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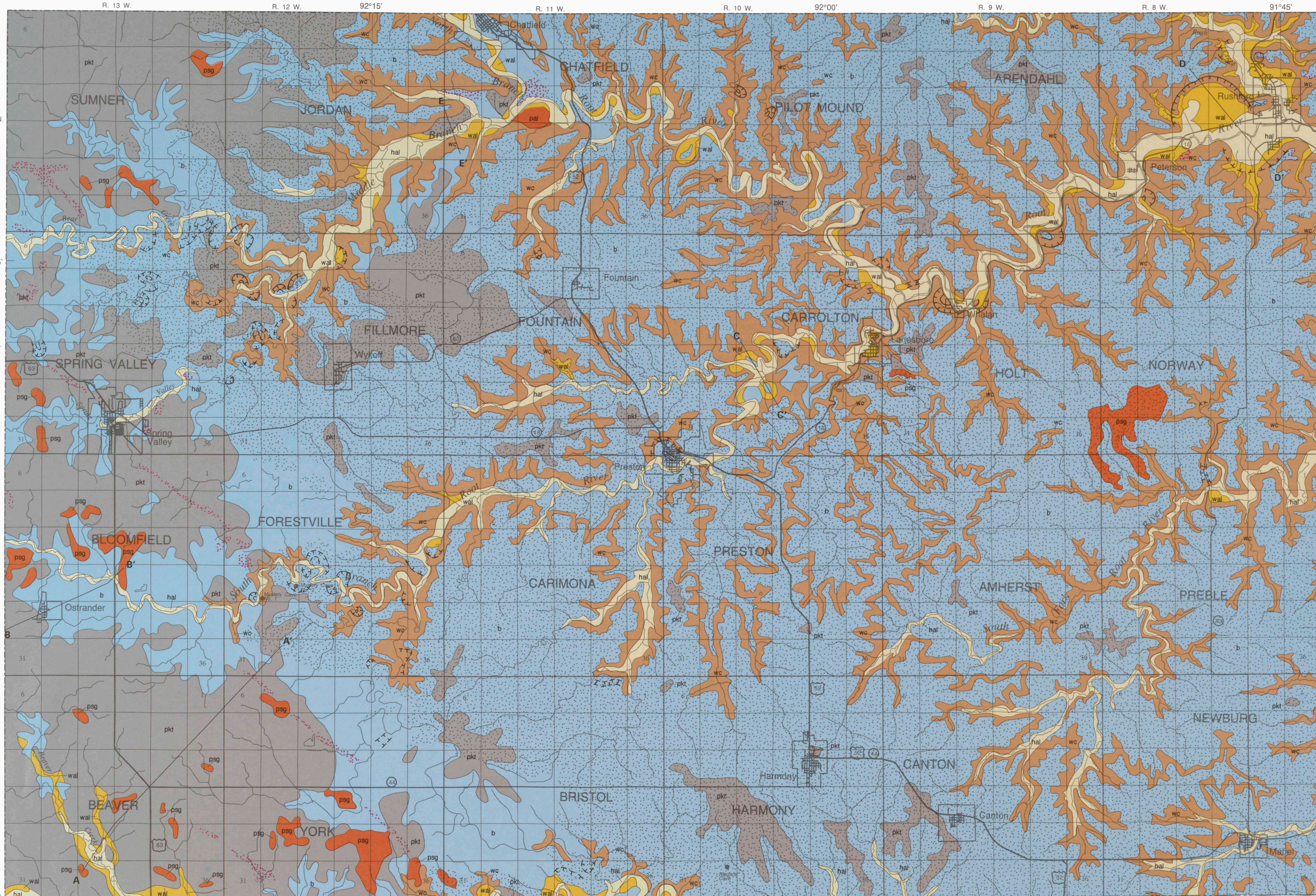


Digital base modified from 1990 Census TIGER/Line Files of U.S. Bureau of the Census (source scale,1:100,000); digital base annotation by Minnesota Geological Survey

Universal Transverse Mercator Projection, grid zone 15
1927 North American Datum

SCALE 1:100 000

Field mapping done in Summer 1992 and 1993
Cartography by Joyce Meints and Philip Heywood

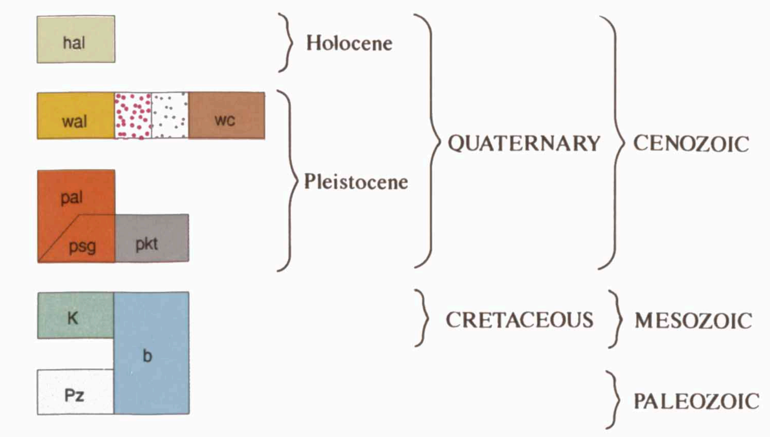
SURFICIAL GEOLOGY

By

Howard C. Hobbs

1995

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

hal ALLUVIUM—Deposits of modern streams; channel sand and gravel overlain by overbank silt and clay. Areas mapped alluvium have been flooded in Holocene time, but not necessarily in historic time

wal WISCONSINAN ALLUVIUM—Deposits of streams of the last glaciation; chiefly sand and gravel with minor silt and clay beds. Occurs in the same valleys as modern streams and in some meander cutoffs that have not been reoccupied since unit was deposited. Interpreted as braided-stream deposits

wc COLLUVIUM—Hillslope deposits derived from bedrock and from loess upslope. Typically consists of two units: a rocky lower unit of angular carbonate clasts in a silty to sandy matrix; overlain by an upper unit primarily of silt, which contains a few carbonate clasts. The composition of the lower unit reflects the bedrock upslope; the upper unit is largely reworked loess. Both strata are thin (less than 5 feet) on the upper part of the slope; they thicken downslope to a maximum thickness of more than 30 feet. Bedrock exposures are common, especially along the upper parts of slopes

LOESS—Windblown sediment; uniform unbedded silt mixed with some clay and fine sand. Includes minor amounts of fine sand, especially in the lower part of the thick loess in the western boundary area. Shown as a fine stipple pattern where thicker than 5 feet. Pattern omitted on colluvium

EOLIAN SAND—Unbedded fine to medium sand

pkt TILL—Unsorted, unstratified drift deposited directly by glaciers; a mixture of sand, silt, and clay—typically loam to clay loam containing subangular to rounded clasts of both local and erratic rocks. Typically gray and calcareous where unweathered; an upper zone has been oxidized to grayish brown and brown, and leached of carbonate. Mapped where generally thicker than 5 feet; thinner patches occur in many places mapped as bedrock. Represents deposits of several glaciations, undivided

pal OLDER ALLUVIUM—Deposits of pre-Wisconsinan streams. Includes sand and gravel (channel and braided-stream sediment) and silt and clay (floodplain and ponded sediment). Some sand and gravel may be glacial outwash. Most of its surface is weathered. Distinguished from glaciofluvial deposits by geomorphic position: older alluvium occupies valleys cut into bedrock; glaciofluvial deposits occupy upland positions

psg GLACIOFLUVIAL DEPOSITS—Chiefly sand and gravel with minor beds of silt and clay in places. Strongly weathered from the top to a depth of several feet to as much as 15 feet. Calcareous material occurs beneath the weathered zone in places

b BEDROCK, UNDIVIDED—Outcrops and bedrock that is generally within 5 feet of the surface exclusive of loess. On this map it includes the Windrow Formation (see Plate 2) and the weathering residuum (see Plate 4) and weathered local rock. Solid bedrock is, therefore, deeper than 5 feet in parts of this mapping unit. Shown on map only

K CRETACEOUS WINDROW FORMATION—Shown only on cross sections

Pz PALEOZOIC BEDROCK—Shown only on cross sections

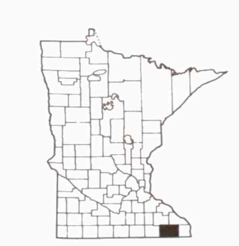
MAP SYMBOLS

GEOLOGIC CONTACT—Most are approximately located; less precise where covered by thick eolian sediment

ABANDONED STREAM VALLEYS CUT IN BEDROCK—Shown where they do not coincide with a geologic contact and are no longer occupied by streams

BEDROCK MEANDER SCAR—Relatively distinct; eroded and obscure. Inner hill, if present, is not hachured

ABANDONED CHANNEL IN BEDROCK



LOCATION DIAGRAM

INTRODUCTION

The extensive blue area on the map is the area where no significant thickness of sediment—except loess where stippled—overlies the bedrock. All the other colors represent younger layers overlying the bedrock. On the cross sections, the Paleozoic bedrock is distinguished from the overlying Cretaceous Windrow Formation, which is absent in much of the county; they are combined on the map.

The Quaternary map units also occur in layers in Fillmore County. Holocene alluvium may overlie Wisconsinan alluvium, which in turn may overlie older alluvium. Colluvium typically rests directly on bedrock, but it also interfingers with Wisconsinan alluvium deposited at the same time (sections C-C', D-D', and E-E'). The map shows only the uppermost, youngest Quaternary layer. Younger units never underlie an older unit, but in places stream deposits of the last 10,000 years rest directly on bedrock.

Colluvium occurs along steep bedrock slopes in two settings: (1) The steep sides of river valleys cut into bedrock, and (2) the escarpment between the upper carbonate bedrock units (Galena through Cedar Valley Groups) and the lower carbonate units of the Prairie du Chien Group. The St. Peter Sandstone and other intervening rocks are easily eroded and form a steep slope between the two plateaus of resistant rock. All the rocks dip gently to the southwest. If the bedrock surface were smooth, this escarpment would be straight and simple, stretching northwest to southeast roughly from Chatfield to Mabel. Before the deep dissection of the last few million years, that is probably how it looked. Now, however, the escarpment has been deeply embayed by streams cutting into the bedrock. Some of the streams can be recognized on the surficial map by their alluvium. But even smaller streams, whose alluvium is not wide enough to map at this scale, have cut away large volumes of rock and made the escarpment quite jagged.

The colluvium on the sides of valleys that are cut into bedrock is distinct in some places; in other places it merges with the colluvium on the escarpment between the carbonate plateaus, as it does a few miles west of Lanesboro. Some valleys are relatively straight and probably joint controlled, such as the Root River tributaries between Lanesboro and Rushford. In other places, the whole valley meanders, such as the main Root River in the same area.

The late Wisconsinan glaciers that brought thick deposits of till to much of Minnesota did not reach Fillmore County. Pre-Wisconsinan glacial till is widespread and relatively thick in the western part of the county, but thin and patchy in the central and eastern parts. The glaciers advanced into the county from the west and northwest, and some advances covered only the western part of the county. A valley system buried by till in the southwest corner of the county (section A-A') slopes southward more or less parallel to the course of Beaver Creek. In contrast to the modern valleys (C-C', D-D', E-E'), buried valleys like this are broad, and their bedrock sides are gently sloping. The buried valleys probably are preglacial; they are at least older than the till which fills them.

Till is most widespread on drainage divides away from major streams. Each till sheet probably was continuous when the ice melted, but much of it has since been removed by erosion. The last glacier covered the western part of Fillmore County several hundred thousand years ago; the eastern part of the county may have been free of ice for more than a million years. For the most part, till is absent from modern valleys, which probably are deeper now than they were when glaciated. However, there is a patch of till on a bedrock bench in the Middle Branch of the Root River (section E-E').

The distribution of glacial stream deposits (**psg**) is similar to that of the till, but more patchy. There is no way to determine how much of this sediment was deposited as outwash by meltwater flowing away from a glacier and how much was deposited in, under, or against the ice. Presumably, outwash was deposited in the valleys leading away from the ice sheet, and most of the major valleys in the county have this orientation. Conversely, some of unit **pal,** such as the patch on a bedrock bench by the confluence of the North and Middle Branches of the Root River, may be outwash, but the deposits in valley bottoms (sections C-C', D-D') are likely to be younger, because the valleys are deeper now than they were when the last outwash was deposited.

Valley Form

In the northwest corner of Spring Valley Township, Bear Creek flows across the Galena-Cedar Valley plateau in a valley cut 50-70 feet into the carbonate bedrock. The valley sides are only moderately steep, and the relatively little colluvium cannot be shown at this scale. The river slopes about 10 feet per mile and meanders a little. Where meander cutoffs start to appear, their bottoms are 20 to 70 feet above the present valley floor, and indicate that the valley has continued to deepen as it meanders. In this reach of the river, it doubles its rate of descent.

Bear Creek joins Deer Creek and Spring Valley Creek to form the Middle Branch of the Root River in north-central Fillmore Township. At this point, the valley widens and the gradient decreases to less than 10 feet per mile, partly because the stream has cut through the weak St. Peter Sandstone, and is flowing on the resistant Prairie du Chien Group.

As the river narrows downstream, the Prairie du Chien appears as a bedrock bench above an inner valley (section E-E'). Farther downstream the bench widens into a plateau.

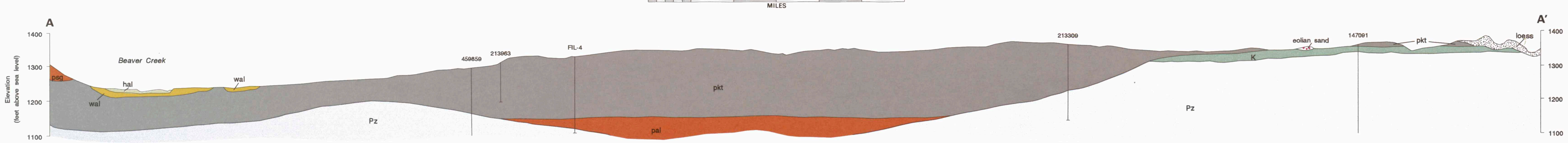
A little downstream from the confluence with the North Branch of the Root River south of Chatfield, the valley starts meandering again, and the valley gets deeper. The valley walls are steep and mantled with colluvium. In some places, the bedrock slope is gentler on the insides of meander bends.

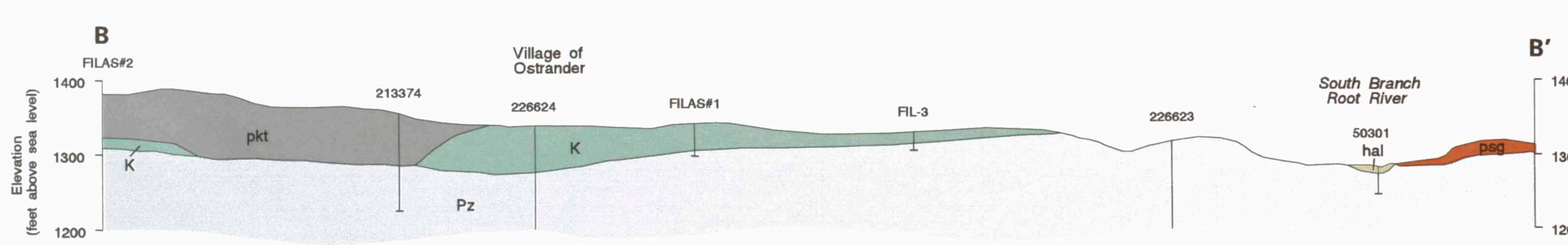
The loop of map unit **wal** in Pilot Mound Township is a relatively recent meander cutoff, and some older cutoffs farther downstream are indicated on the map by line symbols. The river cuts through the Prairie du Chien into the softer Jordan Sandstone in this township, and the stream gradient decreases to about 5 feet per mile in this stretch. The total thickness of alluvium (**hal** plus **wal**), however, increases from 15-20 feet to 50-60 feet in the deepest part of the valley. Subsurface information is not spaced closely enough to show if the increase is gradual or abrupt.

After it joins the South Branch, the Root River follows a continuation of the course of the South Branch. This direction is up the regional bedrock dip, and the rise of the Prairie du Chien plateau makes the valley deeper. Several meander cutoffs show that the river has meandered as it has cut down. The tributaries are generally parallel to the bedrock strike and appear to be controlled by bedrock joints. The stream falls about 80 feet over about 18 miles between the confluence and Rushford, about 4.5 feet per mile, but the bedrock bottom of the valley slopes more steeply. By Rushford the average thickness of alluvium is more than 100 feet, and the valleyside bluffs are 400 to 500 feet high (section D-D').

The wide valley west of Rushford is interpreted as the combination of two big meander loops, and terrace remnants of Wisconsinan alluvium are prominent.

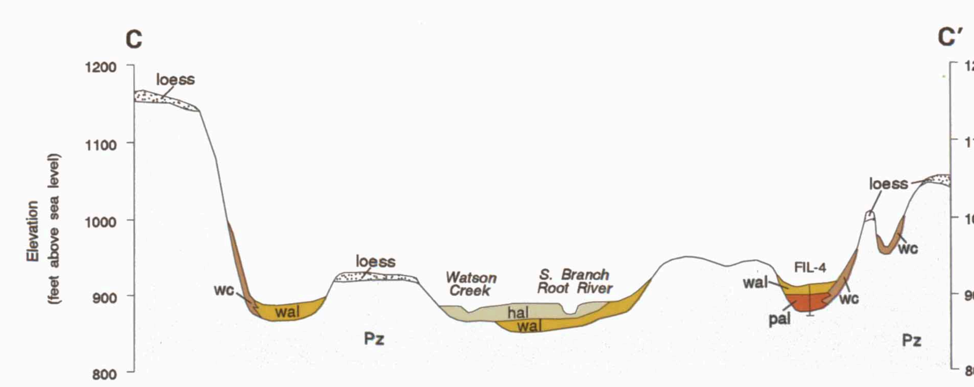
This tour of one drainage line summarizes the most typical phenomena. The downstream changes in valley form and sediments are related to bedrock geology, as well as to the Quaternary history of the area.

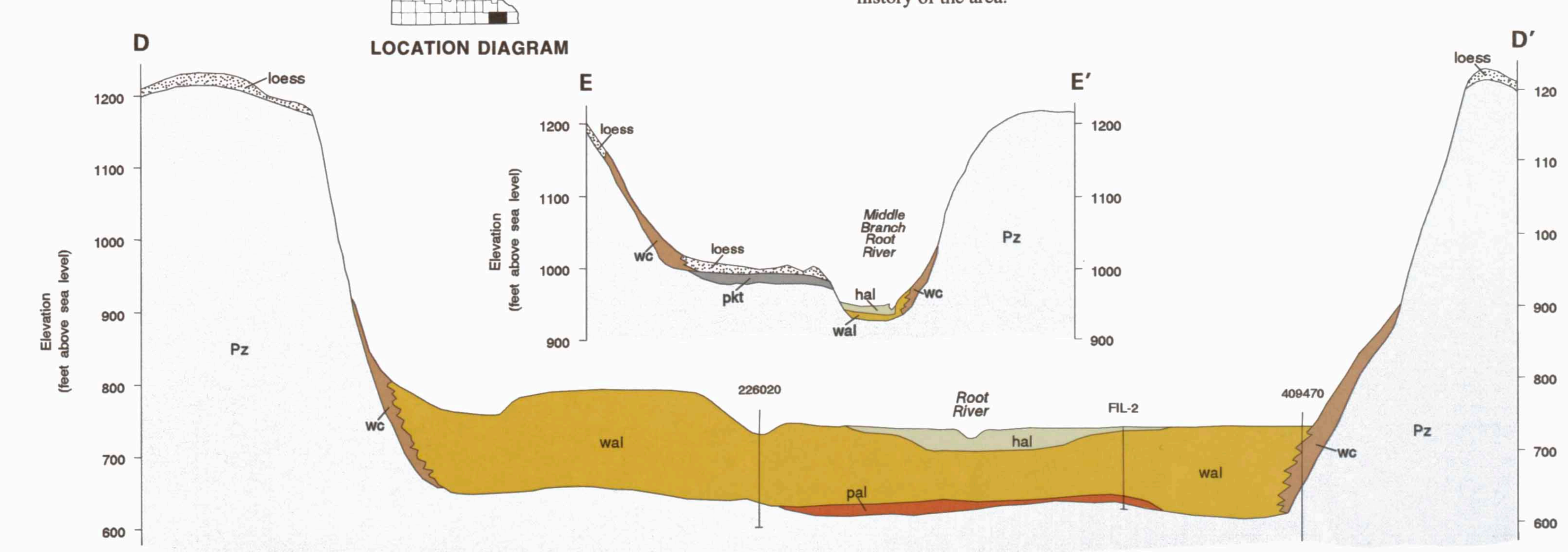




SCALE 1:24 000

Vertical exaggeration x10





Partial funding for this project approved by the Minnesota Legislature (M.L. 91, Ch. 254, Art. 1, Sec. 14, Subd. 4[F], and M.L. 93, Ch. 172, Sec. 14, Subd. 11[g]) as recommended by the Legislative Commission on Minnesota Resources from the Minnesota Environment and Natural Resources Trust Fund