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COPY

Canyon Fuel Company, LLC
Skyline Mines
HC 35 Box 380
Helper, Utah 84526
(435) 448-6463 Fax: (435) 448-2632

July 1, 2004

Coal Regulatory Program
Attn.: Pam Grubaugh-Littig
Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Box 145801
Salt Lake City, Utah 84114-5801

Incoming
C/007/0005 OR
Task ID#1976

RE: Modification to Allow for Subsidence Mining in the North Lease Extension, Skyline Mine, Canyon Fuel Company, LLC, Permit # C/007/005

Dear Ms. Grubaugh-Littig:

Please find enclosed with this letter are modifications to the Skyline Mine M&RP to allow for the subsidence mining of the North Lease extension to the mine. Included are seven clean copies and four redline/strike through copies of the modified text. Singed and notarized copies of the C1 form are also included.

Please be aware that as your staff reviews the redline/strikethrough text, the pagination may or may not match the actual pagination of the M&RP. Also, please note that clean copies of pages have been included where, perhaps, there have been no changes to the words in the text. This is necessary since adding text to one page may force original text onto the following pages. Finally, most of the existing permit maps already include water and subsidence monitoring sites related to subsidence of the North Lease. Therefore, no changes have been proposed to these maps and drawings and no new copies are included.

We appreciate your attention to this permit modification. Though the mine has been temporarily idled, approval of this modification to the permit will be needed to extract coal once the mine reopens. If you have any questions, please give me call at (435) 448-2669.

Sincerely,

Chris D. Hansen

Chris D. Hansen
Environmental Coordinator
Canyon Fuel Company, LLC.

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For additional information

APPLICAT N FOR COAL PERMIT PROCESS G

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

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: North Lease Subsidence Submittal
Description, Include reason for application and timing required to implement:
Modification to the M&RP to include subsidence mining on the North Lease

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

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

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

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

DANIEL R MEADORS
Print Name

Mine Manager 6-23-04
Sign Name, Position, Date

Subscribed and sworn to before me this 23 day of JUNE, 2004

Vicky Sue Miller
Notary Public

My commission Expires: 1-5, 2008

Attest: State of UTAH } ss:
County of CARBON

VICKY SUE MILLER
NOTARY PUBLIC • STATE of UTAH
1776 KENILWORTH RD.
HELPER, UTAH 84526
COMM. EXPIRES 1-5-2008

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Form DOGM- C1 (Revised March 12, 2002)

APPLICATIC FOR COAL PERMIT PROCF ING

Detailed Schedule Of Changes to the Mining And Reclamation Plan

COPY

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine
Permit Number: C/007/005
Title: North Lease Subsidence Submittal

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

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Replace M&RP Table of Contents pages xxvi through xxviii
☒ Add	☒ Replace	☐ Remove	Replace Table of Content Page in Appendix Volume A-1
☐ Add	☒ Replace	☐ Remove	Replace Table of Content Page in Appendix Volume A-3
☐ Add	☒ Replace	☐ Remove	Replace Table of Content Page in Appendix Volume A-3
☐ Add	☒ Replace	☐ Remove	Replace pages 2-40 through 2-47
☐ Add	☒ Replace	☐ Remove	Replace pages 2-48 through 2-51 b
☐ Add	☒ Replace	☐ Remove	Replace page 2-63e
☐ Add	☒ Replace	☐ Remove	Replace pages 2-65 through 2-68 and pages 2-70 through 2-71d
☒ Add	☐ Replace	☐ Remove	Add to Appendix Volume A-2 the EarthFax Engineering Perennial Length and Gradient Studies of Winter Quarters Canyon and Woods Canyon Creeks, 2002 and 2003
☒ Add	☐ Replace	☐ Remove	Add to Appendix Volume A-2 the Mt. Nebo Scientific Riparian Plant Community Survey Near Scofield, Utah, Winter Quarters Canyon and Woods Canyon, 2002
☒ Add	☐ Replace	☐ Remove	Add to Appendix Volume A-3 the Mt. Nebo Scientific Macroinvertabrate Studies 2002 and 2003 Summary, Winter Quarters and Woods Canyon
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

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CANYON FUEL COMPANY, LLC
SKYLINE MINE

NORTH LEASE SUBSIDENCE PERMIT MODIFICATION SUBMITTAL

JULY 2004

TABLE OF CONTENTS

VOLUME A-1

Aerial Photographs

Hydrology

EarthFax Engineering, Perennial Length and Gradient Studies of Winter Quarters Canyon and Woods Canyon Creeks, 2002 and 2003

Hydrologic Inventory of the Skyline Property and Adjacent Areas

Determiniation of the 100-year Flood Plain of Eccles Creek and Mud Creek

General Hydrologic Considerations Related to Coal Development and Subsequent Impacts

UPDES Permit

Air Quality

Radian Report

Table of Contents

VOLUME A-2

SOILS AND VEGETATION

Report of Vegetation, Plant Community Analysis, Threatened and Endangered Species, Soils and Reclamation Plan

Report of Vegetation and Soils, Proposes Waste Rock Disposal Site

Skyline Project Supplemental Soils Report

Response to Deficiencies in the Waste Rock Disposal Area Report

Vegetation Monitoring of Reclaimed Slopes and Corresponding Reference Areas - 1985

Report of Revegetation Success and Vegetation Monitoring of Reclaimed and Reference Areas at Skyline Mine During the 1982 Field Season

Response to Stipulations Regarding Vegetation and Soils for the Skyline Mine - December 1981

Conveyor Bench Revegetation Plan - SCS Document

Conveyor Bench Revegetation Plan Progress Summary (1989 - 1991)

Sample Analysis Results of Waste Rock and Electric Lake Sediment Used to Reclaim South Fork Portals, Mine 1.

Riparian Plan Community Survey Near Scofield, Utah, Winter Quarters Canyon and Woods Canyon, 2002

TERRESTRIAL WILDLIFE

Wildlife Assessment of the Skyline Mining Property and Adjacent Areas

Baseline Data Report on Presence and Utilization of Eccles Canyon by Elk, Mule Deer and Moose

AVIFAUNA REPORTS

The Avifauna and Raptors of the Skyline Mine Project

TABLE OF CONTENTS

VOLUME A-3

Archeological Reports

Historical Reports

A Brief History of the Eccles Canyon Coal Mine

Aquatic Wildlife

Aquatic Ecology of Surface Waters Associated with the Skyline Project

General Aquatic Resource Description

Fish Habitat Plan

Monitoring of Aquatic Macroinvertebrates and Sediments in the Eccles Creek Drainage - December 1985

Monitoring Aquatic Macroinvertebrates, Sediments of Eccles Creek - 1984 Summary

Recovery of the Cutthroat Trout (Salmo clarki) Fishery in Eccles Creek, Utah, From Coal Mining Impacts

Stream Diversion Documentation

Geotechnical

Dames and Moore Report

Geology

Roy Full Reports

Geologic Cross Sections

Macroinvertebrates Studies, 2002 and 2003, Winter Quarters and Woods Canyon

2.4 SURFACE WATER HYDROLOGY

As previously discussed, the Skyline permit area is located in the headwaters of the Price and San Rafael River Basins. Snowmelt is the primary source of water for the perennial streams in the two basins, with only a small amount of the total flow in the region being derived from rainfall. As a result, flow volumes per unit area are high in the headwaters and low near the mouths of the two basins.

The quality of surface water in the headwaters region is excellent, with total dissolved solids (TDS) concentration normally varying between 100 and 400 milligrams per liter. However, this quality deteriorates rapidly as the streams cross the saline Mancos Shale downstream and receive irrigation return flows from Mancos-derived soils. TDS concentrations in the Price and San Rafael Rivers, near their confluence with the Green River, generally vary between 1,500 and 4,000 milligrams per liter. Sediment yields in the two basins experience similar geographic variations, with the bulk of the sediment yielded at the mouths of the two major rivers coming from those areas which are underlain by the highly erodible Mancos Shale. Data summaries presented in this section are taken from the Skyline water quality monitoring program, Mundorff (1972) and Southeastern Association of Governments (1979). Information presented in this section summarizes and updates the original consultant's reports found in Appendix Volume A-1.

2.4.1 Drainage Basin Characteristics

Portions of five perennial watersheds drain the Skyline project area and include the Eccles Canyon, Green Canyon, Winter Quarters Canyon, Woods Canyon (all tributaries of Mud Creek in the Price River Basin) and Upper Huntington Creek (a tributary of the San Rafael River). Channels draining the permit area form dendritic patterns, with stream channels of the area flowing in all four major directions. All surface streams have been classified by the Utah Division of Health as follows:

- 1C - protected for domestic use with prior treatment process,

- 2B - protected for secondary contact recreation,
- 3A - protected for cold water aquatic life, and
- 4 - protected for agricultural uses including stock watering.

Electric Lake has been classified as 2B, 3A and 4 while Scofield Reservoir has been classified as 1C, 3A, 4, and 2B.

Slopes on the permit area are steep, averaging approximately 31 percent. Dominant drainage aspects are to the west in the Huntington Creek Basin and to the east in the Price River Basin. The landscape varies greatly, with most of the permit area being covered with conifer and aspen vegetative communities.

Because of the climatological conditions of the area (high precipitation and low evapotranspiration resulting in excess water), there are numerous water sources in the Skyline project area. Most of these are undeveloped springs, seeps and streams. The one notably developed water body located partially in the project area is Electric Lake, a 31,200 acre-foot reservoir whose upstream tip covers a small portion of the southwest corner of the project area in the Huntington Creek Basin. This reservoir is owned and operated by Utah Power and Light Company as a storage facility for water used at coal-fired power plants.

The thick vegetative cover on the project area has resulted in a well-maintained soil of high organic matter content, thus developing a more open soil structure with high infiltration rates. As a result, the potential for runoff from a rainfall event on the project area is low. Thus, snowmelt produces most of the runoff from the area during periods when soils are frozen and/or saturated.

2.4.2 Flow Characteristics

The seasonal distribution of flows in the perennial streams draining the project area is typical of western high elevation, snowmelt streams, where the majority of the flow occurs within a relatively short period of time in late spring and early summer (April, May and June). Flows in Huntington Creek above Electric Lake can be expected to vary from 1 to 100

cubic feet per second while those of Eccles Creek above Mud Creek normally vary between 1 and 50 cubic feet per second and those in Mud Creek vary between 5 and 380 cubic feet per second.

The watersheds draining the project area yield an average of approximately 13.5 inches of water annually to the Price River Basin. However, because the relatively impermeable Blackhawk Formation underlies all of the Huntington Creek Basin above the southern boundary of the project area (either on the surface or directly beneath the surface member), the yield to the San Rafael River Basin is slightly higher (averaging approximately 16 inches per year).

A significant surface water quality sampling program has been conducted in Eccles Creek, Burnout Creek, and Huntington Creek as well as in a representative sampling of seeps and springs in the Skyline permit area. The following briefly describes the major water quality characteristics of the permit area.

Surface water in the Skyline project area is of a calcium bicarbonate type. Total dissolved solids concentrations in the area are generally lowest during the months of April through June when flows are highest and affected by the diluting effect of direct snowmelt. As flows decrease and the majority of the flow is derived from seepage of local groundwater systems, the dilution effect becomes less pronounced and dissolved solids concentrations tend to increase. As a result, the dissolved solids content of surface water in the area varies from less than 100 milligrams per liter (headwaters of Huntington Creek during the high flow season) to slightly greater than 500 milligrams per liter (Eccles Creek during low flow conditions). Suspended solids concentrations in the area tend to vary proportionately with flow rate. During the snowmelt runoff season, concentrations are also naturally higher in Eccles Canyon than in the Huntington Creek drainage basin. Channel erosion, although relatively low throughout the area, appears to be more extensive in the steeper Eccles Canyon than in the Huntington Creek Basin and is probably the source of most of the increased sediment concentrations. Mud slides, when present, add considerably to the suspended solids concentration.

Hydrogen ion activity (pH) tends to be rather constant in the surface waters on and adjacent to the Skyline project area, varying normally between 6.5 and 8.6. The basic condition of the water with low acidity and high alkalinity indicates that acid drainage problems do not develop as a result of mining in the permit area.

Total and dissolved iron measurement values vary widely throughout the area, with the potential source being the iron contained in Blackhawk Formation cementing agents. Total iron, which varied in measurements from less than 0.01 to over 45 milligrams per liter during the observation period, tends to be somewhat directly related to the flow rate, and is associated with sediment loading. In contrast, dissolved iron tends to be much more constant.

Total manganese concentrations in the area were low, varying normally between 0.01 and 2.0 milligrams per liter with occasional higher concentrations associated with sediment loading. No distinct seasonal variations were noted.

The Burnout Creek area was the subject of a subsidence study directed by the U.S.F.S. A portion of the study continues and includes monitoring the flows in the stream biweekly and performing annual stream gradient surveys. Four surface water monitoring points were monitored in this area and in the adjacent Upper Huntington Creek since 1981 as a part of the surface water monitoring program. Eight flumes, F-1 through F-8 (Plate 2.3.6-1) were installed and are presently being monitored as part of the modified subsidence study. However, only one flume, F-5, is currently part of the quarterly water monitoring program. Flume F-5 is the same sampling point as CS-7 of the quarterly water monitoring program. In general, stream flow rates in this part of the permit area are decreasing. This is likely due to the present drought conditions (Climatology, Volume 4). Water samples from all four monitoring stations are of a calcium-bicarbonate character. Chemical concentrations have remained relatively consistent through time.

Baseline concentrations of various constituents were normally well within the State of Utah standards for waters of the Skyline project area.

A summary documenting the water quality data in the mine area may be found in Volume 4.

Additional baseline data has been collected in the James Canyon drainage as part of the Burnout Canyon study. Flows have been obtained from flume F-9 since 1993 in James Canyon. This information is contained in Volume A-1, Hydrology. Water quality samples have not been collected from this stream since no surface facilities are located in this drainage. Also, water quality samples collected since the early 80's and 90's from streams that have been undermined by the Skyline Mines (Burnout, Eccles, other tributaries of Upper Huntington Creek, Plate 2.3.6-1 and 2.3.6-1a) indicate water quality is not noticeably affected by underground mining activities.

Prior to March 1999, Skyline Mine discharged water to Eccles Creek at an average rate of approximately 350 gpm. From March 1999 through November 2002, the discharge rate gradually increased to between 9,500 and 10,500 gpm. The increase in discharge rate is related to increased ground water inflow to the Mine #2 area of the Skyline Mine. A flow of 10,500 gpm in Eccles Creek due to the increased mine discharge is approximately 42 times the minimum measured base flow (approximately 250 gpm) of Eccles Creek. The increased flow to Mud Creek of the 10,500 gpm of mine water discharge represents an increase of approximately 10.5 times the minimum measured base flow (approximately 1,000 gpm measured in 1981) at the USGS flow gaging station located below the confluence of Mud and Winter Quarters Creeks. The average daily flow of Mud Creek at the USGS gaging station from 1979 to 2001 is approximately 2,700 gpm. The mine discharge rate of 10,500 gpm is about 4 times average daily flow of Mud Creek. The discharge to Eccles Creek diminished after July 2003 when the JC-3 well was completed by PacifiCorp. The JC-3 well was

completed in the 10 Left area of the mine and pumps mine water to Electric Lake. The rate of discharge from JC-3 has varied between approximately 1,500 and 5,100 gpm. The rate of discharge to Eccles Creek after July 2003 has subsequently varied between 900 gpm and 6,000 gpm, dependant upon the operation of JC-3 and allowing of portions of the mine to flood. The anticipated changes to mine inflow volumes is discussed in greater detail in the July 2002 Addendum to the PHC, Appendix F and K.

An ongoing study of the effects of the increased flows on Eccles and Mud Creeks was initiated in the winter of 2001. EarthFax Engineering, Inc. was contracted with to establish six monitoring stations on Mud Creek and three on Eccles Creeks. The flow, water chemistry, stream channel morphology, vegetation are monitored at these sites for any significant changes that could be related to the increase in mine water discharge. Initial results of the study indicate that no significant effects have been noted at the monitoring sites due to increased discharges. However, the study will continue until the mine discharge volumes return to pre-March 1999 levels. Data collected will be included in the mine's annual report.

2.4.3 Sediment Yield

Prior to March 1999, the Skyline project area had a sediment yield which averaged approximately 0.44 acre-feet per square mile per year, based on methods developed by the Pacific Southwest Inter-Agency Committee (1968)
(Volume A-1, Hydrology, page 49). This converts to a total annual yield of 1.25 acre-feet of sediment to the Price River Basin and 3.07 acre-feet of sediment to the San Rafael River Basin. The majority of this sediment
is yielded as suspended sediment, with only a small fraction occurring as bedload. After March of 1999, the sediment yield to the Price River basin through Mud Creek increased by approximately 7%.

This increase in load was determined by the Division using the results of TSS monitoring at Valley Camp sites VC-1 and VC-9 on Mud Creeks and Skyline site CS-6 on Eccles Creek. The Division calculated an average sediment yield for Eccles and Mud Creeks at 2,710 tons/year prior to March 1999 and 2,908 tons/year since March 1999 through June of 2002. The sediment yield will be monitored for Eccles and Mud Creeks and reported each year in the mine's annual report.

The suspended load in the stream flow of Eccles and Mud Creeks is being monitored as a result of the increased mine discharge. In addition to the stations already monitored on Eccles Creek as part of the existing monitoring program, six new sites have been added. These sites are MC-1, MC-2, MC-3, MC-4, MC-5 and MC-6. As discussed in the previous section, the sites are monitored for TSS. The first sampling of these sites occurred in June 2002 and the results reported to the Division. No significant increase to the TSS levels above background were noted during the initial sampling. (Site MC-5 is located on Mud Creek above the confluence with Eccles Creek and assumed to represent background).

2.4.4 Monitoring Program

The surface water monitoring program outlined in this section has been updated based on the findings and conclusions of the 1996 PHC by Mayo and Associates and as a result of a cooperative effort between the operator, the Division, and the Forest in an effort to better understand and monitor the effect of increased ground water inflows to the mine and mine discharge. It incorporates practices designed to provide the baseline data necessary to validate the determination of the probable hydrologic consequences of proposed and existing mining and reclamation operations. The program also is designed to meet site specific requirements and have the flexibility for change if necessary. Specific attention has been given to insure that proper upstream and downstream monitoring is included within the

monitoring program for all disturbed areas, and that adequate sampling of potentially impacted flow regimes is completed.

A PHC study completed in 1996 entitled "Investigation of Surface and Groundwater Systems in the vicinity of the Skyline Mines, Carbon, Emery, and Sanpete Counties, Utah; Probable Hydrologic Consequences of Coal Mining at the Skyline Mines and Recommendations for Surface and Groundwater Monitoring" by Mayo and Associates, recommended some changes to the original monitoring plan. These changes were made by Mayo and Associates after a careful review of local hydrogeology, monitoring conditions, sampling parameters, and sampling data. The changes proposed by Mayo and Associates are considered valid and reasonable and are therefore incorporated herein. An evaluation of UPDES and waste rock disposal site monitoring stations were not included within the scope of work completed by Mayo, but continue to be an integral part of the water monitoring program.

A copy of the 1996 PHC evaluation is included within Appendix A-1 Volume 2 of this MRP. An update to the PHC, "Addendum to the PHC, July 2002" has also been included in this M&RP. Since the modifications to the PHC have taken place over time and conditions within the mine have changed, it should be assumed that where the most recent text conflicts with text in earlier modifications or original text, the latest supercedes the earlier.

Surface water monitoring programs are conducted at each of the appropriate stations identified in Tables 2.3.7-1, 2.3.7-2, 2.3.7-2A and 2.3.7-3 and shown on Drawings 2.3.6-1 and 2.3.6-2. Except where noted, samples are obtained at the monitoring sites three times a year. The monitoring periods are defined by the seasons. Samples are collected during the high flow season, April through June and the low flow season in August through September. Late fall samples are obtained in October through November. These time periods were selected because the sites are usually inaccessible until late June and after November due to snow depth and frozen water courses.

Several sites on Eccles Creek are monitored in December through February since they are adjacent to a maintained road and the water discharged from the mine normally keeps the stream from freezing over.

Surface water stations in Eccles Canyon were sampled more frequently than those on Huntington Creek during the initial phases of mining.

Eccles Canyon stream stations are shown on Table 2.3.7-3 and are analyzed for those constituents identified in Tables 2.3.7-2 and Table 2.3.7-2A with an annual monitoring as per Table 2.3.7-1. South Fork tributary station CS-15 will be monitored for flow only beginning fall 1988. The purpose of this station is to check for subsidence effects from longwall mining.

Sampling will continue at all surface water stations throughout the post-mining period and until the reclamation effort is determined successful by the regulatory authority. Samples will also continue to be analyzed for the parameters outlined in Tables 2.3.7-1, 2.3.7-2, 2.3.7-2A and 2.3.7-3A throughout the post-mining period, unless deletions in the list of parameters is determined to be appropriate.

Several monitoring stations were added to the monitoring schedule with the incorporation of the North Lease Tract. CS-19 and CS-21 have been added to monitor the quantity and quality of the water in Woods Canyon Creek and CS-20 has been added to monitor the quantity and quality of the water in Winter Quarters Creek.

As part of the Skyline Mine subsidence monitoring plan, nine new water monitoring sites have been identified in the North Lease area (Table 2.3.7-1). Sites NL-1 through NL-7 have been selected to monitor flows on the tributaries to and on Winter Quarters Creek six months prior to, during, and at least six months following subsidence due to mining. Sites NL-8 and NL-9 have been selected to monitor flows in Woods Canyon under the same frequency as the NL-1 through

NL-7 sites. Flow, conductivity, pH, dissolved oxygen, and temperature of the water will be measured at each location. The sites will be monitored monthly in June through October. If accessible earlier than June or later than October, the mine will monitor the sites. The results of the monitoring will be reported with the other required monitoring data. The purpose of this monitoring is to determine the effects, if any, on the stretches of perennial streams in the Winter Quarters Creek and Woods Canyon Creek drainage that will be subsided due to mining. This monitoring will also help indicate if mitigation is required for loss of surface or ground water and, subsequently, habitat associated with the water.

Skyline has conducted field studies to determine the location of the perennial portions of both Winter Quarters and Woods Canyon Creeks, though no mining is currently planned within the next five years in the Woods Canyon drainage. The perennial nature of the streams were determined using a variety of parameters including vegetation and surface flow monitoring. Field studies were initiated and completed in October and November 2002 and October 2003. Copies of the studies are included in Volume A-1 Hydrology Section. The studies will be used by the Forest in their environmental assessment of the potential effects of undermining Winter Quarters and Wood Canyon Creeks.

Sampling will continue according to Tables 2.3.7-1, 2.3.7-2, 2.3.7-2A, and 2.3.7-3 as approved at all surface water stations throughout the post-mining period and until the reclamation effort is determined successful by the regulatory authority. Changes will be made to the monitoring program only when additions or deletions to the list of parameters and/or schedule is determined to be appropriate, and when approved by the regulatory agency.

In addition to the above outlined monitoring program, UPDES discharge permits have been acquired as necessary. Monitoring and operation of all surface water discharges are conducted in accordance with conditions of this permit. 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. A copy of this permit (UPDES No UT-0023540) is appended to Volume A-1, Hydrology Section. The monitoring locations are shown on Map 2.3.6-1.

As required, water quality data collected from the surface water monitoring stations will be submitted to the Utah Division of Oil, Gas, and Mining. Such reports will normally be submitted within 90 days of the completion of each quarterly monitoring program.

The Permittee conducted a search for seeps or springs in the downslope area west of the rock disposal site in the spring of 1984 and found no seeps or springs. Should surface flow occur, surface water monitoring will be carried out, though the exceedingly ephemeral nature of the water flows in the area will necessarily affect the frequency of sampling. The Permittee commits to the following surface water monitoring program when surface flow is present.

1. Four monitoring stations will be established: two stations on the drainage from the east and two sites on the drainage from the south. Stations will be located both above and below the rock waste disposal site in each of the drainages. (See Drawing 2.3.6-1.)
2. When flow is present, these stations will be monitored, when accessible, at the same frequency and for the same constituents as the stations in Eccles Creek. The data will be tabulated and reported in the same manner as the Skyline water quality data.
3. The data from these stations will be evaluated for non-point source contribution from ground water aquifers. This procedure offers the best potential for detection of ground water contamination.

The Upper O'Connor seam required a breakout to improve ventilation. The breakout is on a south facing slope in a side canyon of the South Fork of
Eccles Creek (see map no. 3.2.11-1). A new road was built across this canyon to gain access to the breakout area. The canyon flows water in all but the driest of years. During construction, the creek was sampled above and below the site on a daily basis. The samples were tested for total suspended solids and settleable solids as an aid in regulating construction activities and in implementing control measures. Construction related solids fluctuations were encountered throughout this phase of the project.

The volume of water discharged from the mine increased significantly in August 2002 after large volumes of ground water were encountered within the mine. The mine was concerned about what effects the increased flows might have on Eccles and Mud Creeks. EarthFax Engineering, Inc. was contracted to perform a stream bank stability analysis on the streams using flows ranging between 5,000 and 30,000 gpm. The initial results of the report indicated that the stream banks would be stable at flows up to 30,000 gpm. Further study was requested by the Division and EarthFax was again contracted to continue the study of the effects on Mud and Eccles Creeks of sustained increased discharges from the Skyline Mine. The study will continue as long as the mine is discharging flows in excess of the pre-September 2001 rates plus one year. The study consists of the following:

Reference sites have been established on Eccles and Mud Creeks corresponding to cross sections used in previous investigations (EarthFax Engineering, 2002). The reference sites were established in general conformance to the recommendations of Harrelson et al. (1994). This involved the following:

- Establishing benchmarks at each site. Benchmarks will consist of cement or boulder monuments, with a metal marker stamped with the site number.

- Establishing monumented cross sections. The endpoints of cross sections will be marked with roof bolts or steel reinforcing bar that has been driven into the ground. These bars will be painted to increase visibility.

- Surveying the channel at each site. Surveying will be performed using a level and survey rod, with both the cross section and longitudinal profile of the stream being surveyed.

- Establishing photo points. As recommended by Harrelson et al. (1994), convenient locations will be selected to take photographs upstream, downstream, and across the channel at each cross section location.

- Collecting streamflow data. The flow will be measured at each site, using standard procedures, with a rotating-cup flow meter. Indicators of bankfull stage will also be gathered.

Samples of the bed and bank materials were collected at the newly established stations to evaluate geomorphic and stability relationships at those locations. Similar samples were collected in February 2002 at the remaining sites (EarthFax Engineering, 2002) and are still considered valid.

The depth to groundwater was determined at each of the reference sites. In areas where the flood plain is narrow (along all of Eccles Creek and the upper portion of Mud Creek), this was accomplished with one temporary piezometer installed in the alluvium adjacent to the stream. The piezometer was installed using portable flighted augers and a hammer drill. Perforated PVC pipe was installed in the hole and the water table allowed to stabilize for a period of at least 4 hours prior to measuring the depth to water. The relative elevation of the piezometer was established by standard surveying techniques from the previously-established benchmark at each site.

Flow data on file with the U.S. Geological Survey was gathered for Eccles Creek near Scofield, Utah (station 09310600) and for Mud Creek below Winter Quarters Canyon at Scofield, Utah (station 09310700).The data were provided to the Division in electronic form.

Historic aerial photographs were gathered of Pleasant Valley between the town of Scofield and the confluence of Mud Creek and Eccles Creeks. Both private sources (on file with aerial photography companies) and government sources (USDA, USGS, EROS) were searched. These photographs were evaluated to assess historic land use in this reach of Pleasant Valley. This information, together with the additional data collected as part of this study, were used to evaluate whether or not Pleasant Valley could be classified as an Alluvial Valley Floor. The Division used this study along with the EarthFax Eccles and Mud Creek study and made a determination that portions of Pleasant Valley could be considered alluvial valley floor but the increased discharge from the mine would not have a significant impact on the valley sediments or vegetation.

Water-quality samples are collected at the monitoring points. In addition to the collection of flow data as indicated in Section 2.1, these samples are analyzed for total dissolved solids (TDS), total suspended solids (TSS), and total phosphorus.

As field information is gathered, sufficient data will be gathered to determine the bank erodibility hazard (Rosgen, 1996; 2001) for each reference site. These data will include measurements of the following values:

- Bank height
- Bankfull depth
- Rotting depth
- Root density
- Bank slope
- Degree of surface protection of the bank

The in-stream velocity gradient (between the core of maximum velocity and the stream bank) and the ratio of average hydraulic stress and near-bank hydraulic stress will also be calculated. Each of these indexes will be compared with typical values provided by Rosgen (1996; 2001) to provide another assessment of bank stability in addition to that provided previously (EarthFax Engineering, 2002).

Flow and water-quality data (TDS, TSS, total phosphorus) are collected at the monitoring points on a seasonal basis and will continue

to be until one year following a sustained reduction in mine-water discharge to a rate of 5,000 gpm or less (i.e., pre-September 2001 levels). Channel cross sections and longitudinal profiles will be collected from each reference site annually during the same period.

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2.5 HYDROLOGICAL IMPACTS OF MINING ACTIVITIES

Presented in the following subsections are summaries of the hydrological impacts of the mining activities of the Skyline project. The details backing the conclusions stated in this section and supplemental discussion can be found in the PHC evaluations included as part of this section, and within the Hydrology Section of Appendix Volume A-1 Volumes 1 and 2. Details of the consultant's flow calculations may be found in the flood plan calculations also in Appendix Volume A-1. The PHC was also updated in July 2002 October 2002, April 2003, and June 2004 by the addition of the Addendum to the PHC associated with the drilling of the wells in James Canyon, the significant inflows to Mine #2, and the ground water model prepared by HCI.

The potential hydrologic impacts discussed herein represent the latest information available and, generally, correspond to the consultant's original report. (See General Hydrologic Consideration Related to Coal Development and Subsequent Impacts, Vaughn Hansen Associates, February 1981, found in Appendix Volume A-1. Updated analyses of the "Probable Hydrologic Consequences" reflecting all current data are appended to this section.

- **Exhibit A of Section 2.5**, "Probable Hydrologic Consequences of Mining at the Skyline Mines, Carbon and Emery Counties, Utah"; prepared by Earthfax Engineering, Inc., Salt Lake City, Utah; dated September 30, 1992.
- **Addendum to the Probable Hydrologic Consequences, July 2002 (James Canyon Update - further updated in October 2002, April 2003, and June 2004)**.
- **Appendix A-1, Volume 2** (September 2002), "Investigation of Surface and Groundwater Systems in the Vicinity of the Skyline Mines, Carbon, Emery, and Sanpete Counties, Utah: Probable Hydrologic Consequences of Coal Mining at the Skyline Mines and Recommendations for Surface and Groundwater Monitoring".

2.5.1 Potentially Affected Water Rights

Surface and groundwater rights in the general project area are primarily for stockwatering and irrigation. Stockwatering rights are located almost entirely and directly on the streams. The

nearest irrigation rights are centered around the two areas of Scofield and in Flat Canyon, southwest of the permit area. Irrigated lands consist primarily of pasture. Only stockwatering rights are present in the Skyline permit area. A limited number of wells are located in the general area, none of which are located directly on the property or within the permit area. Recent large mine inflows to Mine #2 has resulted in concern voiced by local government and private interests that water entering the mine is coming from nearby Electric Lake. However, data collected and analyzed by Skyline Mine for the purpose of determining the source of the inflows strongly indicates there is no significant connection between the surface waters and the mine waters. As discussed in the July 2002 Addendum to the PHC (modified in October 2002, April 2003, and June 2004), the Star Point does not transmit water easily. Fractures within the Star Point in the mine area has allowed the sandstone to begin dewatering by discharging to the mine. The Star Point does not appear to have a significant discharge point located immediately down gradient of the mine. Indeed, the age of the water in the sandstone suggests it takes several thousand years to move through the aquifer in spite of the high transmissivity of the fractures within the sandstone. Therefore, it is unlikely any surface or ground water rights are being adversely affected. Because it is not certain that the ground water discharges into the Huntington Creek drainage, there is no evidence that water is being removed from that drainage to Eccles Creek, part of the Price River drainage. Tritium analysis of the water in the 10 Left area of Mine #2 and water from the James Canyon well JC-1 indicates a minor amount of modern water is being pumped from the well and the mine. However, this water is not necessarily originating from Electric Lake. Therefore, there does not appear to be a significant volume of surface water being transferred between drainage basins.

2.5.2 Mining Impact on Water Quantity

Due to the high shale content of the Blackhawk Formation, recharge to the deep ground water system through the Blackhawk Formation is slow. Fractures in the formation seal readily due to swelling of the bentonitic shale when wet. As a result, the impact of mining (including subsidence) on the quantity of water in the permit area will be minimal. This has been verified through the results of the subsidence study in Burnout Canyon. (A discussion of the mining impacts on the aquatic resources may be found in Section 2.8.) The Burnout Canyon study resulted in the determination that no significant impacts had occurred to the stream drainage as a result of mining induced subsidence.

While the gradient of the stream was flattened in a few locations and slightly increased in others, the overall change in the stream morphology was not significantly different than changes that occur in similar stream systems naturally. Biweekly flow monitoring and aerial photographic surveys continue each year as mining continues in the area. Additionally, three years of macroinvertabrate studies and two years of fish population surveys have been conducted starting in 2000. These studies are described in greater detail in Section 2.8.1.

The purpose of the Burnout Canyon study was to determine the impacts of undermining perennial streams in the Skyline Mine area. The intent of the study was to determine if significant impacts would occur by undermining the Burnout stream and, if no significant impacts occurred, then the Forest would consider allowing the undermining of perennial streams with similar geologic and geomorphic conditions to occur. Additional geomorphic and macroinvertabrate studies have been conducted in Winter Quarters and Woods Canyons and the results of those studies are included in this M&RP.

When subsidence occurs, the subsidence cracks tend to seal rapidly, preventing the deep percolation and subsequent loss of water previously destined for springs and other water sources. The location of a spring may change by a few feet, but no significant loss of water is anticipated. The sealing of potential cracks will be accelerated where subsidence occurs under stream bodies, due to the natural deposition of silt in the stream channel along with the swelling of the shale.

Although the Blackhawk Formation contains partially or completely saturated sandstone channels above the proposed mine workings, a relatively small quantity of water is being encountered in the mine due to the impermeable nature of the formation, which limits the recharge rate and the ability of the rock to readily yield water. Ground water within the Blackhawk formation above the mine workings was determined in the 1996 PHC to be found within highly localized perched aquifers. The 1996 PHC evaluation failed to locate a regional ground water aquifer within the immediate area. The relatively small quantity of water being encountered in the mine was believed due to 1) the general impermeable nature of the formation, which limits the recharge rate and the ability of the rock to readily yield water, and 2) the local nature of local perched aquifer systems.

The inflow to the mine had been less than 100 gallons per minute per active face, with mine entries generally dry approximately 100 to 200 feet up-dip from the face. Some roof bolt holes, however, continued to flow up to 2 GPM for an extended period of time. However, in 2002 a fractured channelized sandstone was encountered during mining of the southwestern permit area which produced approximately 1,400 gpm. This was repeated at several locations in areas of Mine #2 until the mine was discharging approximately 8,500 to 9,500 gpm in August 2002 and 9,000 to 10,500 gpm in October 2002. Even though the large inflows have significantly subsided since October 2002, the near future mining activities have been directed toward the North Lease area.

The PHC for the Skyline Mine was updated by an Addendum to the PHC dated July 2002 and further updated in October 2002, April 2003, and June 2004. The addendum contains significant information regarding the large inflows to the mine. To better understand the hydrologic system and the water within the Star Point Sandstone, Skyline Mine contracted with Hydrologic Consultants, Inc. of Lakewood, Colorado produce a ground water model of the Star Point Sandstone. This model endeavored to delineate the possible areal extent of the aquifer, the volume of water contained in the aquifer, and the potential sources and discharge locations of the aquifer. The model has been used to help determine what, if any, impacts are occurring to the waters available in the mine area, including State appropriated water rights. The model was completed and improved in June 2004 and a copy of the report describing the results of the modeling effort has been added to the PHC.

As described in the July 2002 Addendum to the PHC, draining of the ground water contained within the Star Point Sandstone does not appear to have a significant impact on discharges of ground water in the mine or adjacent area nor does it appear that the water entering the mine is causing a loss of surface water in the Huntington or Price River drainages. The majority of the flows into the mine enter through faults and fractures that trend generally north-south to northeast-southwest. The flows move up through the floor of the mine in almost all cases. The water is apparently stored in the Star Point Sandstone under significant potentiometric head. Ages of the water indicate that water moves very slowly through the Star Point system in spite of the fractures and faults that appear to be open enough to allow water to flow freely into the mine in isolated locations. This suggests that the aquifer does not have a discharge point that releases large volumes of water nor is the aquifer replenished at a high rate of inflow. While the

Star Point is exposed in out crop north, south, and east of the mine, significant volumes of water would need to be entering the system at an elevation great enough to create the potentiometric head encountered in the Star Point beneath the Mine #2 workings. Skyline continues to monitor stream flows in Winter Quarters, Eccles, and Mud Creeks to identify any impacts if they occur in these drainages related to the mine inflows.

No springs or water production wells in the mine permit or adjacent areas have reportedly been negatively impacted by the large mine inflows. There has been some concern voiced by local government and private interests that water entering the mine is coming from nearby Electric Lake. However, data collected and analyzed by Skyline Mine for the purpose of determining the source of the inflows strongly indicates there is no significant connection between the surface waters and the mine waters. As stated previously, this is discussed at length within the July 2002 Addendum to the PHC.

Water encountered in the mine is either utilized underground as processed water or is pumped from the mine. Procedures for handling of mine water are discussed in detail in Section 3.2. Indigenous water associated with the coal will be removed from the area. This, however, will represent only a small fraction compared to the water flowing from the Wasatch Plateau. The water pumped from the mine is added to the flow of Eccles Creek and into Electric Lake and has a positive effect on the aquatic flow systems.

The construction of surface facilities utilized in conjunction with the Skyline Mines (yard areas, roads, conveyor lines, etc.) resulted in temporary increases in the suspended sediment concentration of the adjacent stream. However, because of the regulatory requirement that sediment control measures be provided for all areas of surface disturbance, concentrations of suspended material were significantly reduced. Minimization efforts, however, met with varying degrees of success.

Over long periods of time, groundwater in the Wasatch Plateau can be expected to flow towards the lowlands if not removed, passing through saline shales and emerging to augment streamflow with a dissolved solids content that significantly exceeds the concentrations found in the headwaters area. Because the Skyline Mines will act as interceptor drains, the groundwater that is brought to the surface from the mines has a much lower dissolved solids content than would have existed if the water was to continue its downward movement through shaley layers. Thus, the mines will have some beneficial impact on the chemical quality of water in the region.

The increased stream flow resulting from mine discharges, particularly during the summer low flow period, appears to benefit the Eccles Creek fishery by creating flow and temperature stabilization. The increased flows to Scofield Reservoir most likely benefitted the fish population in the lake by maintaining a sufficient level of dissolved oxygen to avoid a general fish kill that frequently occurs in the lake during periods of drought periods, such as has been occurring in the mine area since 2000. The mine has also been discharging large volumes of water since August 2002 with TDS concentrations only slightly higher than background levels. This good quality water flows to and is stored in Scofield Reservoir. The water stored in Scofield Reservoir is used for culinary and irrigation purposes in Helper, Price, and Wellington, Utah. The State Engineers office in Price, Utah indicated that without the additional discharge from Skyline Mine to the Price River drainage, the reservoir would have been at a dead pool level in late August of 2002, thus cutting short the irrigation season downstream.

Similarly, discharges to Electric Lake will be an overall benefit to the water users on Huntington Creek. The discharge of high quality water from mine dewatering wells JC-1 and JC-3 will increase the volume of water in Electric Lake, provide additional cooling water for the Huntington Power Plant, and provide additional irrigation water for agricultural uses in Emery County. Without the additional discharge of water to Electric Lake from the James Canyon wells, it is possible that in the summer and fall of 2003, the Huntington Power Plant would need to significantly scale back the production of electrical power due to insufficient cooling water. A reduction in power generation from the plant would have significant economic impacts on Carbon and Emery Counties from the loss of jobs and an increase in power rates for consumers of power generated by PacifiCorp.

The completion and operation of JC-3 will not result in an overall increase of mine water discharge from the Skyline Mine. Operation of the well will decrease the amount of mine water discharged to Eccles Creek and result in additional water discharged to Electric Lake.

The large volume of ground water inflow to the mine has resulted in the mine discharging significantly greater volume of water than were initially anticipated when the mine was planned and opened. The current mine UPDES permit was written when flows were expected to be less than 1000 gpm and limits on total dissolved solids (TDS) were created based on this volume of flow. A 7.1 ton/ day limit of TDS was assigned to the mine with a maximum TDS concentration of 1310 mg/l TDS. It was not unusual

tor the mine, prior to March 1999, to discharge water with 1000 mg/l TDS. However, after the large inflows into the mine were encountered in March 1999, the volume of water discharged increased steadily and the concentration of TDS decreased. Also at that time, the mine began to have trouble passing the chronic Ceriodaphnia dubia toxicity test required by the UPDES permit. It was determined through extensive testing that the toxicity test was failed due to a slight increase in the nickel concentration in the water. The toxic limit of dissolved nickel concentration appeared to be 15 ug/l or greater and the water discharged from the mine in late 1999 until the end of 2001 contained a maximum of 42 ug/l dissolved nickel. These concentrations of dissolved nickel are well below drinking water standards. The significant inflow to the mine from the 10 Left area and changes of how water was handled underground resulted in a decline in TDS and dissolved nickel over time. As a result, the mine has been able to pass its chronic water testing.The Utah Division of Water Qualityrecently modified the mine's UPDES discharge permit to include a limit of 500 mg/l TDSand no total ton per day limit or the mine would discharge less than 7.1 tons per day of TDS if the water had a TDS concentration greater than 500 mg/l.

A UPDES permit was obtained by PacifiCorp to operate the JC-3 mine dewatering well in James Canyon. This well will discharge high quality mine water to Electric Lake. However, since it is mine water, Skyline will be obligated under SMCRA to assure the quality of the water discharged is within the UPDES permit limits assigned to JC-3. Skyline will submit the required DMRs to the Division as required in Section 2.3.7.

Periodically, due to difficult recovery conditions or roof collapse, mining equipment is abandoned underground. Prior to leaving equipment underground, hazardous materials and lubricating fluids are drained when 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 is not anticipated. A map illustrating the location of equipment left underground is provided as Drawing 2.3.6-3. The drawing includes a description of each piece of equipment.

Because of the high alkalinity and low acidity concentrations in the area (differing normally by two orders of magnitude), acid drainage problems do not occur as a result of mining. This is supported by the fact that coal in the area has a low sulphur content.

The amount of water that is discharged from the mine will equal the inflow minus that which is consumed in the mining operation (dust suppression and evaporation). Based on experience at Skyline Mine, the rate of water to be consumed is estimated to be 51,870,720 gallons per year (approximately 271 gpm). Skyline Mine anticipates potentially discharging approximately 2,800 gpm of mine water to Eccles Creek after the completion of mining and subsequent abandonment of the 11 Left, 12 Left A and B, and 6 Left B panels in 2004. However, this rate may vary with changes in the operation of JC-3 and because of the steady decline in potentiometric head within the aquifer discharging into Mine #2. Assumptions used in developing the discharge amount can be found in July 2002 Addendum to the PHC in Appendix F.

The water consumed in operating underground equipment, dust suppression, and evaporation is obtained from ground water sources within the mine. These underground water sources are not connected to the surface waters in the area. Extensive research has been performed by the mine to verify that water currently entering the mine is not coming from the surface or depleting surface waters. The recent July 2002 Addendum to the PHC presents data supporting this statement. The data suggests the water intercepted underground is at least 4,000 to 25,000 years old and, based on the results of tritium analyses from most of the mine waters, does not typically contain water that has been exposed to the atmosphere in the past 50 years. Additionally, the steady rate of decline in ground water levels in monitoring wells within the permit area and the results of age-dating the ground water inflows to the mine indicating the water is not getting appreciably younger, suggests that the aquifer is not receiving significant recharge of "young" surface waters.. Continued monitoring by the mine of the surface waters and seeps and springs flows in the permit and adjacent areas have shown no discernable impacts due to the increased mine inflows that were encountered in March 1999 and have continued through November 2002. It is the operator's position that the water consumed in operating Skyline Mine is not depleting surface water sources. In fact, there is an overall net gain to local river systems discharging to the Colorado River as a result of Skyline Mine discharge.

2.5.3 Alternative Water Supply

OSM Regulation 30 CFR 783.17 requires that alternative sources of water supply be identified if mining impacts will result in the contamination, diminution, or interruption of existing sources.

Because no significant adverse hydrologic impacts are expected as a result of mining in the Skyline permit area, no individual or collective source of alternative water supply has been identified.

However, the Permittee presently owns approximately 556 acre-feet of water rights in the Scofield Reservoir. Of these water rights, water sufficient for the Permittee's needs has been exchanged for rights from wells located near the mine site and at the mouth of Eccles Canyon for use in culinary and dust suppression water systems. Of this 556 acre-feet, a 148 acre-foot exchange has already been approved by the State Engineer of Utah.

It is recognized that seeps and springs are important to wildlife, particularly to small, less mobile species, and that flow reduction could potentially negatively impact these species. While flow reduction from mining related activities, including subsidence, is not expected to cause a problem, however, should such a loss be documented, mitigation measures will be taken after consultation with the Division of Oil, Gas and Mining and the Division of Wildlife Resources.

The Permittee will replace the water supply of any land owner if such a water supply proves to be contaminated, diminished or interrupted as a result of the Skyline 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, Skyline will correct any material damage resulting from subsidence caused to surface lands (which includes water rights), to the extent technologically and economically feasible, by restoring the land to a condition capable of maintaining the value and reasonably foreseeable uses that it was capable of supporting before subsidence damage. 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 Skyline will explore the transferring water rights to the injured party in flow equal to the determined loss and/or monetary reimbursement for proven material damages.

Historically, the mining activities at Skyline Mine have not resulted in the loss of surface waters or significant changes in the discharge of seeps and springs within the permit area. While significant volumes of ground water have been encountered while mining in the west and southwest portions of the permit area, no impacts to surface discharges of seeps and springs, the flow of streams, or bodies of water have been found. Age-dating of samples of water obtained from the mine indicate the water has been in place for several thousands of years. This suggests that ground water is moving very slowly through the area strata and does not discharge at a significant rate down gradient of the mine.

Very little ground water was encountered while mining in the northern portion of the existing permit area prior to the addition of the North Lease. The same geologic and hydrogeologic conditions are anticipated to occur in the North Lease as occurred in the northern portion of the existing permit area (Mine 3). Therefore, no significant inflows of ground water are anticipated as mining progresses into the North Lease area. Selected surface discharges of ground water and stream flows in the areas that could be impacted by mining activities will be monitored. Mining related subsidence is the only surface impact anticipated since no new surface facilities are currently planned for the North Lease area. If impacts to the waters within the permit area are determined to have occurred, mitigation will be implemented immediately using BTCA as described previously.

There has been some concern that Electric Lake has been impacted by the inflows of ground water to the Skyline Mine since 1998. As presented in the Addendum to the Probable Hydrologic Consequences, July 2002 and updated in October 2002, April 2003, and June 2004, a direct connection between the water in Electric Lake and the mine inflows cannot be found. However, the water flowing into the 10 Left area of the mine and discharging from the James Canyon JC-1 well contains a slight percentage of tritium. No other significant inflows of ground water into the mine contained tritium levels that would suggest a modern component of recharge. As stated by Petersen (Appendix A, Addendum to the Probable Hydrologic Consequences, July 2002, Updated October 2002):

> "It is calculated that the maximum modern component in the fault-related system could range from approximately 6.9 to 12.4 percent. It is also apparent that since routine sampling of the 10 Left groundwater system began in May 2002, the percentage of modern recharge in the groundwater system has not increased. Based on the potential modern recharge percentage calculations presented above, it is determined that of the total inflow to the 10 Left region

(approximately 3,800 gpm), a maximum of approximately 262 to 471 gpm could have originated as modern recharge. Inasmuch as Canyon Fuel has been pumping approximately 2,200 gpm from the 10 Left groundwater system into Electric Lake since September 2001, the potential net impact to the Electric Lake watershed, were it occurring, would be completely mitigated by the current pumping. Additionally, groundwater that would not otherwise be available for use without the pumping activity is being added to the watershed. Since October 2002, PacifiCorp has increased the pumping rate at JC-1 to more than 4,000 gpm. Thus, currently, the amount of groundwater being pumped into Electric Lake from JC-1 represents a volume approximately one order of magnitude greater than that which could potentially be derived from modern sources. It should be noted that there is currently **no** information that would indicate that the potential modern component in the fault-related mine inflows is directly or indirectly related to losses from Electric Lake."

Based on the above information and assuming the same percentages of modern versus ancient water applies to the water pumped from the JC-1 well at a rate of 2,200 gpm, a maximum of approximately 152 gpm to 273 gpm could have originated as modern recharge. The maximum estimated volumes of modern recharge water being discharged to the mine and from the James Canyon well would have been 744 gallons. This volume is still less than the approximately 2,200 gpm that JC-1 discharged to Electric Lake from September 2001 through September 2002.

October 2002, PacifiCorp negotiated with Skyline Mine to install a higher capacity pump in JC-1 well. The discharge after the new pump was installed was approximately 4,200 gpm. The rate of discharge from JC-1 dropped to approximately 3,900 gpm in March of 2003 and should be sustained at approximately that rate through 2004. The cause of the decline in the pumping rate is unknown but may be related to changes in well or pump efficiency.

After the new pump was installed in JC-1, the tritium concentrations in the water discharged from the well increased slightly. It appears that since January 7, 2003 the tritium concentration in the JC-1 well water has slightly increased, ranging between 1.83 and 2.34 TU. This suggests that between 6 and 22 percent of the water now being pumped from the JC-1 well has a component of water that could be considered younger than 50 years old (The percentages are based on a comparison of 2.34 TU in the well water with tritium concentrations measured in water

samples from area springs and Electric Lake that range between 8.6 and 30 TU. Table 2 of Appendix G). Assuming the calculated range of 7.8 to 27.2 percent represents the portion of young water discharged from JC-1 when the well is operated at a pumping rate of 3,900 gpm, the range of modern water discharged from JC-1 is between 304 gpm to 1,061 gpm.

The 10 Left area of the mine was sealed in October 2002 and additional uncontaminated samples of the water inflows in that area can no longer be obtained. Calculations of the percentage of modern water in the 10 Left inflows can no longer be based on actual sample data. If it is assumed the JC-1 water is representative of the 10 Left inflows, the JC-1 well water is not being "contaminated" with modern water from sources that do not normally flow into the mine, and the inflow rate of ground water to 10 Left is approximately 3,000 gpm (as estimated in March 2004), the inflow rate of modern water to 10 Left might be between 234 gpm and 816 gpm. Combining the calculated inflow rates of modern water from JC-1 and the 10 Left area results in a range of 538 gpm to 1,877gpm of a total of 6,900 gpm of water removed from the ground from JC-1 and the mine.

JC-3 pumps water from the flooded portions of the mine that include the 6 Left through 12 Left A and B panel areas. Water from the 11 Left and 12 Left A and B areas do not appear to contain modern waters. Without the JC-3 well, the from these flooded portion of the mine would be pumped to Eccles Creek and not Electric Lake. The pumping of the JC-3 well could be considered to further mitigate for the maximum possible inflow of modern water to the mine. The JC-3 well is expected to be operated for at least several years or until the persistent drought conditions end.

If a determination were made that Skyline Mine impacted Electric Lake and upper Huntington Creek waters, the JC-1 and JC-3 wells would continue to be operated by the mine to discharge water into the Huntington Creek drainage. Thus, through the mine's effort to dewater the Star point Sandstone to allow for the continuation of mining in the southwest portions of Mine 2, specifically to maintain the West Mains, any potential mitigation for the loss of water has been and continues to be accomplished.

PLANT COMMUNITIES

A report was prepared earlier by *Mt. Nebo Scientific, Inc.* (Collins 1992) of the vegetation of the Winter Quarters Canyon area (North Lease Tract Area). This report was submitted to the USDA Forest Service. The report has been included in Appendix A-2.
Revised: 11/02
Methodologies for this previous study relied on general vegetation mapping done by using existing information and limited ground-truthing techniques. Most of the mapping was done using existing maps and data from range analyses prepared by the USDA Forest Service (Manti-LaSal National Forest, Price, Utah).

Plant community named in the aforementioned study were revised to be consistent with the existing vegetation map of the permit area (Drawing 2.7.1-1a). The existing vegetation map of the area was revised using both black and white and color aerial photography. No field work or ground-truthing methods were implemented.

In October 2002 the vegetation at specific sites along the perennial streams within the North Leasewas ground truthed. This information is included in Appendix A-2. This information will be gathered in conjunction with information being gathered for the Manti-La Sal Forest Service in the preparation of an Environmental Assessment. Total acreage of each vegetation type for the North Lease area will be provided once this information has been gathered and compiled.

Aspen

The Aspen community was the most common vegetation type of the Winter Quarters Tract Area. Aspen (*Populus tremuloides*) was the dominant overstory species, whereas, depending on the area and environmental variables, snowberry (*Symphoricarpos oreophilus*) or Oregon grape (*Mahonia repens*) were the dominate understory species.

Conifer Timber

Also important by relative number of acres, these communities were dominated by Engelman spruce (*Picea engelmanii*) and subalpine fir (*Abies lasiocarpa*). Understory varied from relatively

2.8 AQUATIC WILDLIFE RESOURCES

Introduction

Both Huntington Creek and Eccles Creek flow through the project area and both provide habitat for reproducing resident populations of cutthroat trout. Cutthroat trout from Electric Lake use upper Huntington Creek for spawning and nursery activities. Scofield Reservoir, although stocked with rainbow trout exclusively, has numerous cutthroat trout which have been produced in Eccles Creek and other tributary streams such as Winter Quarters, Woods Creek, Lost Creek, Fish Creek, Pondtown Creek, Pleasant Valley Creek and possibly Boardinghouse Creek.

Eccles Creek

Eccles Creek is a small mountain stream draining west to east into Pleasant Valley Creek which flows north approximately 3 miles where it empties into Scofield Reservoir. Discharges in Eccles Creek are frequently as low as 2 cfs during late summer, fall and winter months; and high flows seldom exceed 50 cfs, even at the creek mouth. Water temperatures of streams such as Eccles Creek fluctuate because of turbulence from the rough channels. During November to March, water temperatures remain between 0-2° C. In the summer, water temperatures often fluctuate from 12-15° C daily although high temperatures seldom exceed 20° C.

Through natural erosion of mudstone, sandstone and shale deposits, Eccles Creek has periods of high total suspended solids (sedimentation). This occurs, however, during periods of high runoff when the stream waters have sufficient energy (velocity) to carry the fine sediments out of the canyon rather than depositing them on the coarser substrate materials. During normal runoff years, there are numerous clean trout spawning gravel beds in Eccles Creek. During low runoff years, fine sediments may not be flushed from the spawning grounds. Maintenance of this resource is dependent upon a continuation of flow, adequate substrate, food base and water quality conditions.

The existing aquatic species of Eccles Creek, fish and macroinvertebrates, have adapted to tolerate natural temperature fluctuations and sediment loads. The macroinvertebrate communities

of Eccles Creek have a high diversity of species representing all major trophic groups. There are species found only in high quality water streams indicating the high water quality of Eccles Creek. There are also environmentally resistant taxa present. This high diversity represents a resiliency to environmental change, especially short term changes.

Upper Eccles Creek above the White Oak Mine Road (at sampling stations ECO3, ECO2, UPMF, UPSF, Figure 2.8-A), have numerous taxa of macroinvertebrates found only in high quality waters and stable habitats. Lower Eccles Creek (Stations ECO4 and ECO5) has a more tolerant macroinvertebrate community with taxa tolerant to sedimentation dominating the community.

Cutthroat trout have historically maintained naturally reproducing populations in Eccles Creek from the National Forest boundary downstream to the creek mouth. Recent migrations, however, have been impeded by obstacles unrelated to mining, such as, irrigation diversions, and numerous beaver dams. There are no fish in the upper forks of Eccles Creek.

Construction activities caused sufficient sediment loading into Eccles Creek resulting in a significant reduction in fish populations. Cooperative efforts with DWR, however, resulted in habitat improvement by 1986 sufficient for near recovery of these populations. (See DWR report, "Recovery of the Cutthroat Trout (Salmo Clarki) Fishery in Eccles Creek, Utah From Coal Mining Impacts", Donaldson & Dalton, Volume A-3, under Aquatic Wildlife.)

Huntington Creek

Huntington Creek above Electric Lake is a small mountain stream draining north to south into Electric Lake. Discharges are frequently as low as 1.5 cfs, with spring high flows sometimes reaching 100 cfs. Water temperatures fluctuate during summer months, although daily highs seldom exceed 20°C. During winter months water temperatures seldom exceed 2°C and the stream is nearly completely iced over.

Through natural erosion of existing stream channel geological formations and adjoining hillsides, Huntington Creek waters have high loads of fine sediments during runoff periods. This occurs when runoff is high and these sediments are carried into Electric Lake rather than being deposited

on spawning gravels or other coarse substrate materials. Huntington Creek has numerous clean trout spawning gravel beds and the amount of fine sediments is not high enough to hinder spawning.

Huntington Creek has a diverse aquatic community with macroinvertebrate taxa representing all trophic levels. The successful cutthroat trout spawning and high number of resident trout evidence the high quality waters and habitat of Huntington Creek plus the ability of the macroinvertebrate community to support quality fisheries. Cutthroat trout, according to Utah Division of Wildlife Resources (UDWR) surveys, are increasing in numbers in Huntington Creek above Electric Lake. Trout produced in Huntington Creek provide an important part of the total number of fish in Electric Lake.

Winter Quarters Canyon Creek

As indicated in the 1995 environmental assessment prepared by the Forest Service and the Bureau of Land Management Winters Quarters Canyon Creek has a moderate population of macroinvertebrates. Perennial flow in the canyon has produced Stonefly larvae as far up as Box and Bob's Canyons. Mayfly nymphs were also found present in waters tested. Cutthroat trout were found within the creek east of the Forest Boundary on June 7, 1994 indicating fish are likely within perennial sections of the creek containing significant flows. Surveys conducted in Winter Quarters Canyon Creek in 2002 and 2003 indicate similar conditions exist and species were present.

Woods Canyon Creek

As indicated in the 1995 Environmental Assessment, Mayfly nymphs were found within the upper portions of Woods Canyon Creek in higher quantities than those found within Winter Quarters Canyon. Stonefly larvae were also found as high as the fork in the stream near the center of Section 34 (T 12 S, R 6 E). No fish were seen during the 1994 field survey although some may have been present. Surveys conducted in Winter Quarters Canyon Creek in 2002 and 2003 indicate similar conditions exist and species were present.

Project Impacts on Fisheries Resources

The surface facility disturbances in the portal area encroached on sections of all three upper Eccles Creek forks. In order to reduce sedimentation of these stream segments and the main stream, the tributaries and a section of Eccles Creek proper immediately below the tributary confluences were diverted into closed culverts. This modified approximately 4,200 feet of total stream habitat but did not reduce available fish habitat since fish were not found above the U.S. Forest boundary, prior to the diversion. Downstream drift of macroinvertebrates from the upper reaches of these forks still occurs as before.

At the coal loadout facilities near the mouth of the canyon (Station ECO5), approximately 600 feet of stream was moved to the north into a new channel. The new channel is 100 feet shorter but has nearly the same gradient (3 feet additional vertical drop/1,000 feet horizontal channel).

Degredation of Eccles Creek between the National Forest boundary and the coal loadout facilities should continue to be minimal since road and conveyor plans were developed and are being implemented to minimize effects on the stream.

Water being discharged from the mine is augmenting the Eccles Creek stream flow. This increased stream flow is especially beneficial during summer months when normal stream flows are low. Water temperatures are also moderated by this increased flow.

There should be little impact on Huntington Creek above Electric Lake. Impacts to date have been associated only with the construction of a new UDOT highway. Sediment control measures minimized the impact during the construction activity.

At this point in time there are believed to be no potential impacts on either Winter Quarters or Woods Canyon Creeks since no surface mining impacts are planned.

2.8.1 Aquatic Monitoring Program

An aquatic monitoring program has been conducted to meet the intent of the requirements of R614-301-311. The main purpose of the monitoring program is to gain sufficient knowledge to prevent and/or minimize impacts through wise project planning. Monitoring has: (1) described existing resources; (2) detected existing perturbations; and (3) provided the basis for wise project planning, operation and resource restoration.

The biological (macroinvertebrate and fish) and habitat (sediment and channel surveys) monitoring stations on Eccles Creek are shown in Figure 2.8-A. Sampling dates are limited by weather, but June and late October samplings are usually possible. Two seasonal sampling dates per year are required to differentiate natural seasonal intrastand variance from impact induced changes. Samples were taken annually through the project planning and early development. The biological sampling has been performed in conjunction with normal stream water monitoring so that comparative analysis is possible.

Seven stations on Eccles Creek were selected in relation to impact areas, UDWR fish sampling stations, existing macroinvertebrate and sediment stations, and water quality monitoring stations. At each station on the scheduled sample date (Table 2.8-1), four macroinvertebrate samples were taken from selected optimal substrates with a modified Surber Sampler. Three sediment samples were taken from potential spawning grounds. Replicate samples were taken to enable an analysis of variance between samples.

Habitat surveys, following methodologies used by USBLM and USDFS fisheries habitat specialists, were made annually throughout construction at critical Eccles Creek stations (Table 2.8.1). Measurements included: stream bank stability, channel substrate composition; stream gradient; riparian vegetation (type, relative cover); water width, depth and velocity at various discharges (Q) and channel width and tortuosity.

Fish surveys are conducted by UDWR personnel out of the Price office. Fish surveys are usually made in August so year class I fish will be large enough to sample and young-of-year fish are large enough to observe. Fish are measured as to total length and weight, counted and then released. These data are compared with earlier UDWR collection records, thus illustrating present fish population conditions compared with years past.

Table 2.8-2 summarizes the stream monitoring data. A summary of the sediment composition data, taken in accordance with the schedule on Table 2.8-1, is shown on Table 2.8-3. The UDWR reports have been added to the Aquatic Wildlife section of Volume A-3.

James and Burnout Creeks

A fish and macroinvertebrate monitoring program for James and Burnout Creeks will be implemented prior to undermining the lower portion of James Canyon. The fish survey consists of multi-pass electro fishing to estimate fish populations in the streams for one year and then every third year thereafter. The fish surveys will be performed in the fall of each year on or about the same date. The fish survey was initiated on October 16, 2001.

A macroinvertebrate survey of Burnout Creek will be performed twice a year for two consecutive years and then every three years thereafter. This survey will be performed in the fall and spring of each year, with the fall macroinvertebrate survey will being performed in conjunction with the fall fish survey. The macroinvertebrate survey was initiated on October 16, 2001.

A macroinvertebrate survey of James Creek initiated on October 16, 2001 will be performed twice a year for two consecutive years and then every three years thereafter or for a period determined by Canyon Fuel Company, LLC, DOGM and the DWR, to be long enough to provide data to establish population trends . This survey will be performed in the fall and spring of each year on or about the same date. The fall macroinvertebrate survey will be performed in conjunction with the fall fish survey.

The following methods have been used previously on this creek and will continue to be used for future macroinvertebrate sampling. Slight variations to the methods may occur during the field work or based on comments from regulatory agencies.

Three benthic sites will be sampled. They will be located beginning approximately 162 meters (528 feet) above the reservoir. A map with these stations will be prepared with the next sample report for James Creek.

Quantitative samples will be taken with a modified box sampler. The three samples taken will be field preserved in 70% ethyl alcohol and returned to the laboratory for processing. The samples will be sorted and invertebrates identified to the lowest possible taxonomic level using the keys of Merritt and Cummins (1996). Those of questionable identity will be further examined and

identified under magnification. The mean, standard deviation, density per square meter, and standing crop will be calculated and estimated using the same methods as in previous analysis.

Calculations of the USFS Biotic Condition Index (Winget and Mangum 1979) will be completed using the abundances of the benthic taxa to generate the dominance weighted community tolerant quotient (CTQd). The predicted community tolerant quotient (CTQp) will be calculated using water chemistry data provided in Winget (1972) for the Huntington Creek drainage.

Cluster analysis will be run using the Bray-Curtis dissimilarity index with the UPGM clustering algorithm.

Winter Quarters Canyon and Woods Canyon Creeks

During the Fall of 2002 and early Summer of 2003 fish and macroinvertebrate data for the perennial reaches within Winter Quarters Canyon and Woods Canyon Creeks in the North Lease area were gathered. Copies of the reports are included in Appendix Volume A-3.

A macroinvertebrate survey of portions of Winter Quarters Canyon and Woods Canyon Creeks will be performed twice a year for two consecutive years and then every third year thereafter or for a period determined by Canyon Fuel Company, LLC, DOGM and the DWR, to be long enough to provide data to establish population trends. This survey will be performed in the fall and spring of each year on or about the same date. The fall macroinvertebrate survey will be performed in conjunction with a fish survey.

The following methods have been and will be used for macroinvertebrate sampling. Slight variations to the methods may occur during the field work or based on comments from regulatory agencies.

Three benthic sites will be sampled in each creek. Following the first survey a map with these stations will be prepared and submitted with the next sample report (included in the following year's annual report). Quantitative samples will be taken with a modified box sampler. The samples taken will be field preserved in 70% ethyl alcohol and returned to the laboratory for processing. The samples will be sorted and invertebrates identified to the lowest possible taxonomic level using the keys of Merritt and Cummins (1996). Those of questionable identity will

be further examined and identified under magnification. The mean, standard deviation, density per square meter, and standing crop will be calculated and estimated.

Calculations of the USFS Biotic Condition Index (Winget and Mangum 1979) will be completed using the abundances of the benthic taxa to generate the dominance weighted community tolerant quotient (CTQd). The predicted community tolerant quotient (CTQp) will be calculated using water chemistry data provided in Winget (1972) for the Huntington Creek drainage.

Cluster analysis will be run using the Bray-Curtis dissimilarity index with the UPGM clustering algorithm.

Fish studies will consists of multi-pass electro fishing to estimate fish populations in the stream for one year and then every third year thereafter or for a period determined by Canyon Fuel Company, LLC, DOGM and the DWR, to be long enough to provide data to establish population trends. The fish studies will be performed in the fall of each year. The study will be included in the annual report.

The above described fish and macroinvertebrate studies will continue for two years after active mining and subsidence stops in the applicable drainages unless statistical analysis demonstrates impacts have occurred or may occur to these streams. In the event subsidence causes quantifiable damages to fish populations, stream flows, or other negative impacts on fish or wildlife habitat, the mine will identify, research and implement measures sufficient to correct the problems. If monitoring data suggests potential adverse impacts have occurred but cannot be conclusively demonstrated by the three years of collected data, a new monitoring plan to determine the type and extent of the impact will be developed by DOGM, DWR and Skyline Mine. The additional monitoring will continue until such impacts are either demonstrated or dismissed by joint consent of DOGM, DWR, and Skyline Mine. Areas where there is potential for habitat loss from subsidence are shown on Plate 4.17.3-1a. The consumption rate of water from mining activities is provided in Section 2.5.2.

Future aquatic monitoring is planned only on an as needed basis. Need will be established in conjunction with UDWR personnel and will be required only in case of a major perturbation in fish populations or other anomalous conditions. Monitoring data will be reviewed for mining related impacts, and, if found, a mitigation plan will be developed in conjunction with UDWR and UDOGM

personnel. The Permittee will cooperate with UDWR in the investigation of any such conditions. This approach to future monitoring is consistent with the requirements recommended by the UDWR, Price office.

Eccles Creek

To determine the impacts to Eccles Creek , if any, related to discharge of mine water, semi-annual macroinvertebrate studies will be conducted. The studies will start in the spring of 2002 and will continue for three (3) consecutive years or for a period determined by Canyon Fuel Company, LLC, DOGM and the DWR, to be long enough to provide data to establish population trends.

The following methods have been used previously on this creek and will be used for future sampling. Slight variations to the methods may occur during the field work or based on comments from regulatory agencies.

Four samples will be taken at intervals separated by approximately 20 to 30 m. Samples will continue to be taken from three stations on the stream, with five replicates per station. These stations on Eccles Creek are located above South Fork (site 1), Eccles Creek at Whisky Canyon (site 2), and Lower Eccles Creek (site 3). A map with these stations has been added to the Aquatic Wildlife section of Volume A-3.

A box sampler will be used to collect the samples. Samples will be taken in areas with rubble or cobble substrates to insure that similar habitats are examined. When possible, samples will be taken from parts of the stream channel that had been submerged continuously throughout the year. The substrate will be stirred to a depth of approximately 5 cm. Rocks within the area of the sampler will be removed and washed to insure quantitative assessment of the invertebrates. The box sampler will have a net mesh of approximately 250 microns. The samples will be concentrated on a screen with a mesh of approximately 64 microns and field preserved in ethyl alcohol.

In the laboratory the samples will be sorted in a pan illuminated from below. All invertebrates will be removed and identified to the lowest possible taxonomic level using the keys of Merritt and Cummins (1996). The mean density and standard deviation per sample will be calculated for each taxon and the mean values will be used to determine the density per square meter.

The collected data will be compared to the previous data collected in 1979 through 1983 and included in Appendix A-3. After comparing historical data with data obtained in the three year study starting in 2002, a determination will be made if the macroinvertebrate in Eccles Creek are impacted by the mine water discharge. If impacts are found, the significance of the impacts will be determined and appropriate mitigation is necessary will be performed.

Fish studies will be conducted on Eccles Creek in 2003.The fish study consists of multi-pass electro fishing to estimate fish populations in the stream for one year and then every third year thereafter. The fish studies will be performed in the fall of each year. Results from sampling will be compared with all available historic studies done on this creek.

Aquatic Monitoring Summary

Aquatic monitoring data have been accumulated for a period of six years. Summaries of these data are presented in Tables 2.8.2 and 2.8.3. Backup data for these summaries, including the consultants original report and subsequent summary reports, may be found in Appendix Volume A-3, Aquatic Wildlife.

During a 23 year time span macro-invertebrate data was collect on 24 site visits to Eccles Creek and compiled into a report entitled "A Compilation and Comparison of Eccles Creek Macro-Invertebrate Data for the Period of 1979 - 2002" prepared by Dennis Shiozawa, Ph.D., Professor of Fisheries Biology at Brigham Young University, Provo, Utah. The report documents that Eccles Creek has undergone changes in the benthic community structure through the years of study and demonstrates the resilience and adaptability of the creek to disturbance by multiple sources. The report is available for review at the Division of Oil, Gas and Mining public library.

EarthFax Engineering
Perennial Length and Gradient Studies of
Winter Quarters Canyon and Woods Canyon Creeks
2002 and 2003

June 29, 2004

Chris Hansen
Canyon Fuel Company
Skyline Mine
HC 35, Box 380
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Subject: Winter Quarters Canyon and Woods Canyon GPS Survey.

Dear Chris Hansen:

As per your request, EarthFax Engineering, Inc. conducted a stream-channel survey in Winter Quarters Canyon and Woods Canyon in central Utah. The purpose of the survey is to map stream channels with perennial flow and create stream profiles. This was accomplished on October 22 and 23, 2003 and June 25, 2004 using Trimble Pro XRS® Global Positioning systems (GPS) receivers with sub-half-meter accuracy. GPS data were recorded in Universal Transverse Mercater (UTM), Nad 27 coordinate system. The perennial stretches of the survey area streams are indicated on Plate 1 based on the perennial stream survey conducted by EarthFax on October 31, 2002 and summarized in Table 1. This survey defined and mapped the uppermost perennial points in all streams within the Woods and Winter Quarters drainages. In addition, Plate 1 shows the locations of all GPS points and Plates 2 and 3 show stream profiles based on the GPS elevation data. It should be noted that two perenial Bob's Canyon tributaries (BT) were added to the survey as result of the GPS survey performed in 2003, BT-2 and BT-3.

GPS data are separated into two appendices based on watershed. Appendix A contains the data from the Winter Quarters Canyon drainage which includes the main Winter Quarters Canyon and its tributaries (WQT), Bob's Canyon, Bob's Canyon tributaries (BT), and Box Canyon. Woods Canyon and its tributaries (WT) are represented in Appendix B. The data are presented for each channel in descending order from at or near the uppermost perennial point.

Numerous active and inactive beaver ponds were encountered during the survey. The locations of active beaver ponds are identified on the map and the stream profiles. Also observed in the field was a fresh stream cut in the stream bank that is approximately 30 feet high by 50 feet long. It is located on the south side of Bob's Canyon near the confluence with Box Canyon and is also identified on the map and the stream profiles.

Problems and limitations that were encountered during the GPS survey pertain to the ability of the GPS receivers to recognize satellites. In some areas reliable data could not be obtained due to narrow canyon walls and/or dense conifer cover. These areas are shown on the map and are represented by dashed lines on the stream profiles. In other areas the accuracy of the data was reduced due to interference caused by trees confusing the GPS signal. The discrepancies are obvious on the stream profiles where the stream channels appear to gain elevation in the downstream direction at some locations. It is important to realize that these problems are inherent to GPS systems in dense cover. Surveying by traditional methods will potentially yield more accurate results but are extremely cost prohibitive given the remote nature of the permit area.

Thank you for the opportunity to help serve your environmental needs. If you have any questions about this survey please call me.

Sincerely,

James Hoggard
Geologist

Enclosures (Map, Plates, and Appendices)

TABLE 1

Start of perennial stream flow, North Lease area, October 31, 2002 and October 22, 2003

ID[a]	Person	WGS-84 Datum (Typical Default Field GPS Reading)				NAD-27 Datum (USGS Map Coordinate)			
		Latitude (N)	Longitude (W)	UTM Easting (m)	UTM Northing (m)	Latitude (N)	Longitude (W)	UTM Easting (m)	UTM Northing (m)
P1	JRH	39° 43' 44.34"	111° 14' 52.80"	478747	4397707	39° 43' 44.5"	111° 14' 50.2"	478808	4397502
P2		39° 43' 37.08"	111° 14' 45.42"	478922	4397482	39° 43' 37.2"	111° 14' 42.8"	478984	4397276
P3		39° 43' 56.46"	111° 14' 17.17"	479596	4398078	39° 43' 56.6"	111° 14' 14.5"	479659	4397873
P4		39° 43' 51.48"	111° 13' 57.54"	480063	4397923	39° 43' 51.6"	111° 13' 54.9"	480125	4397717
P5		39° 43' 46.38"	111° 13' 45.12"	480358	4397765	39° 43' 46.5"	111° 13' 42.5"	480420	4397559
P6		39° 44' 1.08"	111° 12' 44.52"	481802	4398215	39° 44' 1.2"	111° 12' 41.9"	481864	4398009
P7	LDJ	39° 41' 47.40"	111° 13' 39.65"	480479	4394097	39° 41' 47.5"	111° 13' 37.0"	480542	4393890
P8		39° 43' 28.80"	111° 14' 3.00"	479931	4397224	39° 43' 28.9"	111° 14' 0.4"	479992	4397018
P9	LCD	39° 43' 23.3"	111° 15' 14.7"	478224	4397059	39° 43' 23.4"	111° 15' 12.1"	478286	4396854
P10		39° 43' 23.7"	111° 15' 6.4"	478421	4397071	39° 43' 23.8"	111° 15' 3.8"	478482	4396865
P11		39° 42' 23.6"	111° 14' 39.9"	479047	4395217	39° 42' 23.7"	111° 14' 37.3"	479109	4395011
P12		39° 42' 14.1"	111° 13' 56.8"	480073	4394921	39° 42' 14.2"	111° 13' 54.2"	480135	4394715
P13		39° 42' 59.3"	111° 13' 39.5"	480488	4396313	39° 42' 59.4"	111° 13' 36.9"	480551	4396107
P14		39°43'23.8"	111° 14' 46.7"	478890	4397073	39° 43' 23.9"	111° 14' 44.1"	478953	4396867
P15		39° 42' 48.4"	111° 14' 48.6"	478842	4395982	39° 42' 48.5"	111° 14' 46.0"	478904	4395776

[a] See Plate 1

Appendix A

GPS Data from the Winter Quarters Canyon Drainage,
Including Bob's Canyon and Box Canyon

MAIN WINTER QUARTERS DRAINAGE

Easting	Northing	Elevation
Main Winter Quarters Canyon		
480165.27	4394761.356	9003.961
480189.743	4394781.588	8979.122
480232.6	4394930.135	8905.668
480279.219	4395006.664	8849.905
480336.299	4395155.287	8777.947
480318.996	4395322.586	8712.362
480316.708	4395410.069	8668.1
480324.806	4395483.366	8639.351
480348.462	4395561.362	8618.092
480359.883	4395637.113	8565.636
480366.818	4395667.805	8549.674
480394.696	4395712.66	8515.338
480479.068	4395732.603	8490.506
480585.183	4395790.767	8466.751
480653.204	4395862.981	8451.373
480692.773	4395910.514	8431.016
480737.206	4395946.635	8415.842
480811.357	4395987.525	8404.484
480918.012	4396015.444	8378.216
481052.874	4396031.605	8357.36
481163.691	4396071.438	8328.573
481264.278	4396141.725	8311.9
481363.327	4396218.467	8299.712
481443.644	4396278.116	8279.651
481555.817	4396314.459	8253.849
481638.116	4396343.706	8245.756
481728.175	4396366.203	8228.592
481807.611	4396387.602	8217.017
Tributary WQT 1		
480453.868	4396145.338	8586.516
480477.531	4396138.365	8595.798
480557.839	4396094.727	8521.902
480599.137	4396064.14	8492.769
480647.121	4396031.526	8466.066
480684.465	4395994.894	8449.097
480737.206	4395946.635	8415.842
Tributary WQT 2		
480545.406	4393892.039	9199.971
480586.197	4393913.453	9149.745
480672.431	4393887.236	9090.034
480733.655	4393907.877	9057.873
480782.151	4393927.892	9039.592
480838.419	4393973.73	8995.71
480894.796	4394128.461	8936.02
480922.548	4394157.969	8929.418
480970.377	4394199.376	8907.053
481030.367	4394258.444	8939.723
481119.928	4394312.801	8847.582
481163.233	4394340.403	8829.778
481180.263	4394353.13	8791.899
481252.656	4394397.154	8775.074
481286.873	4394421.957	8754.149
481320.539	4394486.646	8724.505

Easting	Northing	Elevation
WQT 2 continued		
481319.215	4394582.85	8736.016
481282.199	4394696.388	8669.503
481258.891	4394836.952	8639.079
481259.459	4394912.47	8611.571
481275.593	4394976.496	8600.382
481316.248	4395073.163	8574.886
481252.671	4395261.438	8526.584
481225.283	4395352.561	8495.274
481193.145	4395474.362	8469.144
481197.96	4395521.329	8461.018
481182.56	4395597.086	8485.734
481181.653	4395680.852	8430.29
481120.928	4395911.601	8388.424
481136.702	4395989.544	8353.012
481163.691	4396071.438	8328.573
Tributary WQT 3		
480008.609	4396994.453	9174.888
480064.23	4397003.186	9141.747
480098.689	4397012.172	9091.118
480150.188	4397010.779	9009.739
480190.572	4397012.972	8979.28
480257.263	4397019.899	8995.854
480383.584	4396992.694	8854.21
480453.636	4396975.975	8824.176
480504.614	4396954.88	8798.997
480573.795	4396925.881	8764.913
480645.92	4396924.002	8743.507
480738.404	4396901.839	8698.145
480840.898	4396873.01	8643.609
480941.681	4396826.481	8604.404
481031.895	4396795.277	8580.088
481103.578	4396759.549	8545.703
481155.348	4396734.152	8513.782
481231.532	4396673.757	8460.175
481312.017	4396615.629	8424.266
481368.382	4396575.16	8388.961
481411.164	4396519.927	8356.191
481494.347	4396429.509	8310.341
481557.204	4396337.095	8270.2
481555.817	4396314.459	8253.849

BOB'S CANYON DRAINAGE

Easting	Northing	Elevation
Main Bob's Canyon		
478269.359	4396869.739	9508.648
478280.791	4396858.677	9487.319
478302.953	4396846.925	9450.062
478328.05	4396834.172	9402.659
478367.38	4396803.106	9322.949
478776.495	4396464.194	8966.706
478861.974	4396415.221	8933.832
478921.415	4396399.979	8908.255
479000.216	4396351.982	8882.284
479146.455	4396257.093	8847.262
479175.051	4396201.92	8814.521
479264.005	4396158.339	8781.221
479329.219	4396129.587	8774.615
479421.129	4396081.256	8748.834
479482.109	4396057.34	8729.771
479541.437	4396033.5	8713.857
479601.712	4396010.154	8709.706
479783.367	4395905.04	8664.649
479889.095	4395845.216	8642.768
479968.643	4395807.187	8618.689
480040.197	4395791.581	8622.307
480133.693	4395749.901	8574.708
480177.519	4395725.068	8563.048
480291.847	4395702.924	8534.252
480394.696	4395712.66	8515.338
Tributary BT 1		
478488.729	4396852.495	9305.504
478484.966	4396872.077	9340.533
Tributary BT 2		
478953.096	4396867.268	9471.122
478913.206	4396816.239	9421.515
478905.507	4396797.593	9399.464
478878.032	4396762.748	9358.4
478868.253	4396718.104	9287.029
478864.152	4396701.642	9275.71
478849.422	4396656.843	9175.079
478844.328	4396644.114	9154.346
478831.627	4396616.117	9113.133
478804.619	4396552.115	9027.037
478808.562	4396525.966	9023.392
478776.495	4396464.194	8966.706
Tributary 'BT 3		
478904.77	4395776.819	9054.076
478955.157	4395885.144	8981.243
479004.356	4395991.776	8901.166
479075.917	4396051.211	8856.117
479154.444	4396088.255	8827.408
479219.103	4396114.412	8810.217
479308.579	4396113.904	8788.103
479329.219	4396129.587	8774.615

BOX CANYON

Easting	Northing	Elevation
479474.205	4395166.595	8924.967
479677.06	4395210.468	8823.077
479797.134	4395246.373	8796.001
479950.003	4395293.89	8741.746
480019.979	4395331.822	8729.314
480085.98	4395350.579	8714.842
480160.848	4395412.676	8691.672
480291.129	4395703.353	8544.313

Appendix B

GPS Data from the Woods Canyon Drainage

WOODS CANYON DRAINAGE

Easting	Northing	Elevation
Main Woods Canyon		
478722.489	4397424.696	9279.925
478962.288	4397600.417	9071.565
479055.359	4397687.643	9048.773
479123.862	4397784.556	9005.195
479143.628	4397812.683	9008.876
479175.559	4397849.856	8975.095
479213.04	4397884.953	8969.044
479230.4	4397913.271	8951.616
479264.603	4397947.296	8921.303
479309.855	4397968.378	8928.027
479339.379	4397987.615	8908.164
479378.732	4398009.263	8898.459
479429.987	4398034.29	8887.048
479468.493	4398035.885	8895.369
479575.875	4398041.945	8856.906
479600.676	4398036.96	8827.027
479618.589	4398026.565	8830.477
479647.329	4398030	8831.42
479692.637	4398032.089	8806.647
479738.669	4398035.736	8791.481
479782.977	4398062.648	8792.87
479834.652	4398084.725	8770.856
479892.752	4398073.6	8761.411
479948.297	4398058.721	8756.521
480011.268	4398037.925	8735.755
480068.909	4398000.362	8716.837
480119.799	4397969.34	8698.815
480164.26	4397948.348	8690.271
480254.337	4397911.697	8670.606
480289.739	4397892.872	8662.481
480327.79	4397883.435	8658.487
480384.691	4397857.483	8644.207
480420.774	4397846.282	8646.002
480455.958	4397847.224	8626.387
480488.929	4397843.145	8614.543
480536.946	4397834.073	8620.67
480606.015	4397861.275	8591.53
480654.598	4397902.498	8600.45
480702.148	4397917.593	8572.259
480739.607	4397968.403	8569.743
480789.337	4398007.599	8564.623
480854.981	4398066.489	8536.1
480915.508	4398144.607	8525.847
481012.867	4398199.699	8500.02
481122.774	4398246.817	8481.872
481187.034	4398263.214	8452.957
481258.226	4398271.134	8441.866
481379.993	4398295.894	8447.314
481448.916	4398307.16	8418.486
481509.44	4398306.579	8388.611
481623.948	4398284.902	8370.354
481743.124	4398235.049	8357.257
481812.951	4398186.435	8339.286
481881.818	4398157.688	8314.097
481936.842	4398145.292	8308.387
482037.485	4398123.672	8295.685

Easting	Northing	Elevation
Tributary WT 1		
478978.548	4397265.942	9328.937
478962.288	4397600.417	9071.565
Tributary WT 2		
479655.372	4397899.433	8879.342
479657.893	4397931.354	8853.308
479675.238	4397992.576	8824.985
479692.637	4398032.089	8806.647
Tributary WT 3		
480120.764	4397700.664	8862.08
480141.231	4397722.482	8811.232
480169.292	4397765.066	8776.821
480205.391	4397824.898	8737.648
480227.718	4397856.727	8712.938
480289.739	4397892.872	8662.481
Tributary WT 4		
480422.071	4397582.238	8836.209
480471.948	4397622.122	8751.261
480484.869	4397665.009	8727.019
480508.269	4397721.961	8677.767
480531.047	4397785.255	8649.678
480536.946	4397834.073	8620.67
Tributary WT 5		
481936.842	4398145.292	8308.387
481860.07	4397985.708	8397.947
481891.185	4398054.242	8365.663
481918.47	4398115.323	8366.735

RIPARIAN PLANT COMMUNITY SURVEY NEAR SCOFIELD, UTAH

WINTER QUARTERS CANYON AND WOODS CANYON

2002

MT. NEBO SCIENTIFIC

RIPARIAN PLANT COMMUNITY SURVEY
NEAR SCOFIELD, UTAH

WINTER QUARTERS CANYON
&
WOODS CANYON
2002

Winter Quarters Canyon Creek

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TABLE OF CONTENTS

INTRODUCTION 1

METHODS 1

RESULTS 2

LITERATURE CITED 3

SAMPLE DATA TABLES 4-25

COLOR PHOTOGRAPHS 26-31

SAMPLE LOCATION MAPS 32-33

RIPARIAN PLANT COMMUNITY SURVEY

WINTER QUARTERS CANYON
&
WOODS CANYON
2002

INTRODUCTION

Due to proposed mining expansions into an area north of the mine, the Skyline Mine was required to collect baseline data of some of the biological resources in two canyons located within the new permit area. The purpose of this report is to provide baseline data for the year 2002 of the riparian communities of Winter Quarters Canyon and Woods Canyon.

METHODS

A survey was conducted in representative riparian plant communities in Winter Quarters Canyon and Woods Canyon. Although slightly modified, the study was based on methods written for a Level II Survey (USDA Forest Service 1992). Most of the fieldwork was conducted in October 2002 with some follow-up work done in November 2002. Using the Forest Service protocol, data from representative "reaches" along the creek of Winter Quarters Canyon and Woods Canyon were recorded. Field parameters used are shown on Table 1. Additionally, several other reaches were observed and photographed to note major changes (if any) from the representative

sample reaches. Specific sample locations are shown on the enclosed maps. The data recorded from these sample locations have been provided on the summary tables in this report. Color photographs of each sample site were taken at the time of sampling which have been included in this report. Photographs were also taken of several reaches between each sample site. These photos were *not* included in this report, but can be made available if they are needed for reference in the future.

TABLE 1: Field Parameters for the Riparian Survey

COMPLEX	PHOTOGRAPH TAKEN
WATERBODY NAME	LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA
LOCATION	RIPARIAN AREA
DATE	SPECIES OBSERVED
OBSERVER(S)	POOL ATTRIBUTES
QUAD NAME	% area in pools
GEOLOGIC PARENT MATERIAL	% pool area made up of pools > 2' deep
ASPECT	AQUATIC VEGETATION
VALLEY BOTTOM TYPE	% streambed with filamentous algae
STREAM GRADIENT	% stream margin with rooted aquatic
ELEVATION	BANK TYPE & VEGETATION OVERHANG
SIZE OF COMPLEX	% bank length undercut (<90°)
SOIL FAMILY	% bank length gently sloping (>135°)
ADJACENT UPLAND VEGETATION	% bank length with overhanging vegetation
VEGETATIVE DESCRIPTION	BANK CONDITION
SUCCESSIONAL STATUS	% bank length vegetated, stable
APPARENT FORAGE TREND	% bank length unvegetated, stable
ESTIMATED FORAGE PRODUCTION	% bank length vegetated, unstable
BEAVER ACTIVITY	% bank length unvegetated, unstable
GREEN LINE (Hydric):	ADDITIONAL NOTES:

RESULTS

The tables on the following pages provide baseline data and other information about each sample site in the riparian areas of Winter Quarters and Woods Canyon.

LITERATURE CITED

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology. Pagosa Springs, CO.

USDA Forest Service. March 1992. Integrated riparian evaluation guide. Intermountain Region. Ogden, UT.

TABLE 2: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - WQ-R1

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: See enclosed map

DATE: 27 September 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows east

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 3.0°

ELEVATION: 8,400 ft.

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Fir Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Grass/Sedge/Forb	100%

SUCCESSIONAL STATUS: somewhat transitional

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 700 lbs/ac

TABLE 2 (continued)
Winter Quarters
Sample Site: WQ-R1

BEAVER ACTIVITY: moderate to heavy near sample area

GREEN LINE (Hydric): Water width = 6 ft; green line = 6 ft.

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Graminoids
Picea pungens	*Ribes cereum*	*Naturtium officinale*	*Agrostis stolonifera*
Pseudotsuga menziesii		*Geranium richardsonii*	*Carex sp.*
Abies lasiocarpa		*Caltha leptosepala*	*Elymus glaucus*
Abies concolor		*Urtica dioica*	

POOL ATTRIBUTES

% area in pools: 20

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 35

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 25

BANK CONDITION

% bank length vegetated, stable: 70

% bank length unvegetated, stable: 15

% bank length vegetated, unstable: 8

% bank length unvegetated, unstable: 7

NOTES:

- Good flows in stream.
- Spring on the side slope.
- Walked up and down this general area. Stream characteristics were similar.
- Some instability here (see photograph).

TABLE 3: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - WQ-R2

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: See enclosed map

DATE: 27 October 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows east

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 10°

ELEVATION: 8,560 ft.

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Herbland Right: Spruce/Fir/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Redtop/Sedge/Rush	100%

SUCCESSIONAL STATUS: climax

APPARENT FORAGE TREND: decreasing due to drought conditions

ESTIMATED FORAGE PRODUCTION: 500 lbs/ac

TABLE 3 (continued)
Winter Quarters
Sample Site: WQ-R2

BEAVER ACTIVITY: None observed

GREEN LINE (Hydric): 4.5 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Graminoids
			Agrostis stolonifera
			Carex sp.
			Juncus sp.

POOL ATTRIBUTES

% area in pools: 40

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 40

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 90

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

NOTES:

- Lots of moss in this area.
- Only a trickle of water flowing in this tributary.

TABLE 4: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - WQ-R3

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: See enclosed map

DATE: 27 October 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows Northeast

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 4.0°

ELEVATION: 8,470 ft.

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Fir/Aspen Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Grass/Sedge/Forb	100%

SUCCESSIONAL STATUS: somewhat transitional

APPARENT FORAGE TREND: decreasing due to drought conditions

ESTIMATED FORAGE PRODUCTION: 600 lbs/ac

TABLE 4 (continued)
Winter Quarters
Sample Site: WQ-R3

BEAVER ACTIVITY: none observed

GREEN LINE (Hydric): 6 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Graminoids**
Picea pungens	*Ribes aureum*	*Geranium richardsonii*	*Agrostis stolonifera*
Pseudotsuga menziesii		*Fragaria vesca*	*Carex sp.*
Abies lasiocarpa			*Juncus sp.*
Abies concolor			

POOL ATTRIBUTES

% area in pools: 45

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 5-10

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 25

BANK CONDITION

% bank length vegetated, stable: 95

% bank length unvegetated, stable: 5

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

NOTES:

TABLE 5: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - WQ-R4

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: See enclosed map

DATE: 27 October 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows northeast

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 2.5°

ELEVATION: 8,310 ft.

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Snowberry/Big Sagebrush Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Grass/Sedge/Forb	100%

SUCCESSIONAL STATUS: somewhat transitional

APPARENT FORAGE TREND: decreasing due to drought conditions.

ESTIMATED FORAGE PRODUCTION: 1000 lbs/ac

TABLE5 (continued)
Winter Quarters
Sample Site: WQ-R4

BEAVER ACTIVITY: None observed

GREEN LINE (Hydric): 7.5 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Graminoids
Picea pungens	*Symphoricarpos oreophilus*	*Cirsium sp.*	*Agrostis stolonifera*
Pseudotsuga menziesii	*Artemisia tridentata*		*Carex sp.*
Abies lasiocarpa	*Salix sp.*		
Abies concolor			

POOL ATTRIBUTES

% area in pools: 40

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 10

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 90

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

NOTES:

TABLE 6: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - WQ-R5

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: See enclosed map

DATE: 27 October 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows east

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 3.0°

ELEVATION: 8,240 ft.

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Snowberry/Big Sagebrush Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Grass/Sedge/Forb	100%

SUCCESSIONAL STATUS: somewhat transitional

APPARENT FORAGE TREND: decreasing due to drought conditions.

ESTIMATED FORAGE PRODUCTION: 100 lbs/ac

TABLE 6 (continued)
Winter Quarters
Sample Site: WQ-R5

BEAVER ACTIVITY: none observed

GREEN LINE (Hydric): 15 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Graminoids**
Picea pungens	*Symphoricarpos oreophilus*	*Naturtium officinale*	*Agrostis stolonifera*
Pseudotsuga menziesii	*Chrysothamnus nauseosus*	*Geranium richardsonii*	*Carex sp.*
Abies lasiocarpa		*Cirsium sp.*	*Bromus carinatus*
		Senecio sp.	*Juncus articus*
		Achillea millefolium	
Abies concolor		*Urtica dioica*	

POOL ATTRIBUTES
- % area in pools: 45
- % pool area made up of pools > 2' deep: 0

AQUATIC instability
- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 15

BANK TYPE & VEGETATION OVERHANG
- % bank length undercut (<90°): 0
- % bank length gently sloping (>135°): 100
- % bank length with overhanging vegetation: 10

BANK CONDITION
- % bank length vegetated, stable: 70
- % bank length unvegetated, stable: 20
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 10

NOTES:
•

TABLE 7: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - WQ-R6

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: See enclosed map

DATE: 6 November 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows southeast

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 2°

ELEVATION: 8,630 ft.

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Grass/Sedge/Forb	100%

SUCCESSIONAL STATUS: climax

APPARENT FORAGE TREND: decreasing due to drought conditions.

ESTIMATED FORAGE PRODUCTION: 800 lbs/ac

TABLE 7 (continued)
Winter Quarters
Sample Site: WQ-R6

BEAVER ACTIVITY: some activity in general area, but not right at sample area

GREEN LINE (Hydric): 9 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Graminoids
Picea pungens	*Symphoricarpos oreophilus*		
Pseudotsuga menziesii			
Abies lasiocarpa			
Abies concolor			

POOL ATTRIBUTES

% area in pools: 35

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 15

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 85

% bank length unvegetated, stable: 15

% bank length vegetated, unstable: 3

% bank length unvegetated, unstable: 2

NOTES:

- A decision was later made to re-visit area and sample a couple more areas
- Some data was difficult to take due to frozen water.

TABLE 8: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - WQ-R7

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: See enclosed map

DATE: 6 November 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows north

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 10° - 12°

ELEVATION: 8,630 ft.

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Fir Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Grass/Sedge/Forb	100%

SUCCESSIONAL STATUS: climax

APPARENT FORAGE TREND: decreasing due to drought conditions.

ESTIMATED FORAGE PRODUCTION: 750 lbs/ac

TABLE 8 (continued)
Winter Quarters
Sample Site: WQ-R7

BEAVER ACTIVITY: none observed

GREEN LINE (Hydric): 8 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Graminoids
Picea pungens	*Symphoricarpos oreophilus*		*Agrostis stolonifera*
Pseudotsuga menziesii			*Carex sp.*
Abies lasiocarpa			
Abies concolor			

POOL ATTRIBUTES

% area in pools: 20

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: (too frozen to get good data here)

% stream margin with rooted aquatic:

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 0

BANK CONDITION

% bank length vegetated, stable: 65

% bank length unvegetated, stable: 25

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 5

NOTES:

- The stream was too frozen to get very good data on this date.

TABLE 9: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - W-R1

WATERBODY NAME: Woods Canyon Creek

LOCATION: See enclosed map

DATE: 26 October 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows east

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 3.5°

ELEVATION: 8,680 ft

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).
Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Snowberry/Grass Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Redtop	80%
Willow	10%
Rush	10%

SUCCESSIONAL STATUS: climax

APPARENT FORAGE TREND: decreasing due to drought conditions.

ESTIMATED FORAGE PRODUCTION: 1000 lbs/ac

TABLE 9 (continued)
Winter Quarters
Sample Site: W-R1

BEAVER ACTIVITY: none observed at this site, but beaver in other areas near this.

GREEN LINE (Hydric): 8 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Graminoids**
Picea engelmannii	*Symphoricarpos oreophilus*	*Viola sp.*	*Agrostis stolonifera*
		Achillea millefolium	*Juncus sp.*

POOL ATTRIBUTES

% area in pools: 10

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 15

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 60

BANK CONDITION

% bank length vegetated, stable: 80

% bank length unvegetated, stable: 20

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

NOTES:

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TABLE 10: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - W-R2

WATERBODY NAME: Woods Canyon Creek

LOCATION: See enclosed map

DATE: 26 October 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows northeast

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 4°

ELEVATION: 8,620 ft.

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Fir/Aspen Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Redtop	100%

SUCCESSIONAL STATUS: climax

APPARENT FORAGE TREND: decreasing due to drought conditions.

ESTIMATED FORAGE PRODUCTION: 800 lbs/ac

TABLE 10 (continued)
Winter Quarters
Sample Site: W-R2

BEAVER ACTIVITY: none observed

GREEN LINE (Hydric): 7 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Graminoids
			Agrostis stolonifera

POOL ATTRIBUTES

% area in pools: 50

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 10

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 80

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 5

NOTES:

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TABLE 11: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - W-R3

WATERBODY NAME: Woods Canyon Creek

LOCATION: See enclosed map

DATE: 26 October 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows east

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 3°

ELEVATION: .8,370 ft

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Herbland Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Redtop	100%

SUCCESSIONAL STATUS: climax

APPARENT FORAGE TREND: decreasing due to drought conditions.

ESTIMATED FORAGE PRODUCTION: 1,000 lbs/ac

TABLE 11 (continued)
Winter Quarters
Sample Site: W-R3

BEAVER ACTIVITY: none observed

GREEN LINE (Hydric): 15 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Graminoids
Picea pungens	*Symphoricarpos oreophilus*	*Urtica dioica*	*Agrostis stolonifera*
Pseudotsuga menziesii			

POOL ATTRIBUTES

% area in pools: 20

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: 5

% stream margin with rooted aquatic: 15

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 85

% bank length unvegetated, stable: 5

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 5

NOTES:

- There was some snow on the riparian vegetation in some areas.

TABLE 12: RIPARIAN COMPLEX DATA SHEET (LEVEL II)

COMPLEX: Riverine - W-R4

WATERBODY NAME: Woods Canyon Creek

LOCATION: See enclosed map

DATE: 26 October 2002

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah, USGS 7.5 Minute Series

GEOLOGIC PARENT MATERIAL: Mesaverde Group

ASPECT: Stream flows east

VALLEY BOTTOM TYPE: Valley Type II (Rosgen 1996)

STREAM GRADIENT: 3°

ELEVATION: 8,280 ft

SIZE OF COMPLEX: (refer to distance between sample points on map and the respective data).

SOIL FAMILY:

- Curecanti family-Pathead complex (Map Unit 23)
- Trag-Croydon complex (Map Unit 118)

Reference: Jensen, E.H., J.W. Borchert. 1988. Soil Survey of Carbon Area, Utah. USDA Soil Conservation Service (Natural Resource Conservation Service).

Note: *The above reference had mapped and described the soils adjacent to the study area, but did not quite include the study area. Therefore, the most likely soils to be in the study area were listed based on this SCS survey.*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Herbland Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
Redtop	100%

SUCCESSIONAL STATUS: climax

APPARENT FORAGE TREND: decreasing due to drought conditions.

ESTIMATED FORAGE PRODUCTION: 1,100 lbs/ac

TABLE 12 (continued)
Winter Quarters
Sample Site: W-R4

BEAVER ACTIVITY: none observed

GREEN LINE (Hydric): 15 ft

PHOTOGRAPH TAKEN: yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Graminoids
Picea pungens	*Symphoricarpos oreophilus*	*Urtica dioica*	*Agrostis stolonifera*
Pseudotsuga menziesii			

POOL ATTRIBUTES

% area in pools: 20

% pool area made up of pools > 2' deep: 0

AQUATIC instability

% streambed with filamentous algae: 5

% stream margin with rooted aquatic: 15

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 85

% bank length unvegetated, stable: 5

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 5

NOTES:

- There was some snow on the riparian vegetation in some areas.

Figure 1: Winter Quarters Canyon Sample Site: WQ-R1

Figure 2 : Winter Quarters Canyon Sample Site: WQ-R2

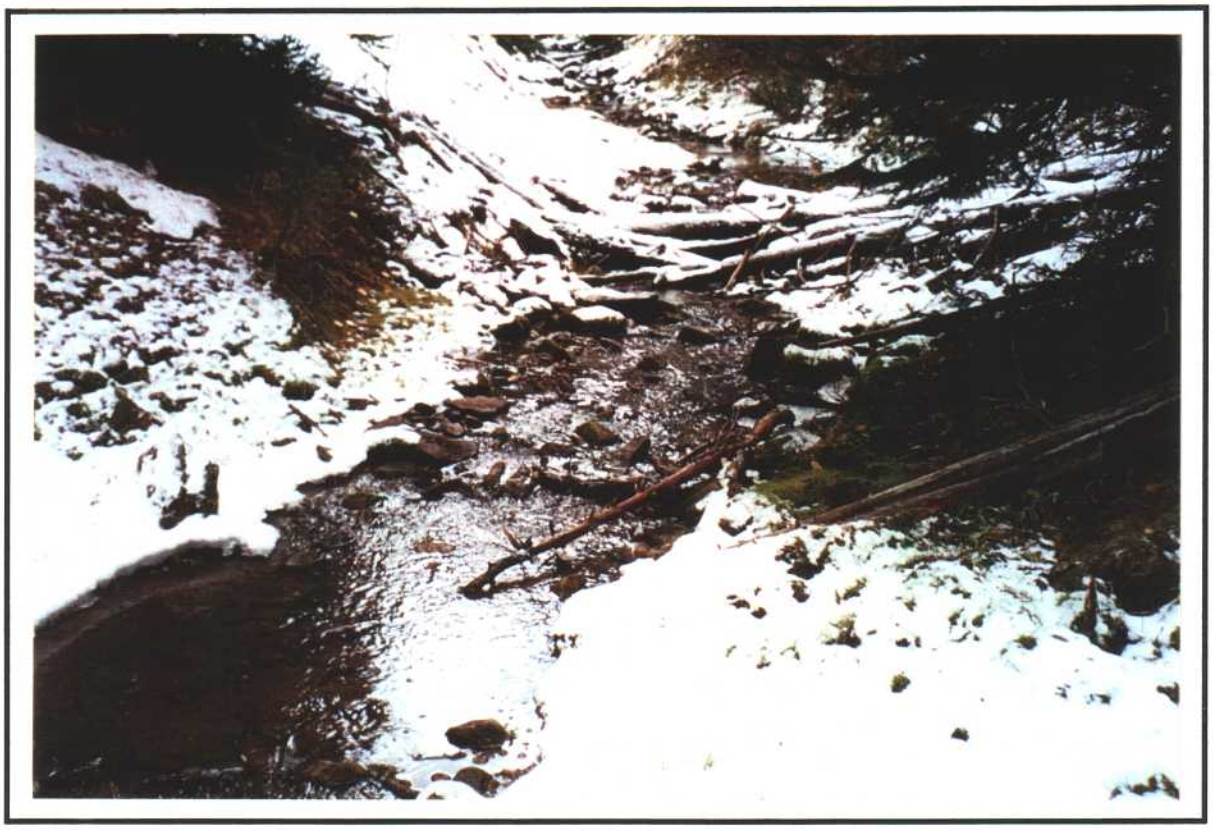


Figure 3: Winter Quarters Canyon Sample Site: WQ-R3

Figure 4 : Winter Quarters Canyon Sample Site: WQ-R4

Figure 5: Winter Quarters Canyon Sample Site: WQ-R5

Figure 6: Winter Quarters Canyon Sample Site: WQ-R6

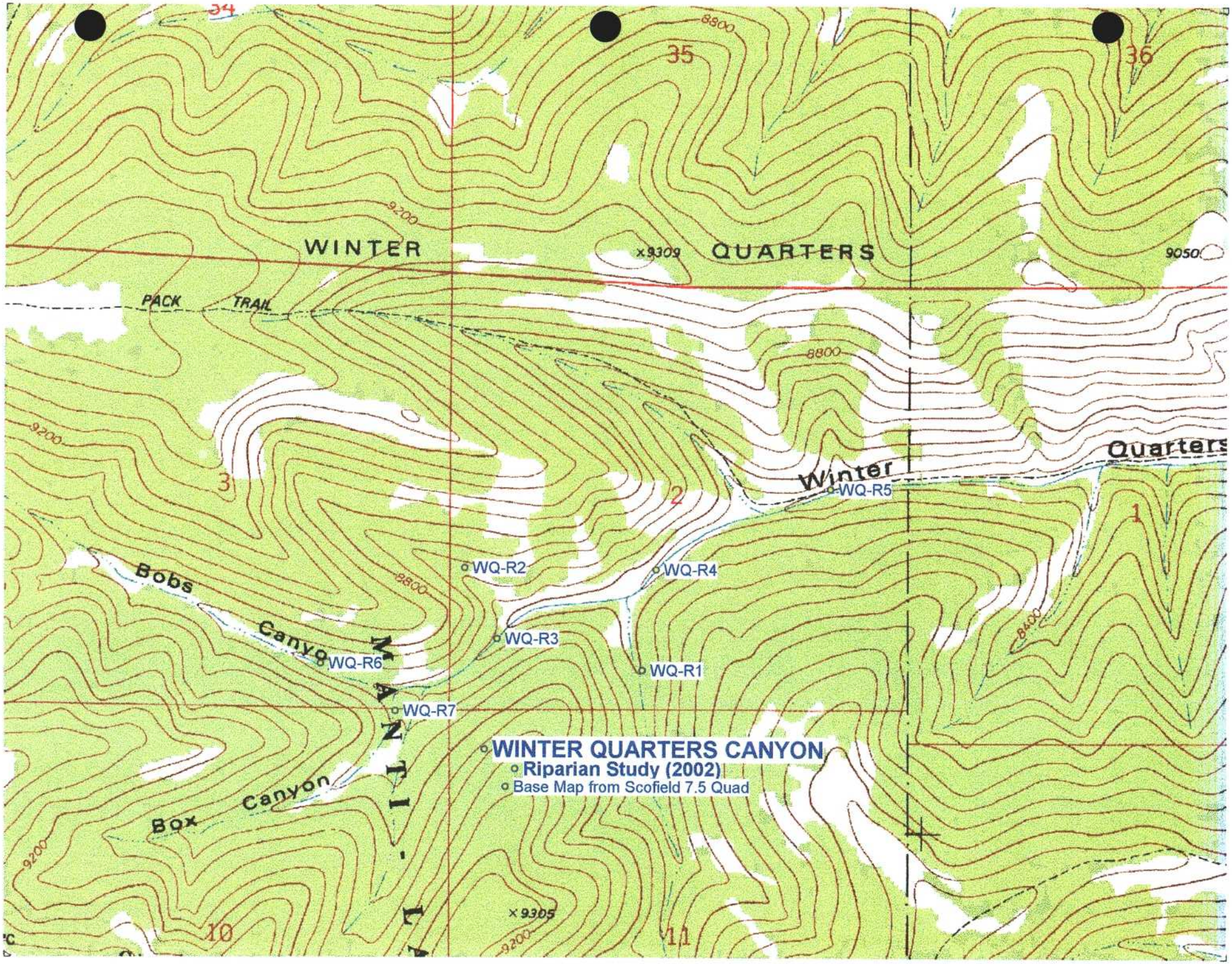
Figure 7: Winter Quarters Canyon Sample Site: WQ-R7

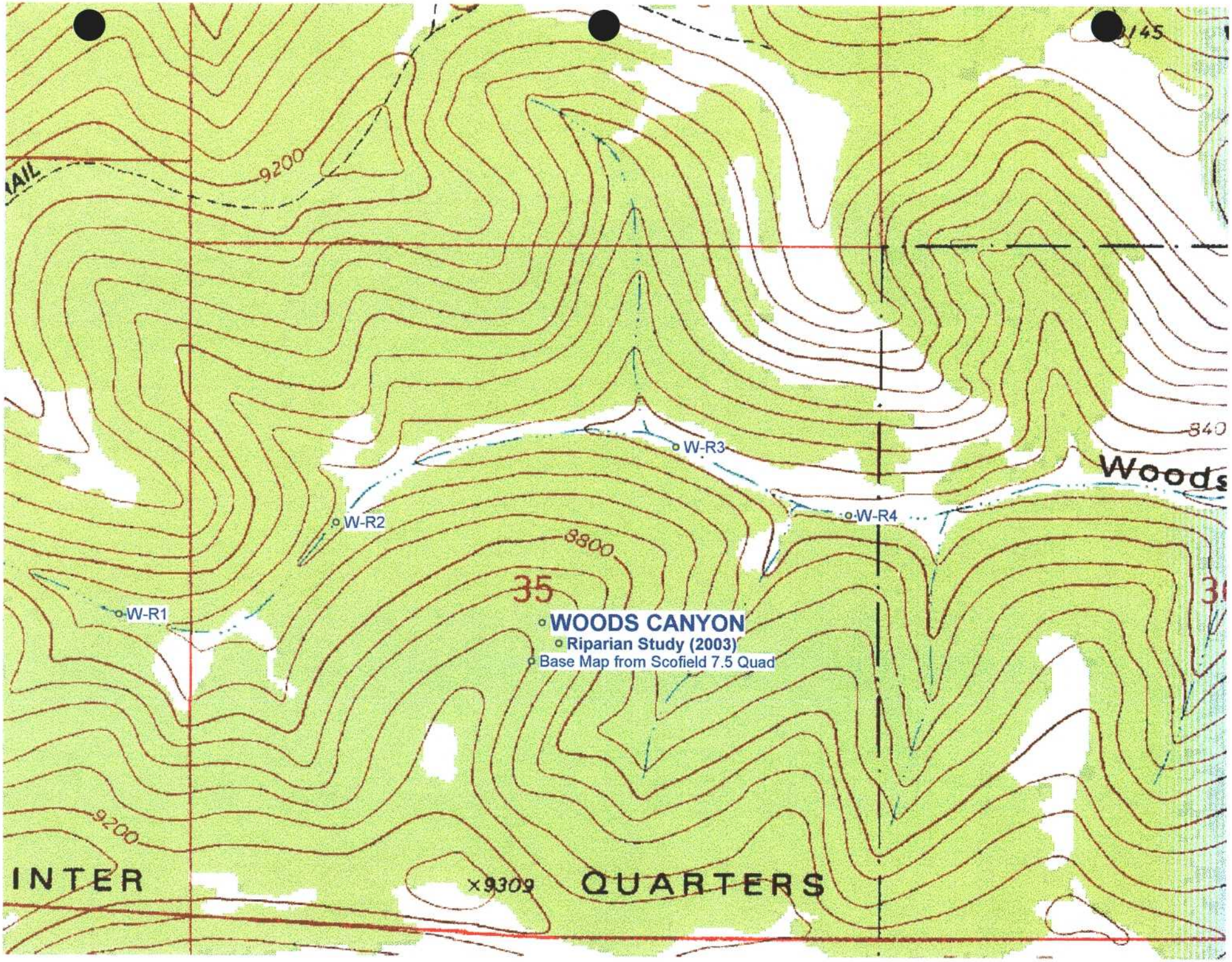
Figure 8: Winter Quarters Canyon Sample Site: W-R1

Figure 9: Winter Quarters Canyon Sample Site: W-R2

Figure 10: Winter Quarters Canyon Sample Site: W-R3

Figure 11: Winter Quarters Canyon Sample Site: WQ-R4


WINTER QUARTERS CANYON
Riparian Study (2002)
Base Map from Scofield 7.5 Quad
WINTER
QUARTERS
PACK TRAIL
Winter Quarters
Bobs Canyon
Box Canyon
MANTI-LA
WQ-R1
WQ-R2
WQ-R3
WQ-R4
WQ-R5
WQ-R6
WQ-R7
9309
9305
9050
8800
9200
8400
34
35
36
3
2
1
10
11


9200
W-R3
W-R4
W-R2
W-R1
8800
35
WOODS CANYON
Riparian Study (2003)
Base Map from Scofield 7.5 Quad
9200
INTER
×9309
QUARTERS
Woods

MACROINVERTEBRATE STUDIES

2002 and 2003 SUMMARY

WINTER QUARTERS AND WOODS CANYONS

MT. NEBO SCIENTIFIC