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

Gregg Galecki, Environ. Engineer
HCR 35, Box 380
Helper, UT 84526
(435) 448-2636 - Office
(435) 448-2632 - Fax

July 9, 2012

Mr. Daron R. Haddock
Coal Program Manager
Division of Oil, Gas, and Mining
1594 West North Temple
Salt Lake City, Utah 84114-5801

RE: Termination of Color Infrared (CIR) Aerial Photography Monitoring , Response to Task #4096, Canyon Fuel Company, LLC, Skyline Mine, C/007/005,

Dear Daron:

Attached to this letter are C1 and C2 forms outlining information submitted to terminate the collection of Color Infrared photographic monitoring (CIR) currently being conducted in conjunction with Skyline Mine's annual Subsidence survey. A comprehensive review of the data collected annually from 2005 through 2011 was evaluated by Dr. Patrick Collins of Mt. Nebo Scientific, Inc. The review determined no adverse impact had been observed in the data. The results of the report, combined with the intensive riparian study that is conducted in perennial drainages support the determination that the CIR survey can be eliminated. Information that was noted as being deficient in Task #4096 has been corrected on page 4-101 in Section 4.17.8 of the M&RP.

The pertinent information is being submitted electronically to the Division WebDav website will be the following files:

- This cover letter and C1 and C2 forms (.pdf format)
- Chapter 4, Section 4.17 Subsidence Control Plan,; (1) text file (Note: the submitted file is currently being reviewed and modified under Task 4092. Items identified in redline-strikeout are associated with the current amendment.
- A Comparison of the Plant Communities Using Color Infrared Aerial Photographs for the North Lease Area 2005-2011, Mt. Nebo Scientific, Inc. February 2012

A total of three (3) files are being submitted.

If you have any questions regarding this information, please give me a call at (435) 448-2636.

Sincerely:

Gregg A. Galecki
Canyon Fuel Company, LLC.
Environmental Engineer – Skyline Mines

APPLICATION FOR COAL PERMIT PROCESSING

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

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: Termination of Color Infrared photography (CIR)data collection
Description, Include reason for application and timing required to implement:
Response to Task 4096 - Eliminating the collection CIR photography during Annual subsidence monitoring

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.

Wesley K Sorensen — Wesley K Sorensen
Print Name — Sign Name, Position, Date

General Manager
7/9/12

Subscribed and sworn to before me this 9th day of July, 2012

Kathleen Atwood
Notary Public

My commission Expires: 12-2-2015
Attest: State of Utah } ss:
County of Carbon }

KATHLEEN ATWOOD
NOTARY PUBLIC-STATE OF UTAH
COMMISSION# 650015
COMM. EXP. 12-02-2015

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

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

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: Response to Task 4096 - Termination of Color Infrared photography (CIR) data collection during Annual Subsidence monitoring

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

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Chapter Section 4.17 - Subsidence Control Plan; page 4-99, 4-101
☒ Add	☐ Replace	☐ Remove	Appendix A-2 Volume 2, A Comparison of the Plant Communities Using Color Infrared Aerial Photographs for the North Lease Area 2005-2011, Mt. Nebo Scientific, Inc. February 2012
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	

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

4.17 SUBSIDENCE CONTROL PLAN

This section describes in further detail the Permittee's mine plan design, ensuring subsidence effects of the Skyline Mine produce minimum environmental impact. Section 3.1 - SKYLINE MINING OPERATION PLAN describes in detail the proposed methods of coal extraction and mine development which were selected partly on subsidence and nonsubsidence criteria. Section 2.2 presents the detailed geological information which provided an analytical base for mine plan and subsidence control design. The following subsections describe the principal factors involved in measuring and controlling subsidence resultant of the proposed mining operations.

4.17.1 Subsidence Probability Survey

Prior to mining, a careful review of the permit area shows that the following areas could face potential subsidence impact which may be of concern: Mountain Fuel Supply gas pipeline, U-264, Burnout Creek and James Creek which cross the permit area. Upper reaches of Electric Lake Reservoir, upper Huntington Creek, Bolger Creek and South Fork of Eccles Creek will not be subsided. The gas line was moved to Burnout Canyon in the early 1990's to allow for undermining the previous location. The gas line was re-established in its original location in the fall of 2000 and a second gas line was placed in the corridor in the fall of 2001.

A pre-subsidence survey was conducted in the fall of 2002 of the North Lease area (Winter Quarters Lease). A map was generated to illustrate the locations of any structures, water rights, and renewable resource lands that could be adversely affected by subsidence. This map is included as Drawing 4.17.3-1A and illustrates the locations where surface cracks may appear as a
result of subsidence, the expected maximum amount of subsidence, locations of water rights,

and the area where the overburden is 700 feet or less over the mineable coal seam,

the Lower O'Connor "A"(See Section 4.17.3 Subsidence Prevention Measures). No buildings, pipelines, or maintained roads were found in the areas to be subsided as a result of implementing the North Lease mine plan. The only mapped pack trail in the North Lease area runs east-west on the ridge between Winter Quarters Canyon and Woods Canyon, dropping down into Winter Quarters Canyon. The trail is outside the area to be subsided, therefore, no subsidence related impact is anticipated on the trail. In 2010 the panels located north of the Winter Quarters Canyon graben (North-of-Graben), were rotated 90 degrees to maximize coal recovery further east that originally outlined in 2002. The modification did not impact any additional buildings, pipelines or maintained roads with the additional acreage being undermined.

As discussed in detail in Section 2.2 of this M&RP, the rocks in the North Lease area are in compression. The state of compression of the rocks in the North Lease area will likely allow the subsidence forces to be transmitted across fault and fracture planes thus resulting in uniform subsidence. Previous mining in Mine #3, where the rocks are also under compression, did not result in focused subsidence along faults or fractures. Indeed, in the southern portion of the mine permit area where the rocks are subjected to extensional forces, focused subsidence did not take place.

Drilling and field work conducted in the North Lease by Skyline geologist Mr. Mark Bunnell indicates the

Castlegate Sandstone in the head of Winter Quarters and Woods Canyons in the permit area consist of two thin sandstone units, separated by slope-forming shale and siltstone. Because of the thinner, "ledge and slope" nature of the Castlegate in the permit area, the potential for subsidence-induced escarpment failures or landslides is minimal (3/3/05 M.Bunnell memo). As discussed in Section 4.17.3 and illustrated in Drawing 4.17.3-1A, the combination of geology, depth of cover, and mine plan should keep subsidence affects to a minimum (See Section 2.2 for detailed geology discussion). Drawings 4.17.1-1 and 4.17.1-2 illustrate that, if the maximum subsidence does occur, no reduction o perennial stream flow should occur. This is due primarily to the existing

stream gradient, projected worst-case subsidence, depth of cover, and depth of alluvium within the drainage corridor. Although the gradient is reduced in some areas, no significant ponding or over-steepening of the gradient is anticipated. Potential areas of *minor* cracking, as illustrated on Drawing 4.17.3-1A, are primarily a function of the advancement direction of the longwall panel, steepness of slope, the lack of confining pressure, and how the bedrock subsides into the void left by longwall mining.

The mine will not subside any of the perennial streams in the North Lease without approval from the Forest and Division. The rotating of the panels north of the Winter Quarters Canyon graben in 2010 did not impact the undermining of the portions of perennial streams on the Manti-La Forest. The Burnout Canyon Study (Appendix A-1, Volume 2), conducted in cooperation with Canyon Fuel Company, LLC, and The Manti-Lasal National Forest, was completed in July 1998. Quoting the Burnout Final Report, "This study was initiated in 1992...to address the effects of longwall minnig and related subsidence in the Wasatch Pleateau on hydrology, channel condition and habitat changes in perennial and intermittent reaches of a mountain stream." The Burnout Canyon study concluded that any changes in flow in Burnout Creek areas were likely related to climatic changes (drought) and not mining activities (DOGM EDI). The stratigraphy, depth of cover, and general dip of the formations in Woods and Winter Quarters Canyons are very similar to Burnout Canyon (See sections 2.3.1, 2.5, 4.17.3, and Appendix A-1, Volume 2 for details). The permittee believes the Burnout Canyon Study can be used to predict the impacts of undermining both Winter Quarters and Woods Canyons and that mining in the North Lease area can be conducted with minimal impacts to perennial streams due to subsidence.

The Forest has indicated that the forest land is considered to have renewable resources related to wildlife and grazing. The timber resources are extremely limited and isolated in this

extraction thickness rule-of-thumb. However, this criteria was meant to be applied only to extraction below area of the forest and will likely never be harvested (Carter Reed, Manti-La Sal National Forest, Oral Communication 10-2002).

Included in the Subsidence Probability Survey for Woods Canyon, Skyline contracted Agapito Associates, Inc. (AAI) to evaluate the subsidence impacts of conducting full-extraction mining in areas with as little as 400 feet of overburden (Appendix A-1, Vol.2). The AAI analysis utilizes a numerical model – Surface Deformation Prediction System (SDPS) (Agiotuantis and Karmis 2002) that incorporates, information from the Burnout Canyon area study, local geology, mining and subsidence data. The study predicted less than five(5) feet of subsidence would occur in the Woods Canyon area and mining could safely be conducted in areas with 475 feet of overburden. Other items identified in the AAI study inculde: 1) the average gradient in Woods Canyon (5.71%)is greater than in Burnout Canyon (4.12%) which suggests the hoizontal strain will be spread along a longer stream path and dampen direct impacts of tensile strain; and 2) the US Bureau of Mines (USBM) criteria for subsidence classifies Woods Canyon as having class III (shaley and silty sandstone) overburden, and the appropriate overburden thickness multiplier would be 461 feet. Incidentally, the same USBM report (1979) originated the 60 times the bodies of water of 'catastrophic' potential size such as large rivers and lakes. The 60 time the extraction thickness is a conservative generalization that somewhat mis-characterizes the USBM study recommendations.

4.17.2 Mining Methods

The mining methods to be used by the Permittee include longwall mining, room and pillar mining with pillar removal, and room and pillar mining with pillars left in place. Certain room and pillar mining systems are designed to provide full support and will prevent subsidence. Subsection 3.1.5 contains descriptions of the mining methods to be implemented.

Full extraction areas include room and pillar panels with pillar removal and longwall panels. Subsidence prediction work has shown the expected maximum planned and controlled subsidence will vary from 0 to 24 feet, assuming that the total cumulative extraction from the three mineable seams will not exceed 30 feet.

4.17.3 Subsidence Effect Prevention Measures

It is anticipated that the planned subsidence will result in a generally uniform lowering of the surface lands in broad areas, thereby limiting the extent of material effect to those lands and causing no appreciable change to present land uses and renewable resources. The Permittee established a subsidence monitoring program in the early stage of mining for use in reviewing the surface effect of mining and as an aid in future mine planning.

In areas where mining related subsidence would damage resources, room and pillar mining methods will be used. Wherever the pipeline and creek buffer zones coincide, creek buffer zone requirements take precedence. Where the yield pillar/barrier system is used, the

critical area will not influence the surface. The width of the area of supp et (25 feet on each side of the pipeline centerline no surface movement) plus t as shown in the I988 Annual Report and included in Vol. 4, multiplied by th ied coal bed:

- Nonsubsidence Mining Width = 50 feet + (2 X tan 22^{o} x depth)

The width of the supportive mining area will be adjusted, as appropriate, when future information and monitoring shows it to be necessary.

The 22 degree draw angle is conservative and conforms to the Permittee's data on permit area subsidence as well as experience from other comparable mining activity in the Wasatch Plateau (Plate 4.17.3-1).

There will be no mining caused subsidence under either the Electric Lake Reservoir, Upper Huntington Creek and Bolger Creek inlets to the reservoir, and no mining from which subsidence at a 22-degree (from vertical) angle of draw would influence either these reservoir inlets or the high-water level of Electric Lake Reservoir. The width of the buffer zone was calculated as follows:

- Buffer zone width = tan 22^{o} x overburden depth

The width of the buffer zone has been calculated using the overburden depths to the coal seams.

There is a very substantial tonnage of coal which lies to the west of Upper Huntington Creek and Electric Lake Reservoir, which the Permittee plans to mine.
Mains under the Huntington Creek (Drawing 3.1.8-3) will be a full support room and pillar mining system. These mains will be designed to avoid short or long-term surface affects from mining. Prior to abandonment of these mains,
Revised: 8-24-05 4-95

INCORPORATED
12/02/05
Division of Oil, Gas & Mining

failure of the entries, as mutually agreed with regulatory agencies. The entries in Skyline Mine No. 2 will enter the Huntington Creek buffer zone for a short distance as approved by the Division/U.S. Forest Service

No mining will be conducted beneath Electric Lake.

Full extraction mining techniques under the creek buffer zones will only be proposed if evidence shows surface effects, if any, can be mitigated. Full extraction mining techniques and associated mitigation plans must first be approved by the Division/U.S. Forest Service.

Drill holes show that there are clay rich shale layers present which will likely swell into an impervious clay when wet. This characteristic is expected to seal possible subsidence cracks to prevent downward migration of water and subsequent loss of springs and other water sources based on information supplied by Roy Full (Volume A-3)and supported by the Burnout Canyon Study (Appendix 1-A, Vol.2).

Extensive experience with mining-induced subsidence at Skyline Mine indicates the subsidence factor (SF) relative to mining height is as follows:

Overburden 200-500' - SF 0.7
Overburden 500-1000' - SF 0.5
Overburden 1000-1500' - SF 0.3
Overburden 1500-2000' - SF 0.15

Approximately 20-30 percent of the planned subsidence will be occurring where overburden thickness ranges from 500 to 1000 ft. and 70-80 percent of the subsidence occurring where overburden thicknesses are greater than 1000 ft(3/3/05 M. Bunnell memo). Given the projected mining thickness is 9-11 feet, and the approximate minimum overburden is 600 feet in the North Lease area, the maximum subsidence anticipated is less than 6 feet. Drawing 4.17.3-1A illustrates most of the subsidence will be in the 2 to 4 ft. range. Areas identified as having 6-feet of subsidence were rounded-upward to provide a six-foot contour line. Six-feet of subsidence is generally a worse-case scenario. The subsidence factor identified above suggests subsidence in the range of seven (7) feet could be seen in Woods Canyon. Through 2009, this has been a conservative factor since the most subsidence that has been noted is approximately four (4) feet in Winter Quarters Canyon and its tributaries. The AAI modeling report in Appendix A-1, Volume 2 suggest subsidence will remain less than six (6) feet even in areas with 500 feet of overburden.Revised: 9-16-10 4-95a

A section of a natural gas pipeline in the Burnout Canyon-Huntington Creek area was decommissioned in October 2000. Its replacement section was constructed in the pre-existing pipeline right-of-way on top of Trough Spring Ridge. Since the Trough Springs Ridge area will not be undermined again and subsidence from previous mining under this

INCORPORATED
02/09/11
Division of Oil, Gas & Mining

area is essentially complete, the Burnout Canyon-Huntington Creek portion of the pipeline is labeled as “old pipeline” on the mine maps and is still owned by Questar. However, it has been decommissioned by Questar to allow undermining by Skyline Mine. The future utilization and status of decommissioned portion of the pipeline is Questar’s responsibility.

4.17.4 Mitigation of Subsidence Effects

Surface structures which may be affected by subsidence include the Permittee's buildings and facilities incidental to the coal operation, the natural gas pipeline which crosses the coal lease area, and roads within the area. No additional structures are located within the new UP&L lease area.

Should subsidence damage any of the surface structures despite the planned subsidence prevention measures, the Permittee will arrange for their repair. Any subsidence related damage to SR 264 will be repaired by the Permittee in accordance with the DOT Subsidence Impact Agreement dated July 17, 1989 (see Exhibit 1).

Hydrologic information during a four year period (1984-1989) at the Skyline Mine indicates that there is a reasonably good correlation between the amount of mine water discharged from Mine #3 and the amount of coal mined (see Drawing 4.11.4-A). The mine water historically encountered in Mine #3 was produced from the Blackhawk Formation. Data from the approved water monitoring program Indicate mine dewatering is not affecting any surface springs or seeps. Water monitoring data suggests the migration of water through the aquifer in Mine #3 is extremely slow to the extent that the water should be considered “perched or trapped water.” Since the North Lease mining will be occurring in the area adjacent to the previous Mine #3 workings and under the same geologic environment, similar inflow conditions are anticipated.

In 2010 full extraction mining in Woods Canyon was extended ½ mile further east into areas with less than 600 feet of overburden. As a mitigatin effort to monitor subsidence, a total of nine (9) piezometers or shallow groundwater wells have been established adjacent to the creek starting at the USFS boundary and extending east

of the proposed mining. The piezometers were established to monitor the shallow groundwater adjacent to the stream to both determine whether Woods Canyon creek is an gaining or losing stream, and to gauge any flow impacts associated with mining.

If it is determined that subsidence causes material damage or a loss of flow in a perennial stream, the Permittee commits to using the best technology currently available (BTCA)to mitigate the damage. Methods may include backfilling with surrounding native material, incorporating bentonite or other water-retaining native material into the backfill, or possibly even temporarily bypassing/piping flow through impacted areas until mitigation is achieved.

Coastal States Energy Company
a subsidiary of The Coastal Corporation
175 E. 400 S. • #3 • Suite 800 • Salt Lake City, UT 84111

EXHIBIT 1

July 17, 1989

Mr. Dyke LeFevre
Director, District 4
Utah Department of Transportation
P.O. Box R
Price, Utah 84501

Re: State of Utah Highway SR-264-Subsidence Impact Agreement

Dear Mr. LeFevre:

Since SR-264 traverses areas which are proposed to be mined by Coastal States Energy Company (Coastal), portions of SR-264 may be affected by subsidence from Coastal's underground coal mining operations. This letter agreement is to set forth the obligations and rights of Coastal with respect to subsidence from Coastal's Skyline mining operations, and the effects therefrom, if any, on SR-264.

If accepted and agreed to by the Utah Department of Transportation (UDOT), UDOT has no objection to and will allow Coastal's mining operations being conducted, as proposed by Coastal, within the area of influence of SR-264. In consideration for such authorization, Coastal agrees to repair promptly all damage, such as surface impacts, to SR-264 due to subsidence caused by the mining activities at Coastal's Skyline Mines.

If UDOT agrees to the provisions contained herein, please sign all three copies of this letter agreement and return one of which to Coastal.

Very truly yours,

Vernal J. Mortensen
Senior Vice President

VJM/jm/0201c

Agreed and accepted this 19th day of July, 1989

Dyke LeFevre
Director, District 4
Utah Department of Transportation

Howard Richardson
Assistant Director
Utah Department of Transportation

At this point in time it is difficult to suggest specific mitigation of impacts or reclamation on renewable resources that are impacted by undermining, since we can only assume those impacts and their effect. Mitigation measures are site-specific, and will be contingent upon the findings of the subsidence monitoring program. Subsidence data is available on Drawing 4.17.3-1 and is updated in annual reports submitted to DOGM. Mining in the area has been conducted since 1982, providing over twenty (20) years of subsidence data. As noted in Section 4.17.3 and substantiated within the Burnout Canyon study (Appendix A-1,Volume 2), the amount of subsidence is directly related to surface and subsurface geology and depth of cover. To date, the only areas where mitigation efforts have been implemented are in areas where two-seam mining was conducted. Tension cracks formed in areas where a barrier between panels was present in both seams - effectively creating a 20-foot pedestal. These associated cracks were mitigated by backfilling using a dozer and/or a track hoe. As data are collected, methods of mitigation will be formulated. This will be done in coordination with appropriate regulatory agencies. Since subsidence may continue to occur after final mining, the monitoring program will continue until it is determined by the Permittee in cooperation with the regulatory agency that it is no longer needed, or subsidence has stopped.

Impacted water rights, if any, will be replaced as discussed in Section 2.5.2.

4.17.5 Subsidence Monitoring Program

The Permittee has chosen to establish a subsidence monitoring program using aerial photogrammetrics patterned after a program developed by the Manti-LaSal National Forest to determine the effects of underground coal mining on surface

renewable resources and surface improvements. The monitoring program secures adequate baseline data prior to any subsidence to quantify the existing surface renewable resources and surface improvements on and immediately adjacent to the permit area. The baseline data was established so that future programs of observation can be incorporated at regular intervals for comparison. The monitoring program establishes a system to locate, measure, and quantify the progressive and final effect of underground mining activities on the surface renewable resources and surface improvements. The system utilizes techniques which will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the permitted area. The continuum of data shall incorporate and be an extension of the baseline data.

A network of control monuments consistent with the desired photogrammetric map accuracy are being established over both the permit area and the immediate adjacent areas not expected to be disturbed by subsidence. The monuments are constructed as survey control points for monitoring the effects of subsidence on surface renewable resources and surface improvements (Map 4.17.5-1). The monuments are located and tied to a state plane coordinate system which is the same for both the surface and mine control surveys. This allows the surface survey to be superimposed over the subsurface mine workings. The monuments have the X, Y, and Z coordinates accurately measured and established by ground survey methods.

The initial aerial photography covers the entire permit area and will be either color or black and white, flown at a scale such that elevations to within one foot vertically and horizontally (± 0.5') can be attained by photogrammetric

methods. It is anticipated that the nominal or mean scale will be 1:6,000 for a 6" focal length camera, unless aerial constraints such as safety dictate flying at a high altitude, but will not exceed 1:7,200. This photography was used for constructing the initial baseline surface map. It also provides the master base to assist in documenting changes caused by subsidence.

To aid in the collection of additional base data on surface renewable resources, color infrared aerial photography (CIR) of the permit area may be utilized. If this technique is used, the photographs will be of the same scale as the other aerial photography.

Subsequent annual black and white or color photography for subsidence monitoring will cover the area mined and the area to be mined in the next 18 months (plus angle of draw). Subsequent CIR photography for monitoring surface resource trends will be flown as needed.

In 2012, a comprehensive review of the CIR data collected annually from 2005 through 2011 was evaluated by Dr. Patrick Collins of Mt. Nebo Scientific, Inc. The review determined no adverse impact had been observed in the CIR data. The results of the report, combined with the intensive riparian study that is conducted in perennial drainages support the determination that the CIR survey no longer needs to be collected.

Formatted: Font: 12 pt

On all aerial photography for both the baseline data and subsequent flights, a photographic overlap of 30 percent between adjacent flight lines and an average of 60 percent overlap of photographs along the same flight line will be obtained. The baseline data will be digitized to show the undisturbed pre-subsided ground elevations and will use a grid with a nominal

mean grid scale of 200 x 200 feet. The subsequent flights for subsidence will also be digitized using the same grid scale as the baseline to show the elevational deviation from the baseline elevations. The digitized information will be submitted annually to the regulatory agency after subsidence commences.

An on-the-ground visual inspection will be made of the ground surface of subsidence areas (including angle of draw)where the potential for tension cracks or fissures exist. The inspection will be conducted between six (6) and 12 months after mining has occurred. This information is supplemented with the annual subsidence report and corresponding map supplied to the Division.

This inspection will attempt to locate, photograph, and document the presence of subsidence effects to surface improvements, tension cracks, fissures and other surface effects.

The subsidence monitoring data could be used to determine: 1) the critical width across the pressure arch; 2) the draw angle; 3) the ratio of observed subsidence to predicted maximum subsidence (S/Smax); 4) the relationship between mining and onset of subsidence and the correspondence between the face advance and subsidence profile development; and 5) the bulking factor.

Table 4.17.5A illustrates subsidence points in both Mine #3 (where single-seam mining has occurred) and Mines #1 and #2 (where two-seam mining has occurred, and compares the anticipated subsidence (Section 4.17.3) with actual subsidence that has occurred. All the subsidence locations used were

located where a creek crosses the center of a panel. These sites were used due since there is typically better ground control in a stream channel versus a slope, and the concerns related to subsiding streams.

Table 4.17.5A

Subsidence Location	CalculatedSubsidence	**Actual Subsidence**
Mine#3, panel 7R	4.8-ft	5-ft
Mine#3, panel R6	1.95-ft	2-ft
Mine#3, panel 6R	3.9-ft	4-5-ft
Mine#3, panel R5	3.9-ft	4-ft
Mine#3, Panel R4	3.9-ft	3-ft
Mine#2/1, pan. 6L/7L	11.5-ft	
12-ftMine#2/1, pan.	14-ft	12-ft
5L/6L		
Mine#2/1, pan. 4L/5L	12-ft	12-ft
Mine#2, panel 11L	6-ft	6-ft
Mine#2, panel 8L	6-ft	6-ft

Table 4.17.5B cites examples of the maximum extent of subsidence observed at specific sites within the Skyline Mine permit area.

Table 4.17.5B

Subsidence Location	Subsidence Buffer Angle	Actual Maximum Extent of Subsidence
Mine#3 Panel 7R		
Mine#2 Panel 9L		
Mine #2 Panel 11L		

It is important to understand the points of zero subsidence used

to calculate the angle of draw are somewhat subjective due to the accuracy of the survey method. The points of zero subsidence used in these calculations are very conservative, potentially resulting in a greater angle of draw than actually may exist.

The following monitoring program was initiated as part of the Burnout Canyon Study:

	Description	Who	When
1.	Install parshall flumes for stream flow monitoring as shown on plate 2.3.6-1.	Skyline	July 91
2.	Select and install monitoring for spring flows in the subsidence areas as shown on plate 2.3.6-1.	Skyline	July 91
3.	Install subsidence monitoring adjacent to stream drainages on a maximum 200 ft. centers as shown on plate 2.3.6-1. Points will be 3' rebar with no concrete.	Skyline	July 91
4.	Develop summary report of observed subsidence effects on stream drainages as well as surface and subsurface hydrology to date.	Skyline	Dec. 91
5.	Monitor stream, spring, and subsidence points -- monthly during field season. Map any surface cracks that form.	Skyline	June-Nov. 91 June-Nov. 92 June-Nov. 93*?
6.	Year-end summary reports	Skyline	Jan. 92 & 93
7.	Final report	Skyline	Jan. 94
8.	Evaluation and review	Skyline, DOGM & USFS	Feb. 94

4.17.6 Subsidence Control

The Permittee plans to conduct the underground mining operations so as to prevent subsidence from causing material effect to the surface and to maintain the value and reasonable foreseeable use of that surface in accordance with the preceding subsidence control plan.

4.17.7 Public Notice

Since the surface ownership of the areas of planned subsidence is vested in the United States and is under the authority of the U.S. Forest Service, the annual subsidence monitoring report will be provided to them and to the regulatory authority.

4.17.8 North Lease

Infrared aerial photographs (CIR) will be taken either in August or September of each year. An interpretation of the photographs will be made and a written report will be included in the Skyline Mine Annual Report. If a reduction in renewable resources is noted because of subsidence, the appropriate agencies will be notified and mitigation measures will be developed. CIR data collection was discontinued in 2012 after a review of the data from 2005 through 2011 determined no impacts from mining were noted using the procedure.

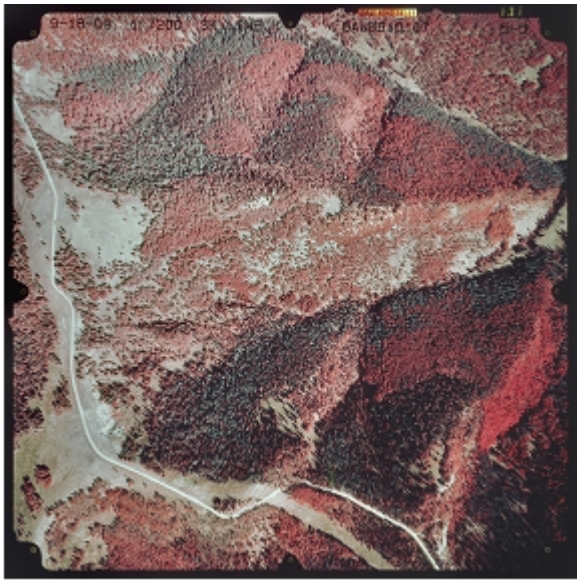
4.17.9 Reduction of Subsidence Monitoring Program

Mining operations were completed in the southern section of Mine #3 (Panels 3R-7R and 1R NM-6R NM) in August 1996. No adverse effects related to subsidence were observed in the area after 1997. The subsidence monitoring program was terminated after monitoring in 2003.

Mining operations were completed for Mines #1 and #2 in August 1998 and April 2004, respectively. No adverse effects related to subsidence were observed in the area after 2004. The subsidence monitoring program was terminated for this area after monitoring in 2006.

A Comparison of the Plant Communities Using Color Infrared Aerial Photographs for the North Lease Area 2005-2011

at the
Skyline Mine
Carbon County
Utah



Prepared by

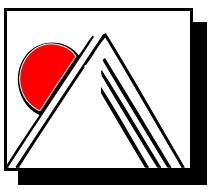
MT. NEBO SCIENTIFIC, INC.
330 East 400 South, Suite 6
P.O. Box 337
Springville, Utah 84663
(801) 489-6937

by

Patrick D. Collins, Ph.D.

for

CANYON FUEL COMPANY, LLC
Skyline Mines
HC 35 Box 380
Helper, Utah 84526



February 2012

TABLE OF CONTENTS

INTRODUCTION. 1

METHODS. 2

RESULTS 3

DISCUSSION 4

INTRODUCTION

The Skyline Mine is a coal mine located in Eccles Canyon, south of the town of Scofield, Utah. Planned subsidence, or the predicted movement and readjustment of the ground surface due to collapse of overburden from mining underneath it, could potentially impact the plant communities and wildlife habitat above. As one method to monitor the impacts of subsidence, Skyline Mine's, Mining and Reclamation Plan (MRP) has a commitment to review year-to-year color infrared (CIR) aerial photographs of the areas that have been recently mined within their permit area.

Using CIR photography for vegetation analyses can distinguish active transpiring plants from those that may be dead, dying, have become senescent, or have gone dormant. This happens because actively growing plants show high reflectivity in the infrared wavelength range. Healthy growing leaves reflect high levels of near infrared wavelengths which show up as varying degrees of red on CIR film. Dying, unhealthy or dormant vegetation usually appear light-red or blue-green in color on the film.

The objective in reviewing the CIR's is not to reveal *subtle* changes to plant community structure and species composition, rather, it is to try and observe *major* impacts to the plant communities and habitats such die-offs or shifts to

different community types (e.g. from tree or shrub stands to herbaceous, weedy, invasive or pioneer species).

This document reports the findings from a comparison of Skyline Mine's CIR's from years 2005 through 2011 for the North Lease area.

METHODS

To begin the study, Gregg Galecki, environmental engineer for the Skyline Mine, provided contour maps of the permit area including a boundary showing the recently mined areas, called the *North Lease Area*. Also provided by Mr. Galecki were **electronic files** of the CIR aerial photographs of years 2005 through 2011. In addition, CIR aerial **color prints** for 2011 were supplied.

The 2011 color prints were used as the "baseline" for the study – or the most current state of the vegetation. All other years (2005-2010) were compared with each other, along with the baseline prints, on large computer monitors. Viewing the CIR electronic files on the monitors enabled the reviewer to "zoom in" to areas that required closer scrutiny; the prints enabled the reviewer to observe specific areas in 3-D using stereoscopic lenses when desired. The study boundary line was placed on the prints using drafting tape making it easy to also see where this boundary would be on the electronic photographs.

RESULTS

Table 1 lists the CIR photographs and flight dates utilized for the study. Review of overlapped areas was minimized by carefully planning the layout design of the prints. As mentioned above, the 2011 prints, the most recent CIR aerial photographs, were used for the baseline set and compared to the earlier years.

Table 1: CIR color photograph dates and print numbers reviewed in the study area.

2005 (22 October)	2006 (12 October)	2007 (15 October)	2008 (15 November)	2009 (18 September)	2010 (13 October)	2011 Baseline Prints (28 September)
5-02	5-02	5-02	5-02	5-02	5-02	5-02
5-03	5-03	5-03	5-03	5-03	5-03	5-03
5-04	5-04	5-04	5-04	5-04	5-04	5-04
5-05	5-05	5-05	5-05	5-05	5-05	5-05
5-06	5-06	5-06	5-06	5-06	5-06	5-06
						5-06
6-02	6-02	6-02	6-02	6-02	6-02	5-07
6-03	6-03	6-03	6-03	6-03	6-03	
6-04	6-04	6-04	6-04	6-04	6-04	6-01
6-05	6-05	6-05	6-05	6-05	6-05	6-02
6-06	6-06	6-06	6-06	6-06	6-06	6-03
6-07	6-07	6-07	6-07	6-07	6-07	6-04
6-08	6-08	6-08	6-08	6-08	6-08	6-05
						6-06
7-02	7-02	7-02	7-02	7-02	7-02	6-07
7-03	7-03	7-03	7-03	7-03	7-03	6-08
7-04	7-04	7-04	7-04	7-04	7-04	
7-05	7-05	7-05	7-05	7-05	7-05	7-01
7-06	7-06	7-06	7-06	7-06	7-06	7-02
7-07	7-07	7-07	7-07	7-07	7-07	7-03
7-08	7-08	7-08	7-08	7-08	7-08	7-04
						7-05
8-02	8-02	8-02	8-02	8-02	8-02	7-06
8-03	8-03	8-03	8-03	8-03	8-03	7-07
8-04	8-04	8-04	8-04	8-04	8-04	7-08
8-05	8-05	8-05	8-05	8-05	8-05	7-09
8-06	8-06	8-06	8-06	8-06	8-06	
8-07	8-07	8-07	8-07	8-07	8-07	8-01
						8-02
						8-03
						8-04
						8-05
						8-06
						8-07
						8-08
						8-09

No significant differences in the plant communities from mining-related subsidence were noted from years 2005 through 2011.

DISCUSSION

To reiterate the point made in the Introduction above, *the primary objective in reviewing the CIR's was not to reveal minor changes in the vegetation , rather, it was to try and observe major impacts to the plant communities and habitats*.

Strengths of the methods used for this study included: 1) a complete set of color CIR electronic files that were available for the Skyline Mine for each year from 2005 through, and including, 2011, 2) the electronic files enabled one to "zoom in" for closer observations when desired, 3) CIR color prints were also available showing the most recent condition of the vegetation making stereoscopic viewing available when desired, and 4) contour maps of the study area were also made available for referencing with the CIR's.

One potential weakness of the methods was the time periods of some of the flights when the CIR photographs were taken. Four of the 7 years of photographs were taken in mid-October, a little late in the growing season for optimum viewing of the reflective qualities to the vegetation of the CIR film. This consequence, however, was decreased by the fact that for the most part leaves were still on the trees

(when closer observations by zooming in was done). The redness showing healthy or actively growing leaves were obviously much more subdued, but the fact the September photos were available, especially in the most recent year (2011) greatly increased the probabilities that the lack of "healthy-looking" vegetation in some areas was a function of the time of year (causing the natural decrease in transpiration) rather than an indication of dying or unhealthy condition of the plant communities.