



A Look into **CLIMATE CHANGE** and **LANDSLIDES**

Do Landslides pose a risk to the Selkirk First Nation People?

The Selkirk community wanted to know if the health of the general population was being negatively affected by landslide activity, which appeared to be increasing due to climate change. The goal of this project, funded by Health Canada, was to determine if landslides pose a risk to the Selkirk people. Both Elders and scientists were surveyed to get a better understanding about the issues.

Historical Information from Elders

The Elders said they did see an increase in the frequency of landslides over the past ten years compared to before this time, but there were few details provided. They also noticed an increase in the size of landslides over the past ten years. Most people knew about the mud slough on the MacMillan River, which almost crossed the river and continues to grow. However, no other large landslides were named.

The Elders said there were more landslides occurring now compared to 20 or more years ago (before 1989). Over half of the interviewees thought that there were no harmful effects from landslides over 20 years ago.

It was unanimous that landslides didn't cause any notable illnesses in the people over 20 years ago.

Regarding current information about landslide activity, most Elders thought that changes have definitely occurred in the fish harvest, as few fish came upstream in the summer of 2008, and the fish that did come were either smaller or slower than normal. They also noted a decline in the moose populations with few moose tracks being seen this past winter. One person noted that it is difficult to say as

there is no monitoring program that will do proper measurements over time.

The Elders were then asked about how these landslides affected their lives.

Everyone noted that landslides have a variable, but negative effect on the environment. Some of the effects from landslide activity are changing river channels, creating heavy silt that affects fish spawning grounds and makes the water undrinkable, changing the ability to travel up the rivers or cross historical hunting routes over land.

Hunting was affected because people have to find new hunting areas as the animals have moved, or find new routes to hunting areas due to physical blockages on land or in the rivers.

Another outcome mentioned by a couple of Elders is that landslide activity damages the natural flora and fauna that provides plants for traditional medicines. Landslides also affected peoples' ability to travel to areas where harvesting of traditional medicines & foods – berries roots, sap and bark – occurs.

Objective #1 of this research project was to survey SFN elders for historical information about landslide activity in the SFN TT, and any resulting health effects from these landslides.



Figure 10. The Kalkas landslide covered an area of nearly 4 ha and was approximately 250 m wide in 2006. The inset shows the location of the headscarp on a 1989 aerial photograph (National Air Photo Library; A27516-188). The dashed line traces the edge of an older overgrown retrogressive thaw slump.

Here are two photos of the same landslide, one from 1989 and a later photo from 2006. Major changes occur over the 17 year time span as the soil continues to thaw, causing the soil to slump forward into the river. The edge where the undisturbed soil meets the fallen slope is called the 'headscarp'. Since the headscarp moves farther back with every slide, this type of landslide is called a retrogressive thaw slump.

(Courtesy of Panya Lipovsky, YTG)

Landslide Pollution Information from Scientists

According to the scientists, the primary result of a landslide is physical damage through the large scale influx of earth to streams and rivers, causing turbidity. This siltation of the water is quite harmful to juvenile fish and spawning grounds. Another serious change is the potential for the landslide debris to block the watercourse (i.e. acting as a dam), causing the water to back up into a small pond or lake. This type of dam will prevent fish migration and upstream spawning, but is usually short-term. The scientists point out that this is quite a natural phenomenon that may have just as much positive effect as negative on the local ecosystem because it may rejuvenate biodiversity and increase the long term health of the area.



Figure 9. Oblique aerial photograph of a retrogressive thaw slump (#5 in Fig. 3) that was contributing sediment to the Pelly River in 2006. This landslide has been active and increasing in size since at least 1989. View is to the south. Estimated width of main failure is approximately 200 m.

There are a number of contaminants that may emerge from a landslide. Every type of earth has something in it and a landslide allows whatever naturally occurs in that area to go free. It could be **tannins** from an area that contains peat that will colour the water brownish and make the water slightly more acidic. It could be naturally occurring **phosphates** that will encourage an

algae bloom. However, the scientists believe that toxic damage from landslides in the SFN Traditional Territories (TT) is minimal to non-existent. The other issue to consider is that most landslides have a temporary, acute effect, which passes through the stream ecology within days or weeks.

Some scientists believe that the total volume of earth moving into watercourses due to landslides is considerably less than general bank erosion that occurs daily and seasonally. Generally, in a glaciated area like the SFN TT, landslides contain the same earth moving from land to water as is being eroded continuously from the river bank.

In general, heavy metals are found naturally in the landscape; most commonly in rock. The greater the portion of metal-bearing rocks in the landslide, the higher the likelihood of heavy metal contamination. However, the landscape of the SFN TT contains little metal-bearing loose rock formations that will generate significant contamination.

Most of the contamination that occurred naturally in the SFN TT happened thousands of years ago during the ice age. Therefore, the potential incidence of organic mercury formation in the landscape as a result of recent landslide activity is considered minimal. The scientists believe the only significant source of heavy metal contamination in SFN TT is from mining sites, either existing or abandoned.

In March of 2008 the Yukon Contaminants Committee published a report titled, Regionally relevant health risk assessments for mercury levels in fish in the Yukon. The report states, "Overall, First Nations people in the Yukon have low exposure to contaminants through their traditional food. However, past and current research related to mercury in fish at different sites in the Yukon show that it is one of the contaminants of concern, as levels are high and not decreasing." "After reviewing the data, the YCC decided there was no need to issue any health advice regarding Mercury and fish consumption."

From other published material, the primary sources of organic mercury in the environment are stated as being coal burning power plants, volcanoes and forest fires. Testing is in progress now at Fox Lake, near Whitehorse, to measure the origin and amount of airborne mercury coming to the Yukon area.

Objective # 2 was to survey the scientific community about the possible release of base metals and other chemicals from landslides in the SFN TT.



Landslide Numbers, Location and Age

Panya Lipovsky of the Yukon Geological Survey and Crystal Huscroft of Thompson Rivers University conducted “a reconnaissance inventory of permafrost-related landslides in the Pelly River watershed in 2006 using aerial photograph analysis, satellite imagery, and visual inspection from a fixed-wing aircraft. Over 100 permafrost related slides were located near the Pelly and MacMillan rivers and various tributaries”.

The authors state that, “It is evident from this survey that permafrost-related landslides have occurred widely throughout the study area for several decades. While a small number of landslides have been initiated in the last 15 years, some of the older ones have remained active for long periods. Following initial failure, most of this ongoing activity is gradual, and very few landslides were directly contributing sediment into the Pelly and MacMillan rivers in 2006. Considering the large size of the study area, and the ongoing amount of sediment inputs from continual bank erosion, it seems unlikely that permafrost-related landslides have contributed enough sediment to cause noticeable impacts to water quality as far downstream as Pelly Crossing.”

A follow-up survey of satellite imagery, aerial photos and river-level reconnaissance was performed for this 2009 project by Jim Coates of Kryotek Arctic Innovation. He reports there are three new small landslides [less than 4 meters (13 ft) wide], one new big one [500 m long by 250 m wide] along the Pelly River, and

a reactivation of an existing landslide that have occurred since the Lipovsky and Huscroft study in 2006.

The five scientists interviewed for this study haven't seen a noticeable increase in landslides over the past five years, but definitely over the past 25 years. Some said that there has been an increase over the past ten years, while others said that there was little change in central Yukon, but more change in Northern Yukon or Northern BC.

Their expectation for the future is similar in that little change in frequency is expected over five years, while some say that landslides will be more frequent over the next 25 years for sure. To quote one scientist, there is too much weather variability over a five year period to predict this. Climate change effects are more readily identified over a longer period.

The recent findings show low activity over the past two years. Given the wet summer experienced in 2008, the resulting landslide activity appears to be minimal as opposed to accelerated, not likely causing significant harm to wildlife, plant life or fish stocks.

It is not obvious that a measurable risk exists to warrant further study of the impact of landslides due to climate change on the health of the Selkirk people. **Both the Elders and the scientists agree that landslides have caused minimal damage to the Selkirk people over time.** Further to this point, there is nothing SFN members can do to change the likelihood of a landslide occurrence.

Objective # 3 of this research project was to find out how many landslides exist in the SFN TT, where they are, and when they occurred to correlate the science with the stories from the people.

Community Coping Strategy



*Above: NTC Elder Dan Van Bibber (Mayo) and Elder Clyde Blackjack (Carmacks) at the 2006 May Gathering.
Below Right: Roger Alfred explains Dooli to Lizzie Hall (Translator) also at the 2006 May gathering.*

The research performed in this study does not clearly identify coping strategies to deal with future landslide activity. Landslides tend to be unpredictable regarding place or timing. Triggers such as forest fires, long hot spells, or other exceptional weather events cannot be forecasted and are uncontrollable when they do occur.

Finally, research objective # 4 was to identify a possible approach to coping with these changes within the SFN Traditional Territories.

Both the scientists and the Elders are in agreement that landslides will happen and there's nothing people can do to stop them.

Research performed by YTG in the summer of 2009 will focus on a risk assessment of landslides affecting the Alaska Highway. Although this approach is in its early stages, it does address what some people consider the greatest threat to the people in Central Yukon, which is a blocked transportation route.

Dr. Antoni Lewkowicz from the University of Ottawa is developing a computer model to measure the susceptibility of the Yukon landscape to landslide activity. The output of this research is to map the land attributes on a 30 sq metre (100 sq ft) grid that will show the places most likely to produce landslides. Hopefully, this prediction model will assist the experts in forecasting the place and timing of future landslide events.

Perhaps the best possible approach in coping with these environmental changes is to begin development of a community adaptation plan.



