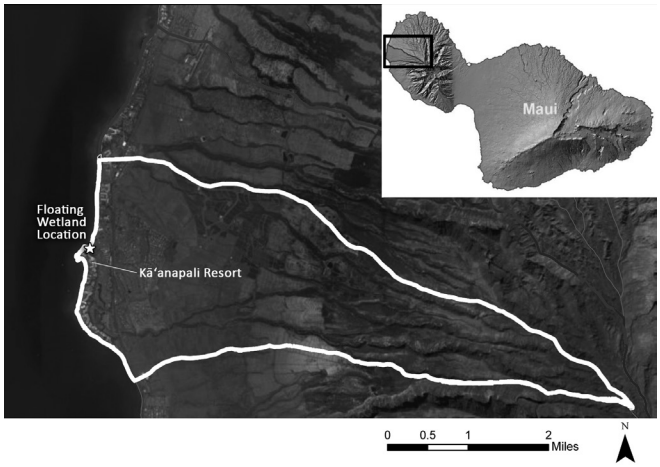
KĀ'ANAPALI RESORT LAGOON FLOATING WETLANDS: CASE STUDY

Prepared by Roth Ecological Design International, LLC

PROJECT BACKGROUND

The Wahikuli Watershed Management plan has identified sources of land-based pollutants, which are the result of the watershed's land uses, its physical condition, and human activities. The West Maui Ridge to Reef Initiative has helped to develop actions to remediate these and reduce stress on coral reefs. Land-based pollutants include sediment, nutrients, and other pollutants that are transported in surface and ground water and deposited in the ocean. In 2018-2019 Roth Ecological Design Int. (REDI) received funding from National Fish and Wildlife Foundation to design and install floating wetlands to remediate the waters from a drainage canal located at the Kā'anapali Resort and monitor pollution removal.



TECHNOLOGY USED

Floating engineered wetlands are designed to remove nutrients from the water column though natural biological processes. This location was selected since this water body receives stormwater runoff containing pollutants from the surrounding area and is connected to the ocean. Past water quality monitoring of the lagoon and from the culvert inlet into the canal, have shown elevated nitrogen concentrations, which can cause algal blooms and affect the health of sensitive coral reef ecosystems.

The floating wetland media allows for >300 square feet of surface area per cubic foot, which combined with the native Hawaiian wetland plants, provides habitat for the wetland ecology to remove nutrients and clean the water before it enters the ocean. This help protect the reefs and maintain good water quality for everyone to enjoy. In addition to the wetlands, baffles were installed to promote mixing and associated oxygenation of the water column. The baffles were also designed to help "retain" the canal water around the wetlands for monitoring of potential nutrient removal.

NATIVE PLANTS SELECTED FOR ENGINEERED WETLANDS

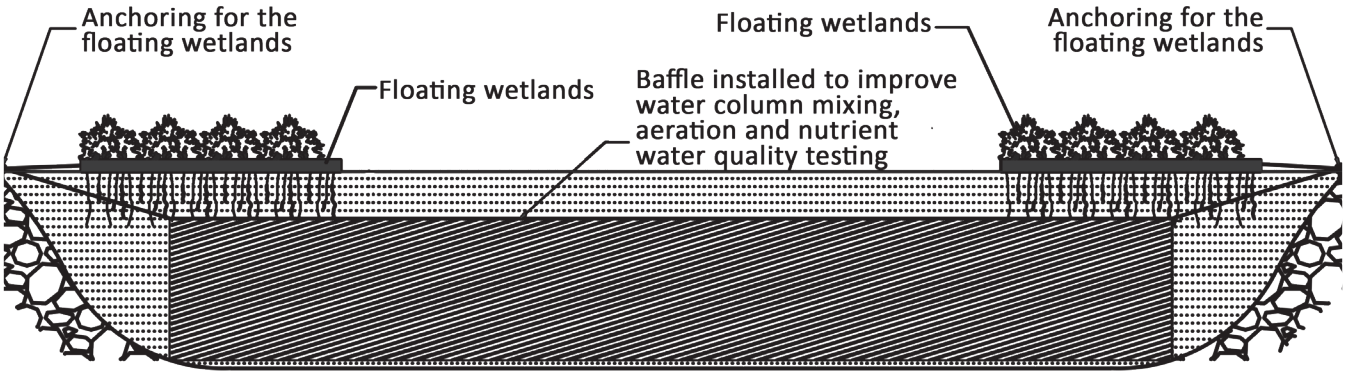

'Ahu'awa


'Ae'ae


Pōhuehue


'Ākulikuli

SECTION VIEW OF THE FLOATING WETLANDS

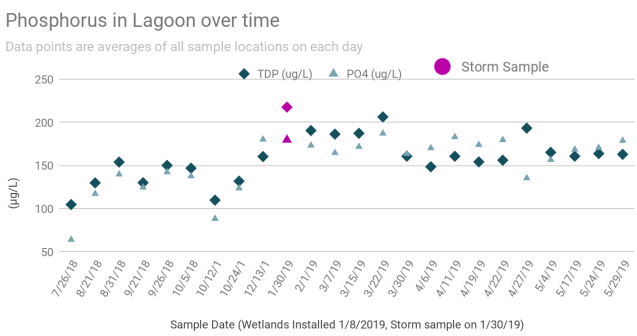


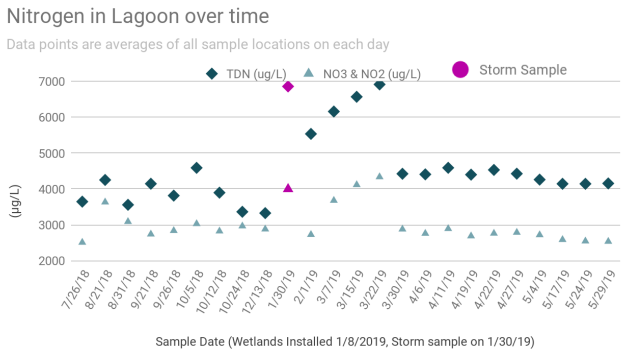
RESULTS

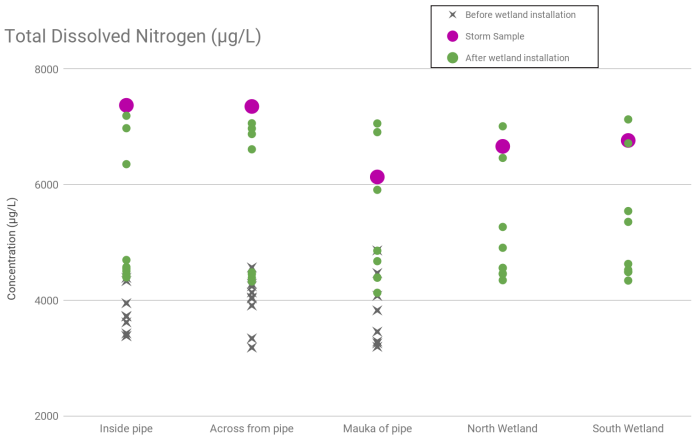
Baseline water quality was taken in the fall of 2018 and compared to post installation of the floating wetlands. There was no statistical difference of nutrient removal found between before and after results and between the different sites. This seems to indicate that the water is well mixed and that the regular tidal influence may have affected the residence time needed to show significant nutrient results. In addition, typically a pulse of nutrient influx would occur during the initial period of a storm event and the timing of sampling likely missed this "first flush" effect. Moreover, water quality testing post installation of the wetlands occurred only during the first six months after planting. Typically as the ecology becomes more established (and has greater biomass) more nutrients are extracted. In their review of nutrient removal in floating wetland plants, Pavlineri et al. found significant evidence showing that "successful biomass establishment seems to linearly and predominantly correlate to efficient nutrient removal rates" (2017). The literature also shows that nutrient allocation (aerial tissue vs. roots) and nutrient uptake rates vary seasonally.

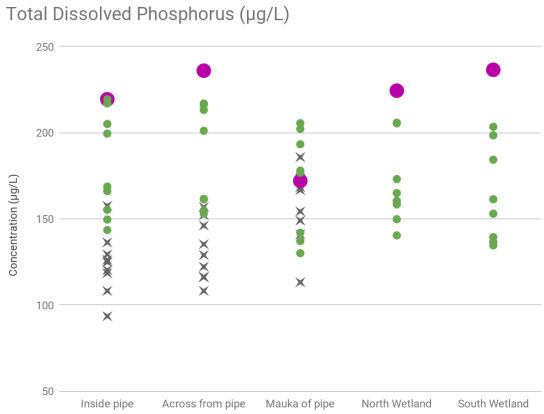
Map of sample locations

Water quality results



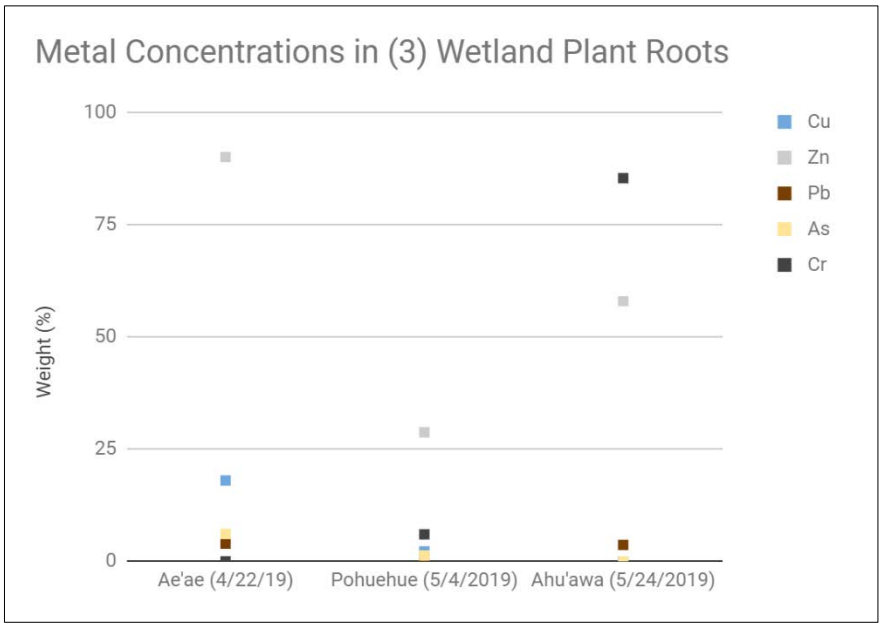


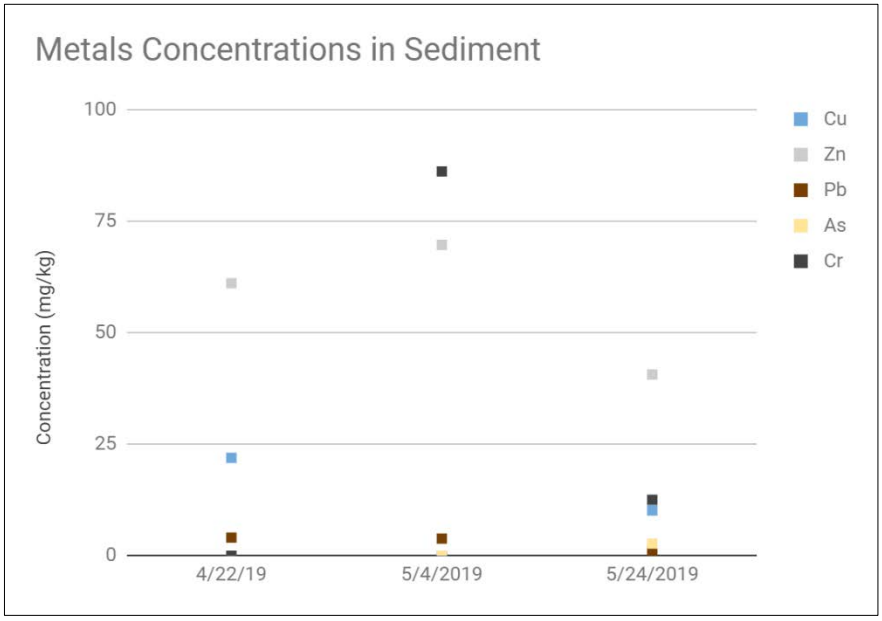




N. Pavlineri, N.T. Skoulikidis, V.A. Tsihrintzis. Constructed floating wetlands: a review of research, design, operation and management aspects, and data meta-analysis.Chem. Eng. J., 308 (2017), pp. 1120-1132

Metals were sampled from the water column, stormwater culvert inlet, sediment in the channel as well as within the roots of three of the floating wetland plants. Initial results indicate that the heavy metals were present in sediment and generally nondetectable in the water column, which was to be expected since metals tend to bind to sediment particles. Although it would require more research to conclude, initial metals results from the floating wetland plants' roots, indicate that the plants may be undergoing phytoremediation by trapping sediments and taking up of the heavy metals.





LESSONS LEARNED

This project generally provided positive results, however a couple lessons learned included the following:

Detatached cable after swell

1. LOCATION

The wetlands were placed in a location that is susceptible to strong tides, ocean swells and storm surges. Although stainless steel cables and moorings were used, following large swells, some cables and moorings snapped. The intensity of ocean swells in the canal to break cable specified for >4000 lbs of force was unexpected. Locating wetlands in areas with less extreme ocean forces would be recommended in the future.

2. TIMELINE FOR WATER QUALITY MONITORING

The timeline for water quality monitoring may have been too short to see significant treatment results. Recommend water quality monitoring for at least 1 year following the installation of natural systems technologies to allow more time for the ecology to establish and monitoring of nutrient removal.

Wave dissipater,
indicative of strong swells

DISCUSSION

The project received a lot of positive feedback from the community and resort visitors indicating that the wetlands are serving as an outstanding educational outreach tool. The installation of the sign helped to inform the visitors about the pollution issues and how the wetlands were installed to mitigate these issues and protect the reef.

ACKNOWLEDGEMENTS

A special thanks to Tova Callender and Charley Dofa (pictured above) of West Maui Ridge to Reef for the time and energy they put into this project. Thank you for your commitment to keep West Maui's oceans clean!