From:	Hig
To:	Sam Owen
Subject:	Eklutna geohazards need more study
Date:	Sunday, February 4, 2024 1:49:44 PM

Hello,

I'd like to comment on proposed measures to improve salmon habitat and alter hydropower generation at Eklutna Lake. This comment does not support or oppose any specific proposal, but instead raises a concern that may be critical to consider, regardless of the option under consideration.

I am a geologist who studies natural disasters, especially landslides and tsunamis. About a year ago a colleague pointed out evidence that there are large sections of the mountains above Eklutna Lake that have slowly deformed in the past. This past deformation raises concerns about the possibility that one of these slopes could suddenly collapse in the future, generating a tsunami in the lake.

This concern has led a number of geologists including myself to make some initial steps to study the potential hazard. We have been working in coordination with Carrie Brophil and Marc Lamoreaux at Eklutna Village Tribe. This work is unfunded and we have only the most preliminary results to report.

I put details below, but in short my recommendation is that any proposed development be informed by study of the potential for large (> 1 million cubic meter) deep-seated landslides from the mountains around Eklutna Lake, with the potential to create tsunamis in the lake.

First - what we do know:

The evidence of past slope deformation is extremely strong - it is almost certain that this has happened in the past. The evidence we are focusing on is for "deep-seated" landslides, which are much thicker than common landslides involving just soil. They can extend hundreds of feet into the bedrock.

We also know that similar slopes in the area have failed suddenly ("catastrophically") in the past few thousand years. In particular, there is clear evidence of a landslide that crossed upper Eklutna River and formed a dam, which eventually eroded through. There's also evidence of a large landslide that swept across upper Eagle River Valley. However, we also know that there probably have been no large landslides from the mountains into Eklutna Lake since glaciers retreated, based on surveys studying smaller landslides that happened on deltas in Eklutna Lake.

In preliminary surveys of one of the unstable slopes above Eklutna Lake, we found evidence that it has moved recently, though that evidence was quite localized - not on the scale of the full instability, which appears to be approximately 100 million cubic meters.

We have reason to believe that these mountains have permafrost in them. There are areas where "rock glaciers" occur, such as upper Thunderbird. Rock glaciers are commonly associated with permafrost. This is potentially significant because there are areas in Alaska, Iceland, and Greenland where permafrost is getting weaker as it warms up, and this is leading

to more and larger landslides.

It is also common that when we study recent catastrophic landslides, there are signs of slow creeping deformation that happened before the catastrophic landslide. This creeping deformation is what we see at Eklutna. However, it's important to remember that there are many cases where slow deformation never leads to catastrophic failures.

Finally, where we see landslides of similar size on similar slopes fall into water, they produce very destructive tsunamis that can reach hundreds of feet up shorelines. Events like this have happened in Alaska at least 5 times in the past century. Such a tsunami in Eklutna Lake could destroy existing infrastructure or future development. If a tsunami like this resulted in failure of the dam allowing more water to escape from the lake, this could increase downstream impacts.

Second, what we don't know:

Unfortunately, sites like this, where deep-seated landslides are occurring in permafrost, are very poorly understood. There is currently no generally recognized technique for estimating the probability of failure - a crucial variable with any rational assessment of cost and benefit of development at Eklutna.

We also know little about the current status of the slope. In summer of 2023 we installed a number of temperature loggers that may help us estimate the extent of permafrost. This might be the basis for future work to estimate how this permafrost is changing and what might happen in the future.

However we have no instrumentation on site to detect deformation, if it is happening. By using instruments like GPS and tilt meters to measure deformation it might be possible to see signs of acceleration that can precede catastrophic failure.

Also, while we can say in general that a catastrophic failure could create a dangerous tsunami, no modeling has yet been completed to see how extensive the impacts of such an event might be.

In short, there is a lot that could be done to better understand the slope, but this work has barely begun.

Finally - recommendations:

I believe that in cases like this where there is strong evidence of a possible hazard, it is important to accurately characterize that hazard before making costly investment in new infrastructure.

It is also important to look at the potential for added risk when the lake-level is elevated for hydropower energy storage. If this elevated risk is substantial, this might favor development that minimized elevating the lake level.

Thank you for your attention, and please feel free to reach out to me if there is more detail I can provide, or if you wish to coordinate on research.

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Hig (Bretwood Higman, PhD)
hig314@gmail.com
907 290 6992
Ground Truth Alaska (www.groundtruthalaska.org)