

# Current State of Hypotheses : Palaeotsunami Inundation at Nu‘u, Kaupō Maui, Hawai‘i

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November 2021



## Nu'u Refuge (Hawai'i Land Trust)

Peninsula: Ka Lae Apole (~50 acres; A'a lava flow ~1,800 BP);

Wetlands: Palustrine Discharge (~6 acres);

Shoreline: ~400 meters in length

Note: Photo is looking east





~6-acre Nu'u Wetlands: Anthropogenically modified to become a fishpond, likely in the ~17th-18th century.



# Nu‘u Wetlands/Pūpuka Fishpond

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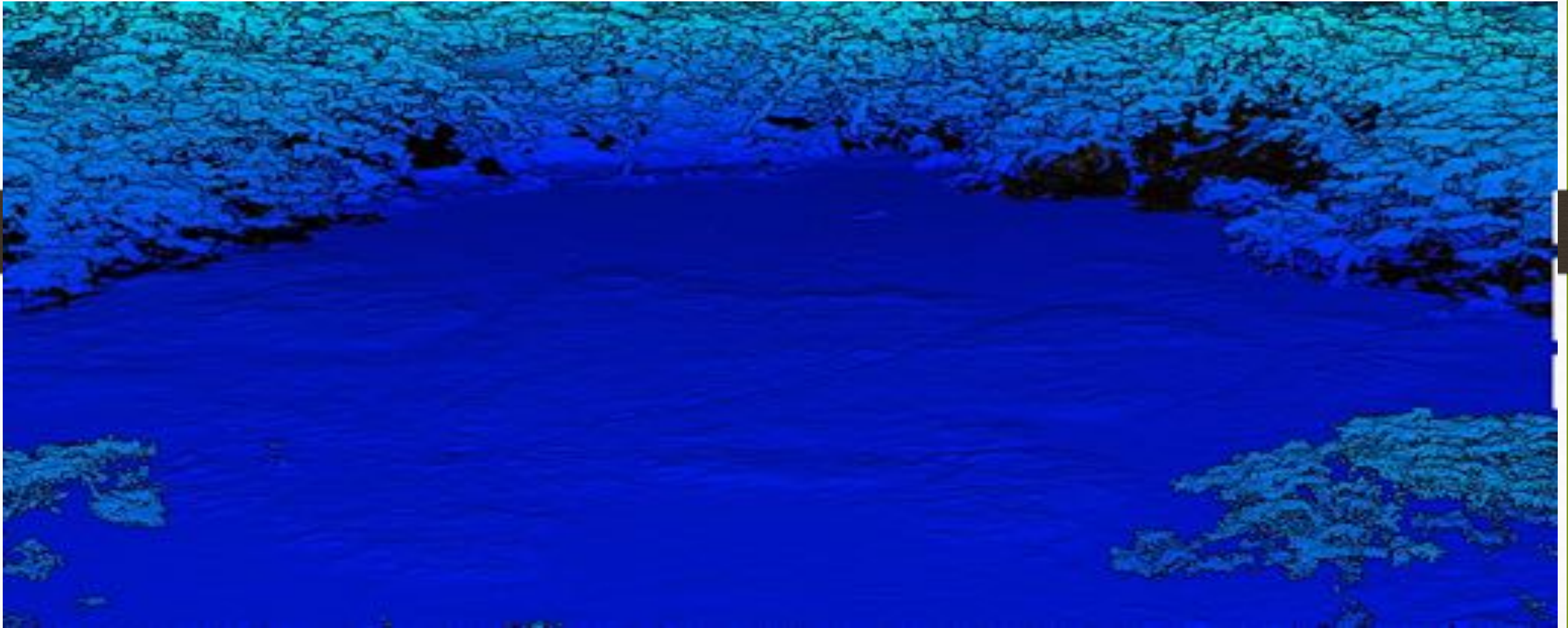
- Sediment cores taken at the Nu‘u Wetlands (a former fishpond) (photo below) (January, 2016);
  - Floral composition prior to human arrival is fairly well-understood (Myrsine, Chenopodium and Poaceae); transitions to different species is also fairly well understood.
  - Identification of Diatoms, including some Freshwater-Brackish species;
  - Identification of terrigenous material (sand layer and some coral) in the wetlands;
  - Shells and shell hash of the freshwater species *Tyronia porrecta* in a concentrated layer (55-57 cmbs).

## Sediment Coring at Nu'u Pond, January, 2016

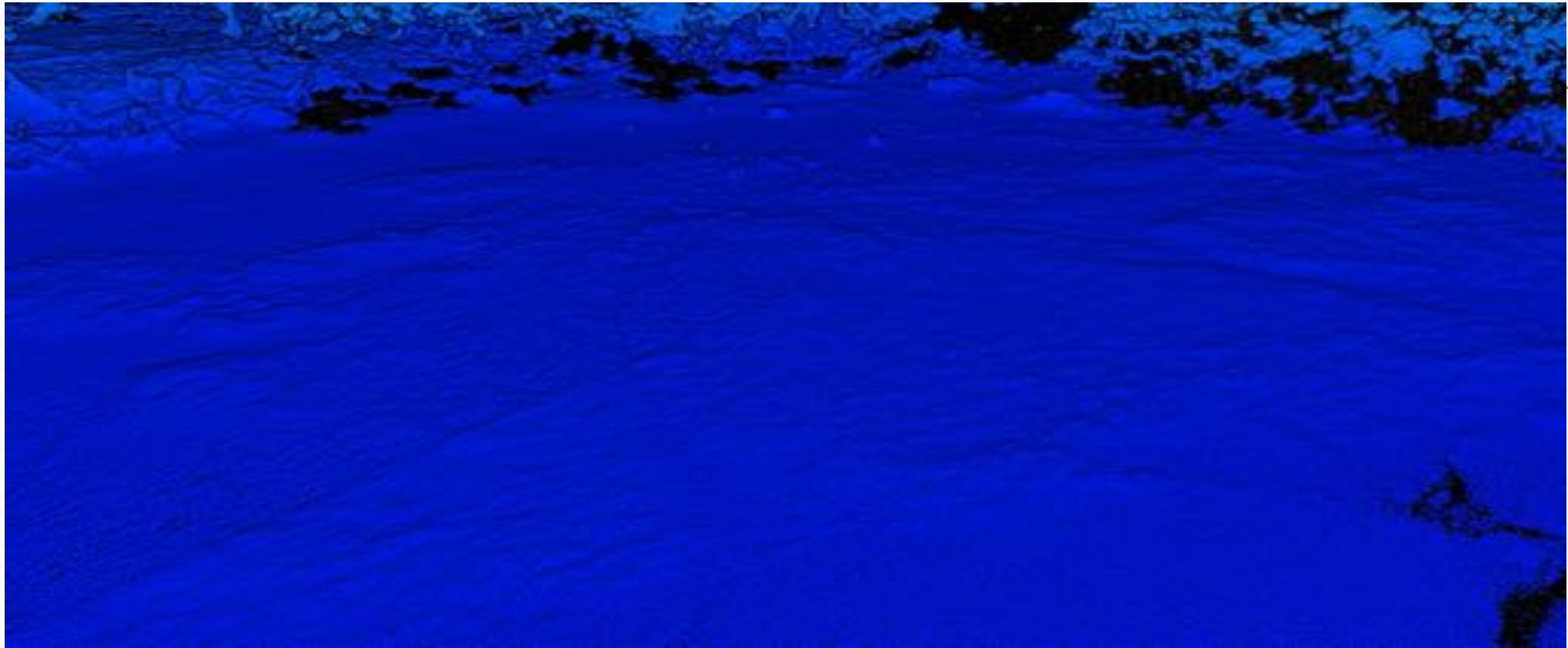




Lidar Photo of Nu‘u Wetlands: Possible Sediment Lobes of Tsunami Origin in the Wetlands (photo is looking east)



Lidar Data: Nu'u Pond Looking Northwest Showing the Former  
Fishpond wall Buried in Sediment, Possibly due to Tsunami inundation  
(wall is visible at the bottom left running to the top right).





Coral Boulders: Located ~10-12 m amsl; ~100-150 m inland; weight:  
>32 kg (largest boulder)



Inland Coral Debris Line: Numbers Indicate Locations of Coral Cobbles and boulders (Note: blank area between clusters has not been investigated)





Possible Hummocky Feature on a Geologically Young Basalt Peninsula (~1,600 BP), Ka Lae 'Apole (Note: this hypothesis requires substantial additional evaluation; photo is looking south-east)





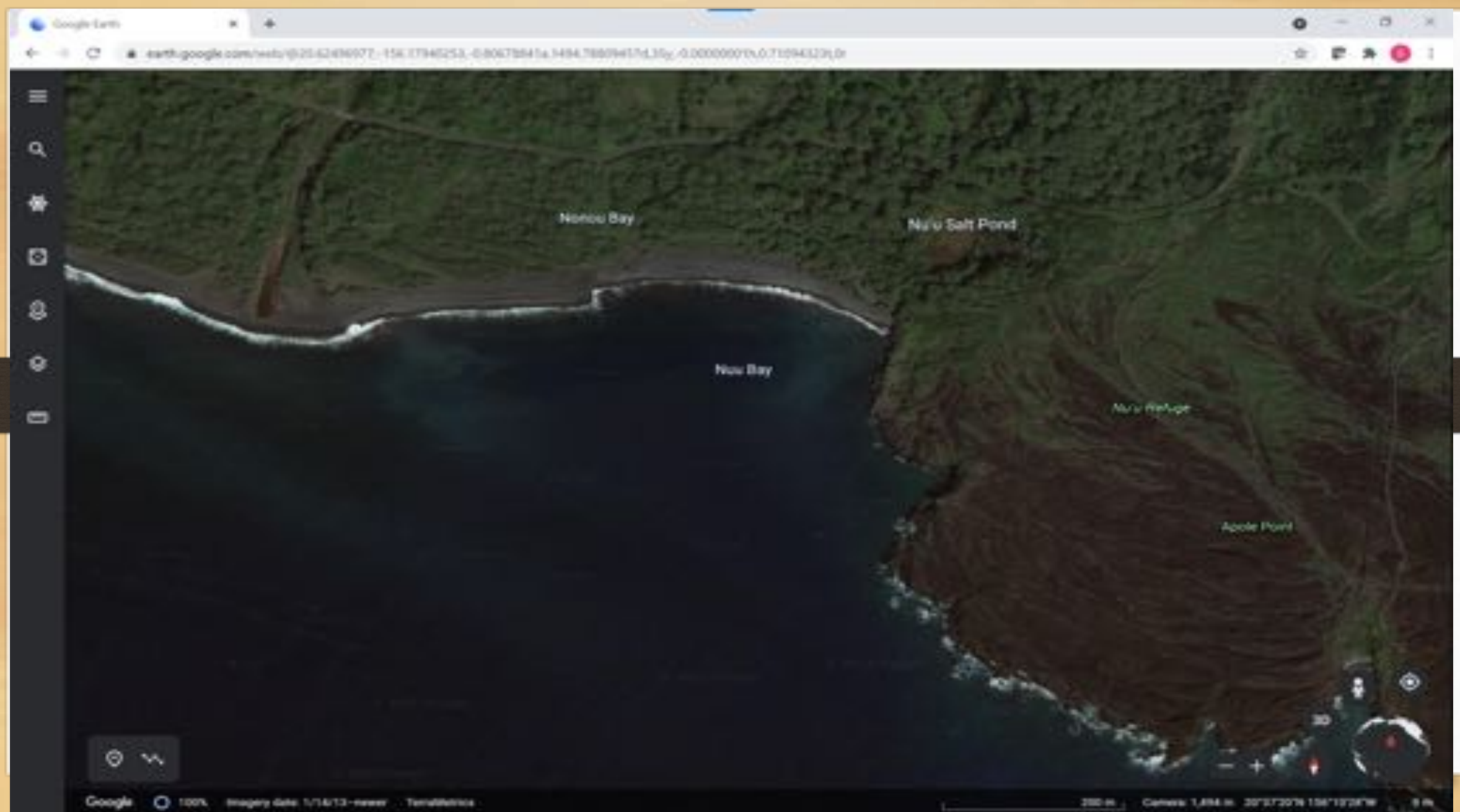




## Comparison of Current Coastal Landscape Modification After the April 1st, 1946 Aleutian Islands Tsunami

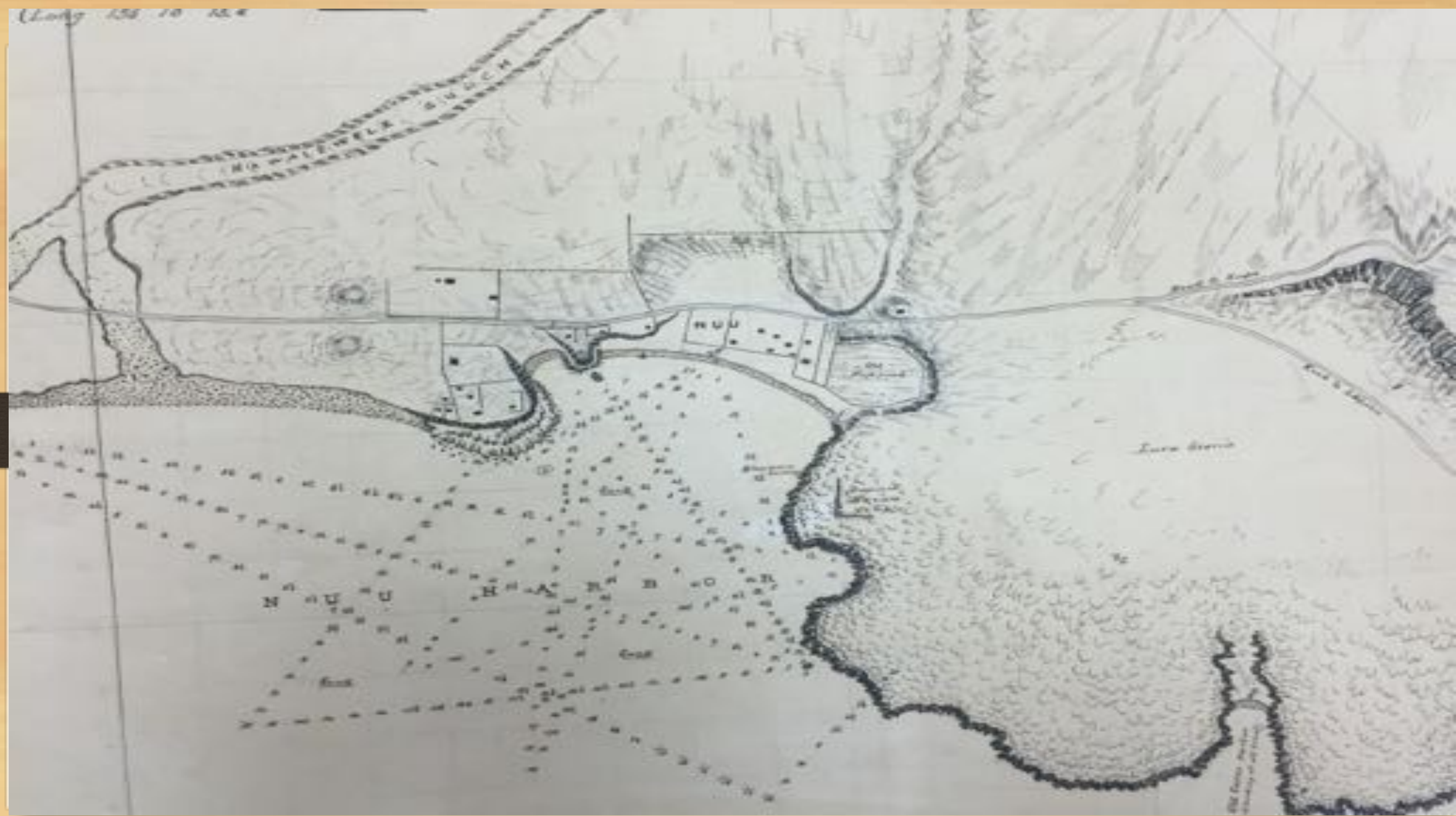
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- Photo 1: Contemporary Google Maps photo of the Coastline;
- Photo 2: 1882 Jackson Map (w/benthic survey)
- Photo 3: Overlay of Jackson Map on orthorectified Google Maps Photo
- The largest tsunami to have impacted Nu‘u between 1882 and today was the April 1<sup>st</sup> 1946 Aleutian tsunami, with wave heights in excess of 3 m;
- Local reports in 1946 described substantial accretion of the shoreline, in some areas up to 100 m





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Overlay of 1882 Jackson map of New



# Historic Photographs (~1921) Showing Geomorphological changes along the Coast, I

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- Photo 1: 1921 photo taken from Huakani Bay looking west (~2 km from Nu'u), showing cobble deposits along the shoreline;
- Photo 2: 2021 photo from approximately the same position on the coast.
- Erosion in photo is possibly the result of an edge wave from the 1946 Aleutian Islands Tsunami which redeposited water-worn basalt cobbles along the coast in a west to east direction.
- This is possibly evidence of reverse flow sedimentary (water worn cobbles) deposition (typical direction of movement along this coast is east to west)







# Historic Photographs (~1921) Showing Geomorphological changes along the Coast, II

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- 1. Nu‘u at the intersection of the shoreline and Ka Lae ‘Apole; the Nu‘u Pond is barely visible through the trees.
- 2. Photo taken at the same vantage point in 2021 (Note: vehicles are in the approximate location of the structures).











# Historic Accounts

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- 1. Pacific Advertiser account from July 24th 1869 (possibly a local source tsunami);
- 2. Ku'oko'a account from November 23rd 1867: Description of an account of a "Kai Lumaluma'i," literally a "Destructive Ocean" event hitting Nu'u. (Possibly another local event; uncertainty as to whether this is a tsunami or some other phenomenon, although, so far, Nu'u seems to have been the only location experiencing this event.

about only days. The business will make a trip to the Eastern States and return as soon as possible.

✓ From the *Kuokoa* we learn that the coasts of Kaupo, on Maui, and Puna, Hawaii, were visited on the 24th July by a heavy surf, which rolled in from the eastward. At Kaupo the sea rolled inland from six to nine hundred feet, in some places over an embankment fifteen feet high. At Kahaulea the school house and several dwelling houses were washed away and the road badly damaged. On the Puna coast damage was inflicted at several points, the principal damage, however, was at Kahaulea.

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# Summary of Current Working Hypothesis for Paleo- and Historic Tsunami Inundation at Nu‘u

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- Nu‘u has been subject to Tsunami inundation at least 3 times, possibly 4: a pre-historic event which likely deposited the coral on Ka Lae ‘Apole, and possibly inundated the fishpond; possible tsunamis in 1867 and 1869, and the most destructive modern tsunami on April 1st, 1946.
- At least two of these waves seem to have been edge waves;
- These edge waves transported water worn cobbles from west to east along the coast, redepositing them at Ka Lae ‘Apole, where, because of the Peninsula, the tsunami wave was attenuated.
- The energy of the tsunami deposited a large quantity of material along the coast, in the pond, and up Ka Lae ‘Apole.
- The less-dense coral cobbles and boulders were preferentially deposited on the heights of Ka Lae ‘Apole.
- Tsunamis pose a serious threat to the wetlands; because the tsunami damage appears to be along the coast (in the form of an edge-wave) a forested bioshield can be designed to reduce the damaging impacts of an edge-wave by using a combination of layered Pandanus (which dramatically reduce wave energy and sediment transport) and indigenous and endemic hardwoods.
- This forested bioshield could provide over 400-meters of depth, running parallel to the coast, achieving a high degree of ‘defense in depth.’
- Such a forested bioshield could provide important plant material for use by Hawaiian cultural practitioners, while ensuring the integrity of critical waterbird habitat.

# Future Research

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- Geochemistry, most likely in the Nu‘u Pond, including ITRAX
- Dating of Coral, either U-Th or  $^{14}\text{C}$ , or both;
- Additional Palynology;
- Additional Diatom;
- Possibly Foraminifera;
- Supporting historical or oral history documents: newspaper (including Hawaiian language), 1946 survivors or witnesses, photographs;