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GEOLOGY OF THE JAMESTOWN AREA

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LITHOLOGY

Two examples of till (contact is marked by the arrows). Each till represents a separate glacial advance over the Jamestown area.

Qt Till consists of an unsorted, unstratified mixture of boulders, cobbles, pebbly sand, silt, and clay, which was deposited directly by, and beneath glacial ice. It is by far the most widespread map unit in the Jamestown area.

The eastern half of Stutsman County, including the city of Jamestown lies within the Glaciated Plains, a physiographic region of North Dakota dominated by landforms and sediments derived from glaciers that covered this area during the last major southward expansion of ice between about10,000 and 26,000 years ago. The thickness of glacial sediment in the region may be as much as 500 feet and is sufficient to mask the underlying bedrock topography.

The landscape is characterized by gently rolling hills and swales with low to moderate relief of generally less than 100 feet. Drainage is typically nonintegrated, consisting of a network of poorly connected lakes, sloughs, and seasonal streams. Glaciofluvial landforms such as eskers Qe and kames Qk form slightly elevated linear or ellipsoid structures on this landscape. These features were formed by the deposition of sediment by streams flowing beneath, within or on a melting glacier. Eskers are sinuous ridges of sand and gravel that mark the course of a subglacial meltwater stream. Kames are cone-shaped hills comprised of similar material that was deposited when meltwater spilled into a crevasse or hole in the glacier.

The disproportionately wide valleys of the James River and Sevenmile Coulee are also the product of glacial meltwater. These valleys are believed to have formed by the sudden, catastrophic release of enormous volumes of water from proglacial lakes. Outbursts such as these typically form relatively straight, steep-walled channels, often with a well-defined outer channel, which contained flow before the main channel was eroded. Terrace sediments Qtr, consisting primarily of till eroded by glacial meltwater, form the steep valley walls that separate the outer channel from the main channel. The modern James River and the intermittent stream that flows within Sevenmile Coulee thus occupy valleys that were formed by much larger and more powerful watercourses.

Glacial erratics like this large boulder (six feet diameter) on the eastern shore of Jamestown Reservoir are also components of till.

Rounded, water-worn pebbles and cobbles in sandy meltwater channel deposits.

Qa2 Channel sediment that was deposited by meltwater streams consists of poorly bedded sand and gravel, cobbles and boulders. Higher level channel sediments Qa3 are essentially indistinguishable from sediments deposited on terraces within the main channel. Despite their high shale content, both have been exploited for their sand and gravel. The shale in these deposits tends to be highly weathered and brittle, a fact that quarry operators take advantage of in reducing the shale content by mechanical screening and by exposing it to further weathering.

Modern river and lake deposits Qa1 and Ql are generally distinguished from older, Pleistocene material by their high organic content, which imparts a dark brown or brownish-black color to the sediment.

Heavily fractured and jointed exposure of Pierre Shale. The cliffs in this picture are approximately twenty feet high.

Kp The Pierre Formation is a sequence of mostly gray shale that was deposited in an offshore marine environment during Cretaceous time, about 70 to 80 million years ago. In the Jamestown area it is about 500 feet thick, although in western North Dakota, particularly in the deeper parts of the Williston Basin, it may be up to 2,300 feet thick.

The Pierre Formation is exposed along the shores of Jamestown Reservoir and for a short distance to the south along the James River valley. Most Pierre Formation exposures are restricted to wave-cut banks several feet in height; smaller exposures outcrop sporadically through a colluvial cover Qc. There is often a subtle break in slope at the contact between the Pierre Formation and overlying glacial sediment. Some of the best and most easily accessible exposures are located in the Stutsman County Recreation Area along the northwestern side of the “island”.

Close-up of joints in Pierre Shale.

Kp In the Jamestown area the Pierre Formation consists of medium-light gray to light olive-gray fissile, flaky, noncalcareous shale. Locally it is blocky in outcrop, although it invariably weathers to thin flakes. Where a colluvial cover is thin or absent, the Pierre Formation weathers to sparsely vegetated slopes of small shale flakes. The shale is highly jointed, with brown to brown-black iron-manganese stains common on joint surfaces. Joints are occasionally filled with coarsely crystalline calcite or iron-manganese oxides. Bedding is generally poorly developed and obscured by the fissile character of the shale.

Concretions are common and occur along selected horizons. They are oblate in shape and commonly about 1 foot in diameter. The most conspicuous feature of these concretions is their weathered rind of yellowish-brown to brownish-black iron-manganese oxides. The interiors of the concretions typically consist of light olive gray micrite (lime mudstone) or calcareous mudstone. Although the concretions are harder than the enclosing shale, like the shale they are jointed, and tend to form broken piles when weathered.

Folding and faulting in Pierre Shale. This type of deformation was probably the result of glacial activity. The structure in this photograph measures about three feet in height.

Kp In the subsurface, the fine texture and relative impermeability of the Pierre Shale means that, for the most part, it is not a good aquifer. However, in places, including parts of Stutsman County, the upper 50 to 200 feet of the Pierre Shale is heavily fractured. Groundwater is able to move along the joints and fracture planes and thus provide water to wells that penetrate these zones in the shale.

The quality of water from the Pierre Shale is highly variable. Typically, it contains sodium as its principal cation with varying concentrations of bicarbonate, chloride and sulfate. Chloride levels are often sufficiently high to impart a brackish or salty taste to water from the Pierre Shale. The water is generally classified as hard to very hard and may require softening for many domestic and industrial applications

References

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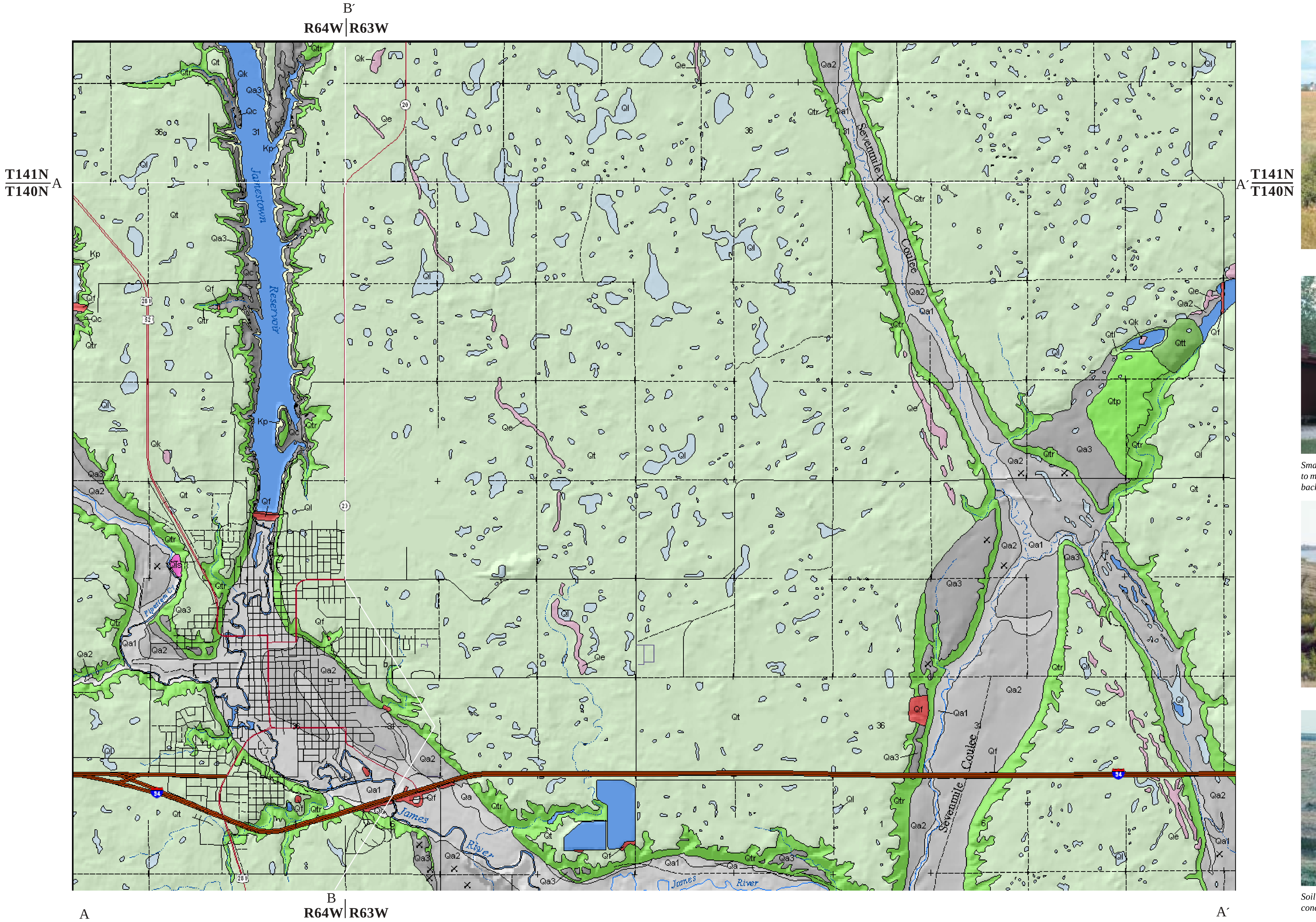

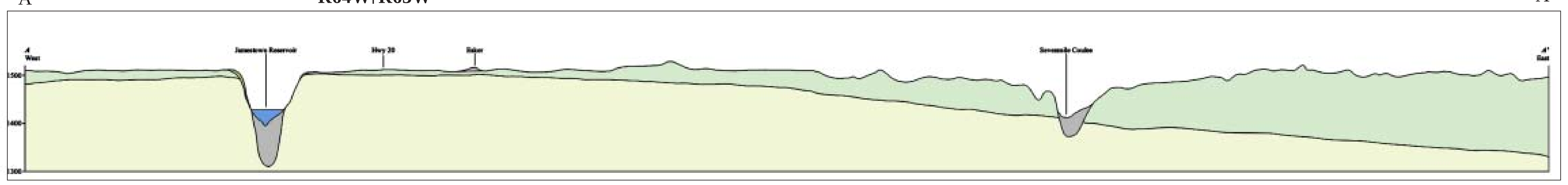

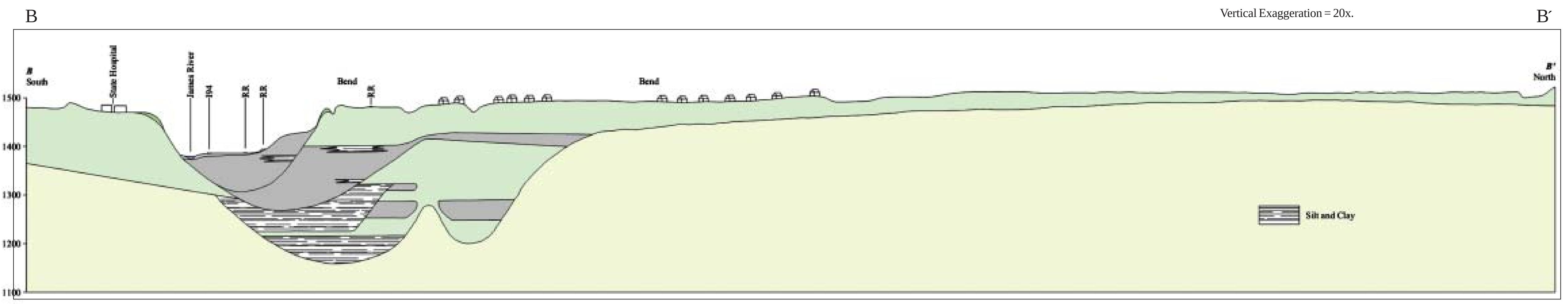

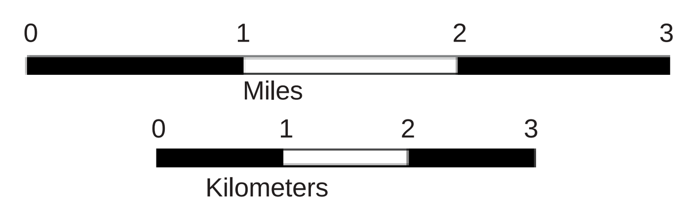

Map Scale 1:48,000
The map has been placed on a shaded relief background.

GEOLOGIC HAZARDS

SLOPE FAILURE

Rotational slump on the western shore of Jamestown Reservoir.

Qls Most slope failures in the greater Jamestown area occur in the form of small rotational slumps on slopes that have been undercut or oversteepened by the improper placement of fill. Slumping is governed by a number of physical factors that may weaken slopes, but it is most likely to occur after periods of prolonged, heavy precipitation, when the ground is saturated with moisture and the water table is elevated, implying that water is the primary cause. Water decreases slope stability in several ways, principally by reducing the cohesive, stress, and frictional forces between the particles of an unconsolidated material such as soil or till. It also appears to function as a lubricant, enabling the unconsolidated mass to slide, often as a unit, along a well-defined, concave-up basal plane.

Small rotational slump that occurred in 1993. The toe of this slope was cut to make room for a swimming pool and backyard. The slump destroyed the back of the house.

In 1993 an unusually wet summer resulted in a number of small rotational slumps in and around Jamestown. All were located on the steep walls of the major river channels where the existing slopes had been incorrectly modified. Because much new construction in the Jamestown area is taking place on and near steep valley walls, the potential for landslide damage is increasing.

An older, larger landslide along Pipestem Creek was formed in river-eroded glacial sediment on the outside bend of a meltwater channel meander. Although extensively reshaped by excavation and placement of fill, and somewhat subdued by erosion the characteristic hummocky landslide topography is still visible.

Wave-eroded Pierre Shale.

In addition to creating conditions favorable for slope failure, and the consequent loss of river- and lakeside property, wave-induced shoreline erosion is also a contributing factor to the process of reservoir siltation. Siltation, as the term implies, is the deposition and accumulation of silt, and left unchecked it can have a profound effect on water quality. In addition to reducing the life of the dam, uncontrolled siltation can destroy aquatic habitat, pollute, and severely impair a river or lake’s recreational and commercial activity.

Soil creep on slopes a few miles north of Jamestown. Note the shallow, concentric scars typical of this kind of mass movement.

The steep valley walls of the major streams in the Jamestown area are also subject to the process of soil creep. Soil creep, as its name implies, is the imperceptibly slow downhill movement of soil under the influence of gravity. It is visible as shallow, concentric scars on valley walls, and is typically confined to the top few feet of soil. Soil creep is responsible for the downslope tilting and/or displacement of trees, telephone poles, fences, and other objects apparently secured in the ground. Poorly supported retaining walls and even the walls of buildings may also sustain damage when large masses of soil accumulate upslope as a result of creep.

Soil creep is especially common where bedrock is close to the surface.

GRAVEL PITS

Gravel pits in Pipestem Creek valley.

Although restricted to the James River, Pipestem Creek, and Sevenmile Coulee valleys, the greater Jamestown area has significant reserves of sand and gravel. Deposits occur in the meltwater channel sediments (Qa2 and Qa3) and are believed to have been deposited as bars in alcoves along the valley walls and on the inside bends of meanders.

Sand and gravel deposits are typically unconsolidated, and when disturbed become unstable and prone to collapse. Loose material and steep pit faces in both working and abandoned operations should always be treated with extreme caution.

Waste dumped in disused sand and gravel pits may contaminate local groundwater supplies. The metal drum in the foreground once contained an industrial lubricant.

Abandoned sand and gravel pits are often used as dumps for waste. In many instances sand and gravel pits are associated with important groundwater supplies, and any waste placed in these pits may adversely affect groundwater quality.

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program. Robert Biek is a geologist with the Utah Geological Survey where his principal involvement is with its geologic mapping program. Bob was a geologist with the North Dakota Geological Survey from 1992 to 1996.