# Report for 2005GU58B: Watershed Management for Enipein Watershed, Pohnpei Island, the Federated States of Micronesia.

Publications

- Conference Proceedings:
    - Khosrowpanah, Shahram; Mark, Lander; Leroy, Heitz, 2005, Pohnpei – The Wettest Island on Earth? Tools for Managing Watershed, “Institutions for Sustainable Watershed Management: Reconciling Physical and Management Ecology in the Asia Pacific”, AWRA Summer Specialty Conference, Honolulu, Hawaii, 1-7pp.
- Other Publications:
    - Lander, Mark; Shahram, Khosrowpanah, 2005, Is there a Pot of Gold at the end of Pohnpei’s Rainbow, College of Liberal Arts and Social Sciences 26th Annual Research Conference, 4pp.

Report Follows

# PROJECT SYNOPSIS REPORT

**Project Title: Watershed Management for Enipein Watershed, Pohnpei Island, the Federated States of Micronesia**

## Problem and Research Objectives

The Enipein Watershed Basin (shown in the figure 1 and 2), situated in the Kitti Municipality in the South of Pohnpei Island, is home to around 1,000 people. This area of approximately 10 square miles boasts one of Pohnpei's most remarkable watersheds, which includes unique native forests, a spectacular web of rivers, steams and fresh water swamps, and extensive mangrove forests, sea grass beds and coral reefs. According to the Conservation Society of Pohnpei (CSP) many of Pohnpei's 110 endemic plants and 13 endemic bird species along with thousands of other terrestrial and marine creatures are found in this area. The Enipein Watershed is also unique in that the area actually encompasses part of the Pohnpei Watershed Forest Reserve, and the whole of the Enipein Mangrove and Marine Sanctuary/Park and the Nahtik Marine Protected Area.

With Pohnpei's growing population and the resident's ever-increasing need for cash, the Enipein watershed's fragile habitats and invaluable resources are becoming highly threatened. In recent years large areas of native forests and ecologically sensitive areas are being cleared for housing and road development projects and unmanaged agricultural activities (e.g., sakau/kava plantations). These new development activities are now negatively impacting the biodiversity health of the area, the freshwater resources, as well as the mangrove forests and coral reefs. But more importantly to the people of Enipein are the serious health risks and economic costs caused by these unregulated development activities. The Cholera outbreak of 2000, which was born in the Enipein Community due to unsanitary water sources, ultimately took over the entire island and resulted in numerous cases and several deaths and substantial financial losses to the government. There are also a growing number of landslides in the area which are contributing to increased soil erosion, poor water quality and adding probable danger to the lives of the people of Enipein. Sediment eroded from the watershed accumulates on reefs offshore, which could have a negative impact on mangrove swamps, fisheries, and corals.

To implement any watershed management scheme to protect the Enipein fragile environment requires having a better understanding of the physical and environmental components of the watershed. The objectives of this project were to: 1) install stream flow, sediment, and rain gages for selected sites within the Enipein Watershed; 2) monitor the gages and develop stage discharge rating curves for selected sites; 3) develop a correlation between stream flow, sediment load and rainfall; and 4) develop a hydrologic database for future use. The baseline information will be used for future comparison between Enipein watershed and other watersheds that have less human activity such as the some of the watershed in Madolenihmw. The results will reveal the impact of the various activities such as land clearing, land slide/slope failures, and population growth on the quality of the watershed.

## Methodology

The methodology that was used for completing the project was: site selection, instrument installation, training CSP personnel for data collection, data collection and analysis, and finally development of a database for future use. Within the Enipein watershed there are two streams that join together in a mangrove swamp before draining onto the reef as shown in Figure 1 and 2. We selected two sites for installing the instruments. The criteria for site selection were: easy accessibility, natural or man-made protection from flooding; close proximity of stream-flow and rain gages; and locations in the streams where the cross sectional area could be easily measured.

The cross section description of each of the selected sites was surveyed using standard level and stadia surveying methods. The distance between the two sites was measured and recorded and cross sectional data and plots were developed for each of the sites. Two level loggers were installed at each of the selected cross sections. The location and elevation of each level logger was surveyed and recorded. The function of the level logger is to measure the changes of the river depth versus time. The level logger stores the data internally on site for downloading at a later date. We found that the loggers could easily hold two months of data between downloads. To make necessary adjustment for barometric pressure changes, a barometric logger was installed at a site close to the stream-monitoring site. All Level data was taken at 15 minute intervals. Two personnel from CSP were trained in downloading the data from the level loggers. They were also trained in stream flow measuring techniques. The hand streamflow measurements were used in the development of a rating curve of flow vs. level for the sites where the loggers were installed. Direct streamflow measurements were made on a monthly basis and the level and baro-loggers were downloaded every other month.

Two recording tipping bucket rain gages were installed in the basin (see Figure 2) and the data from the gages were used to develop a correlation between the water level and flow changes in the stream and rainfall. The rainfall data, which had 1-second time resolution, was downloaded from the gages as frequently as every two months. The level of turbidity of each stream was measured using a field turbidimeter.

## Principal Findings and Significance

The first goal was to develop a stage discharge rating curve for flow at the selected site. Having a rating curve and the level of water (using level logger data) will enable us to estimate the flow rate at the selected site. To do this, we first determined the elevation differences between the two selected sites from the level loggers. Using a roughness calculation (Chow, 1959) we estimated the Manning's roughness coefficient between the two selected sites (n=0.06). We ran a standard step backwater calculation between the two sections and we determined the value for flow rate by trial and error between the two sections. This process needs to be continued

for a longer time in order to have a better relationship between flow and the depth of water. To improve the accuracy of the calculated rating we measured the flow rate at the selected site using a portable flow meter on a monthly basis. The measured values were compared to those determined using the backwater calculation techniques. The data collection and analysis will be continued until a reliable rating curve has been developed.

The relationship between streamflow and rainfall was also examined. As shown in Figure 3, there is a close relationship between rainfall and changes in streamflow at the recording site. Figure 3 shows that the response of the watershed to rainfall is very rapid. This flashy response characteristic could cause rapid flooding in the stream and also elevated soil erosion. Since the watershed response is very fast, any of man's activities such as clearing the land will have a huge impact on the stream's water quality as well as the mangrove forests and coral reefs that they streams drain into. At the present time we are collecting stream turbidity data and a relationship between rainfall, stream flow and level of turbidity for the stream will be develop as more data is collected.

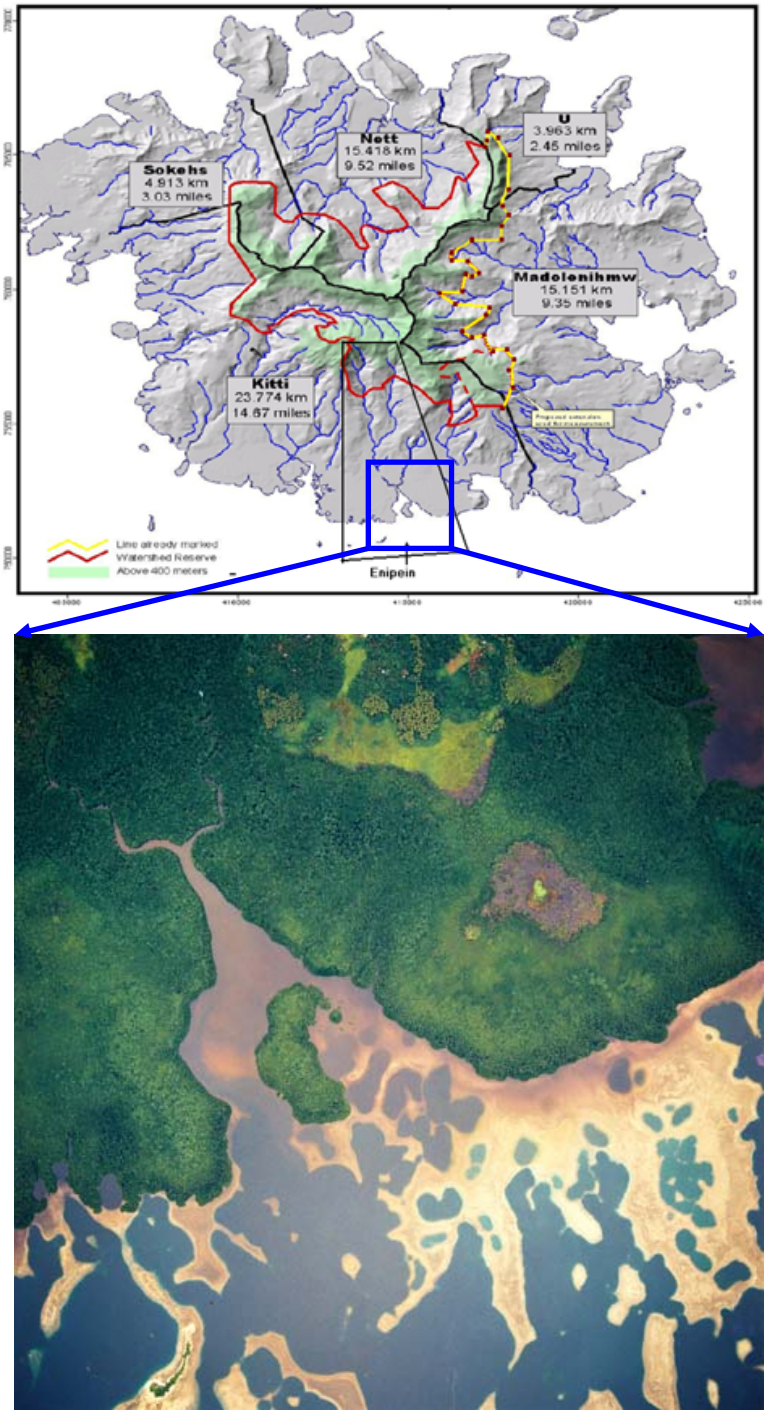


Figure 1. Enipein Watershed, Kitti Municipality, Pohnpei Island.

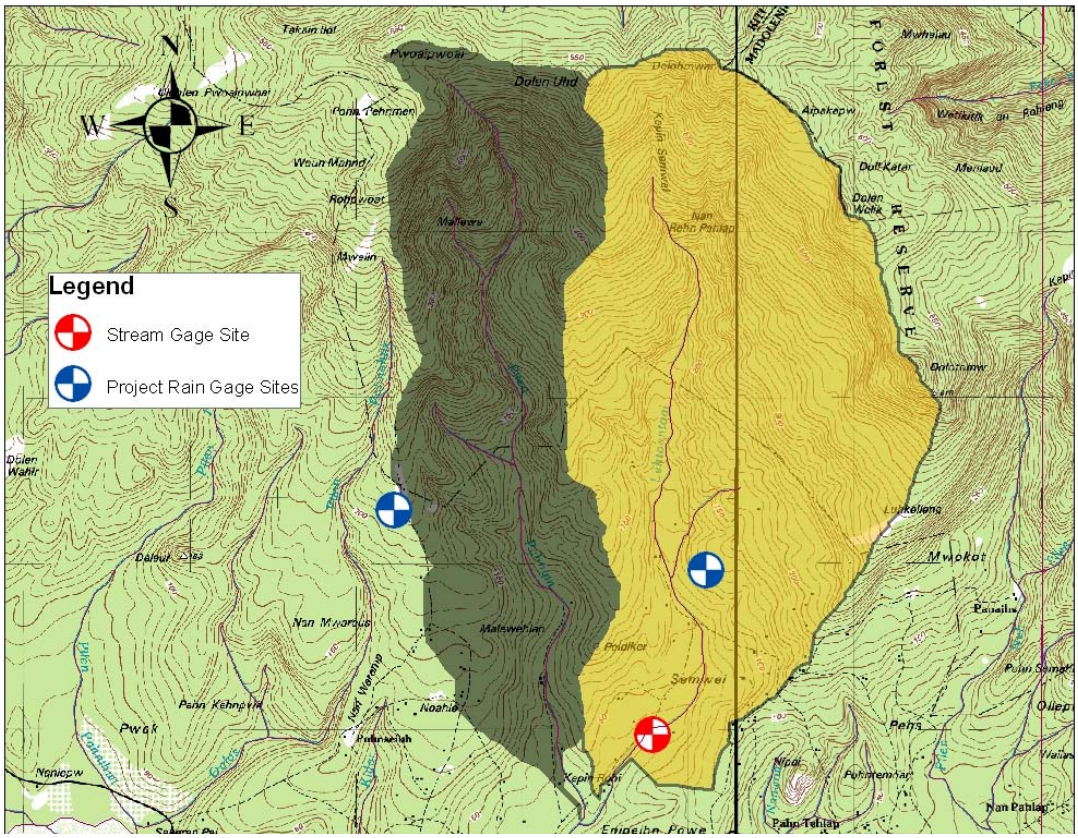


Figure 2. Enipein watershed boundary and gage locations.

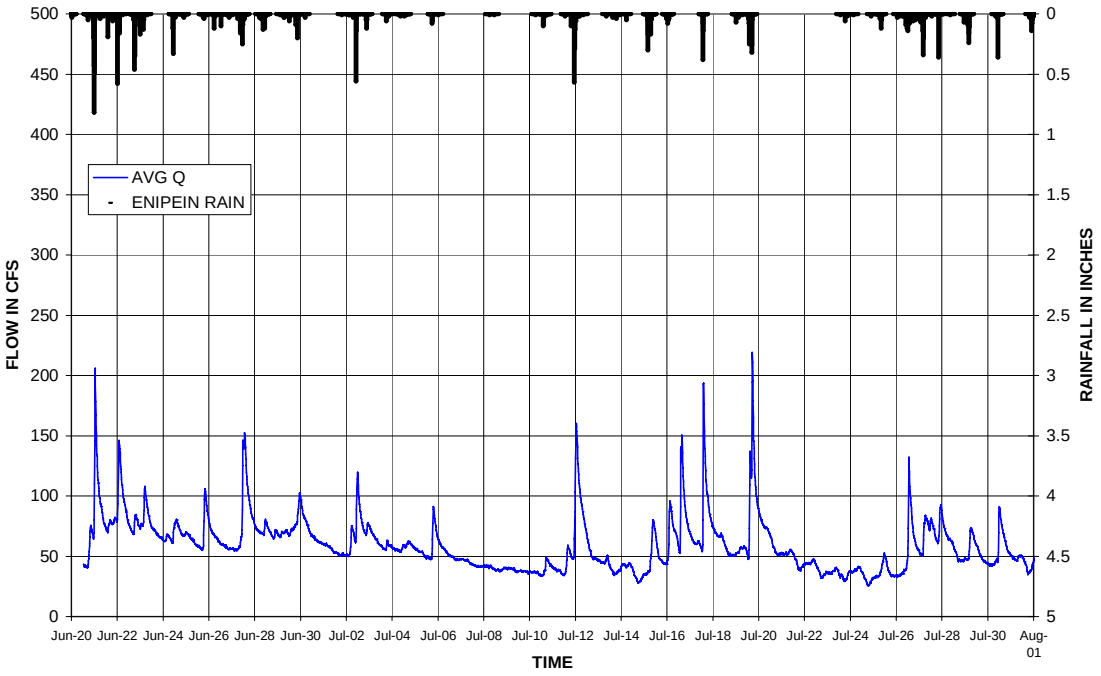


Figure 3 Calculated streamflow vs. measured rainfall in Enipein Watershed for June and July 2005.