NORTH DAKOTA GEOLOGICAL SURVEY
NORTH DAKOTA STATE WATER COMMISSION

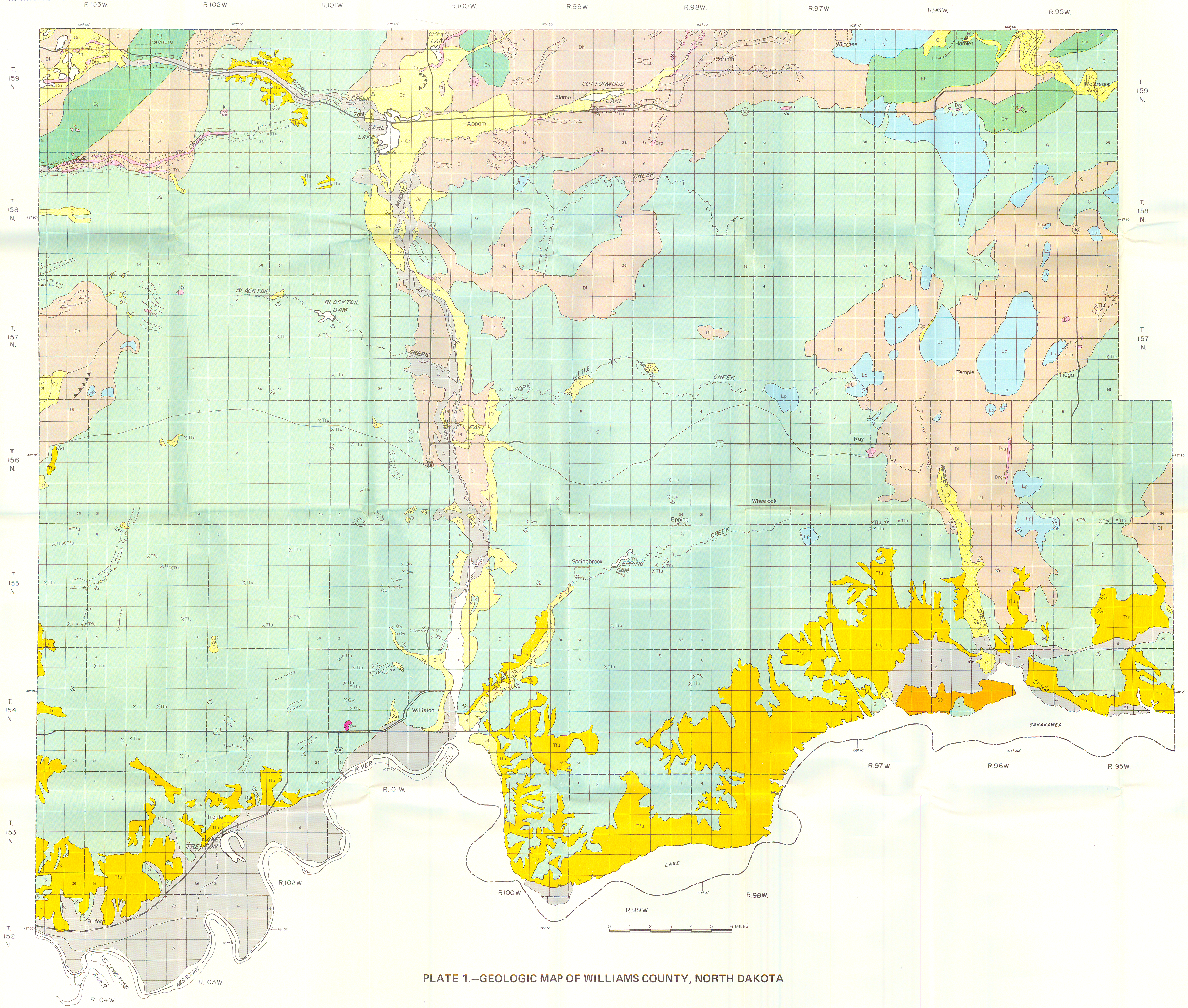

PLATE 1.—GEOLOGIC MAP OF WILLIAMS COUNTY, NORTH DAKOTA

Base prepared from North Dakota State Highway Department county highway maps

BULLETIN 48
COUNTY GROUND WATER STUDIES 9
PLATE I

EXPLANATION

GLACIAL LANDFORMS

Ea — APPAM END MORAINE
A CURVED, LOOP-SHAPED RIDGE OF DRIFT WITH MANY SMALL SUPERIMPOSED LINEAR RIDGES. COMPOSED CHIEFLY OF TILL. THE MORAINE IS ABOUT 3 MILES LONG AND 1.5 MILES WIDE WITH MEDIUM TO HIGH LOCAL RELIEF (25 TO 100 FEET BETWEEN ADJACENT HIGHS AND LOWS).

Eg — GRENORA END MORAINE
AN AREA OF SMALL LINEAR RIDGES AND SOME DEAD-ICE MORAINE FEATURES EXTENDING FROM GRENORA SOUTHWEST TO THE MONTANA LINE. COMPOSED MOSTLY OF TILL AND HAS LOW TO HIGH (10 TO 50 FEET) LOCAL RELIEF.

Eh — HAMLET END MORAINE
A BAND OF LOW PARALLEL RIDGES WITH SOME DEAD-ICE FEATURES EXTENDING FROM HAMLET 5 MILES TO THE SOUTHWEST. LOCAL RELIEF IS LOW (LESS THAN 20 FEET). COMPOSED MOSTLY OF TILL.

Em — McGREGOR END MORAINE
A NORTHEAST-SOUTHWEST TRENDING BAND OF LOW RIDGES NORTHWEST OF McGREGOR. RELIEF IS LOW, BUT THE RIDGES CAN BE DISTINGUISHED ON THE AERIAL PHOTOS.

Dh — DEAD-ICE MORAINE (HIGH-RELIEF)
HILLS, KNOBS, SLOUGHS, KETTLES, RIDGES, TRENCHES, AND MANY DEAD-ICE FEATURES. RIDGES MAY BE PRESENT AS IN AN END MORAINE, BUT THERE IS NO OVERALL TREND OF ACTIVE-ICE LINEAR FEATURES. TILL IS THE PRIMARY CONSTITUENT, BUT SMALL AREAS OF SAND AND/OR GRAVEL CAN BE FOUND THROUGHOUT THE AREA. LOCAL RELIEF RANGES FROM 25 TO 150 FEET. GENERALLY THERE IS NON-INTEGRATED DRAINAGE.

Dl — DEAD-ICE MORAINE (LOW-RELIEF)
SAME AS HIGH RELIEF DEAD-ICE MORAINE EXCEPT THAT THE LOCAL RELIEF IS GENERALLY LESS THAN 50 FEET. THERE IS SOME INTEGRATED DRAINAGE.

G — GROUND MORAINE
A FLAT TO GENTLY ROLLING DRIFT PLAIN CONSISTING MAINLY OF TILL. LOCAL RELIEF IS LOW (LESS THAN 15 FEET).

S — SHEET MORAINE
A THIN SHEET OF GLACIAL DRIFT DRAPED OVER THE PRE-EXISTING TOPOGRAPHY AND REFLECTING MUCH OF THE UNDERLYING TOPOGRAPHY. COMPOSED MOSTLY OF TILL. OCCURS IN THE SOUTHERN 1/4 TO 1/2 OF WILLIAMS COUNTY.

Oc — OUTWASH PLAIN, COLLAPSED
A HILLY AREA UNDERLAIN PRIMARILY BY SAND AND GRAVEL. LOW TO HIGH LOCAL RELIEF (10 TO 75 FEET) WITH SOME KETTLES.

Lc — LAKE PLAIN, COLLAPSED
A GENTLY ROLLING TO HILLY AREA OF LAKE DEPOSITS, MOSTLY OF CLAY AND SILT. LOCAL RELIEF IS LOW (LESS THAN 15 FEET).

K — KAME
A MOUND OR HILL OF STRATIFIED SAND AND GRAVEL.

Kt — KAME TERRACE
A LINEAR DEPOSIT OF STRATIFIED DRIFT, PREDOMINATELY SAND AND GRAVEL, PRESENT ALONG THE WALLS OF COTTONWOOD CREEK MELTWATER CHANNEL.

Iu — ICE CONTACT DEPOSIT UNDIFFERENTIATED
AN IRREGULAR-SHAPED DEPOSIT OF DRIFT, MOSTLY SAND AND GRAVEL BUT WITH SOME TILL.

Drg — DISINTEGRATION RIDGE, GRAVEL
A NARROW, STEEP-SIDED RIDGE OF SAND AND GRAVEL. MAY BE SEGMENTED OR CONTINUOUS AND STRAIGHT OR SINUOUS.

Drt — DISINTEGRATION RIDGE, TILL
A NARROW STEEP SIDED RIDGE OF TILL.

DRIFT-MANTLED BEDROCK SCARP
A STEEP ABUTMENT ON THE GROUND MORAINE OR SHEET MORAINE UNDERLAIN BY THIN GLACIAL DEPOSITS OVER A BEDROCK SCARP.

DRIFT-MANTLED CHANNEL OR KETTLE CHAIN
A LINEAR DEPRESSION UNDERLAIN BY TILL. STEEP SIDED IN THE AREAS OF GROUND MORAINE AND DEAD-ICE MORAINE.

ICE CONTACT FACE
A STEEP ABUTMENT OF GLACIAL DRIFT.

PROGLACIAL LANDFORMS

O — OUTWASH PLAIN
A GENTLY UNDULATING TO NEARLY FLAT SURFACE UNDERLAIN BY SAND AND GRAVEL WITH SOME SILT AND CLAY. COMMONLY STRATIFIED.

Ot — OUTWASH TERRACE
A NEARLY LEVEL, BENCHLIKE, WATER-DEPOSITED ACCUMULATION OF SAND AND GRAVEL, SANDY GRAVEL, GRAVELLY SAND WITH A FEW BOULDERS AND COBBLES.

Lp — LAKE PLAIN
GENTLY UNDULATING TO FLAT DEPOSIT OF CLAY, SILT AND SOMETIMES SAND AND GRAVEL, GENERALLY STRATIFIED.

MELTWATER CHANNEL
A STEEP-SIDED TRENCH THAT CARRIED MELTWATER FROM A GLACIER; MAY BE UNDERLAIN BY SAND, GRAVEL OR TILL. ARROW SHOWS THE DIRECTION OF THE MOST RECENT FLOW OF MELTWATER.

NONGLACIAL LANDFORMS

A — ALLUVIAL FLOODPLAIN
A LEVEL TO GENTLY UNDULATING ACCUMULATION OF STREAM DEPOSITS THAT ARE GENERALLY STRATIFIED AND ADJACENT TO A STREAM. UNDERLAIN BY INTERBEDDED CLAY, SILT, SAND, GRAVEL AND SOME ORGANIC DEBRIS.

At — ALLUVIAL TERRACE
A FLAT OR GENTLY SLOPING BENCH ABOVE AND ADJACENT TO THE FLOODPLAIN OF THE MISSOURI RIVER. UNDERLAIN BY INTERBEDDED CLAY, SILT, SAND, GRAVEL AND ORGANIC DEBRIS.

SD — SAND DUNES
AN AREA OF AEOLIAN SAND DEPOSITS CHARACTERIZED BY LOW MOUNDS OF SAND AND BLOWOUTS.

NAMED FORMATIONS

Qw — QUATERNARY WIOTA GRAVEL
FINE TO MEDIUM SAND AND SANDY GRAVEL CONSISTING OF 70 TO 80 PERCENT CHERT AND QUARTZITE. REDDISH BROWN TO BROWN. OVERLAIN BY TILL IN WILLIAMS COUNTY.

Tfu — TERTIARY FORT UNION GROUP
TONGUE RIVER-SENTINEL BUTTE FORMATIONS UNDIFFERENTIATED. EXPOSED IN THE AREA OF STUDY, BUT THE CONTACT BETWEEN THE TWO FORMATIONS HAS NOT BEEN ESTABLISHED. CONSISTS OF CLAY, SILT, SAND AND LIGNITE BEDS. COLORS RANGE FROM LIGHT GRAY TO YELLOWISH GRAY TO YELLOW.

SYMBOLS

LIGNITE MINE

GRAVEL PIT (GLACIAL GRAVELS)

Qw — GRAVEL PIT (WIOTA GRAVEL, BROWN, QUARTZITIC

s — GRAVEL PIT ("SCORIA ROCK")

NESSON ANTICLINE

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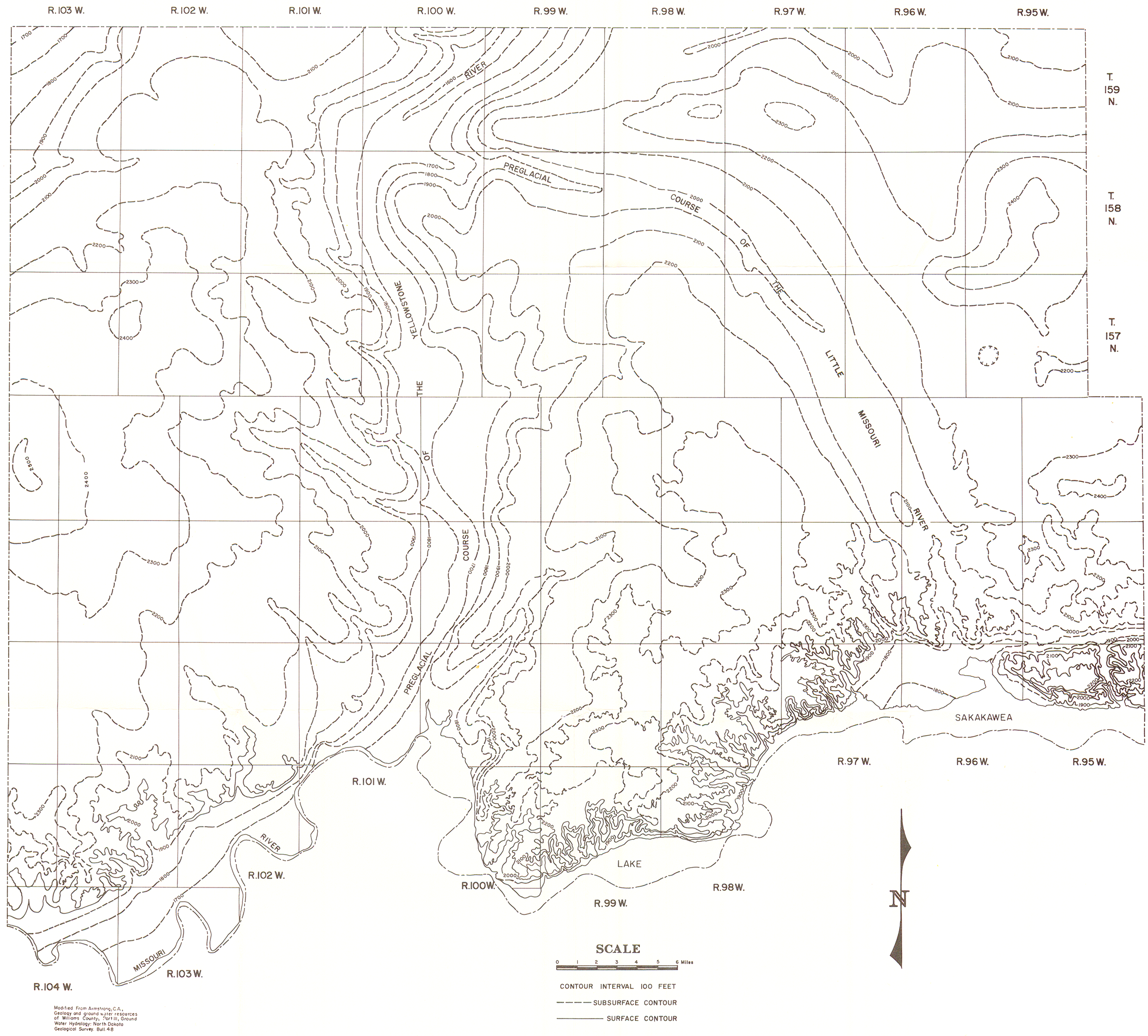
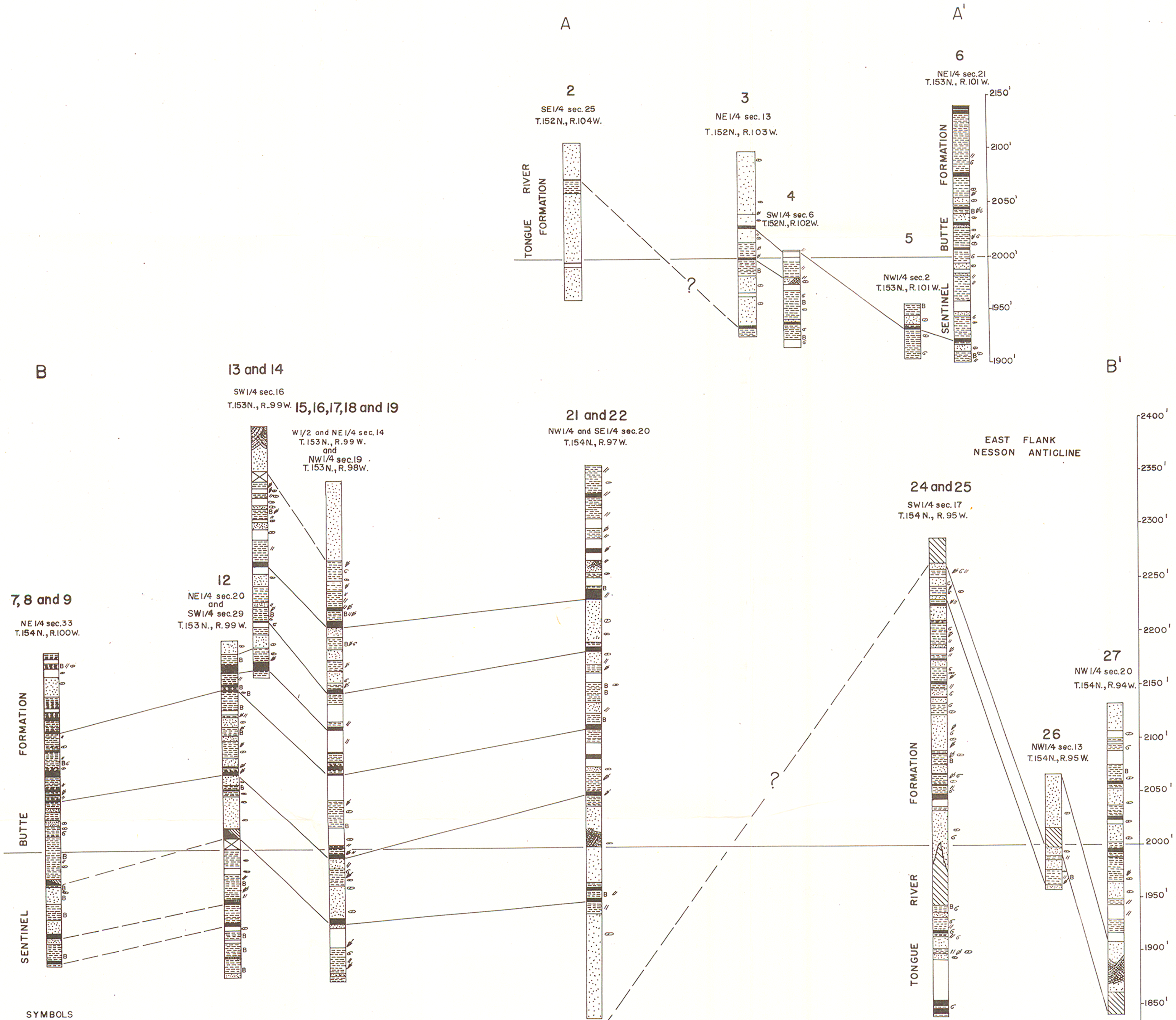
PLATE 2



BEDROCK TOPOGRAPHY OF WILLIAMS COUNTY, NORTH DAKOTA

Stratigraphic Cross-Sections Along The Missouri River From The Yellowstone River To The Mountrail-Williams County Line

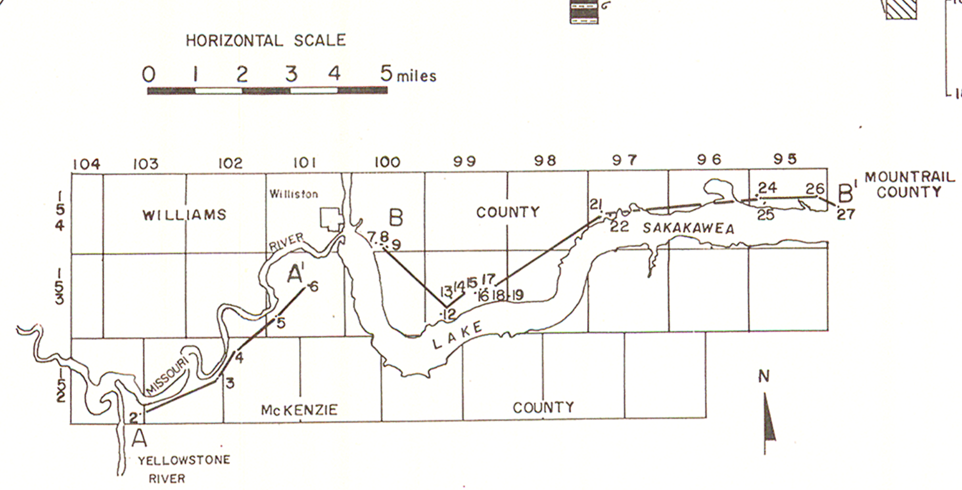


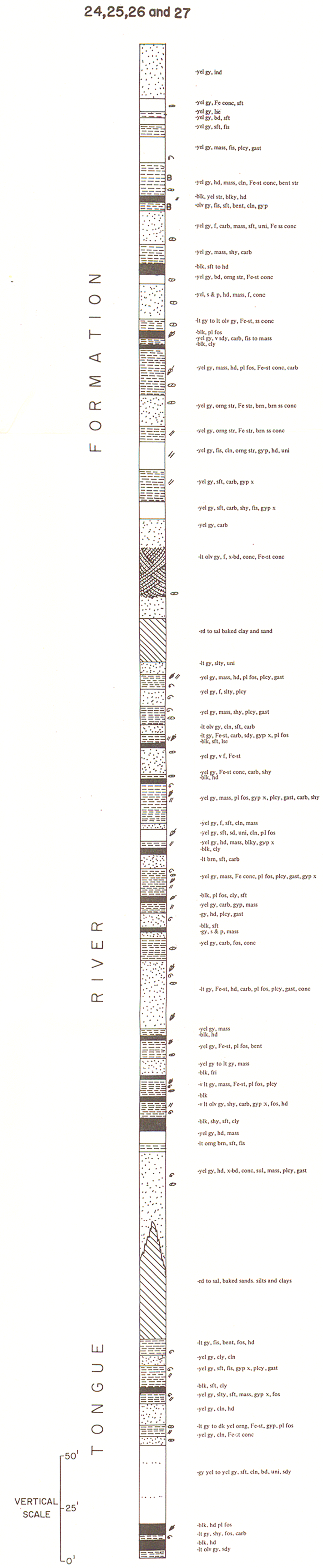
SYMBOLS

- Sand or sandstone
- Silt or siltstone
- Shale, clay or claystone
- Lignite
- Lignite or "scoria"
- "Scoria"
- Concretions
- Gastropods and pelecypods
- Plant fossils
- Bentonitic
- Gypsiferous
- Covered, no description

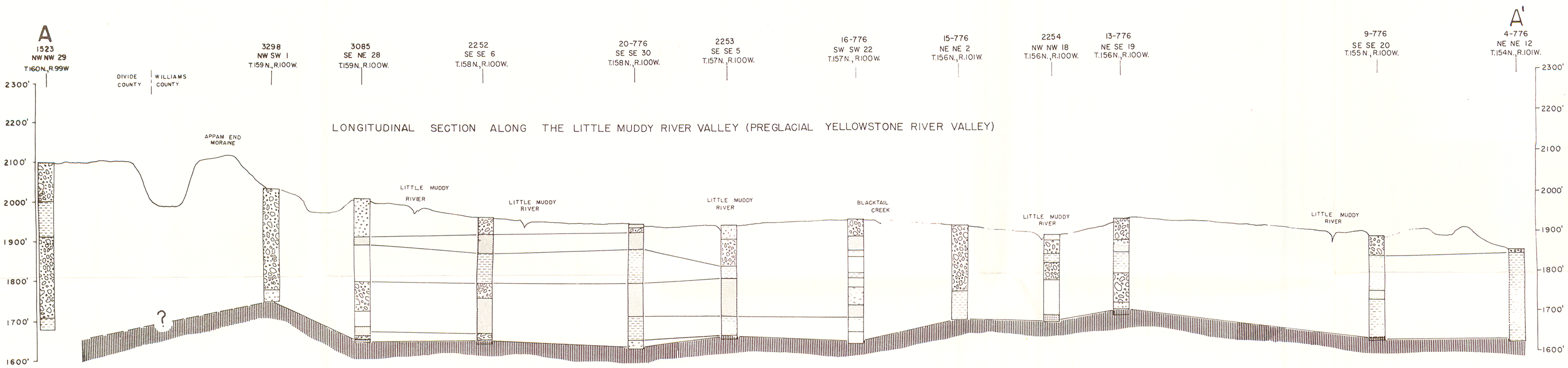
ABBREVIATIONS

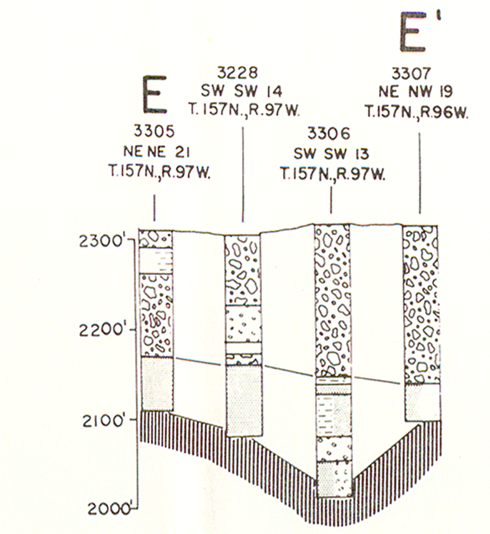
bd	bedded or bedding	lt	light
bent	bentonite or bentonitic	lse	loose
bf	buff	mass	massive
blk	black	olv	olive
blky	blocky	orng	orange
brn	brown or brownish	plcy	pelecypods
carb	carbonaceous	pl fos	plant fossils
cln	clean	rd	red
conc	concretion(s)	sal	salmon
dk	dark	sdy	sandy
f	fine	sft	soft
Fe	Ferrouginous	shy	shaley
Fe-st	ironstone	slty	silty
fis	fissile	s&p	salt and pepper appearance
fos	fossils	ss	sandstone
fri	friable	str	streaked
gast	gastropods	uni	uniform
gy	gray	v	very
gyp	gypsum	x	crystal(s)
hd	hard	x-bd	crossbedded
ind	indurated	yel	yellow

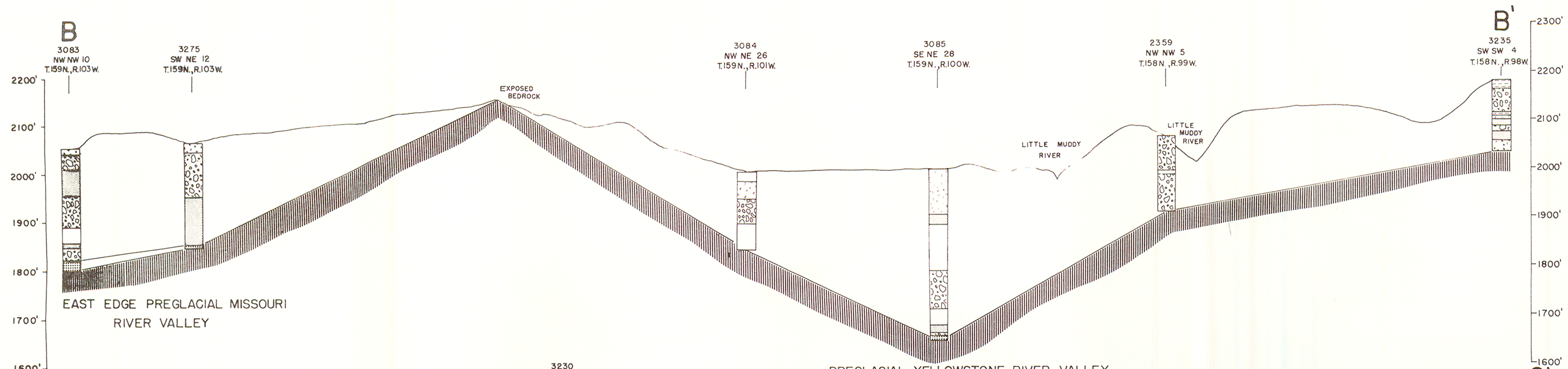


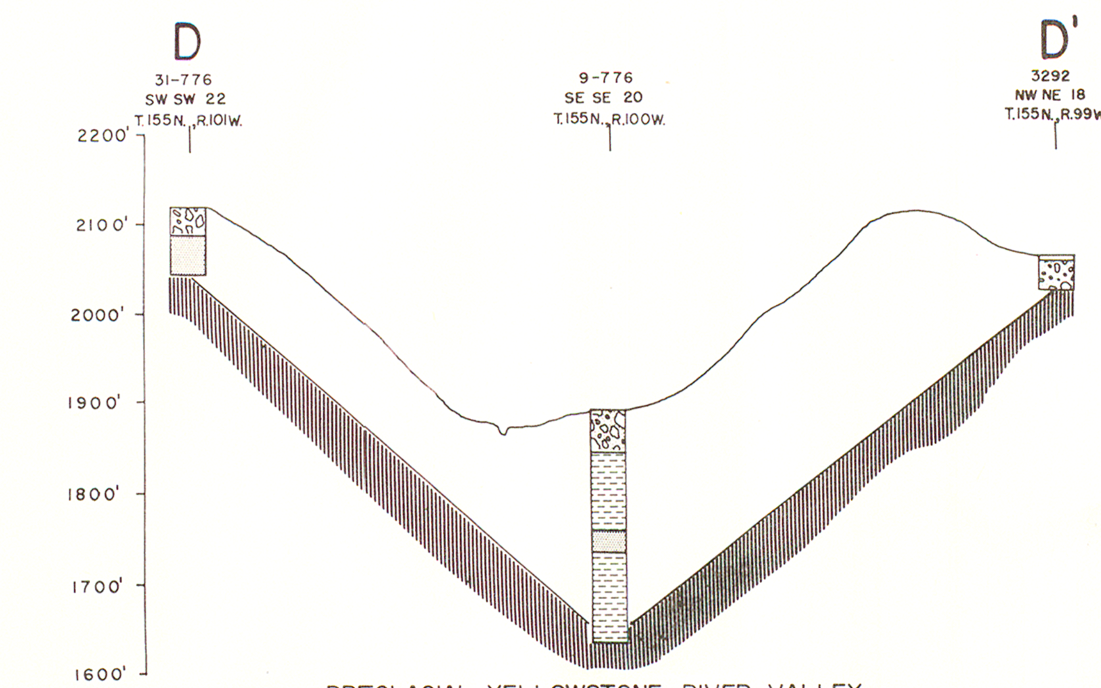


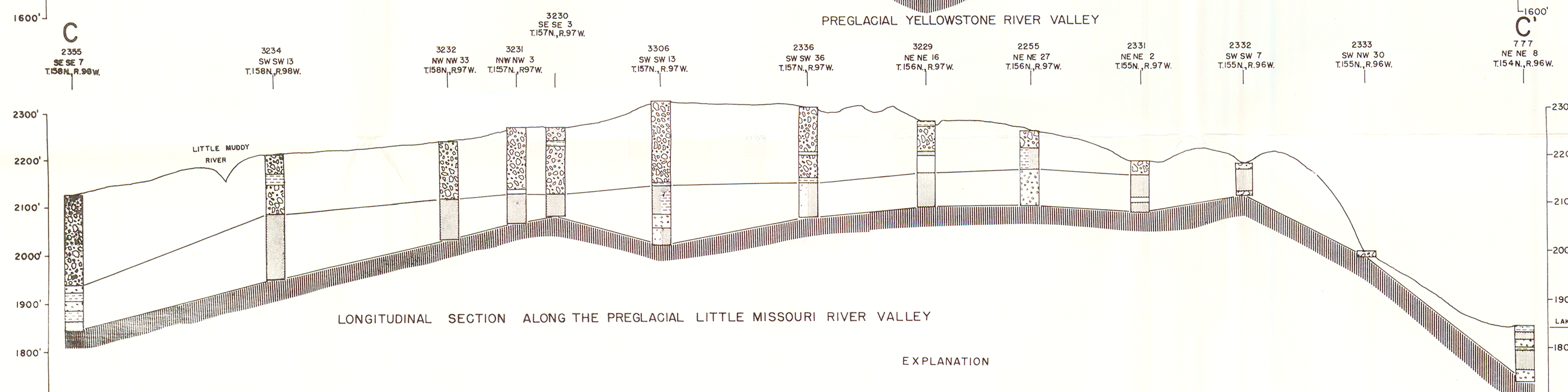
GEOLOGIC SECTIONS OF GLACIAL DRIFT IN WILLIAMS COUNTY, NORTH DAKOTA

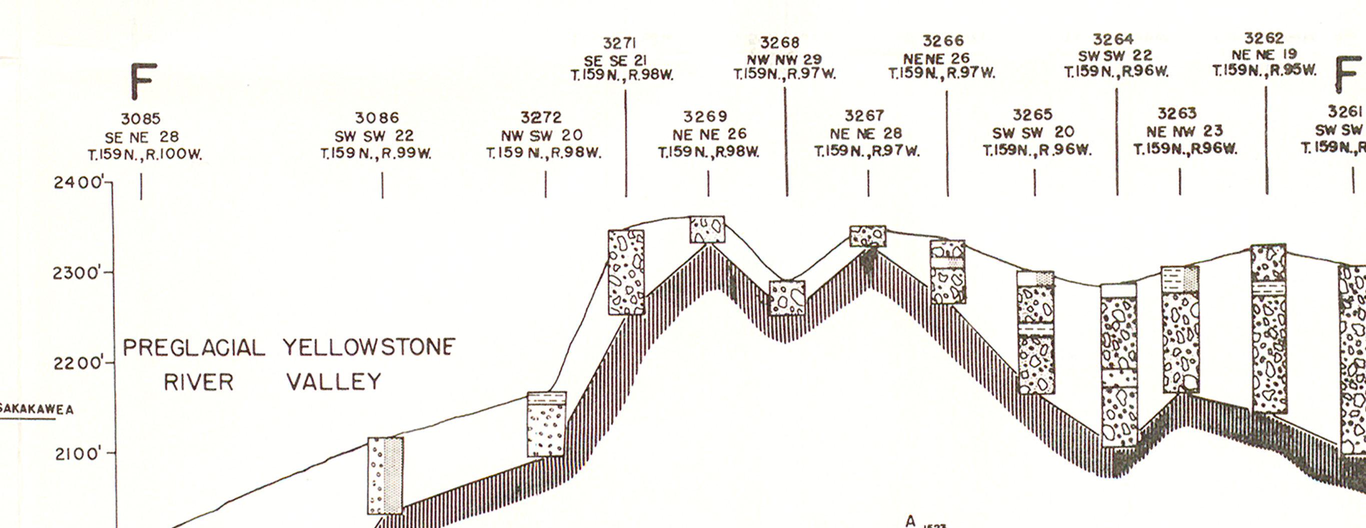




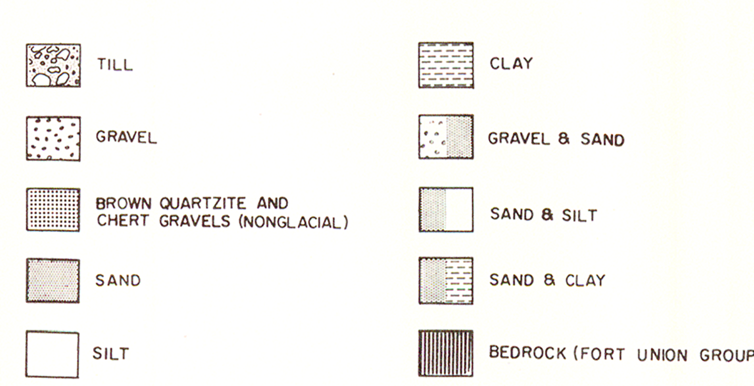








EXPLANATION



Configuration of ground surface based on Army Map Service Quadrangle NM 13-12 Williston, scale 1:250,000, contour interval 100'.

All well data (except for Divide County well 1523) is available in North Dakota Geological Survey Bull. 48, Geology and Ground Water Resources of Williams County, North Dakota, Part-II Basic Data by Clarence Armstrong.