Integrated watershed hazard assessment for wildfire, floods, and debris flows in the Navajo Nation

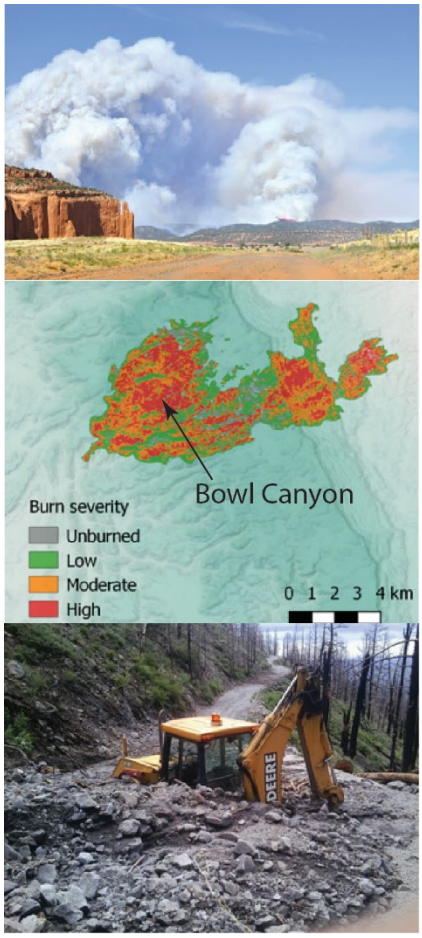
Project synopsis: We will be conducting an integrative hazard assessment for one or more key watersheds of the Navajo Nation by evaluating and mapping the likelihood and potential impacts of fire, flood, and debris flow events. Results from this project will aid managers of natural and cultural resources as well as current and future infrastructure projects in the Navajo Nation. Our aim is to help managers to prioritize areas for forest restoration and other improvements toward enhanced tribal resilience.

We are distributing this flier to inform Navajo Nation communities, divisions, and departments about our project. We sincerely invite participation to ensure that all voices are heard and the study will meet the needs of the Navajo Nation.

The project will begin January, 2020 and run for one year, unless additional funds become available.

The project is currently funded by the BIA Tribal Resilience Program. Contact information for project leaders are provided below.

Project description: This project is designed in response to ongoing drought in the Navajo Nation that has heightened the risk of destructive wildfires, such as the large (15,000 acre) fire in the Bowl Canyon watershed of Asaayi Lake in the Chuska Mountains. The 2014 Asaayi Lake Fire killed trees in large patches across the watershed and led to substantial erosion and sedimentation into the lake. It cost upwards of $8 million, according to a *Navajo Times* report, which also quoted then Navajo President Ben Shelly stating "the Nation cannot afford another fire."



The 2014 Asaayi Lake Fire and its burn severity map. At bottom, a small debris flow following the 2010 Schulz Fire near Flagstaff.

Conditions in Navajo Nation forests, however, are primed for more large and destructive fires. Forest densities and fuel loads are high in many areas, having accumulated for over a century without the cleaning effect of frequent, surface fire. Coupled with current drought conditions, these fuel-laden forests are at extreme risk to tree-killing crown fires. As was the case with the Asaayi Lake Fire, extreme fire events can have detrimental long-term impacts to the forest ecosystem. Clean water, stable soils, and traditional forest uses are among the ecosystem services that are affected. Intense summer monsoon precipitation following extreme burning can trigger massive floods and debris flows that threaten lives, property, water quality, and infrastructure, resulting in irreversible losses in some cases and costly repairs in most cases.

Mitigating the risk of fire in Navajo Forests is possible once areas of particular vulnerability are identified. Applying forest restoration treatments in those areas can reduce the likelihood of

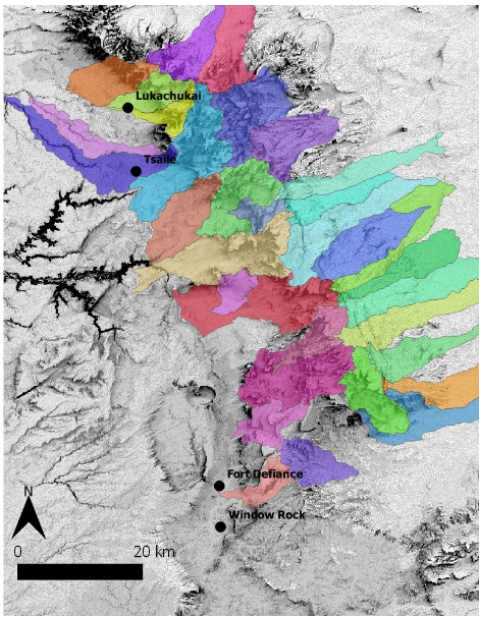
high-severity fire and the associated damage from post-fire erosion. There must be action now to reduce the risk of another large and devastating fire.

Our project will quantify the **relative risks of individual watersheds to high-severity fire behavior, calculate the likelihood that burned slopes will generate floods and/or debris flows, and identify flood and debris-flow hazard zones.** Results from this study will aid in rapid determination of priority areas for forest restoration and management actions to reduce the risks of extreme fires, and to direct infrastructure improvements toward greater resilience.

Similar risk assessments have been conducted for Coconino County, Arizona and the Jemez Mountains, New Mexico. Findings from those studies have resulted in forest restoration treatments, community planning, and watershed improvement projects. To our knowledge, no data on fire-flood-debris-flow risks exists for the Navajo Nation.

Project plan:

Phase I: *Watershed prioritization.* We ask Navajo communities, departments, and agencies to help us decide which watershed(s) will be given priority for study in this project. Our plan is to complete a risk assessment for 1-2 watersheds (due to funding limitations). Prioritization will be done in two steps: rank order voting and consultation. We will begin by sharing watershed maps and requesting all interested parties to rank-order the watersheds they perceive as most vulnerable to extreme events and associated societal impacts. We will narrow down the tally until there is a clear majority winner or 2-4 watersheds appear equally valued. In early spring of 2020, we will convene a meeting with all interested parties and agency stakeholders to share our findings, visit some areas, and discuss options. This will provide an opportunity to solicit feedback and advice, and to gather all relevant and useful information and data on those watersheds which receive highest priority. This initial meeting is an opportunity to spur collaboration and synergy among the research team and tribal management offices.



Watersheds of the Chuska Mountains, Navajo Nation

Please inform the project team if you would like to participate in this vital prioritization effort.

Phase II: *Burn scenario modeling.* We will run a suite of computer simulations that integrate local topography, forest structure and fuels, climate, and wind. We will leverage forest inventory and fuels data from the Navajo Forestry Department and/or supplement with new forest plots. Fire behavior metrics and fuel layers will be calibrated against local data currently being generated by collaborative partners and us. One model will include a worst-case scenario wildfire using conditions associated with the 2014 Asaayi Lake Fire. All scenarios will modified by simulating forest treatments in the watershed(s) and assessing outcomes. Results from this phase will be maps of potential burn severity under current and treated forest conditions for use in flood and debris-flow modeling.

Phase III: *Flood and debris-flow risk modeling for simulated fires under current and treated forest conditions.*

1. *Flood risk:* Hydrologic models will utilize the simulated burn severity maps to develop estimated flood levels for different design storms (e.g. simulated 2–, 10-, and 100-year storm events) under (i) current conditions with no fire, (ii) current conditions with fire, and (iii) treated conditions with fire.
2. *Debris flow risk* – High-severity fire changes soil properties such that rainfall cannot infiltrate, and the soil is more easily eroded and transported, so even small volumes of intense rainfall can result in a devastating cascade of debris, dirt, rocks, and boulders. In a multi-step approach, the study watershed(s) will be assessed for (i) evidence of past debris flows because past occurrence indicates future possibilities, (ii) the likelihood of debris flows given the simulated burn severity maps and design storm parameters, and (iii) estimated extent of potential debris flows.

Phase IV: *Integrative watershed risk assessment.* We will model and corroborate potential fire-flood-debris flow events with three design storms (2-, 10- and 100-year events) on three forest scenarios: (1) Current forest conditions pre-fire; (2) Current forest conditions post-fire; and (3) Treated forest conditions post-fire. Results from the modeling will be used to create hazard zone maps for (i) high-severity crown fire activity, (ii) flood pathways and inundation zones, and (ii) debris-flow hazard zones. These data will be combined with resource management data concerning homesites, water sources, roads, and other values-at-risk such as culturally-important locations. The risk assessment will aid in identifying efficient and effective mitigation projects, pre-wildfire planning for forest health treatments, infrastructure improvements, fire-safe communities, and emergency response strategies.

Regional watershed hazard assessments

Coconino County
Risk zone maps:
https://goo.gl/6F4Wva
Main page:
https://goo.gl/f5oEDz

Jemez Mountains
Interactive map:
https://goo.gl/7kXX5D
Report:
https://goo.gl/zxUUi6

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