

APPENDIX 7-15
PROBABLE HYDROLOGIC
CONSEQUENCES DETERMINATION

INCORPORATED
EFFECTIVE:
APR 15 2005
UTAH DIVISION OIL, GAS AND MINING
PRICE FIELD OFFICE

This document has been prepared in accordance with requirements of the State of Utah R645 Coal Mining Rules. The format follows the regulations R645-301-718.100 through R645-301-728.400. This Probable Hydrologic Consequences evaluation of the coal mining and reclamation operations has been prepared by GENWAL Resources, Inc. to provide a description of the potential impacts of the mining operation on the hydrologic systems and the means to prevent or mitigate those identified impacts.

R645-301-728.100 **Determination**

This determination section presents a brief summary of the surface water, groundwater, and geologic resource descriptions of the permit area and the South Crandall Lease area and the U-68082 lease mod area and a description of the possible impacts of the coal mine on the hydrologic resources.

The geologic and hydrologic data and their associated appendices are contained in Chapter 6 and Chapter 7, respectively. The potential sources of contamination to the hydrologic resources in the area of the mine were identified through site visits, knowledge of the working operations of the mine and discussions with GENWAL Resources personnel. These potential contamination sources and impacts include:

Water Quantity

- Interception of groundwater and surface water
- Water consumption within the mine
- Seepage from mine sumps
- Pumping from Crandall Creek

Water Quality

- Additional sediment contribution
- Fugitive dust
- Oil and grease
- Mine water discharge
- Acid-toxic materials
- Flooding or Streamflow Alteration



Each of these potential sources of contamination or impact and their associated mitigating measures or circumstances are discussed in the following sections.

Water Quantity Impacts

Possible impacts to the surface and groundwater systems from the mining operation could affect the quantity of water in the mine area. Interception, consumption, and seepage of surface or groundwater are possible mechanisms which could affect the water systems.

Interception.

A limited potential exists for interception of groundwater or surface water due to subsidence which may affect the perched aquifers (springs and seeps), and stream flows in Crandall Canyon, Blind Canyon, Horse Creek, the upper headwaters of the Indian Creek drainage (Upper Joes Valley), and the streams and springs of the South Crandall Lease area and the U-68082 lease mod area. The potential for hydrologic impacts may result from creating subsurface interconnections from the more permeable zones in the strata as a result of mine subsidence. This can be expressed by the potential interrelated occurrences of intercepted groundwater flow in the overlying perched aquifers, the interruption or lessening of flow to springs, or the interception of surface water flow from ephemeral streams.

Groundwater Interception.

Typically, groundwater interception and translocation of that water is the primary mechanism by which the groundwater system may be impacted. As indicated in Section 7.24.1 of this permit, the regional groundwater system, located in the Blackhawk-Starpoint aquifer at the Crandall Canyon Mine, is below the Hiawatha Coal.

Monitoring of in-mine and surface wells indicate that the potentiometric surface of the regional Blackhawk-Star Point aquifer in the mine area lies approximately 50 to 60 feet below the top of the Star Point Sandstone over most of the mine. In the westernmost portion of the mine, near the Joes Valley Fault system, the potentiometric surface of the Star Point Sandstone is at or slightly above the elevation of the floor of the mine. In these areas, minor amounts of groundwater weep from the floor of the mine. In the remainder of the mining areas, because mining is being conducted in the Hiawatha seam of the Blackhawk Formation, which overlies the Starpoint Sandstone, dewatering of the Blackhawk-Starpoint aquifer by the Crandall Canyon Mine is not possible.

Historically, the springs within the permit area which are monitored on a quarterly basis, in the perched aquifer of the Blackhawk Formation above the mine, have not been affected by operating the Crandall Canyon Mine. Because of the tightness of the joints and the presence of aquicludes, significant mine in-flows from the overlying strata have not occurred and nor are they anticipated.

A reconnaissance of field information and data available from the old Huntington #4 permit indicates that Little Bear Spring located in T16S-R7E-Sec 9 (see Plates 7-12, 7-13, and 7-14) emanates from the Panther (lowest member) of the Star Point Formation. Previous drilling within the mine area has shown that the three members of the Starpoint Sandstone are vertically isolated

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from one another. The Spring Canyon member is located within the upper 100 feet of the Starpoint Sandstone. This member has been found to contain water in some areas of the mine. The Storrs member was isolated from the Spring Canyon member by interbedded shale and siltstone. It did not appear to contain any appreciable water. The Panther member was found to be about 36 feet thick at a depth of 315 to 351 feet. Flow from this bed varied from about 2.1-7.0 gallons per minute. Although Little Bear spring emanate out of the Panther member, age dating showed the water to be of recent age (<50 years old). Age dating of water from the Starpoint Sandstone shows it to be of an age greater than 10,000 years old. It appears that Little Bear Spring emanates from a fault zone which may be serving as a conduit for diversion of recent water intercepted in some of the larger drainages in the area. It is doubtful that mining activities would have any affect on flow from Little Bear Spring due to the large age difference between the water encountered underground and the water flowing out of Little Bear Spring.

Meetings with the Castle Valley Special Service District officials and their representatives, as well as the other water user districts of the area, was held on 10 June 1993. The concern of the Castle Valley Special Service District regarding diminution and mitigation of the Little Bear Spring flow that could result from future mining were discussed. Given the elevations of the Starpoint potentiometric surface, in relation to that of the Hiawatha Coal Seam, it was shown that the present and future mine workings would not interfere with the Starpoint aquifer.

Little Bear Spring is a developed spring that provides municipal water to nearby municipalities. It emanates from a fracture system in the Panther Member of the Star Point Sandstone that trends in an approximate northeast-southwest direction.

Because of its importance as a municipal water supply source and its proximity to proposed mining areas, Little Bear Spring has been extensively studied. Several hydrologic studies have been performed since 1977 to investigate the recharge source for Little Bear Spring (Forest Service Project File). These studies have agreed that the spring flow is supported by a fault/fracture system. Since Little Bear Spring lies more than 300 feet below the level of the mineable coal seams and past mining encountered the fault/fracture system without significant inflow of water, there is general consensus among the Castle Valley Special Service District (CVSSD), mine operators, scientific community, and the regulatory agencies that adverse effect to the spring are unlikely.

Several studies have been done that suggest a northerly component of flow feeding Little Bear Spring. These studies include:

- Vaughn Hansen Associated, *Water Quality and Hydrologic Study in Vicinity of Huntington Creek Mine No. 4 and Little Bear Spring*, Prepared for Swisher Coal Company, August 1977.
- Hydro-Sciences, Inc., *Ground Water Hydrology in the Vicinity of the Huntington No. 4 Mine*, Prepared for ARCO Coal Company, December 19, 1980.
- Beaver Creek Coal Company, *Huntington Canyon No. 4 Mining and Reclamation Plan*, Prepared for UDOGM, 1983.

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- Utah Geological and Mineral Survey, *Effects of Coal Mining at Huntington Canyon No. 4 Mine on Little Bear Spring, Emery County*, Prepared for Castle Valley Special Services District, Job No. 84-005, January 21, 1984.
- Vaughn Hansen Associated, *Hydrologic Conditions in Huntington Canyon No. 4 Mine*, 1984.

These referenced studies are available for review at the Division's Public Information Center.

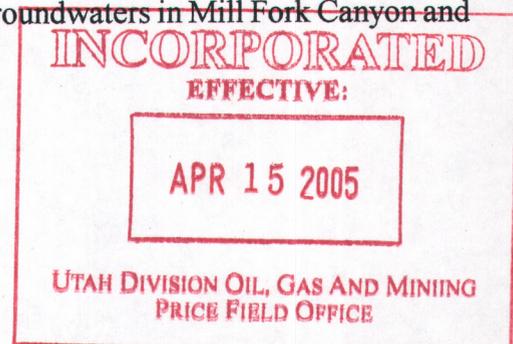
Other studies indicate that the Little Bear Spring may possibly be fed by fault/fracture system which intercepts surface water in Mill Fork Canyon southwest of the South Crandall Lease area. These scientific investigations include an investigation of the Little Bear Spring groundwater system and the groundwater systems encountered in the Crandall Canyon Mine (Appendix 7-52), a solute and isotopic investigation of groundwater from Little Bear Spring and the Star Point Sandstone and Blackhawk Formation groundwater systems the Crandall Canyon Mine (Appendix 7-53), an investigation of the hydraulic conductivity of the Star Point Sandstone in the vicinity of the Crandall Canyon Mine (Appendix 7-54), an investigation of the alluvial groundwater system in Mill Fork Canyon with implications for recharge to Little Bear Spring (Appendix 7-55), an investigation of the potential for Little Bear Spring recharge in Mill Fork Canyon (Appendix 7-56), and a fluorescent dye-tracing study that conclusively demonstrates the hydraulic connection between the stream/alluvial groundwater system in Mill Fork Canyon and Little Bear Spring (Appendix 7-57). Sunrise Engineering also performed a series of investigations using a proprietary geophysical technique that demonstrated a hydraulic connection between Little Bear Spring and the surface drainage in Mill Fork Canyon. These investigations are included as Appendix 7-59, Appendix 7-60, Appendix 7-61, and Appendix 7-62.

These studies, taken as a whole, have indicated that Little Bear Spring is possibly recharged through surface water and alluvial groundwater losses in Mill Fork Canyon, located well beyond the boundary of the South Crandall Lease area, approximately 1.5 miles southwest of the spring. The basis for this assumption is discussed briefly below. The reader is referred to the above mentioned appendices for a more rigorous discussion of the recharge of Little Bear Spring.

The assumption that Little Bear Spring may possibly be recharged from surface-water and alluvial groundwater losses in Mill Fork Canyon is based on several findings. These include:

1) the finding that, from a water budget standpoint, there is sufficient water available in Mill Fork Canyon to account for the recharge to Little Bear Spring and any surface water drainage that leaves the Mill Fork drainage and flows into Huntington Creek,

2) the finding that there is a chemical and isotopic match (or a plausible chemical evolutionary pathway) between surface waters and alluvial groundwaters in Mill Fork Canyon and groundwater at Little Bear Spring, and



3) the finding that there is a demonstrated hydraulic connection between Mill Fork Canyon and Little Bear Spring and the hydraulic gradient and flow volume through the connection is sufficient to provide Mill Fork water to the spring.

These findings are discussed below.

An investigation was performed in 2001 to determine the quantity of water available in Mill Fork Canyon to recharge Little Bear Spring (Appendix 7-56). It is the finding of this investigation that there is an excess of approximately 300 gpm in the Mill Fork drainage that is available for recharge to the spring. Indeed, it is difficult to explain the loss of approximately 300 gpm from the drainage basin without taking the recharge to Little Bear Spring into account. This finding is based on a comparative analysis of baseflow in the Crandall Creek drainage, which is very similar in geology, topography, aspect, and elevation to the Mill Fork Creek drainage. The baseflow in Crandall Canyon Creek during most years is approximately 300 gpm greater than that in Mill Fork.

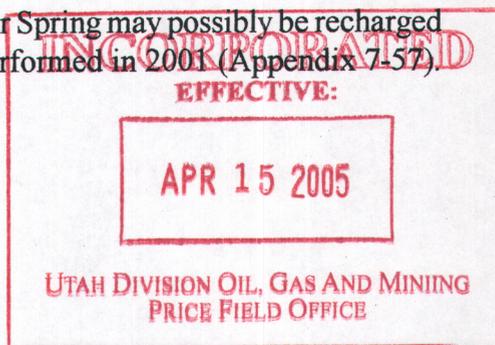
Another investigation examined the capacity of the alluvial groundwater system in Mill Fork Canyon to transmit sufficient groundwater to sustain the baseflow of Little Bear Creek during periods when there is not surface flow in the Mill Fork drainage (Appendix 7-55). This investigation was based on a quantitative determination of the flow of groundwater migrating through the alluvial groundwater system above the spring recharge location compared to that flowing through the alluvial deposits below the spring recharge location in Mill Fork Canyon. It is the conclusion of this investigation that there is appreciably more groundwater flowing through the alluvial deposits above the spring recharge location as compared to that flowing in the alluvial deposits below the spring recharge location (approximately 300 gpm more).

Investigations regarding the solute and isotopic compositions of groundwater at Little Bear Spring and other shallow groundwater systems in the vicinity have been performed. These investigations have also examined the solute and isotopic compositions of Star Point Sandstone groundwater systems encountered in the Crandall Canyon Mine. These studies are included as Appendix 7-52 and Appendix 7-53. It is the findings of these investigations that groundwater discharging from Little Bear Spring is modern in origin (>50 years old), while groundwater from deep Star Point Sandstone groundwater systems in the Crandall Canyon Mine have a mean groundwater age of many thousands of years. Shallow Groundwater systems (that provide baseflow to upper Mill Fork Creek) are modern in origin. The solute composition of groundwater in Little Bear Spring and that of surface water and shallow alluvial groundwater in Mill Fork Canyon are similar.

The fact that the discharge in Little Bear Spring shows rapid seasonal variations in discharge rate suggests that the recharge is related to a shallow recharge source that is closely tied to seasonal recharge. The ancient groundwater systems encountered in the Star Point Sandstone in area coal mines do not exhibit seasonal variability.

Finally, in order to explore the assumption that Little Bear Spring may possibly be recharged from Mill Fork Canyon, a fluorescent dye tracing study was performed in 2001 (Appendix 7-57).

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In this investigation, fluorescent dye was placed in the upper Mill Fork drainage immediately above the spring recharge location. A positive dye recovery occurred at Little Bear Spring within 40 days of the dye placement. Thus, a hydraulic connection between the alluvial system in upper Mill Fork Canyon was positively confirmed.

The elevation of the spring recharge location in upper Mill Fork Canyon is approximately 7710 to 7790 feet, while the elevation of Little Bear Spring is approximately 7475 feet. Thus, there is a substantial hydraulic gradient between the possible Mill Fork recharge location and Little Bear Spring. It is important to note that the possible recharge location for Little Bear Spring in Mill Fork Canyon is outside the boundaries of the South Crandall Lease area. Likewise, the groundwater flowpath connecting Mill Fork Canyon and Little Bear Spring is outside of the area of potential coal mining by GENWAL Resources.

While the flow mechanisms conveying water to Little Bear Spring are not completely understood, additional hydrologic studies performed since the Mill Fork EA was written have indicated that adverse impacts to the spring are not expected due to the vertical separation between the coal seams and flow. (Forest Service, BLM Joint Decision Notice/Finding of No Significant Impact, Coal Lease Application UTU-78953)

In conclusion, because mining occurs above the Panther Member of the Star Point Formation, the source of water of the Little Bear Spring; because the mine is relatively dry; and because age dating has shown that the water sampled underground from the Starpoint Sandstone and from Little Bear Springs are not the same age (: there is little, if any chance, that current or proposed future mine workings of the Crandall Canyon Mine could affect the Little Bear Spring. Operation of the mine should not adversely impact the Star Point aquifer or Little Bear Spring.

Mitigation for potential disruption to the Little Bear Spring will be accomplished through the construction of a water treatment plant which will provide replacement water for the spring. Construction of this water treatment plant will be done under the provisions of a water replacement agreement between GENWAL Resources, Inc. and the Castle Valley Special Service District who maintain culinary water rights to Little Bear springs. A copy of this water replacement agreement is included in Appendix 7-51. With construction of this water treatment plant an uninterrupted supply of culinary water will be assured irrespectively of whether mining can be conclusively shown to have affected Little Bear Spring. This is in compliance with special stipulation #17 of federal lease UTU-78953 (see Appendix 1-13).

Spring and Seep Interception.

There is a potential for impact to overlying seeps and springs through interception of the perched aquifers as a result of subsidence. Seeps and springs throughout the mine area and the South Crandall Lease area and the U-68082 lease mod area have been identified through intensive field and aerial surveys. These survey results are presented in Chapter 7, Section 7.24.1, associated appendices, and are shown on Plate 7-12. Water rights have also been researched and are provided in Chapter 7, Table 7-6.

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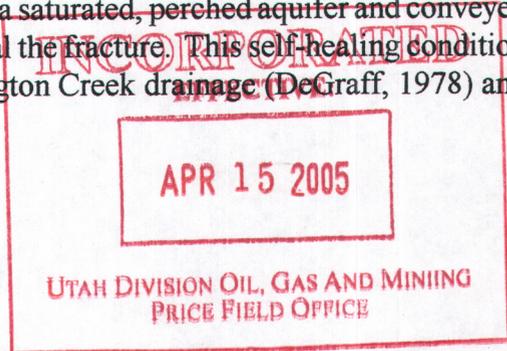
Genwal is currently monitoring the water flow rates and quality of representative springs and seeps as indicated in section 7.31 within and adjacent to the current mine permit area (including LBA No. 9 and the South Crandall Lease area). The springs which are monitored cover both the proposed aerial extent of the mine and also are located within each of the major lithologic units from the Blackhawk (above the regional aquifer) to the North Horn Formation (which caps the highest portions of the top of East Mountain).

As stated in Section 7.24.1, the water emitting from seeps and springs which overlie the coal seam originates from perched aquifers. These perched aquifers appear to have no direct communication with the Star Point Sandstone, or with the mine. Isotopic sampling has shown the chemistry of these springs to be substantially different than water from underground sources or the Starpoint Sandstone. These springs do not appear to have any vertical communication with the Blackhawk or Star Point Sandstone formations even when subsidence has occurred. This is due to the extensive interbedded shale in the intervening strata. Also, during the drilling conducted for the LBA No. 9 only one hole, DH-7, intercepted any groundwater. These data indicate that a significant zone of non-saturated, low-permeability strata (aquitard or aquiclude) are present between the Star Point Sandstone and the overlying perched aquifers .

Natural groundwater inflow to the Crandall Canyon Mine is limited. Inflows tend to be of short and limited duration. Most of the natural inflows are from mined-out areas of the longwall. Less frequently, natural inflows occur from bolt holes in the roof and from very limited sections at the face. Genwal has an operational monitoring plan which includes monitoring surface flows from Crandall, Blind Canyon and Indian Creeks using flumes and continuous recorders. In addition, Genwal has committed to monitor Horse Canyon at station H-1 on a quarterly basis. Genwal is currently monitoring 14 springs on a quarterly basis across their potential area of influence (see Chapter 7 for additional details).

Due to the dryness of the mine, water from Crandall Creek had been pumped into the mine to provide dust control water and water for the mining equipment. A water supply well provides shower water for the bathhouse. Based on the 1992 mine water records, approximately 6.9 million gallons of water were used in the mining operation. Of this volume, it is estimated that approximately 6.2 million gallons of water were pumped into the mine from either the water supply well MW-1 or from Crandall Creek. These volumes, indicate that the water collected from natural inflow underground was approximately 700,000 gallons, which is about 10 percent of the 1992 water usage. This amounts to a 1.3 gpm inflow rate. Much of the natural inflow water is used in the mining operation. Discharge from the mine had occurred only 3 times prior to 1990.

In the event that a subsidence fracture did reach the surface or intercept one of the overlying perched aquifers, it is likely that the affect would be temporary in nature. As indicated in Appendix 7-41, the clays within the Blackhawk Formation have a tendency to swell when exposed to water. Therefore, if the fracturing from subsidence did intersect a saturated, perched aquifer and conveyed water, the clays within the formation would swell and seal the fracture. This self-healing condition has been identified within the headwaters of the Huntington Creek drainage (DeGraff, 1978) and at other mines in the area.



An alternative water source plan has been developed in the event any water rights or springs/seeps impacted in a long-term manner by the mining operation or reclamation activities. This plan is detailed in Chapter 7, Section 7.27.

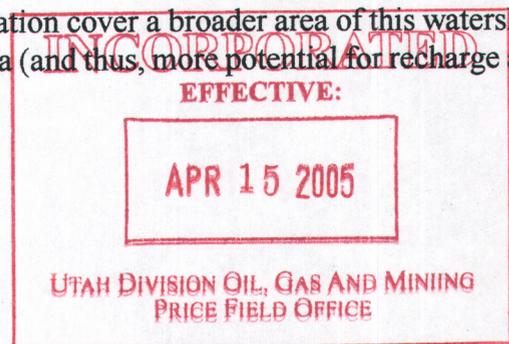
Surface Water Interception.

The possible surface water interception impacts may affect stream flows in Crandall Canyon, Blind Canyon, Horse Creek, the headwaters of Indian Creek, and drainages in the South Crandall Lease area and in the U-68082 lease mod area. These impacts would likely be the result of subsidence fractures intersecting the ground surface. If these fractures occur within or across a surface drainage channel, then a potential is created for the surface flow within the drainage to be temporarily intercepted. For the drainages within and adjacent to the Crandall Canyon Mine, all sections of the streams that are perennial will be protected from subsidence by limiting retreat mining activities within the area of the stream buffer zones as discussed in Section 5.25 of this permit.

The potential for significant water loss for these drainages is minimal. This conclusion is based on the existing hydrologic and geologic information presented in Section 7.24 and Appendices 7-2 and 7-23 and past mining experience within the Huntington Creek drainage. In addition, the streams in the majority of the surface area which overlies the current or proposed mine workings are ephemeral. However, due to the concerns raised by the U.S. Forest Service, regarding their uncertainty in supporting this conclusion, Genwal Resources Inc. has initiated extensive studies of within Blind and portion of Crandall Canyon to determine if mining through these drainages have an adverse affect on the surface or groundwater resources within the drainage. Until the results of these studies are determined, Genwal will continue to protect the those portions of the streams that have been proven to be perennial.

It is important to note that the geologic units located in the formations stratigraphically above the Blackhawk Formation and the Hiawatha coal seam at the Crandall Canyon mine are hydrologically isolated from the contiguous area. East Mountain is bounded on the north by the South (Left) Fork of Huntington Creek; on the west by Upper Joes Valley; on the south by Cottonwood Canyon; and on the east by Huntington Canyon. Data show that the regional aquifer is located below the Hiawatha Coal. Field data indicate that Blind Canyon is ephemeral and that Horse Canyon is perennial only in that area where it intersects or is below the regional aquifer. Based on the baseline data (Appendix 7-58), it is apparent that all of the surface-water drainages in the South Crandall Lease area are likely ephemeral or intermittent in nature. The drainages in the U-68082 lease mod area are all ephemeral or intermittent.

The perennial portion of Crandall Canyon extends above the regional aquifer. This occurs because the perched Price River and North Horn Formation cover a broader area of this watershed and because Crandall Canyon has a larger drainage area (and thus, more potential for recharge and increased runoff) than the other two canyons.



Consumption.

The consumption of water by the mining operation is a combination of moisture added to the mined coal through the mining process and that which is extracted with the coal as well as evaporation due to ventilation of the mine workings. It is estimated that mining extraction and the mining process utilize approximately 200 gpm during the two 8-hour mining shifts per day. The volume of water extracted by ventilation is estimated to be approximately 50 gpm.

Seepage from Mine Sumps.

Underground sumps are utilized to store water pumped underground or collected from groundwater inflows until the water is used as mine process water. During the period that water is stored in these sumps it is probable for some seepage to occur to the underlying formation (Spring Canyon member). For the Crandall Canyon Mine, the potential volume of such seepage is expected to be quite low because of the presence of a fine grained mudstone strata underlying the Hiawatha seam within the Blackhawk Formation. This layer limits the downward movement of seepage to a very slow rate.



Pumping from Crandall Creek.

Due to the past need for supplemental water underground, there is also potential for decreased surface flows in Crandall Canyon due to pumping from Crandall Creek. Surface water availability could only be impacted by excessive pumping of water from Crandall Creek for the operation. This is not expected to occur since Genwal has committed to not pump from Crandall Creek at a rate that will dewater the stream (Chapter 7, Section 7.24.2). (Genwal will have determined the baseline water flow which needs to remain within Crandall Creek to sustain the existing flora and fauna by August 31, 1995).

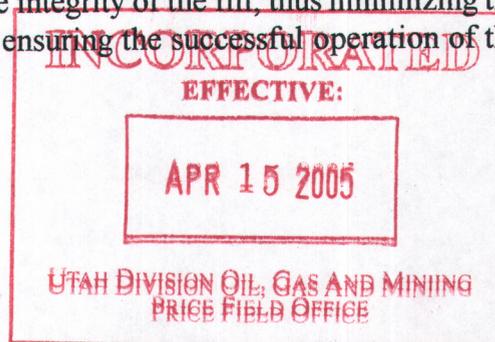
Water Quality Impacts.

The quality of the surface and groundwater in the mine area may potentially be affected by increased sediment loading, dust from the operations, mine water discharges, hydrocarbons used in the mining operations, and seepage losses from within the mine. The following sections discuss these potential impacts and mitigating measures.

With the installation of the main diversion culvert during the expansion of the mine yard facility area it is possible that additional sedimentation could occur. Genwal will install a pair of silt fences downstream in Crandall Canyon to collect any suspended material that may occur as a result of the installation of the 18" drain pipe bedded in drain rock or the 72" culvert. The silt fences will be checked periodically and cleaned out as needed to maintain maximum efficiency.

Once the culvert is in place and operable, the creek will be diverted through the culvert thus bypassing the disturbed area and minimizing the potential for runoff from the disturbed area accidentally flowing directly into the creek. The sediment pond may experience an increase in sediment loading during the construction process and until the construction has been completed. This would be a short term effect. The sediment pond will also be enlarged during the construction process to accommodate the increase in disturbed area. The net result will be that the pond will be better suited to handle runoff from the disturbed area once it has been reconstructed and enlarged. Drainage from the Forest Service parking area will now report directly to the sediment pond. All drainage from the disturbed area will report directly to the sediment pond and the potential for drainage to bypass the sediment pond and flow into the creek untreated will be virtually eliminated.

Flow in Crandall Creek will be temporarily (during the remainder of the life of the mine) diverted through the 72" culvert. However, when reclamation occurs, the channel will be replaced exactly in the same location as it existed prior to the culvert placement. Genwal will lay a geotextile over the existing channel to preserve the channel morphology prior to installation of the drain rock and 18" drain pipe. The drain rock and drain pipe will serve to allow any drainage from the channel bed or adjacent seepage from colluvial materials to flow downstream. Then, the 72" diversion pipe will be placed over this drain. The drain will preserve the integrity of the fill, thus minimizing the potential for problems from settling of the 72" pipe and ensuring the successful operation of the bypass culvert.



Increased Sediment Loading.

As discussed in Section 7.24.2, the permit area is drained by ephemeral, intermittent, and perennial watersheds. These watersheds are steep (with average slopes 50 percent) and well vegetated (with vegetative cover also often exceeding 50 percent). The primary potential for impact to surface water is in the form of increased sedimentation from the operations.

Sediment yield will naturally increase (on a temporary basis during construction and revegetation) from areas disturbed for the operation. A runoff control plan, required by the Division of Oil, Gas, and Mining, provides for the containment or treatment of all runoff and sediment produced from the disturbed areas. Based on this plan, described in Chapter 7, Section 7.42.22, the majority of the disturbed area runoff is directed to the sediment pond. The designed sediment storage for the pond is 1.02 acre feet, including 0.084 acre feet from disturbed areas and 0.018 acre feet from undisturbed and reclaimed areas, over a 10 year period. Storm runoff was determined to be 1.98 acre feet. The pond is designed with a total storage volume of 3.27 acre feet, which allows for complete containment of sediment.

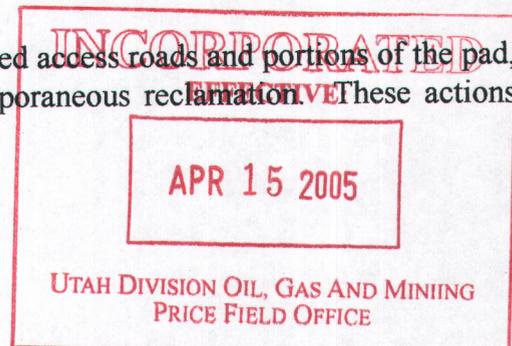
There are 7 small areas (ASCA 2, 5, 6, 7, 8, 9, & 10) which do not drain to the sediment pond, as shown on Plate 7-5, and described in Chapter 7, Section 7.42.21. Sediment yield from these areas is minimized through the use of sediment traps, straw bale dikes, silt fences, and vegetation as described in Section 7.42.21. Sediment yield from the facility and the disturbed areas is minimized through the installation and maintenance of the above described controls.

A secondary potential source may exist due to subsidence creating surface irregularities which would be more susceptible to erosion. Calculations presented in Appendices 7-27 to 7-40 indicate a very small potential for increased sedimentation reaching a perennial stream. A study has been conducted by Genwal and the U.S. Forest Service in Blind Canyon to measure the amount of subsidence, erosion, and the associated sediment yield which may be produced as a result of current mining operations. (Refer to Appendices 7-38 and 7-39).

Fugitive dust.

The potential impacts of fugitive dust from the Crandall Canyon Mine includes reduced air quality in the facilities area and a small decrease in the surface water quality of Crandall Creek. The air quality degradation result from particulate emissions from the paved road and pad, reclamation activities, and from coal loading operations. The water quality degradation and sediment loading increase would result from the settlement of dust within the waters of Crandall Creek. Placement of the stream within the culvert under the expanded mine yard will serve to minimize the possibility of coal dust settling in Crandall Creek.

These impacts are mitigated by sweeping the paved access roads and portions of the pad, water sprays in the coal handling process, and contemporaneous reclamation. These actions minimize the dust production from the facilities area.



Oil and grease.

The use of oil, grease, and flammable hydrocarbon-based products in the mine facilities area creates the possibility of contamination within and adjacent to the facilities area. Contamination could result from spillage of these products during maintenance of the mine equipment, accidental spillage during filling of fuel tanks, or leakage from equipment during operations. Such contamination could impact the soils, groundwater, and possibly surface waters downstream of the facility.

The impacts from spillage during maintenance activities and during filling of tanks will be mitigated by the implementation of the SPCC plan. Additionally, the runoff from all areas of the site where equipment will be operating is drained to the sedimentation pond. The pond is equipped with an oil and grease skimmer to prevent the release of hydrocarbons.

Mine water discharge.

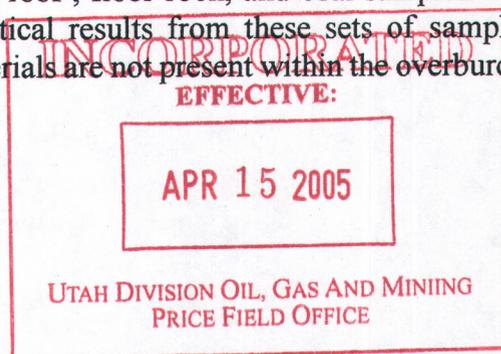
A potential impact to water quality would be from mine water discharges. Currently there is no discharge from the Crandall Canyon Mine. However, when the underground sumps are full and mining consumption is minimal, such as during a longwall move or vacation, discharges may occur. Prior to 1990, there were only three discharges from the mine and these discharges were of a limited nature in both duration and quantity. The mine has an UPDES discharge permit. The quality of the discharge water is good, and meets the requirements of the discharge permit.

Acid-toxic materials.

As discussed in Section 5.28.30, waste rock is not normally produced during mining operations. When incidental quantities of rock are encountered, the rock is left in the mine and will not be removed in the future; thus, the strata which overlie and underlie the Hiawatha seam are not expected to cause any negative effects or create acid-forming potential. Additionally, the mine is currently considered to be a "dry-mine" and the minimal volume of water that is encountered underground does not exhibit any acid or toxic characteristics. All waters encountered have had a slightly alkaline chemistry. Laboratory data have shown that no materials are present within the coal, underburden, overburden, etc. which are of an acid or toxic nature.

Further, handling plans have been implemented for earth, refuse, and acid-toxic forming materials (if encountered), which, if needed, will prevent or control discharge of pollutants to the hydrologic system (Section 7.31.3). This will be accomplished using the best technology currently available.

However, to further characterize the acid-forming potential of strata immediately above and below the Hiawatha seam, the applicant has collected roof-, floor-rock, and coal samples from locations within the current mine workings. Analytical results from these sets of samples, Appendix 6-2, indicate that acid and toxic forming materials are not present within the overburden or underburden.



Flooding or Streamflow Alteration.

The potential for flooding is minimized by the design and installation of adequately sized diversions, sediment pond and velocity control structures as described in Chapter 7, Section 7.40. All diversions are sized for a 25 year - 24 hour storm event. Ditches, culverts and sediment pond are designed for a 10 year - 24 hour storm event. Ditches, culverts and sediment pond are designed for a 10 year - 24 hour storm event.

Crandall Creek will be culverted for a distance of about 1,100 feet through the expanded mine yard area. While a minimal short term impact will occur as the culvert is being installed, the long term affect will be to reduce the potential for sediment to flow from the disturbed area into the creek. It will also reduce the potential for flow within Crandall Creek to impinge upon the sediment pond embankment due to their close proximity. The slopes of the sediment pond will be 2:1 on the outslope. The toe of the sediment pond has been fortified with an additional 2 feet of 12.5 inch D-50 rip-rap for protection and stabilization. The culvert outlet downstream from the pond will minimize the potential for impact from running water to damage the sediment pond embankment. An analysis of the Crandall Creek flow and pond protection measures indicates that these measures are adequate for a return period in excess of 10,000 years (Section 7.42.22). A slope stability analysis has also been performed on the pond embankment, indicating it meets the required slope-stability safety factors (Chapter 7, Table 7-7).

R645-301-728.200 **Basis for Determination**

The PHC Determination for this operation is based on baseline hydrologic, geologic, and other information gathered specifically for this site and the surrounding area by the permittee. This includes information from the South Crandall Lease area and from the U-68082 lease mod area. Additionally, regional information has been provided through various published reports as noted in the plan.

Specific groundwater information is provided in Section 7.24.1 and Appendices 7-16, 7-17, 7-18, 7-19, 7-21, 7-24, 7-40, 7-41, 7-43, 7-46, 7-47, and 7-48 of Chapter 7. Surface water data is presented in Section 7.24.2 and Appendices 7-14, 7-23, 7-25, 7-26, 7-27 through 7-39, 7-43, 7-44, 7-45, and 7-48 of Chapter 7. Geologic information is provided in Chapter 6 and Section 7.24.3, while climatic information is provided in Section 7.24.4.

R645-301-728.300 **Findings**

7.28.310

Chapter 7, Sections 7.24.1 and 7.24.2, indicate the potential for adverse impacts to the hydrologic balance to be minimal in both the existing permit area and in the South Crandall Lease area, and in the U-68082 lease mod area. The basis for this determination is through extensive

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studies, past and on-going groundwater and surface water monitoring, past history, and performance of the on-going operation, and various protection plans for operations and reclamation. A summary of potential impacts is provided in Table 1 of this PHC.

7.28.320

Waste rock is produced in limited quantities on a very infrequent basis during mining operations. When incidental quantities of rock are encountered, the rock is left in the mine and will not be removed in the future. These conditions, coupled with the fact that the waste rock does not have acid or toxic characteristics indicate that little potential exists for any impacts from toxic- or acid-forming materials.

Further, handling plans have been implemented for earth, refuse, and acid-toxic forming materials, which, if needed, will prevent or control discharge of pollutants to the hydrologic system (Section 7.31.1). This will be accomplished using the best technology currently available.

7.28.330

The following are expected impacts from the coal mining and reclamation operation:

7.28.331

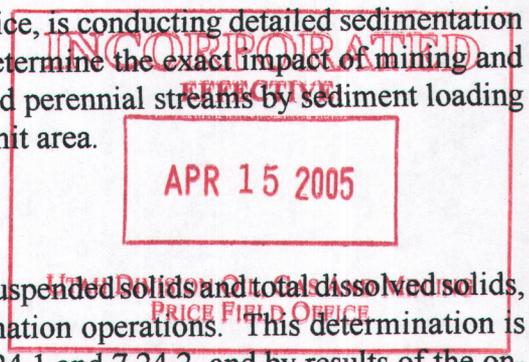
Sediment yield does naturally increase on a temporary basis from areas disturbed for the operation. However, the majority of the disturbed area runoff is directed to the sediment pond. The pond is designed with a total storage volume of 0.98 acre feet, which allows for complete containment of sediment. The 7 small areas which do not drain to the sediment pond, as shown on Plate 7-5, are treated through the use of sediment traps, straw bale dikes, silt fences, and vegetation.

Genwal, in cooperation with the U.S. Forest Service, is conducting detailed sedimentation and erosion studies in the Blind Canyon watershed to determine the exact impact of mining and subsidence. To date, negative impacts to intermittent and perennial streams by sediment loading and increased turbidity has not been observed in the permit area.

7.28.332

Water quality parameters, including acidity, total suspended solids and total dissolved solids, are not expected to be impacted by the mining or reclamation operations. This determination is based on information provided in Chapter 7, Sections 7.24.1 and 7.24.2, and by results of the on-going water monitoring program detailed in Section 7.31.2.

It is unlikely that groundwater quality or quantity will be affected by the underground mining operation (as discussed in Section 7.24.1 and associated appendices, and Section 7.28.100). There exists a potential for impacts to the surface water. However, these potential impacts are expected to be minimal for the following reasons:



- (1) Sediment controls are in place and maintained to minimize sediment loading to drainages;
- (2) All discharges from the sediment pond (or mine) are conducted in accordance with requirements of a U.P.D.E.S. Permit;
- (3) Historical data from this site (which is summarized in the Annual Report and Appendices 7-16, 7-17, 7-18, 7-19, 7-21, 7-24, 7-40, 7-41, 7-43, 7-46, 7-47, and 7-48) show no indication of mine related impacts on the hydrology of the area;
- (4) The water monitoring program will continue to be followed as described in Chapter 7, Section 7.31.2. Results will continue to be analyzed and any problem areas noted will be corrected to prevent further impacts to the hydrology.

728.333

The potential for flooding of the surface facilities is minimized by the design and installation of adequately sized diversions, sediment pond and velocity control structures as described in Chapter 7, Section 7.40.

728.334

The Crandall Canyon Mine is expected to have little impact on groundwater. As mentioned earlier, the mine does not appear to have any hydrologic connection to surface water above the mine nor any connection to groundwater in the Star Point Sandstone below.

Monitoring of in-mine and surface monitoring wells drilled within and adjacent to the Crandall Canyon Mine, and completed in the regional Blackhawk-Starpoint aquifer indicate the potentiometric surface of this aquifer generally lies 50 to 60 feet below the top of the Star Point Formation in all but the westernmost portion of the mine. Thus, mining of the Hiawatha Coal Seam at the base of the Blackhawk Formation, overlying the Star Point Formation, will not intersect and drain any water from the regional aquifer. Nor would water from underground mining enter the Star Point Sandstone due to the relatively impermeable shale zone that lies between the Hiawatha seam and the sandstone below.

There may be some potential for impact to seeps and springs through subsidence. Genwal is currently monitoring the water flow rates and quality of the water rights associated with seeps and springs within and adjacent to the current mine permit area. No evidence of impacts have been identified; however, an alternative water source plan has been developed in the event any water rights or springs/seeps are adversely affected by the mining operation or reclamation activities.

The groundwater system that supports discharge at Little Bear Spring will not be subsided. As discussed above, the groundwater discharging from the spring is NOT derived from a regional Star Point aquifer. Rather, it is recharged from surface-water and alluvial groundwater losses in Mill Fork Canyon outside of the permit area. The significant fracture in the Star Point Sandstone from which the spring discharges serves primarily as a conduit for the conveyance of the Mill Fork water to the spring. Groundwater in the Star Point Sandstone that is not within the fracture system does not contribute appreciable quantities of groundwater to the spring. For these reasons, the potential for impacts to Little Bear Spring resulting from mining operations in GENWAL's permit area is considered extremely unlikely..

Impacts to the surface water quality and quantity are minimized through the installation and maintenance of surface runoff and sediment control structures, and a commitment (Section 7.24.2) to not pump from Crandall Creek at a rate that will cause the in-stream flow to decrease below the minimum required rate.

In addition, groundwater and surface water quantity and quality are monitored on a quarterly basis to determine seasonal flow conditions for the permit and adjacent areas. Further, handling plans have been implemented for earth, refuse, and acid-toxic forming materials, which will prevent or control discharge of pollutants to the hydrologic system. Implementation of these plans will be accomplished using the best technology currently available.

Based on the above, there is some potential for the operation to have an impact on the groundwater and surface water resources of the area; however, the impacts are expected to be minimal due to natural geologic and hydrologic conditions, and the implementation of control and protection systems. Therefore, the "Probable Hydrologic Consequences" of this operation are expected to be minimal, if not negligible.

7.28.335

Additional information will be provided if deemed necessary by the Division.

R645-301-728.340 N/A

This is an underground operation.

R645-301-728-400 Updated PHC

This document is provided as an up-dated PHC for the ~~permit renewal in accordance with~~ the State of Utah R645-Coal Mining Rules.

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**TABLE 1
POTENTIAL HYDROLOGIC IMPACTS**

POTENTIAL IMPACT	POTENTIAL EFFECT	POTENTIAL MAGNITUDE OF IMPACT	PROBABILITY OF OCCURRENCE	MITIGATION MEASURES
Leaching of acid or toxic forming materials	Degradation of surface and groundwater quality	Low (no such materials present)	Low	Monitoring materials handled by approved methods
Groundwater Availability	Decrease in spring flow due to subsidence	Low to moderate depending on location	Low (No history of impact)	Monitoring
Groundwater Availability	Interception of groundwater by mine workings	Low	Low (on-going)	Monitoring
Groundwater Availability	Removal of water with coal	Low	Moderate (on-going)	Monitoring
Groundwater Quality	Decrease in quality due to hydrocarbons	Low	Low	SPCC Plan, monitoring inspections and maintenance
Sediment Yield	Increase in TSS	Moderate	Low	Sediment pond, diversions, sediment control, monitoring
Flooding	Damage to downstream area	Low	Low	Sediment ponds, diversions, and monitoring
Streamflow Alteration	Damage to streams due to subsidence	Low	Low	Protection of perennial streams, monitoring
Surface Water Quality	Decrease in quality due to hydrocarbons	Low	Low	SPCC plan, inspections, monitoring, maintenance
Surface Water Quality	Increase in TSS due to coal fines and dust	Low	Low	Sweeping of access road and pads, misting of coal
Surface Water Quantity	Decrease in flow in Crandall Creek below mine	Moderate	Low	Monitoring, maintaining baseflow

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