100K Series: WfdC-1

# Areas of Landslides
## Watford City 100K Sheet, North Dakota


| | | |
|---|---|---|
| Culbertson | Williston | Stanley |
| Sidney | | Parshall |
| Glendive | Grasey Butte | Killdeer |

Adjoining 100 K Maps

North Dakota Geological Survey
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General Information on Landslides

Landslides are masses of rocks and sediment that have tumbled or slid down a slope under their own weight. These geologic hazards can destroy buildings, roads, railroad tracks, pipelines, transmission lines, and other types of infrastructure. Landslides are generally characterized in the field by steep, near-vertical slopes (the scarp) that are upslope from a mound of displaced rock (the body). The body of the slide may be relatively intact or it may be severely fragmented. Recent or relatively new landslides are generally characterized by a fresh (well-exposed rock) scarp and a sparsely vegetated body. Older slides are typically more difficult to identify in the field because the scarps may be covered with vegetation and the landslide bodies are often well-vegetated, covered by mature trees.

Landslides are most readily identifiable from aerial photographs. Landslides mapped on the Watford City Sheet were identified from a complete set of aerial photographs (1:20,000 scale) that were flown between May and October of 1958. It is unfortunate that these photographs were taken when leaves were on the trees because groves of leaf-bearing trees tend to obscure landslides, especially small ones. On the other hand, leaves can sometimes make it easier to identify these features. Trees and bushes are often aligned within very distinct parallel-, transverse-, and/or semi-circular-depressions that occur generally occur within the body of the landslide.

Slopes fail for various reasons including the steepness or angle of the slope, rock type, bedding, and moisture content of the rocks. Most landslides in western North Dakota are rotational slumps that have a well-defined head and toe. Typically, the part of the slope that breaks apart slides down the slope as a single unit and the beds tilt back in the direction of the slope. The failed mass of rock is, however, almost never a cohesive unit; tension cracks generally cause the failed material to splinter into smaller portions. Successive landslides may occur at the same location. Over time, the accumulated material from multiple, adjacent landslides can cover an area that is several thousand feet wide and several miles long.

The Watford City Sheet

Most of the area of the Watford City Sheet is underlain by the Sentinel Butte Formation (Paleocene), which consists of alternating beds of sandstone, siltstone , mudstone, claystone, clinker, and lignite. A veneer of glacial deposits covers much of the upland areas.

In the Watford City Sheet, landslides are most prevalent within the Little Missouri River Badlands and in badlands topography north of Arnegard. The rock types in these two areas are no different than those outside of these landslide -prone areas. In contrast to the slow erosive processes that have carved most of the landforms in this map sheet, the buttes, valleys, coulees, and ravines within the Little Missouri River Badlands were carved relatively quick ly (in geologic terms) when glacial ice diverted the ancestral Little Missouri River into this area. Approximately 600,000 years ago, glaciers blocked the path of the north -flowing ancestral Little Missouri River near the southwestern border of the North Unit of the Theodore Roosevelt National Park. The glacier forced the river to turn east and carve the steep, rugged badlands in this area. As a result, the older, north-trending segment of the Little Missouri River Badlands (Marmarth to Grassy Butte) is wider with gentler slopes than the younger, narrow er east-trending segment within this map sheet.

A 20-to 30-foot thick bed of bentonite, the Sentinel Butte ash/bentonite or Blue bed, is present throughout the central portion of this map, including the slide-prone areas in and around the North Unit of the Theodore Roosevelt National Park and the area north of Arnegard. Although this clay has been disrupted by landslides near the Park, the swelling clay does not appear to have been a major contributing factor for most slides in the area. It has yet to be determined what role, if any, it played in slope stability problems north of Arnegard.

A total of 1,853 landslides were identified in the Watford City Sheet. Many of these slides are complexes, consisting of multiple landslides that formed from a half dozen or more individual events. Therefore, the number of individual landslides in this sheet is much higher. These slides cover an area of 28,700 acres or approximately 3% of the area. More importantly, landslides occupy up to 30 or 40% of the Little Missouri River Badlands in this sheet. Most of these landslides are well-vegetated indicating they are quite old, perhaps thousands of years old, occurring relatively quickly after the steep-sided slopes had formed.

In the Little Missouri River Valley, careful consideration is required prior to construction to avoid landslide prone areas. Construction activities can reactivate landslides that have been stable for hundreds or thousands of years. Furthermore, the presence of numerous landslides in an area generally indicate widespread slope instability necessitating extreme caution be used when building on, or adjacent to, slopes anywhere within that area.

### UNIT DESCRIPTIONS

**GU** **Surface geology undifferentiated**

**QUATERNARY**

RECENT/PLEISTOCENE

**Qs** **Landslide**
A mass of sediment and/or rock that have slid or tumbled down a slope. A pink area on the map may represent dozens of individual landslides.

**Other Features**

- Water
- Marsh
- Federal Land Boundaries
- River/Stream
- Stream - Intermitent
- Section Corner
- County Boundary
- Federal Highway
- State Highway
- Paved Road
- Unpaved Road
- TRNP Theodore Roosevelt National Park
- FUHS Fort Union National Historic Site

**Geologic Symbols**

- Known contact between two geologic units

Note: This map was expanded beyond the normal Watford City 100k Sheet to include an additional width of two miles to the Montana border.

The North Dakota Geological Survey compiled this map according to conventional cartographic standards, using what is thought to be the most reliable information available. The North Dakota Geological Survey does not guarantee freedom from errors or inaccuracies and disclaims any legal responsibility or liability for thereon. The text for the general information on landslides section was modified only slightly from the Parshall 100 K Landslide sheet.

Scale 1:100,000
0 1 2 3 4
Miles

Mercator Projection — 1927 North American Datum
Standard parallel 47° 45' — Central meridian 103° 30'
Shaded Relief - Vertical Exaggeration 9x

Cartographic Compilation: Elroy L. Kadrmas