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# COAL RESOURCES OF THE SOUTHWEST QUARTER OF THE SOLDIER SUMMIT 15-MINUTE QUADRANGLE UTAH, CARBON, AND SANPETE COUNTIES, UTAH

By

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CONTENTS

## ILLUSTRATIONS

# INTRODUCTION

## Purpose

This report was compiled to support the land planning work of the Bureau of Land Management and to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) in the Western United States. It supplements the land planning requirements of the Federal Coal Leasing Amendments Act of 1976 (Public Law 94-377) sec. (3)(B) which states, in part, that "Each land-use plan prepared by the Secretary [of the Interior] (or in the case of lands within the National Forest System, the Secretary of Agriculture pursuant to subparagraph (A)(i)) shall include an assessment of the amount of coal deposits in such land, identifying the amount of such coal which is recoverable by deep mining operations and the amount of such coal which is recoverable by surface mining operations."

Published and unpublished public information were used as data sources for this study. No new drilling nor field mapping were done to supplement this study. No confidential nor proprietary data were used.

## Location

The Southwest Quarter of the Soldier Summit 15-minute quadrangle is located at the north end of the Wasatch Plateau coal field in central Utah. The north half of the quadrangle lies in Utah County and the south half is in Carbon County with the exception of a narrow 0.16 mile- (0.26 km-) wide strip on the west edge which lies in Sanpete County. The city of Provo is the county seat of Utah County and is 33 miles (53 km) northwest of the quadrangle. The city of Price is the county seat of Carbon County and is 23 miles (37 km) southeast of the quadrangle. The city of Manti is the

county seat of Sanpete County and is 40 miles (64 km) southwest of the quadrangle. Scofield Reservoir is located in the southeast quarter of the quadrangle.

## Accessibility

Utah Highway 96 traverses the eastern edge of the quadrangle in a north-south direction. This highway intersects U.S. Highway 6 approximately 5.3 miles (8.5 km) east of the quadrangle. U.S. Highway 6 provides direct access to the cities of Price and Provo. Utah Highway 96 provides access to the town of Scofield 2 miles (3 km) south of the quadrangle, and the town of Clear Creek which is 7 miles (11 km) south.

A gravel road runs up the South Fork of Soldier Creek on the north side of the quadrangle and then drops down into Bear Creek Canyon to Scofield Reservoir and the west side of Pleasant Valley. Several unimproved dirt roads and jeep trails provide access into some of the more rugged canyons and upland areas.

A branch line of the Denver and Rio Grande Western Railroad passes through the southeast corner of the quadrangle. This subsidiary line joins the main line of that railroad 6.5 miles (10.5 km) east of the quadrangle at Colton. The main line provides rail connections to Salt Lake City, Utah and Denver, Colorado. The branch line continues south of the quadrangle to the towns of Scofield and Clear Creek.

## Physiography

The Wasatch Plateau is a high and deeply dissected tableland, the eastern margin of which is a sweeping stretch of barren sandstone cliffs

some 80 miles (129 km) long. The strata generally dip at low angles and resistant cliffs and ledges line the walls of some of the steep-sided canyons. In this quadrangle a soil mantle covers most of the hills and valleys and the extent of bedrock exposure is not as great as on the eastern side of the Wasatch Plateau.

The area within the quadrangle is rugged and mountainous, with altitudes ranging from 6,875 ft (2,096 m) where the South Fork of Soldier Creek leaves the north side of the quadrangle to 9,245 ft (2,818 m) on Bear Ridge along the west side. Scofield reservoir occupies the lower end of Pleasant Valley in the southeast corner of the quadrangle. Scofield dam is an earth-fill dam that was built in a narrow part of upper Price Canyon just outside the quadrangle boundary.

## Climate

The Wasatch Plateau is in the mid-latitude steppe climate zone. Semi-arid conditions generally prevail at the lower elevations near the base of the plateau. In this quadrangle the normal annual precipitation ranges from 23 inches (58 cm) in the southeast corner to approximately 32 inches (81 cm) in the high mountainous area in the southwest corner of the quadrangle.

Temperatures on the Wasatch Plateau in the area of the quadrangle are cool in summer and cold in winter. The annual mean temperature at the Scofield Dam is 37.7 degrees F (3.2 degrees C) with temperature extremes of 89 degrees F (31.7 degrees C) in the summer and -42 degrees F (-41 degrees C) in the winter (U.S. Department of Commerce, 1957).

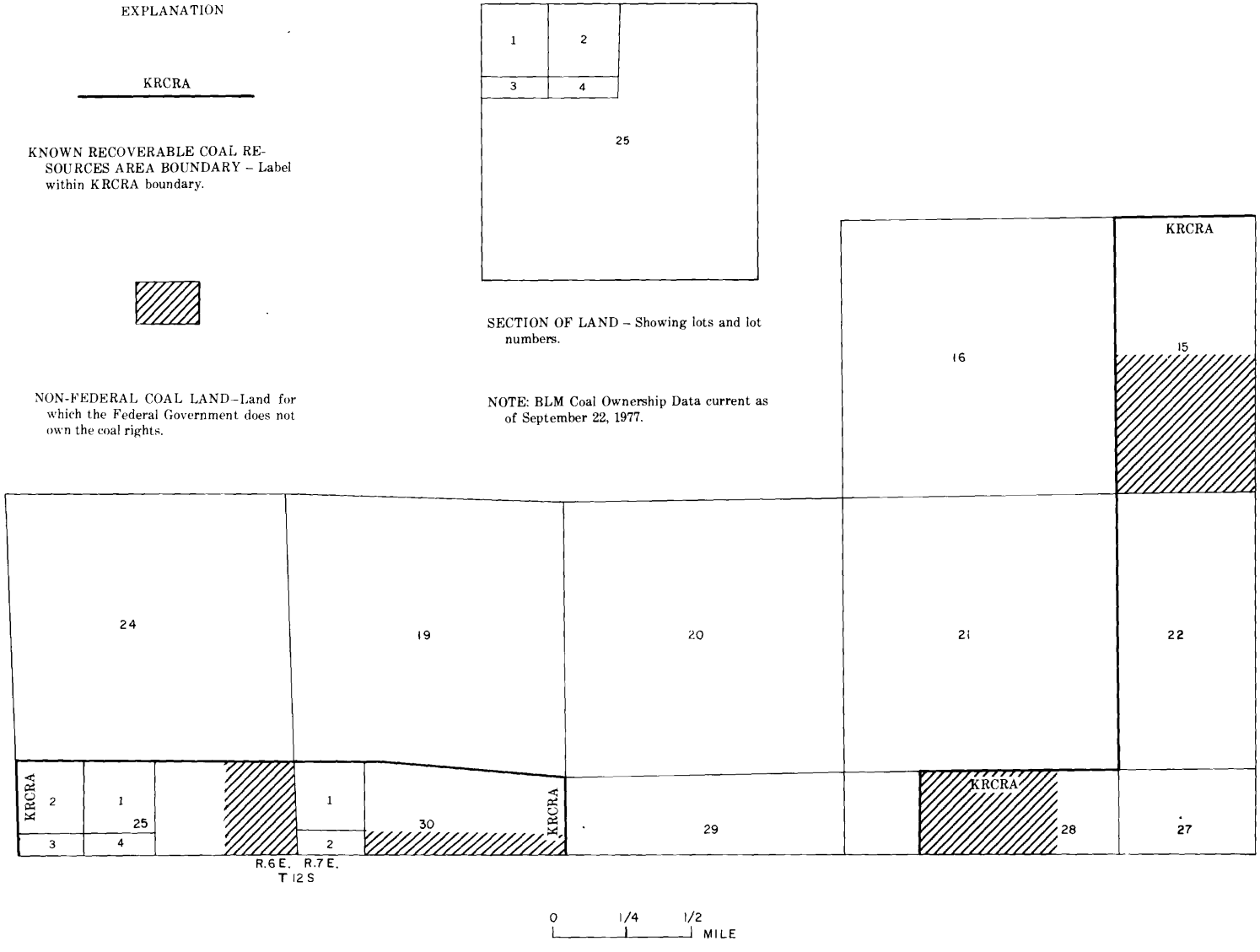



PLATE 1. Boundary and coal data map, Southwest Quarter of the Soldier Summit 15-minute Quadrangle, Utah, Carbon, and Sanpete Counties, Utah.

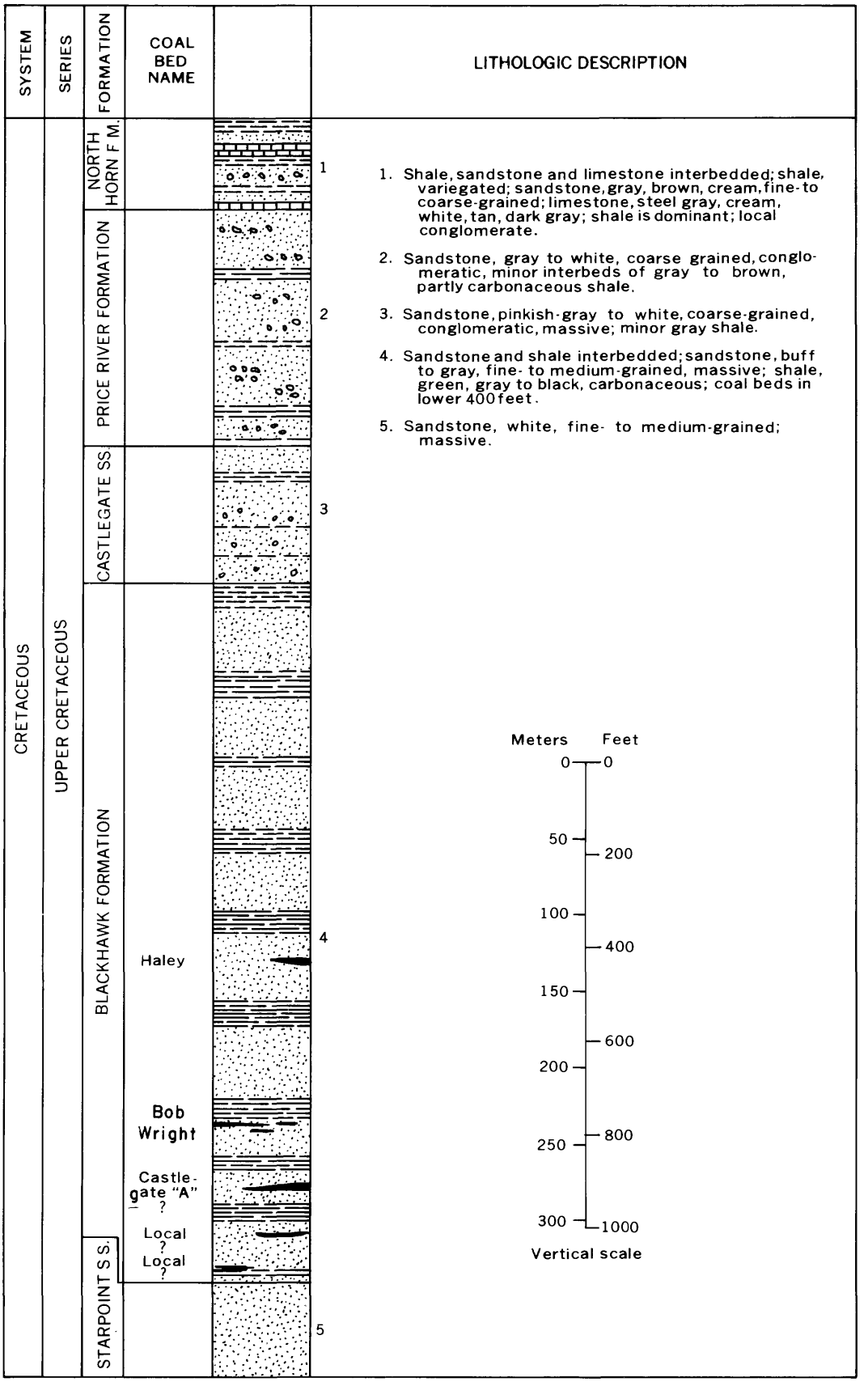



PLATE 2. Composite columnar section for the Southwest Quarter of the Soldier Summit 15-minute Quadrangle, Utah, Carbon, and Sanpete Counties, Utah.

## Land Status

The Southwest Quarter of the Soldier Summit 15-minute quadrangle is located at the north end of the end of the Wasatch Plateau Known Recoverable Resource Area (KRCRA). The KRCRA covers approximately 1,200 acres (486 ha) of the quadrangle. This area is divided into 900 acres (364 ha) of unleased Federal land and 300 acres (121 ha) of non-Federal land. The areal distribution of these lands is shown on plate 1.

# GENERAL GEOLOGY

## Previous Work

Spieker (1931) mapped the geology and coal deposits of the Wasatch Plateau and his map is the most detailed work presently available. The stratigraphy of the area is further described by Spieker and Reeside (1925), Katich (1954), and Moussa (1965). Doelling (1972) has summarized the geology and updated the coal data for the Wasatch Plateau area. AAA Engineering and Drafting, Inc. (1979a and 1979b) has prepared coal resource and coal development potential maps for the adjoining quadrangles on the east and south.

## Stratigraphy

The sedimentary rock formations which crop out in the quadrangle area include the Blackhawk Formation, Castlegate Sandstone, and Price River Formation which comprise the Mesaverde Group of Upper Cretaceous age. The Price River Formation is overlain by the North Horn Formation of Upper Cretaceous and Tertiary ages. The Star Point Sandstone underlies the Blackhawk Formation but is not exposed in the quadrangle area (see plate 2).

The oldest formation exposed in the quadrangle is the Blackhawk Formation which contains the important coal beds. The Blackhawk is from

1,500 to 1,600 ft (456 to 488 m) thick and is composed of yellow to gray fine- to medium-grained sandstone interbedded with subordinate gray carbonceous shale and coal beds.

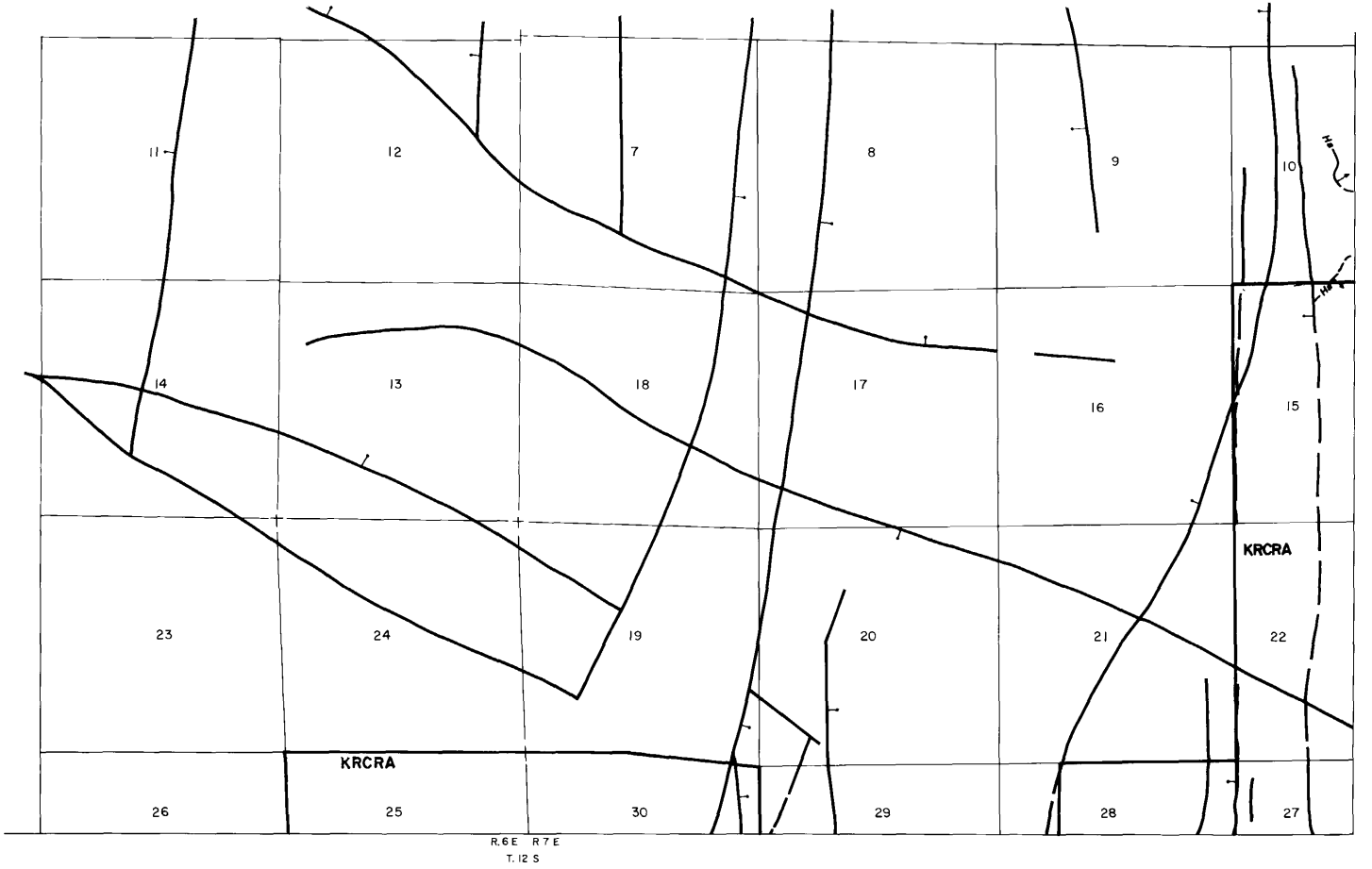
The overlying Castlegate Sandstone ranges from 200 to 500 ft (51 to 153 m) thick, and is composed of white to gray, coarse-grained, conglomeratic sandstone which forms prominent cliffs and weathers to shades of brown. The Price River Formation overlies the Castlegate Sandstone and consists of about 550 ft (168 m) of gray, sandstone interbedded with minor shales and conglomerate.

The overlying North Horn Formation marks the transition from the Cretaceous to the Tertiary, and is the lowest member of the Wasatch Group. It is nearly 600 ft (183 m) thick and consists of variegated shale and lesser amounts of sandstone, conglomerate, and freshwater limestone.

## Structure

The dominant structural feature of the quadrangle is the Pleasant Valley fault zone which consists of multiple north-south trending normal faults in the south half of the quadrangle (see plate 3). One of the faults in the western third of the quadrangle extends into the adjoining quadrangle to the north. The fault zone continues southward from the quadrangle 30 miles (48 km) to the Cottonwood Creek area. Spieker (1931) believes the Pleasant Valley area contains the most complex and intricate faults of the Wasatch Plateau.

In the coal mining areas in the adjoining quadrangle to the south, the fault system has created numerous mining problems which have been solved in most cases. Generally the fault displacements are small, but some have been large enough to cause significant changes in mining plans and the creation of new mining units.




EXPLANATION

*Ha* – Haley

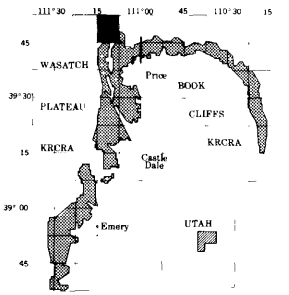
COAL BED SYMBOL AND NAME

TRACE OF COAL BED OUTCROP – Letters designate the name of the coal bed as listed above Arrow points toward the coal bearing area Dashed line indicates inferred outcrop Trace of coal outcrop modified (from Spieker, 1931) to fit modern topographic map

FAULT – Dashed where approximately located bar and ball on downthrown side

KRCRA

KNOWN RECOVERABLE COAL RESOURCES AREA BOUNDARY – Label within KRCRA boundary.




**MAP SHOWING LOCATION OF THE SOUTHWEST QUARTER OF THE SOLDIER SUMMIT 15-MINUTE QUADRANGLE (SHADED) AND THE BOOK CLIFFS AND WASATCH PLATEAU KNOWN RECOVERABLE COAL RESOURCE AREAS (STIPPLED), UTAH.**

0 1/4 1/2 MILE

SCALE

PLATE 3. Coal data map, Southwest Quarter of the Soldier Summit 15-minute quadrangle, Utah, Carbon, and Sanpete Counties, Utah.

The regional dip is northward toward the axis of the Unita Basin. The beds in the fault blocks generally dip to the north or northwest. On the west side of the fault zone the beds dip gently to the northwest at angles less than 7 degrees.

## COAL GEOLOGY

The more important coal beds of the Wasatch Plateau that have been mined in areas south and southeast of the quadrangle occur in the lower part of the Blackhawk Formation. Only the upper part of that formation is exposed in the fault blocks on the south side of this quadrangle.

### Haley Coal Bed

A coal bed called the Haley bed crops out in the canyon referred to as Fish Creek Canyon by Spieker (1931). This canyon isn't named on Spieker's map but the outcrop traces occur in the canyon in which Scofield dam was built and in which the upper Price River flows in the adjoining quadrangle to the east. Plate 3 shows the western end of the coal outcrop traces mapped by Spieker (1931). No thickness measurements of the bed are known in this quadrangle, but in the quadrangle to the east the bed ranges from 3.0 to 6.0+ ft (0.9 to 1.8+ m) in thickness (AAA Engineering and Drafting, Inc., 1979a). The coal becomes thin and dirty westward toward Scofield Reservoir. The lateral extent and commercial value of the Haley bed have not been determined and no chemical analyses are available.

Spieker (1931, p. 89) states that "The stratigraphic relation of the Haley bed to the identifiable coal beds of the Blackhawk Formation in near-by areas is not definitely known. The Castlegate sandstone member of the Price River Formation lies about 900 feet stratigraphically above

the Haley coal bed, and if the rocks in that interval were at all constant between the east side of the plateau and Fish Creek Canyon the Haley bed would not be far from the position of the Hiawatha coal bed. Farther south and west in Pleasant Valley, however, the Castlegate sandstone is much farther above the known coal beds than it is on the east side of the plateau, and it is likely that a similar condition prevails in Fish Creek Canyon; if so, the Haley bed is much higher stratigraphically than the Hiawatha and Castlegate 'A' beds. The Haley coal bed has not been recognized outside of Fish Creek Canyon."

## Other Coal Beds

In the Pleasant Valley area in the adjoining quadrangle to the south at least four coal beds or zones are recognized. In ascending order above the Star Point Sandstone the coal beds recognized by Spieker (1931) are the Union Pacific bed, Castlegate "A" bed, and the Bob Wright zone. Other local names such as "Flat Canyon", "Lower O'Connor", "Upper O'Connor", and "McKinnon" have also been used as names for the coal beds found or mined in the area.

## Coal Bed Correlation Problems

The correlation of coal beds from the east side of the Wasatch Plateau to the Pleasant Valley area is made difficult, if not impossible, by several conditions. Much of the surface is forested and has a thick soil cover. Coal outcrops are few in number and cannot be traced on the surface. There is a lack of non-proprietary drilling data in the wide areas between outcrops. The dislocation of coal beds by numerous faults has made correlations difficult. The pinching and thickening of coal beds and non-coal intervals has added to the uncertainty of correlation. And the characteristic

rock succession and rock-interval separation between coal beds have been difficult to correlate because of facies changes in this area.

Because of the correlation uncertainties, many of the coal beds mined in the adjoining quadrangle to the south were given local names and little or no attempt was made to solve the correlation problems. Spieker (1931) has probably made the greatest attempt at correlating the coal beds in that quadrangle even though little drilling data was available to him. Spieker (1931, p. 87) summarized his correlations as follows: "The Castlegate 'A' bed is the one mined at the Clear Creek Nos. 1 and 2, Utah, Gibson, Upper Union Pacific, Winter Quarters, Kinney, and Blue Seal mines. The thick bed mined at the Union Pacific No. 1 mine is probably at the horizon of the Gordon bed of the North Gordon area. The Hiawatha bed is not known to be economically important anywhere in Pleasant Valley. The beds 150 to 200 feet above the Castlegate 'A' bed at Winter Quarters and Clear Creek and in the intervening territory probably belong to the Bob Wright coal group."

There has not been a consistent use of local coal bed names in the past. One preliminary naming system (U.S. Geol. Survey, personal communication) includes the following coal-bed names, in ascending order, above the Star Point Sandstone: Flat Canyon, Lower O'Connor "A", Lower O'Connor "B" (200 to 300 ft (61 to 91 m) above the Star Point may be equivalent to Spieker's Castlegate "A" bed), Upper O'Connor "A", Upper O'Connor "B", and the McKinnon bed.

### Projections from Adjoining Quadrangle

Inasmuch as no non-proprietary drilling information is available for this quadrangle area the depths to the coal beds in the KRCRA area are unknown.

The Castlegate "A" bed of Spieker (1931) has been the most important coal bed in the area of the Scofield quadrangle to the south. Most of the large mines in that area have operated on it. The nearest point of measurement for this bed occurs about 1,500 ft (457 m) south of this quadrangle in the Kimball mine. The Castlegate "A" bed is 4.8 ft (1.5 m) thick at that point. Based on other measurements and an isopach map of the bed (AAA Engineering and Drafting, Inc., 1979b) the coal apparently thins northward and thickens southward from the quadrangle boundary area. If the thinning continues northward, it is expected that the Castlegate "A" bed will generally be less than 5.0 ft (1.5 m) thick in the KRCRA area of the Southwest Quarter of the Soldier Summit 15-minute quadrangle. Based on the structure-contour and overburden-isopach maps for this bed (AAA Engineering and Drafting, Inc., 1979b) the coal dips approximately 3 degrees to the northwest near the south boundary of the quadrangle and the depth to the coal bed is expected to range from 300 feet (91 m) to 1,500 ft (457 m) in the KRCRA area.

The nearest point of measurement for the Bob Wright coal bed of Spieker (1931) is approximately 4.3 miles (6.9 km) south of the quadrangle (AAA Engineering and Drafting, Inc., 1979b). An outcrop measurement of the coal bed at that point was 7.2 ft (2.2 m) thick. The isopach map of the bed shows it thinning northward. Because of the distance to the measured section it is difficult to predict, from that information alone, whether or not the coal bed will be more or less than 5 ft (1.5 m) thick in the KRCRA area of this quadrangle. The Bob Wright bed or zone is 100 to 200 ft (30 to 61 m) above the Castlegate "A" bed. If the Bob Wright bed or beds continue northward into this quadrangle, they are expected to be that much shallower than the Castlegate "A" bed.

## Chemical Analyses of the Coal

Doelling (1972) lists ninety-three analyses of coal samples from the adjoining quadrangle to the south. Eighty-eight of the samples were taken from the Castlegate "A" coal bed and five from the main bed in the Bob Wright zone. The five samples from the Bob Wright zone were all taken in the Clear Creek No. 4 mine in the southeast corner of that quadrangle. The analyses are summarized in table 1.

Table 1. Average coal analyses, Northwest Quarter of the Scofield 15-minute quadrangle, Carbon, Emery, and Sanpete Counties, Utah.*

| | No. Analyses | Percent Average | Range |
|---|---|---|---|
| | Castlegate "A" Coal Bed | | |
| Moisture | 88 | 7.54 | 3.6-14.5 |
| Volatile | 81 | 41.11 | 35.3-54.3 |
| Fixed carbon | 81 | 44.91 | 28.3-53.5 |
| Ash | 86 | 6.24 | 3.8-13.5 |
| Sulfur | 65 | 0.61 | 0.4-1.06 |
| Btu/lb** | 76 | 12,042 | 10,250-13,650 |
| | Bob Wright Main Coal Bed | | |
| Moisture | 5 | 6.15 | 2.8-8.2 |
| Volatile matter | 5 | 44.90 | 42.0-46.1 |
| Fixed carbon | 5 | 45.00 | 44.1-46.9 |
| Ash | 5 | 3.94 | 3.1-5.0 |
| Sulfur | 5 | 0.52 | 0.5-0.6 |
| Btu/lb** | 5 | 12,900 | 12,680-13,100 |

*After Doelling, 1972, p. 221
**To convert Btu/lb to Kj/kg multiply by 2.326

Based on the average analyses in table 1, the Castlegate "A" coal is ranked on the borderline between high volatile B and high volatile C bituminous. The Bob Wright coal is ranked as high volatile B bituminous (American Society for Testing and Materials, 1977).

No analyses of the Haley coal bed are available.

## Mining Operations

The mining of coal in the Pleasant Valley area in the adjoining quadrangle to the south dates back to the late 1800's. Numerous coal mines have been operated at various and intermittent times in that quadrangle. The earliest mines generally had small productions and only produced coal for local use. Several mines developed into operations that eventually produced many millions of tons. Doelling (1972, p. 223) reported an estimated total coal production from mines with portals in that quadrangle from 27.0 to 29.6 million short tons (24.5 to 26.9 million metric tons). Specific mine production totals were also reported by Doelling (1972) as follows:

| Mine(s) | Short tons | Metric tons |
|---|---|---|
| Clear Creek mines | 14,196,000 | 12,878,611 |
| Winter Quarter mines | 10,800,000 | 9,797,760 |
| Scofield (Union Pacific) mine | 2,000,000 | 1,814,400 |
| Utah mines | 713,800 | 647,559 |
| Kinney mine | 687,000 | 623,246 |
| Eagle mine | 116,000 | 105,235 |
| Colombine mine | 69,000 | 62,597 |
| Monay mine | 63,000 | 57,154 |

At the time of this report (1979) the only active mine in the adjoining quadrangle to the south was the Belina No. 1 operated by Valley Camp of Utah, Inc. The "Upper O'Connor" coal bed was being mined. That company was also preparing to open a new mine, the Belina No. 2, on a coal bed above the one being produced in the Belina No. 1 mine.

In the adjoining quadrangle to the east two mines operated on the Haley coal bed: The People's Coal and Coke mine in section 11, T. 12 S., R. 7 E., and the Carbon Dale mine in section 13, T. 12 S., R. 7 E. The estimated total production from both mines is 6,000 short tons (5,443 metric tons) (Doelling, 1972). At the time of this report (1979) there were no active mines in that quadrangle.

## COAL RESOURCES

No coal resource tonnages have been calculated for the unleased Federal land in the KRCRA of this quadrangle.

No coal beds of reserve base thickness, over 5 ft (1.5 m), are known to occur and such coal thicknesses have not been projected into the KRCRA from the adjoining quadrangles.

## COAL DEVELOPMENT POTENTIAL

### Development Potential for Surface Mining Methods

No development potential for surface mining methods exists in the area of this quadrangle because of the rugged topography, steep-sided canyons, extreme relief, and thick overburden. There may be very small areas where some rim stripping could be done, but in general the area is not conducive to surface mining methods.

### Development Potential for Subsurface Mining and In Situ Gasification

In this quadrangle there are no known areas in the KRCRA where coal beds are 5.0 (1.5 m) or more in thickness. However, the occurrence of coal beds in the adjoining quadrangles on the south and east indicate that coal beds are present in the KRCRA at depths of less than 3,000 ft (914 m) and all of the unleased Federal coal lands in the KRCRA in this quadrangle are therefore classified as having an "unknown" coal development potential.

The in situ coal gasification methods of development potential classification are based on the dip and depth of coal beds having a minimum thickness of 5 ft (1.5 m). There are only two development potential classifications--moderate and low. The criteria for in situ classification include coal bed dips of 15 to 90 degrees and coal bed depth of 200-3,000 ft (61-914 m).

Inasmuch as the coal beds dip less than 15 degrees in the Southwest Quarter of the Soldier Summit 15-minute quadrangle, the in situ coal gasification methods of development potential classification do not apply.

AAA Engineering and Drafting, Inc. has not made any determination of economic mineability for any of the coal beds described in this report.

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