22 April 2018

Denali Commission Award #01486-01
Environmentally Threatened Community Initiative, Phase 2.
Task Order #2, Statewide Threat Assessment Program Project

Quarterly Progress Report; January 2018 – March 2018

Summary

This project is a collaborative effort between the University of Alaska Fairbanks (UAF), the US Army Cold Regions Research and Engineering Laboratory (CRREL), and the US Army Corps of Engineers - Alaska District (USACE). USACE is responsible for identifying the risk from flooding and erosion. However, new work carried out by USACE will focus primarily upon flooding, because erosion was considered extensively in the 2009 Baseline Erosion Assessment. UAF, with assistance from CRREL, is responsible for evaluating the risk from thawing permafrost, as well as integrating the individual risks from coastal/riverine erosion, flooding, and permafrost degradation into a normalized, overall hazard index for each rural Alaska community with a year-round population greater than 20 (approximately 230 locations).

Progress This Quarter, January 2018 – March 2018

Project Meetings

UAF, CRREL, and the Corps of Engineers worked closely together during the reporting period to integrate the threat analyses for erosion, flooding, and permafrost. To this end, team members met on 2/6, 2/22, 2/28, 3/8, and 3/16, as well as follow up meetings in April.

Task-Based Progress

Task 1: Determine Permafrost Characteristics for Each Community. *Responsible Persons: Yuri Shur, Kevin Bjella, and Misha Kanevskiy.*

Scope: Make a determination on the existence of permafrost for each community. Based on an initial review of existing data by UAF, there appear to be approximately 100 communities in areas which do not contain permafrost or the permafrost is thaw stable with little or no potential for thaw consolidation. However, it is anticipated that 130 - 150 communities will need detailed evaluation, and that approximately 65 locations will have high permafrost hazard. Existing geotechnical data will be used to estimate the ice content and potential thaw consolidation resulting from thawing permafrost.

Progress: This task is complete.

Task 2: Inventory and Estimate the Potential for Damage Due to Thawing Permafrost. *Responsible Person: Il Sang Ahn*

An inventory of existing public infrastructure will be developed for each permafrost community using existing databases and other available information. Based on that inventory, damage to critical facilities will be estimated based on the risk of thaw consolidation. Damage estimates will be qualitative based on the amount of movement required to cause cosmetic damage, functional damage and structural damage. These estimates will be based on experience rather than structural analysis.

Progress: The team plans to employ the concept of fragility curves to estimate the damage to infrastructure to thawing permafrost. This is a modeled result rather than an observed result, since we have found it difficult to obtain inventories of public structures along with their design parameters necessary to predict their response to thawing permafrost.

Task 3: Inventory Existing Damage Due to Thawing Permafrost. *Responsible Persons: Bill Schnabel, Billy Connor, Kelsey Dean*

Communities expected to experience damage due to thawing permafrost will be contacted to confirm the inventory developed in Task 2, and to determine if existing infrastructure is showing damage due to thawing permafrost. Other relevant/responsible organizations such as ANTHC, ADEC, ADOT&PF, and regional health corporations will also be contacted. Phone and/or other off-site interview techniques will be used to determine whether the damage is cosmetic, functional or structural.

Progress: The team continued to disseminate and collect results from the survey over the period of review.

Task 4: Develop Scoring Criteria for Permafrost Vulnerability. *Responsible Persons: Billy Connor, Bill Schnabel, and Kevin Bjella*

Using the data assembled in Tasks 1 – 3 a scoring criteria similar to Hong, et. al. will be developed and applied to each community in order to rank them with respect to damage due to thawing permafrost. The scoring will account for the presence of permafrost, the potential for thaw consolidation, existing damage and anticipated future damage.

Progress: Scoring criteria were developed for permafrost vulnerability and implemented in our first draft of the rankings. However, another set of criteria were developed in order to be consistent with criteria used by Corps of Engineers to evaluate erosion and flood threats. The team has utilized both criteria to evaluate permafrost threats to communities, and has sought input from Denali Commission regarding which criteria to employ. The permafrost-only criteria is more appropriate for evaluating permafrost per the scope of this study. However, the Corps

criteria were developed as part of the Baseline Erosion Estimate, and approved by numerous management agencies.

Task 5: Combine Scoring From Erosion, Flooding and Permafrost Damage. *Responsible Persons: Billy Connor and Bill Schnabel*

Review erosion and flood data provided by USACE, draft scoring criteria developed by USACE for these two threats, and collaborate with USACE and the Denali Commission to develop a normalized, aggregate risk index for all three threats when considered together. Consider using a weighted matrix approach to create the final score. For example, existing or near term damage may have a higher weight than damage anticipated well into the future. Frequent flooding events may have a higher weight than events that may be expected to occur once every one hundred years.

Assist the Denali Commission in presenting the draft threat assessment methodology at public meetings at 2 – 3 locations outside of Anchorage, and with other interested government stakeholders such as Alaska DCCED, DNR, DOT&PF, DEC, and USDA, USDOC, FAA, BIA before finalizing the methodology.

Progress: A first draft of the scores for the individual threats has been developed. The team is currently discussing with Denali Commission and team members different options for reporting the scores together. One promising option is to report three separate numbers representing the three threats, all in a single icon. Representing the results this way acknowledges that the nature of the threats are different. For example, permafrost threats are likely slower-acting that flood threats, but they are also more predictable.

Task 6: Develop a GIS That Presents Data and Scoring. *Responsible Person: Andrew Balser*

Scope: Collaborate with USACE and the Commission on how best to store and present the flood, erosion and permafrost data assembled during the project, and the resultant vulnerability indices. At a minimum develop a query-able web-distributed data format (example Google Earth .kml file) that will present summary threat information for each community. Provide full GIS data (format suitable for download) to include the following information in a common format for Denali Commission.

- *Summary permafrost data (example: kml file(s) of village locations w tabular data)*
- *Detailed permafrost data (GeoDatabase, shape files, etc.) with provisions for flood*, and erosion* data*
- *Supporting geospatial imagery (public re-distribution of high-resolution, commercial satellite imagery is restricted under U.S. Federal Law, and by the auspices of the NextView contract between the U.S. Government and commercial imagery providers. Re-distribution determinations are made by U.S. National Geospatial Intelligence Agency (NGA)).*
- *Vulnerability index for each specific threat**

• *Aggregate vulnerability index**

* *flood and erosion data and corresponding threat indices for each community are to be developed by the U.S. Army Corps of Engineers Alaska District in Anchorage as a separate section of the project as complete, georeferenced vector and/or raster GIS datasets with metadata and description of data development.)*

Progress: The team is still discussing the best way to present the data. The data avails itself to a fully-functional GIS-based database. Such a database would be useful for managers, planners, and engineers performing future work in the communities. However, such a database is not necessary merely to present the results of this work. Static maps with accompanying data tables may be the most appropriate presentation approach, as information in that form is readily printed and transmitted.

Task 7: Reporting *Responsible Persons: Billy Connor, Bill Schnabel, and Kevin Bjella*

Scope: Separate final reports will be prepared summarizing the work related to permafrost and the overall aggregate risk methodology. The permafrost report will describe the data, data sources, and interpretation of the data. It will also describe the scoring criteria for the permafrost index and results by community. The second report will summarize the methodology developed that combines all three threats. The report will also include a description of the GIS, layer structure, the data table associated with the GIS, and a summary of the knowledge/data gaps that should be addressed in future updates.

Progress: No progress this quarter.

Task 8: Presentation *Responsible Persons: Billy Conner and Bill Schnabel*

Scope: A presentation of the final work products will be given at a mutually acceptable time and location to the Denali Commission.

Progress: No progress this quarter.

Future Work

In the upcoming quarter, the team will work closely with Denali Commission to finalize the project. Most of the evaluation work has been completed at this point, and the remaining work revolves around interpreting, discussing, and presenting the results.

Please contact me with any questions or concerns,

William Schnabel, PhD, PE

Director, UAF Institute of Northern Engineering