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# Remote Sensing Methods for Identifying Ephemeral Water Bodies Across Arizona

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## Abstract

A variety of remote sensing methods are investigated for their ability to detect ephemeral water bodies across the state of Arizona. The strengths and weaknesses of each are discussed.

## Plain Language Summary

Results and methods for detecting transient water bodies using satellite data.

## 1 Introduction

As part of the Arizona Tri-University Recharge (ATUR) project, multiple methods for identifying and quantifying ephemeral water bodies across the state of Arizona (AZ) are investigated. For reasons that will be discussed, accurate identification of ephemeral, or temporary, water bodies is a challenge, and efforts to-date have shown limited success. Methods, results, and challenges are discussed, and potential paths forward are explored.

Ephemeral water bodies are common features in the arid American southwest. Typically very shallow, these water bodies range in size from a few cm rock pools to flash flood associated sheet flow, and playas up to several km in diameter (Crawford, 1981; Whitford & Duval, 2020). While playas and intermittent streams are well mapped across AZ, there is no consensus on the volume of water which flows through these systems. More to the point, there is no widely accepted estimate of the volume of water which either evaporates or recharges from these internally draining basins.

It is not clear what fraction of water which flows onto a playa is evaporated vs. recharged. On the one hand, the nature of playas results in the slow accumulation of surface salts and fine sediments (clays and silts), which are generally impervious and detrimental to infiltration and subsequent recharge (Whitford & Duval, 2020). Additionally, playas may be an oasis for drought resistant flora, increasing local evapotranspiration, even after shallow surface soil layers have dried out (Crawford, 1981). Alternately, these mineral rich surface crusts may be prone to expansion when wetted, and are frequently characterized by deep cracks which provide avenues for water infiltration below the impervious layers (Whitford & Duval, 2020). While the majority of water flowing onto most playas will be lost to evaporation, there may be specific playas where water loss by infiltration may exceed evaporation (Whitford & Duval, 2020). At least initially, we will assume that all water flowing onto playas shall be evaporated, subject to later reevaluation and refinement.

The primary target of this study is to estimate and quantify the volume of water flowing into small to medium sized playas, on the order of ~50 m to ~1 km in diameter, although identification of sheet flow may also be incidental. The general method outlined is to use remote sensing technology to identify standing water broadly across the study area, across a time series. By identifying standing water, and assuming a constant water depth, water volume can be estimated. Additionally, an approximation of “continuously wetted” days can provide an initial estimate of evaporation rates, and through comparison with alternate evapotranspiration estimates, may be useful for estimating infiltration rate (e.g. if water loss rate is  $2 \text{ cm}^3/\text{day}$  and the evapotranspiration rate is  $1.5 \text{ cm}^3/\text{day}$  then the implied infiltration rate would be  $0.5 \text{ cm}^3/\text{day}$ ).

The study area used for method development is primarily Hualapai Playa (a.k.a. Red Lake), located in northwest AZ, approx. 60 km south-southwest of Lake Mead (Figure 1). This ephemeral playa is roughly 1 km in diameter, and is one of the largest playas in AZ. Furthermore, local landowners surrounding Hualapai Playa have expressed sincere interest in our project, creating additional public-relations incentives related to this particular playa. Lastly, it’s proximity to Lake Mead and

Lake Mohave provide a convenient region for testing these methods against known areas of permanent surface water.

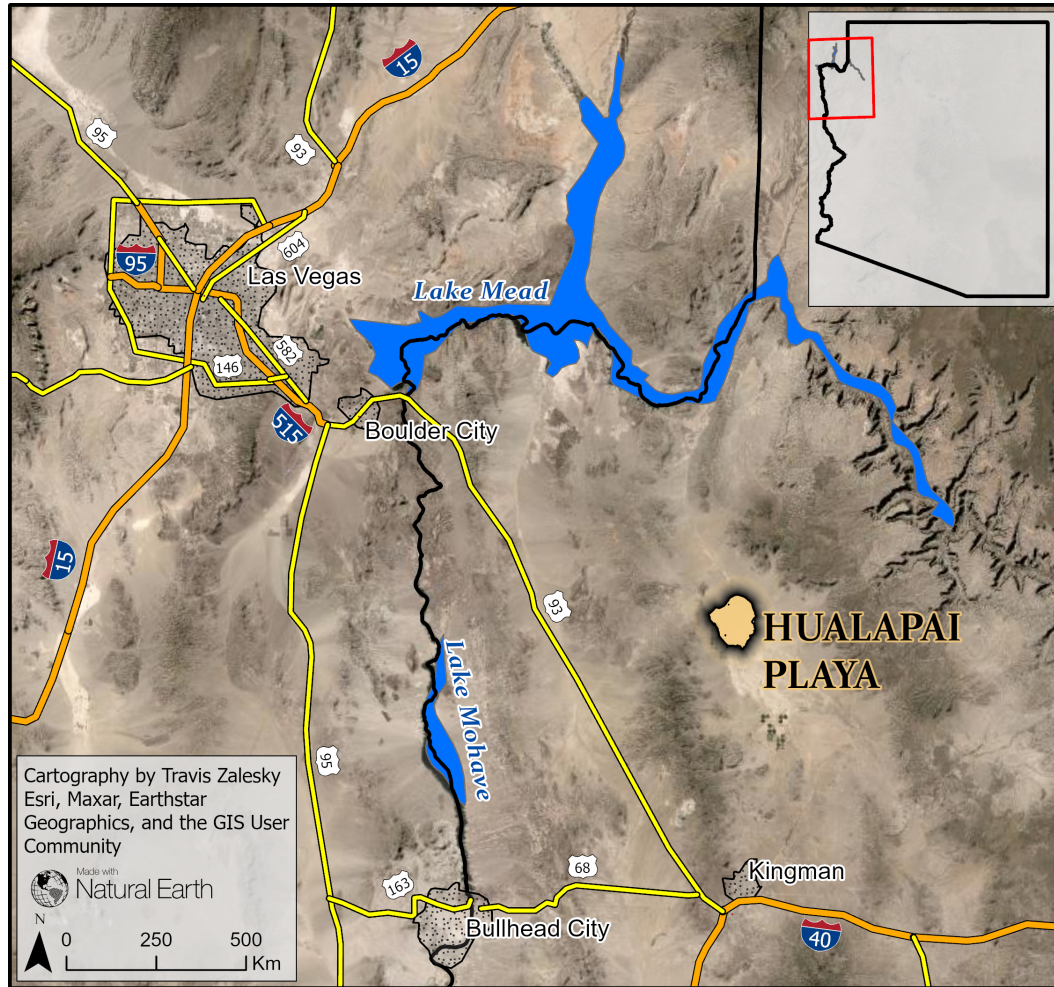


Figure 1: Hualapai Playa locator map.

One of the most challenging aspects of developing these methods is the lack of quality ground-truth data. Without existing data regarding date and duration of standing water within these ephemeral features, it is extremely difficult to validate our methods. While reasonable assumptions can be made about method accuracy (or inaccuracy as the case may be), any method, either those presented herein, or future methods not yet considered, will have to be validated using a known and well characterized ephemeral water body, ideally within AZ, or elsewhere in a similar arid environment.

## 2 Methods & Results

## 3 Further Recommendations

## 4 Conclusion

## References

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