Cumulative Hydrologic Impact Assessment

Summit Coal Company
Boyer Mine
PRO/043/008 #2
Summit County, Utah

and

Summit Minerals, Inc.
No. 1 Coal Mine (Blackhawk Mine)
Reclamation Plan
PRO/043/001
Summit County, Utah
5/87

I. Introduction

This report is a Cumulative Hydrologic Impact Assessment (CHIA) of the mining area encompassing Summit Coal Company's Boyer Mine and Summit Minerals Inc.'s # 1 Mine (Blackhawk) Reclamation Project in Summit County, Utah. This assessment depicts the probable cumulative impacts of the proposed coal mining activities on the hydrologic regime encompassing the general area of the above mentioned operations. The operations are designed to prevent damage to the hydrologic balance outside the proposed mine plan areas. The Permit Application Packages (PAP) submitted by the mining companies and this report comply with federal legislation promulgated under the Surface Mining Control and Reclamation Act (SMCRA) and subsequent Utah and federal regulatory programs outlined under UMC 786.19(c) and 30 CFR 784.14(f).

Mining activities currently taking place in the Coalville Field consist of a coal exploration operation being conducted by Summit Coal Company at the Boyer Mine and a mine reclamation operation proposed by Summit Minerals, Inc. at the Blackhawk minesite. No other operating mines or mining prospects exist in the Coalville Field at this time.

Mining has taken place in the Coalville Field since 1854. Doelling (1972) lists several abandoned minesites within the Coalville Field (Table 5, page 350) which were mostly small operations around the turn of the century. Two mines, the Wasatch and Chappell Mines, were substantially larger mines that operated until 1954 and 1970 respectively. These two mines lie approximately 7 miles west of the Boyer and Blackhawk minesites.

In 1879 the N. B. Morby Shaft was sunk near the present Blackhawk mine site . Additional entries were opened by subsequent operators and developed into the old Blackhawk mine. The old Blackhawk Mine workings encompassed about 16 acres. The mine was closed in the mid-1950's. A new Blackhawk Mine was developed east of the old site by Utah Coal and Energy, Inc. The old Blackhawk mine openings were buried during face preparation of the new mine site.

The Boyer and Blackhawk minesites are located approximately 12 miles east of the town of Coalville and about 30 miles northeast of Salt Lake City, Utah (Figure 1).

The mine sites are physiographically located near the western edge of the Central Rocky Mountains. The area is bounded on the west by the Wasatch Mountains and on the east by the Uinta Mountains. This transition zone reflects a topography characterized by high mountainous hills and well developed drainages. Relief in the vicinity of the proposed mines range from 6200 feet at Chalk Creek to 8270 feet on the crest of Porcupine Ridge. Bedrock structure in combination with faulting, erosion and landslides have created irregular drainage patterns and topographic features in the surrounding area.

The climate of the mine area is typically semiarid and continental. Average monthly temperatures vary from 32^{o} in January to 79^{o} in July. The temperatures are predominately cool with an average length of freeze-free period at the site of about 80 days each year (Jeppson et al., 1968). Most precipitation in the region of the mines occurs due to frontal activity during the winter months. Two-thirds of the annual average precipitation occurs during the months of October through April. Two periods of peak precipitation activity take place. During the fall months high precipitation occurs mainly in the form of snow, and in the spring precipitation occurs as mixed rain and snow events (Figure 2). Annual rainfall averages about 20 inches.

Two oil wells shown in Plate 1 ("S" #1 and "S" #2) have been drilled east of the CHIA on the axis of the Dry Canyon Anticline by AMOCO Production Co. The wells are located in T. 3N. R. 7E. Section 30. Well "S" #2 (in CIA) was drilled after part of the drill stem was lost in "S" #1 (east of CIA). Total depth in well "S" #2 was 13,041 feet. Neither well contacted oil or gas.

II. Cumulative Impact Area (CIA)

The Cumulative Impact Area encompasses approximately 1580 acres and is shown in Plate 1. The CIA was established to incorporate potential mining areas adjacent to current proposed operations.

III. Scope of Mining

The proposed operations are 1 mile east of Upton, Utah on the hillsides adjacent to the valley of Chalk Creek. The Boyer Mine is located on the south facing slope. The Blackhawk reclamation site and the proposed No. 1 Coal Mine are located on the north facing slope (Plate 1).

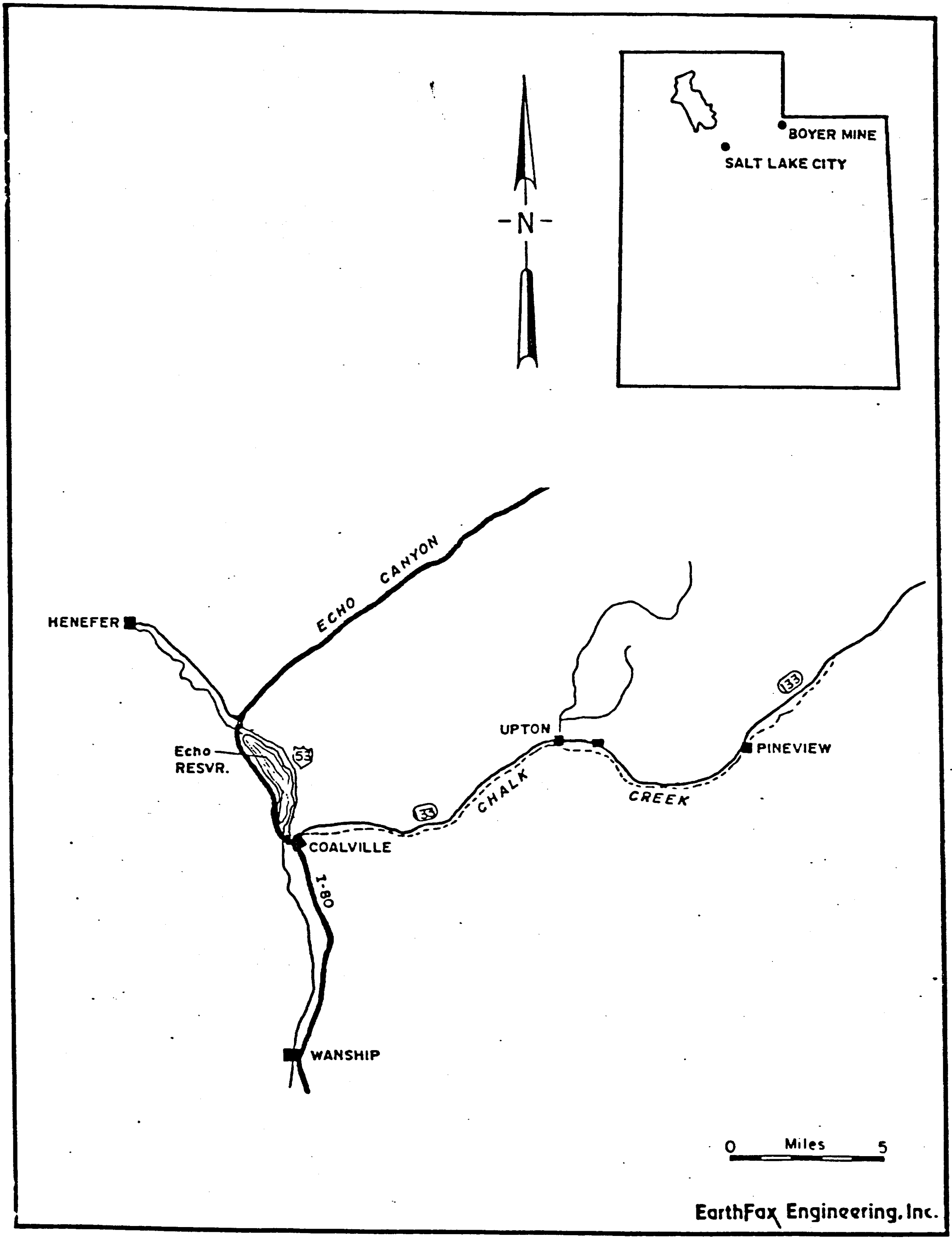

Figure 1. Boyer-Blackhawk CIA vicinity map.

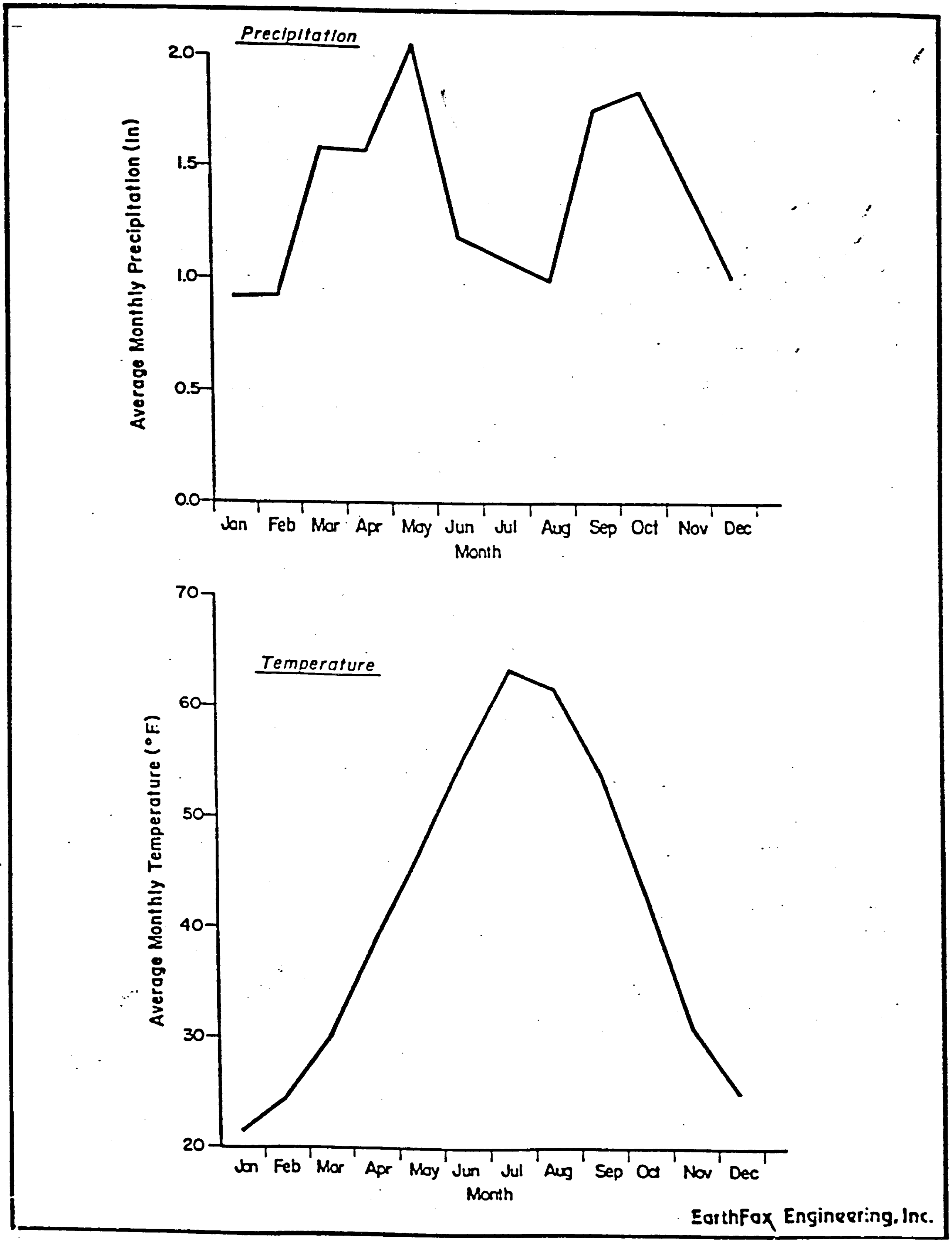

Figure 2. Average monthly precipitation and temperatures at the Coalville weather station.

The mines are being developed in the Wasatch Coal Bed of the Frontier Formation in an area where sporadic mining activities have occured over the past 90 years.

A. Boyer Mine

Summit Coal Company received a coal exploration permit for the Boyer Mine on August 1, 1985. The permit entitled Summit Coal Company to extract 10,000 tons of coal for testing purposes. The permit was later modified (September 25, 1986) to allow another 15,000 tons or a total of 25,000 maximum tons of coal to be extracted for test purposes.

Recently, Summit Coal Company submitted a permit application to expand their mine workings to an area of about 170 acres. The mine is projected for room and pillar mining utilizing a continuous miner. The layout is typical with mains driven down dip and panels developed on the strike. The layout has been modified to parallel property boundaries and avoid old workings. The submains will be driven at 45 degrees to the dip to reduce the mine grade from the average dip grade of 17 degrees to 12 degrees. Mining projections show that mining will be limited to development of submains for the first two years through 1989 before the first panel will be driven southwest along the strike toward the outcrop.

B. Blackhawk Mine

Summit Minerals, Inc. is in the process of obtaining a Reclamation Permit for the Blackhawk Mine which consists of 17.7 acres of surface disturbance and a small amount of underground activity (Plate 1). Plans have also been submitted by Summit Minerals, Inc. to establish a new mine called the No. 1 Coal Mine which will encompass about 480 acres in the south 3/4 of Section 36, T.3N., R.6E. (Plate 1).

IV. Study Area

A. Geology

The CIA is located near the eastern border of the Coalville Coal Field. The Coalville Coal Field lies within the southern portion of the Idaho-Wyoming-Utah overthrust belt. Folds related to eastward thrusting associated with Cretaceous organic events are the dominant feature. The Coalville anticline is the largest feature within the Coalville Coal Field. It is an asymmetrical anticline 10 miles long and 6 to 8 miles wide. The axis trends northeast. The west limb is badly faulted and three predominately north striking normal faults have been mapped. The east limb of the anticline dips steeply and is sometimes vertical or overturned. About 1.5 miles to the east is the Clark Canyon syncline. Its east limb dips 15 to 25 degrees and forms the west limb of the Dry Canyon anticline, the structural feature of the CIA area.

The geology in the vicinity of the CIA consists of stratigraphic units of consolidated rock ranging in age from Late Cretaceous to Tertiary (Figures 3 and 4). The exposed Cretaceous formations were deposited during the Albian through Campanian Ages and consist of resistant sandstones, conglomerates, shales and interbedded coal seams. Angularly overlying all other beds are the redish conglomerates and variegated shales of the Knight Formation, Tertiary in age. Erosion has created long deep canyons that are filled with Quaternary alluvial gravels and remnant terraces.

The Cretaceous and Tertiary rocks make up at least 18,000 feet of strata in the vicinity of the coal field. There are three coal zones within the limits of the coal field, the Dry Hollow seam in the Wanship Formation and the Wasatch and Spring Canyon. All coal seams exist in the Frontier Formation.

Major disconformities exist in the area due to thrust faulting. These faults do not appear near the surface of the CIA, but exist several thousand feet below the surface and are the source of some oil reserves a few miles east of the property in the Pineview Oil Field. Folded Cretaceous strata and deposition of fluvial Tertiary strata (Wasatch Formation) created a significant unconformity seen on the mining property.

Faulting is prevalent in the coal field as a result of structural deformation from eastward thrusting. One fault is noted to the east of the Boyer Mine. Its throw is estimated to be from between 50 to 150 feet. Its presence should not have an influence on the current mine plan.

V. Hydrologic Resources

A. Ground water

Ground water exists in confined and unconfined states in the vicinity of the CIA. Snowmelt at higher elevations provides most of the source of ground water recharge, particularly where permeable lithologies are exposed at the surface. Vertical migration of ground water occurs through permeable rock units and/or along zones of faulting and fracturing. Lateral migration initiates when groundwater encounters impermeable rock and flows laterally until either the land surface is intersected creating a perched spring or until vertical movement can continue.

Unconfined aquifer conditions occur in the alluvial sediments that fill the valleys of Chalk Creek, Huff Creek and Josh Hollow adjacent to the mine plan areas. Other unconfined aquifers, actually a perched aquifers, exists within the nearly horizontal Knight Formation where shale beds act as aquatards to impede downward groundwater movement.

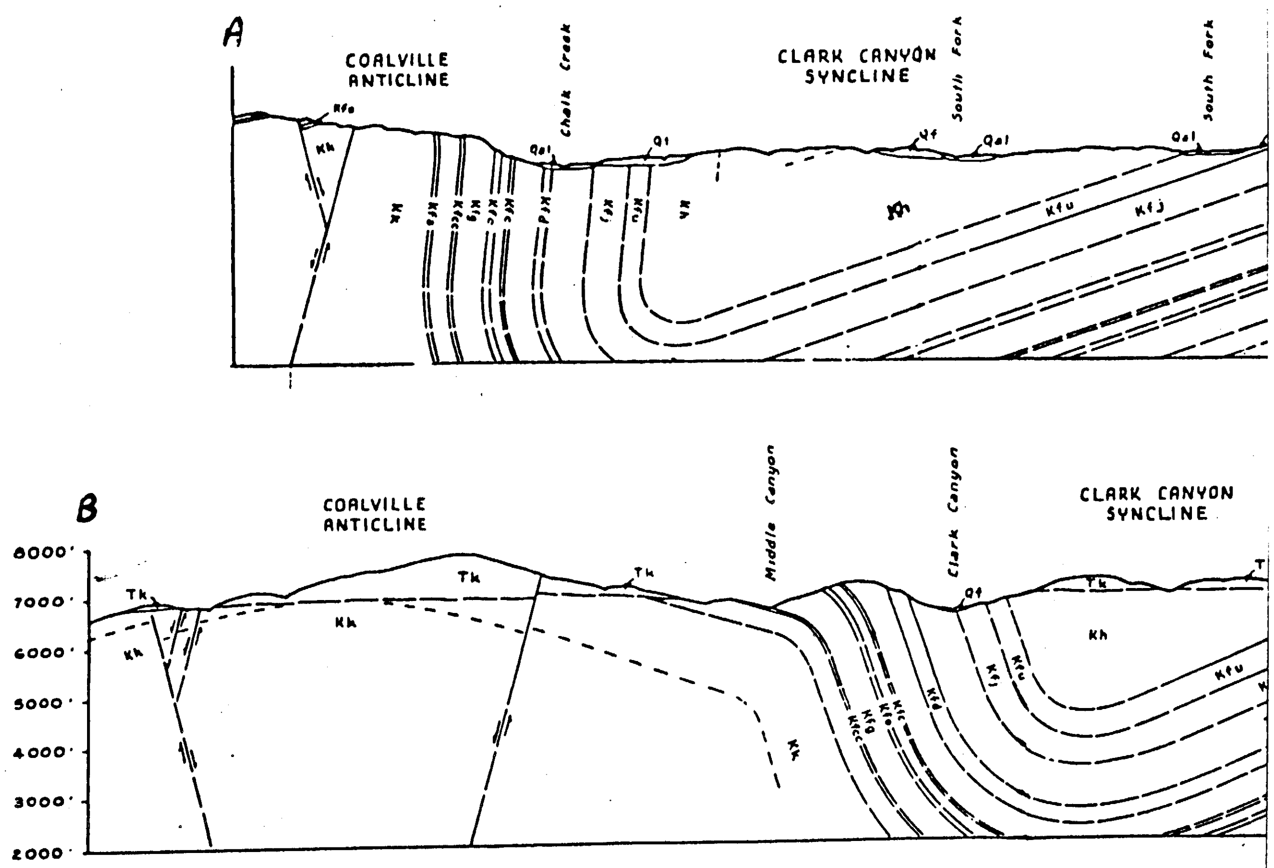

Figure 4. Geologic cross-sections showing structure south an
(Modified from Trexler, 1966)

While drilling a monitoring well on the Boyer Mine property Summit Coal Company contacted a confined aquifer in a gravel bed about 100 feet below the Wasatch coal seam (Figure 5).

The alluvium of Chalk and Huff Creeks comprises the major ground water source for the area. The water source that supplies these aquifers comes from the stream itself. The stream originates high up in the mountains from springs or direct runoff from snowmelt. The alluvium is quite permeable and can yield up to 2000 gallons per minute (gpm) in some areas. Only a few wells in the vicinity withdraw water from the alluvial aquifer at low rates (2 to 10 gpm) for culinary purposes.

Surveys were conducted by EarthFax Engineering, Inc. in June and October 1985 to identify the locations and characteristics of seeps and springs in the vicinity of the Boyer Mine permit area (Figure 6). Five springs are located within the CIA area and a total of thirty-four seeps and springs were found within one mile of the CIA boundary. Most issued near the contact between the Tertiary Knight Formation and the Quaternary alluvial gravels between the 6400 and 6600 foot elevation. During the June survey, 11 of the sources existed as seeps where no measurable flow was occurring, but water was visible. Maximum measured flows were 10 gallons per minute (gpm). By that October, 7 of the seeps and 7 of the springs were dry and flows at the other springs had decreased (Table 1).

There are 10 wells in the vicinity of the CIA (Figure 7, Table 2). Three wells were drilled near the town of Upton, the LDS well, the Boyer-2 well and the Orgill well. The Clark well lies west of Upton and has little bearing on the CIA. The LDS well was drilled to a depth of 517 feet, in a shale bed and did not contact water. The Boyer and Orgill wells are developed in the alluvium of Huff Creek to a depth of 183 feet and 160 feet. Water was contacted in both wells at about the 100 foot level. The Staley well and Old well lie along the southwest edge of the Boyer Mine property. Both wells appear to be developed in the same source aquifer and apparently receive water from a perched aquifer that discharges into the alluvium from the Knight Formation. The Morby and Boyer-1 wells are located on the eastern border of the CIA. The Morby well withdraws water from the alluvial gravels of Chalk Creek that seems to be a mixture of water from the Knight Formation and the alluvial aquifer of Chalk Creek. Whereas, the Boyer-1 well appears to withdraw water from the alluvial aquifer of Chalk Creek. A fault situated between the wells and the mine may obstruct the westward migration of water within the perched aquifer of the Knight Formation and cause it to discharge in the vicinity of the Morby well. This would account for the higher water level readings in the Morby well as compared to the Old and Staley wells. The Jones well is also located in the alluvial gravels of Chalk Creek. Its depth is 58 feet and static water level is 10 feet near the level of the creek. The Utah Coal and Energy well was drilled 325 feet deep and extends into the Frontier Formation. Unfortunately, no other information could be found concerning water levels or quality.

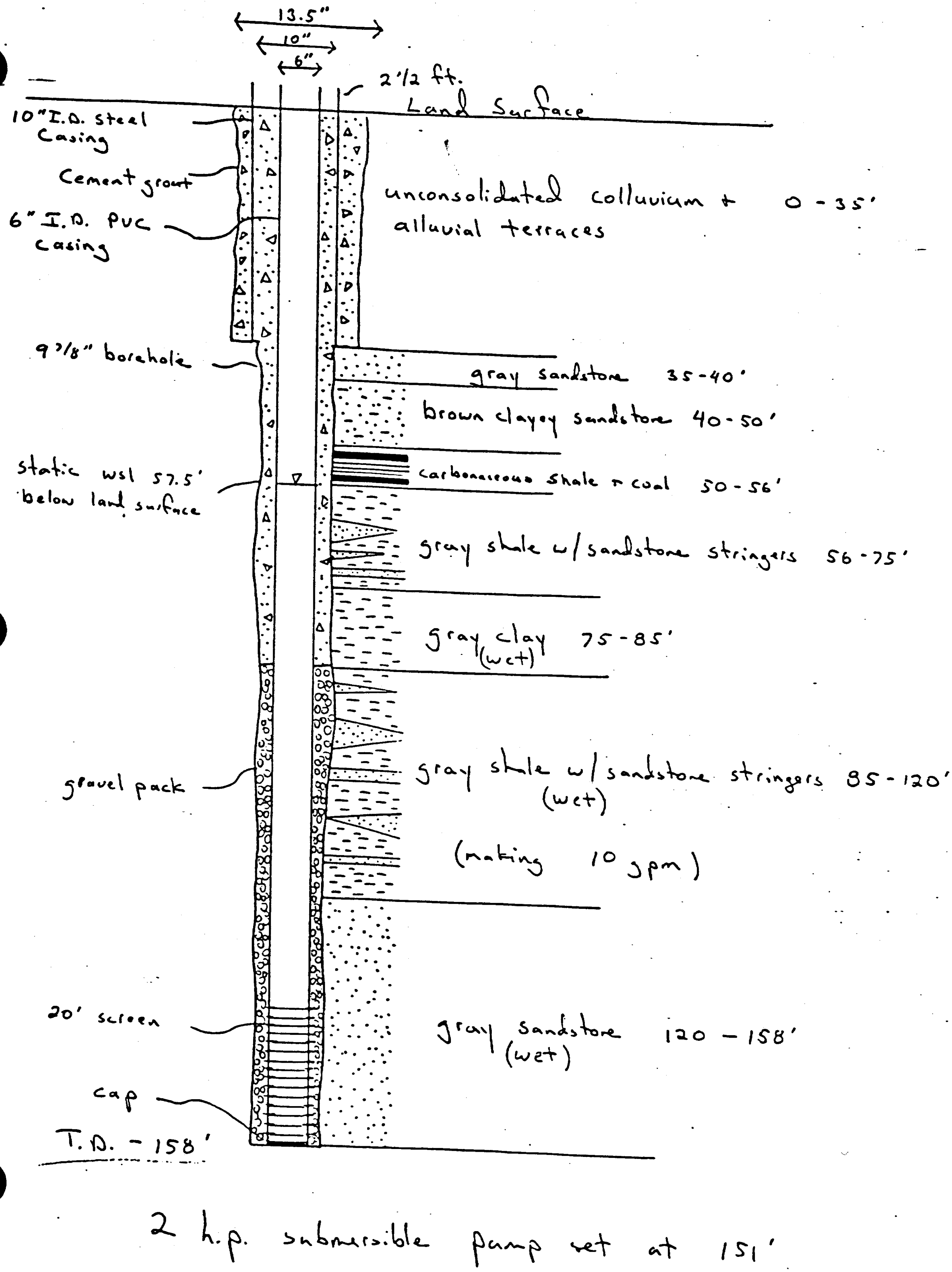

Figure 5. Boyer Mine well log.

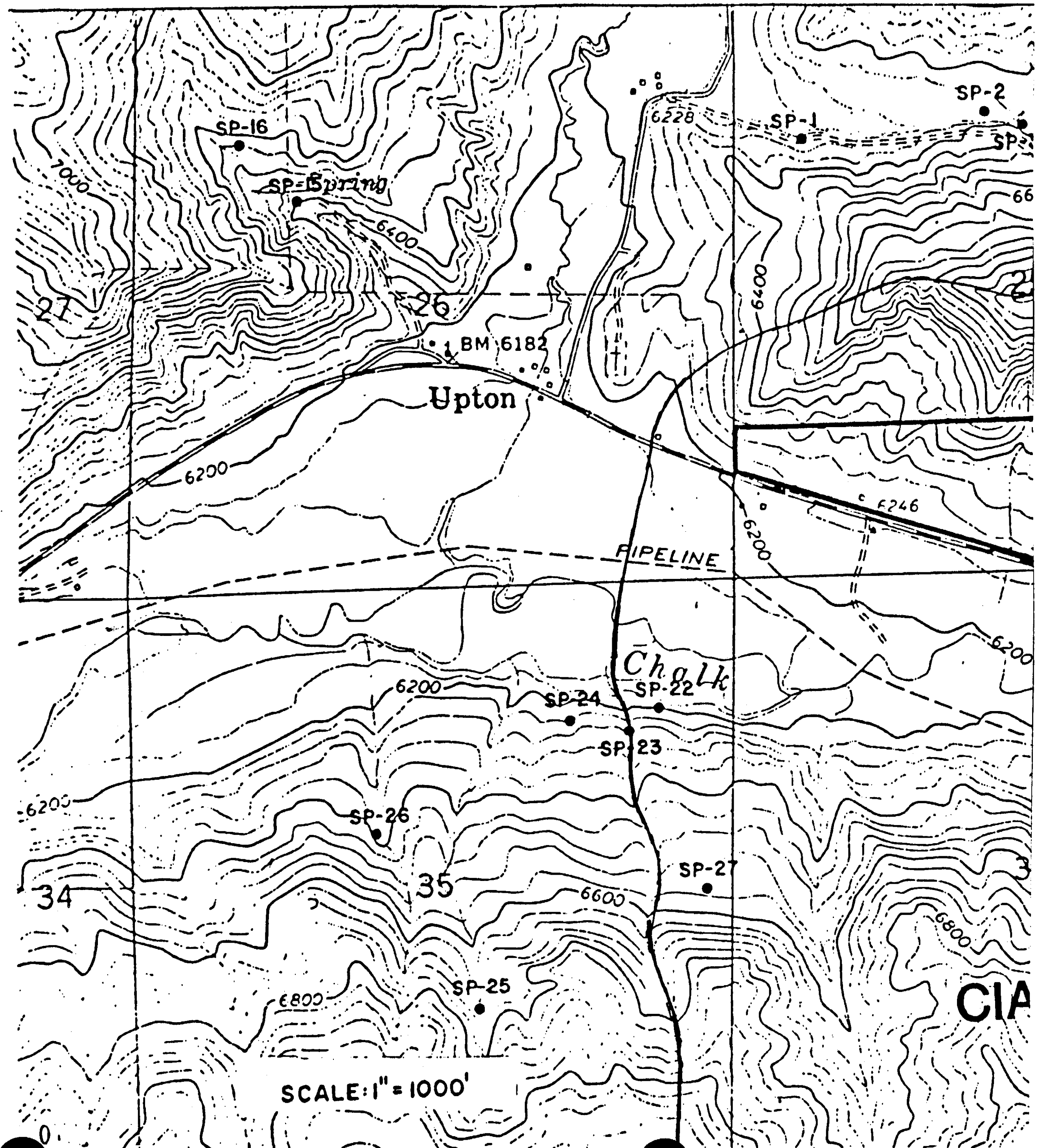

Figure 6. Spring and seep locations on and adjacent to

Table 1. Characteristics of seeps and springs in the permit and adjacent areas.

Field Number	May and June 1985 Flow (gpm)	May and June 1985 pH (units)	May and June 1985 Sp. Cond.(a)	October 1985 Flow (gpm)	October 1985 pH (units)	October 1985 Sp. Cond.(a)	Geologic Conditions	Comments
SP-1	4	6.48	850	4	7.5	850	See comments	Flowing well
SP-2	1	6.84	900	<<1	(b)	(b)	From alluvial terrace	Diffuse seepage
SP-3	5	7.10	930	Dry	(b)	(b)	Alluvium (top of terrace	Diffuse seepage
SP-4	0	(b)	(b)	Dry	(b)	(b)	Alluvium (top of terrace)	Diffuse seepage
SP-5	0	(b)	(b)	Dry	(b)	(b)	Alluvium (top of terrace)	Diffuse seepage
SP-6	4	7.03	700	Dry	(b)	(b)	Soil over conglomerate	Diffuse seepage
SP-7	0	(b)	(b)	Dry	(b)	(b)	Alluvium adjacent to channel	Diffuse seepage
SP-8	3	7.22	590	Dry	(b)	(b)	Alluvium from channel bottom	Stock usage
SP-9	<1	7.21	510	<1	8.6	550	Colluvium over sandstone	Hillside seepage
SP-10	0	(b)	(b)	0	(b)	(b)	Colluvium over sandstone	
SP-11	3	7.36	650	5	7.3	950	Alluvium in Morby Creek	Several springs
SP-12	3	7.44	620	1	7.2	920	Alluvium in Morby Creek	Iron stains
SP-13	2	7.88	1140	<1	7.8	1060	Alluvium in Morby Creek	Several springs, stock usage
SP-14	1	7.90	1000	2	7.9	1040	Road fill over conglomerate	
SP-15	10 (overflow)	7.66	920	8 (overflow)	7.1	1050	Sandstone over shale?	Developed for domestic use
SP-16	<1	7.80	1110	1	7.2	1400	Sandstone over shale?	Developed for stockwatering
SP-17	3	7.25	550	1	7.9	550	Sandstone over siltstone	Developed with berm to pond

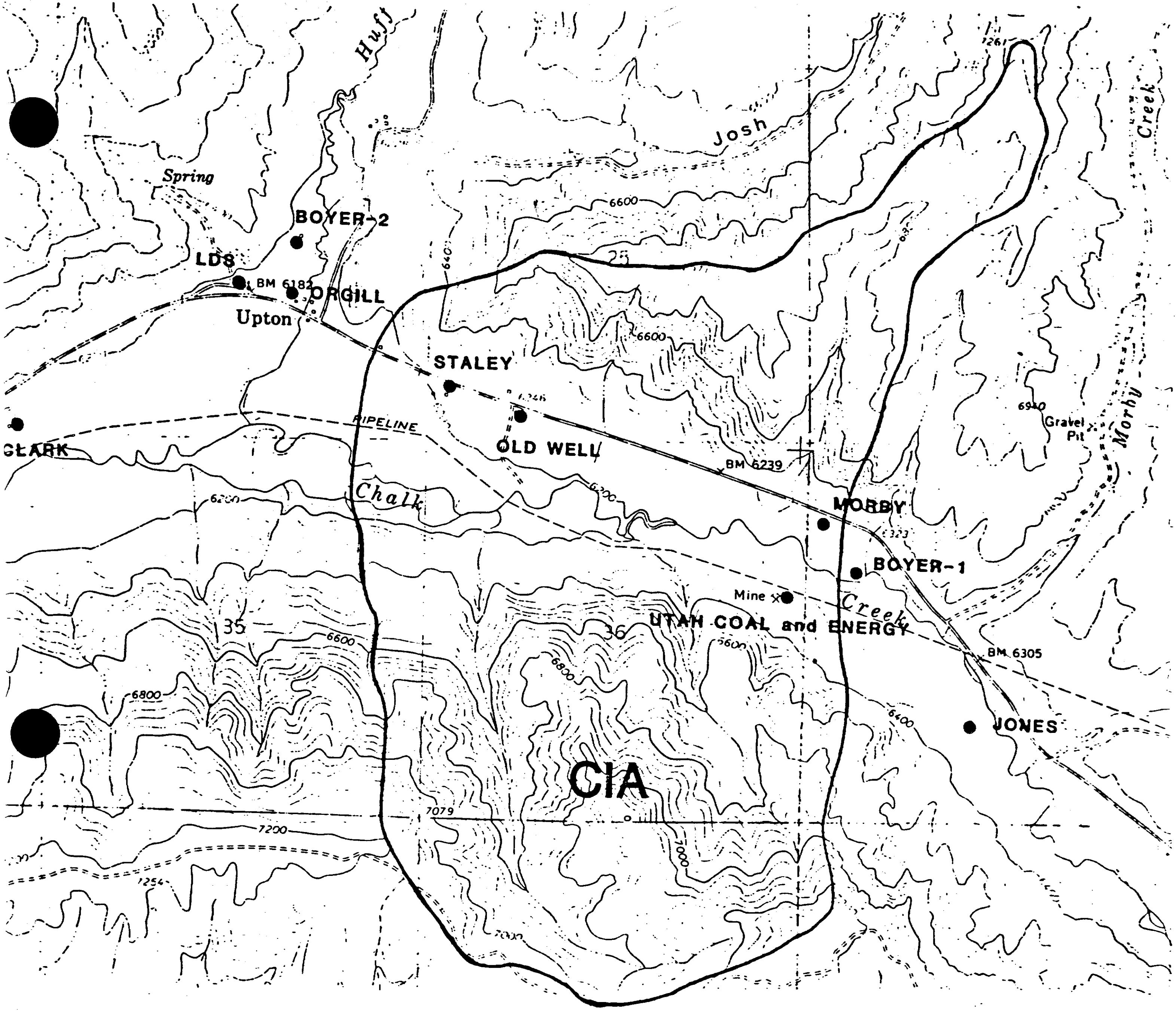

Figure 7. Location of water wells on and adjacent to the CIA.

Table 2. Selected information for water wells in the Upton area.

Well Name	Diameter (in)	Total Depth (ft)	Screened Interval (ft) From	Screened Interval (ft) To	Lithology[a]	SWL (ft)	Date Measured	Estimated Flow Rate (gpm)[b]
Boyer-1	6	170	110	170	SS	20	4/81	4.6
Boyer-2	8	183	Open below 140		Cg	110	11/76	nd
Clark	6	45	Not reported		Cg	12	3/58	nd
Jones	6	58	None		Cg	10	3/50	nd
LDS	6	517	None		Reported dry hole		9/80	nd
Morby	nd	nd	nd		nd	nd	nd	nd
Old Well	6	120	Not reported		SS	50	4/58	10
Orgill	6	160	140	160	Sh	90	10/66	nd
Staley	6	80	Not reported		SS	40	3/58	nd
Utah Coal	7.5	325	295	325	SS	nd	nd	nd

[a] SS=sandstone, Cg=conglomerate, Sh=shale
[b] Yield reported on drillers log (Attachment D)
nd = no data

Groundwater quality varies, depending on geology, physiography, and elevation. The best quality usually occurs in or near mountain recharge areas and the poorest quality in lowland areas. Major chemical concentrations in groundwater contained in bedrock near Chalk Creek consist of sodium, calcium and bicarbonate. Closer to the ridges on either side of Chalk Creek ground water contains higher concentrations of calcium, magnesium and chloride. The concentration of dissolved solids in water from the Old well which is thought to discharge from a perched aquifer of the Knight Formation ranges from 2580 to 2870 mg/l. Dissolved solid concentrations in water from the Boyer-1 well and the Morby well range about 380 mg/l and 1000 mg/l which are considered to be alluvial in nature. The higher concentration of dissolved solids in the Morby may be caused by mixing of water from a perched aquifer of the Knight Formation and alluvial aquifer. The dissolved solid concentration in the Mine well located in the Frontier Formation ranges about 370 mg/l.

B. Surface Water

The CIA is located in the Chalk Creek drainage. Chalk Creek is tributary to the Weber River. Their confluence lies near Coalville, Utah.

The Weber River Basin has a drainage area of approximately 2080 square miles (mi^2). The Weber River heads in the Uinta Mountains and generally flows northwestward through the Wasatch Range and into the Great Salt Lake. Elevations in the Weber River basin range from approximately 4210 feet to 11,708 feet. There are five major tributaries to the Weber River; Ogden River and East Canyon, Lost, Chalk, and Beaver Creeks.

The CIA, as shown on Plate 1, consists of 1,580 acres of the Chalk Creek watershed. Topography in the area is gently sloping to steep with slopes ranging from 2 to 70 percent.

The CIA is divided by Chalk Creek flowing east to west with ephemeral tributaries that drain into Chalk Creek. Other water resources within or adjacent to the CIA include several low yielding springs and seeps. There are no major ponds, reservoirs or lakes within or adjacent to the CIA.

The estimated annual sediment yield is approximately 0.42 to 1.20 ac-ft/mi^2 for the Boyer Mine permit area (Earthfax Engineering, 1986). Due to the similarity of soil types over the entire CIA the average annual sediment yield of the CIA is estimated to be 1.09 to 2.96 ac-ft for undisturbed conditions.

Chalk Creek

The headwaters of Chalk Creek are located in the Chalk Creek Basin near the border of Utah and Wyoming. The creek flows for approximately 25 miles generally westward to its confluence with the Weber River near Coalville, Utah.

The Chalk Creek drainage area contains 250 sq. mi. above USGS gaging station 10131000, Chalk Creek at Coalville, Utah, which is approximately 0.3 mile from the confluence of Chalk Creek and the Weber River. The period of record for this station is 1904-1905 and 1927 to present. The extreme flows recorded include a maximum of 1570 cubic feet per second (cfs) on June 1, 1983 and a minimum of less than 1 cfs for several days in 1934. The average annual maximum discharge is 4.9 cfs (U.S.G.S, 1984).

Dissolved solids concentrations in Chalk Creek tend to be significantly higher than in the Weber River (Thompson, 1983). Near their junction, Thompson (1983) reported that the total dissolved solids concentrations of the Weber River varied from 163 to 256 mg/l during his investigations (September 1979 through August 1950), while Chalk Creek water varies from 237 to 446 mg/l. Additionally, the quality of water in Chalk Creek in the CIA is generally of better quality than at the mouth of the stream. Thompson (1983) reported that dissolved solids concentrations approximately three miles upstream from the mining operations varied from 202 to 234 mg/l during his investigation compared with the 237 to 446 mg/l at the mouth of Chalk Creek.

A hydrologic investigation of the Boyer Mine permit area was performed by Earthfax Engineering during 1985 and 1986. Several hydrologic characteristics of Chalk Creek were studied in detail near the permit area. The following discussion of Chalk Creek is based on the investigation performed by Earthfax.

Surface water monitoring stations were established on Chalk Creek at the locations shown on Figure 8. Table 3 contains several hydrologic parameters for Chalk Creek and the Chalk Creek drainage basin. Geomorphic parameters for Chalk Creek before and after spring (1986) runoff are listed in Table 4. These data indicate that selected reaches of Chalk Creek in the CIA underwent degradation (intermediate station and SS-6) while other reaches remained nearly stable (SS-5).

Storage discharge relations were developed for cross sections from Chalk Creek using the Manning equation and the continuity equation

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

and

$$Q = AV$$

where

V = velocity (feet per second)
n = Mannings roughness coefficient
R = Hydraulic Radius (feet)
S = Hydraulic Slope (feet per foot)
Q = Discharge (cubic feet per second)
A = Flow area (square feet)