

FIRE AND FLOOD

Evacuation Route Assessment for Lahar Hazard in Orting, Washington

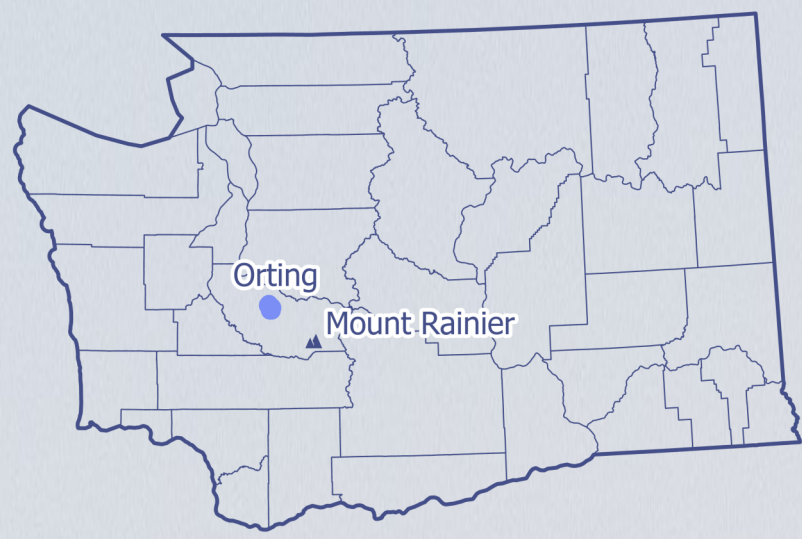
Risks of Mount Rainier

The city of Orting, Washington sits about 50 kilometers¹ from Mount Rainier, an active stratovolcano. Eruptions in this area are known to generate slurry-like debris flows, called lahars.

Lahars occur when hot volcanic rocks and ash mix with ice, snow or water. Lahars travel down river valleys, accumulating material as they flow.² If Mount Rainier were to erupt, residents of Orting would have around 45 minutes to evacuate to higher ground.¹

Since Orting is a small semi-rural city, most residents will rely on either private vehicles or walking to escape the lahar.³ Most residents will have to cross a bridge over the surrounding rivers in order to reach higher-elevation. This has the potential to cause congestion along road routes, and may cause evacuees to choose to walk.

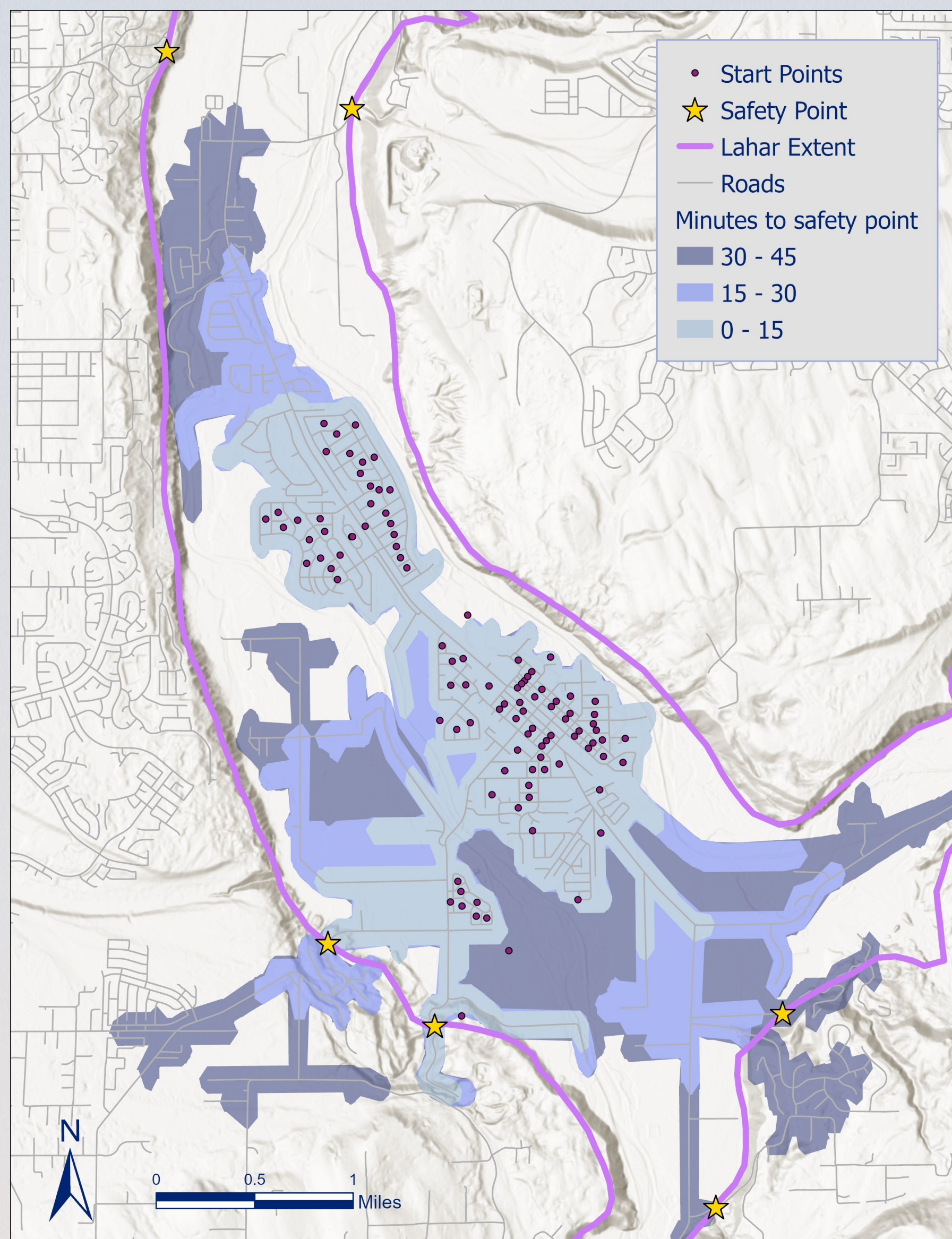
Lahars are considered to be the greatest volcanic hazard close to Mount Rainier.⁴ Knowing which evacuation routes are feasible will be of great importance if a lahar were to occur.



Lahar at Mount St. Helens, WA



Service Area Analysis

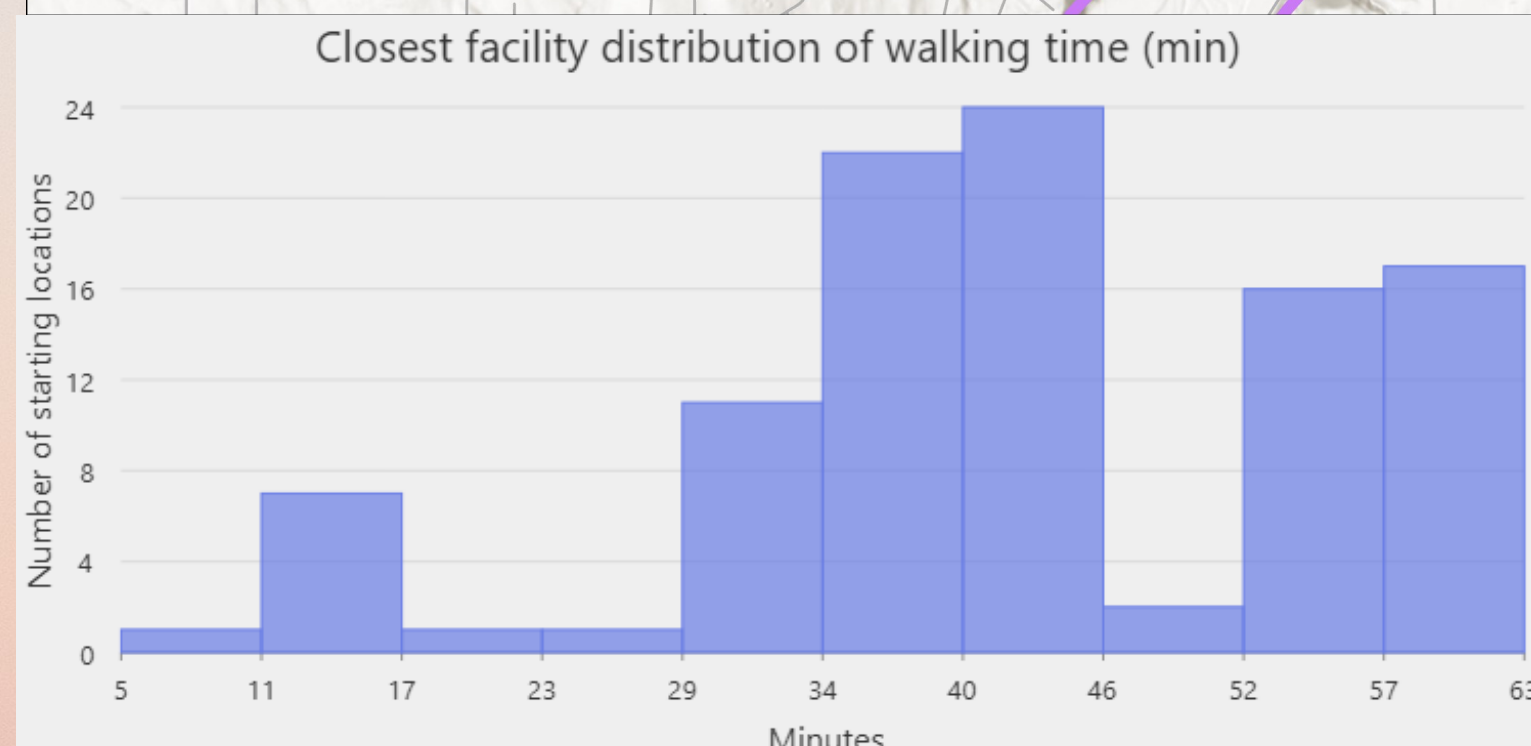
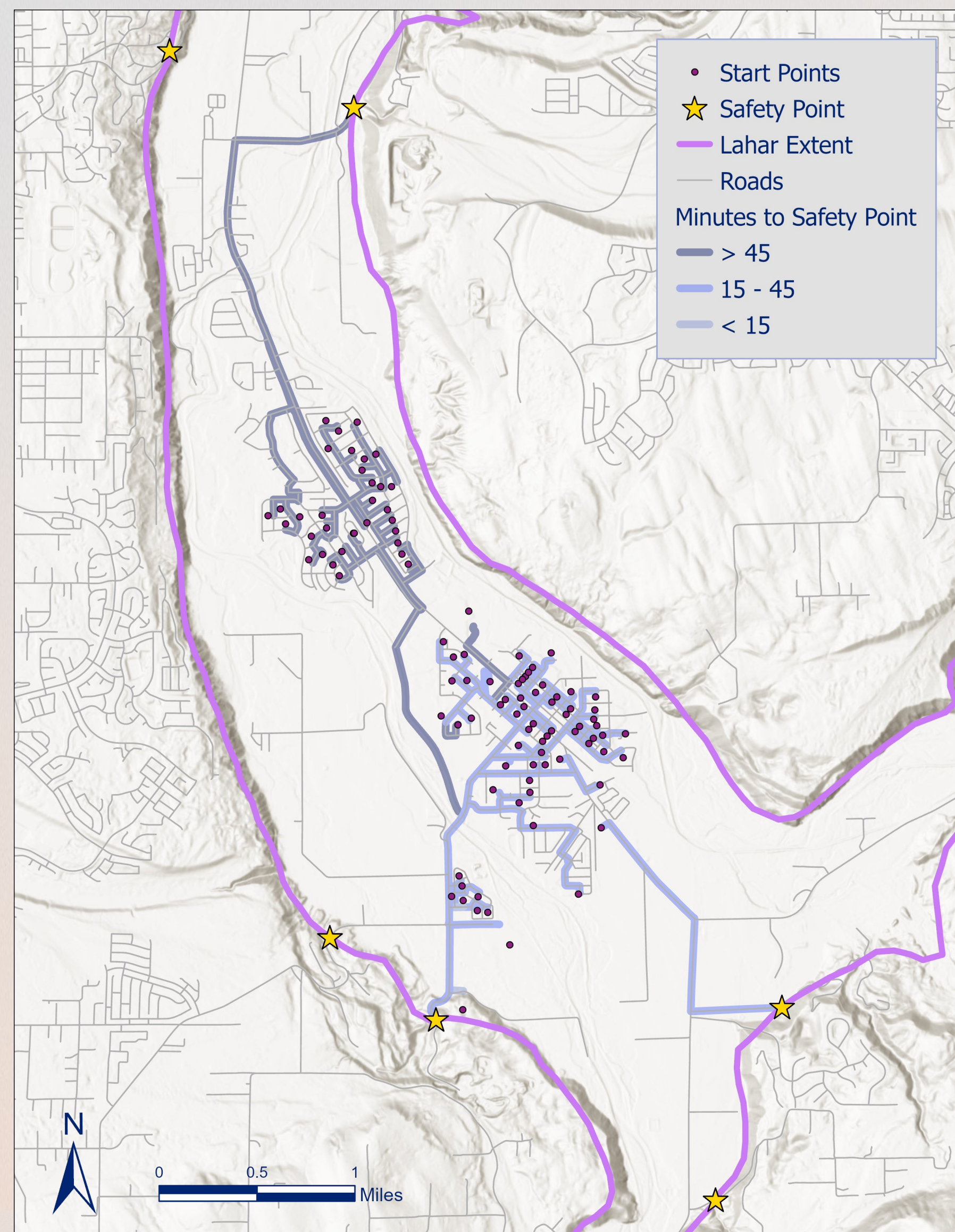


Moving Forward

For most people, walking is not an efficient means of evacuating Orting in the case of a lahar hazard. In the **closest facility** network analysis, the average time to a safety point was ~43 minutes. People in the southern section generally had evacuation times under 45 minutes, whereas the northern section had exclusively longer than 45 minutes. The **optimal path** analysis had an average evacuation time of ~45 minutes. These evacuation times were less clustered, and more people in the southern section had evacuation times over 45 minutes. The optimal path likely had longer evacuation times as the routes started directly from the starting location, whereas the network analysis started at the nearest road.

As seen in the **service area** map, the northernmost cluster of households in Orting would not be able to reach the northern safety points in time. This result was generated using a ~5 km/hr walking speed, so some residents of the southern section of Orting may be able to use running as an exit strategy. However, when making disaster plans and routes, walking should generally not be advised. Policy makers in Pierce County, WA should publicize this advice when providing residents with evacuation plans. Lahars travel fast, but proper planning and communication can help to make them less of a disaster.

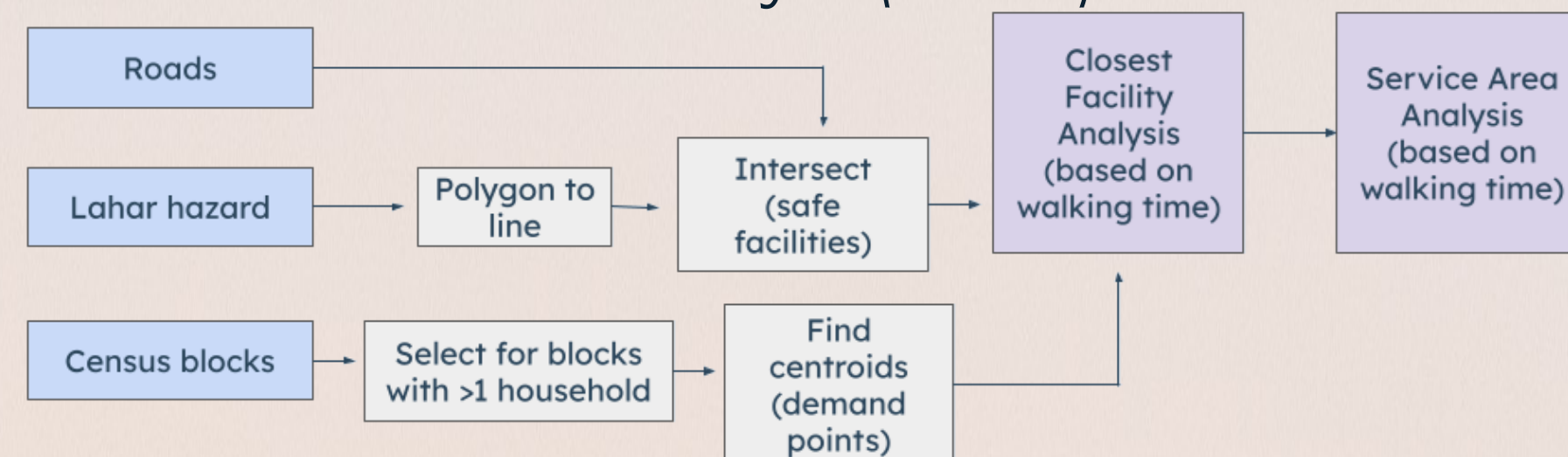
Closest Facility Analysis



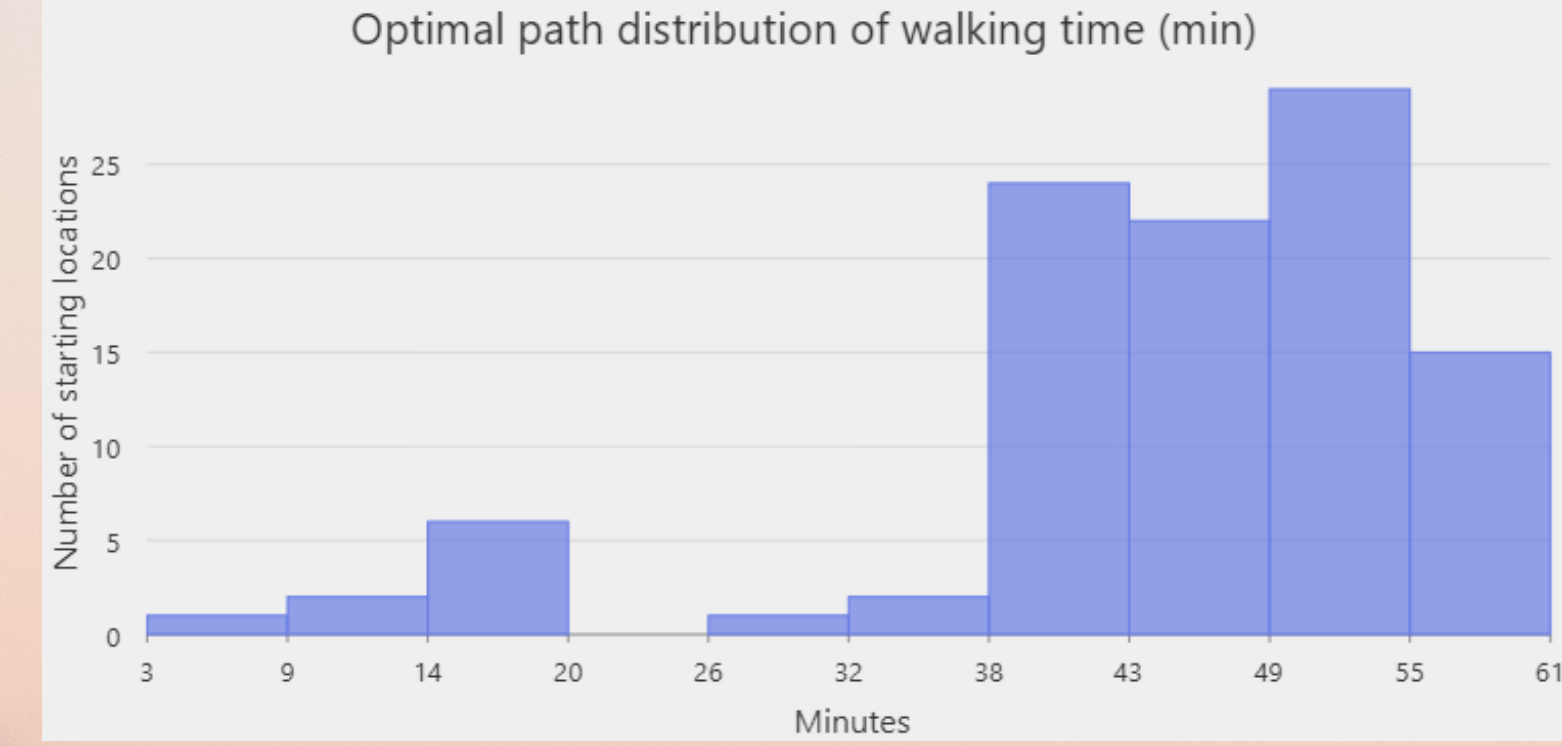
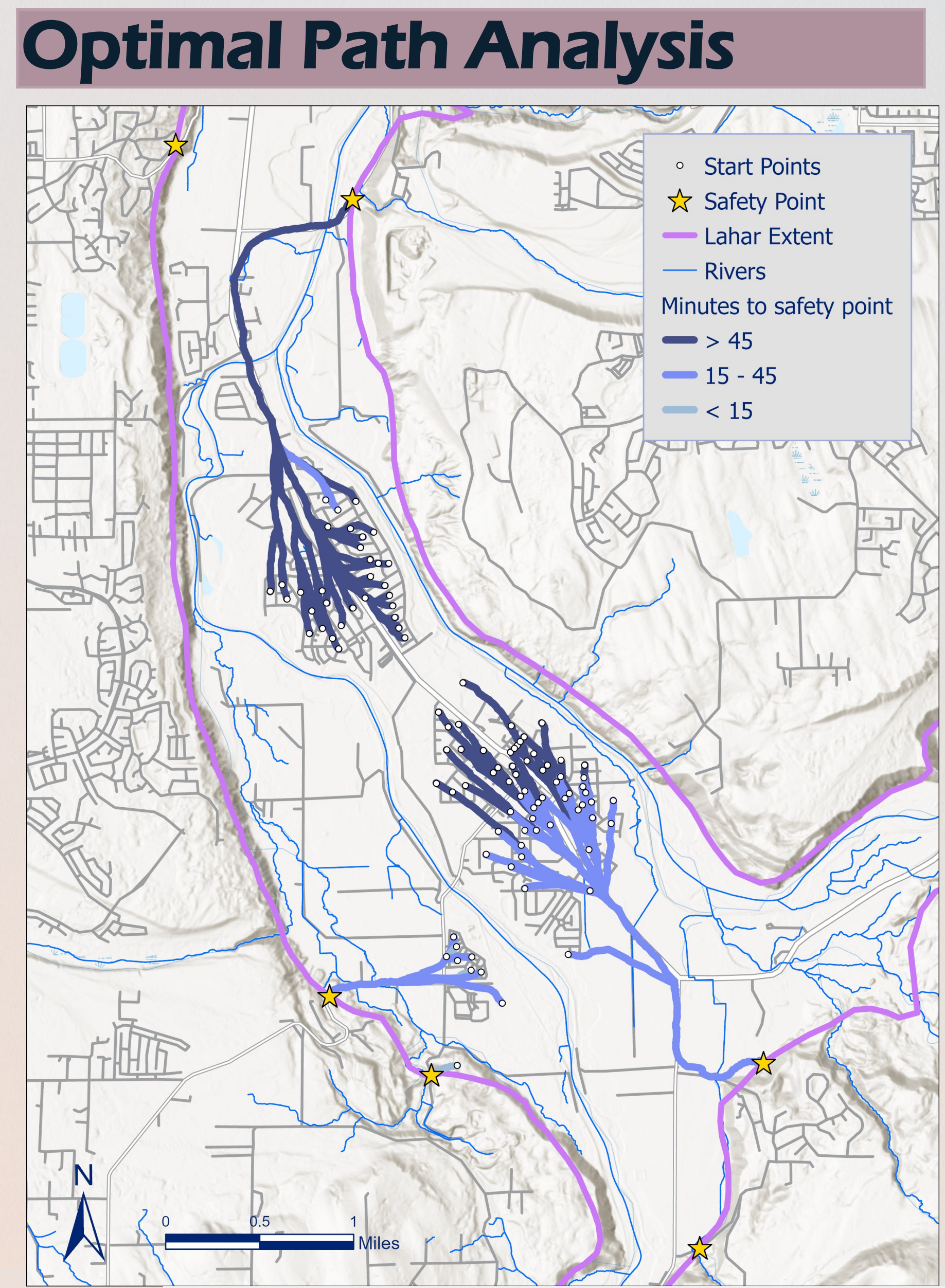
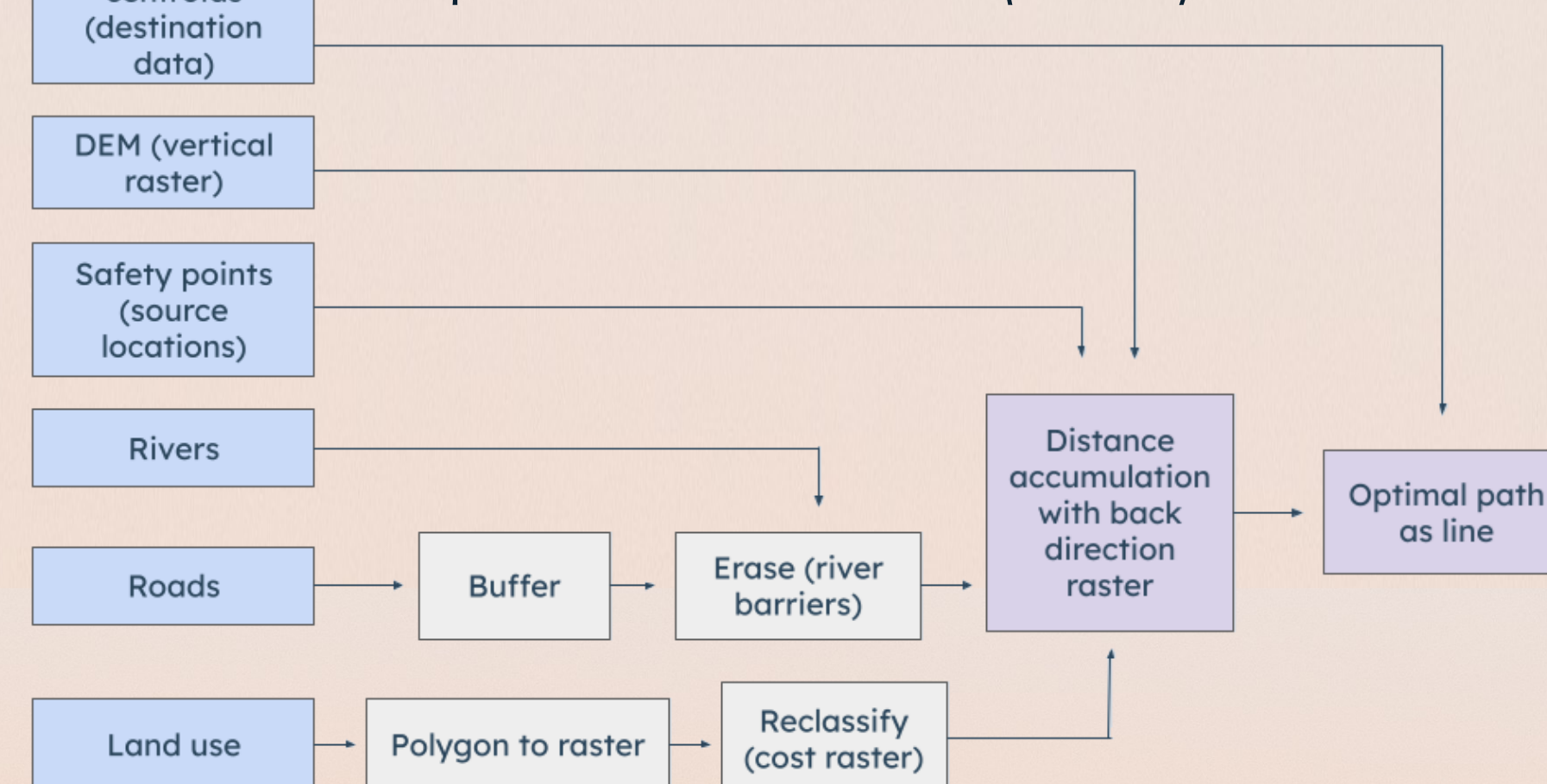
Evacuation Models

Two methodologies were used to measure effectiveness of walking along roads (network analysis) compared to walking across various land surfaces (optimal path as line). Both types of analysis start from the centroids of housing blocks and end at the safety points above the lahar hazard zone. To see which safety points were accessible by walking, time zones of 15 min, 15 - 45 min, and 45 min were established.

Network Analysis (vector)



Optimal Path as Line (raster)



Projection: NAD 1983 HARN StatePlane
Washington South FIPS 4602 (US Feet)
Photo Sources: Caleb Riston (background),
Tom Casadevall (small lahar photo)
Data Sources: USGS, Pierce County,
Washington Spatial Data

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05/05/25

1. Scott, K. M. (2001). Catastrophic debris flows transformed from landslides in volcanic terrains: mobility, hazard assessment, and mitigation strategies (No. 1630). US Department of the Interior, US Geological Survey.
2. Lahars move rapidly down valleys like rivers of concrete. USGS. (n.d.). <https://www.usgs.gov/programs/VHP/lahars-move-rapidly-down-valleys-rivers-concrete>
3. Bard, J. (2016). Finding high ground: simulating an evacuation in a lahar risk zone.
4. Volcanic hazards at Mount Rainier. USGS. (n.d.-b). <https://www.usgs.gov/volcanoes/mount-rainier/science/volcanic-hazards-mount-rainier>