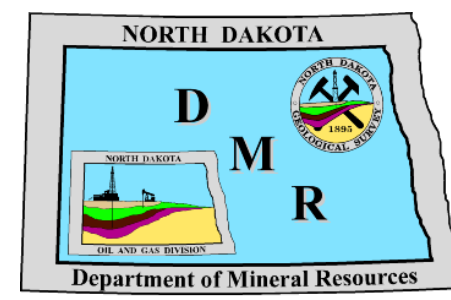
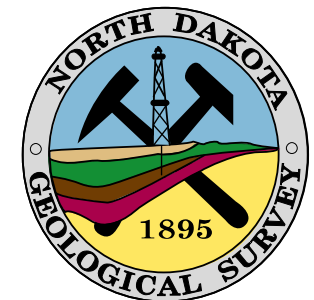


# LANDSLIDE AREAS IN MCKENZIE COUNTY, NORTH DAKOTA

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## LANDSLIDES IN MCKENZIE COUNTY

Landslides are masses of rocks and sediment that have tumbled or slid down a slope under their own weight. Landslides are one of the most common geologic hazards in North Dakota and 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 topography of the scarps and bodies may be smoother and more subdued due to weathering. Landslides are most readily identifiable from Light Detection and Ranging (LIDAR) data, supplemented with aerial imagery.

Landslides in McKenzie County were mapped from LIDAR data collected in October 2014 along with NAIP digital imagery from 2016 to 2022 and a complete set of historical aerial photographs flown from June to September in 1958 at a scale of 1:20,000. The aerial photographs were taken when leaves were on the trees which is unfortunate 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 as trees and bushes are often aligned within very distinct parallel, transverse, and/or semi-circular depressions that generally occur within the body of the landslide. Using LIDAR elevation data allows us to see through most of the areas previously obscured by vegetation in the historical imagery and aerial photography and greatly increases our ability to identify additional landslide areas.

A total of 18,144 landslide areas were identified in McKenzie County. Some of these slide areas are complexes, consisting of multiple landslides that formed from different events. Therefore, the number of individual landslides in this county is likely somewhat higher. Collectively, these landslide areas cover 137 square miles (87,576 acres) or approximately 4.8% of the county. Most of the landslides occur within the badlands of the Little Missouri River in the southeastern part of the county and along the slopes of the Missouri River Valley in the north along Lake Sakakawea. Most of the larger slide areas are found along the slopes in the Little Missouri River Valley. These areas are landslide complexes consisting of several large, coalesced slides.

Most of the slides in McKenzie County (77%) cover less than four acres (fig. 1). On the larger side of the scale, 1,685 (9.2%) are larger than 10 acres with an average of 33 acres. Landslides are commonly concentrated along drainages, ravines, and coules, and within areas of high local topographical relief along the major hydrologic corridors of the Missouri and Little Missouri Rivers. All, or portions, of the head of a ravine typically fail, presumably because headward erosion causes these areas to undergo some of the fastest rates of erosion, oversteepening slopes.

Several historical abandoned mine lands (AMLs) are found in McKenzie County, mostly in the northern half. These small coal mines, commonly referred to as wagon mines, are found somewhat concentrated southwest and northeast of Watford City with scattered locations in the western part of the county around Alexander and Johnson's Corner in the east. No collapse features from underground voids were visible on the surface, but uncollapsed mine voids may occur in the subsurface beyond the boundaries of the known AML locations since a mine is reported to have existed at these locations, according to records compiled by the North Dakota Public Service Commission. It can be difficult to determine whether small surface irregularities along drainage slopes are old mines or slumps, further complicated as abandoned mines are susceptible to slope failure. Thus, some areas mapped as landslides may include the collapse of abandoned mine headwalls.

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, 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 sedimentary bedrock geology of McKenzie County consists of sandstone, siltstone, mudstone, claystone, and lignites deposited in rivers, floodplains, and swamps during the mid-Tertiary (Paleocene). These rocks are included in the upper Fort Union Group, with the late Paleocene Sentinel Butte Formation comprising the majority of the surficial outcrops in the county and the older Bullion Creek Formation exposed in the southeastern and far northeastern part of the county along the Little Missouri Badlands and Missouri River Valley. Thin glacial sediments mantle the sedimentary bedrock in the central portion of the county. Most of the landslides in McKenzie County occur in the Sentinel Butte Formation (79%) and the Bullion Creek Formation (17%), with 8% found within Quaternary sediments. It is not uncommon for landslides to occur across multiple formations and displace several units.

Small landslides, 10 acres or less in size, are common throughout the rugged topography of western North Dakota. Many of these, as well as larger landslides, can be obscured by siltwash or colluvium. Layers or blankets of siltwash typically cover the lower portion of a slope and extend horizontally from its base. Thick smooth layers of siltwash can completely obscure the broken, jumbled beds of landslide material. In some areas, smaller landslides, or landslides that are very old and have been inactive for a long period of time, are only visible if siltwash is thin or absent, or the beds are sufficiently displaced to create subtle irregularities at the surface. An area with many landslides suggests that the slopes in that area may be predisposed to future slides. Even when landslides are not identified in these types of settings, these areas often remain vulnerable to slope failure and should be evaluated prior to the development of any civil works or energy infrastructure projects and, when possible, be avoided.

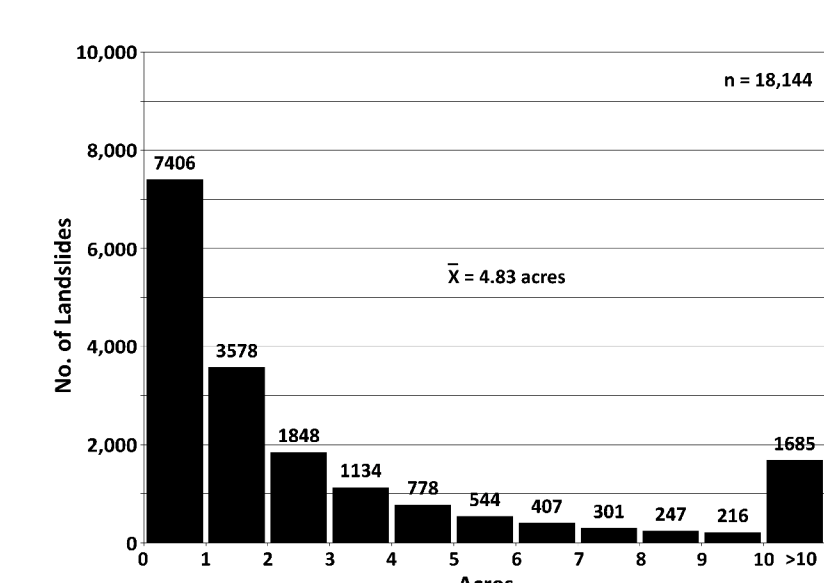
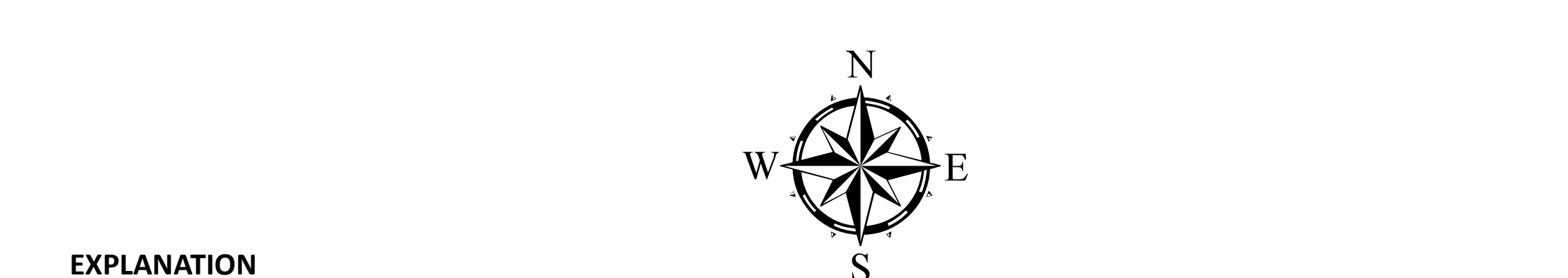
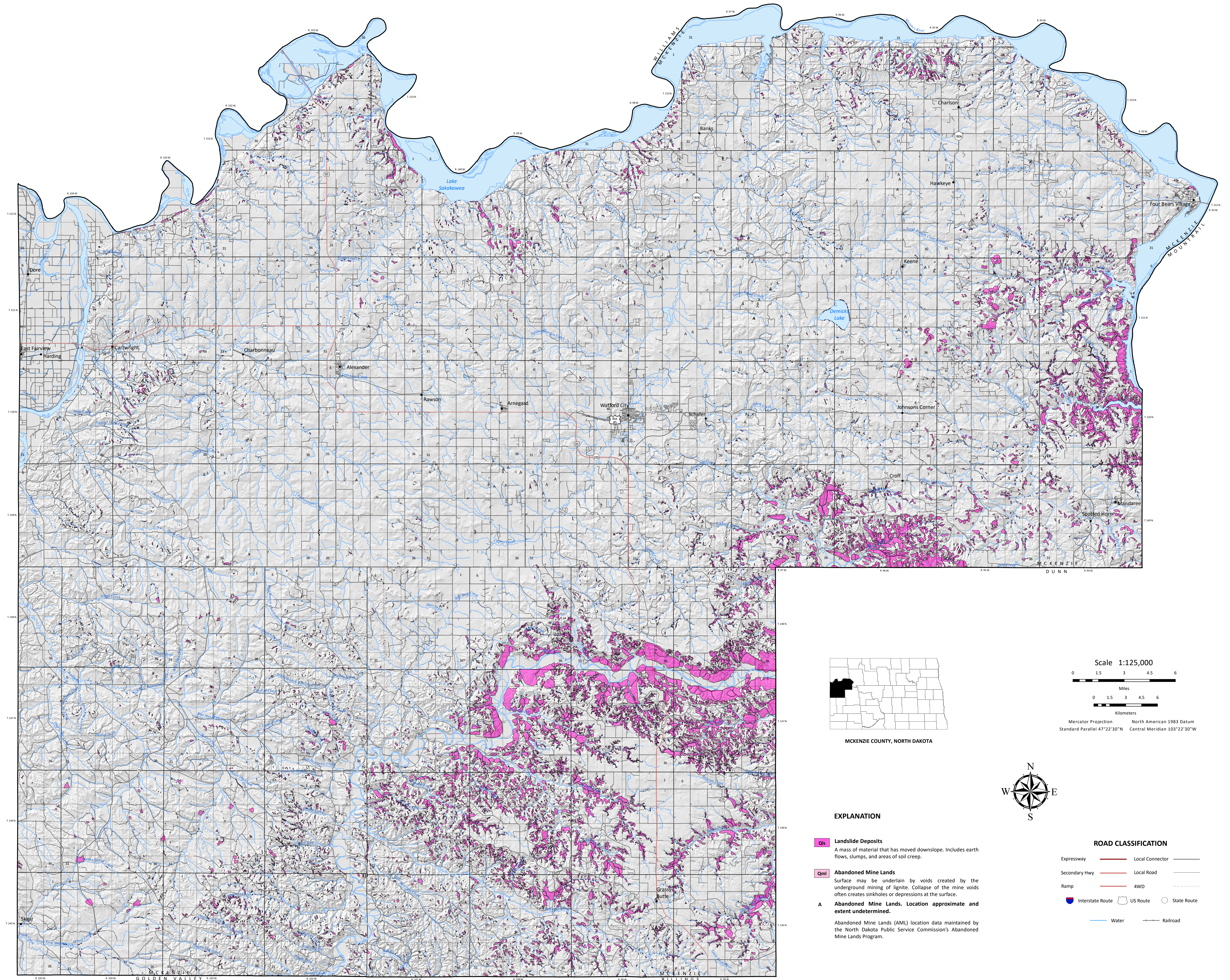


Figure 1. Distribution of landslide areas mapped in McKenzie County. Most landslide areas (77%) cover less than four acres. Some slides (9.2%) are over ten acres in size. The mean (x) landslide area size is 4.83 acres. The number of landslide areas (n) in this distribution is 18,144. Within the 1,685 landslide areas that are greater than 10 acres, the mean is 32.6 acres.



Index to 1:24,000 Quadrangles



### EXPLANATION

**Qs** Landslide Deposits  
A mass of material that has moved downslope. Includes earth flows, slumps, and areas of soil creep.

**Qml** Abandoned Mine Lands  
Surface may be underlain by voids created by the underground mining of lignite. Collapse of the mine voids often creates sinkholes or depressions at the surface.

**A** Abandoned Mine Lands. Location approximate and extent undetermined.

Abandoned Mine Lands (AML) location data maintained by the North Dakota Public Service Commission's Abandoned Mine Lands Program.

### ROAD CLASSIFICATION

Expressway ——— Local Connector ———  
Secondary Hwy ——— Local Road ———  
Ramp ——— 4WD ———  
Interstate Route ——— US Route ——— State Route ———  
Water ——— Railroad ———