

Summary of Technical Memorandum by Wagner & Bonsignore

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Does the “Groundwater Dependent Ecosystem (GDE) Identification and Monitoring Program Report” prepared by UC Irvine, Tubb Canyon Desert Conservancy, and the San Diego Natural History Museum comply with the BAS standard?

The Sustainable Groundwater Management Act (SGMA) requires the use of **Best Available Science (BAS)**

BAS refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.

CONCLUSION of the UTS report:

The Borrego **mesquite bosque is using groundwater** (thus a GDE by SGMA definition).

OBJECTIVES:

1. Determine whether the methods used in the UTS study comply with BAS.
2. Determine whether interpretations of the acquired data comply with BAS.

Key Findings of the UTS Report:

1. Isotope analyses confirm groundwater use by the mesquite bosque.
2. Evapotranspiration (ET) monitoring and water balance models reveal that the mesquite bosque ecosystem uses water at rates exceeding annual precipitation.

We refute both findings because they are not supported by a scientifically defensible interpretation of the data. Although the isotope analyses, ET monitoring, and water balance modeling methods themselves are consistent with Best Available Science (BAS), the interpretation of the isotope, ET, and water balance results does not comply with BAS.

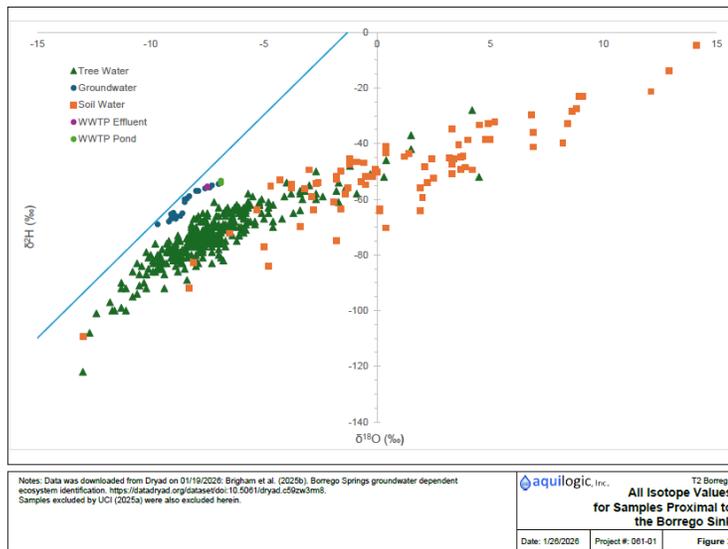
Stable Isotope Analysis

Stable isotope analysis is currently the only accepted field method that directly identifies the source water used by vegetation by chemically matching plant water to potential sources such as precipitation, soil water, or groundwater.

The use of stable isotope analysis complies with BAS.

The UTS report estimates the percentage of groundwater in mesquite tissue between 54% and 82%. However, due to an incomplete analysis of their data this **interpretation does not comply with BAS.**

Bias of UTS Interpretation of Isotopes Data



UTS measured oxygen-18 ($\delta^{18}\text{O}$) and deuterium ($\delta^2\text{H}$) isotope ratios of tree water, groundwater, and soil water. Deuterium excess was calculated from these variables. Our isotope expert Dr. Andy Campbell and Aquilogic found it unusual that the interpretation relied mainly on $\delta^{18}\text{O}$ and d-excess to conclude that groundwater contributes 54% to 82% of tree water; $\delta^2\text{H}$ was not used.

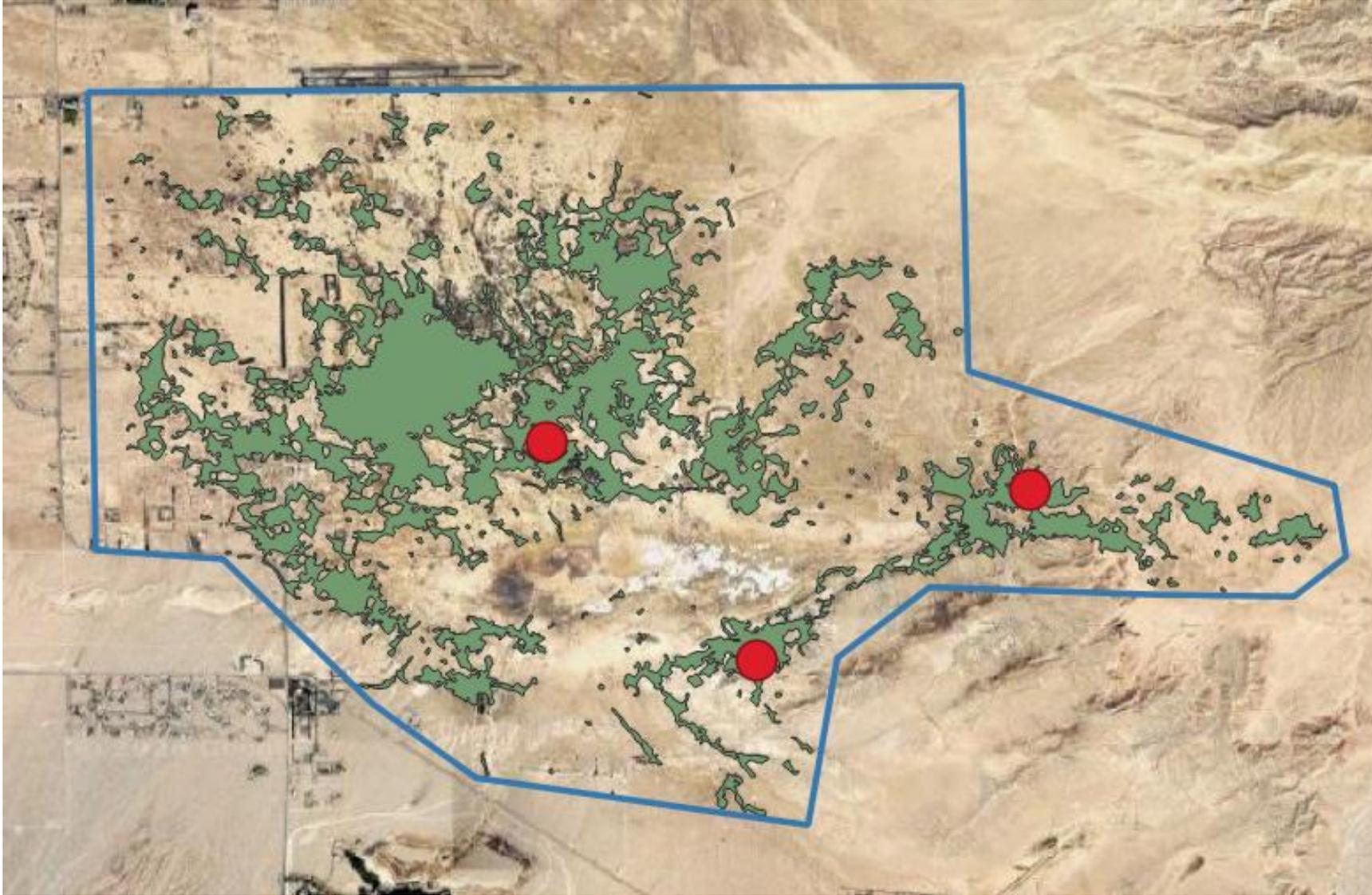
Inspection of the above Aquilogic isotope plot shows that a straight mixing line can be drawn through the tree-water samples (green triangles) and the shallow soil-water samples (orange squares), while the groundwater samples (blue points) plot above that line. This pattern indicates that the isotopic composition of tree water is not consistent with a linear mixture of shallow soil water and groundwater but instead reflects mixing between shallow and deeper soil-water pools. An extensive reanalysis of the full UTS isotope dataset by TAC member Aquilogic concludes that—contrary to UTS’s conclusions—soil water is the principal contributor to mesquite hydration, not groundwater. **This interpretation, based on analysis of all data, complies with BAS.**

Evapotranspiration (ET) Monitoring

OpenET provides monthly ET maps for the mesquite bosque using five methods plus an ensemble estimate. The key issue is which estimate is most reliable. This requires validation against field ET measurements and selection of the method that best matches those data. **The UTS report outlines this workflow, consistent with BAS.**

The UTS report estimates ET by taking the mean of all methods and adding 50%; **this interpretation does not comply with BAS.** We will reanalyze their workflow and validate OpenET methods using ET sensor measurements.

Mesquite Bosque Ecosystem



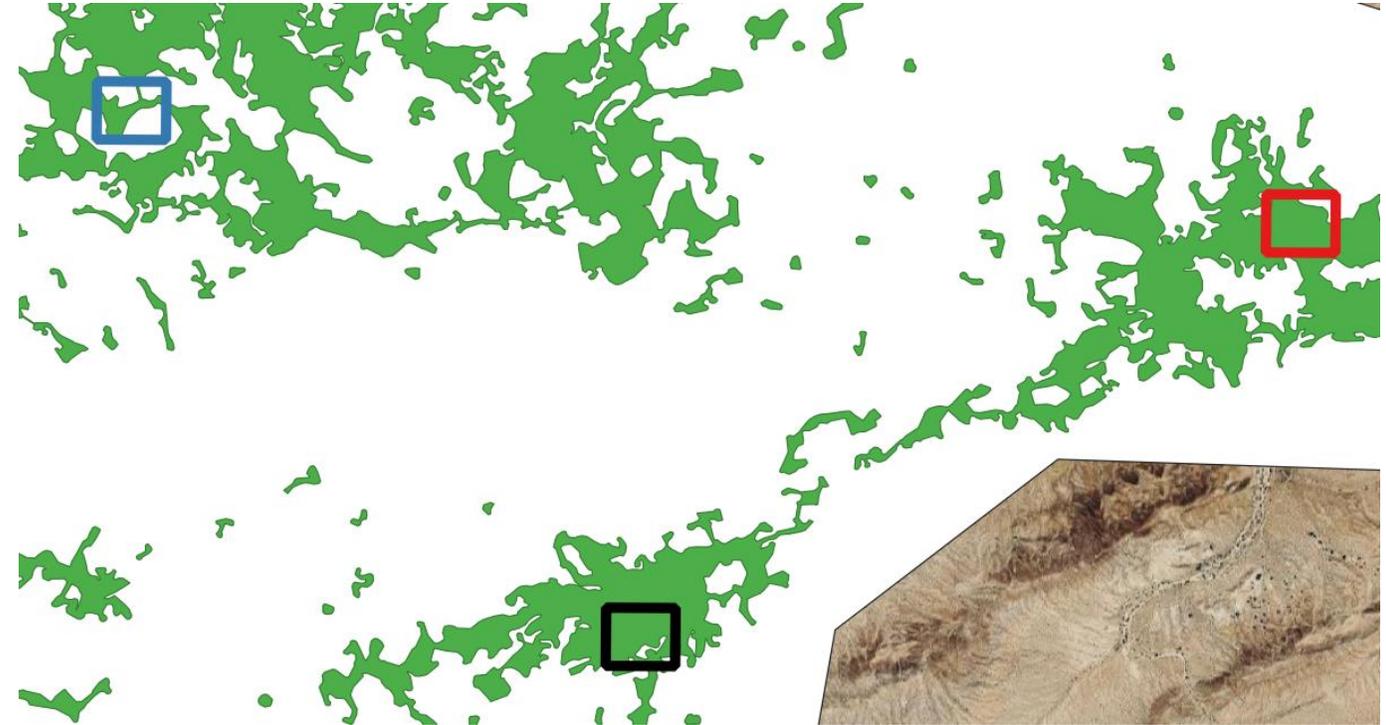
Boundary – blue

ET sensor – red

Mesquite - green



Footprints of ET Sensor Towers

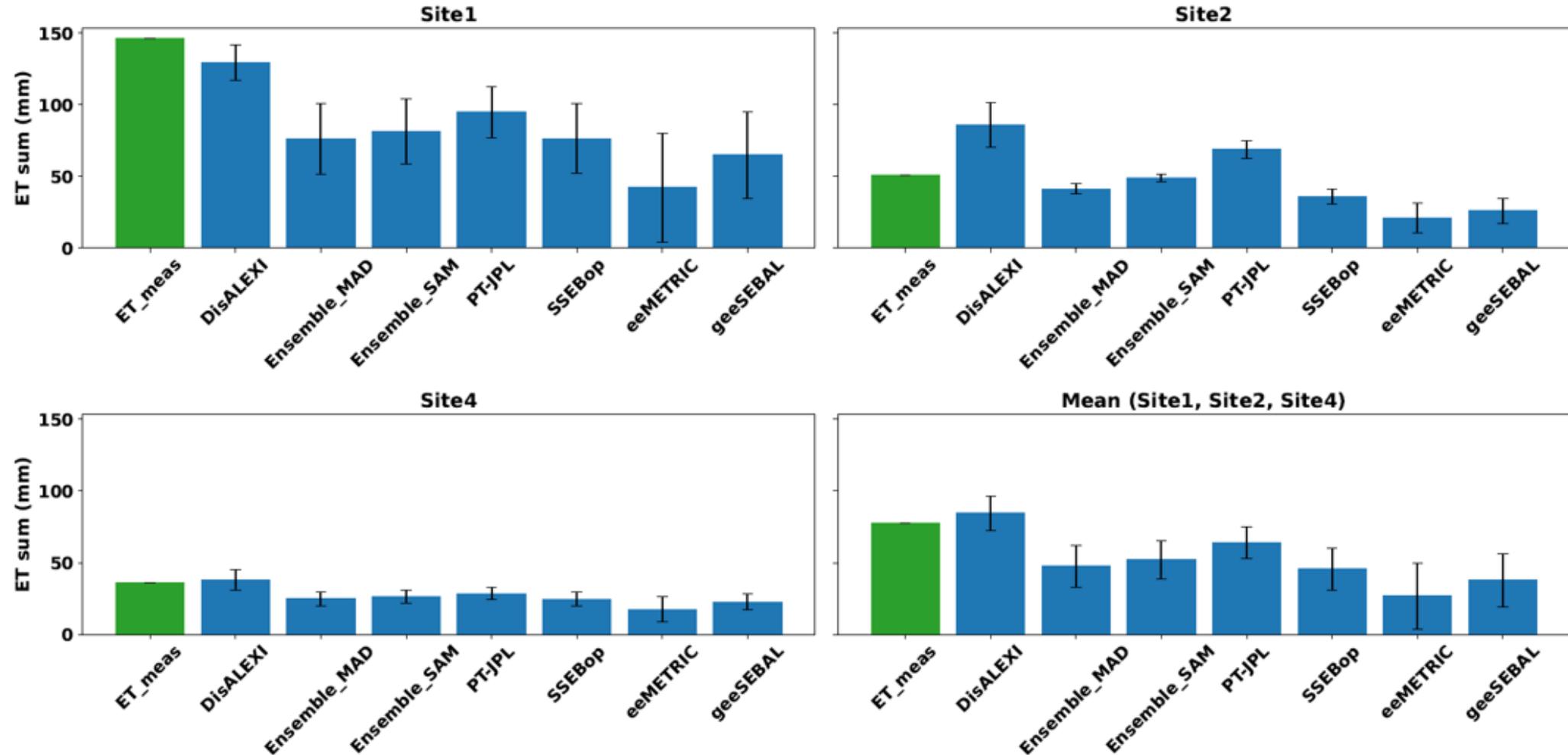


Site 1- black Site 2 – red Site 4 – blue

Each sensor footprint covers 7×7 Landsat pixels (210×210 m), with the tower located in the center pixel. The ET flux from these 49 pixels accounts for more than 80% of the flux measured at the tower. An OpenET model is validated by comparing the predicted mean ET of the footprint pixels with the tower ET measurement. Seven OpenET models are validated.

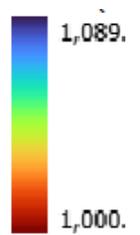
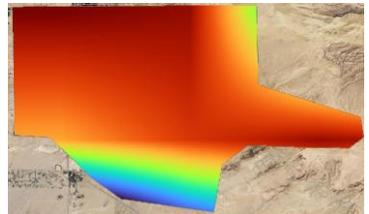
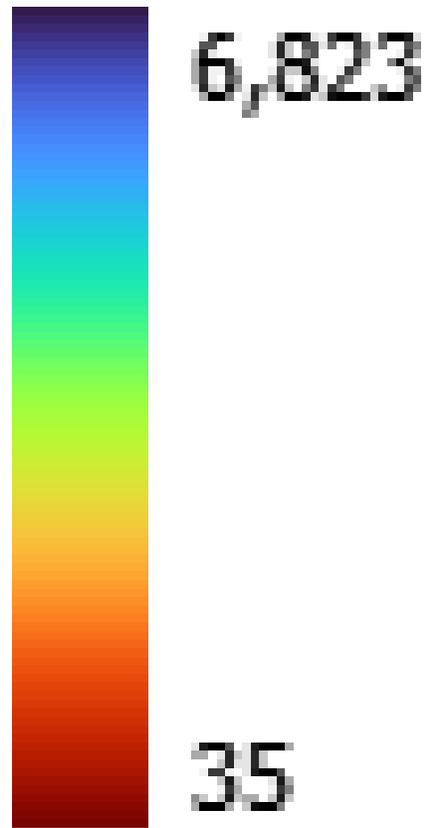
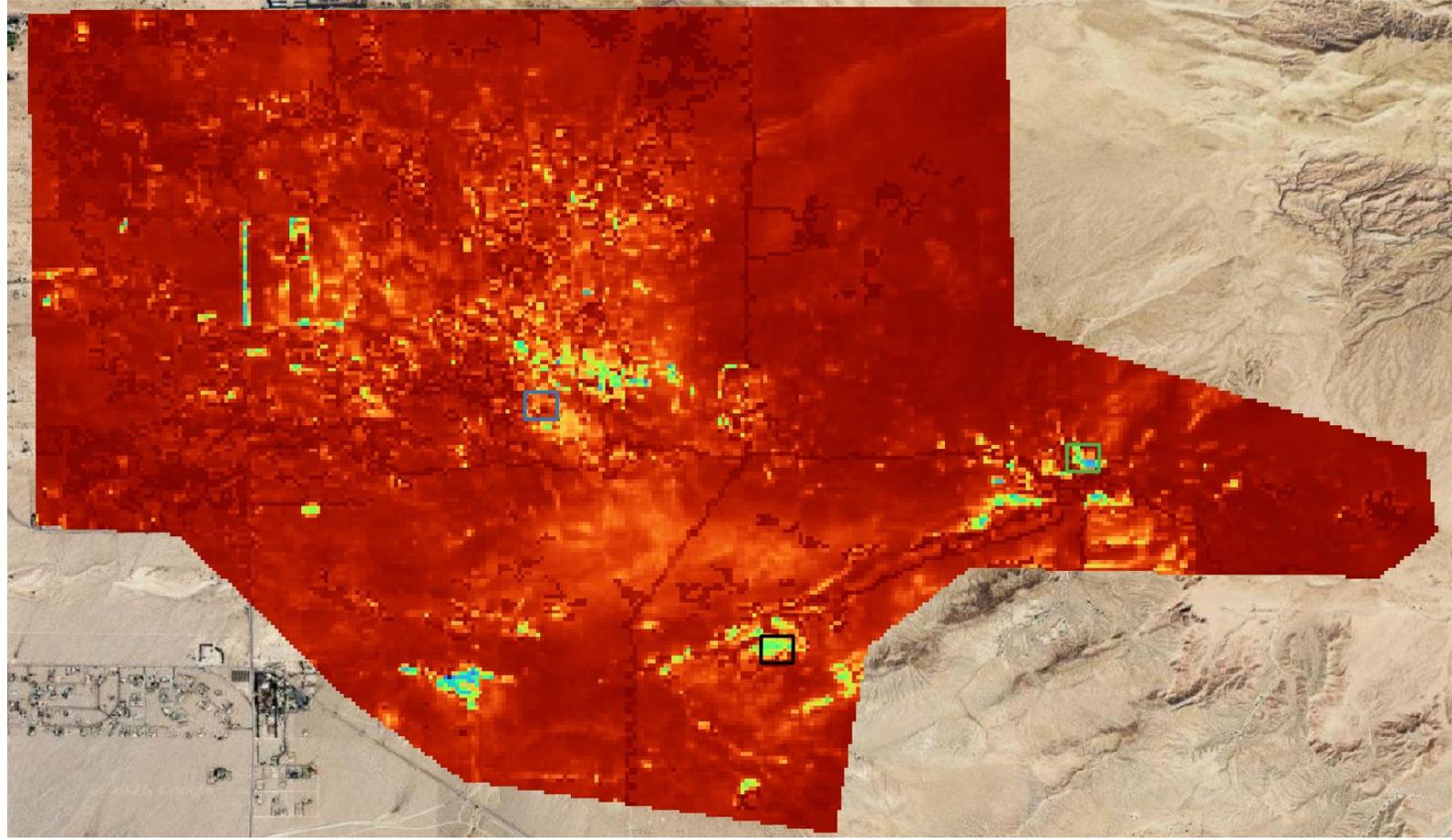
Validation of OpenET Models vs ET Sensor Measurement

Vertical axis is sum of ET during July - August



DisALEXI is selected as the BAS OpenET model for mapping ET in the Mesquite Bosque Ecosystem

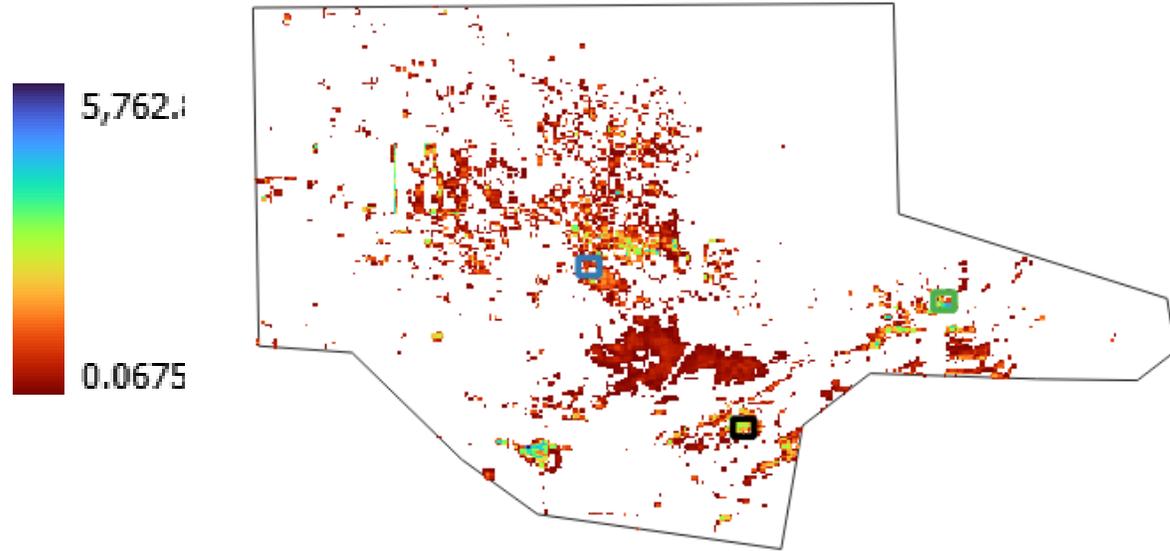
BAS cumulative 2015 – 2024 ET (mm) map predicted by validated OpenET model DisALEXI.



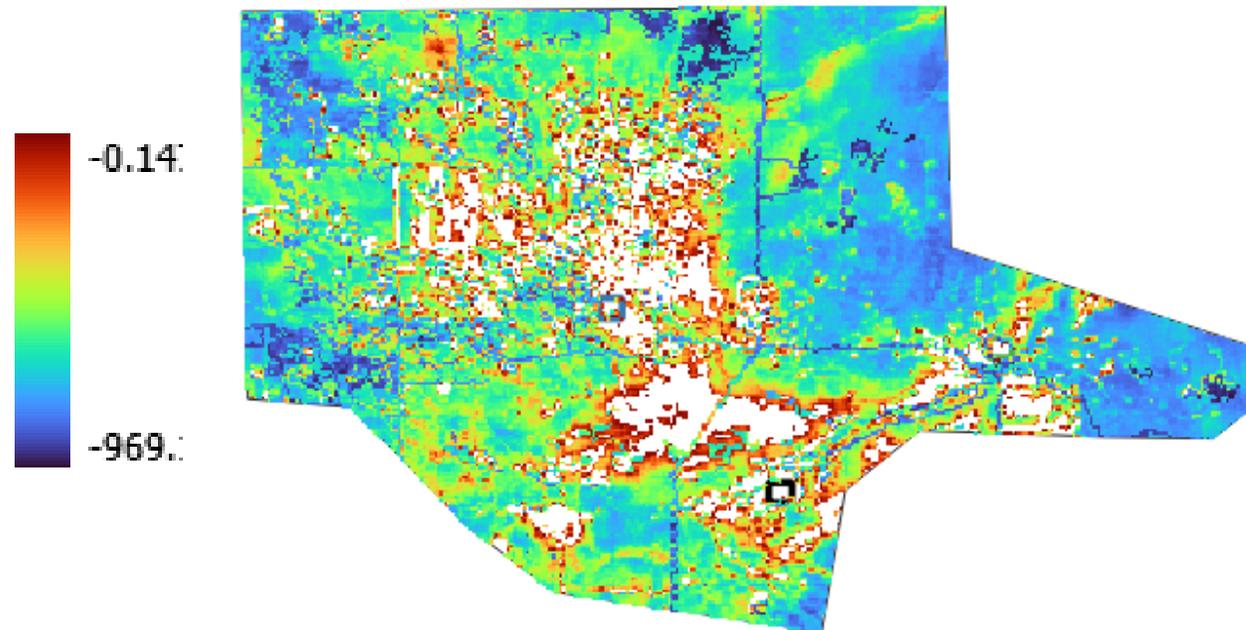
The BAS cumulative 2015 – 2024 Precipitation (mm) from gridMET (left).

These files are used to map ET – P in the mesquite bosque.

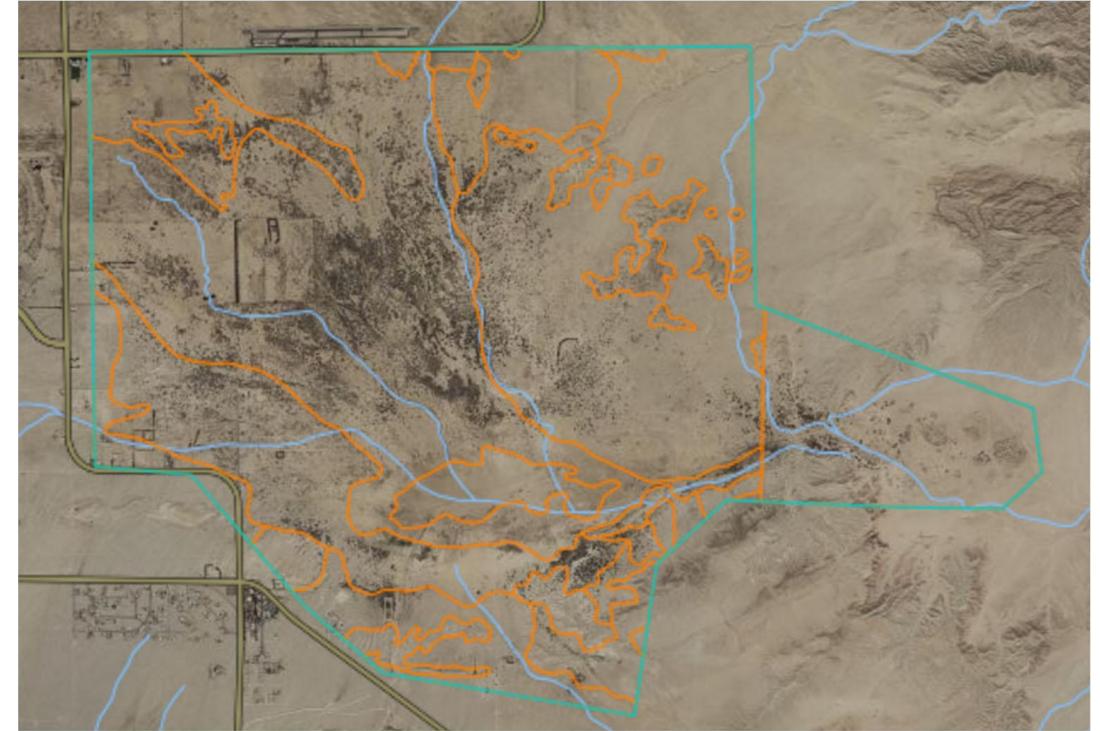
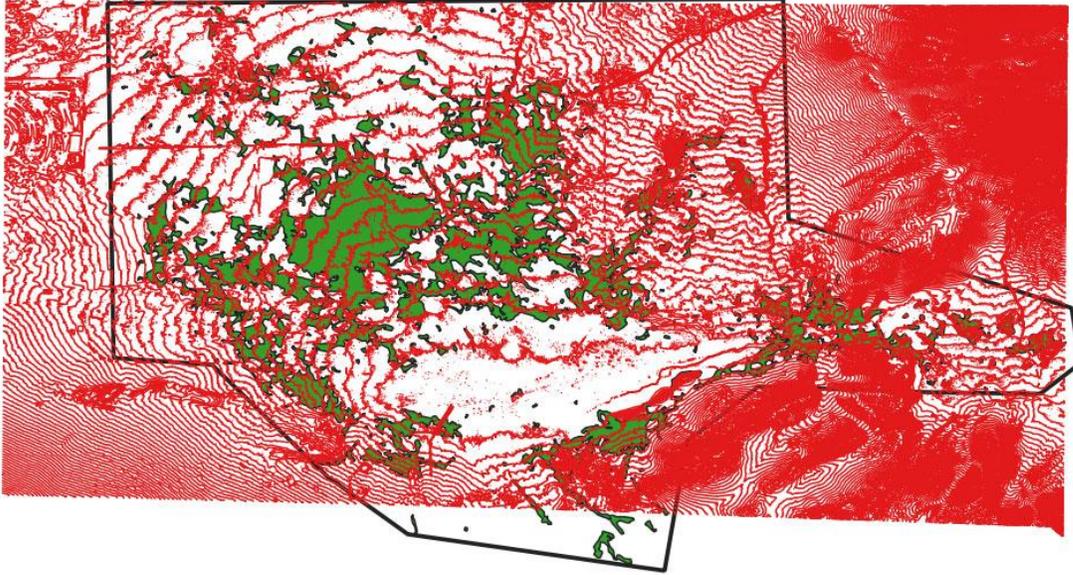
Map of $ET - P > 0$: what is the water source for these pixels?



Map of $ET - P < 0$: where is the water draining from these pixels?



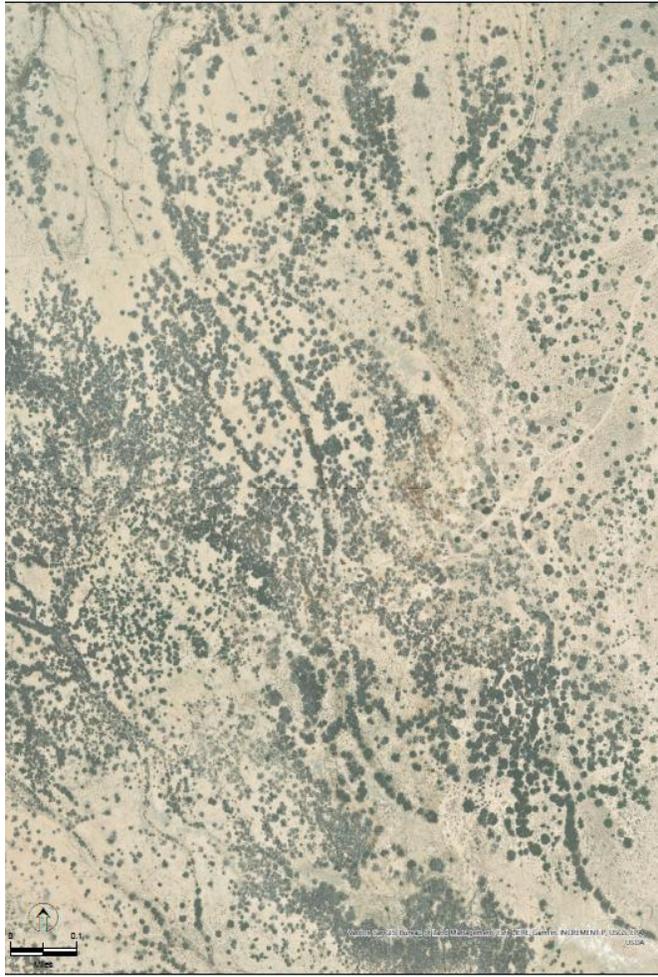
BAS Topography Inspection of Mesquite Bosque



The 1-meter contour lines (red) indicate that **run-off and run-on** occur during precipitation events.

Three ephemeral flow channels (light blue) cross through the mesquite ecosystem and two originate in it. During years with rainstorms the mesquite not only receives precipitation but also **run-on from areas surrounding this ecosystem.**

BAS Topography Inspection of Mesquite Bosque by Aquilologic

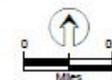


**Honey Mesquite Bosque
Aligned with Streams
North of Borrego Sink**
Date: 2/2/2026 | Project #: 061-01 | Figure 17



Streams and Rivers (USGS National Hydrography Dataset)
Borrego Sink
Honey Mesquite Bosque Mapped by UCI (2025b)

Note: All locations are approximate.



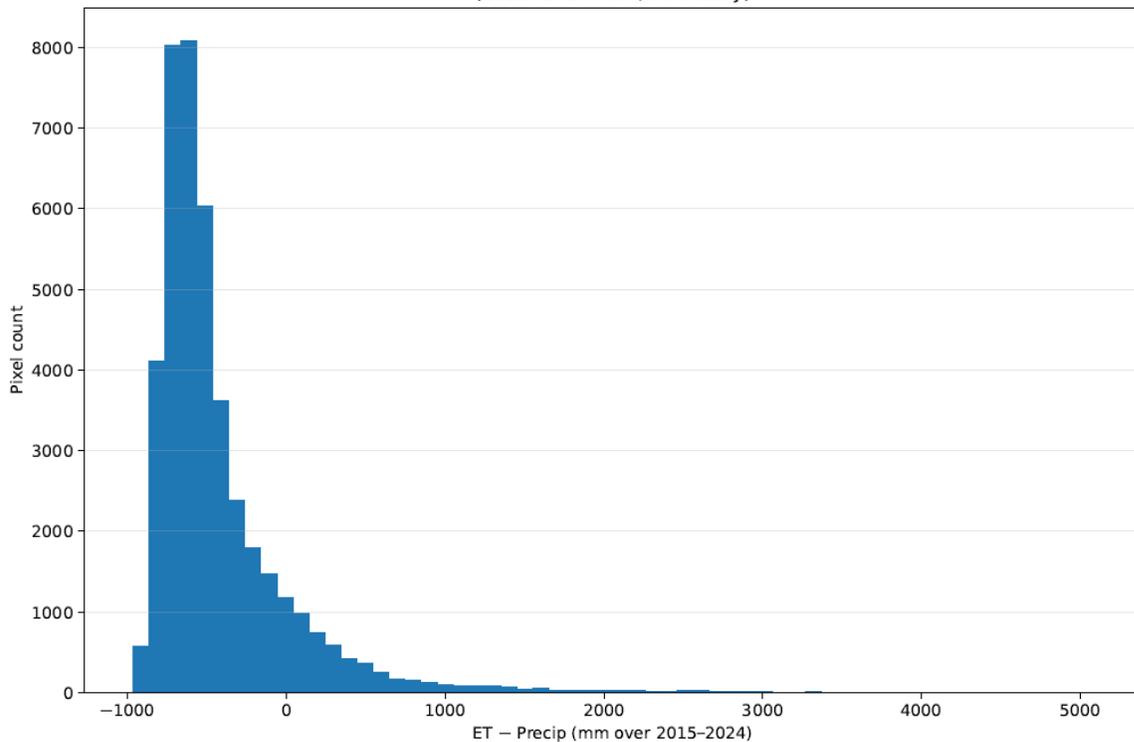
**Honey Mesquite Bosque
Aligned With Streams**
Date: 2/2/2026 | Project #: 061-01 | Figure 18

The mesquite trees are aligned with small ephemeral flow channels. Site 1 with a high ET ($ET - P > 0$) is located just to the west of the center in the left figure.

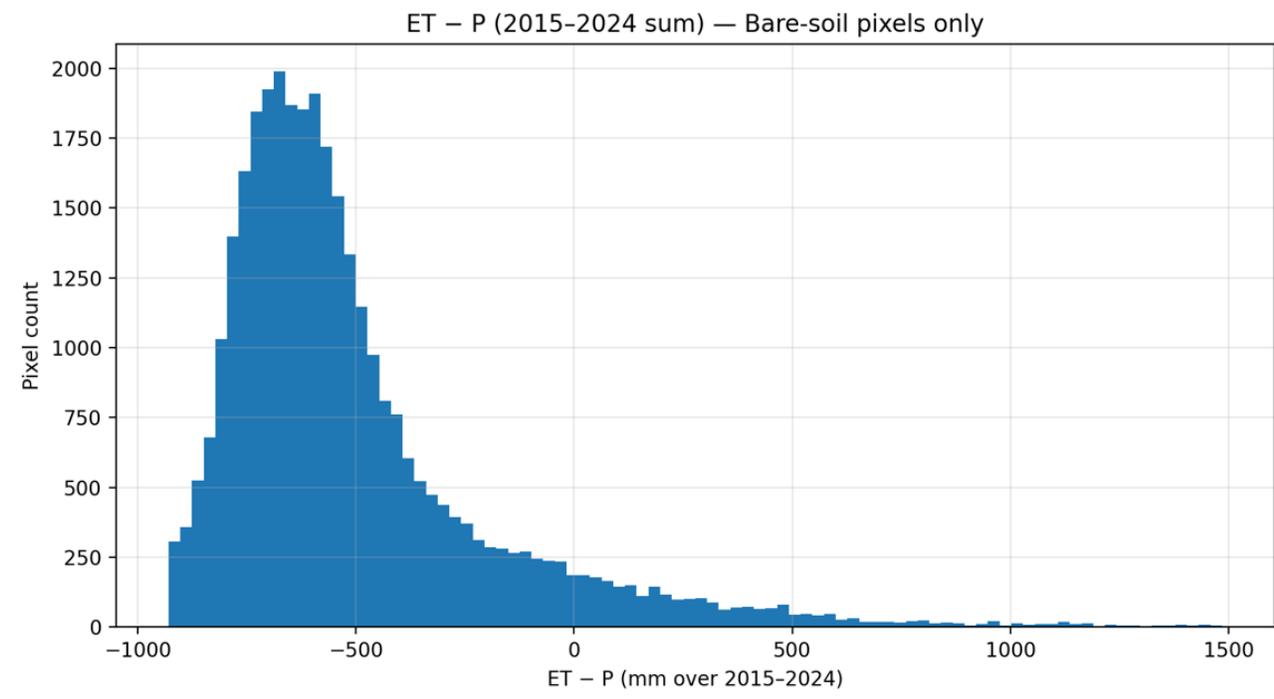
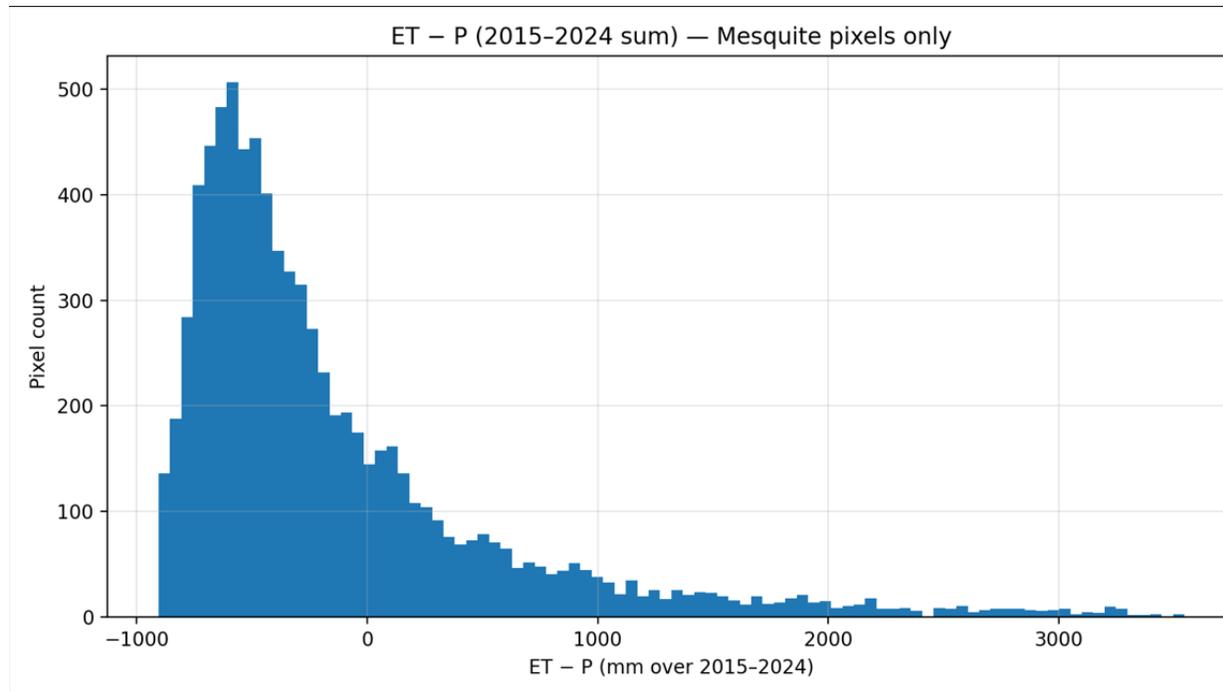
The water source for pixels with $ET - P > 0$

Based on the BAS-compliant isotope analysis, the principal water source for mesquite is soil water. Topographic inspection has shown that mesquite preferentially grows along ephemeral channels that occasionally receive run-off from pixels where $ET - P < 0$. This runoff infiltrates and is stored in the soils beneath and adjacent to these channels.

Histogram of $ET - Precip$ (all pixels with valid diff)
(2015–2024 sum, boundary)



The histogram shows far more pixels with runoff than run-on: 88% of pixels in the mesquite bosque have $ET - P < 0$, and 12% have $ET - P > 0$. Most run-on pixels receive less than 600 mm per decade (≈ 60 mm/year). The water table lies about 6 m below land surface, and the overlying unsaturated zone has a volumetric air content of at least 10%, corresponding to a storage capacity of at least 600 mm. Thus, sufficient subsurface space is available to absorb water from occasional intense runoff events.



	total	mesq	bares	Mes ET > P	Mes ET < P	bare ET > P	bare ET < P
n_pixels	41902	8210	33692	2327	5883	2855	30837
area_acs	9319	1826	7493	518	1308	635	6858
P_mm	1012	1015	1011	1014	1016	1011	1011
P_acft	30942	6081	24861	1721	4360	2107	22754
ET_mm	597	907	522	1859	530	1467	434
ET_acft	18255	5432	12823	3156	2276	3057	9767
ET-P_mm	-415	-108	-490	845	-485	456	-577
ET-P_acft	-12687	-649	-12037	1435	-2084	950	-12988

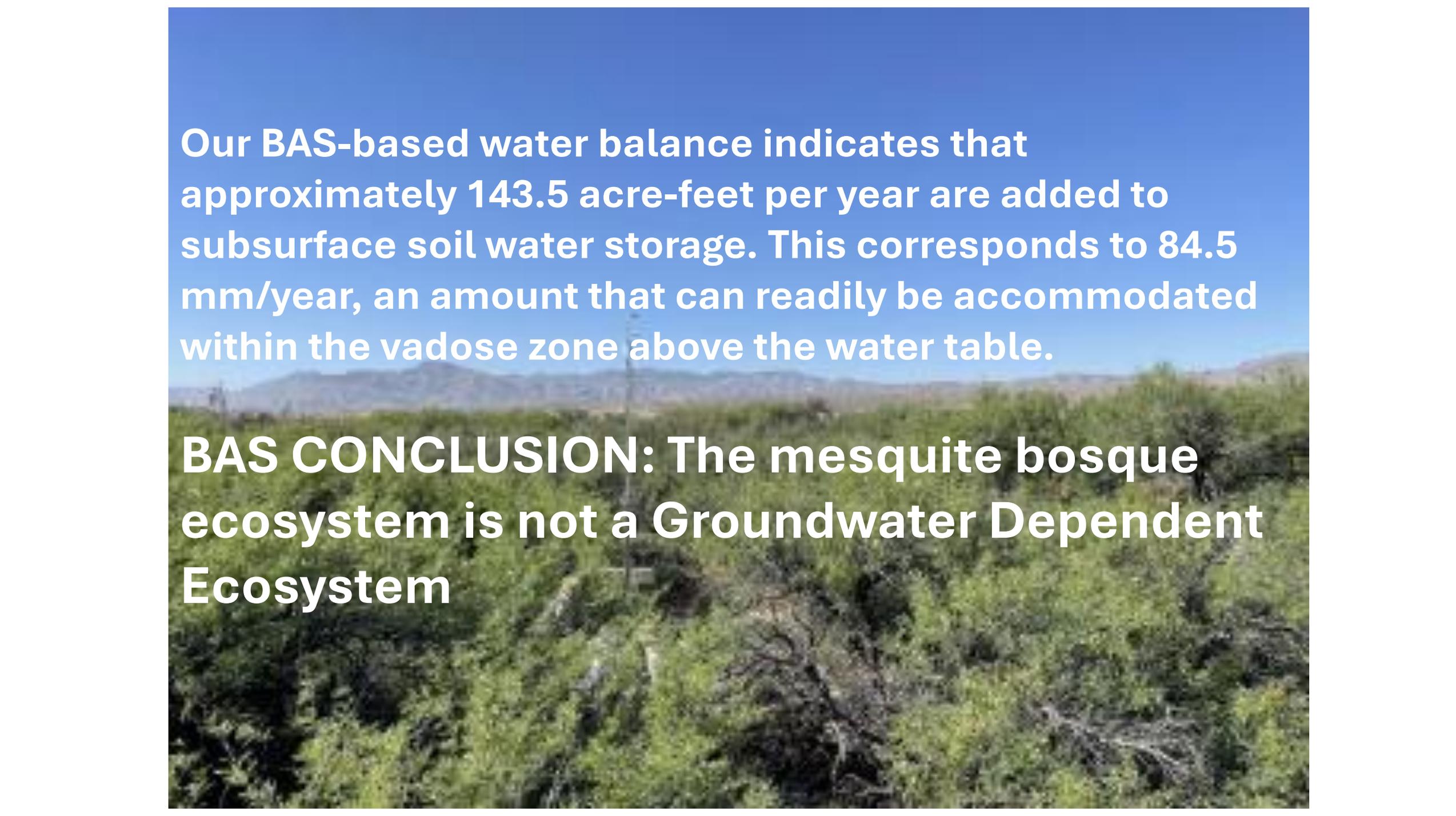
There are 2327 mesquite pixels out of 8210 pixels that receive an average run-on of 143.5 ac ft/year

NON BAS UTS water balance $ET - P = \text{Mesquite Groundwater Use}$

The NON BAS water balance in the UTS report wrongly concludes that there is 143.5 ac ft/year groundwater transpiration.

The BAS water balance $ET - P = \text{Mesquite Groundwater Use} + \text{Change Soil Water Storage} + \text{Runon} + \text{Drainage to Aquifer}$

The isotope analysis concluded Mesquite Groundwater Use = 0; Drainage to Aquifer ≈ 0 so that $ET - P = \text{Change Soil Water Storage} + \text{Runon} \approx 143.5$ ac ft/year. During a wetting event Runon will play a role and Soil Water Storage increases; during a dry year Runon = 0 and Soil Water Storage decreases.



Our BAS-based water balance indicates that approximately 143.5 acre-feet per year are added to subsurface soil water storage. This corresponds to 84.5 mm/year, an amount that can readily be accommodated within the vadose zone above the water table.

BAS CONCLUSION: The mesquite bosque ecosystem is not a Groundwater Dependent Ecosystem