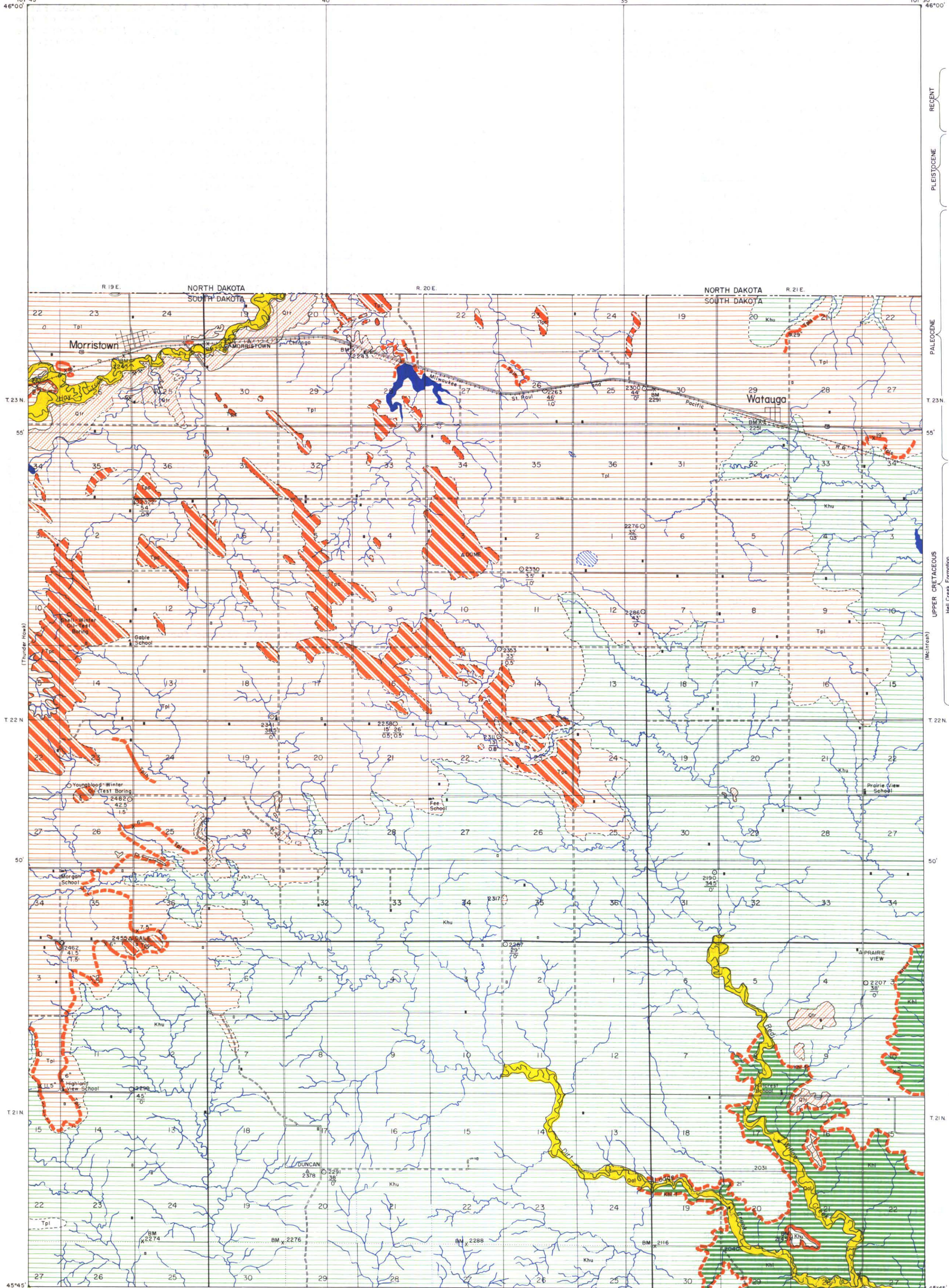


AREAL GEOLOGY OF THE MORRISTOWN QUADRANGLE

STATE OF SOUTH DAKOTA
SIGURD ANDERSON, GOVERNOR

STATE GEOLOGICAL SURVEY
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EXPLANATION

SEDIMENTARY ROCKS

RECENT

QUATERNARY

Qal
Alluvium
(Floodplain deposits of silt, sand, and gravel in present major stream valleys)

Qtr
Terrace Rubble
(Terrace deposits of fluvial angular gravel and silty sand locally derived mainly from the Cannonball formation)

Tpl
Cannonball Formation
(Grey to buff clay and clayey fine quartzose sand with numerous dark grey limestone concretions. Abundant small lenses of calcareous sandstone. Marine invertebrate fossils. Interfingers with Ludlow formation)

PALEOCENE

TERTIARY

Ludlow Formation
(Grey to buff, medium and fine grained, arkosic and greywacke sands and silts, clayey sands and sandy clays. Numerous slobby lenses of calcareous sandstone. Abundant cross-bedding. Tails and Tail-Shadels and Hillen lignite facies. One or more than (1"-3") seams of black blocky or fissile lignite and associated sands, clays, and peat-clays. Interfingers with the Cannonball formation)

Upper Member
(Lensing interbeds of buff or "pepper and salt" fine grained greywacke and arkosic sands, bentonitic in part; and grey to tan bentonitic clay, silt, and sandy clay. Some horizons of ironstone concretions)

Lower Member
(Lensing interbeds of white to tan fine grained greywacke and arkosic sands, in part bentonitic and somewhat cross-bedded, grey slightly bentonitic clay, buff to brown bentonitic clay, and brown peat-clay. Occasional horizons of ironstone concretions. *Khu-f*-Isabel-Fire-steel coal facies 2"-2 1/2" seam of black sub-bituminous to lignite coal and associated beds of brown peat-clay)

HELL CREEK FORMATION

CRETACEOUS

DRAINAGE

Intermittent Streams

Intermittent Lakes

CULTURE

Buildings
(House, church and school)

Roads and Trails

Altitudes
(In feet above sea level)

Bench Marks
(Monuments marking points of known altitude)

Triangulation Stations
(U.S. Coast & Geodetic and/or U.S. Geological Survey monuments marking points of exact geographic location)

Operating
Abandoned

Coal mines and Gravel pits

Drill Holes
Shell Oil Co.
Winter No. 1

Oil-test Borings

Geology by R. E. Stevenson
Assisted by K. Loken, A. C. Doyle, D. Swift.
Surveyed in 1952.
Coal-Test Holes Drilled in 1953.

Scale 1" = 42500'

Vermillion, South Dakota
1954

Base Map by South Dakota State Geological Survey.

APPROXIMATE MEAN DECLINATION 1951

Quadrangle Location

By

Robert E. Stevenson

INTRODUCTION

This quadrangle was mapped in the summer of 1952 as a part of the State Geological Survey coal resources program. Exploratory drilling for sub-surface coal was done in 1953.

LOCATION

The quadrangle lies along the North Dakota line in eastern Corson Co. It is also in the Standing Rock Indian Reservation. The area is approximately 120 miles NNW of Pierre and 150 miles NE of Rapid City.

GEOGRAPHY

The area is a slightly populated region of rolling prairie lands with occasional badland topography along the major streams. The quadrangle lies mostly on the south side of the Cannonball-Grand interstream divide and all the larger youthful intermittent streams drain southward to the Grand River, which is a few miles south of the area.

The areas maximum relief is 250' and its approximate average elevation is about 2250' above sea level.

The only permanent water bodys in this area are artificial lakes formed by the railroad embankment and large stock dams.

The climate is semi-arid with an average rainfall of 14-17 inches. Dry-land farming is practiced on the upland areas, and the badlands are used for stock grazing.

The only towns in the area Morrirstown, with a population of 190, and Watauga with 100 inhabitants are both on the mainline of the Chicago, Milwaukee, St. Paul, and Pacific Railroad and U. S. Highway 12. Numerous county and township roads make the quadrangle fairly accessible.

STRATIGRAPHY

The quadrangle has only Cretaceous, Tertiary and Quaternary sediments exposed at the surface.

Hell Creek formation Brown 1907 - Lower Member: Forty-five plus feet of these strata crop out in the badlands in the southern part of the quadrangle. A variety of interbedded and lensing lithologic types make up this member: buff and white, medium to fine-grained arkosic and graywacke sands with local lenticular calcareous "cementations"; white medium bentonitic sand; grey, tan, brown bentonitic clay and silt with plant fragments; brown peat-clay with glauconite; several horizons of ironstone concretions; and scattered dinosaur bone fragments. The Isabel-Firesteel coal facies is locally present in the area and consists of 1 to 2 coal seams (1" to 21" thick) and associated, white sand, clays and peat-clays. It is 2' to 7' in thickness.

Hell Creek formation Brown 1907 - Upper Member: Scattered exposures occur on the grassed high areas in the southern part of the quadrangle. It consists of grey to buff, medium to fine graywacke and arkosic sand, and silt in part bentonitic with interbeds of gray, tan, bentonitic clay with plant fragments, and horizons of ironstone concretions. The thickness is estimated at 60 (plus or minus) feet.

Ludlow formation Lloyd and Hares 1915: Scattered outcrops are found on the grassed uplands in the northern half of the quadrangle. Like the Hell Creek, the Ludlow is very heterogeneous consisting of interbedded and lenticular: buff to grey, medium to fine grain arkosic and greywacke sand and silty sand with local slabby lenticular calcareous "cementations"; grey fissile to massive clay and silty clay containing plant fragments; with associated brown clays and peat-clays. Locally at the base there is the Shadehill coal facies; one or more thin coal seams 1/2" to 30" and associated sands, clays and peat-clays, totalling 10' to 20'. About 60' (plus or minus) above the Shadehill facies there is occasionally the Hillen facies; one or more thin coals (1/2" to 7") and associated sediments to 40' in thickness. The upper Ludlow interfingers laterally with the Cannonball formation. The formation is approximately 250' plus thick.

Cannonball formation Lloyd 1914: Good exposures are practically non-existent, but fragments of the characteristic concretions are scattered over the hills in the northern part of the quadrangle. The formation consists of grey to buff, silty sand, silt and clay with numerous dark grey limestone concretions, and small lenses of calcareous sandstone. The limy rocks carry a molluscan fauna of small forms. The formation, lenticular in character, interfingers with the Ludlow, principally with the upper Ludlow and locally is never more than 60-75 feet thick.

Terrace Rubble: Terrace deposits generally occur near a major stream and consists of fluvial coarse angular gravel and silty sand derived principally from the concretions and cementations of the Ludlow and Cannonball formations.

STRUCTURE

There is a slight regional dip to the northwest and center of Dakota Basin. Superimposed upon this regional structure are small minor faults and folds with displacements and amplitude of a few feet. Elevations on scattered coal exposures indicate the possibility of local "highs".

ECONOMIC GEOLOGY

The quadrangle contains a number of mineral

resources both of actual a currently-exploited and potential value, but not in large quantities. These resources are coal, gravel and clay. At the present time only gravel is being exploited.

COAL

There are three discontinuous coal facies in this area, the Isabel-Firesteel facies of the lower Hell Creek, the Hillen and Shadehill facies of the Ludlow. None of these have present-day commercial potentialities except the Shadehill coal in a small area 1 mile NE of Watauga. Thw Watauga deposit is described as follows:

Thickness: The exposed thickness is 29 inches.

Physical Character: Black, fissile, and blocky, soft, lignite coal. It has a black streak, and exhibits poorly developed laminations. It contains occasional amber resin pellets and streaks of melanterite. It slacks moderately upon drying and is non-coking.

It has a 1-inch medium white sand parting and scattered thin lenses of white and grey medium sand and brown peat-clay.

Chemical Character: Chemical analyses provide a satisfactory basis for comparing the coal with other and determining its rank, grade and commercial qualities. The proximate analysis furnishes necessary data concerning the quality and combustion properties of coal (moisture, volatile or gaseous matter, fixed carbon or the chief heat-producing constituent, ash, sulfur, and the heating value in B.T.U.'s).

An analysis of the Shadehill coal in the Watauga area follows: Moisture 42.26%, volatiles 32.60%, fixed carbon 15.02%, ash 10.12%, sulfur 0.70, B.T.U. 4,657. It is to be noted that air drying will increase the heating value to about 8,065 B.T.U.

Character of Overburden: The overburden which is not a detriment to strip mining consists of sands and clays. The sands may be indurated locally. The average thickness in this area is 30 (plus or minus) feet.

Estimated Coal Reserve. The reserve in this area is classified as indicated (reserves located within 1/2 to 1 1/2 miles of an outcrop). In the Watauga area on the basis of an average thickness of 2' and an area of 304 acres there is an indicated reserve of 1,033,600 tons.

Over the rest of the quadrangle the various coal seams of the different facies are not of present-day commercial thickness. Brief descriptions of the different facies follow:

Isabel-Firesteel facies (Hell Creek formation); black, flaggy and blocky, lignite coal seam with ash spots varying in thickness from 1 3/4" to 21". One-half mile south of the quadrangle is the Zubroad Mine with a 39" seam.

Shadehill facies (Ludlow formation); black, fissile and blocky, sometimes boney, lignite coal seams which vary in thickness from 1" to 12".

Hillen facies (Ludlow formation); black, fissile to blocky, lignite coal seams 1" to 26" in thickness.

Following are coal analyses from the area:

Coal	Location	Moisture	Volatiles	Carbon	Ash	Sulfur	B.T.U.
Isabel-Firesteel	Zubroad Mine	41.07%	32.20%	20.78%	5.95%	0.39%	5,586
Shadehill	Watauga Area	42.26%	32.60%	15.02%	10.12%	0.70%	4,657
Hillen	Morrirstown Vicinity	45.40%	29.37%	9.69%	15.54%	0.66%	3,515

Gravel

Angular gravel deposits occur along Hay Creek and Red Willow Creek as terraces. The deposits contain a high percentage of silt and clay, but are still adequate for road metal. Estimated volumes for the larger deposits are given in the following table.

Sec.	Twp.	Rge.	Acres	Ave. Thick.	Est. Cu. Yards
25,26,27,34,35,	23	19	318	2-4	1,255,025
25,26,36	23	19	146 1/2	5	1,181,767
19,20,24,25	23	19,20	273	2	880,880
4,8,9	21	21	95	2	306,533
9,16	21	21	50	2	161,111
20,21,28,29	23	20	35	2	112,933
19,24	23	19-20	17	3 1/2	94,299

Clay

Many clay horizons in the Hell Creek formation contain a high percentage of bentonite and thus can be used as a sealer for earthen dams.

GENERALIZED COLUMNAR SECTION

