Quantifying the Effects of Watershed Restoration as a Flood Mitigation Approach

Emaz Arshad[1], Connie Maxwell[2], Kaustuv Neupane[1], Noel Prandoni[1], Alexander Fernald[1,2,3], James Phillip King[4]

1) Water Science and Management Program, New Mexico State University, Las Cruces, NM
2) New Mexico Water Resources Research Institute, New Mexico State University, Las Cruces, NM
3) Department of Animal and Range Sciences, New Mexico State University, Las Cruces, NM
4) King Engineering & Associates Inc.

Introduction

Stakeholder goals: Southern New Mexico stakeholders have shared that flooding and the intensity of flood events has been increasing, and that watershed restoration and quantifying the benefits are critical priorities.

Issue and Gap: The traditional and commonly used flood infrastructure engineering approaches, which limit consideration of the surrounding natural system processes, are not increasing landscape capacities to buffer floods and droughts. Yet difficulties in characterizing the natural system processes hinder predicting the benefits of watershed restoration due to significant variability in surface flow and inundation dynamics within watersheds.

Goal and Objectives

The goal of this study is to quantify the benefits of watershed restoration approaches that consider overall watershed dynamics. The objectives are to characterize and quantify the effects of restoration on the flow, inundation and sediment dynamics.

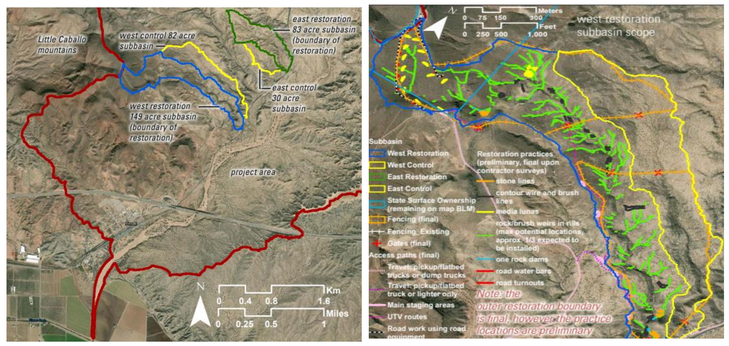

Figure 1. Aerial view of the Rincon Arroyo study area and restoration practices in the West Subbasin.
Photo credit: Connie Maxwell

Methods and Expected Results

Comparisons will be made with base conditions prior to restoration, as well as comparing subbasin dynamics with restoration to control subbasins.

Flow Dynamics: We will characterize the effects of flow dynamics through measuring stage (flow depth) and using hydrologic modeling.

- We will better understand the flow dynamics by measuring stage (flow depths) using pressure transducers, Hobos, and staff gauges that are installed on-site.
- HEC-HMS model will be created for the hydrological modeling to estimate the runoff quantity. Calibration and validation of these hydrological models will be done using stage measures obtained from field monitoring.

Inundation Dynamics: We will characterize the effects of inundation dynamics through measuring flow characteristics and using hydraulic modeling.

- HEC-RAS model will be used to estimating the flow characteristics and extent of inundation due to floods, in the form of flood maps.
- Data from soil moisture probes will further confirm the flooding extent by measuring the moisture content pre and post rainfall
- Small temperature sensors, Ibees, will indicate the presence of flow through the temperature changes at the surface with the presence of water

Sediment Transport Dynamics: We will characterize the effects of sediment transport dynamics using the calibrated hydrologic and hydraulic models.

- We will identify erosion in flow paths, entrenchment, to identify high flow energy locations in the watershed. The restoration practices are designed to mitigate the energy and thus reduce the erosion.
- We will estimate the ability of restoration practices to mitigate erosion through estimating the before and after sediment transport quantities. The calibrated hydrological models in HEC-RAS will be used for estimating the sediment transport.

Figure 2. Field monitoring instruments in one of the subbasins at the Rincon Arroyo study area.

Conclusions and Broader Implications

The quantification of this and further similar studies across variable landscapes of the effects of restoration practices for flood reduction in arid regions will provide critical information for stakeholders to be able to plan for restoration on regional scales.

Grant number and Citations

This research was funded by the US Environmental Protection Agency and New Mexico Environment Department Award for the “Rincon Sub-basins 319 Project,” NMED prime agreement #s C9 996101-17, C9 996101-18, AND C9 996101-19, NMED sub-grant agreement with NM WRRI #667-429-2F.