms prominent cliffs along the outcrop, and is well cemented with calcareous cement.

A limited number of springs issue from the Castlegate Sandstone in the Quitchupah lease area, with flow generally less than 1 gpm. In the Pines Tract area, several springs issue from and near the base of the Castlegate Sandstone. The waters from these springs feed the Main Fork and East Fork of Box Canyon Creek. Base flow from these springs is generally less than 1 to 2 gpm with a few flowing at rates of 5 to 6 gpm.

Based on information from the exploration drill holes and observation wells in the area, the Castlegate Sandstone contains small quantities of groundwater. No significant quantities of
groundwater (more than 2 gpm) were encountered in any of the exploration holes nor was groundwater identified in all drill holes.

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

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

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

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

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

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

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

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

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

Generally, flow rates from the springs and seeps issuing from the Blackhawk Formation are moderate to low in the spring and decline through the summer and into the fall (Appendix 7-1). These flow rates are typically less than 1 gpm with a few flowing at a slightly higher rate in the Pines Tract area.
At the SUFCO mine, groundwater is encountered in the underground workings. Since 1982, the mine has discharged at an average flow rate of 580 gpm (1.29 cfs). The underground water is primarily encountered at the working faces and is associated with faults, fractures, and roof bolt holes. As with many of the mines in the Wasatch Plateau, these zones yield water readily when new areas are opened, but inflow rates normally decrease rapidly as mining progresses. The inflow rates are commonly less than 5 gpm at any given point and cease after a few months, suggesting the presence of perched aquifers of limited areal extent. Monitoring point SUFCO-062, which has been the only underground monitoring point for inflow, averages 0.0011 cfs (0.49 gpm).

Hydrographs of water levels in selected Blackhawk Formation observation wells are presented in Figure 7-3. As indicated in these hydrographs and the remaining data provided in Appendices 7-3, seasonal water-level fluctuations are typically less than two feet. However, the long-term trend is for water-level elevations to be decreasing.

The downward trend in water-level elevations is probably caused by two factors. First, decreased precipitation during the past few years (see Section 7.2.4.4 of this M&RP) has contributed to lower groundwater recharge in the area. Second, interception of groundwater by mining operations has increased groundwater discharge from the area.

**Star Point Sandstone.** The Star Point Sandstone is fine to medium grained in texture with the coarser grained material occurring in the upper portions of the formation. The Star Point forms a well defined cliff between the slopes of the Mancos Shale and the overlying Blackhawk Formation. Except where eroded or exposed in deep canyons, the Star Point Sandstone underlies the entire lease area.

In 1989, four monitoring wells were completed in the basal Blackhawk/upper Star Point Sandstone Formation. The wells ranged from 1012 to 1300 feet deep and were completed in the intervals indicated on Table 7-1. These holes did not encounter significant quantities of groundwater.

Recharge to the Star Point Sandstone probably occurs primarily from vertical movement of the water through the overlying Blackhawk Formation. Discharge from the Star Point is considered to be primarily to adjacent canyons at the contact with the underlying Mancos Shale. These discharge points are generally covered with alluvial fill of the stream systems. Therefore, little surface expression of the discharge has been identified. This was noted in Convulsion Canyon, however there was no evidence of this occurring in Muddy Creek Canyon.
Mancos Shale. Underlying the mine area and exposed in the deep canyons is the Mancos Shale. This dark, slope-forming, marine shale is relatively impermeable and is not considered to be a regional or local aquifer (Danielson and Sylla, 1983).

Quaternary Alluvium. Unconsolidated Quaternary deposits are present along streams and generally consist of silts, sands, and occasional gravels. The deposits, which have low to moderate permeability, receive water from the adjacent bedrock in some of the deeply incised canyons. Discharge from these materials is to the surface water system. SUFCO collects water in the alluvium at the base of East Spring Canyon and pumps it to the mine for use as culinary water. The average flow from this source is approximately 25 gpm. Water is probably supplied to the alluvium by seepage from the Blackhawk Formation and Star Point Sandstone.

RECHARGE
Recharge within the area occurs primarily on the exposed upland outcrops of the Price River Formation and the Castlegate Sandstone. The annual recharge to these units is estimated to be 1.2 percent of the total annual precipitation. "Much recharge occurs" on outcrops of the Flagstaff Limestone and the North Horn Formation west of the lease area (Thiros and Cordy, 1991). Recharge to the Blackhawk Formation and the Star Point Sandstone probably occurs primarily from vertical movement of water through the overlying formations. The Mancos Formation underlies the entire area and is exposed in the deep canyons. It is relatively impermeable. Groundwater descending from the Star Point Sandstone flows along the Mancos-Star Point contact and discharges to the surface.

Locally, recharge is probably greater where surface fractures intersect topographic highs (plateaus). These areas occur where the North Horn Formation or the Castlegate Sandstone crops out (Thiros and Cordy, 1991). The North Horn Formation crops out in the northwest corner and along the western border of the lease area. The Castlegate Sandstone generally crops out along the top edges of the steep-walled canyons (Plate 6-1). However, in the east and north central parts of the permit area, the Castlegate Sandstone caps the plateaus in relatively large areas. According to Thiros and Cordy (1991), recharge is increased where fractures extend down through the Price River Formation to the Castlegate Sandstone. This may occur in the southwestern corner of the permit area where subsidence cracks have been seen to penetrate the Castlegate Sandstone and Price River Formation (Thiros and Cordy, 1991). Additionally, faults along the western and northern margins of the permit area may increase secondary permeability, thus locally increasing recharge.
Recharge occurs in the northwest corner (T.21 S., R.4 E., sections 11 and 23) and the northeastern part of the permit area (T.21 S., R.5 E., section 16). The first area is a topographic high and fractured where the North Horn Formation crops out. The second area is a topographic high, capped by the Price River Formation. Linear features that imply fracturing are located in this area (Plate 6-1 and SUFCO, 1992).

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

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

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

**Greens Hollow Tract**

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

Pre-mine head in the coal has been measured in four observation wells completed in the Upper Hiawatha coal seam in the vicinity of Duncan Mountain. The three wells near the edge of the Wasatch Plateau were found to be dry. The head in the mine following cessation of mining and pumping would be expected to recover to approximately 80 percent of the premining level. Based on this assumption the heads in the mined-out area of the Greens Hollow tract would be expected to remain below the elevation at the outcrop of the Hiawatha coal seam near the edge of the Wasatch Plateau. Pressure redistribution with the coal supports rapid recovery of about 80 percent.
of the potentiometric levels to pre-mining levels. The final 20 percent of recovery occurs more slowly. Most of the water entering the coal during final recovery is stored within units of the Blackhawk Formation. Any effects on the ground water discharges from the underlying Star Point Sandstone or the hydrogeologic units located stratigraphically above the coal would be low and unmeasurable. (Cirrus, (2013c).

According to the FSEIS “water conveying faults are not expected to be encountered during underground mining in the Greens Hollow Tract”. Anderson (2004a) found faulting in the study area to be minimal. Should water underground be encountered that is flowing directly from formation greater than 1 CFS, which continually flows for 30 days, a sample will be collected for lab analysis. The sample will be analyzed for the parameters listed on Table 7-2, subcategory D9. The analysis for tritium age dating will be completed once during the 30 day sampling period (carbon 14, carbon 13 and tritium). Flow measurements will be taken weekly until access is no longer available and/or flow stabilizes/stops. A map will be created showing the approximate panel location of the flow (as described above), the monitoring information and map will be incorporated into Appendix 7-27.

Mine Water Management System. Water is both pumped to and from mining districts underground. Process water is pumped into mining districts for uses on the longwall and in continuous miner sections. During the mining process water is primarily used on the longwall shearer, continuous miner, roof bolter and along conveyor belts for dust suppression. Water is also used in a mining district to clean equipment and assist with maintenance work. Water is collected from the mining districts in sumps, where particulate matter can settle prior to being either recirculated for use, pumped to a sealed mine workings for storage/further treatment or discharged to the surface. The mine discharges water as UPDES Outfall 003 the location is shown on Plate 7-3.

WATER QUALITY
Observation wells and springs that are monitored as part of the SUFCO hydrologic monitoring program are monitored three times per year. Due to the general inaccessibility of the sample points during the winter, no winter sampling occurs. A historical summary of water-quality analyses for groundwater samples (wells, springs and mine inflow) collected from the permit and adjacent areas is presented in Appendix 7-4.

Groundwater-quality samples have been collected in the permit and adjacent areas from:
Springs that issue from the North Horn Formation, the upper Price River Formation, the Castlegate Sandstone, the Blackhawk Formation, and the Star Point Sandstone,

In-mine monitoring well finished in the Starpoint Sandstone formation in the vicinity of the Greens Hollow Lease boundary,

Monitoring wells at the waste-rock disposal site that are completed in the upper Price River Formation, and

Mine inflow that issues from the Blackhawk Formation.

Results of analyses of these samples have been submitted to UDOGM. Historical results are summarized in Appendix 7-4.

Historical data have been collected from one spring issuing from the North Horn Formation (SUFCO-057A). Over its period of record, the water issuing from this spring has been a calcium bicarbonate type with an average total dissolved solids (TDS) concentration of 371 mg/l and an average pH of 7.5. Total and dissolved iron concentrations have averaged 0.24 and 0.02 mg/l, respectively. Total manganese concentrations have averaged 0.09 mg/l. Except for one apparent outlier, dissolved manganese concentrations at the spring have averaged 0.04 mg/l. Insufficient data are available to determine seasonal trends in water quality from this spring.

One spring and three monitoring wells completed in the upper Price River Formation have been sampled in the permit and adjacent areas. Historical data collected from the spring (GW-13) indicates that this water is a sodium bicarbonate type with an average TDS concentration of 745 mg/l and an average pH of 7.3. Dissolved iron and dissolved manganese concentrations have averaged 0.08 and 0.05, respectively, during the period of record. Data concerning total iron and total manganese are not available. The limited data suggest that pH and TDS concentrations are inversely proportional to flow while iron and manganese concentrations are directly proportional to flow. However, the data base is currently insufficient (seven sampling events) to draw detailed conclusions.

Historical data collected from the monitoring wells (located at the waste-rock disposal site) indicate that the water in this area is of mixed chemical type with no consistently dominant ions. TDS concentrations in groundwater immediately underlying the waste-rock disposal site are high relative to other portions of the permit area (average TDS concentration of 2100 to 6170 mg/l), with average pH values that are approximately neutral (varying between the wells from 6.8 to 7.2). Dissolved iron and dissolved manganese concentrations have averaged 0.1 mg/l or less at the three wells (with the exception of one apparent outlier manganese value). Data concerning total
iron and total manganese are not available. Although there are no historic seasonal trends in the available data, the water quality data show that in 1991, sulfate and bicarbonate concentrations increased and chloride concentrations and pH values decreased from spring to fall (Appendix 7-4 and Waste Rock Volume).

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

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

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

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

Historical data collected from stations SUFCO-047 and SUFCO-062 are considered representative of the Blackhawk-Star Point aquifer. Although station SUFCO-047 consists of seepage collected from alluvium and used for the mine domestic water supply, it is regarded as being fed by outflow from the adjacent Blackhawk-Star Point aquifer. Station SUFCO-062 represents inflow to the mine from the surrounding Blackhawk Formation.
Groundwater from these two sources is a calcium bicarbonate type, with historical TDS concentrations averaging 373 to 492 mg/l and pH values averaging 7.2 to 7.5. Between the two sources, average total iron concentrations range from 0.08 to 0.15 mg/l while average dissolved iron concentrations are both equal to 0.02 mg/l. Total manganese concentrations average 0.05 to 0.06 mg/l between the two sources, while dissolved manganese concentrations average 0.02 to 0.05 mg/l. The data have not exhibited consistent seasonal trends.

As a general point of comparison, the groundwater quality analyses were compared to the primary drinking water standards (40 CFR 141) and the secondary drinking water standards (40 CFR 143). These comparisons indicate that there were no exceedances of the primary drinking water standards for any of the groundwater samples. Exceedances of the secondary drinking water standards were found in groundwater samples only for sulfate and TDS concentrations (with recommended standards of 250 mg/l and 500 mg/l, respectively). All of the sulfate exceedances and most of the TDS exceedances occurred in groundwater collected from monitoring wells at the waste-rock disposal site. These exceedances are probably due to the natural dissolution of marine salts known to exist in the local strata (Waddell et al., 1981).

4 Right 4 East Panel - Water Quality
The area of the panel was initially surveyed for surface and ground water resources in the late 1980's and early 1990's to provide information for the USFS and BLM Environmental Assessment of the Quitchupah Lease (U-63214) and the US Geological Survey Water Resources Investigation Report 90-4084. At approximately 11:30 AM on April 24, 2017 a walking survey of the surface above and immediately adjacent to the panel was conducted by a qualified CFC employee to locate surface and groundwater resources. The day was cloudy with a temperature of approximately 50 degrees F and wind ranging from approximately 5-10 mph. There were no surface or groundwater sources identified during the survey. Two exploration wells were drilled in August of 2017 near the 4R4E panel. The head geologist over the drilling project reported that no water was encountered in either well while drilling. See Table 7-11 below for drill hole locations, completion dates and other information. See Plate 7-10C for the 4R4E drillhole logs and 7-11 for the drillhole location map. The closest known surface water is an established natural pond approximately 3/4 mile northwest of the panel in T21S, R5E, Section 28.
Table 7-11

SUFCO 2017 DRILLHOLE INFORMATION- 4RIGHT 4 EAST PANEL AREA

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Greens Hollow Tract
The description is based on an extensive three year study of the Muddy Creek area and a 2-mile buffer surrounding the tract performed by Cirrus in 2004 and the continuation of sampling by the Permittee. Springs were identified as occurring in the Castlegate, Price River and North Horn formations. “The overall risk for permanent water loss at any spring located within the tract should be relatively low” (FSEIS, 2015).

Cirrus- A total of 33 springs were measured for flow and various parameters during the spring and fall seasons for 2001 to 2004. A summary of the collected data in included in the Tables 2A & B located in the PHC Tables. Water quality samples were collected for laboratory analysis from eight springs during 2001 - 2004. The field parameter monitoring results for the springs indicate that the relevant criteria for the State of Utah with the exception of dissolved oxygen, which is typically low in springs. Laboratory analysis met the relevant criteria except for some slight exceedances in arsenic, cadmium, lead, TDS, selenium and zinc. Based on the knowledge of local geology and soil the water chemistry reflects natural conditions.

The permittee continued monitoring selected springs and surface water locations shown on Plates 7-3, 7-10 and the data is summarized in the PHC in Appendix 7-28. Summaries include data spring data for M-SP 4 - 12, 14,15, 19, 20, 40, 41, 44, 45, 53, 60 and etc.
7.2.4.2 Surface Water Information

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

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

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

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

Link Canyon, in the area of the portals, is typified by four types of stream gradient segments or reaches. The initial drainage segment, Segment 1, flows across a low gradient surface with a slope of approximately 3 percent (Plate 7-9). The drainage sits on top of the Castlegate Sandstone.
and the channel floors consist of bed rock with a thin covering of loose, fine to coarse grain sands and silts. Channels can be shallow and broad or narrow and deeply incised in the minimal soil cover. Surface water is observed flowing in this reach only after significant storm events or on a few warm days during the spring runoff. No significant riparian vegetation is associated with this reach of the drainage.

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

The third segment of the stream, Segment 3, is approximately 1500 feet long and extends from a point approximately 1200 feet below Pines 100 to a point approximately 250 feet below the Link Canyon Mine Portals. The slope of the gradient in this reach is approximately 50 percent. The drainage cuts through the Blackhawk Formation and the upper Star Point Sandstone. This reach is typified by alternating sandstone ledges and shaley slopes with little to no soil cover. The channel contains large boulders, cobbles and gravel and at times is poorly defined. Surface water above the mine portals has only been observed in this reach during and shortly after significant storm events. Surface water flows downstream of the portals for a distance typically less than 500 feet. Riparian vegetation is located slightly upstream and for approximately 800 feet below the Link Canyon portals. This vegetation is typified by willow, alder, stinging nettle, rose, horsetail, carex, Kentucky Bluegrass, rush, and clematis. As in segment 2, the riparian vegetation is typically
limited to the bottom of the channel or a short distance up the channel walls. This suggests that the water source for these plants is the water discharged from the mine into the channel and not an areal extensive aquifer discharging to the channel at numerous locations and elevations.

The final reach of the drainage, Segment 4, described herein runs from a point beginning approximately 250 feet below the portals to the USFS boundary and the south section line of Section 26, or approximately 2600 feet. The slope of the gradient in this reach is approximately 10 percent. The drainage channel cuts through the Mancos shale in this reach and typically has a floor of sandstone cobbles and boulders resting in fine to coarse sand and silt. The channel itself can be incised in the minimal soil cover or be broad and flat where bedrock is exposed and little soil cover is found. Surface water would flow in this reach only after significant precipitation events. However, in five years of monitoring the two sites, Link 001 (located near the base of the third stream segment) and 002 (located near the base of the fourth stream segment), surface water has not been observed in the channel.

Station locations are indicated on Plate 7-3. All other streams within the permit and adjacent areas are ephemeral, unless specified otherwise.

Based on channel-geometry measurements and a technique described by Fields (1975), Waddell et al. (1981) estimated that the historic average annual flow of Quitchupah Creek is approximately 3800 acre-feet immediately above the confluence with Link Canyon. With a drainage area of 85.4 square miles (Waddell et al., 1981), this results in a unit-area average annual streamflow of 44.5 acre-feet per square mile per year (AF/mi²/yr) for Quitchupah Creek above Link Canyon.

The U.S. Geological Survey collected streamflow data from Ivie Creek from 1951 through 1961 at a station located approximately 11 miles south of the mine surface facilities. During the period of record, data published by the U.S. Geological Survey indicate that the average annual streamflow at this station was 2830 AF/yr. Based on a published drainage area of 50 mi², the unit-area average annual streamflow of upper Ivie Creek was 56.6 AF/mi²/yr. This compares favorably with the unit-area yield of Quitchupah Creek and with the mean annual water yields presented by the Utah Division of Water Resources (1977).

Seasonal variations in historic streamflow in the vicinity of the lease area are portrayed graphically in Figure 7-5. The Muddy Creek station is located approximately 6 miles downstream from the
confluence of Box Canyon and Muddy Creek while the Ivie Creek station was located about 11 miles south of the mine surface facilities. These trends (which are considered representative of perennial streams in the permit and adjacent areas) indicate that peak monthly stream flows in the area generally occur in May or June, probably as a result of snowmelt runoff. The Ivie Creek data also indicate that an additional rise in the monthly hydrograph occurs in July or August, probably as a result of summer thunderstorm activity.

Even though selected stations have been monitored for over eight years, no streamflow data are available for ephemeral drainages in the permit and adjacent area. When it does occur, ephemeral runoff in the area is expected to occur predominantly in the months of July, August, and September as a result of thunderstorm activity. These storms are expected to result in runoff with a short duration and high intensity.

Greens Hollow Tract
Surface runoff from the tract flows into tributaries of Muddy Creek and the North Fork of Quitchupah Creek. Watersheds for the tract include most of the Greens Canyon, Greens Hollow, Cowboy Creek, North Fork Quitchupah Creek and South Fork Quitchupah Creek watersheds. The main stem of Muddy Creek is perennial as it passes along the northern edge of the Greens Hollow tract. North Fork of Quitchupah Creek does not flow into Muddy Creek but does have perennial flow. According to USGS records the annual average flow for Muddy Creek near Emery is 37.5 cfs (USGS 2013). In 2001 the average flow was 33.2 cfs.

A loss/gain study for Greens Canyon and its tributaries, Greens Hollow and Cowboy Creek was done in 2001. The study showed losses for the streams in the Blackhawk Formation and Castlegate Sandstone. Cirrus was not confident that this study was representative of normal conditions. Quarterly field visits by Cirrus to stock ponds in the Muddy Creek Tract boundary from summer 2002 through fall 2003 showed most ponds being empty by early summer.

Cirrus did monitoring of surface water and as did the permittee, locations are shown on Plate 7-3 and the data is summarized in Tables 2A & B in PHC. Summaries include data for the South Fork of Quitchupah (Upper), U-Mud and MSTR-6.
Small catchment ponds have been constructed in the permit and adjacent areas to capture water for wildlife and stock watering. Those catchment ponds are located as shown on Plate 7-2 and on a plate in Appendix 7-27 (Ponds, Troughs and Water Monitoring Locations). Appendix 7-27 contains a table providing historic (2008 -2017) information about the ponds inside the Greens Hollow Lease boundary and within an approximate one mile radius of the lease boundary. The catchment ponds capture water either from an adjacent spring and/or precipitation (rain, snow, etc). SUFCO commits to visiting the ponds (M-P 02 - 05, 07 -10 and GH-P01 thru 09) within the Greens Hollow Lease and immediately adjacent area when accessible in the spring of each year (typically late April to June), photographing each pond, observe the pond for evidence of cracking, estimate the depth and surface area of water contained in the pond, inspect the immediate drainage area for evidence of surface cracking, note general soil moisture conditions within the pond, and note the general condition of the pond. The same data will be collect during an additional monitoring visit made in the Fall annually (typically late September to early November). The pond monitoring information will be compiled and submitted in an annual report or provided to the Division's hydrologist upon written request (e-mail, etc.). Refer to Appendix 7-27 for additional information pertaining to ponds adjacent to and within the Greens Hollow Lease.

The Suco mine has three UPDES discharge monitoring points. The locations of these points are shown on Plate 7-3.

UPDES monitoring point 001 represents an emergency mine discharge point that is used only in the event of a failure of the mine dewatering system. To discharge from this point, the emergency in-mine pump must be started and the valve on the discharge pipe must be manually opened. When the point is used, water is discharged into the East Spring Canyon 72-inch bypass culvert shown on Plate 7-6.

UPDES monitoring point 002 represents discharge from the East Spring Canyon sedimentation pond. Discharge from this point occurs only infrequently as a result of pond dewatering.

UPDES monitoring point 003 (equivalent to hydrologic monitoring station SUFCO-021) represents normal discharge from the underground workings into the North Fork of Quitchupah Creek. As indicated in the 1990 annual report, discharge at this point averaged approximately 550 gpm during the period of 1983 through 1990. From 1988 through 1990, this discharge rate generally increased
from a pre-1988 rate of about 450 gpm to about 1,000 gpm (see Figure 7-6). Discharge rates tend to relate to coal production rates and are not seasonally affected.

Note that the waste-rock disposal area sedimentation pond does not have a UPDES permit since this is a total-containment, non-discharge facility (see the Waste Rock Volume of this M&RP).

**WATER QUALITY**

Surface-water quality samples have been collected in the permit and adjacent areas from stations located on Quitchupah Creek, the North and South Forks of Quitchupah Creek, mine discharges into the North Fork of Quitchupah Creek, drainages to Muddy Creek and Box Canyon. Historical data from these sources are summarized in Appendices 7-4, 7-17 and 7-18.

Historical data collected from stations SUFCO-006 (upper South Fork of Quitchupah Creek) and SUFCO-007 (upper North Fork of Quitchupah Creek) indicate that water in the upper reaches of this drainage is predominantly a calcium-bicarbonate chemical type with an average TDS concentration that varies from about 330 to 470 mg/l. The pH of this water is slightly alkaline, averaging 7.9 to 8.0. Total iron concentrations at these stations typically ranges from 1.7 to 3.0 mg/l, with dissolved iron concentrations averaging 0.03 to 0.04 mg/l. Total manganese concentrations at these stations average 0.11 to 0.12 mg/l, with dissolved manganese concentrations averaging 0.02 to 0.05 mg/l.

Alkalinity typically exceeds acidity at these upper stations by a factor of approximately 25. TDS concentrations tend to be inversely proportional to flow, while total iron and manganese concentrations are typically directly proportional to flow. Consistent seasonal variations in pH, dissolved iron, and dissolved manganese concentrations are not apparent.

The historical mine discharge at SUFCO-021 (UPDES monitoring station 003) is a calcium-bicarbonate-sulfate water with an average TDS concentration of 603 mg/l and an average pH of 7.4. Sulfate concentrations in the mine-water discharge average 236 mg/l. This compares with an average sulfate concentration of 81 mg/l between stations SUFCO-006 and -007 and an average of 66 mg/l in the mine inflow (station SUFCO-062). This increase in sulfate (and TDS) in the mine-water discharge as compared with adjacent surface and underground water may be the result of dissolution of the calcium-sulfate based rock dust used in the mine.
Total and dissolved iron concentrations in the mine-water discharge average 0.08 and 0.03 mg/l, respectively. Total and dissolved manganese concentrations in this water average 0.02 and 0.01 mg/l, respectively. On the average, the alkalinity exceeds the acidity by a factor of approximately 20. The chemical data have not exhibited consistent seasonal variations.

At the mouth of the North Fork of Quitchupah Creek (SUFCO-042), the predominant ions are calcium, bicarbonate, and sulfate. The average historical TDS concentration at this location is 518 mg/l, with an average pH of 7.9. Total and dissolved iron concentrations at this station average 3.4 and 0.03 mg/l, respectively, with total and dissolved manganese concentrations averaging 0.08 and 0.01 mg/l, respectively. Alkalinity exceeds acidity by a factor of more than 20.

TDS concentrations at SUFCO-042 are generally inversely proportional to flow, while total iron and manganese concentrations are directly proportional to flow. Seasonal variations in pH, dissolved iron, and dissolved manganese are not apparent.

Stations SUFCO-046 and SUFCO-041 monitor Quitchupah Creek above East Spring Canyon and above the North Fork of Quitchupah Creek, respectively. Average historical TDS concentrations at these stations vary from 697 to 685 mg/l, with pH averaging 7.6 to 8.0. Water in Quitchupah Creek is of mixed chemical type. Average total iron concentrations range from 0.28 mg/l at the 7-23D upstream station to 3.76 mg/l at the downstream station. Average dissolved iron concentrations range from 0.03 to 0.04 mg/l at the two stations. Total manganese averages 0.08 at both stations, with dissolved manganese ranging from 0.06 mg/l at the upstream station to 0.02 mg/l at the downstream station.

Alkalinity typically exceeds acidity in Quitchupah Creek by a factor of at least 25. Flow-TDS and flow-total metal relationships are as indicated above. Seasonal variations in pH, dissolved iron, and dissolved manganese are not apparent.

The historical chemical quality of surface water in East Spring Canyon at station SUFCO-047A is similar to that of Quitchupah Creek at SUFCO-046. The water is of mixed chemical type, with an average TDS concentration of 724 mg/l and an average pH of 7.4. Total and dissolved iron concentrations average 0.43 and 0.04, respectively, with total and dissolved manganese
concentrations averaging 0.04 and 0.02, respectively. Alkalinity typically exceeds acidity in East Spring Canyon by a factor of approximately 20. Flow-TDS and flow-total metal relationships are as indicated above. Seasonal variations in pH, dissolved iron, and dissolved manganese are not apparent.

The historical chemical quality of streamflow in Box Canyon (as monitored at station SUFCO-090) contains an average TDS concentration of 93 mg/l and an average pH of 7.1. No total iron or manganese data are available. However, dissolved iron and manganese concentrations have averaged 0.27 and 0.04 at the station, respectively. The data base is insufficient to assess seasonal variations. However, trends between flow, TDS, and total metals are anticipated to be as described for the North and South Forks of Quitchupah Creek. Data collected from monitoring sites Pines 407 and Pines 408 are included in Appendices 7-17 and 7-18.

As a general point of comparison the surface-water analytical data were compared to primary and secondary drinking water standards. With the exception of two slight exceedances of the barium standard of 1.0 mg/l (one at SUFCO-007 and one at SUFCO-041), no exceedances of the primary drinking water standards occurred at the monitored stations. Exceedances of the secondary drinking water standards occurred for both sulfate and TDS. With the exception of the mine discharge, these exceedances are likely due to dissolution of marine salts in the sediments and outcropping rocks (Waddell, 1979 and Doelling, 1972).

7.2.4.3 Geologic Information
Geologic information related to the permit and adjacent areas is presented in Chapter 6 of this M&RP.

7.2.4.4 Climatological Information
Climatological data have been collected from a station location at the mine surface facilities since July 1986. Historical monthly summaries of these data are presented in Appendix 7-5. These and other regional data are summarized in this section. Updated climatological data have been submitted to the Division in annual reports.

Precipitation. Based on regional data, normal annual precipitation at the mine is about 18 inches per year (Utah Division of Water Resources, 1977). Approximately 42 percent of this precipitation
falls in the period of May through September, with the remainder falling in the October through April period, primarily as snow (Utah Division of Water Resources, 1977).

During the historical period of record at the mine site, precipitation has been below the regional normal cited above, averaging 12.51 inches per year (see Appendix 7-5). Average monthly precipitation at the mine has ranged from 0.59 inch in June to 1.65 inches in August, with the August peak being the result of summer thunderstorm activity. Snow cover is typically on the ground from September through May.

**Wind.** The station closest to the mine that reports wind data is located at Gunnison, Utah (approximately 28 miles northwest of the mine). Due to the mountainous conditions in the area, the wind data collected at this station are not considered representative of the mine site. Periodic observations by mine personnel suggest that the prevailing wind at the mine is up the local canyons (i.e. south to north at the mine surface facilities).

**Temperature.** The normal annual temperature at the Salina, Utah station (located 24 miles west of the mine) is 49.5° F (National Weather Service, 1989). Seasonally, this temperature varies from a normal monthly low of 27.6° F in January to a normal monthly high of 73.7° F in July. During the period of record, temperatures at the mine have ranged from a low of -19° F in February 1989 to a high of 92° F in July 1989.

### 7.2.4.5 Supplemental Information

No supplemental information is required at this time.

### 7.2.4.6 Survey of Renewable Resource Lands

The existence and recharge of aquifers in the permit and adjacent areas is discussed in Section 7.2.4.1 of this M&RP. A discussion of the potential for material damage or diminution of these aquifers and their recharge areas due to subsidence is provided in Section 7.2.8 of this M&RP.

### 7.2.4.7 Alluvial Valley Floor Requirements

Information regarding the presence or absence of alluvial valley floors in the permit and adjacent areas is presented in Chapter 9 of this M&RP.

7-25
7.2.5 Baseline Cumulative Impact Area Information
The hydrologic and geologic information required for UDOGM to develop a Cumulative Hydrologic Impact Assessment is presented in this M&RP under Chapters 6 and 7. Required information not available in these chapters is available from the Utah Division of Water Rights and Water Resources and from the U.S. Geological Survey, the U.S. Bureau of Land Management, and the U.S. Forest Service. The Greens Hollow PHC is located in Appendix 7-28.

7.2.6 Modeling
No numerical groundwater or surface water modeling was conducted in support of this M&RP.

7.2.7 Alternative Water Source Information
No surface mining has been or will be conducted in the permit and adjacent areas. Therefore, this section does not apply to the SUFCO Mine.

7.2.8 Probable Hydrologic Consequences
This section addresses the probable hydrologic consequences of coal mining and reclamation operations in the mine permit and adjacent areas. Mitigating measures are discussed generally in this section and in detail in Section 7.3 of the M&RP. The Greens Hollow PHC is located in Appendix 7-28.

7.2.8.1 Potential Impacts to Surface and Groundwater
Potential impacts of coal mining on the quality and quantity of surface and groundwater flow may include:

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

**Greens Hollow Seep & Spring Inventory** - In the time that has elapsed subsequent to the 2000-2004 spring and seep survey and baseline monitoring activities performed by Cirrus Ecological Solutions in the Greens Hollow Tract (U.S. Forest Service, 2005), Petersen Hydrologic personnel have traversed all of the major surface water drainages and observed hydrologic conditions (including spring discharge locations and conditions) within the tract and adjacent area. The areas traversed include the Muddy Creek drainage in the vicinity of the northern portions of the tract, the Greens Hollow area, the upper and lower Cowboy Canyon areas, the North Fork stream drainage, the South Fork stream drainage, Big Ridge, and the broad upland plateau areas that are situated between the major drainages that are developed on erosional surfaces in the Price River Formation within and adjacent to the Greens Hollow Tract. Additionally, Petersen Hydrologic personnel have in the past several years routinely traversed the Box Canyon and Skutumpah Canyon areas adjacent to the Greens Hollow Tract. In addition, many of these areas have also been traversed by Canyon Fuel environmental specialists in recent years (personal communication, Vicky Miller, 2017).

The field visits to these areas have occurred in conjunction with quarterly hydrologic monitoring in the area (2000-2017), supplemental quarterly baseline monitoring activities specifically for the Greens Hollow Tract (2014-2017), and in conjunction with miscellaneous hydrologic field investigations that have been performed in the area (2000-2017). Most of the areas have been traversed by foot, while others have been observed from vehicles or ATVs, or during aerial surveys from helicopters. In the course of these field visits and observations, a single previously unidentified spring, USP-2 (a Price River Formation spring with measured flows less than 0.5 gpm), was identified by Petersen Hydrologic personnel. USP-2 was incorporated into the water monitoring plan. No additional significant springs (i.e. with measurable discharges) were identified within the Greens Hollow Tract during these site visits.

During the course of the supplemental baseline hydrologic monitoring that has been performed at the Greens Hollow Tract by Petersen Hydrologic (2015-2017), all of the springs within the Greens Hollow Tract previously identified in the 2000-2004 spring and seep and baseline monitoring activities conducted by Cirrus Ecological Solutions have been visited, monitored and observed by Mr. Petersen during 2nd, 3rd and 4th quarters each year (2015 - 2017). During these field visits, it
was noted that the metallic field spring-identification tags that were placed at individual spring locations during the 2000-2004 Cirrus Ecological Solutions surveys were found for almost all of the previously identified springs. Additionally, the geographic UTM coordinates that were determined by Cirrus (2000-2004) using hand-held GPS devices were field verified by Petersen Hydrologic using a Garmin hand-held GPS device for all of the identified spring locations during the recent traverses. The Cirrus locations and the recent Petersen Hydrologic locations were found to be in agreement. There is no indication that there has been any substantial movement of spring discharge locations during the time that has elapsed since the initial 2000-2004 spring identification activities. There was likewise no indication that any new substantial springs had emerged subsequent to the 2000-2004 surveys.

Hydrologic monitoring of springs and streams was performed by Petersen Hydrologic as follows:

Discharge measurements at springs were performed using a stopwatch and a calibrated container. Typically, the spring discharge measurements were performed by damming and diverting the spring discharge through a pipe, and then performing time-to-fill measurements using an appropriately sized container of known volume. Time-to-fill measurements were repeated at a site until the discharge through the pipe had stabilized. Generally, after the discharge from the pipe had stabilized, at least three additional time-to-fill measurements were performed. The time-to-fill values measured after the discharge had stabilized were averaged and used to calculate the reported discharge rate.

Discharge measurements at stream monitoring sites where stream discharge rates were low were typically performed using the time-to-fill technique described above. Where stream flows were greater, discharge measurements were usually performed using current-velocity techniques described by the United States Geological Survey. Stream velocity measurements were performed using a Marsh-McBirney brand electromagnetic current-velocity meter and top-set wading rod. In some locations, discharge measurements were performed using a portable 90-degree v-notch weir or a portable 3-inch Parshall flume constructed in accordance with United States Department of the Interior, Bureau of Reclamation specifications. Discharge measurements at the historic monitoring site on the South Fork of Quitchupah Creek (Sufco 006) were commonly measured using the permanently installed 12-inch Parshall flume at the monitoring station when flows were substantial.
Temperature measurements were performed using a Taylor brand electronic digital thermometer or a conventional glass-bulb thermometer. Discharge temperature measurements at springs were performed as close to the spring discharge locations as possible. Stream temperature measurements were performed, where possible, in a shaded, actively flowing portion of the stream.

Specific conductance measurements were performed using an Extech brand model EC400 conductivity meter with automatic temperature compensation or a Hanna brand Tester Dist 5 model with automatic temperature compensation. The instruments were calibrated using NIST traceable conductivity standard solutions in accordance with the manufacturer's recommendations.

Water pH Measurements were performed using an Oakton model pH Testr 30 with automatic temperature compensation, or a Hanna Model pHep 5 with automatic temperature compensation. The instruments were calibrated using NIST traceable pH standard solutions in accordance with the manufacturer's recommendations.

Dissolved oxygen measurements were performed using a YSI brand model 55 dissolved oxygen meter. The meter was calibrated using atmospheric oxygen calibration methods in accordance with the manufacturer's recommendations.

Water quality laboratory analyses were performed by SGS Laboratories of Huntington, Utah or Chemtech-Ford Laboratories of Murray, Utah. Both of these laboratories are NELAC certified water analysis laboratories. Information regarding laboratory standard analytical methods and procedures used and laboratory detection limits are recorded on laboratory reporting sheets.

Field data from monitoring events were recorded in bound, water-resistant field notebooks and archived for future reference.

Groundwater and surface-water quantity and quality information from the Greens Hollow Tract area was compiled into an electronic format. The compiled hydrologic information was utilized in the performance of investigations of groundwater and surface-water systems and the determination of the probable hydrologic consequences of coal mining in the Greens Hollow Tract. The compiled groundwater and surface-water monitoring data for springs, seeps, and streams in the Greens Hollow Tract area are presented in Appendix 7-28, Tables 2-A, 2-B, 4 and 5. Once the mining
plan for the Greens Hollow Lease area is approved the Division’s Coal Water Quality On-line Electronic Database will be updated to include the added monitoring sites and their associated water data.

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

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

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

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

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

7.2.8.3 PHC Determination
Potential Impacts to the Hydrologic Balance. Potential impacts to the hydrologic balance are addressed in the following subsections of this M&RP and in Appendices 7-17, 7-18, 7-19, 7-20 and 7-24. Appendices 7-18, 7-20 and 7-24 contain PHC determinations for mining activities in the
Acid- or Toxic-Forming Materials. Information on acid-and toxic-forming materials is presented in Chapter 6. These data reveal boron, sodium absorption ratio, and specific conductance exceedances of the Table 2 guidelines for management of topsoil and overburden (Leatherwood and Duce, 1988) in waste rock from the SUFCO mine. As noted in Section 7.2.4.2 of this M&RP, the alkalinity of the mine discharge water typically exceeds the acidity of this water by a factor of 20. Additionally, mine discharge water typically meets the standards for water quality for the state of Utah (Utah Water Quality Board, 1987). Thus, analytical data obtained from mine-water discharges indicate that although potential exists in localized portions of the mine for acid- or toxic-forming materials to be present, there has been no known impact to the surface or groundwater in the permit and adjacent areas.

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

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

Sediment yields may increase locally due to subsidence. Subsidence cracks which intersect ephemeral drainages with steep gradients could, for a short period of time, increase the sediment yield of the stream. However, this sediment increase would cause the crack to be quickly filled.
recreating pre-subsidence stream channel conditions. Thus, the potential impact to sediment yield would be minor and of short duration.

An assessment of the Alternative Sediment Control Measures to be implemented during reclamation was performed as indicated in Appendix 7-15. These calculations indicate that the implementation of each sediment control measure substantially reduces the amount of sediment erosion from the reclaimed areas, to the point that the mulch theoretically inhibits soil loss more effectively than a baseline level of undisturbed ground cover. In fact, the combination of surface soil preparation, an application of wood fiber hydromulch at 2000 pounds per acre, and the use of silt fences results in a 37% to 85% reduction of soil erosion below that which would be expected from naturally vegetated grass/sage slopes. Thus, sediment control measures to be implemented during reclamation will preclude adverse impacts to the environment.

In the area of the Link Canyon Portal and Link Canyon Substation No. 1 and No. 2 pads and access roads, sediment yield from the disturbed areas will be controlled with berms and/or silt fences. The calculations supporting the use of berms and /or silt fences for these areas are presented in Appendix 7-15. Undisturbed runoff from above the Link Canyon Portal pad area that naturally flowed down the Link Canyon drainage will be diverted under the pad area by the use of a diversion culvert and will be channeled back into the existing Link Canyon drainage. Undisturbed runoff from above the substation pad areas that naturally flowed directly into the existing Link Canyon Road inside ditch will be diverted around the substation pad areas by the use of a diversion ditch and will be channeled back into the existing Link Canyon Road inside ditch. Sediment yield from the undisturbed drainage ditch will be controlled with a silt fence. From the point that the Substation No. 2 undisturbed drainage reenters the existing Link Canyon Road ditch the existing road ditch drainage flows for about 30’ along the inside of the road before the flow is diverted across the road by an existing water bar were the flow is directed toward the channel at the bottom of Link Canyon. This drainage is by Division definition an intermittent stream. However, water only flows in this canyon in the substation areas as the result of snow melt runoff or the occasional summer thunderstorm.

**Acidity, Total Suspended Solids, and Total Dissolved Solids.** Probable impacts of mining and reclamation operations to the acidity and total suspended solids concentrations of surface and
groundwater in the permit and adjacent areas were addressed previously in this section. Impacts to water quality parameters within the Pines Tract area are addressed in Appendix 7-18.

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

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

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

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

Second, according to data presented in Section 7.2.4.2, although the discharge of mine water into the North Fork of Quitchupah Creek increases the TDS and sulfate concentrations of the receiving
water (compare data from SUFCO-006, SUFCO-007 and SUFCO-042), the TDS concentration of the discharge water is less than that of Quitchupah Creek above the influence of the mining operation (compare data from SUFCO-046). As a result of these factors, the impacts of increased TDS and sulfate concentrations in the mine-water discharge relative to the adjacent natural water are not considered significant.

Finally, as indicated on Plate 6-1, surface water in the North Fork of Quitchupah Creek flows across Mancos Shale immediately downstream from the mine discharge point. Similarly, Quitchupah Creek crosses Mancos Shale immediately downstream from the confluence with East Spring Canyon. Since the Mancos Shale is a gypsiferous formation, sulfate and TDS concentrations are naturally high in areas underlain by this unit. Thus, the additional input of these constituents from the mine waters to local streams is considered minimal.

As indicated previously, tension cracks created by subsidence may locally increase the rate of downward percolation of groundwater. However, as indicated by Mayo in Appendix 7-17, the potential for increased vertical percolation of groundwater due to subsidence is not considered to be significant and should have no impact on mine discharge water quality.

No subsidence is anticipated to occur in the Link Canyon Substation pad area. Therefore, disturbance in this area is not anticipated to adversely effect groundwater. Surface water will not be adversely effected in this area since runoff will be treated prior to discharge, thus limiting the amount of total suspended solids. Additionally, the soils in the area are not toxic or acid forming and the total increase of dissolved solids added to the runoff from the limited area of the pad will not be significant. The receiving waters pass over large areas of exposed Mancos Shale before it is put to beneficial use. Therefore, the contribution of TSS and TDS from the pad area when compared to the contribution of the in-place soils and shale bedrock will be insignificant.

**Flooding or Streamflow Alteration.** Runoff from all disturbed areas is treated through sedimentation ponds or other sediment-control devices prior to discharge to adjacent undisturbed drainages. Three factors indicate that these sediment-control devices minimize or preclude flooding impacts to downstream areas as a result of mining operations:

1. The sediment-control facilities have been designed and constructed to be geotechnically stable. Thus the potential is minimized for breaches of the sediment-control devices to occur that could cause downstream flooding.
2. The flow routing that occurs through these sediment-control devices reduces peak flows from the disturbed areas. This precludes flooding impacts to downstream areas.

3. By retaining sediment on site in the sediment-control devices, the bottom elevations of stream channels downstream from the disturbed areas are not artificially raised. Thus, the hydraulic capacity of the streams channels is not altered.

Following reclamation, stream channels will be returned to a stable state (see Section 5.4.2.2). The reclamation channels have been designed to safely pass the peak flow resulting from the 100-year, 24-hour storm. Thus, flooding in the reclaimed areas will be precluded. Interim sediment-control measures and maintenance of the reclaimed areas during the post-mining period will preclude deposition of significant amounts of sediment in downstream channels following reclamation, thus maintaining the hydraulic capacity of the channels and precluding adverse flooding impacts.

The mine has been designed to minimize subsidence impacts to perennial streams (see Section 5.2.5.1). Any material damage to the stream channel will be mitigated. Streamflow volume in the North Fork of Quitchupah Creek will, however, increase due to mine water discharge.

Mine water discharge to the North Fork of Quitchupah Creek has increased streamflow by over 1000 gpm (2.25 cfs). Waters encountered in the Pines Tract will be pumped to the Quitchupah discharge point. The worst case flow increase is estimated to be approximately 3.75 cfs. Once mining has ceased, the mine will be sealed and no discharges will occur. The streamflow volume will return to pre-mining discharge levels. Increased flow to the North Fork of Quitchupah during seasonal flow conditions are addressed by Mayo in Appendix 7-17.

Subsidence tension cracks that propagate to the surface, will increase the secondary porosity of the formations overlying the SUFCO mine. Thiros and Cordy (1991) state that bentonitic shale and plastic flow in mudstone within the perching layers could possibly slow or stop the downward movement of groundwater. If these cracks do not become blocked with bentonite, recharge to aquifers that feed spring flow may increase. Thus, subsidence may contribute to increases in streamflow.

Subsidence may decrease spring flow if the perched aquifer which supplies the spring is intersected by tension cracks, allowing groundwater to drain to underlying strata (Thiros and Cordy, 1991). Subsidence has occurred beneath East Spring (monitoring station 001), but no major
changes in flow rate or water quality have been detected from 1985 to 1986 (Thiros and Cordy, 1991). Groundwater monitoring data (Appendices 7-4 and 7-17) indicate that flow rates of this spring have declined from 1987 to 1995. This decline in flow, however, is likely due to the drought conditions of the last several years (Appendix 7-5). Flow rates from other springs currently monitored by SUFCO, but located in unsubsided areas (057A and FS-109), have also declined during the last several years (Appendices 7-4 and 7-17).

Subsidence will occur in areas occupied by ephemeral and perennial stream channels. According to Thiros and Cordy (1991), surface water flow to natural drainages has the potential of being intercepted by subsidence fractures that extend to the land surface. In addition, the broad depressions created by subsidence may locally retain runoff that would normally discharge from an area. Although surface cracks that result from subsidence in the area tend to heal with time (see Appendix 5-4), stream flows may be partially intercepted prior to completion of the healing process. However, the following factors indicate that the impact of subsidence on streamflow will be minimal:

1. Bentonitic shale and plastic flow in mudstone within perching layers could possibly slow or stop the downward movement of previously perched groundwater (Thiros and Cordy, 1991).
2. Field observations indicate that there are no sustained above normal inflows in the mine. Thus, flow along fractures is either from a relatively small source, or the conduits become sealed quickly.
3. Ephemeral streamflow in the area is sporadic, allowing significant periods of time which may allow for surface cracks to heal between flow events.
4. Ephemeral streamflow typically carries a high sediment load. During precipitation runoff events, perennial streams will also carry a high sediment load. This sediment will fill remaining cracks. As the cracks heal, the potential for interception of streamflow is minimized.
5. The depressions created by subsidence are sufficiently broad that changes in slope are not typically of an ample magnitude to cause ponding in anything other than local areas. If ponding does occur, the shallow depressions will fill with sediment quickly due to the periodic high sediment load of streams and the drainage will return to the previous pattern.
Groundwater and Surface Water Availability. The potential impacts of mining on reductions in surface-water availability are discussed above. As indicated, these impacts are not considered to be significant.

As noted in Section 7.2.4.2, groundwater is encountered in the SUFCO mine and pumped to the surface, generally into the North Fork of Quitchupah Creek at UPDES station 003.

According to Mayo (Appendix 7-17), the rate of discharge from the mine has increased since 1987 from approximately 1.0 cfs (450 gpm) to about 3.56 cfs (1,600 gpm).

The increase in flow into and out of the mine is considered to be the result of increased coal production. The primary method of mining converted from room-and-pillar to longwall in October 1985. As a result of this change, production in the mine increased (see Figure 7-6). With the increase in production, new areas were mined at an increasingly higher rate. According to Mayo (Appendix 7-17), the mine discharge hydrograph shows that the rate of mine water discharge does not increase as the total area of the mine increases, but rather, the rate of discharge is related to the amount of recently mined areas.

As indicated in Section 5.2.3 of this M&RP, long-term production from the SUFCO mine is expected to average about 6 million tons. Projecting this production rate and the mine discharge rate on Figure 7-6, it is estimated that long-term discharge of groundwater from the mine will average approximately 2.6 cfs (1,200 gpm).

It should be noted that the discharge of mine water to a stream probably results only in a local increase in flow and not a basin-wide increase. As noted on Plate 6-1, the Mancos Shale outcrops in the North Fork of Quitchupah Creek just upstream from the mine-water discharge point and in Quitchupah Creek above the confluence with East Spring Canyon. The shales of this formation have a low permeability (Waddell et al., 1981), thus forcing groundwater to the surface as streamflow. Thus, although the discharge of water from the mine may result in a local loss of groundwater and gain in surface water, this discharge does not disrupt the hydrologic balance of the basin.
The long-term mean mine discharge to North Fork Quitchupah Creek is 980 gpm and discharge varies between 460 and 1760 gpm. The mean upstream flow during high-flow conditions (June) is 2,650 gpm and during low-flow conditions (October) the flow is 290 gpm. Thus, mine discharge represents a mean increase in creek discharge of 37% and 337% for June and October, respectively. The mean low flow discharge measured at site 042, 5 miles downstream from the mine discharge point, is 950 gpm. This suggests that the lower reaches of North Fork Quitchupah Creek could go dry in late summer and early fall without the contribution of mine water to the stream.

Subsidence has occurred in the leased mined area (Plate 5-10). More subsidence is expected to occur in the future as longwall mining progresses. Fractures that remain open or fill with permeable material would locally increase the hydraulic conductivity of the strata. However, when tension fractures intercept mudstones or shale units that contain bentonitic or montmorillonite clays, these fractures become sealed, stopping vertical flow (Thiros and Cordy, 1991). When tension fractures intercept strata that are more brittle or less amenable to sealing by clays, such as the Castlegate Sandstone, these fractures will heal naturally by filling in with silt and organic material such as sticks, pine needles, pine cones, and pine cone fragments. This natural healing could take longer to seal the cracks with the potential to impact water resources for a period of time. A discussion of the potential impacts to water resources due to subsidence is provided in Section 7.2.8.3 of this M&RP and in Appendix 7-17. DeGraff (Appendix 5-4) indicates that tension cracks in the leased area typically heal quickly. There are no sustained above normal inflows in the mine due to mining or subsidence. Thus, most fractures in the leased area appear to become sealed in a relatively short period of time. Intersection of locally perched aquifers by subsidence cracks could divert groundwater from a spring. Water will not be lost from a specific basin, but may become diverted within the basin.

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

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

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

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

**TABLE 7-1A**

FLOW OBSERVATIONS IN LINK CANYON WATER MONITORING SITES
Link 001, Link 002, Link Portal West, and Link Portal East

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>DATE OF OBSERVATION</th>
<th>FLOW (gpm)</th>
<th>SAMPLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link 001 and Link 002</td>
<td>06-03-97</td>
<td>No Flow</td>
<td>E. Petersen</td>
</tr>
<tr>
<td></td>
<td>10-29-97</td>
<td>No Flow</td>
<td>E. Petersen</td>
</tr>
<tr>
<td></td>
<td>11-03-97</td>
<td>No Flow</td>
<td>E. Petersen</td>
</tr>
<tr>
<td></td>
<td>06-29-98</td>
<td>No Flow</td>
<td>E. Petersen</td>
</tr>
<tr>
<td></td>
<td>09-16-98</td>
<td>No Flow</td>
<td>E. Petersen</td>
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<td></td>
<td>11-04-98</td>
<td>No Flow</td>
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<td></td>
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</tr>
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<td></td>
<td>05-18-02</td>
<td>No Flow</td>
<td>E. Petersen</td>
</tr>
<tr>
<td></td>
<td>09-26-02</td>
<td>No Flow</td>
<td>E. Petersen</td>
</tr>
<tr>
<td></td>
<td>10-08-02</td>
<td>No Flow</td>
<td>E. Petersen</td>
</tr>
</tbody>
</table>
### TABLE 7-1A (Continued)

**FLOW OBSERVATIONS IN LINK CANYON**

**WATER MONITORING SITES**

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

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>DATE OF OBSERVATION</th>
<th>FLOW (gpm)</th>
<th>SAMPLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link Portal - West</td>
<td>09-17-77</td>
<td>5 (estimated)</td>
<td>Hydrometrics</td>
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<td>08-04-86</td>
<td>1.5</td>
<td>Thiros &amp; Cordy*</td>
</tr>
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<td>08-20-86</td>
<td>2.2</td>
<td>Thiros &amp; Cordy*</td>
</tr>
<tr>
<td></td>
<td>09-15-86</td>
<td>1.6</td>
<td>Thiros &amp; Cordy*</td>
</tr>
<tr>
<td></td>
<td>11-04-86</td>
<td>1.3</td>
<td>Thiros &amp; Cordy*</td>
</tr>
<tr>
<td></td>
<td>05-11-87</td>
<td>2.0</td>
<td>Thiros &amp; Cordy*</td>
</tr>
<tr>
<td></td>
<td>06-16-87</td>
<td>1.5</td>
<td>Thiros &amp; Cordy*</td>
</tr>
<tr>
<td></td>
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<td>1.7</td>
<td>Thiros &amp; Cordy*</td>
</tr>
<tr>
<td></td>
<td>09-08-87</td>
<td>1.6</td>
<td>Thiros &amp; Cordy*</td>
</tr>
<tr>
<td></td>
<td>09-16-98</td>
<td>1.0 (estimated)</td>
<td>Erik Petersen</td>
</tr>
<tr>
<td></td>
<td>12-07-01</td>
<td>0.5 (estimated)</td>
<td>Chris Hansen</td>
</tr>
<tr>
<td></td>
<td>10-26-02</td>
<td>No Flow - Standing Water</td>
<td>Erik Petersen</td>
</tr>
<tr>
<td></td>
<td>10-30-02</td>
<td>No Flow - Standing Water</td>
<td>Erik Petersen</td>
</tr>
<tr>
<td></td>
<td>11-06-02</td>
<td>No Flow - Standing Water</td>
<td>Erik Petersen</td>
</tr>
<tr>
<td></td>
<td>11-15-02</td>
<td>No Flow - Standing Water</td>
<td>Erik Petersen</td>
</tr>
<tr>
<td>Link Portal - East</td>
<td>12-07-01</td>
<td>0.5 (estimated)</td>
<td>Chris Hansen</td>
</tr>
<tr>
<td></td>
<td>10-26-02</td>
<td>No Flow - Standing Water</td>
<td>Erik Petersen</td>
</tr>
<tr>
<td></td>
<td>10-30-02</td>
<td>No Flow - Standing Water</td>
<td>Erik Petersen</td>
</tr>
<tr>
<td></td>
<td>11-06-02</td>
<td>No Flow - Standing Water</td>
<td>Erik Petersen</td>
</tr>
<tr>
<td></td>
<td>11-15-02</td>
<td>No Flow - Standing Water</td>
<td>Erik Petersen</td>
</tr>
</tbody>
</table>
Vegetation in the Link Canyon channel below the mine will be photographically monitored on a quarterly basis, except in the winter months, to determine what, if any, impacts the reduction of discharge from the western portal has on the vegetative community. The vegetation monitoring was started in the summer of 2005 and will continue through the reclamation of the portals. The general health of the willows, Woods Rose, clematis, and wire grasses present in the vegetative community will be observed and the observations reported in the mine’s annual report. If significant changes occur in the vegetation monitored, these changes will be reported to the Division and the Forest Service. A plan may be developed and instigated at that time to mitigate any damages to the vegetation as a result of mining activities. Refer to Section 3.2.2.2 for additional vegetation information.

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

Prior to disturbing the portals, additional samples have been obtained from both the east and west portals in October and November 2002. One sample from each portal was obtained for four consecutive weeks. No surface flow was present in the summer of 2002 at either of the portals. However, a small pool of standing water was present at the mouth of the west portal through most of the year. The samples were obtained by first excavating a depression near the mouth of the east portal and allowing water to gradually fill the depression and by sampling the standing water at the mouth of the western portal. These samples were obtained as baseline samples in compliance with a request from the Forest. The samples have been analyzed according to the Division’s guidelines for baseline water monitoring samples. Copies of the sample analyses results for samples obtained on October 26, October 30, November 6, and November 15, 2002 are included in Appendix 7-4. Included in Appendix 7-4 is a brief report by Erik Petersen of Petersen Hydrologic, Inc. that discusses the various sampling events, the results of the sample analyses, and an interpretation of the data as it relates to the origin of the water in the Link Canyon Mine.
Mr. Petersen discusses in his report that water issuing from the Link Canyon portals is likely not sourced from the springs at the head of the canyon but probably from surface water that enters the mine through the weathered bedrock near the surface. It appears that during periods of normal or greater than normal precipitation, the water discharged from the mine has a TDS level of near 500 mg/l. However, in drought years, as has occurred in the area beginning in 1999 and continuing through 2002, the TDS levels in the water naturally rises due to a lack of fresh water flushing of the abandoned mine workings water. Hence, the samples obtained in the fall of 2002 had TDS concentrations greater than 1400 mg/l.

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

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

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

Several springs and stream locations in the leased area are monitored for quantity and quality as prescribed by the M&RP water monitoring program. Analysis of the monitored flows indicated that very little impact has occurred to springs and streams. Erik Petersen of Petersen Hydrologic, Inc evaluated the flow data collected from several springs and surface flows in the Box Canyon drainage. His evaluation was forwarded to Sufco in the form of a letter report dated August 14, 2003 and is included in Appendix 7-19. Mr. Petersen determined that since mining began in the Pines Tract, a few the area springs have exhibited an increase in flow during a period of prolonged
drought. He also concluded that perhaps one spring, Pines 303, in the lower portion of the Box Canyon, may have experienced reduced flows as a result of mining activities. However, because of the prolonged drought in the area that began in 1998, it is not possible to determine with certainty whether mining activities, drought conditions, or both have resulted in the loss of spring flow. A loss in flow from this spring was a predicted possibility described in the Pines Tract EIS. The loss of flow from this spring (less than 4 gpm) has apparently not adversely affected area vegetation or wildlife. Because of the increased discharge of springs farther up canyon, the loss of the less than the 4 gpm contribution of ground water from Pines 303 to Box Canyon Creek is insignificant to the total flow of the creek. No water rights were found to have been filed on this spring discharge.

Mr. Petersen has noted an increase in the flow of springs Pines 209 and 212 and in the flow of the Main Fork of Box Canyon Creek that appears to coincide with mining in the western portion of the Pines Tract. He reasons that the increase in spring flow is related to subsidence enhanced recharge or hydraulic conductivity of the aquifers sourcing the springs. The increase in spring flow has resulted in the increase in flow in the Main Fork of Box Canyon Creek. This has been noted as a positive impact to the creek during a time of drought. Analysis of the flow data presented by Petersen suggests the increase in flow from these springs may be short lived. He has also indicated that flow from these springs will not cease but should return to near pre-mining rates. In fact, the data presented in his August 14, 2003 letter report suggests the flow rates may already be beginning to return to pre-mining rates.

**Greens Hollow Tract**

Although subsidence has occurred beneath springs and streams in areas adjacent to the Greens Hollow Tract, few springs or streams have been permanently effected. The sedimentary geology is the dominant factor influencing the hydrologic system of the area, determining how subsidence affects the surface and subsurface water resources. The geologic units of importance in this commentary are the Blackhawk Formation, the Castlegate Sandstone, Price River Formation and North Horn Formation. Widespread subsidence impacts across the Greens Hollow tract would not be expected. Refer to Appendix 7-4, FSEIS pages 147 - 150, highlighted portions.

"The overall risk for permanent water loss at any spring located with the tract would be relatively low. If the flow at a particular spring is diminished as a result of subsidence-induced surface tensile
fracture, the ground water would not be drained to the mine or lost from the hydrogeologic system" (FSEIS, 2015).

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

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

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

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

Periodically due to difficult recovery conditions or roof collapse, mining equipment is abandoned underground. Abandoned mining equipment locations are shown on Figure 7-7. Prior to leaving equipment underground, lubricating and hydraulic fluids are removed to the extent possible. Since the equipment is steel and not too different compositionally from the roof support throughout the mine, contamination to ground water from abandoned equipment will cause minimal, if any,
disturbance to the hydrologic balance within the permit and adjacent areas and is not expected to cause material damage outside the leased area. Assuming the mine were to flood and the abandoned equipment were to be covered with water, several probable results and impacts can be evaluated:

1. Flooding of the abandoned mine might be relatively rapid, but once flooded, flow of ground water into, through, and out of the void spaces of the mine should be slow.
2. If steel or other metals in the equipment were to oxidize, it would be at a very slow rate and the amount of iron and other metals added to the ground water at any one time would be very small.
3. Oxides of most metals are insoluble or slightly soluble in water. At temperatures expected in the mine, metal oxides would tend to precipitate as solids within the mine rather than flow in solution in the ground water. If any metal were to go into solution, concentrations would be highest near the abandoned equipment, but the volume of water in the flooded mine would dilute concentrations outside the immediate vicinity of the equipment.
4. Because of dilution and dispersion, natural seasonal fluctuations, changes in water quality would not be expected to be large enough to be detected at the surface at springs, ground-water baseflows to streams, or in discharges from the mine.

Road Salting. No salting of the mine road occurs within the permit area. This impact is not a significant concern.

Coal Haulage. Coal is hauled over the paved county road from the mine portal area to Interstate Highway 70. Past experience has indicated that approximately one truck load of coal (43 tons) is spilled annually. Residual coal following cleanup of the spill may wash into local streams during a runoff event. Possible impacts to the surface water are increased total suspended solids and turbidity from the fine coal particulates. The probability of a spill occurring in an area sufficiently close to a stream channel to introduce coal to the stream bed is considered small.

In order to minimize fugitive coal dust haulage trucks are either covered or modified to reduce the amount of coal dust blown off the trucks. The impact from fugitive coal dust is therefore considered to be insignificant due to the small amounts lost during haulage in the permit and adjacent areas.
3 Right 4 East Panel(s)

In 1986/1987 an experimental practice of subsiding escarpments on the west side of Quitchupah Canyon containing the North Fork of Quitchupah Creek in Section 32, Township 21 South, Range 5 East and Section 5, Township 22 South, Range 5 East was approved by the Division. The planned 3 Right 4 East panel straddles Sections 28, 29, 32 and 33, Township 21 South, Range 5 East on the east side of Quitchupah Canyon. The planned panel (northern) and the experimental area (southern) are both in Section 32, across the canyon from one another. The objective of the practice was to ascertain whether or not the escarpment could be undermined by a longwall while causing minimal surface damage.

In 1991 a report was written discussing the observations, the information collected was submitted to the Division in annual reports. The escarpment test area was monitored visually, by photography and by reliable survey measurements for horizontal and vertical movement. The conclusion of the report state the “One independent block of rock fell during subsidence and a few tension cracks were created along the cliff face. No other visible signs of mining were found even though the surface elevations were reduced several feet.”

Because spalling is considered a natural feature of the Castlegate Formation it is anticipated that cliff spalling may occur, since the entire area of the Quitchupah Canyon escarpment is heavily fractured by natural jointing and in some areas is highly sculpted where the combined effects of jointing and erosion are the most severe. The slopes are littered with block of stone which have eroded way from the Castlegate and other sandstone members to the Blackhawk Formation. The channel grade in the North Fork of Quitchupah Creek which lies to the west of the panel to be mined should be sufficient to allow the flow to continue should rocks from spalling enter the creek channel. It is not anticipated that enough rock from spalling will enter the North Fork to block flow, but the surface flow at water monitoring site 042 downstream of the panel will be checked during the mining of the 3 Right 4 East panel to determine if an action is required. There are no known groundwater sites in the area of the 3 Right 4 East panel.

7.2.9 Cumulative Hydrologic Impact Assessment (CHIA)

A Cumulative Hydrologic Impact Assessment to include the permit and adjacent areas is to be prepared by the UDOGM.
7.30 Operation Plan

7.3.1 General Requirements
This permit application includes an operation plan which addresses the following:
- Groundwater and Surface Water Protection and Monitoring Plan;
- Sediment Pond Sludge Sampling and De-watering Plan;
- Design Criteria and Plans;
- Performance Standards; and
- Reclamation Plan.

7.3.1.1 Hydrologic-Balance Protection

Groundwater Protection. To protect the hydrologic balance, coal mining and reclamation operations will be conducted to handle earth materials and runoff in a manner that minimizes acidic, toxic, or other harmful infiltration to the groundwater system. Additionally, SUFCO will manage excavations and disturbances to prevent or control discharges of pollutants to the groundwater. SUFCO commits to replace loss of any surface water identified for protection in this M&RP that are impacted by mining at the SUFCO mine.

Surface Water Protection. To protect the hydrologic balance, coal mining and reclamation operations will be conducted to handle earth materials and runoff in a manner that minimizes acidic or toxic drainage, prevents, to the extent possible, additional contributions of suspended solids to streamflow outside the permit area, and otherwise prevents water pollution. Additionally, SUFCO will maintain adequate runoff- and sediment-control facilities to protect local surface waters. SUFCO commits to mitigating any material damage resulting from subsiding perennial streams in the leased area as indicated in Chapter 5 of this M&RP. The plan for protection of the perennial streams meets the BLM requirements for protection of their water rights (BLM, 1992).

Sedimentation Pond Sludge Plan. Sludge contained in the sediment ponds will be cleaned from the ponds and temporarily stockpiled upstream of the pond to allow water to drain from the sludge back into the pond. The sludge will be sampled for acid and toxic forming substances prior to being transported to the waste rock disposal site. Sedimentation pond sludge will be incorporated into the fill as described in Section 536 of Waste Rock Volume.
7.3.1.2 Water Monitoring

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

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

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

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

Pines East Panel(s) - The closest quarterly groundwater monitoring locations are springs GW-21 and Pines 100 located in Link Canyon. Pines 101 spring was monitored twice in 1997 and is located approximately 0.2 mile from the potential area of subsidence (Plate 7-3). A report has been included which discusses Pines 310 a spring northeast of the panels and spring GW-21 located east of the panels (Appendix 7-18). Pines 310 spring was previously mined beneath and is part of a migration project completed by the Permittee. Water right spring 94-591 will be added to the monitoring plan in 2019 and monitoring will cease in 2023 following mining of the Pines East
panels. The table below provides water sampling information for springs and surface water locations contiguous to the mining panels.

### Pines East Panels - Water Sampling

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

* Issue from Castlegate Sandstone

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

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

Sampling for the SUFCO Mine and adjacent areas is accomplished in accordance with the schedule outlined on Tables 7-2 through 7-5A. Sampling for the waste rock disposal site is accomplished in accordance with the schedule and the parameter list as outlined in Chapter 7 of the Waste Rock Volume of this M&RP.

Groundwater monitoring data are submitted to UDOGM by the end of the quarter following sampling. Monitoring data are submitted in an annual summary by March 31 of the subsequent year.
Groundwater monitoring will continue through the mining and post-mining periods until bond release. The monitoring requirements, including the analytical parameters and the sampling frequency may be modified in the future in consultation with the UDOGM if the data demonstrates that such a modification is justified.

Groundwater monitoring wells US-77-7, US-77-8, US-77-9, US-79-9, US-79-10, US-79-12, US-81-1, US-81-2, US-81-3, 89-16-1, 89-16-1W, 89-18-1, 89-20-1, 89-20-2, and 89-21-1 have been removed from the operational monitoring plan and are listed as historic monitoring wells because these are old baseline wells, wells that have been discontinued or wells the water level measurements are not possible due to the collapse or blockage of the casing. These historic monitoring wells will be permanently sealed along with all the operational groundwater monitoring wells during the final reclamation of the mine in accordance with Sections 6.3.1 and 7.4.8.

In addition to gathering groundwater samples from seeps and springs at the surface, SUFCO will obtain a groundwater sample, if ground water is encountered, in-mine within the proposed 150 acre lease expansion located in T21S, R5E, Section 10. This sample will be taken shortly after the start-up of the longwall and will be age-dated using isotopic analysis methods. After the longwall advances through approximately 50% of the panel length within the 150 acre lease expansion, a second ground water sample will be obtained from the face and analyzed for the same parameters. The results of the analysis and a sample location map will be submitted to the Division.

Total hardness, total alkalinity, dissolved iron, and dissolved manganese were not included in the groundwater operational monitoring plan proposed by Mayo and Associates (Appendices 7-17 and 7-18). The reasons for excluding these parameters are discussed below:

- Mayo does not believe that total hardness is a necessary parameter in the operational monitoring plan. Total hardness describes the soap-consuming capacity of water, but has very limited value in geochemical studies. This parameter is generally calculated from the milliequivalent concentrations of Ca²⁺ and Mg²⁺. Because Ca²⁺ and Mg²⁺ are included in the operational monitoring plan, the parameter could be calculated if it were ever necessary to evaluate total hardness.

- Mayo does not believe that total alkalinity should be included in the operational monitoring plan. In the waters of Wasatch Plateau, total alkalinity is almost exclusively the product of bicarbonate and carbonate alkalinity. Both bicarbonate and carbonate alkalinity are included in the operational monitoring plan.
plans. Contributions to alkalinity from hydroxide, silicate, borate, and organic ligands are trivial.

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

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

### TABLE 7-2

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

**Streams**

<table>
<thead>
<tr>
<th>Streams</th>
<th>Protocol</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUFCO 006</td>
<td>C,2</td>
<td>Upper South Fork Quitchupah Creek</td>
</tr>
<tr>
<td>SUFCO 006D</td>
<td>F,1</td>
<td>Upper South Fork Quitchupah Creek</td>
</tr>
<tr>
<td>SUFCO 007 (North Fork Lower)</td>
<td>C,2</td>
<td>Upper North Fork Quitchupah Creek</td>
</tr>
<tr>
<td>SUFCO 041</td>
<td>C,2</td>
<td>Lower Quitchupah Creek</td>
</tr>
<tr>
<td>SUFCO 042</td>
<td>C,2</td>
<td>Lower North Fork Quitchupah Creek</td>
</tr>
<tr>
<td>SUFCO 046</td>
<td>C,2</td>
<td>Upper Quitchupah Creek</td>
</tr>
<tr>
<td>SUFCO 047A</td>
<td>C,2</td>
<td>Lower East Spring Canyon Creek</td>
</tr>
<tr>
<td>SUFCO 090</td>
<td>C,1</td>
<td>Upper Box Canyon Creek</td>
</tr>
<tr>
<td>Pines 106</td>
<td>C,2</td>
<td>Upper East Fork Box Canyon</td>
</tr>
<tr>
<td>Pines 302</td>
<td>C,1</td>
<td>Muddy Creek-Last Water Creek Confluence</td>
</tr>
<tr>
<td>Pines 403</td>
<td>C,2</td>
<td>Lower Box Canyon Creek</td>
</tr>
<tr>
<td>Pines 405</td>
<td>C,2</td>
<td>Muddy Creek - Box Creek Confluence</td>
</tr>
<tr>
<td>Pines 406</td>
<td>C,1</td>
<td>Lower Muddy Creek</td>
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### TABLE 7-2 (Continued) Water Monitoring Program

<table>
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<th>Streams</th>
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<tr>
<td>Pines 406b*</td>
<td>C,1</td>
<td>Lower Muddy Creek</td>
</tr>
<tr>
<td>Pines 407</td>
<td>C,1</td>
<td>Box Canyon Creek</td>
</tr>
<tr>
<td>Pines 408</td>
<td>C,1</td>
<td>East Fork Box Canyon Creek</td>
</tr>
<tr>
<td>USFS-109</td>
<td>C,1</td>
<td>Upper Main Fork of Box Canyon Creek</td>
</tr>
<tr>
<td>Link 001</td>
<td>C,2</td>
<td>Link Canyon Drainage</td>
</tr>
<tr>
<td>Link 002</td>
<td>C,2</td>
<td>Link Canyon Drainage</td>
</tr>
<tr>
<td>FP-1</td>
<td>G,6</td>
<td>East Fork of Main Fork of Box Canyon</td>
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<tr>
<td>FP-2</td>
<td>G,6</td>
<td>East Fork of East Fork of Box Canyon</td>
</tr>
<tr>
<td>M-STR1</td>
<td>C,1</td>
<td>Cowboy Creek</td>
</tr>
<tr>
<td>M-STR4</td>
<td>C,1</td>
<td>Cowboy Creek</td>
</tr>
<tr>
<td>M-STR6</td>
<td>C,8</td>
<td>Top Greens Canyon</td>
</tr>
<tr>
<td>Muddy ABF</td>
<td>C,8</td>
<td>Lower Muddy Creek</td>
</tr>
<tr>
<td>U-Mud</td>
<td>C,8</td>
<td>Confluence North &amp; South Fork Muddy</td>
</tr>
<tr>
<td>Cowboy Top</td>
<td>C,2</td>
<td>Top of Cowboy Creek</td>
</tr>
<tr>
<td>Cowboy Middle</td>
<td>C,2</td>
<td>Mid segment of Cowboy Creek</td>
</tr>
<tr>
<td>Cowboy Bottom</td>
<td>C,2</td>
<td>Bottom of Cowboy Creek</td>
</tr>
<tr>
<td>SP60 Creek</td>
<td>C,2</td>
<td>Creek adjacent to Monitoring point SP60</td>
</tr>
<tr>
<td>CPC Upper</td>
<td>C,2</td>
<td>Top of Tributary to North Fork Quitchupah</td>
</tr>
<tr>
<td>CPC Middle</td>
<td>C,2</td>
<td>Mid segment of Tributary to North Fork Quitchupah</td>
</tr>
<tr>
<td>CPC Lower</td>
<td>C,2</td>
<td>Just above North Fork confluence</td>
</tr>
<tr>
<td>North Fork Upper</td>
<td>C,2</td>
<td>Top of North Fork Quitchupah at lease edge</td>
</tr>
<tr>
<td>North Fork Middle</td>
<td>C,2</td>
<td>Mid segment of North Fork Quitchupah just above CPC confluence</td>
</tr>
<tr>
<td>ULGH</td>
<td>C,2</td>
<td>Upper Left Fork Greens Hollow Creek</td>
</tr>
<tr>
<td>URGH</td>
<td>C,2</td>
<td>Upper Right Fork Greens Hollow Creek</td>
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<tr>
<td>GH at Road</td>
<td>C,2</td>
<td>Greens Hollow Creek at road crossing</td>
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<tr>
<td>Muddy Creek below Horse</td>
<td>C,2</td>
<td>Muddy Crk below confluence with Horse Crk</td>
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<tr>
<td>Muddy Creek above Horse</td>
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<td>Muddy Crk above confluence with Horse Crk</td>
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<td>Horse Creek</td>
<td>C,2</td>
<td>Horse Creek at confluence with Muddy Creek</td>
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### Springs

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<tr>
<th>Springs</th>
<th>Protocol</th>
<th>Description</th>
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<td>SUFCO 001</td>
<td>D,3</td>
<td>Blackhawk Formation</td>
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<td>SUFCO 047</td>
<td>D,4</td>
<td>Star Point Sandstone</td>
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<td>SUFCO 057A</td>
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<td>SUFCO 089</td>
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<td>GW-8</td>
<td>D,5</td>
<td>Price River Formation</td>
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<td>Pines 206</td>
<td>D,5</td>
<td>Blackhawk Formation</td>
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<td>Pines 209</td>
<td>D,5</td>
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<td>Pines 212</td>
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<tr>
<td>Pines 214</td>
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<td>Pines 218</td>
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<td>Castlegate Sandstone</td>
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<tr>
<td>Pines 303</td>
<td>D,3</td>
<td>Blackhawk Formation</td>
</tr>
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<td>Pines 310</td>
<td>D,7</td>
<td>Castlegate Sandstone</td>
</tr>
<tr>
<td>Pines 311</td>
<td>D,7</td>
<td>Castlegate Sandstone</td>
</tr>
<tr>
<td>Link Portal-West</td>
<td>D,4</td>
<td>Link Canyon Portal</td>
</tr>
<tr>
<td>Link Portal-East</td>
<td>D,4</td>
<td>Link Canyon Portal</td>
</tr>
<tr>
<td>M-SP01</td>
<td>D,3</td>
<td>Price River Formation</td>
</tr>
<tr>
<td>M-SP02</td>
<td>D,3</td>
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<td>M-SP04</td>
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</tr>
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<td>M-SP05</td>
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<td>M-SP06</td>
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</tr>
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<td>North Horn Formation</td>
</tr>
<tr>
<td>M-SP103</td>
<td>D,9</td>
<td>North Horn Formation</td>
</tr>
</tbody>
</table>
Springs | Protocol | Comments
---|---|---
M-SP104 | D,9 | North Horn Formation
M-SP105 | D,9 | North Horn Formation
M-SP106 | D,9 | North Horn Formation
Mud Spring | D,5 | Price River Formation
Broad Hollow | D,5 | Blackhawk Formation
USP-2 | D,9 | Price River Formation
94-591*** | D,3 | Castlegate Sandstone
Wedge Spring | H,3 | Castlegate Sandstone
Amanda Spring | H,3 | Castlegate Sandstone
94-113 Seep | H,3 | Price River Formation

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

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

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

**TABLE 7-3**
Field and Laboratory Measurement Protocol

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

<table>
<thead>
<tr>
<th></th>
<th>Water quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stream: quarterly surface water quality field measurements</td>
</tr>
<tr>
<td>2</td>
<td>Stream: quarterly surface water quality operational laboratory measurements</td>
</tr>
<tr>
<td>3</td>
<td>Spring: quarterly groundwater quality field measurements</td>
</tr>
<tr>
<td>4</td>
<td>Spring: quarterly groundwater quality operational laboratory measurements</td>
</tr>
</tbody>
</table>
5  Spring: groundwater quality operational laboratory measurements quarterly for two (2) years, then reverting to quarterly water quality field measurements

6  Stream: flow measurements only, no water quality samples required.

7  Spring: initially ground water field measurements June 2006 through December 2006 as accessible then quarterly groundwater field measurements thereafter.

8  Stream: quarterly surface water quality field measurements and analysis for total dissolved solids, total suspended solids, total iron, total manganese.

9  Spring: quarterly ground water quality field measurements and analysis for total dissolved solids, total iron, total manganese.

**TABLE 7-4**

*Groundwater Operational Water Quality Parameters*

<table>
<thead>
<tr>
<th>FIELD MEASUREMENTS</th>
<th>REPORTED AS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Level or Flow</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>pH units</td>
</tr>
<tr>
<td>Specific Conductivity</td>
<td>μS/cm @ 25°C</td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LABORATORY MEASUREMENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total dissolved solids</td>
<td>mg/l</td>
</tr>
<tr>
<td>Carbonate</td>
<td>mg/l</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>mg/l</td>
</tr>
<tr>
<td>Calcium (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Chloride</td>
<td>mg/l</td>
</tr>
<tr>
<td>Iron (total)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Iron (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Magnesium (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Manganese (total)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Manganese (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Potassium (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Sodium (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Sulfate</td>
<td>mg/l</td>
</tr>
<tr>
<td>Cations</td>
<td>meq/l</td>
</tr>
<tr>
<td>Anions</td>
<td>meq/l</td>
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</tbody>
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### TABLE 7-5
Surface Water Operational Water Quality Parameters

<table>
<thead>
<tr>
<th>FIELD MEASUREMENTS</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>pH</td>
</tr>
<tr>
<td>pH</td>
<td>pH units</td>
</tr>
<tr>
<td>Specific Conductivity</td>
<td>μS/cm @ 25°C</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>mg/l</td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LABORATORY MEASUREMENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dissolved Solids</td>
<td>mg/l</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>mg/l</td>
</tr>
<tr>
<td>Carbonate</td>
<td>mg/l</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>mg/l</td>
</tr>
<tr>
<td>Calcium (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Chloride</td>
<td>mg/l</td>
</tr>
<tr>
<td>Iron (total)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Iron (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Magnesium (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Manganese (total)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Manganese (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Potassium (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Sodium (dissolved)</td>
<td>mg/l</td>
</tr>
<tr>
<td>Sulfate</td>
<td>mg/l</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>mg/l</td>
</tr>
<tr>
<td>Cations</td>
<td>meq/l</td>
</tr>
<tr>
<td>Anions</td>
<td>meq/l</td>
</tr>
</tbody>
</table>

**Surface Water Monitoring.** Surface water monitoring is conducted in the SUFCO Mine permit and adjacent areas based upon the monitoring plans contained in Tables 7-2 through 7-6. Surface water monitoring locations are identified in Plate 7-3. The parameters monitored meet the requirements of R645-301-731.222.1, 40 CFR 122 and 123, R645-301-751, and the applicable UPDES permits. These tables are based on studies done by Mayo (Appendices 7-17 and 7-18) and supersede previous plans. For clarification of the apparent discrepancies over the classification of stream-monitoring site 047A in the M&RP and the Mayo report (Appendix 7-17) which identified site 047A as a spring-monitoring site. SUFCO has always called the station a surface water monitoring site because samples are taken in a drainage. However, Mayo called this site a spring in their report and recommended monitoring plan. When Mayo first collected samples from the site, they were surprised to learn that water from...
this site had essentially no tritium. Modern surface waters contain abundant tritium. They visited this site again in June 1996 and located several springs in the drainage several hundred feet above where samples are collected and classified the site as a spring-monitoring site. Nevertheless, Mayo now agrees with SUFCO that this site should be considered a surface water site for monitoring purposes because, at times, this drainage has flow which is contributed by snow melt, precipitation, or sediment pond discharge.

Monitoring sites are sampled three times per year. Surface water monitoring data are submitted to UDOGM by the end of the quarter following sampling. Monitoring data are submitted in an annual summary by March 31 of the subsequent year. UPDES reporting requirements will be met for the three UPDES discharge sites at the mine (see Appendix 7-7).

To better understand the effects that mining will have, if any, on the stream flows within Box Canyon, surface water monitoring sites Pines-407 and Pines-408 will be monitored for stream flows in gallons per minute once every week during the months of June, July, August, September, and October in 1999. Starting in the year 2000, sites 407 and 408 will be monitored once a month in July, August, September, and October for a five year period. If analysis of the data shows no significant changes during this time period, monitoring at these points will be eliminated from the water monitoring program on Table 7-2. Flow measurements at these two sites will be obtained on the same day. Also, the operator will endeavor to obtain the required samples at least five days after the last precipitation event in the drainage area.

To better understand the effects that mining will have, if any, on the stream flows within the South Fork of Quitchupah, surface water monitoring sites SUFCO 006A and SUFCO 006B will be monitored quarterly starting in 2010 for stream flows in gallons per minute and once every two weeks when accessible while mining is occurring within the 15 degree angle-of-draw of the stream channel. Two additional surface water monitoring sites will be monitored quarterly, SUFCO 006C starting in 2011 and SUFCO 006D starting in 2012. Once mining has been completed within the angle-of-draw, the sites will be monitored on a quarterly basis for two years after mining has progressed past the 15 degree angle-of-draw. If analysis of the data shows no significant changes during this time period, monitoring at these points will be eliminated from the water monitoring program on Table 7-2. Flow measurements at these four sites will be obtained on the same day.

Areas identified on Plate 7-3 as FP-1 and FP-2 will be monitored on or near October 1 of each year to determine the extent of perennial stream flow, if any, present in the East Fork of the Main Fork of Box Canyon Creek and the East Fork of the East Fork of Box Canyon Creek.

Canyon Fuel Company, LLC
SUFCO Mine
Mining and Reclamation Plan
January 17, 2019

7-58

Div. of Oil, Gas & Mining
respectively. Stream flows will be obtained a short distance below the point where the streams become perennial and the location will be mapped.

Monitoring points Pines 106 and USFS 109 are located at or near the points which the streams become perennial in the East Fork of Box Canyon Creek and the Main Fork of Box Canyon Creek, respectively. The drainages in the area of these two points will be monitored on or near October 1 of each year to verify and map the location where the streams become perennial. Flows will be obtained at Pines 106 and USFS 109 on or near October 1.

Data gathered from monitoring points Pines 407, Pines 408, FP-1, FP-2, Pines 106, and USFS 109 will be compared with precipitation data collected from the mine site weather station, and any other appropriate nearby station, to aid in determining if there have been any mining-related effects on the perennial flows. The flow data, perennial stream flow maps, and the results of the weather data/flow data comparison will be submitted in the fourth quarter water monitoring report each year.

Surface water monitoring will continue through the mining and post-mining periods until bond release. The monitoring requirements (except those required by UPDES) may be modified in the future in consultation with UDOGM if the data demonstrate that such a modification is justified.

Operational monitoring at surface water monitoring sites 022 and 030 has been discontinued from the monitoring plan since the data collected has demonstrated that no flow has been recorded during the monitoring of these sites from June 1983 to October 1997.

Total hardness, total alkalinity, dissolved iron, and dissolved manganese were not included in the surface water operational monitoring plan proposed by Mayo and Associates (Appendices 7-17 and 7-18). The reasons for excluding these parameters are discussed below:

- Mayo does not believe that total hardness is a necessary parameter in the operational monitoring plan. Total hardness describes the soap-consuming capacity of water, but has very limited value in geochemical studies. This parameter is generally calculated from the milliequivalent concentrations of Ca^{2+} and Mg^{2+}. Because Ca^{2+} and Mg^{2+} are included in the operational monitoring plan, the parameter could be calculated if it were ever necessary to evaluate total hardness.
Mayo does not believe that total alkalinity should be included in the operational monitoring plan. In the waters of Wasatch Plateau, total alkalinity is almost exclusively the product of bicarbonate and carbonate alkalinity. Both bicarbonate and carbonate alkalinity are included in the operational monitoring plans. Contributions to alkalinity from hydroxide, silicate, borate, and organic ligands are trivial.

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

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

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

**Stock Water Ponds**

Several stock watering ponds are located in the Pines Tract and Quitchupah Lease area. The ponds are identified as Big Ridge South Draw, Big Ridge East Draw, Box, Jensen, Johnson, Rock, Dry Point, Joes Mill, Slab and Verdu. The stock ponds are located either within the lease area or within one-half mile of the lease area. Surface cracking due to mining related subsidence within the Quitchupah Lease has apparently adversely affected a few of the ponds. Action has been taken by SUFCO in the past to mitigate the damage, including applying bentonitic seals to the pond floors and hauling water for livestock. However, ranchers and State and Federal agencies have erroneously claimed that subsidence has adversely affected several ponds outside of the mining areas. In order to more adequately monitor the effects of mining on the stock watering ponds, SUFCO has been negotiating with DOGM, USFS, and the local rancher's association to create a
workable monitoring plan for the ponds that can be agreed upon by all participants. DOGM has taken the lead in this process, and as of May 2000, a plan had not yet been finalized. In the interim, SUFCO commits to visiting the ponds within the Pines Tract and Quitchupah Lease area as soon as they are accessible in the spring of each year (typically late April to early May), photographing the condition of each pond, observe the pond for evidence of cracking, estimate the depth and surface area of water contained in the pond, inspect the immediate drainage area for evidence of surface cracking, note general soil moisture conditions, and note the general condition of the pond. Additional monitoring visits will be made in the late summer (late July to early August) and in the fall (late September to early October) of each year. This information will be kept on file at the mine. The effects of subsidence are dormant in the Pines and Quitchupah lease area per the subsidence monitoring report for 2017 on file with the Division in the annual report. Beginning in 2018 the ponds listed above will be monitored once annually and included in the mine’s annual report.

It is assumed a new monitoring plan can be agreed upon by the State, USFS, and rancher’s association and will be in place prior to the end of 2000. This plan will include the afore mentioned monitoring efforts, as well as determining the functionality and water holding capacity of each potentially affected pond and the determination of the water shed area for each pond. Mitigation requirements in the event of proven mine related effects will also be agreed upon as part of the new monitoring plan.

East Fork of Box Canyon Monitoring and Mitigation Plan
Sufco anticipates undermining and subsiding a portion of the East Fork of Box Canyon beginning in November of 2003 when the mine starts longwalling panel 3LPE. Additional subsidence under the East Fork will occur when the 4LPE panel is mined in 2005. A surface and ground water monitoring and mitigation program more intensive than the general monitoring plan described previously in this Section will be initiated in this area prior to subsidence occurring within the 15-degree angle-of-draw of the stream channel. This monitoring program has included conducting a pre-mining subsidence survey of the East Fork of Box Canyon over the 3LPE and 4LPE panels that incorporated video taping the stream channel from Joe’s Mill Ponds downstream to a point above the western-most gate road of the 3LPE panel. The purpose of the video will be to provide a visual record of the stream channel prior to subsidence. Fourteen sites were identified within the portion of the East Fork video taped where the monitoring of surface and/or ground water flows;
channel width, channel substrate, vegetation, soils, and general geomorphology will occur. The general area in which these sites will be located are illustrated on Figure 7-8.

Stream monitoring sites will be monitored specifically for stream flow, channel width, channel substrate changes, and channel convergence. The geology of spring sources will be identified and described. The substrate of the spring tributary where water discharged from the spring converges with other flows and forms a tributary to the East Fork creek will be described. The width of the spring tributary at the location where the vegetation survey is conducted will be monitored.

Some of the site locations have been identified using a survey grade GPS. However, the locations of sites deeper in the Canyon could not be located with a GPS due to the restrictive nature of the narrow canyon when trying to locate satellites with which to triangulate a location.

The vegetation and soil monitoring program is discussed in greater detail in Section 3.2.2.2 of this M&RP. The surface and/or ground water flows and channel width at these stations will be monitored on a weekly basis while mining is occurring within the 15 degree angle-of-draw of the stream channel. Once mining has been completed within the angle-of-draw, the sites will be monitored once every two weeks for a period of eight weeks after mining has progressed past the 15 degree angle-of-draw. Table 7-5A presents the monitoring site numbers, monitoring parameters, and the frequency of monitoring. The fourth quarter 2003 water monitoring will be conducted prior to mining within the area of concern in the East Fork of Box Canyon. If new springs are created as a result of subsiding the East Fork, the spring flows will be monitored two times per week until the 15 degree angle-of-draw area above the longwall face has advanced beyond the new spring. Thereafter, the spring flows will be monitored once every week for a period of eight weeks followed by monitoring the springs once every two weeks for eight weeks. A report on the impacts, if any, to the stream or ground water flows, vegetation, soils, general geomorphology, location of the longwall, etc., will be provided via e-mail to the Division on a weekly basis.

One goal of monitoring the stream sites in the East Fork of Box Canyon Creek will be to determine the portion of the stream that is perennial and where the stream is gaining or losing flow prior to, during, and after subsidence. In addition to the monitoring stations, the Thalweg of the stream channel between the lower-most monitoring station and Upper Joe’s Mill pond will be surveyed. Also, two pools near monitoring sites EFB-9 and EFB-11, will be monitored before during and after
subsidence. The criteria for monitoring the two pools will be width and depth of the pool and the height of the fall structure.

Monitoring for subsidence cracks within the stream channel of the East Fork of Box Canyon Creek will also be part of this intensive monitoring and mitigation plan. The details of the mitigation plan are discussed in greater detail in Section 5.2.5.1 of this M&RP. However, in an effort to compile as much of the monitoring requirements for the East Fork of Box Canyon in a single location within the M&RP, the parameters and frequency of monitoring for subsidence have been included in Table 7-5A. The subsidence monitoring program will consist of inspecting the stream channel floor within the active 15 degree angle-of-draw on a twice-a-week basis. Mining induced subsidence effects, such as cracks, slumps, offsets, etc., will be identified, mapped, and a brief narrative of the effects will be recorded and forwarded to the Division on a weekly basis. The portions of the stream within the active angle-of-draw will also be measured weekly for stream flow and channel convergence. The portions of the channel where the longwall shear has moved beyond the 15 degree angle-of-draw will then be monitored for subsidence effects, flow, and channel convergence on a once every two weeks basis for a period of eight weeks. Following the eight week period, monitoring will be conducted on a quarterly basis for a two year period after no subsidence, interception of water, or diversions of water are identified. This monitoring program will result in a moving zone of “high intensity” or twice a week channel monitoring occurring within an area defined by the 15 degree angle-of-draw above the active longwall face. As the longwall face advances, the “high intensity” zone advances and is followed by the “moderate intensity” once-a-week monitoring zone for eight weeks that is then followed by the “less intense” once every two week monitoring zone. A weekly report will be provided via e-mail to the Division on the results of the subsidence monitoring and mitigation activities. A summary report to the Division documenting the pre- and post-mining conditions of springs and stream channel will be submitted 90 days after subsidence monitoring is complete for the 3LPE and 4LPE panels. This report will include a description of all activities and work conducted by Sufco for stream channel evaluation and mitigation. All identified impacts and mitigation efforts will be documented. The results of mitigation, if performed, will be discussed.

**Protocol**
A Monitor sites for flow and channel width weekly while site is within the 15 degree angle of draw of the longwall face. Once area is outside angle of draw, monitor on a once every two...
week basis for eight weeks. Note any changes due to mine-induced subsidence to flows, soils, vegetation, geomorphology, etc. and provide a weekly report via e-mail to the Division of Oil, Gas and Mining. Spring sites will be measured for changes in the substrate conditions and width of spring tributary channel in area of vegetation study will be monitored.

B Monitor subsidence features, such as cracks, and repairs (if needed) on twice a week basis while features are within the 15 degree angle-of-draw of the active longwall face. These sites will be monitored for location, type of subsidence feature, frequency, repairs needed, type of repairs, and success of repairs. After the features are outside the angle-of-draw, monitor features on a weekly basis for eight weeks followed by monitoring of the features once every two weeks for an eight week period and then once quarterly for a two year period after observed subsidence effects are no longer active. Provide a weekly report via e-mail to the Division of Oil, Gas and Mining.

C Monitor fall structures closely associated with these stream sites. The related pool will be monitored for width and depth while the fall structure will be monitored for changes in height.

A rain and temperature monitoring station will be established in the area of the East Fork of Box Canyon as soon as permitting allows. The data collected from the station will be used in combination with data collected from local water monitoring stations to aid in determining what, if any, impacts have occurred to surface runoff, stream flows, and local springs as a result of mining activities.

Prior to implementation of any mining-induced subsidence mitigation efforts in the stream channel as described in Chapter 5, a Stream Alteration Permit will be obtained from the Utah Division of Water Rights. Sufco will have the alteration permit(s) prior to undermining the East Fork stream channel since the mitigation efforts will occur as soon as possible after a need for mitigation is determined.

Every reasonable attempt will be made by Sufco to implement and follow the monitoring program schedule. However, mining of 3LP panel under the East Fork of Box Canyon will begin in the late
fall of 2003 and continue through early winter of 2003 and 2004. If access is limited due to snow or inclement weather, the mine’s effort to access the area will be documented in the weekly report to the Division. The time of the access attempt, weather conditions, and reason(s) for failing to monitor the East Fork sites will be provided in the report.

### TABLE 7-5A

**East Fork of Box Canyon Monitoring and Mitigation**

<table>
<thead>
<tr>
<th>Monitoring Sites</th>
<th>Protocol</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFB -1</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
</tr>
<tr>
<td>EFB -2</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
</tr>
<tr>
<td>EFB -3</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
</tr>
<tr>
<td>EFB -4</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
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<td>EFB -5</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
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<tr>
<td>EFB -6</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
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<tr>
<td>EFB -7</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
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<tr>
<td>EFB -8</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
</tr>
<tr>
<td>EFB -9</td>
<td>A, C</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
</tr>
<tr>
<td>EFB -10</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
</tr>
<tr>
<td>EFB -11</td>
<td>A, C</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
</tr>
<tr>
<td>EFB -12</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
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<tr>
<td>EFB -13</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
</tr>
<tr>
<td>EFB -14</td>
<td>A</td>
<td>Monitor flows, vegetation, soils, geomorphology, etc.</td>
</tr>
<tr>
<td>EFB-***</td>
<td>B</td>
<td>Subsidence Feature - Monitor location, type, frequency, repairs, etc.</td>
</tr>
</tbody>
</table>

*** Site numbers and quantity of sites will be dependant upon the number of features created due to subsidence. The weekly report to the Division will include all identified sites once mining begins in the area.
A copy of the October 2003 “Monitoring and Mitigation Plan for Mining Under the East Fork of Box Canyon” prepared by the Division and reviewed and accepted by the Forest with some modifications has been included in Appendix 3-10. The preceding paragraphs have been prepared based on this plan. Sufco will meet all of the monitoring and mitigation responsibilities described in the plan as it pertains to the undermining of the East Fork of Box Canyon.

Springs Pines 310 and Pines 311, located in the east fork (North Water Fork) of the East Fork of Box Canyon, were added to the water monitoring list in July 2006. Initially, these springs have been monitored monthly since June 2006 and will continue to be monitored monthly through December 2006, or as accessible, for field water quality parameters and flow. After December 2006, these sites will be monitored on a quarterly basis for field water quality and flow. The flow from Pines 310 spring area is measured at a point where the majority of the spring area flow coalesce into a channel a few hundred feet north and west of the initial spring discharge area. Field water quality parameters are monitored at one of the points where ground water is discharging from the Castlegate Sandstone. Pines 311 is monitored at the western most point of where ground water is discharging from the outcrop in this spring area.

Pines 105, Joes Mill Pond, Pines 310, and Pines 311 Investigation

The Pines 105 and Joes Mill Pond springs were undermined during the winter of 2005-2006 as Sufco extracted coal from panel 5LPE. In the spring of 2006, Sufco discovered surface discharge of ground water at these locations appeared to have ceased as the area was subsided. The Division concluded that Sufco had caused material damage to the spring areas and required the mine to prepare and submit a plan to restore the spring areas. Initially, Sufco hauled sufficient water to livestock in the area to replace that which was lost when the springs stopped flowing at the surface. In July, Sufco submitted a plan to investigate the effected spring areas and a copy of the investigation plan is included in Appendix 7-22.

The purpose of the investigation proposed is three-fold:

1. Determine if ground water discharge in the area of Pines 105 and Joes Mill Pond springs continue to discharge to the alluvium;
2. Monitor and evaluate the effects of mining on the surface and subsurface water in the Pines 310 and Pines 311 spring areas; and

3. Determine the potential for completing and operating ground water wells in the spring areas as part of the spring site mitigation activities.

The piezometers/wells completed as part of this project will be monitored on a bi-weekly basis through December 2006 or as accessible. Transducers with data loggers will be placed in several of the piezometers to record data on a more continuous basis. The monitoring frequency of the piezometers/wells after December 2006 will be dependant upon the results of the drilling investigation and the impacts to springs Pines 310, 311, 105, and the Joes Mill Pond of mining the 6LPE panel in the fall and winter of 2006.

A report detailing the results of the drilling and piezometer/well installation and completion will be submitted to the Division by the end of October 2006. Water level data collected from the piezometers/wells will be reported to the Division electronically within two weeks at the end of each the month through December 2006. The Division will also be notified within three days via e-mail or telephone of significant changes to ground water elevations in Pines 310, 311, 105 spring areas as the 6LPE longwall panel is mined. A report compiling the water level data and interpretation of the data will be submitted to the Division by the end of January 2007.

Based on the findings of the investigation, Sufco will submit to the Division either additional plans (if water is not found in the Pines 105 and Joes Mill Pond area, additional bedrock drilling may be required to locate a suitable source of ground water) or a final plan for mitigation of the effected spring areas.

South Fork of Quitchupah 2R2S Block “A” and 3R2S Block “B” Monitoring and Mitigation Plan
A monitoring and mitigation plan that is more intensive than the general Mining and Reclamation Plan area has been proposed for monitoring water flows, subsidence cracks, and repair of the cracks in the portions of the South Fork of Quitchupah channel to be undermined. This plan is outlined below.

Prior to the initiation of undermining and subsidence, a pre-subsidence survey of the stream channel will be conducted in the portion of South Fork of Quitchupah that flows over the 2R2S.
Block "A" panel and associated gate roads. The survey will consist of a gain/loss survey of flow within the stream channel paying particular attention to surface flows and ground water discharge, soil conditions, and the general channel geomorphology. A similar study was performed in the past but all stream measurements were not conducted on the same date. The second gain/loss survey will be completed on a single day at or near base flow conditions late in the summer or early fall of 2011. The mine will attempt, as part of this second survey, to occupy the same monitoring sites in the panel area as those chosen in the initial survey.

Two weeks before and then once every two weeks after subsidence mining begins, the measuring locations occupied during the gain/loss survey will be reoccupied and flow measurements of the stream flow will be obtained. The approximate locations of these sites are illustrated on Figure 7-9. The once every other week flow measurements will be supplemented by visual observations of flow performed twice a week or once every three to four days. Flow/no flow conditions will be described on these days. If no flow or diminished flows are noted, the appropriate mine and Forest personnel will be contacted and the mitigation plan to restore flows will be implemented.

Semi-weekly flow observations and visual inspections will continue for at least 12 weeks, or as conditions allow, after the completion of mining under the stream channel. The bi-weekly (once every two weeks) stream flow monitoring will continue for at least four weeks, or as conditions and monitoring results indicate necessary, after the completion of subsidence mining under the stream channel. The monitoring plan will then change to quarterly flow and field parameter measurements for two years at four sites: one upstream of the panel, one within the panel, and two downstream of the panel. The location of these new temporary monitoring sites are listed in Table 7-2 and shown on Plate 7-3 and labeled as sites 006A, 006B, 006C and 006D. Additional flow monitoring may be needed to determine specific locations where flow is being lost, and treatments are needed.

Mining ceased beneath the South Fork of Quitchupah Creek in March 2015 (Panel 3R2S) and per the mitigation plan the weekly monitoring obligation for the ponds, springs and channel upstream of the culvert road crossing ceased on June 30, 2017. Flow data (DOGM database) has provided justification for discontinuing the monitoring. The channel, riparian vegetation and springs appear to be stable and unaffected by subsidence associated with underground mining. Ponds 94-1394, 94-982 and 94-115 have shown no effect from mining in the area of the South Fork of Quitchupah and therefore monitoring was discontinued on June 30, 2017. Weekly water monitoring (per the
mitigation plan) will continue thru the Fall of 2017 from the culvert road crossing downstream to the confluence of the North and South Fork of Quitchupah Creek, as will the search for and repair of mining-induced subsidence damage.

The subsidence monitoring plan for the South Fork of Quitchupah will include frequent inspection of the stream channel during and after active subsidence. While mining is occurring under the stream channel, and within the 15-degree angle-of-draw above the active longwall face, that area of the channel will be inspected semi-weekly for subsidence cracks or other related features. As the longwall face advances and the 15-degree angle-of-draw area follows, the portions of the channel that now lie outside the 15-degree angle-of-draw will be monitored for subsidence features on a quarterly basis for two years following the cessation of subsidence related effects, if any, due to mining.

Mitigation of cracks that interrupt or divert flows from the stream channel will be sealed immediately with an appropriate impermeable grout or, in some cases, native materials. Sufco will attempt to seal cracks with the least intrusive methods (typically hand placement of grout or native materials) first. The sealing material may be placed by pouring it directly into the crack or, if cracks occur in an actively flowing portion of the stream, the stream may be temporarily diverted using native materials (or a designed flume if necessary to maintain the flow) until the crack is sealed. If cracks are present in channel walls defined by soil, the soil cracks may be hand filled using a native soil/bentonite mix. The sealing of the channel floor and walls will be accomplished with hand tools such as shovel, picks, trowels, etc.

As a backup plan, in the unlikely event that cracks too large to be sealed through the efforts of one or two persons in one day do occur and it appears there is a danger of water being diverted from the channel for an extended period of time, the stream will be temporarily diverted using native materials and a pipe to carry the flow over the crack to maintain the channel flow. Arrangements will be made to get a contractor to the site as soon as possible to repair the crack after consultation with the Forest Service.

There may be sections of the stream channel that may require more intensive mitigation efforts to restore surface flows in the creek. These efforts could include the drilling of closely spaced shallow boreholes in and adjacent to the stream channel and the injection of an acceptable impermeable
grout into the alluvium or bedrock. The work will be accomplished either using hand tools or low impact equipment to minimize surface disturbance. Existing roads and turnouts will be used as staging areas to locate larger equipment and supplies. Any hoses or lines will be transported from the staging areas to the nearby work sites either by hand, the use of pack animals, or by helicopter. This work will be done with a contractor selected after consultation with the Forest Service.

Additionally, it may be required to remove loose rock from the channel floor, either where the channel flows across thin-bedded bedrock or where large rock have fallen into the channel and is impeding flows. In the instance of the former, past experience has shown this can occur in the upper Blackhawk Formation and is easily repaired by removing enough of the broken channel surface to again expose the stream flow. In the instance of the later, removal of large rocks could be accomplished by drilling and then fracturing the rock into smaller fragments more easily moved to locations were they are not impeding flow. This work may be completed using available pneumatic or hydraulic tools that do not require road or pad building disturbances. In the unlikely event that large boulders do need to be moved, pumps and tanks necessary to complete the work will be located in pre-disturbed areas, such as roads or turnouts, and hoses will be walked into the work area.

Sufco will conduct longwall mining operations in such a manner as to minimize surface disturbance while mining within the 15-degree angle-of-draw area that includes the South Fork stream channel. This will be accomplished by advancing the longwall on a schedule where mining will not be suspended for a period to exceed 48 hours.

A copy of the “Monitoring and Mitigation Plan for Undermining the South Fork of Quitchupah 2R2S Block “A” and 3R2S Block “B” has been included in Appendix 3-14. The preceding paragraphs have been prepared based on this plan. Sufco will attempt to meet the monitoring and mitigation responsibilities described in the plan as it pertains to the undermining of the South Fork of Quitchupah 2R2S Block “A” and 3R2S Block “B”. Refer to Chapter 3, Section 3.3.3.3 for additional information.

A bi-weekly (once every two weeks) report on the impacts to stream flow and required mitigation, if any, will be submitted via e-mail to the Division and the Forest detailing the results of the inspections while mining is occurring under the stream channel. The reports will include, but not
necessarily be limited to: a map illustrating the current location of the longwall face; descriptions and dates of field activities; noted changes in stream and local geomorphology; location, width, frequency of cracks; and a description of repairs, if any, conducted. If the prescribed inspections cannot be conducted, the reason for the missed inspection and a record of the attempt to conduct the inspection will be submitted to Division and the Forest in the report. Division and the Forest will be notified immediately after mining-induced cracks, if any, are found in the South Fork stream channel and the steps taken or planned to be taken as mitigation. Thereafter, Division and the Forest will be advised of continuing mitigation efforts, if needed, in the report.

Prior to implementation of any mining-induced subsidence mitigation efforts in the stream channel as described in Chapter 5, a Stream Alteration Permit will be obtained from the Utah Division of Water Rights. Sufco will have the alteration permit(s) prior to undermining the South Fork of Quitchupah stream channel since the mitigation efforts will occur as soon as possible after a need for mitigation is determined.

**Greens Hollow.** Refer to Appendix 7-28 for the Greens Hollow PHC which describes the potential impacts on the hydrologic balance. The PHC also contains a drawing showing the location and a description of monitoring data for the monitoring locations within the Greens Hollow Lease. Plate 7-3 shows historic in addition to current water monitoring locations. Plate 7-10 shows current monitoring locations only.

A Greens Hollow Lease progress map (Confidential) will be created highlighting mined out areas segmented with monthly completion dates and labeled showing the current location of the longwall. During mining within the Lease the map will be submitted to the Division within 30 days following the end of the previous quarter with the sediment pond and waste rock quarterly inspection forms.

Locations for surface water monitoring above and below the coal panels within the Greens Hollow Lease are shown in Appendix 7-27 on Figure 1, Plate 7-3, Plate 7-10 and Table 9 of the PHC. The monitoring of the above and below sites began in the first quarter of 2017. A description of the monitoring program for the above and below sites is provided in Table 7-2.
7.3.1.3 Acid- and Toxic-Forming Materials
Results of monitoring of mine discharge, surface, and groundwater, indicate that no impact to these waters from acid- and toxic-forming materials has been found in the permit and adjacent areas (Section 7.2.8.3). Parameters defining acid- and toxic-forming materials continue to be monitored as described in the Waste Rock Volume of this M&RP. In the event that acid- or toxic-forming materials are identified, they will be disposed of in the waste rock disposal area. The treatment of these materials will be handled as indicated in the Waste Rock Volume of this M&RP.

7.3.1.4 Transfer of Wells
Before final release of bond, exploration or monitoring wells will be sealed in a safe and environmentally sound manner in accordance with R645-301-631, R645-301-738, and R645-301-765. Ownership of wells will be transferred only with prior approval of the UDOGM. The conditions of such a transfer will comply with State and local laws. SUFCO will remain responsible for the management of the well until bond release in accordance with R645-301-529, R645-301-551, R645-301-631, R645-301-738, and R645-301-765.

7.3.1.5 Discharges
Three UPDES discharges are associated with the SUFCO mine. These include two mine water discharges and the sedimentation pond discharge. A description of these discharges is provided in Section 7.2.4.2.

The primary mine-water discharge consists of water from the underground mine workings that is diverted into mined-out areas now used as sumps. These sumps are used to settle out fines before discharge to the surface. This diversion is done in accordance with the requirements of R645-301-731.100 through R645-301-731.522 and R645-301-731.800. The clarified water flows through a box weir and pipeline to a point on an outcrop of Star Point Sandstone about 20 feet above the North Fork of Quitchupah Creek (see Plate 7-3). From there, the water flows directly into the creek. This discharge water is monitored for compliance with the UPDES permit standards prior to release from the mine.
An emergency mine-water discharge is also maintained. A description of this discharge point is provided in Section 7.2.4.2.

Water from the disturbed surface area in East Spring Canyon is collected and conveyed to the sedimentation pond. After the collected water is allowed time to settle-out the sediment, the water is discharged to the creek. The discharge water is monitored for compliance with the UPDES permit standards prior to release from the sedimentation pond.

No discharges of surface water are being made to underground mines and none are planned in the future.

Upon abandonment of the mining area, the connection between the Sufco Mine and old Link Canyon Mine works will be sealed and made as water tight as possible. A low area that will capture water will remain in the west portal, in the same area as the roof fall that created the underground pond prior to rehabilitating the old Link Canyon Mine portal. The low area will be allowed to fill and will discharge naturally at the west portal. Some structures used to seal the old works from the rehabilitated works may be removed as the mine is abandoned thus ensuring the discharge at the east portal during reclamation.

7.3.1.6 Stream Buffer Zones

All perennial and intermittent streams in the mine area are protected by 100 foot stream buffer zones on either side of these streams. Coal mining and reclamation operations should not cause or contribute to the violation of applicable Utah or federal water standards and should not adversely effect the water quantity and quality or other environmental resources of the stream.

Stream Channel Diversions. Temporary or permanent stream channel diversions comply with R645-301-742.300.

Buffer Zone Designation. The areas surrounding the streams that are not to be disturbed are designated as buffer zones, and SUFCO has marked these as specified in R645-301-521.260.
7.3.1.7 Cross Sections and Maps
The locations of water rights for current users of surface water flowing into, out of, and within the permit and adjacent areas is provided on Plate 7-2. Discharges associated with the permit and adjacent areas are located as presented on Plate 7-3.

The locations of each water diversion, collection, conveyance, treatment, storage, and discharge facility to be used in the East Spring Canyon area are presented on Plate 7-6. Similar information for the waste-rock disposal site is presented in the Waste Rock Volume of this M&RP. Similar information for the Link Canyon Substation No. 1 and No. 2 facility areas is presented on Plates 5-2D and 5-2E. Similar information for the Link Canyon Portal facility area is presented on Plate 5-2F.

Locations and elevations of each station to be used for water monitoring during coal mining and reclamation operations are presented on Plate 7-3.

The construction details and cross sections for the concrete sediment trap are located in the "Alternate #1 Drainage Facilities and Sediment Control Plan" (Appendix 7-8). The existing topography and cross sections for the primary sedimentation pond are located on Plates 7-4 and 7-5. The design topography and cross sections for the overflow pond are located on Plates 7-4A and 7-5A. The design topography and cross sections for the waste rock disposal site sedimentation pond are located in the Waste Rock Volume of this M&RP.

Other Cross Sections and Maps. Other relevant cross sections or maps are presented and discussed in Chapter 5 of this M&RP.

7.3.1.8 Water Rights and Replacement
Ground and surface water rights do exist within the Sufco Mine leased area. Mitigation has been performed at stock pond locations where claims have been made that the available surface water has been impacted by subsidence. Mitigation at these locations has been performed by the placement of bentonite in the bottom of stock ponds and by hauling replacement water to the ponds for livestock use during summer months.
The Permittee will mitigate and replace the water supply of any land owner or adversely affected State appropriated water if such a water supply proves to be contaminated, diminished or interrupted as a result of mining operations. First, a determination will be made by the Division in accordance with R645-301-731.800 as to whether or not material damage has occurred. Then, in accordance with Regulation R645-301-525.510, the operator will correct any material damage resulting from subsidence caused to surface lands (which includes water rights), to the extent technologically and economically feasible. Negotiations will be held immediately with the impacted party to determine the appropriate mitigation activities. The restoration of water flows to impacted sources will be accomplished using the Best Technology Currently Available (BTCA). These activities may include, but not necessarily be limited to: piping or trucking water to the location of the loss; sealing surface fractures to prevent further losses (i.e., stream floors on bed rock or in shallow alluvium), and; construction of a ground water well and the installation of pumps to restore flows. If the above efforts are not successful, then the operator will explore the transferring of water rights to the injured party in flow equal to the determined loss and/or monetary reimbursement for proven material damages.

The water supply in the East Fork of Box Canyon is of special concern to Sufco and the regulatory authorities. In an effort to protect the minimal surface flows in this area, an intense monitoring and mitigation plan will be implemented prior to full extraction mining taking place under the East Fork. If changes in the quantity and quality of the water in the East Fork are noted, the Division will be immediately notified. A determination of the amount of water, if any, that is lost due to mining activities will be made using surface and ground water flow and climatic data. If a loss of flow is confirmed, the loss will be addressed as described in the proceeding text of this section.

The Forest Service (USFS) continues to work with the Division of Water Rights to develop subbasin claims that would assert a claim of right for all developed and undeveloped water on the National Forest System lands. The majority of the water rights in the Greens Hollow Lease belong to the USFS for stock watering along streams and at springs. The permittee holds five water rights for multiple uses including temporary water mitigation and exploratory drilling.

7.3.2 Sediment Control Measures
The existing sediment control measures within the permit area have been designed, constructed, and maintained to prevent additional contributions of sediment to streamflow or to runoff outside.
the permit area. In addition, they have been designed to meet applicable effluent limitations, and minimize erosion to the extent possible.

The structures to be used for the runoff-control plan for the permit area include disturbed and undisturbed area diversion channels, sedimentation ponds, containment berms, silt fences, and road diversions and culverts.

7.3.2.1 Siltation Structures
The siltation structures within the permit area consist of the sedimentation ponds described in Section 7.3.2.2.

7.3.2.2 Sedimentation Ponds
There are four sedimentation ponds operating at the mine facility. Three of them are located in the immediate vicinity of the existing facilities. A fourth pond is located at the waste rock disposal site.

Concrete Sediment Trap. A sediment trap is located near the southern end of the mine yard which captures all disturbed area runoff from the mine yard area. This concrete sediment trap was designed to remove in excess of 65% of all solids from the disturbed area runoff before the water enters the main sedimentation pond below. The purpose of the concrete sediment trap is to reduce the required size of the main sedimentation pond and to decrease the amount of overall disturbance. A detailed design of the concrete sediment trap is contained in Appendix 7-8.

Operation of the sediment trap includes decanting the existing water and removing the sediment. Except during use, the telescoping decanting valve on the trap is locked to prevent unauthorized drainage of the concrete structure. On regular UPDES sampling days, the structure is inspected for sediment content. If a sediment delta is evident at the water level extending to or beyond the first of the mine discharge pipes, the structure will be decanted within one week of the observation. The decanting period shall not exceed four days. Sediment material from the structure will then be removed with a front-end loader and disposed of at the waste-rock disposal site.

Primary Sedimentation Pond. The primary sedimentation pond is located in the area immediately below the fill on which the existing mine facilities are constructed. The existing sedimentation pond topography and cross sections are presented on Plates 7-4 and 7-5 of this M&RP.
The staff gauge in the pond has been marked to indicate the 60% clean-out elevation of 7408.1 feet as defined in Section 7.4.2. At least once each year following the spring runoff event, the pond will be drained with the decanting device to inspect the accumulated sediment level. The pond will be sampled for effluent quality immediately before the decanting operation.

If sediment has accumulated to the 60% clean-out elevation, the pond will be cleaned. The sediment will be transported and disposed of at the waste rock disposal site.

The southern-most extent of the sedimentation pond dam is located 180 feet south of the lease boundary across East Spring Canyon. The Fishlake National Forest Service issued a special use permit that approved the construction with the stipulation that the dam site be included in the disturbed mine permit area and subject to final reclamation. The area is included in the calculation of the disturbed area subject to bonding and in the calculation of final reclamation costs.

Overflow Pond. The overflow pond is located 800 feet downstream of the primary sedimentation pond. The overflow pond topography, cross sections and details are presented on Plate 7-4A and 7-5A of this M&RP.

The staff gauge in the overflow pond will be marked to indicate a clean-out elevation of 7243.62 feet as defined in Section 7.4.2. At least once each year, following the spring runoff event, the pond will be drained with the decanting device to inspect the accumulated sediment level. The pond will be sampled for effluent quality immediately before the decanting operation. When sediment has accumulated to the clean-out elevation, the pond will be cleaned. The sediment will be transported and disposed of at the waste rock disposal site.

Waste Rock Disposal Site Sedimentation Pond. The sedimentation pond located at the waste rock disposal site is presented on Map 7 in the Waste Rock Volume of this M&RP. A discussion of the operation, maintenance, and reclamation of this pond is also contained therein.

Compliance Requirements. All sedimentation ponds will be maintained until removal in accordance with the reclamation plan (see Section 5.40 of this M&RP). When a pond is removed, the land will be revegetated in accordance with the reclamation plan defined in Section 5.40.
The Primary sedimentation pond and concrete sediment trap were designed together to contain the volume of sediment equal to 0.035 acre-foot per acre of disturbed area. The concrete sediment trap will provide for removal of 65% of this sediment volume, while the sedimentation pond will contain the remaining 35%. In addition, the sedimentation pond will fully contain the runoff from the 10-year, 24-hour storm event. The spillways for both the sedimentation pond and concrete sediment trap will adequately pass the peak flow from the 25-year, 6-hour precipitation event.

The overflow pond has been designed to retain sediment from the disturbed mine facilities and runoff from the 10-year, 24-hour storm event. The spillway for the overflow pond has been designed to safely pass the peak flow from the 25-year, 6-hour precipitation event. The affected area will be included in the calculation of the disturbed area subject to bonding and in the calculation of final reclamation costs.

The waste rock disposal site sedimentation pond was designed to contain a sediment volume equal to 0.1 acre-foot per acre of disturbed area. It will also fully contain the runoff from the 10-year, 24-hour storm event. The spillways for the pond were initially designed to pass the peak flows from the 25-year, 24-hour storm event. The revised design storm (25-year, 6-hour precipitation event) results in a smaller peak discharge and, thus, the spillways are adequately designed.

Additional design standards for all ponds are presented in Section 7.4.2.

**MSHA Requirements.** MSHA requirements defined in 30 CFR 77.216 are not applicable since the existing sedimentation ponds do not impound water or sediment to an elevation of 20 feet or more above the upstream toe of the structure. The ponds also store a volume less than 20 acre-feet.

7.3.2.3 Diversions

The objective of the run-off control plan is to isolate, to the maximum degree possible, run-off from disturbed areas from that of undisturbed areas. This is accomplished by:

- Allowing all upstream run-off to by-pass the disturbed area via a network of culverts.
• Routing run-off from the undisturbed east slope above the facilities down diversion ditches in the east side road to by-pass the disturbed area.

• Routing of any run-off from undisturbed areas which enters the disturbed area into the sediment control system.

The location of each diversion ditch or culvert for the main facility area is presented on Plate 7-6. The location of each diversion ditch for the Link Canyon Portal and Substation No. 1 and No. 2 facility areas is presented on Plates 5-2D, 5-2E, and 5-2F. A brief list of each diversion structure is as follows (refer to Plates 7-6, 5-2D, 5-2E, and 5-2F for the location of each sub-watershed boundary):

**Diversion Ditches:**

• Interception ditch along the East Side Road which drains watershed CBE-5.
• Interception ditch along the East Side Road which drains watersheds CBE-1 through CBE-5.
• Substation pad upper undisturbed interception ditch which drains watershed CBE-4.
• Substation pad lower undisturbed interception ditch which drains watershed CBE-3. This ditch is part of the alternate sediment control measures defined in Section 7.4.2.1.
• Riprap diversion channel for CBE continuance diversion. This diversion drains watersheds CBE-1 through CBE-5.
• Interception ditch which drains undisturbed watershed ESC-6 north of ATOF.
• Interception ditch which drains undisturbed watershed ESC-7 north of ATOF.
• Interception ditch which drains undisturbed watershed MSH-2 north of ATOF.
• Sedimentation Pond access road diversion ditch which drains disturbed watershed DIS-3.
• Main access road diversion ditch which drains undisturbed watershed DWN-1.
• Link Canyon Substation No. 1 ditch which drains watersheds LINK and ASCA-1.
• Link Canyon Substation No. 1 road swell which drains watersheds LINK, ASCA-1, and ASCA-3.
• Link Canyon Substation No. 2 ditch which drains watersheds LINK No.2, ASCA-4, and ASCA-7.
• Link Canyon Portal Access Road Channel No. 1 which diverts the access road disturbed drainage and undisturbed drainage above the access road to the Link Canyon drainage bypass culvert inlet.
• Link Canyon Portal Pad Channel No. 2 which diverts the pad area disturbed drainage and the undisturbed area above the pad to the Link Canyon drainage bypass culvert inlet.
• West Overflow Pond Undisturbed Area Diversion Channel which diverts and drains runoff from watershed DWN-3 around to Overflow Pond Access Road Channel.
• Overflow Pond Access Road Channel which diverts and drains runoff from watershed DWN-3 along the Overflow Pond Access Road.
• East Overflow Pond Undisturbed Area Diversion Channel (Shallow Section) which diverts and drains runoff from watershed DWN-5 around the Overflow Pond.
• East Overflow Pond Undisturbed Area Diversion Channel (Steep Section) which diverts and drains runoff from watershed DWN-5 down the overflow pond impoundment.

Diversion Culverts:

• CBE bypass culvert at substation which drains watersheds CBE-2 through CBE-5.
• Pipe No. 5 diversion culvert which drains undisturbed watershed DWN-1.
• Mud Spring Hollow bypass culvert which drains undisturbed watersheds MSH-1 and MSH-2. This culvert discharges into the East Spring Canyon bypass culvert.
• East Spring Canyon bypass culvert which drains undisturbed watersheds ESC-1 through ESC-7. This bypass also receives flows from the Mud Spring Hollow bypass.
• East Spring Canyon bypass culvert emergency diversion at the main mine fan. This 3.5 foot square drop drain with oil skimmer cap connects into a 48-inch culvert directed into the East Spring Canyon bypass culvert. This serves as an overflow system when the trash rack at the inlet to East Spring Canyon becomes plugged with debris.
• 8-inch pipe diversion for undisturbed watershed ESC-7. This pipe tees to the 10-inch pipe that drains undisturbed watershed ESC-6.

• Main Mine Fan Diversion. The main mine fan is located in a depression which is nine feet below the adjacent mine yard drainage system. A sump pump with automatic float controls in front of the main fan will pump the runoff from this area into the 10-inch mine yard drain line.

• 10-inch mine yard culvert drainage system. This system discharges to the concrete sediment trap.

• Link Canyon Portal bypass culvert which drains watersheds LCP-East and LCP-West.

• The primary sediment pond diversion culvert allows runoff from the disturbed area to bypass the primary sedimentation pond, thereby allowing water to be drained from the primary sedimentation pond for sediment removal. This culvert discharges to the overflow pond.

• The 66-inch overflow pond bypass culvert allows runoff from undisturbed watersheds DWN-1, DWN-2, DWN-3, MSH-1, MSH-2, and ESC-1 through ESC-7 to bypass the overflow pond. This culvert discharges immediately downstream of the overflow pond.

All diversion ditches are maintained with adequate rip-rap or alternative erosion protection in the ditch sections where flow velocities are great enough that a ditch lining is necessary. Adequate ditch capacities are maintained in all ditch sections. Culverts are kept free of debris and each outlet is lined with adequate riprap. Detailed diversion design is presented in Section 7.4.2.

Water bars in roadside ditches have been constructed of rocks to form low dams across the ditches. The rocks are large enough to resist movement during anticipated run-off events. They are arranged to channel water down the center of the ditch rather than around the water bar ends to prevent erosion of the ditch side walls. Accumulations of sediment behind the ditch water bars are permitted to rise to the lowest height of the bar.

Diversion ditch and culvert operation and maintenance for the diversions within the waste rock disposal site are presented in the Waste Rock Volume of this M&RP.
7.3.2.4 Road Drainage

Road drainage facilities include diversion ditches, culverts, containment berms, and/or water bars. The road drainage diversion ditches and culverts for the mine site and Link Canyon facility area are included in the list of diversions presented in Section 7.3.2.3 above. In addition, water bars have been constructed across dirt roads within the disturbed areas to channel water off the road onto downslopes or into roadside ditches. Riprap has been placed along these transitions to minimize the potential for erosion. Water bars have been constructed on the East Side road and along the access road to the sedimentation pond. Additional road drainage design information is presented in Section 7.4.2.

The operation of the road drainage diversions within the waste rock disposal site is presented in the Waste Rock Volume of this M&RP.

All road drainage diversions will be maintained and repaired to original condition following the occurrence of a large storm event. Culvert inlets and outlets will be kept clear of sediment and other debris.

7.3.3 Impoundments

7.3.3.1 General Plans

There are four sedimentation ponds operating at the mine facility as described in Section 7.3.2.2. Three ponds are located at the East Spring Canyon surface facilities. A fourth pond is located at the waste rock disposal site.

The concrete sediment trap is located near the southern end of the mine yard and captures all disturbed area runoff from the mine yard area. A detailed design of the sediment trap is contained in Appendix 7-8.

The primary sedimentation pond is located in the area immediately below the fill on which the existing mine facilities are constructed. The existing sedimentation pond topography and cross sections are presented on Plates 7-4 and 7-5 of this M&RP.
The overflow pond is located 800 feet downstream from the primary sedimentation pond. The overflow pond is designed to allow for flood control and sediment settling while the primary sediment pond is being drawn down for sediment removal. A series of canal boxes with valves will allow the primary sediment pond to be bypassed for draw down, sediment removal, and maintenance. Detailed design information regarding the overflow pond is provided in Appendix 7-23 and Plates 7-4A and 7-5A.

The waste rock disposal site sedimentation pond is located at the waste rock disposal site and is presented on Map 7 in the Waste Rock Volume of this M&RP.

**Certification.** All maps and cross sections of the sedimentation ponds have been prepared by or under the direction of and certified by a qualified, registered, professional engineer.

**Maps and Cross Sections.** The construction details and cross sections for the concrete sediment trap are located in Appendix 7-8. The existing topography and cross sections for the main sedimentation pond are located on Plates 7-4 and 7-5 of this M&RP. The topography and cross sections for the overflow pond are located on Plates 7-4A and 7-5A of this M&RP. The design topography and cross sections for the waste rock disposal site sedimentation pond are located in the Waste Rock Volume of this M&RP.

**Narrative.** A description of each sedimentation pond is presented in Sections 7.3.2.2 and 7.4.2 of this M&RP.

**Subsidence Survey Results.** No underground coal mining occurs beneath the existing impoundments within the permit area and, therefore, there has been no effect from subsidence.

**Hydrologic Impact.** The preliminary hydrologic and geologic information required to assess the hydrologic impacts of the impoundments can be found in Section 7.2.4 and Chapter 6, respectively.

**Design Plans and Construction Schedule.** There are no additional structures proposed for the mining operation at this time. Designs of all existing structures have been described within this M&RP.
7.3.3.2 Permanent and Temporary Impoundments

Requirements. All impoundments have been designed and constructed using current, prudent, engineering practices. Specific foundation design and construction criteria are presented in Chapter 5 of this M&RP. Specific hydrologic design criteria for each impoundment are presented in Section 7.4.3. All impoundments will be inspected regularly based on the schedule contained in Section 5.1.4.3.

Permanent Impoundments. There are no permanent impoundment structures within the mine facilities at this time.

Temporary Impoundments. The UDOGM authorized the construction of the existing temporary impoundments at the mine as part of coal mining and reclamation operations.

Hazard Notifications. The sedimentation ponds will be examined for structural weakness and erosion at least four times per year. A report of these findings will be submitted to the UDOGM on a quarterly basis.

7.3.4 Discharge Structures
The discharge structures within the East Spring Canyon facilities area include the spillways on the concrete sediment trap, primary sedimentation pond, and overflow pond. These discharge structures are defined in Section 7.4.4. The spillways constructed on the waste rock disposal site sedimentation pond are described in the Waste Rock Volume of this M&RP.

7.3.5 Disposal of Excess Spoil
There is no excess spoil generated at the mine.

7.3.6 Coal Mine Waste
Areas designated for the disposal of coal mine waste and coal mine waste structures are constructed and maintained as described in the Waste Rock Volume of this M&RP.

7.3.7 Noncoal Mine Waste
Noncoal mine waste is stored and disposed of as described in Chapter 5.
7.3.8 Temporary Casing and Sealing of Wells
Each groundwater monitoring well identified on Plate 7-3 will be operated and maintained as described in Section 7.4.8.

7.40 Design Criteria and Plans

7.4.1 General Requirements
This M&RP includes site-specific plans that incorporate minimum design criteria for the control of drainage from disturbed and undisturbed areas.

7.4.2 Sediment Control Measures

7.4.2.1 General Requirements
Design. Existing sediment control measures have been designed, constructed and maintained to provide the following:
  • Prevent additional contributions of sediment to stream flow or to runoff outside the permit area.
  • Meet the effluent limitations defined in Section 7.5.1.
  • Minimize erosion to the extent possible.

Appendix 5-11 contains design drawings and information pertaining to the paving of an area in the upper mine yard and the repair/re-paving of an adjacent area. The areas to be paved will have three segments of concrete gutter with drip drains/inlet boxes and a fourth drop drain/inlet box in the asphalt to collect and direct runoff to the lower mine yard.

Appendix 5-11 contains design drawings and information pertaining to the construction of a sump (also referred to as the “West Lease #1 Belt Sump”) at the entrance of the existing West Lease Beltline Tunnel. New drainage line and junction boxes will direct treated water from the sump into existing mine yard drainage culverts. A portion of the mine yard will also be paved/repaved in the vicinity of the West Lease Portal, directly east of the ROM coal storage area (Appendix 5-11-2 drawing)
Measures and Methods. The sediment control measures at the mine include practices carried out within and adjacent to the disturbed area. Sediment control methods include:

- Retention of sediment within the disturbed area;
- Diversion of runoff away from the disturbed area;
- Diversion of runoff using channels or culverts through disturbed areas to prevent additional erosion;
- Cut and fill slopes within the disturbed area will be revegetated with a quick growing vegetative cover (standard seed mix in section 3.4.1.2 minus the shrubs and trees) to provide interim reclamation and stability of the slopes during mining.
- Provide straw dikes, riprap, check dams, mulches, vegetative sediment filters, dugout ponds and other measures that reduce overland flow velocities, reduce runoff volumes or trap sediment;
- Treatment with chemicals; and
- Treatment of mine drainage in underground sumps. There are four portal sites in Quitchupah Canyon. The 4 East portal site is classified as an ASCA. South portals, 3 East portals, and Quitchupah portals have sediment control consisting of routing runoff from disturbed areas into the mine with berms and insloping. The runoff is then treated using in mine settling ponds prior to discharge through approved UPDES points. The disturbed area associated with the South portals is 0.017 acre. The disturbed area associated with the 3 East portals is 0.017 acre. The disturbed area associated with the Quitchupah portals is 0.017 acre. A calculation demonstrating the insignificance of the inflow of surface water into the mine is included in Appendix 7-16.

During construction of the new overflow pond sediment from the disturbed area will be controlled by the use of containment berms and silt fencing.

Several alternate sediment control areas are defined within the mine site and are listed below (see Plates 5-2B,C,D,E,&F):

- The original substation pad area and fire water tank above the office building. The sediment controls include a graveled pad area and silt fences. The disturbed area is 0.324 acre.
The topsoil stockpile near the mine site primary sedimentation pond. The sediment control consists of containment berms and silt fencing. The disturbed area is 0.105 acre.

The topsoil stockpile near the mine site overflow pond. The sediment control consists of containment berms and silt fencing. The disturbed area of the overflow pond topsoil stockpile is 0.141 acres.

The subsoil, topsoil and sedimentation pond topsoil stockpiles at the waste rock disposal site. The sediment controls include containment berms and silt fencing. The disturbed area of the subsoil and topsoil stockpiles is 1.24 acre. The disturbed area of the pond topsoil pile is 0.293 acre.

The area above the mine fan in East Spring Canyon. The sediment control consists of silt fencing. The disturbed area is 0.122 acre.

The pump house in Convulsion Canyon. The sediment control consists of containment berms and silt fencing. The disturbed area is 0.075 acre.

The leach field in Convulsion Canyon. The sediment control consists of containment berms and silt fencing. The area is fenced to prevent grazing. The disturbed area is 0.40 acre.

The new substation pad disturbed area is 0.287 acre. The sediment controls include gravel and silt fences.

The 4 East portal site consists of a pad area where a mine fan has been built. The disturbed area associated with the two portal openings at this site is 0.70 acre. Alternate sediment control at this pad consists of a containment berm, gravel and silt fencing.

The Link Canyon Substation No. 1 facility disturbed area is 0.18 acre. This substation pad area was reclaimed in 2000. The sediment control consists of containment berms, silt fencing, and vegetation.

The Link Canyon Substation No. 2 facility disturbed area is 0.12 acre. The sediment control consists of containment berms, gravel and silt fencing.

The Link Canyon Portal facility disturbed area is 0.18 acre. The sediment control consists of containment berms, gravel and silt fencing.

The total area for Alternate Sediment Control Areas (ASCA) is 4.167 acres. This is approximately 13.6 percent of 30.454 acres of total disturbed area at the mine site, Link Canyon Portal and 7-87
Substation No. 1 and No. 2 facility sites, and waste rock disposal site (including ASCA's and SAE's).

The upper yard concrete gutters and inlet boxes/drop drains will direct surface runoff into existing culverts, which discharge water into the sediment pond(s) for treatment. There will be no additional runoff introduced into the designed drainage system with the paving of the upper yard area. Refer to Appendix 5-11 for details of the gutters and inlet boxes.

The West Lease #1 Belt Sump will capture and treat water from the beltline as well as from portion of the mine yard in the vicinity of the West Lease portal. Treated water from the sump will be directed through new drainage lines and junction boxes to existing mine yard drainage culverts. Refer to sheet number Appendix 5-11-2 for location of sump, drainage lines, and junction boxes. Sump design details are located in Appendix 5-11, West Lease #1 Belt Sump.

7.4.2.2 Siltation Structures

General Requirements. Additional contributions of suspended solids and sediment to stream flow or runoff outside the permit area are being prevented to the extent possible using various siltation structures.

The existing siltation structures for the main facilities area, the concrete sediment trap and primary sedimentation pond, were not constructed before beginning coal mining operations. The structures were constructed upon implementation of applicable State and Federal Regulations. The overflow pond was constructed to allow for continued compliance with State and Federal Regulations. The sedimentation pond for the waste rock disposal site was constructed before the site was used. Each structure has been certified by a qualified registered professional engineer.

All siltation structures which impound water have been designed, constructed and maintained as described in Chapter 5 and Sections 7.3.3 and 7.4.3.

Siltation structures are also provided at the mine-water discharges points. Water is presently being discharged from the mine at UPDES discharge point 003 from the Quitchupah Canyon breakouts. UPDES discharge point 001 is approved as an alternative mine water discharge point. Design of the siltation structures for these discharge points is presented in Section 7.3.1.5.
Sedimentation Ponds. There are four sedimentation ponds operating within the permit area. These ponds are described as follows:

- Concrete sediment trap located at the south end of the main facilities area.
- Primary sedimentation pond located in the area immediately below the fill on which the existing mine facilities are constructed.
- Overflow pond located approximately 800 feet downstream from the primary sedimentation pond.
- Waste rock disposal site sedimentation pond located at the waste rock disposal site.

Sedimentation Pond Use.

Individually or in Series. The concrete sediment trap and the primary sedimentation pond or overflow pond are designed to work in series to manage the design sediment volume and pass the peak discharge rate. The overflow pond is designed to allow runoff from the concrete sediment trap to bypass the primary sediment pond to allow for draw down, sediment removal, and maintenance. The sedimentation pond at the waste rock disposal site functions individually.

Location. All sedimentation ponds are located as near as possible to the disturbed areas. The location of the concrete sediment trap, primary sedimentation pond, and overflow pond are indicated on Plate 7-6. Location of the waste rock disposal site sedimentation pond is presented in the Waste Rock Volume of this M&RP. The concrete sediment trap, primary sediment pond, and waste rock disposal site sediment pond are not located within a perennial stream channel. The overflow pond is located within a perennial stream channel.

Design, Construction and Maintenance.

Sediment Storage Volume. The concrete sediment trap, primary sedimentation pond or overflow pond were designed to, in series, control a sediment volume of 0.035 acre-feet per acre of disturbed area. The disturbed area, contributing sediment to the concrete sediment trap and primary sedimentation pond, contains 15.88 acres from contributing watersheds DIS-1 through DIS-5. The disturbed areas, contributing sediment to the overflow pond, contains 16.49 acres from
contributing watersheds DIS-1 through DIS-6. Refer to Plate 7-6 for a location of the watersheds. Although it contributes runoff to the ponds, a sediment storage volume from the watershed CBW-1 is not included in the calculations because it is an undisturbed area.

The sediment trap was constructed to provide easy access for the removal of 65% of all solids before runoff from the disturbed area enters the primary sedimentation pond. Although the concrete basin does not have 65% of the total sediment volume it permits reduction of the primary pond size by that amount because it provides a sediment control measure for the removal of sediment equal to the reduced volume.

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Curve Number</th>
<th>Area (acres)</th>
<th>Time of Concentration (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIS-1</td>
<td>80</td>
<td>2.46</td>
<td>0.021</td>
</tr>
<tr>
<td>DIS-2</td>
<td>80</td>
<td>9.27</td>
<td>0.226</td>
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<td>DIS-3</td>
<td>80</td>
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<td>0.066</td>
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<tr>
<td>DIS-4</td>
<td>80</td>
<td>2.23</td>
<td>0.022</td>
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<tr>
<td>DIS-5</td>
<td>100</td>
<td>0.34</td>
<td>0.008</td>
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<tr>
<td>CBW-1</td>
<td>72</td>
<td>29.8</td>
<td>0.183</td>
</tr>
<tr>
<td>DWN-1</td>
<td>79</td>
<td>7.23</td>
<td>0.110</td>
</tr>
<tr>
<td>CBE-1</td>
<td>72</td>
<td>12.4</td>
<td>0.187</td>
</tr>
<tr>
<td>CBE-2</td>
<td>90</td>
<td>0.30</td>
<td>0.017</td>
</tr>
<tr>
<td>CBE-3</td>
<td>90</td>
<td>0.05</td>
<td>0.011</td>
</tr>
<tr>
<td>CBE-4</td>
<td>72</td>
<td>3.05</td>
<td>0.119</td>
</tr>
<tr>
<td>CBE-5</td>
<td>72</td>
<td>3.88</td>
<td>0.107</td>
</tr>
<tr>
<td>ESC-1</td>
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<td>1.36</td>
</tr>
<tr>
<td>ESC-2</td>
<td>72</td>
<td>1010</td>
<td>0.875</td>
</tr>
<tr>
<td>ESC-3</td>
<td>72</td>
<td>211</td>
<td>0.453</td>
</tr>
<tr>
<td>ESC-4</td>
<td>72</td>
<td>468</td>
<td>1.18</td>
</tr>
<tr>
<td>ESC-5</td>
<td>72</td>
<td>487</td>
<td>0.776</td>
</tr>
</tbody>
</table>
The concrete sediment trap was constructed after consultation with representatives from the Office of Surface Mining, the Division of Oil, Gas and Mining and the U.S. Forest Service during the spring of 1980 and was built subsequent to approval of the various regulatory authorities. The design was selected in preference to other designs employing a full size pond due to environmental considerations. Among these considerations was that a full size pond would have required the disturbance of at least twelve additional acres of presently undisturbed area. In addition, the resulting pond would have been exceedingly difficult to maintain with respect to regular and frequent sediment recovery and disposal.

The primary sedimentation pond was designed to fully contain the remaining 35% of the design sediment volume. Based on calculations presented in Appendix 7-14, the disturbed area totals 15.88 acres. Therefore, the primary sedimentation pond will contain a maximum of 24,211 cubic feet (0.556 acre-feet) of sediment. The elevation of the maximum sediment level is 7410.4 feet. The 60% sediment clean-out volume of 14,527 cubic feet (0.333 acre-feet) has an elevation of 7408.1 feet.

The overflow pond is designed to work in series with the concrete sediment trap, and/or the primary sedimentation pond. A review of sedimentation pond discharge records for the period of 11/06/99...
to 07/09/08 indicates that normal dust suppression activities at the facility, and wash down of transport vehicles contributes a constant flow of approximately 0.046 cfs from the disturbed area to the concrete sediment trap and primary sedimentation pond. The sediment trap and the primary sedimentation pond were designed to create a quiescent sediment settling area capable of containing runoff from a 10-year, 24-hour storm with a spillway capable of safely discharging the peak flow resulting from a 25-year, 6-hour storm. Dust suppression and washdown water flows almost constantly into these two basins, the overflow pond is sized to more efficiently manage runoff from the 10-year, 24-hour storm from the disturbed and adjacent areas.

The overflow pond was designed to fully contain the design sediment volume for the disturbed area. As indicated in Appendix 7-23, the disturbed area associated with this pond totals 16.49 acres. This disturbed area includes 15.88 acres treated and detained by the concrete sediment trap and primary sediment pond and 0.61 acres of the overflow pond. The 0.61 acres of disturbed area for the overflow pond includes only the pond area itself no additional sediment will be created. Based on a sediment storage volume of 0.035 acre-feet per acre of disturbed area, the overflow pond will contain 24,211 cubic feet (0.556 acre-feet) of sediment. The elevation of the maximum sediment level is 7,245.41 feet. The 60% sediment clean-out volume of 14,526 cubic feet (0.33 acre-feet) has an elevation of 7,243.62 feet.

The design sediment storage volume and 60% clean-out level for the waste rock disposal site sedimentation pond is presented in the Waste Rock Volume of this M&RP.

Detention Time. An adequate detention time will be provided in each pond to allow the effluent to meet UPDES and 40 CFR Part 434 limitations. The decant water will be sampled and discharged from the pond in accordance with the above referenced effluent limitations.

Design Event. The sedimentation ponds are designed to fully contain the 10-year, 24-hour precipitation event.

Overflow Pond, Primary Sedimentation Pond and Concrete Sediment Trap. The calculations contained in Appendix 7-14 were based on the assumption that the primary sedimentation pond will fully contain the runoff from the main facility disturbed areas. The concrete sediment trap will
pass the water to the sedimentation pond, but will not provide significant runoff storage. The concrete sediment trap is used primarily for the removal of sediment.

Several drainage areas, identified on Plate 7-6, contribute runoff to the overflow pond. The disturbed drainage area contributing directly to the overflow pond are DIS-1 through DIS-6. The undisturbed drainage area contributing to the overflow pond is CBW-1.

The curve numbers used to determine the design runoff volume were based on information presented in Appendix 7-11 and Appendix 7-23. The curve number assumed for the disturbed watershed DIS-1 through DIS-4 is 80 and for DIS-5 and DIS-6 is 100, see Appendix 7-11 and 7-23. The curve number for undisturbed watersheds CBW-1 is 72, see Appendix 7-11. Refer to Table 7-6 for a list of all disturbed and undisturbed subwatershed areas and curve numbers within the facilities area. Based on the curve numbers presented above, the storm runoff volume from the 10-year, 24-hour storm event to the overflow pond is 57,898 cubic feet (1.33 acre-feet). The maintenance runoff rate of 0.046 cfs adds 3,975 cubic feet (0.0913 acre-feet) to this volume during a 24-hour period, resulting in a combined required runoff storage volume of 61,873 cubic feet (1.42 acre-feet) without sediment storage. The calculations, presented in Appendix 7-23, are based on hydrologic design methods described in Appendix 7-10. As presented above, the maximum sediment storage volume is 24,211 cubic feet. In order to fully contain the runoff from the 10-year, 24-hour storm event and the maximum sediment storage, the primary spillway elevation for the overflow pond is 7252.5 (2.14 acre-feet), from the stage-capacity table contained in Table 7-8A. The required minimum elevation for the primary spillway with a volume of 24,211 cubic feet is 7,252.26, for ease of construction the primary spillway elevation will be 7,252.50 feet. The actual overflow pond is 3.15 acre feet.

Several drainage areas, identified on Plate 7-6, contribute runoff to the primary sedimentation pond. The disturbed drainage areas contributing to the pond are DIS-1, DIS-2, DIS-3, DIS-4, and DIS-5. The undisturbed drainage area contributing to the pond is CBW-1. The undisturbed drainage CBW-1 is discharged to the pond because it was determined that construction of a diversion ditch along the top of the cut slope from the trash pit north to Mud Spring Hollow may cause some stability problems with the cut slope.
TABLE 7-7
Stage-Capacity Curve for the Concrete Sediment Trap

<table>
<thead>
<tr>
<th>ELEVATION (FT)</th>
<th>AREA (FT²)</th>
<th>INCREMENTAL VOLUME (FT³)</th>
<th>CUMULATIVE VOLUME (FT³)</th>
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<tbody>
<tr>
<td>7436.1</td>
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<td></td>
<td>1469.0</td>
<td>1469.0</td>
</tr>
<tr>
<td>7438.7</td>
<td>770.0</td>
<td>756.0</td>
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<td>7439.6</td>
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<td>2602.0</td>
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<td>7440.0</td>
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<td>7440.6</td>
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<td>7441.6</td>
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</tbody>
</table>
TABLE 7-8
Stage-Capacity Data for the Primary Sedimentation Pond

<table>
<thead>
<tr>
<th>ELEVATION (FT)</th>
<th>AREA (FT²)</th>
<th>INCREMENTAL VOLUME (FT³)</th>
<th>CUMULATIVE VOLUME (FT³)</th>
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<tr>
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<tr>
<td>7402.0</td>
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<td>7403.0</td>
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<td>1770.3</td>
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<td>7405.0</td>
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<td>5196.1</td>
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<td>7406.0</td>
<td>2607.6</td>
<td>2857.8</td>
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<td>7407.0</td>
<td>3108.0</td>
<td>3387.6</td>
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<td>7408.0</td>
<td>3667.1</td>
<td>3941.7</td>
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<td>4216.3</td>
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<td>17,773.3</td>
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<td>7410.0</td>
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<td>22,260.9</td>
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<td>7411.0</td>
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### TABLE 7-8 (Continued)

Stage-Capacity Data for the Primary Sedimentation Pond

<table>
<thead>
<tr>
<th>ELEVATION (FT)</th>
<th>AREA (FT²)</th>
<th>INCREMENTAL VOLUME (FT³)</th>
<th>CUMULATIVE VOLUME (FT³)</th>
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<td>45,929.0</td>
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<td>7415.0</td>
<td>8052.8</td>
<td>7667.6</td>
<td>53,596.6</td>
</tr>
<tr>
<td>7416.0</td>
<td>8758.4</td>
<td>6405.6</td>
<td>62,002.2</td>
</tr>
<tr>
<td>7417.0</td>
<td>9452.0</td>
<td>9105.2</td>
<td>71,107.4</td>
</tr>
<tr>
<td>7418.0</td>
<td>9937.1</td>
<td>6786.2</td>
<td>77,893.5</td>
</tr>
<tr>
<td>7418.15</td>
<td>10,245.7</td>
<td>4541.1</td>
<td>82,434.6</td>
</tr>
<tr>
<td>7418.3</td>
<td>10,346.3</td>
<td>1544.4</td>
<td>83,979.3</td>
</tr>
<tr>
<td>7419.0</td>
<td>10,815.8</td>
<td>7406.7</td>
<td>91,386.0</td>
</tr>
<tr>
<td>7420.0</td>
<td>11,478.6</td>
<td>11,147.2</td>
<td>102,533.2</td>
</tr>
</tbody>
</table>
TABLE 7-8A
Stage-Capacity Data for the Overflow Pond

<table>
<thead>
<tr>
<th>ELEVATION (FT)</th>
<th>AREA (FT²)</th>
<th>INCREMENTAL VOLUME (FT³)</th>
<th>CUMULATIVE VOLUME (FT³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7238.0</td>
<td>928</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7239.0</td>
<td>1,413</td>
<td>1,170</td>
<td>1,170</td>
</tr>
<tr>
<td>7240.0</td>
<td>1,897</td>
<td>1,655</td>
<td>2,825</td>
</tr>
<tr>
<td>7241.0</td>
<td>2,609</td>
<td>2,253</td>
<td>5,078</td>
</tr>
<tr>
<td>7242.0</td>
<td>3,320</td>
<td>2,965</td>
<td>8,043</td>
</tr>
<tr>
<td>7243.0</td>
<td>4,135</td>
<td>3,728</td>
<td>11,771</td>
</tr>
<tr>
<td>7244.0</td>
<td>4,949</td>
<td>4,542</td>
<td>16,313</td>
</tr>
<tr>
<td>7245.0</td>
<td>5,844</td>
<td>5,397</td>
<td>21,710</td>
</tr>
<tr>
<td>7246.0</td>
<td>6,739</td>
<td>6,292</td>
<td>28,002</td>
</tr>
<tr>
<td>7247.0</td>
<td>7,695</td>
<td>7,217</td>
<td>35,219</td>
</tr>
<tr>
<td>7248.0</td>
<td>8,651</td>
<td>8,173</td>
<td>43,392</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9,178</td>
</tr>
</tbody>
</table>
TABLE 7-8A (Continued)
Stage-Capacity Data for the Overflow Pond

<table>
<thead>
<tr>
<th>ELEVATION (FT)</th>
<th>AREA (FT²)</th>
<th>INCREMENTAL VOLUME (FT³)</th>
<th>CUMULATIVE VOLUME (FT³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7249.0</td>
<td>9,705</td>
<td>10,232</td>
<td>52,570</td>
</tr>
<tr>
<td>7250.0</td>
<td>10,759</td>
<td>11,348</td>
<td>62,802</td>
</tr>
<tr>
<td>7251.0</td>
<td>11,937</td>
<td>12,526</td>
<td>74,150</td>
</tr>
<tr>
<td>7252.0</td>
<td>13,114</td>
<td>13,750</td>
<td>86,676</td>
</tr>
<tr>
<td>7253.0</td>
<td>14,386</td>
<td>15,022</td>
<td>100,441</td>
</tr>
<tr>
<td>7254.0</td>
<td>15,658</td>
<td>16,359</td>
<td>115,463</td>
</tr>
<tr>
<td>7255.0</td>
<td>17,060</td>
<td>131,822</td>
<td></td>
</tr>
</tbody>
</table>
The curve numbers used to determine the runoff volumes were based on information presented in Appendix 7-9. The average curve number for the disturbed area is 80. The curve number assumed for the undisturbed watershed CBW-1 is 72. The curve number for the pond area (watershed DIS-5) was assumed to be 100. Refer to Table 7-6 for a list of all disturbed and undisturbed subwatershed areas and curve numbers within the facilities area.

Based on the curve numbers presented above, the storm runoff volume from the 10-year, 24-hour storm event is 57,898 cubic feet (1.329 acre-feet). The calculations, presented in Appendix 7-14, are based on hydrologic design methods described in Appendix 7-10. As presented above, the maximum sediment storage volume is 24,211 cubic feet. Thus, the minimum capacity of the pond at the elevation of the primary spillway must be 82,109 cubic feet (1.885 acre-feet), assuming the spillway does not spill during the 10-year, 24-hour storm.

In order to fully contain the runoff from the 10-year, 24-hour storm event and the maximum sediment storage, the primary spillway on the sedimentation pond will need to be raised. From the stage-capacity curve for the existing pond structure contained in Appendix 7-14, the required elevation of the primary spillway is 7418.15 feet.

**Waste Rock Disposal Site Sedimentation Pond.** The design storm runoff volume for the waste rock disposal site sedimentation pond is presented in the Waste Rock Volume of this M&RP. The sedimentation pond adequately contains the runoff from the 10-year, 24-hour storm event with maximum sediment storage.

**Dewatering Device.** The concrete sediment trap contains a telescoping dewatering device which can decant water from any elevation in the basin. It will be locked to prevent unauthorized drainage of the concrete structure.

The existing dewatering device on the primary sedimentation pond will be modified so the flowline will be at the elevation of the maximum sediment level, elevation 7410.4 feet. Water will be discharged from the pond in accordance with UPDES guidelines.
The overflow pond dewatering device is designed to decant at the 60% sediment level, 7,243.62 feet. Water will be discharged from the pond in accordance with UPDES guidelines.

The dewatering device for the waste rock site sedimentation pond is identified in the Waste Rock Volume of this M&RP.

**Short Circuiting.** Short circuiting is minimized in the primary sedimentation pond and the waste rock disposal site sedimentation pond because both ponds will fully contain the runoff from the 10-year, 24-hour precipitation event.

**Sediment Removal.** Sediment removal from the concrete sediment trap will be performed frequently such that the basin will operate efficiently. On regular UPDES sampling days, the structure will be inspected for sediment content. If a sediment delta is evident at the water level extending to or beyond the first of the mine discharge pipes. Sediment material from the structure will then be removed with a front-end loader and mixed with coal in the adjacent coal storage pile.

Sediment removal from the primary sedimentation pond will be conducted when the sediment level reaches the 60% clean-out level. From the stage-capacity curve presented in Appendix 7-14, the 60% clean-out elevation is 7408.1 feet. The sediment will be transported and disposed of at the waste rock disposal site.

Sediment removal from the overflow pond will be conducted when the sediment level reaches an elevation of 7,243.62 feet or 60% of sediment capacity. The sediment will be transported and disposed of at the waste rock disposal site.

Sediment removal procedures for the waste rock disposal site sedimentation pond are defined in the Waste Rock Volume of this M&RP.

**Excessive Settlement.** Existing sedimentation ponds within the permit area have been operating for a period long enough to ensure that any settlement which may have occurred is now complete. Excessive settlement has not been observed at either the primary sedimentation pond or the waste rock disposal site sedimentation pond. During construction, the embankment of the overflow pond will be compacted to an average of 95% of maximum dry density, to minimize the chance of excessive settling.
Embankment Material. During construction of the primary sedimentation pond, overflow pond and the waste rock disposal site sedimentation pond the embankment materials were free of sod, large roots, frozen soil, and acid- or toxic forming coal-processing waste.

Compaction. During construction the primary sedimentation pond was compacted to an average of 95% of maximum dry density. The sedimentation pond at the waste rock disposal site was compacted to a maximum dry density of 90% as determined by ASTM D1557. During construction of the overflow pond, the embankment of the pond will be compacted to an average of 95% of maximum dry density.

MSHA Sedimentation Ponds. MSHA requirements defined in 30 CFR 77.216 are not applicable at this mine since the existing sedimentation ponds do not impound water or sediment to an elevation of 20 feet or more above the upstream toe of the structure. The ponds also store a volume less than 20 acre-feet.

Other Sedimentation Ponds. All sedimentation ponds within the permit area have primary and emergency spillways that will, in combination, safely discharge a 25-year, 6-hour precipitation event.

Concrete Sediment Trap, Primary Sedimentation Pond and Overflow Pond. The 25-year, 6-hour storm event was routed through the concrete sediment trap and primary sedimentation pond to determine the adequacy of the existing spillways. The concrete sediment trap and sedimentation pond are hydraulically connected since overflow from the basin is discharged to the pond. The computer software SEDIMOT II, as described in Appendix 7-10, was used for the routing. SEDIMOT II assumes that the ponds are full of water up to the spillway elevation at the beginning of the storm event. The overflow pond was designed using HydroCAD version
TABLE 7-9
Summary of Diversion Ditches
- -

Diversion

-

Minimum

Minimum

Minimum

Side Slopes

Minimum

Min. Slope

Max.

Peak

Minimum

Existing diteh

Bottom

Top Width

Depth (ft.)

(H:V)

riprap D50

("!o)

Slope ("!o)

Flowl') (ets)

Free-board

geometry and

Width (ft.)

(ft.)

(ft.)

riprap OK?

1.0

2.2

0.4

1.5:1

0.36

yes

Lower East Side Road diversion draining CSE-1

Lower 1.0

Lower 2.2

Lower 0.5

through CSE-5 (lower and upper sections of ditch)

Upper 1.0

Upper 2.5

Upper 0.5

Upper East Side Road diversion draining CSE-5

(in.)
not required

16.0

38.0

0.09

Lower 1.2:1

Lower 2.0

Upper 3.0

Lower 24.0

0.79

Upper 1.5:1

Upper not

Lower 0.36

Lower yes

Upper 0.29

Upper yes

required
ubstation pad upper interception ditch draining CSE-

1.0

1.6

0.4

0.8:1

not required

1.0

18.0

0.07

0.33

yes

ubstation pad lower interception ditch draining CSE-

1.0

1.6

0.4

1:1

not required

1.0

10.0

0.03

0.35

yes

CSE continuance diversion

1.0

2.5

0.5

1.5:1

3.0

33.0

38.0

0.79

0.37

yes

Interception ditch draining ESC-6 north of ATOF

1.0

1.8

0.4

1:1

not required

1.0

1.0

0.13

0.30

yes

Interception ditch draining ESC-7 north of ATOF

1.0

2.2

0.4

1.5:1

not required

21.0

32.0

0.08

0.37

yes

Interception ditch draining MSH-2 north of ATOF

1.0

2.2

0.4

1.5:1

not required

1.0

20.0

0.08

0.32

yes

Interception ditch draining MSH-2A north of ATOF

1.0

2.2

0.4

1.5:1

not required

1.0

20.0

0.03

0.32

yes

Interception ditch draining DIS-1 A

1.0

2.0

.61

1.5:1

not required

1.0

1.0

0.06

0 ,30

yes

0.31

yes

1.0

2.2

0.4

1.5:1

1.0

21 .0

31.0

0.35Ib)

Main access road diversion ditch draining DWN-1

2.0

4.0

0.5

2:1

not required

1.0

3.0

0.85

0.30

yes

ink Canyon Substation No. 1 ditch draining LINK and

2.0

2.81

0.41

1:1

not required

1.0

9.82

0.87

0.30

yes

Parabolic

10.0

0.398

Parabolic

not required

1.0

2.0

0.89

0.30

yes

0.0

1.52

.51

Left 2:1

not required

1.0

6.7

0.20

0.30

yes

Sedimentation pond access road diversion ditch
draining DIS-3

ASCA-1 [Reclaimed in 2000]
Link Canyon Substation No.1 road swale draining
LINK, ASCA-1, and ASCA-3 [Reclaimed in 2000]

9.
::::

Linl.<'Canyon Substation No.2 ditch draining

()

.....

~

(,')

r.

"?-..J

Right 1:1

- Link No.2. ASCA-4. and ASCA-7
Link Canyon Portal Access Road Channel No. 1

0.0

0.97

0.48

1:1

not required

7.69

11·9

0.10Ib)

0.30

yes

Link Canyon Portal Pad Channel No.2

0.0

0.90

0.45

1:1

not required

5.21

8.3

0.06 Ib )

0.30

yes

West Overflow Pond Undisturbed Area Diversion

0.0

3.0

1.0

1.5:1

not required

0.97

.8

1.23(')

0.49

yes

Access and Maintenance Road Channel

0.0

2.7

0.9

1.5:1

not required

1.0

0.9

1.23(0)

0.49

yes

Fast o. P. Undisturbed Area Dvrsn Channel (shallow

0.0

3.9

1.30

1.5: 1

not required

1.0

0.9

3.13(0)

0.49

yes

East O.P. Undisturbed Area Dvrsn Channel (steep

0.0

2.7

0.9

1.5:1

9.0

0.24

0.25

3.13 (3 )

0.45

yes

Overflow Pond Inlet Swale

5.0

10.0

0.5

5:1

not required

0.025

0.025

6.26Ib)

0.24

yes

-

~

~

-'

::J

en
(al

Peak discharge resulting from the 10-year. 6-hour precipitation event.

(b)

Peak discharge resulting from the 25-year. 24-hour precipitation event.


## TABLE 7-10
Summary of Diversion Culverts

<table>
<thead>
<tr>
<th>Diversion Culvert</th>
<th>Diameter (in.)</th>
<th>Material</th>
<th>Inlet type</th>
<th>Min. Slope (%)</th>
<th>Outlet Slope (%)</th>
<th>Existing riprap D&lt;sub&gt;50&lt;/sub&gt; (in.)</th>
<th>Peak Flow&lt;sub&gt;(a)&lt;/sub&gt; (cfs)</th>
<th>Culvert inlet OK?</th>
<th>Existing riprap D&lt;sub&gt;50&lt;/sub&gt; OK?</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Spring Canyon bypass culvert at inlet</td>
<td>72</td>
<td>CMP</td>
<td>mitered</td>
<td>1.2</td>
<td>N/A</td>
<td>N/A</td>
<td>59.8</td>
<td>yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Bypass culvert for combined East Spring Canyon and Mud Spring Hollow flows</td>
<td>Upper 72</td>
<td>CMP</td>
<td>N/A</td>
<td>Upper 1.2</td>
<td>Upper N/A</td>
<td>Upper 97.7</td>
<td>Upper N/A</td>
<td>Upper</td>
<td>Upper</td>
</tr>
<tr>
<td></td>
<td>Lower 48</td>
<td></td>
<td></td>
<td>Lower 10.0</td>
<td>Lower</td>
<td>Lower 15.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mud Spring Hollow bypass - discharges to East Spring Canyon bypass</td>
<td>42</td>
<td>CMP</td>
<td>mitered</td>
<td>1.8</td>
<td>N/A</td>
<td>N/A</td>
<td>38.1</td>
<td>yes</td>
<td>N/A</td>
</tr>
<tr>
<td>East Spring Canyon bypass culvert emergency diversion at main mine fan</td>
<td>48</td>
<td>CMP</td>
<td>drop</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>59.8</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>CBE bypass at substation</td>
<td>18</td>
<td>CMP</td>
<td>mitered and drop</td>
<td>1.0</td>
<td>10.0</td>
<td>6.0</td>
<td>0.53</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Pipe No. 5 diversion draining DWN-1</td>
<td>18</td>
<td>CMP</td>
<td>mitered</td>
<td>1.0</td>
<td>N/A</td>
<td>N/A</td>
<td>2.4</td>
<td>yes</td>
<td>N/A</td>
</tr>
<tr>
<td>8-inch pipe diversion draining ESC-7</td>
<td>8</td>
<td>steel</td>
<td>mitered</td>
<td>1.0</td>
<td>N/A</td>
<td>N/A</td>
<td>0.24</td>
<td>yes</td>
<td>N/A</td>
</tr>
<tr>
<td>and discharges to 10 inch pipe draining ESC-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-inch pipe diversion draining ESC-6 and ESC-7, discharges to East Spring Canyon bypass</td>
<td>10</td>
<td>steel</td>
<td>mitered</td>
<td>1.0</td>
<td>N/A</td>
<td>N/A</td>
<td>3.19</td>
<td>yes</td>
<td>N/A</td>
</tr>
<tr>
<td>6-inch pipe diversion draining MSH-2A, discharges to East Spring Canyon bypass</td>
<td>6</td>
<td>steel</td>
<td>mitered</td>
<td>1.0</td>
<td>N/A</td>
<td>N/A</td>
<td>0.24</td>
<td>yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Link Canyon Portal bypass culverts</td>
<td>2-36</td>
<td>CMP</td>
<td>mitered</td>
<td>9.09</td>
<td>18.2</td>
<td>6.0</td>
<td>55.32&lt;sup&gt;(b)&lt;/sup&gt;</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Main mine fan diversion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-inch mine yard drainage, discharges to sediment trap</td>
<td>10</td>
<td>Steel</td>
<td>drop</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>6.26&lt;sup&gt;(b)&lt;/sup&gt;</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Sediment Trap Diversion Culvert</td>
<td>18</td>
<td>CMP</td>
<td>mitered</td>
<td>1.2</td>
<td>1.25</td>
<td>N/A</td>
<td>6.26&lt;sup&gt;(b)&lt;/sup&gt;</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Overflow Pond Bypass Culvert</td>
<td>66</td>
<td>CMP</td>
<td>mitered</td>
<td>2.8</td>
<td>3.0</td>
<td>12.0</td>
<td>622.37&lt;sup&gt;(c)&lt;/sup&gt;</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

<sup>(a)</sup> Peak discharge resulting from the 10-year, 6-hour precipitation event.<br>
<sup>(b)</sup> Peak discharge resulting from the 25-year, 24-hour precipitation event.<br>
<sup>(c)</sup> Peak discharge resulting from the 100-year, 6-hour precipitation event.
8.50 software to safely convey the 25-year, 6-hour storm event. HydroCAD assumes that the sediment trap and primary sedimentation pond are full of water up to the spillway at the beginning of the storm.

The stage-capacity data for the sediment trap, primary sedimentation pond, and overflow pond are presented in Tables 7-7, 7-8, and 7-8A. The spillway analysis for the primary sedimentation pond assumes that the primary spillway flowline is raised, per discussions above, to an elevation of 7418.15 feet. Stage-discharge data were computed for both the concrete sediment trap and the sedimentation pond and input directly into SEDIMOT II. The purpose of calculating the stage-discharge relationship in the sediment trap was that the spillway is not a typical design, and SEDIMOT II would not accommodate it directly. A stage-discharge curve was computed for the primary sedimentation pond to incorporate the discharge from both the primary and emergency spillways. The SEDIMOT II input and output for the sediment trap and primary sedimentation pond is contained in Appendix 7-14. The spillway analysis for the overflow pond utilized both HydroCAD version 8.50 and FlowMaster I. HydroCAD was used to calculate the flow rate, FlowMaster was used to calculate the flow velocity. For full calculations see Appendix 7-23.

From the final analysis of the 25-year, 6-hour storm event, the maximum inflow rate to the sediment trap from storm runoff is 2.0 cubic feet per second (cfs) and the maximum outflow rate from the basin is 2.1 cfs. The corresponding high water level in the sediment trap is 7440.0 feet, 1.6 feet below the top of the concrete structure. The maximum inflow rate to the primary sedimentation pond is 2.65 cfs and the maximum outflow rate is 2.2 cfs. The corresponding high water level is 7418.35 feet, 0.2 feet above the primary spillway flowline, and 1.65 feet below the minimum embankment elevation of 7420.0.

The maximum design inflow rate to the overflow pond is 6.31 cfs and the maximum design outflow rate is 6.31 cfs. The corresponding high water level is 7253.24, 0.74 feet above the primary spillway flowline, and 1.76 feet below the minimum embankment elevation of 7255.0.

Details for the concrete sediment trap spillway are presented in Appendix 7-8. Details for the primary and emergency spillways on the primary sedimentation pond can be found on Plate 7-5. Details for the overflow pond primary and emergency spillway can be found in Appendix 7-23 and on Plate 7-5A.
Waste Rock Disposal Site Sedimentation Pond. The sedimentation pond at the waste rock disposal site will adequately pass the 25-year, 6-hour precipitation event through the primary and emergency spillways. Details regarding the spillway design are located in the Waste Rock Volume of this M&RP.

Other Treatment Facilities. There are no other treatment facilities within the mine permit area.

Exemptions. Exemption areas are listed below (see Plate 5-2B):

- The south side of the original substation pad area above the office building. This area is classified as an "Exempt Area". The demonstration for this area is a SEDCAD computer program and is located in Appendix 7-16. The disturbed area is 0.040 acre.
- The spring collection field in Convulsion Canyon. This area is classified as an "Exempt Area". The demonstration for this area is a SEDCAD computer program and is located in Appendix 7-16. The area is fenced to prevent grazing. The disturbed area is 0.39 acre.
- The water tank area northeast of the mine site. This area is classified as an "Exempt Area". The demonstration for this area is a SEDCAD computer program and is located in Appendix 7-16. The disturbed area is 0.193 acre.

The total disturbed area contributing to the primary sedimentation pond is 15.88 acres. The total disturbed area contributing to the overflow pond is 16.49 acres. The total disturbed area contributing to the waste rock disposal site sedimentation pond is 7.93 acres. The total area for Small Area Exemption (SAE) is 0.623 acres. This is 2.1 percent of 30.454 acres of total disturbed area at the mine site, Link Canyon Portal and Substation No. 1 and No. 2 facility sites, and waste rock disposal site (including ASCA's and SAE's).
7.4.2.3 Diversions

General Requirements. The diversions within the permit area consist of drainage ditches and culverts. All diversions within the permit area have been designed to minimize adverse impacts to the hydrologic balance, to prevent material damage outside the permit area and to assure the safety of the public.

All diversions and diversion structures have been designed, located, constructed, maintained and used to:

- Be stable
- Provide protection against flooding and resultant damage to life and property
- Prevent, to the extent possible, additional contributions of suspended solids to stream flow outside the permit area
- Comply with all applicable local, state, and federal laws and regulations

All diversions within the permit area are temporary and will be removed when no longer needed. The diversions will be reclaimed in accordance with the reclamation plan defined in Chapter 5.

Peak discharge rates from the undisturbed and disturbed area drainages within the permit area were calculated for use in determining the adequacy of the existing diversion ditches and culverts. The storm runoff calculations for the temporary diversion structures were based on the 10-year, 6-hour precipitation event of 1.3 inches. Curve numbers were based on those defined in Appendix 7-9 and professional judgement. A description of the methods used to determine the peak discharge rates is presented in Appendix 7-10. The overflow pond bypass culvert was designed to safely convey the 100-year, 6-hour precipitation event of 2.06 inches. For more information of designs and calculations see Plates 7-5A, 7-5B, and 7-5C and Appendix 7-23. The sediment trap outfall culvert, primary sediment pond bypass, and overflow pond inlet swale were designed to safely convey the 24-year, 6-hour precipitation event of 1.55 inches. The remaining overflow pond diversion; overflow pond access road channel, west and east overflow pond undisturbed area diversion channels were designed to safely convey the 10-year, 6-hour event.

The disturbed and undisturbed drainage areas for the facilities area are presented on Plate 7-6. Those drainage areas too large to fit on Plate 7-6 can be found on Plate 7-8. A summary of watershed characteristics is presented in Table 7-6. The disturbed and undisturbed drainage areas
for the Link Canyon facilities area are presented on Plate 5-2D, E, & F. Link Canyon diversion calculations and designs are presented in Appendix 7-12.

The size and location of each existing diversion ditch and culvert were verified in the field. All diversions are located on Plates 7-6 and 5-2D, E, & F. The minimum capacity and freeboard of each diversion ditch was determined based on the minimum ditch slope, while the maximum velocity and minimum riprap protection was calculated based on the maximum ditch slope. The capacity of each culvert was determined using the minimum culvert slope, and the outlet velocity and riprap protection was verified using the culvert outlet slope. Slopes were measured either in the field or from a contour map with the scale of 1" = 50'. A description of the methods used to determine diversion capacities, flow velocities, and riprap sizes is presented in Appendix 7-10 and 7-23. All diversion calculations are presented in Appendices 7-12, 7-13, and 7-23.

**Diversion of Perennial and Intermittent Streams.** Flows from the two tributary streams are diverted under the fill area by two large corrugated metal pipes. Both diversions are temporary, and can adequately pass the peak flows from the 10-year, 6-hour precipitation event.

Mud Spring Hollow flows into a 42-inch diameter CMP. The mitered inlet structure is constructed of concrete and has a headwall of approximately 4 feet. It discharges directly into the 72-inch East Spring Bypass culvert. Based on the calculations presented in Appendix 7-11, the peak flow rate from watershed MSH-1 is 38.06 cfs. The minimum culvert slope is 1.8% which results in a maximum flow depth of 1.79 feet. The existing culvert is adequate in size.

The flows in East Spring Canyon are diverted by a 72-inch diameter CMP. This pipe is large enough to handle the flows from East Spring Canyon and Mud Spring Hollow. This CMP extends under the fill area and discharges downstream below the primary sedimentation pond. The size of the bypass narrows to a 48-inch diameter CMP down the steep fill slope.

The peak flow from East Spring Canyon is 59.6 cfs. The concrete inlet structure was evaluated according to methods described in Appendix 7-10. The inlet structure is adequate to pass the design storm event.
An emergency diversion was constructed at the main mine fan for the East Spring Canyon bypass culvert. This 3.5 foot square drop drain with oil skimmer cap connects into a 48-inch culvert directed into the East Spring Canyon bypass culvert. This serves as an overflow system when the trash rack at the inlet to East Spring Canyon becomes plugged with debris.

The combined peak flow from East Spring Canyon and Mud Spring Hollow for the 10-year, 6-hour precipitation event is 97.9 cfs. The capacity of the culvert was evaluated based on this flow rate and a minimum culvert slope of 1.2%. The resulting maximum flow depth of 2.6 feet indicates that the existing culvert is adequate. The capacity of the 48-inch culvert was also verified. The resulting maximum flow depth, corresponding to the minimum slope of 10%, is 1.75 feet. The 48-inch culvert is adequate to pass the design storm.

The discharge velocity from the 48-inch culvert was determined to verify the adequacy of the existing riprap \( (D_{50} = 15 \text{ inches}) \). The calculated outlet velocity, based on a culvert outlet slope of 10%, is 18.5 feet per second. Using methods defined in Appendix 7-10, the required average riprap size at the outlet is 15 inches. The existing riprap is acceptable.

Outfall from the 48-inch East Spring Canyon and Mud Spring Hollow culvert described above flow approximately 800 feet through the natural stream at the canyon bottom into a 66-inch smooth wall CMP culvert whose inlet will be installed immediately upstream from the overflow pond. The 66-inch smooth wall CMP culvert is designed to safely convey the peak flow from a 100-yr, 6-hr storm for East Spring Canyon, Mud Spring Hollow, overflow from the primary sedimentation pond, and undisturbed areas upstream from the overflow pond (DWN-2 and DWN-4). This culvert will discharge immediately below the overflow pond within the natural stream channel. For more information see Plates 7-4 and 7-5A and Appendix 7-23.

The primary sedimentation pond diversion culvert allows discharge from the sedimentation trap to bypass the primary sedimentation pond and flow directly into the overflow pond. This culvert is also designed to allow discharge from the primary sedimentation pond to flow directly into the overflow pond. Due to this culvert acting as a bypass for the primary sedimentation pond the 18-inch CMP sedimentation trap diversion has been designed to convey the 25-year, 6-hour precipitation event. For more information see Plates 7-4 and 7-5A and Appendix 7-23.
Diversion of Miscellaneous Flows. Diversion ditches and culverts have been utilized within the permit area to divert miscellaneous flows from disturbed and undisturbed area drainages.

Diversion Ditches. A summary table of the minimum channel geometry, channel slope, peak discharge, minimum riprap requirements, maximum flow velocity and minimum freeboard values for each diversion ditch within the facilities area is presented in Table 7-9. All calculations are contained in Appendix 7-12 and 7-23. Each ditch was verified in the field and has adequate capacity and erosion protection to pass the 10-year, 6-hour precipitation event. A description of the diversion ditches within the facilities area is presented below:

- Interception ditch along the East Side Road which drains the undisturbed watershed CBE-5. This diversion drains into the CBE bypass culvert at the substation.
- Interception ditch along the East Side Road which drains the undisturbed watersheds CBE-1 through CBE-5. This diversion drains into the CBE continuance diversion.
- Substation pad upper interception ditch which drains the undisturbed watershed CBE-4. This diversion drains into the CBE bypass culvert at the substation.
- Substation pad lower undisturbed interception ditch which drains the watershed CBE-3. This diversion drains into a drop drain for the CBE bypass culvert at the substation and is part of the alternate sediment control measures defined in Section 7.4.2.1.
- Riprap diversion channel for CBE continuance diversion. This diversion carries flows from the lower interception ditch along the East Side Road to an adjacent ephemeral drainage.
- Interception ditch for the undisturbed watershed ESC-6 north of the ATOF. This diversion discharges to the inlet of the 10-inch pipe diversion which connects into the 72-inch East Spring Canyon bypass system.
- Interception ditch for the undisturbed watershed ESC-7 north of the ATOF. This diversion drains to an 8-inch pipe that tees into the 10-inch pipe which drains ESC-6.
- Interception ditch for the undisturbed watershed MSH-2 north of the ATOF. This diversion drains to the inlet of the 42-inch Mud Spring Hollow bypass.
- Interception ditch for the undisturbed watershed MSH-2A north of the ATOF. This diversion drains to the 6-inch pipe diversion which connects into the 72-inch East Spring Canyon bypass system.

- Interception ditch draining watershed DIS-1A. This diversion drains to one of the drop drain inlets of the 10-inch mine yard drain line.

- Sedimentation pond access road diversion ditch. This diversion drains the disturbed watershed DIS-3 and discharges to the sedimentation pond.

- Main access road diversion ditch which drains undisturbed watershed DWN-1. This ditch drains to the pipe number 5 diversion.

- Link Canyon Substation No. 1 ditch which drains the watersheds LINK and ASCA-1. This diversion diverts the upper undisturbed drainage around the substation and drains to the Link Canyon Substation No. 1 road swale. This diversion ditch was reclaimed in 2000.

- Link Canyon Substation No. 1 road swale which drains watersheds LINK, ASCA-1, and ASCA-3. This diversion carries flows from the Link Canyon Substation No. 1 ditch across the substation access road to the main Link Canyon road drainage. This diversion was reclaimed in 2000.

- Link Canyon Substation No. 2 ditch which drains the watersheds LINK No.2, ASCA-4 and ASCA-7. This diversion diverts the upper undisturbed drainage around the substation and drains to the main Link Canyon road drainage.

- Link Canyon Portal access road Channel No. 1 diversion ditch. This diversion diverts the access road disturbed drainage and the undisturbed drainage above the road to the Link Canyon drainage bypass culvert inlet.

- Link Canyon Portal Pad Channel No. 2 diversion ditch. This diversion diverts the pad area disturbed drainage and the undisturbed drainage above the pad to the Link Canyon drainage bypass culvert inlet.

- The west overflow pond undisturbed area diversion channel. This channel diverts runoff from the undisturbed area immediately west of the overflow pond and conveys the runoff south to the overflow pond access road channel.

- The overflow pond access road channel. This channel diverts runoff from the undisturbed area immediately west of the overflow pond access road and runoff from the west overflow pond channel south along the west side of this road to a swale and across U.S.F.S road.
The east overflow pond undisturbed area diversion channel (shallow section). This channel diverts runoff from the undisturbed area immediately east of the overflow pond and conveys the runoff south to the face of the overflow pond impound.

The east overflow pond undisturbed area diversion channel (steep section). This channel collects runoff from the east overflow pond channel shallow section and diverts it down the impoundment face into the existing natural stream channel at the bottom of east spring canyon.

The overflow pond inlet swale. This swale conveys outfall from gate box #2 south to the overflow pond. This swale will be designed to allow track hoes and bull dozers to drive across it for maintenance purposes.

A description of the diversion ditches within the waste rock disposal site can be found in the Waste Rock Volume of this M&RP.

**Diversion Culverts.** A summary table of the culvert size, slope, peak discharge, existing riprap at outlet, and outlet flow velocity for each culvert within the facilities area is presented in Table 7-10. All calculations are contained in Appendix 7-13. Each culvert has adequate capacity and outlet erosion protection to pass the 10-year, 6-hour precipitation event. The primary sediment diversion culvert allows discharge from the sedimentation trap to bypass the primary sedimentation pond. Therefore this culvert must have adequate capacity to safely pass the peak flow resulting from the 25-year, 6-hour precipitation event. To ensure that the overflow pond embankment remains stable during 100-year, 6-hour storm, the overflow pond bypass culvert was designed to have adequate capacity and erosion protection to pass the 100-year, 6-hour precipitation. A description of the diversion culverts within the facilities area is presented below:

- **East Spring Canyon bypass culvert.** This culvert drains the undisturbed watersheds ESC-1 through ESC-5 and extends under the fill area and discharges downstream below the primary sedimentation pond.

- **Mud Spring Hollow bypass culvert.** This culvert drains the undisturbed watershed MSH-1 and connects into the 72-inch East Spring Canyon bypass culvert system.

- **CBE bypass culvert at the substation.** This culvert drains the undisturbed watersheds CBE-2 through CBE-5 and discharges to the lower East Side Road.
interception ditch. Three drop drains direct the flows to the bypass culvert. The drop drains help reduce the time the runoff water will be on the pad area to reduce the chance of water migrating through the substation pad fill and lubricating the substation slide slip zone.

- Pipe No. 5 diversion culvert which drains the undisturbed area DWN-1. This culvert discharges below the sedimentation pond access road to the natural slope. It does not drain to the pond.
- 10-inch pipe diversion for undisturbed watersheds ESC-6 and ESC-7. This pipe connects into the 72-inch East Spring Canyon bypass system.
- 8-inch pipe diversion for undisturbed watershed ESC-7. This pipe connects to the 10-inch pipe that drains undisturbed watershed ESC-6.
- 6-inch pipe diversion for undisturbed watershed MSH-2A. This pipe connects into the 72-inch East Spring Canyon bypass system.
- Main Mine Fan Diversion. The main mine fan is located in a depression which is nine feet below the adjacent mine yard drainage system. A sump pump with automatic float controls in front of the main fan will pump the runoff from this area into the 10-inch mine yard drain line.
- 10-inch mine yard drainage system. This drainage system was installed to handle normal surface flows in the mine yard and to reduce the occurrence of mud and erosion. The drainage system consists of drop inlets and a 10-inch pipeline discharging to the concrete sediment trap. It was not designed to pass the 10-year, 6-hour precipitation event. Instead, the surface area of the mine yard is graded to divert all runoff to the concrete sediment trap.
- The sediment trap diversion culvert allows the sedimentation pond to drain for sediment removal. This culvert discharges to the overflow pond.
- The 66-inch overflow pond bypass culvert allows watersheds DWN-1, DWN-2, DWN-3, MSH-1, MSH-2, and ESC-1 through ESC-7 to bypass the overflow pond. This culvert discharges immediately downstream of the overflow pond.

A description of all diversion culverts within the waste rock disposal site can be found in the Waste Rock Volume of this M&RP.
7.4.2.4 Road Drainage

All Roads. The existing roads within the facilities area are the mine access road, the primary sedimentation pond access road, the east side road, and overflow pond access road. The existing road within the Link Canyon facilities area is the substation access road. All of the roads have been constructed to include adequate drainage control with the use of diversion ditches, culverts, and containment berms. None of the roads are located in the channel of an intermittent or perennial stream. All roads have been located to minimize downstream sedimentation and flooding. Diversion ditches and culverts for all roads are described in Section 7.4.2.3 above.

Primary Roads. The mine access road is the only primary road within the permit area. The mine access is located, where practical, to minimize erosion. The access road does not ford any stream channels.

The drainage control system for the mine access road includes a diversion ditch, culvert, and berm. The diversions will adequately pass the peak runoff from the 10-year, 6-hour precipitation event. Drainage details for the access road are presented in Section 7.4.2.3 above.

The culvert draining the undisturbed area DWN-1 adjacent to the mine access road is identified as pipe no. 5. It is constructed with an mitered inlet with a trash rack to avoid plugging. The outlet of the culvert, located below the primary sedimentation pond access road, is adequately lined with riprap to prevent erosion. Refer to Section 7.4.2.3 for additional drainage details. The diversion ditch and culvert will be maintained and operated as described in Section 7.3.2.3. No natural stream channels were relocated for the construction of the mine access road.

7.4.3 Impoundments

The existing impoundments within the permit area consist of the four structures constructed for sediment control purposes. These structures are:

- The concrete sediment trap located near the southern end of the mine yard.
- The primary sedimentation pond located immediately below the fill on which the existing mine facilities are constructed.
- The overflow pond located approximately 800 feet below the primary sedimentation pond.
- The sedimentation pond located at the waste rock disposal site.
All pertinent information regarding these sedimentation ponds is presented in Sections 7.3.2.2 and 7.4.2.2.

### 7.4.4 Discharge Structures

The discharge structures within the permit area consist of the primary and emergency spillways on each sedimentation pond. The spillways on all sedimentation ponds within the permit area will adequately pass the peak discharge from the 25-year, 6-hour precipitation event. Detailed information for each sedimentation pond is presented in Sections 7.3.2.2 and 7.4.2.2.

The spillway of the concrete sediment trap consists of an overflow weir which discharges to a 24-inch CMP culvert. The culvert drains into canal box #1. From this canal box it drains either into a 24-inch culvert, then directly into the primary sediment pond, or into the 18-inch primary sediment pond bypass. Specific construction details of the spillway system for the sediment trap are presented in Plates 7-4 and 7-5A and Appendix 7-8 and 7-23.

The primary spillway on the primary sedimentation pond consists of a 12-inch steel riser with a covered oil-skimmer. The primary spillway discharges directly to the 18-inch primary sediment pond bypass culvert. The emergency spillway is a trapezoidal open channel lined with riprap. The bottom width is 14 feet with side slopes of 2:1 (horizontal:vertical). This spillway discharges to the downstream natural drainage system. The design calculations for the spillways are presented in Appendix 7-14 and 7-23. The details for each spillway are presented on Plate 7-5.

The primary spillway on the overflow pond consists of a 24-inch steel riser with an oil-skimmer. The primary spillway discharges directly to the riprap lined emergency spillway channel below the pond. The emergency spillway is a trapezoidal open channel lined with riprap. The top section of the spillway has a bottom width of 1 feet with side slopes of 12H:1V to allow vehicles to be driven across the spillway for maintenance access. The sloped section of the spillway, or bottom section, slopes down the face of the impoundment at 3H:1V with a 1 foot wide bottom. The emergency spillways discharge to the downstream natural drainage system. The primary spillway discharges through a flume to measure flow and then enters the natural drainage system. The details for each spillway are presented on Plate 7-5A.
Details for the discharge structures on the waste rock disposal site sedimentation pond are presented in the Waste Rock Volume of this M&RP.

7.4.4.1 Erosion Protection

Each discharge structure was evaluated to determine the adequacy of the existing riprap, and capacity of the structure during the 25-year, 6-hour precipitation event. The calculations for the discharge structures within the facilities area are presented in Appendix 7-14.

The discharge structure on the overflow pond was evaluated to determine the size of the riprap, and capacity of the structure during the 25-year, 6-hour precipitation event. The calculation for the discharge structures within the overflow pond are presented in Appendix 7-23.

The 24-inch CMP from the concrete sediment trap discharges to the primary sedimentation pond. The outlet slope, measured in the field, is 53%. The peak discharge from the sediment trap is 2.1 cubic feet per second. Using methods discussed in Appendix 7-10, the flow velocity at the culvert outlet is 11.8 feet per second. The flow depth at the outlet is 0.21 feet.

The erosion protection at the culvert outlet consists of one large boulder, 6 to 8 feet in diameter, located approximately 10 feet below the outlet. In addition, riprap with the average size of 14 inches is located at the immediate vicinity of the outlet. Based on methods defined in Appendix 7-10 and an outlet velocity of 11.8 feet per second, an average riprap size of 15 inches is required at the outlet. Therefore, the combination 14-inch riprap and 6-foot boulder erosion protection at the culvert outlet is adequate.

The 12-inch primary spillway on the primary sedimentation pond discharges to 18-inch primary sediment pond bypass. The emergency spillway channel has a bottom width of 14 feet, side slopes of 2H:1V, and an average riprap size of 15 inches.

The adequacy of the existing riprap was initially evaluated assuming the peak discharge of 2.2 cfs flows exclusively down the emergency spillway. In this case, assuming a maximum channel slope of 71%, the maximum flow velocity is 3.7 feet per second. This is considered non-erosional. Finally, the riprap was evaluated assuming the peak discharge flows exclusively through the 12-inch primary spillway. In this case, assuming an outlet slope of 35%, the maximum flow velocity is 11.1 feet per second at the culvert outlet. Using methods defined in Appendix 7-10, the required
average riprap size to provide adequate protection is 12 inches. Therefore, the existing 15-inch riprap is acceptable.

The 18-inch primary spillway on the overflow pond discharges into a flume to measure the outlet flow. From the flume discharge enters the historic natural drainage path. The top or upper emergency spillway channel has a bottom width of 1 feet, side slopes of 12H:1V and an average riprap size of 2-inches. The bottom section, which slopes down the face of the impoundment, has a 1 foot wide bottom, with 2H:1V side slopes and slopes down the impoundment at a 3H:1V.

Assuming a maximum channel slope of 33.3%, the maximum flow velocity for the emergency spillway is 5.53 feet per second. The riprap was evaluated assuming the peak discharge flows exclusively through the 18-inch primary spillway. In this case, assuming an outlet slope of 5.88%, the maximum flow velocity is 4.35 feet per second at the culvert outlet. Using methods defined in Appendix 7-10; the required average riprap size to provide adequate protection for the channel above the primary spillway outfall is 2-inches, and the required average riprap size to provide adequate protection for the channel below the primary spillway outfall is 2-inches.

The riprap design for the discharge structures on the waste rock disposal site sedimentation pond is presented in the Waste Rock Volume of this M&RP.

7.4.4.2 Design Standards
All discharge structures within the permit area were designed and constructed according to standard engineering design procedures.

7.4.5 Disposal of Excess Spoil
There is no excess spoil within the permit area.

7.4.6 Coal Mine Waste

7.4.6.1 General Requirements
All coal mine waste is contained within the waste rock disposal site. All coal mine waste will be placed in a controlled manner to minimize adverse effects of leachate and surface water runoff on surface and groundwater quality and quantity. A description of the methods of placement can be found in the Waste Rock Volume.
7.4.6.2 Refuse Piles
A detailed description of the refuse piles at the waste rock disposal site can be found in Chapter 5 and the Waste Rock Volume of this M&RP.

Based on the size, configuration, and open graded structure of the waste rock fill and its location at the site, no underdrains or rock core chimney drains were required. There are no springs or seeps within the fill area which require special treatment.

All surface precipitation falling on the fill is channeled to the sedimentation pond located down gradient from the toe of the disposal area fill. All surface drainage from the areas above the site is diverted around the disposal area using diversion ditches. Surface drainage from the county road above the site is controlled by a shoulder ditch and diverted away from the fill area. All diversions are lined with either riprap, concrete, or vegetation to minimize surface erosion at the site.

No permanent impoundments will exist on the completed refuse pile.

7.4.6.3 Impounding Structures
There are no impounding structures within the permit area that are constructed of coal mine waste or are used to impound coal mine waste.

7.4.6.4 Return of Coal Processing Waste to Abandoned Underground Workings
Coal processing waste is not returned to abandoned underground workings at this facility.

7.4.7 Disposal of Noncoal Mine Waste
Disposal of noncoal mine waste is discussed in Chapter 5.

7.4.8 Casing and Sealing of Wells
Each water well has been cased, sealed, or otherwise managed, as approved by the UDOGM, to prevent acid or other toxic drainage from entering ground or surface water, to minimize disturbance to the hydrologic balance, and to ensure the safety of people, livestock, fish and wildlife, and machinery in the permit and adjacent area. The drill logs and completion diagrams for the water wells are contained in Appendix 6-1 and 7-25 for the Northwater well(s).
If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the UDOGM.

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

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

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

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

7.5.2.2 Road Drainage
All roads will be located, designed, constructed, reconstructed, used, maintained and reclaimed according to plans and designs presented in Sections 7.3.2.4, 7.4.2.4, and 7.6.2. All roads have been designed to:

- Control or prevent erosion, siltation and the air pollution attendant to erosion by vegetating or otherwise stabilizing all exposed surfaces in accordance with current, prudent engineering practices;
- Control or prevent additional contributions of suspended solids to stream flow or runoff outside the permit area;
- Neither cause nor contribute to, directly or indirectly, the violation of effluent standards given under Section 7.5.1.
- Minimize the diminution to or degradation of the quality or quantity of surface- and ground-water systems;
Refrain from significantly altering the normal flow of water in streambeds or drainage channels.

7.5.3 Impoundments and Discharge Structures
Impoundments and discharge structures will be located, maintained, constructed and reclaimed as described in Sections 7.3.3, 7.3.4, 7.4.3, 7.4.5, and 7.6.0.

7.5.4 Disposal of Excess Spoil, Coal Mine Waste and Noncoal Mine Waste
Disposal areas for coal mine waste and noncoal mine waste will be located, maintained, constructed and reclaimed as described in Sections 7.3.6, 7.3.7, 7.4.6, 7.4.7, 7.6.0 and Chapter 5.

7.5.5 Casing and Sealing of Wells
All wells will be managed as described in Sections 7.4.8 and 7.6.5. Water monitoring wells will be managed on a temporary basis as described in Section 7.3.8.

7.6 Reclamation

7.6.1 General Requirements
A detailed reclamation plan for the mine is presented in Section 5.40. In general, SUFCO will ensure that all temporary structures are removed and reclaimed. SUFCO plans to remove all culverts within the surface facility area during final reclamation. Permanent diversions will be maintained properly and will meet the requirements of the approved reclamation plan for permanent structures and impoundments. SUFCO will renovate the diversion structures if necessary to meet the requirements of R645-301 and R645-302 and to conform to the approved reclamation plan.

7.6.2 Roads
A road not to be retained for use under an approved postmining land use will be reclaimed immediately after it is no longer needed for coal mining and reclamation operations.

7.6.2.1 Restoring the Natural Drainage Patterns
All natural drainage patterns will be restored.
7.6.2.2 Reshaping Cut and Fill Slopes
All cut and fill slopes will be reshaped to be compatible with the postmining land use and to complement the drainage pattern of the surrounding terrain.

7.6.3 Siltation Structures

7.6.3.1 Maintenance of Siltation Structures
All siltation structures will be maintained until removed in accordance with the approved reclamation plan.

7.6.3.2 Removal of Siltation Structures
When the siltation structure is removed, the land on which the siltation structure was located will be regraded and revegetated in accordance with the reclamation plan presented in Section 5.40. Because of the narrow confines of East Spring Canyon it is not practical to remove the mine fill area and restore the area to approximate original contour without removing the sediment pond at the base of the fill. Interim sediment control measures as discussed in Section 5.40 will be implemented during the reclamation stage.

7.6.4 Structure Removal
A timetable for the removal of each structure is presented in Figure 5-2.

7.6.5 Permanent Casing and Sealing of Wells
When no longer needed for monitoring or other use approved by the UDOGM upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the UDOGM. Wells will be sealed and backfilled by placing a concrete plug from TD to surface. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.
REFERENCES:


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


FIGURE 7-1  UPPER PRICE RIVER FORMATION HYDROGRAPHS.
FIGURE 7-2. CASTLEGATE SANDSTONE HYDROGRAPHS.
FIGURE 7-3. BLACKHAWK FORMATION HYDROGRAPHS.
FIGURE 7-4. SURFACE DRAINAGE PATTERNS.
FIGURE 7-5. STREAMFLOW PROBABILITY OF SELECTED STREAMS.
ABANDONED LONGWALL CONVEYOR TAIL DRIVE AND PANLINE LOCATIONS
Figure 7-9 Monitoring stations in the South Fork of Quitchupah Creek area.
CHAPTER 8

BONDING AND INSURANCE
# TABLE OF CONTENTS (December 20, 1991)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.10 Bonding Definitions and Division Responsibilities</td>
<td>8-1</td>
</tr>
<tr>
<td>8.20 Requirement to File a Bond</td>
<td>8-2</td>
</tr>
<tr>
<td>8.30 Determination of Bond Amount</td>
<td>8-3</td>
</tr>
<tr>
<td>8.40 General Terms and Conditions of the Bond</td>
<td>8-4</td>
</tr>
<tr>
<td>8.50 Bonding Requirements for Underground Coal Mining and Reclamation Activities and Associated Coal-Related Surface Facilities and Structures</td>
<td>8-5</td>
</tr>
<tr>
<td>8.60 Forms of Bonds</td>
<td>8-6</td>
</tr>
<tr>
<td>8.70 Replacement of Bonds</td>
<td>8-7</td>
</tr>
<tr>
<td>8.80 Requirements to Release Performance Bonds</td>
<td>8-8</td>
</tr>
<tr>
<td>8.90 Terms and Conditions for Liability Insurance</td>
<td>8-9</td>
</tr>
</tbody>
</table>

# LIST OF APPENDICES

(Appendices appear in Volume 9)

Appendix

8-1 Certificates of Insurance (Historic)
CHAPTER 8
BONDING AND INSURANCE

8.10 Bonding Definitions and Division Responsibilities

This chapter provides information regarding the bonding for coal mining and reclamation operations at the SUFCO Mine. The applicant has on file with the UDOGM a bond or bonds made payable to the UDOGM for performance of all the requirements of the State Program.
8.20 Requirement to File a Bond

The area covered by the bond is outlined on Plate 5-2A,B,C,&D and in Volume 3 of this M&RP which includes all disturbed areas. The disturbed areas and specific acres to be reclaimed are listed in Section 1.1.6. The performance bond period is for the duration of the coal mining and reclamation operations including the extended period designated by the UDGOM. The bond is in the form of a surety bond and is described in Section 8.60.
8.30 Determination of Bond Amount

The present bond should be sufficient to assure the completion of the reclamation plan. The estimated cost to reclaim the SUFCO Mine surface facilities is provided in Appendix 5-9, Volume 6. However, if an adjustment in the bond coverage is necessary, the amount will be increased/decreased per the UDOGM's requirements.
8.40 General Terms and Conditions of the Bond

The performance bond is in the amount determined by the UDOGM as described in Section 8.30 and payable to the UDOGM. In the event the surety company becomes insolvent, the UDOGM will be notified by the permittee. The surety company and permittee will notify the UDOGM of any changes in the bonding terms for Canyon Fuel Company LLC, SUFCO Mine. Duration of the bond is described in Section 8.20.
8.50 Bonding Requirements for Underground Coal Mining and Reclamation Activities and Associated Coal-Related Surface Facilities and Structures

The applicant qualifies for a long-term period of liability and therefore will comply with the stipulation that the bond coverage be extended 30 days prior to the expiration of the bond term. A performance bond for a new term will be submitted to the UDOGM 30 days prior to expiration of coverage.
8.60 Forms of Bonds

The surety bond for the applicant has been executed per the documentation within the reclamation agreement. The surety bond will be noncancellable during its term except with the prior consent of the Division of Oil, Gas and Mining (UDOGM).

Greens Hollow Lease

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

SUFCO Mine does not currently plan to replace the bond for the permit area. However, should a replacement bond be required, the replacement bond will be submitted to and approved by the UDOGM prior to the cancellation of the original bond.
8.80 Requirements to Release Performance Bonds

The applicant will comply with the requirements described in Section R645-301-880 of the UDOGM regulations when applying for the release of performance bonds.
8.90 Terms and Conditions for Liability Insurance

Certificates of Insurance issued to Canyon Fuel Company LLC, SUFCO Mine are submitted to the Division upon renewal. The policy provides for personal injury and property damage protection concurrent with the amounts designated in R645-301-890.100. Said Certificates of Insurance are applicable to coal mining and reclamation operations as proposed in the SUFCO Mine M&RP.

The insurance policy will be maintained in full force during the life of the permit including the liability period necessary to complete all reclamation operations. The policy will include a rider stating that the UDOGM be notified of any changes in the policy including termination or failure to renew.
CHAPTER 9
ALLUVIAL VALLEY FLOOR
TABLE OF CONTENTS (December 20, 1991)

Section........................................................................................................................................ Page

3.20 Alluvial Valley Floors ........................................................................................................... 9-1
  3.2.1 Alluvial Valley Floor Determination .................................................................................. 9-1
    3.2.1.2 Studies Performed During Investigation .................................................................. 9-1
    3.2.1.3 Determination of Alluvial Valley Floor Existence .................................................. 9-2
  3.2.2 Operations Affecting Designated Alluvial Valley Floor .................................................. 9-7

LIST OF PLATES

Plate

9-1 Alluvial Valley Floor Characteristics Determination

LIST OF APPENDICES

(Appendices appear in Volume 9)

Appendix

9-1 Environmental Assessment for Quitchupah Lease
CHAPTER 9
ALLUVIAL VALLEY FLOORS

3.20 Alluvial Valley Floors
All coal mining operations must provide to the UDOGM a determination that the regulations of R645-302-320 do not apply.

3.2.1 Alluvial Valley Floor Determination
This Alluvial Valley Floor (AVF) determination includes field investigations of geologic, hydrologic, land use, soils, and vegetation for all areas where the mine permit or adjacent areas have a valley holding a stream.

3.2.1.2 Studies Performed During Investigation
The studies for AVF determination may include:
- Mapping of unconsolidated stream-laid deposits of areas holding streams, including but not limited to geologic maps of unconsolidated deposits and stream-laid deposits, maps of streams, delineation of surface watersheds and directions of shallow groundwater, topography showing local and regional terrace levels, and topography of terraces, flood plains, and channels showing surface drainage patterns;
- Mapping of all lands included in the permit and adjacent area subject to agricultural activities, showing the areas of different types of agricultural lands, such as flood irrigated lands, pasture lands, and undeveloped rangelands. Also, the productivity measurements for each vegetative type should be included;
- Mapping of all lands that currently are or were historically flood irrigated, showing the location of each diversion structure, ditch, dam, and related reservoir, irrigated land, and topography of those lands;
- Identification of areas which are or are not subirrigated, based on groundwater monitoring data, representative water quality, soil moisture measurements, and measurements of rooting depth, soil mottling, and water requirements of vegetation;
Identification of areas which are or are not flood irrigable, based on stream flow, water quality, water yield, soils measurements, and topographic characteristics; and

Analysis of a series of aerial photographs, including color infrared imagery flown at a time of year to show any late summer and fall differences between upland and valley floor vegetative growth.

Greens Hollow Lease

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

3.2.1.3 Determination of Alluvial Valley Floor Existence

Based on these studies, the UDOGM will determine that an AVF exists if it finds that:

- Unconsolidated stream laid deposits holding streams are present; and,

- There is sufficient water to support agricultural activities as evidenced by:
  - The existence of flood irrigation in the area in question or its historical use;
  - The capability of an area to be flood irrigated, based on stream flow water yield, soils, water quality, and topography; or,
  - Subirrigation of the lands in question, derived from the groundwater system of the valley floor.

As shown on Plate 9-1, the mine permit area consists of plateaus and deep canyons. Evaluation of the mine permit area and UDOGM rules for AVF's show:

1. Unconsolidated stream laid deposits holding streams are present in the following drainages:
Mine Permit Area, Mine Plan Area and Affected Area (see Plate 9-1)

A. North Fork Quitchupah Creek. This drainage is deep and very steep and is narrow at the bottom. Stream laid deposits are present only in small, discontinuous narrow patches. Bedrock is exposed in much of the canyon bottom and the stream cascades over exposed bedrock outcrops.

B. East Spring Canyon. Characteristics of unconsolidated alluvium are the same as in North Fork Quitchupah Canyon.

C. Duncan Draw. This drainage within the permit boundary is narrow and steep with a few small (less than 1 acre) patches of alluvium present. Bedrock is exposed in much of the drainage.

D. Unnamed tributary to Duncan Draw. (T21S, R5E, Section 31E1½). This drainage is steep, but contains narrow patches of unconsolidated alluvium. This drainage has not been investigated in detail, but areas underlain by unconsolidated alluvium are estimated to aggregate a few acres in size.

E. Unnamed tributaries to East Spring Canyon. These small drainages are east of Section 1, R4E, T22S, and are tributaries to East Spring Canyon (Plate 9-1). These drainages are narrow and steep, but have a few scattered patches of unconsolidated alluvium. No detailed investigation of these drainages has been made, but areas underlain by unconsolidated alluvium are estimated to aggregate only a few acres in size.

F. North Fork Quitchupah Creek downstream from mine permit area. While the canyon is steep and narrow, there are unconsolidated alluvial deposits toward the lower end. Similarly, in the adjacent area at the upper end of North Fork
Quitchupah Canyon and its South Fork tributary are small narrow areas underlain by consolidated alluvium. None of these deposits have been mapped in detail.

G. **Duncan Draw and Mud Springs Hollow.** The segments of Duncan Draw and Mud Spring Hollow in the adjacent area contain some small areas underlain by unconsolidated alluvium. Both these canyons are narrow and steep, and probably there are no areas in the canyon where unconsolidated alluvium underlies more than 10 acres.

H. **Convulsion Canyon and Quitchupah Creek.** These drainages contain narrow deposits of unconsolidated alluvium. The canyon bottoms are narrow, but alluvium may be as much as 75 feet thick. Streams are deeply incised into the alluvium creating steep banks with a narrow stream channel in the bottoms. These unconsolidated deposits have not been mapped in detail.

I. **Muddy Creek Canyon.** The portion of the Muddy Creek Canyon that is within and adjacent to the Pines Tract is relatively narrow with unconsolidated alluvium. Alluvium in the bottom of the narrow canyon varies in depth from 0 to more than 50 feet thick. Side drainages are deeply incised into the alluvium creating steep banks with narrow stream channel bottoms. These unconsolidated deposits have not been mapped in detail. A few miles downstream of the Pines Tract the alluvial deposits have been irrigated and cultivated in the past.

J. **Box Canyon.** The drainages associated with Box Canyon have a relatively steep gradient and contain limited very narrow deposits of unconsolidated alluvium. The canyon bottoms are narrow and alluvium is typically less than 15 feet thick. Much of the floor of the channel rests directly on bedrock. These unconsolidated deposits have not been mapped in detail.
K. **Canyons of Greens Hollow Tract.** The drainages have a relatively steep gradient and contain limited very narrow deposits of unconsolidated alluvium. The canyon bottoms are narrow and alluvium is shallow. Much of the floor of the channel rests directly on bedrock. These unconsolidated deposits have not been mapped in detail. Refer to the Geologic Fence Diagram in Appendix 6-4.

2. There is no flood irrigation in the mine plan area or the adjacent area and no evidence of historical use of flood irrigation.

3. Flood irrigation may be possible on a few small patches of alluvium in drainages in the mine permit area. Mud Springs Hollow, Duncan Draw, and the uppermost segment of East Spring Canyon all have small areas underlain by alluvium that could be flood irrigated. Due to small size, steepness, water availability, land ownership, and short growing season, these areas are not practical for flood irrigation. In this region, flood irrigation is not practiced in such high mountain drainages.

4. In the adjacent area, flood irrigation may be possible in a few locations. This includes:

   A. **North Fork Quitchupah Creek and Quitchupah Creek.** In the lower segments of these drainages are narrow alluvial deposits. Due to their small size, steepness, deeply incised streams and rough terrain, flood irrigation is not feasible. Regionally, relatively flat, wide drainage bottoms are flood irrigated. Alluvium in drainages with characteristics similar to Quitchupah Creek and its North Fork, however, are not flood irrigated.

   B. **Duncan Draw, Mud Spring Hollow and small tributaries of the upper segment of North Fork Quitchupah Creek and its South Fork.** These drainages may have small areas capable of flood irrigation. Due to small size, steepness, land ownership, and short growing season, these areas are not practical for flood irrigation. In this region, flood irrigation is not practiced in such high mountain drainages.
C. **Muddy Creek Canyon.** This drainage may have small areas capable of flood irrigation. These areas are located at least 1 mile downstream of the Pines Tract. Due to the limited areal extent, limited access, steepness, land ownership, short growing season, and difficulty in maintaining a diversion, these areas would not be practical for flood irrigation.

5. Subirrigated lands are present in both the mine permit and adjacent areas where agriculturally useful vegetation is dependent on moisture supplied by groundwater or frequent flood flows. In the mine permit area, small areas (less than 2 acres) are present along Duncan Draw and the uppermost end of East Spring Canyon. Limited subirrigated lands are also present in Box Canyon and its tributaries. There are small, narrow areas where riparian vegetation is present along stream banks that are subirrigated.

In the adjacent area, small areas of subirrigated rangeland are present. The upper segment of Duncan Draw, Mud Spring Hollow, Convulsion Canyon, and North Fork Quitchupah Creek and its South Fork, and portions of Muddy Creek contain small subirrigated areas. Narrow strips of riparian vegetation present along stream banks are subirrigated.

**General Area**
A potential AVF exists along portions of Quitchupah Creek from the adjacent area boundary downstream to the general area boundary. This area has not been investigated in detail; however, flood irrigation is practiced on approximately 110 acres and an additional 25 acres may have been irrigated in the past (Plate 9-1). Quitchupah Creek in this segment is deeply incised into the alluvium creating steep banks with a narrow stream channel. Thickness of the alluvium is unknown, but probably is greater than 50 feet.
3.2.2 Operations Affecting Designated Alluvial Valley Floor

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

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

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

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

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