Urban Geology and Landslide Project, Peace River, Alberta

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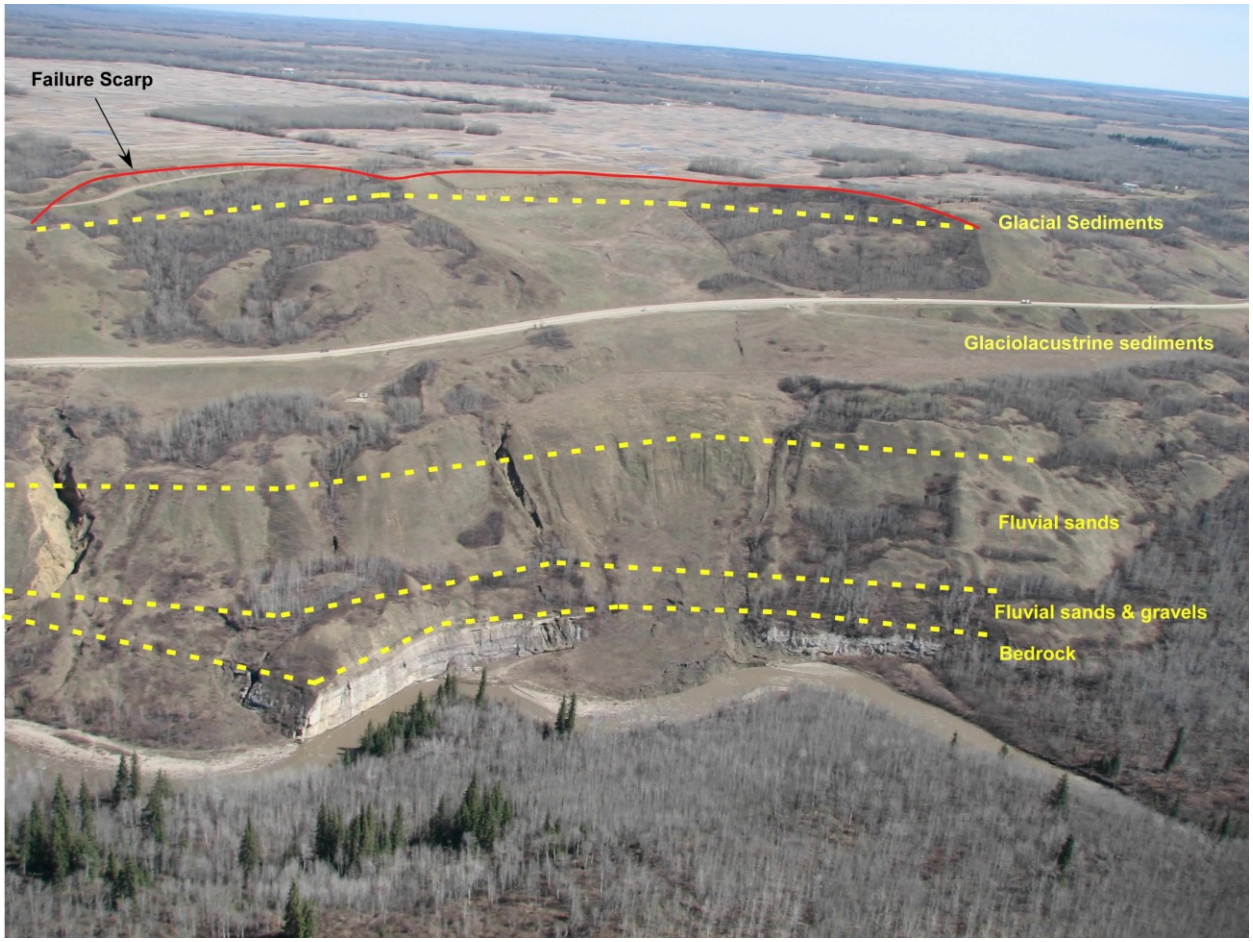
Abstract

In the 1970s and 1980s, the Alberta Geological Survey (AGS) studied surface and subsurface geology in urban areas to provide information that would aid future development and land-use planning. After more than 25 years, AGS has re-initiated this type of study within the Geological Hazards Section, with the first study focusing on the town of Peace River in northwestern Alberta.

The town of Peace River has a large portion of its buildings and roadways built either on the flood plain or on the unstable valley walls of the Peace River Valley. To move goods, products or resources in and out of the town, active landslides must be crossed and the related infrastructure maintained. As there are various types and sizes of landslides that move at various rates, it is important to better understand both these landslides and the complex geological conditions that led to the formation of these features.



Aerial oblique photograph showing the locations of the various stratigraphic units as they are represented on a large landslide on Highway 2, on the eastern side of the study area.

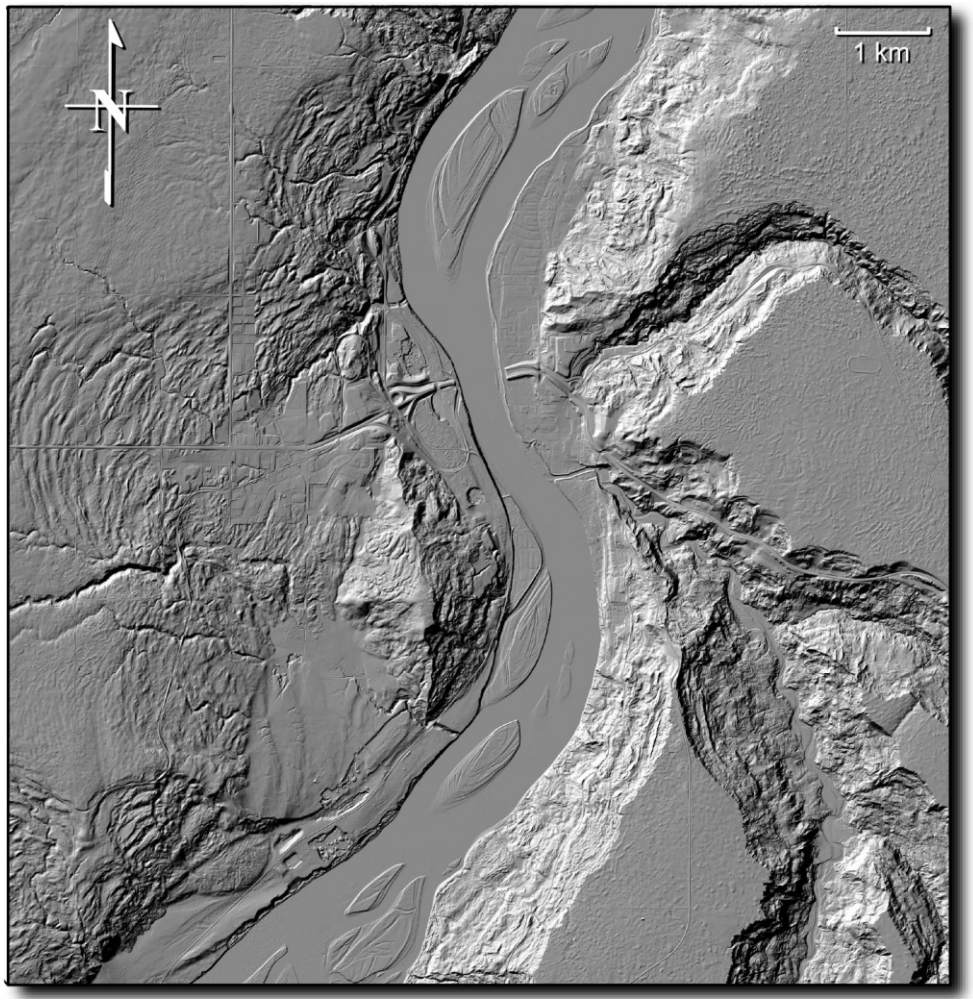
In 2006, a study was initiated to develop a model to better understand the extent, rate and style of the large-scale landslides in and around the municipality. This project is being conducted in partnership with the University of Alberta and Alberta Transportation and is being supported by the Town of Peace River, CN, ATCO Electric, ATCO Pipelines and the Canadian Space Agency.

The first part of the study was to develop a geological model and complete an inventory of landslides in the area. This was necessary because of the geological (glacial) nature of the drift and the various triggers that can initiate the landslides. Alberta Geological Survey and the University of Alberta will use this information to develop logical groupings for the landslide types that have occurred.

To better understand the glacial geology of the study area, more than 1400 well logs were reviewed and a model of the subsurface was developed. Detailed field mapping of available exposures was also undertaken to aid in this process. As there were still some key gaps in the knowledge of the subsurface, AGS initiated a drilling program in the winter of 2008/2009 to gather a continuous profile of the drift column above bedrock at two locations. At each location, the upper 120 metres was continuously cored using rotosonic-drilling techniques and an

adjacent hole was drilled using mud rotary drilling and logged using downhole geophysics. With these core data, supplemented with mapping of exposures in the area, we obtained a complete column of the approximately 170 metres of glacial drift overlying bedrock. Results of the drilling program are available in AGS Open File Report 2009-18.

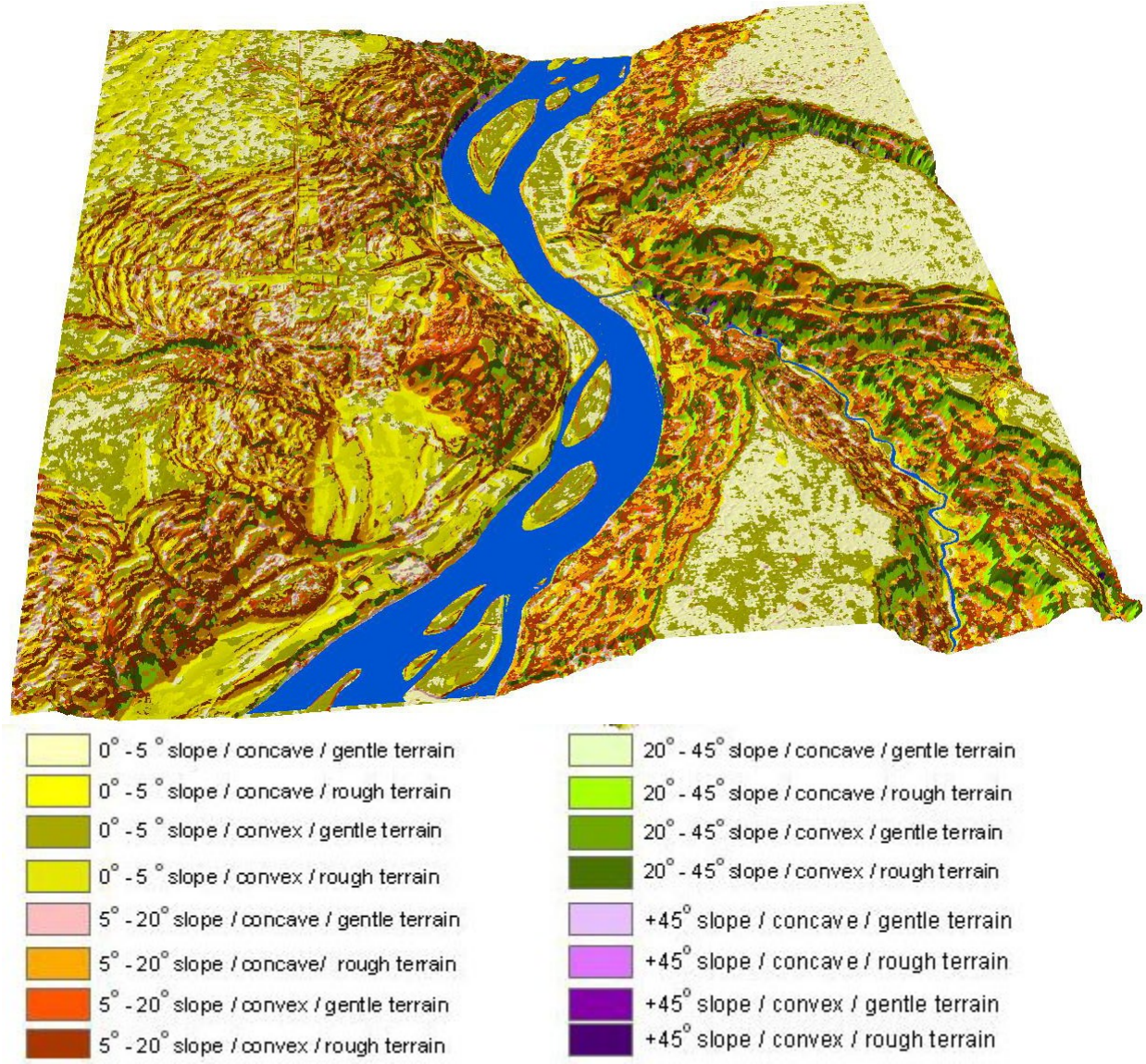
Once the stratigraphy of the subsurface was better understood, high-resolution ground models derived from airborne Light Detection and Ranging (LiDAR) were constructed to correlate common elevations of landslides around the study area and better understand the specific weak zones within the subsurface where the large landslides were occurring.



A sample of the bare-earth LiDAR digital elevation model that is used to map landslide features in the study area.

Not only are the LiDAR data extremely valuable in recognizing the common features of the large landslides that cover the study area, GIS tools are also being utilized to automatically identify different landslide features in the region. In general, the older, flatter landslides are typically less active (moving at a slower rate) than steeper, more active features. By undertaking spatial

analysis on the LiDAR data, and considering factors such as slope angle, surface roughness and slope curvature, the hope is that features will become apparent that will differentiate between different levels of activity. These data would then be coupled with conventional geotechnical monitoring information and other space-borne monitoring data to identify features that are moving at faster rates than other features.



3-D image showing results of automated pattern recognition being applied to high-resolution LiDAR data to aid in identifying various rates of landslide movement at the town of Peace River.