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NATURAL RESOURCES
Utah Geological & Mineral Survey

Scott M. Matheson, Governor
Temple A. Reynolds, Executive Director
Genevieve Atwood, State Geologist

606 Black Hawk Way • Salt Lake City, UT 84108 • 801-581-6831

January 21, 1984

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DIVISION OF
OIL, GAS & MINING

Darrel V. Leamaster
Castle Valley Special Services District
P.O. Box 553
Castledale, Utah 84513

Dear Mr. Leamaster:

Enclosed is a copy of the report on Little Bear Spring that you requested in your letter of September 8, 1982. We hope this will help you in evaluating the best course of action for the Castle Valley Special Services District with regard to proposed mining at Huntington Canyon No. 4 Mine. It is our understanding that you are now working closely with the Utah Division of Oil, Gas and Mining (DOGM) in seeking an equitable resolution to the problem. If we can be of further assistance, please contact our office.

Sincerely yours,

Gary E. Christenson

Gary E. Christenson, Geologist
Site Investigations Section

GEC/co
Enclosure
cc: Gayle J. Smith, Bureau of Public Water Supplies, State Dept. of Health
John Whitehead, Division of Oil, Gas and Mining
Robert L. Furlow, Southeastern Utah Health District
William Howell, Southeastern Association of Governments

Project: EFFECTS OF COAL MIN. AT HUNTINGTON CANYON NO. 4 MINE ON LITTLE BEAR SPRING, EMERY COUNTY (HLG1)			Requesting Agency: CASTLE VALLEY SPECIAL SERVICES DISTRICT
By: Gary E. Christenson	Date: 1/21/84	County: Emery	Job No.: 84-005
USGS Quadrangle: Rilda Canyon (797)			

PURPOSE AND SCOPE

The purpose of this study is to evaluate the possible effects of coal mining at Huntington Canyon No. 4 Mine on Little Bear Spring in Huntington Canyon. Beaver Creek Coal Company operates the mine in Mill Fork Canyon and is expanding it to the west and north in the direction of Little Bear Canyon (attachment 1). The impact of this mining on the quantity and quality of water discharging at Little Bear Spring was the subject of a report by Vaughn Hansen Associates (August, 1977) entitled "Water quality and hydrology study in the vicinity of Huntington Creek Mine No. 4 and Little Bear Spring." A review of this report and an independent assessment of geologic and hydrologic conditions of the area were performed for this study. The review of the Vaughn Hansen Associates report is given in attachment 2. In performing an independent assessment, UGMS reviewed the draft mining and reclamation plan submitted in mid-1983 by Beaver Creek Coal Company to the Utah Division of Oil, Gas and Mining (DOGM) for an Apparent Completeness Review. UGMS and DOGM then requested further clarification of geologic and hydrologic sections of the mine plan which related to Little Bear Spring, and received responses from Beaver Creek Coal Company in December, 1983. We have worked closely with Tom Munsen and John Whitehead of DOGM in evaluating these responses and the sections of the initial draft mine plan relating to the spring.

The scope of work included:

1. Literature search, including review and comment on the Vaughn Hansen Associates report and on the draft Mining and Reclamation Plan, Huntington Canyon No. 4 Mine Permit Application by Beaver Creek Coal Company
2. Air photo analysis
3. Brief site reconnaissance

The site reconnaissance was performed on November 8, 1982. Due to a moderately deep snow cover, only the immediate area of the spring was accessible.

GEOLOGY

Huntington Canyon No. 4 Mine is in the Wasatch Plateau coal field in central Utah (Doelling, 1972). It is on the highly dissected east edge of the Wasatch Plateau between Mill Fork and Little Bear Canyons, both of which are western tributaries of Huntington Canyon (attachment 1). Sedimentary rocks ranging in age from Late Cretaceous to Quaternary are exposed in the

Huntington Canyon area. The oldest is the Mancos Shale which is overlain, in order of decreasing age, by the Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone, Price River Formation, North Horn Formation, and Flagstaff Limestone. The Mancos Shale occurs in canyon bottoms with overlying units forming canyon walls. The North Horn Formation underlies the dissected plateau surface and caps most ridges with the overlying Tertiary-age Flagstaff Limestone occuring locally on the highest ridge crests. Quaternary-age alluvium and colluvium are found along streams and mantling slopes in the area. Characteristics of these geologic units are summarized in table 1.

The Upper Cretaceous Blackhawk Formation is the coal-bearing unit at Huntington Canyon No. 4 Mine and contains two prominent coal seams in the mine area. The Hiawatha seam is at the base of the Blackhawk Formation directly above the Star Point Sandstone. The Blind Canyon seam is about 100-130 feet above the Hiawatha seam, also in the lower part of the Blackhawk Formation (Beaver Creek Coal Company, 1983). Mining to date has been principally in the Blind Canyon seam and approximate limits of this mining as of October, 1981, are shown in attachment 1. Since that time, the mine has extended to the west approximately 1000 feet in the Blind Canyon seam and mining has recently begun in the Hiawatha seam near the mine entrance.

The regional dip of bedding is less than 5 degrees to the south, but several east-west-trending folds and north to northwest-trending high-angle normal faults interrupt this regional structure. Detailed geologic studies in the mine vicinity by Beaver Creek Coal Company (1983) indicate an east-plunging syncline in Little Bear Canyon with its axis roughly parallel to Little Bear Creek. The mine is south of this syncline along the east-plunging nose of the adjacent Flat Canyon anticline (Walton, 1954). Both are broad, gentle folds and bedding dips on the flanks are low.

The section of the plateau between Joe's Valley and Huntington Canyon in which the mine occurs is considered to be a horst, or upthrown block, between two major north-trending fault zones - the Joe's Valley fault zone to the west and the Pleasant Valley fault zone to the east. Within this block, several minor northwest-trending faults with maximum displacements of 30 feet are found in the mine area (attachment 1; Beaver Creek Coal Company, 1983).

GROUND WATER AND POSSIBLE IMPACTS OF MINING ON LITTLE BEAR SPRING

Little Bear Spring discharges from a lower sandstone bed of the Star Point Sandstone about 350 feet below the base of the Blackhawk Formation (Beaver Creek Coal Company, 1983). The Star Point Sandstone is a known aquifer and is the source of many of the largest springs in the Huntington Canyon - Cottonwood Canyon area (Danielson and others, 1981). Little Bear Spring is unique in that it is the largest spring and the only major spring discharging from the Star Point in the mine area, including Rilda, Mill Fork, Little Bear, and Crandell Canyons. The flow rate varies seasonally, and four recordings in 1978 ranged from 430 gallons per minute (gpm) in April to 190 gpm in November (Danielson and others, 1981). Maximum discharges from other springs in the Star Point and other formations in the mine area are less than 75 gpm and generally on the order of 30 gpm or less. Given the relatively small drainage area in Little Bear Canyon, it is apparent that the spring is not recharged from this drainage basin alone and is probably a discharge point for a regional aquifer. The large discharge and reported immediate increase in flow

Table 1.- Stratigraphic relationships, thicknesses, lithologies, and water-bearing characteristics of geologic units (adapted from Stokes, 1964 by Danielson and others, 1981)

System	Series	Formations and members	Thickness (feet)	Lithology and water-bearing characteristics
Quaternary	Holocene and Pleistocene		0-100	Alluvium and colluvium; clay, silt, sand, gravel, and boulders; yields water to springs that may cease to flow in late summer.
Tertiary	Eocene and Paleocene	Flagstaff Limestone	10-300	Light-gray, dense, cherty, lacustrine limestone with some interbedded thin gray and green-gray shale; light-red or pink calcareous siltstone at base in some places; yields water to springs in upland areas. (See table 9.)
	Paleocene	North Horn Formation	800±	Variegated shale and mudstone with interbeds of tan-to-gray sandstone; all of fluvial and lacustrine origin; yields water to springs. (See table 9.)
Cretaceous	Upper Cretaceous	Price River Formation	600-700	Gray-to-brown, fine-to-coarse, and conglomeratic fluvial sandstone with thin beds of gray shale; yields water to springs locally.
		Castlegate Sandstone	150-250	Tan-to-brown fluvial sandstone and conglomerate; forms cliffs in most exposures; yields water to springs locally.
		Blackhawk Formation	600-700	Tan-to-gray discontinuous sandstone and gray carbonaceous shales with coal beds; all of marginal marine and paludal origin; locally scour-and-fill deposits of fluvial sandstone within less permeable sediments; yields water to springs and coal mines, mainly where fractured or jointed.
		Star Point Sandstone	350-450	Light-gray, white, massive, and thin-bedded sandstone, grading downward from a massive cliff-forming unit at the top to thin interbedded sandstone and shale at the base; all of marginal marine and marine origin; yields water to springs and mines where fractured and jointed.
		Masuk Member Mancos Shale	600-800	Dark-gray marine shale with thin, discontinuous layers of gray limestone and sandstone; yields water to springs locally.

in response to spring snowmelt in Little Bear Spring indicates high permeabilities and rapid flow rates through the aquifer, probably controlled by fractures and faults rather than porosity or bedding in the sandstone.

The source of recharge to the Star Point Sandstone aquifer has been shown to be snowmelt at higher elevations (Danielson and others, 1981). Hydro-Sciences, Inc. (1980) considers recharge to be principally from the west and northwest while Vaughn Hansen Associates (1977) consider the source to be principally from the north. The former is probably more correct (see attachment 2), with water infiltrating downward along fault and fracture zones from water-bearing units in overlying beds (Danielson and others, 1981). Once water reaches the Star Point Sandstone, further downward percolation is inhibited by the underlying less-permeable Mancos Shale and water moves laterally along fractures and faults to discharge points on hillsides such as Little Bear Spring.

A principal question with regard to the effect of the proposed coal mining on Little Bear Spring is whether or not the mine is in the spring recharge area. At this time, data are insufficient to answer this question, and a network of ground-water monitoring wells and perhaps a series of tracer dye tests would be required to make a conclusive determination. However, in view of the local geologic structure and location of the spring, it is highly likely that the mine and/or proposed mine extentions are in the recharge area or are between the principal recharge area and the spring and thus are in the zone through which ground water is travelling.

It is considered unlikely that a significant amount of recharge occurs from downward infiltration from the surface through the Blackhawk and overlying beds directly above the mine. Slopes are steep and underlain by low permeability materials of the North Horn, Price River, and Blackhawk Formations. Most rainfall and snowmelt would run off rapidly with little infiltration. This is supported by the reported lack of roof seepage and the dry nature of faults in the Blackhawk Formation in the mine (Hydro-Sciences, Inc., 1980; Beaver Creek Coal Company, 1983).

It is probable, however, that the mine is in a zone of ground-water movement between principal recharge areas to the west and northwest and the principal discharge point (Little Bear Spring). Most water is moving through the Star Point Sandstone, the major aquifer from which Little Bear Spring discharges. Possible ground-water conditions in the mine area are shown in attachment 3. Hydro-Sciences, Inc., (1980) and Beaver Creek Coal Company (1983) consider water in the Star Point to be either unconfined (attachment 3A) or confined (attachment 3B) beneath the Hiawatha seam . Danielson and others (1981) and Lines and others (1983) consider the Star Point and Blackhawk to act as a single aquifer in which unconfined water table conditions exist as shown in attachment 3C. If the conditions shown in either attachments 3B or 3C are present, flow of water into the mine will accompany extraction of the Hiawatha seam, particularly in areas of faulting. If an unconfined water table extends into the Blackhawk (attachment 3C), water may be intercepted in the Blind Canyon seam as well. The only pertinent data available regarding this question comes from an in-mine drill hole (MC-4-1, attachment 1) in which the water level was 38.2 feet below the top of the Star Point. The fact that the water level at the drill hole in this area of little or no recharge is so much higher than at the spring and so near the top of the

Star Point indicates that levels in the proposed mine area in the direction of principal recharge (west of the spring) may be above the Star Point as depicted in Attachment 3B or 3C. Also, this drill hole is east of all faults in the mine area. If faults are acting as barriers to ground-water flow or conduits for flow in the Star Point, particularly high water levels may exist in and up-gradient (west) from fault zones as well and may be encountered during mining.

CONCLUSIONS

Given the existing data, it cannot be determined if mining will impact ground-water quality or quantity at Little Bear Spring. Information presented by Beaver Creek Coal Company (1983) in their mining and reclamation plan for Huntington Canyon No. 4 Mine and in their responses to questions posed by UGMS and DOGM in the Apparent Completeness Review are insufficient to ensure that no impact will occur. Water-level measurements in the Star Point Sandstone west of the present mine area, particularly in the northwestern-most parcel, will be required before a definite assessment can be made. Coal exploration holes presently exist in this area (HCD-1, HCD-2, DH-2-76a; attachment 1), but they are not monitored and water levels were not recorded during drilling. If levels are below the Hiawatha seam throughout the proposed mine area, interception of recharge waters to Little Bear Spring is unlikely. If water levels are above the Star Point Sandstone, whether confined beneath or extending into or above the Hiawatha seam, interception of flow (at least during mining of the Hiawatha seam) is likely. In any case, contamination of spring water is possible by washing of materials on the mine floor into fractures and ultimately into the Star Point aquifer. This will be particularly critical following extraction of the Hiawatha seam when the Star Point will be exposed on the mine floor. The potential for contamination and interception of flow during mining of the Blind Canyon seam is somewhat lower but still present. Injection of tracer dyes into fractures on the mine floor with monitoring at the spring may yield valuable information with regard to ground water flow paths and potential for contamination during mining.

In the mining and reclamation plan for Huntington Canyon No. 4 Mine, Beaver Creek Coal Company includes an agreement with the City of Huntington to replace any water intercepted and/or treat any water contaminated as a result of their mining operations. At present, the Division of Oil, Gas, and Mining plans to require Beaver Creek Coal Company to either bond to cover the cost of replacement and/or treatment of any spring water affected or to perform the necessary work to prove that mining will not affect the spring. We feel that this is an appropriate course of action and one that is in the best interest of both the city and Beaver Creek Coal Company.

REFERENCES

Beaver Creek Coal Company, 1983, Mining and reclamation plan, Huntington Canyon No. 4 Mine, chapters 6 (Geology) and 7 (Hydrology).

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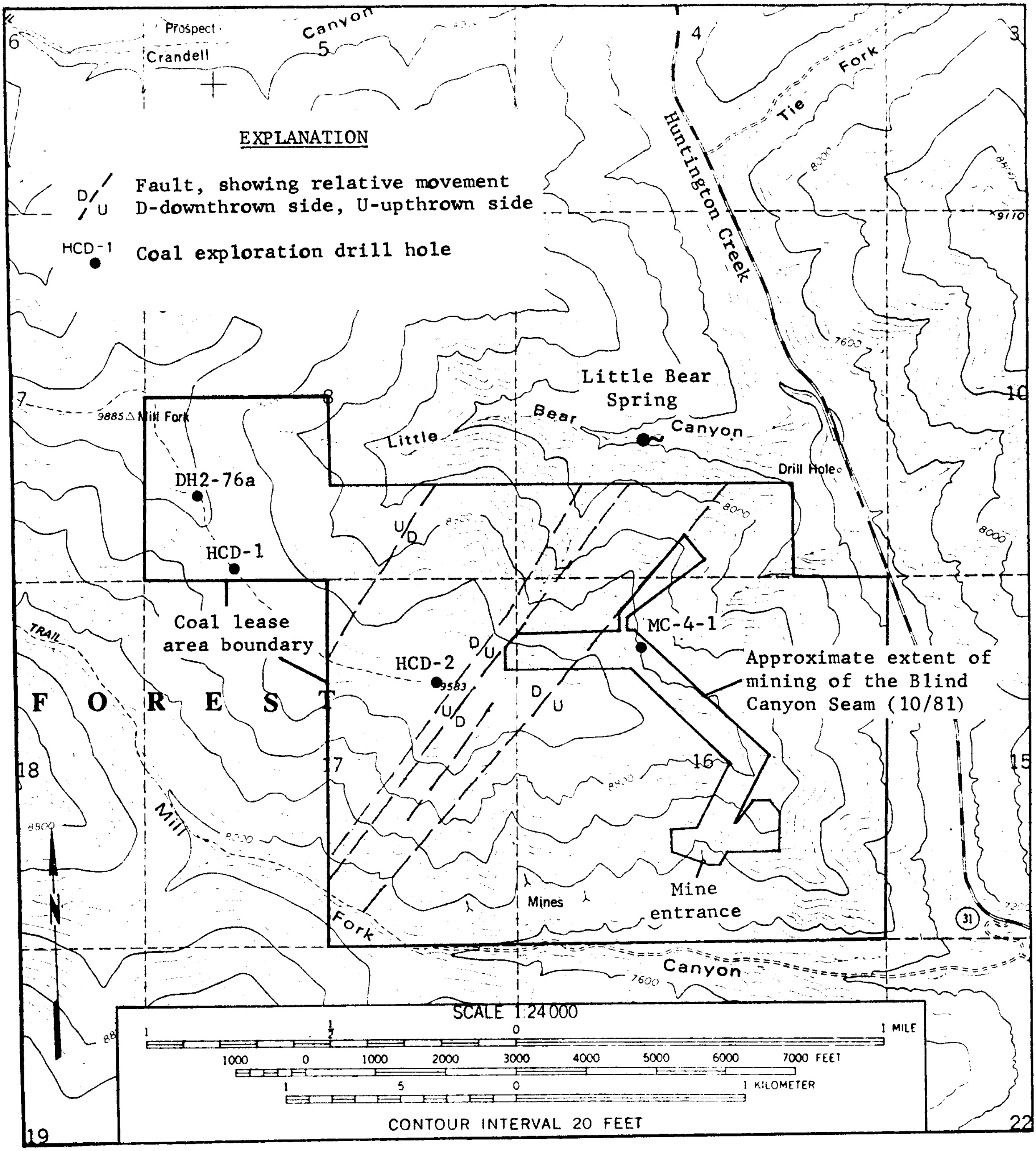
Walton, P. T., 1954, Wasatch Plateau coal fields, in Intermountain Association of Petroleum Geologists, Geology of portions of the high plateaus and adjacent canyon lands, central and south-central Utah: Fifth Annual Field Conference, p. 79-85.

Base map from: USGS 7½' topo quad
Rilda Canyon, Utah 1979



Location of signficant features in the Huntington Creek No. 4 mine near Emery County

Attachment 2, report of 1/21/84 to Darrel V. Leamaster

COMMENTS ON VAUGHN HANSEN REPORT

The principal findings in the Vaughn Hansen Associates report of significance to Little Bear Spring are: (1) spring and surface water flow rates decrease in a southerly direction from canyon to canyon, particualry from Little Bear to Mill Fork to Rilda Canyons (p. 12), and (2) concentrations of most dissolved constituents in both ground water (springs) and surface water increase from north to south and west to east (p. 20). These findings led to the conclusions that: (1) water in Little Bear Spring originates primarily in the north and flows through the Star Point Sandstone (p. 14 and 21) whereas surface flow and subsurface flow in other units enters from both the north and west (p. 21), and (2) the proposed increased mining will have little or no effect on Little Bear Spring since it is south of the spring and recharge is from the north.

The conclusion that most surface and subsurface water enters from the west and north is probably correct and is supported by water quality data. However, the contention that water in Little Bear Spring is primarily from the north is not supported and is in fact contradicted in the report. It is stated that Crandell Canyon (next canyon north of Little Bear Canyon; see attachment 1) acts as a major interceptor drain cutting into the Star Point Sandstone (p. 21). If this were true and recharge to Little Bear Spring were from the north, Crandell Canyon would intercept most of the flow. The statement thus contradicts the conclusion that principal recharge to Little Bear Spring is from the north. In fact, both statements are probably incorrect. No springs are reported by Vaughn Hansen Associates or Danielson and others (1981) to be present in the Star Point in Crandell Canyon. It is apparently not acting as an interceptor drain and flow in the Star Point is probably not from north to south in this area. Other evidence given in the report for soutward flow of ground water in the Star Point is the southward decrease in flow in the so-called lower springs in Little Bear, Mill Fork, and Rilda Canyons (see figure 4, p. 13; p. B-1 and B-2 of the report). The data actually show that flow in the Mill Fork and Rilda Canyon springs alternates seasonally with respect to greatest discharge and that no significant trend exists. The only significant observation from these discharge records is that an anomalously large spring is present in Little Bear Canyon. Because the report's conclusion that mining will have no effect on Little Bear Spring is based on the above inferences which we believe to be incorrect, the UGMS is of the opinion that the report's conclusions have no credence.

DIAGRAM IC CROSS-SECTIONS SHOWING POSS E GROUND-WATER CONDITIONS IN THE MINE AREA

<u>Explanation</u>

Kbh — Blackhawk Formation, showing coal seams bc-Blind Canyon seam, h-Hiawatha seam

Ksp — Star Point Sandstone

Km — Mancos Shale

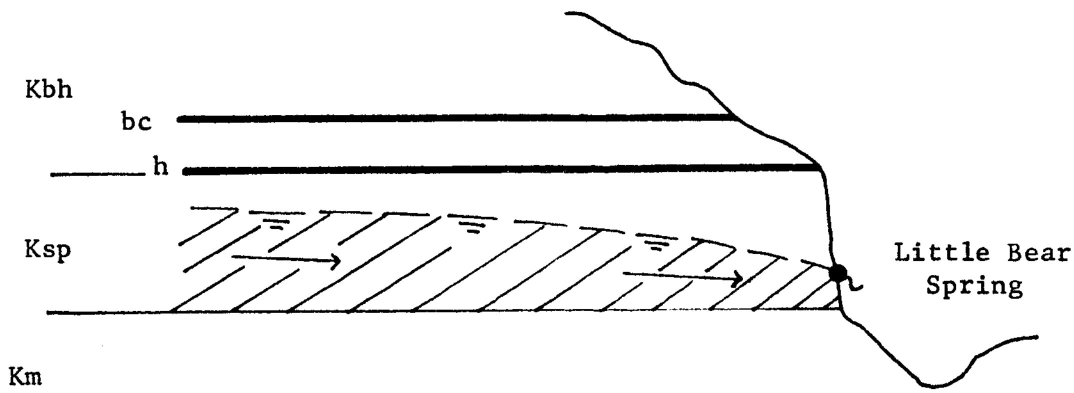
water table

piezometric surface

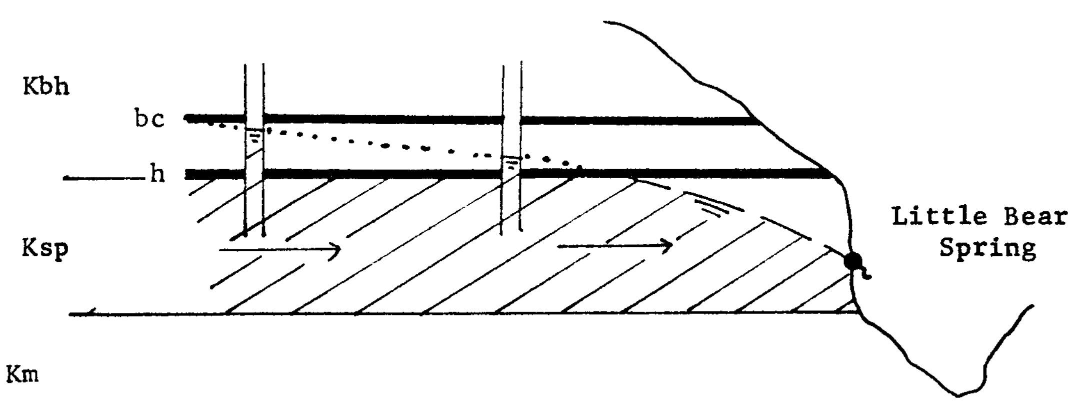
direction of ground-water movement

saturated zone

A. Unconfined water table in the Star Point Sandstone beneath the Hiawatha seam



B. Confined (artesian) conditions in the Star Point Sandstone, Hiawatha seam acting as an aquiclude or confining layer



Attachment 3 (cont.)

C. Unconfined water table in the Star Point-Blackhawk aquifer