ACTUAL EVAPOTRANSPIRATION ANALYSIS
December - 2020

Prepared for

Eastern Tule Groundwater Sustainability Agency

Prepared by

LAND IQ

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INTRODUCTION

The Eastern Tule Groundwater Sustainability Agency (ETGSA) has partnered with Land IQ to develop spatial datasets of monthly actual evapotranspiration (ETa) within their district boundaries. In this analysis, remotely sensed data from satellites are calibrated against in-situ measurements from ground-based climate stations to create a spatially continuous map of ETa within ETGSA for the month.

ANALYSIS

Consumptive use analysis is done in in two main parts:

1. Ground truthing measurements and calibration
2. Remotely sensed analysis and summarization

GROUND TRUTHING

A current map of the stations showing all locations along with the crop distribution across the district (Figure 1) demonstrates the variety of calibration data available for model building. Included in this month's report, Table 2 shows the daily precipitation totals for the month measured by Land IQ stations and California Department of Water Resources CIMIS stations, and the precipitation among the entire area is shown in Figure 2.

TABLE 1. SENSORS USED IN DAILY AND MONTHLY ETA ANALYSIS BY CROP CATEGORY

	Number of Active Stations	Number of Used Stations in Model
Alfalfa	8	5
Almonds	19	6
Annuals	2	1
Citrus	13	8
Fallow/Native	3	3
Grapes	9	3
Olives	2	2
Pistachios	9	4
Pomegranates	1	1
Walnuts	1	1

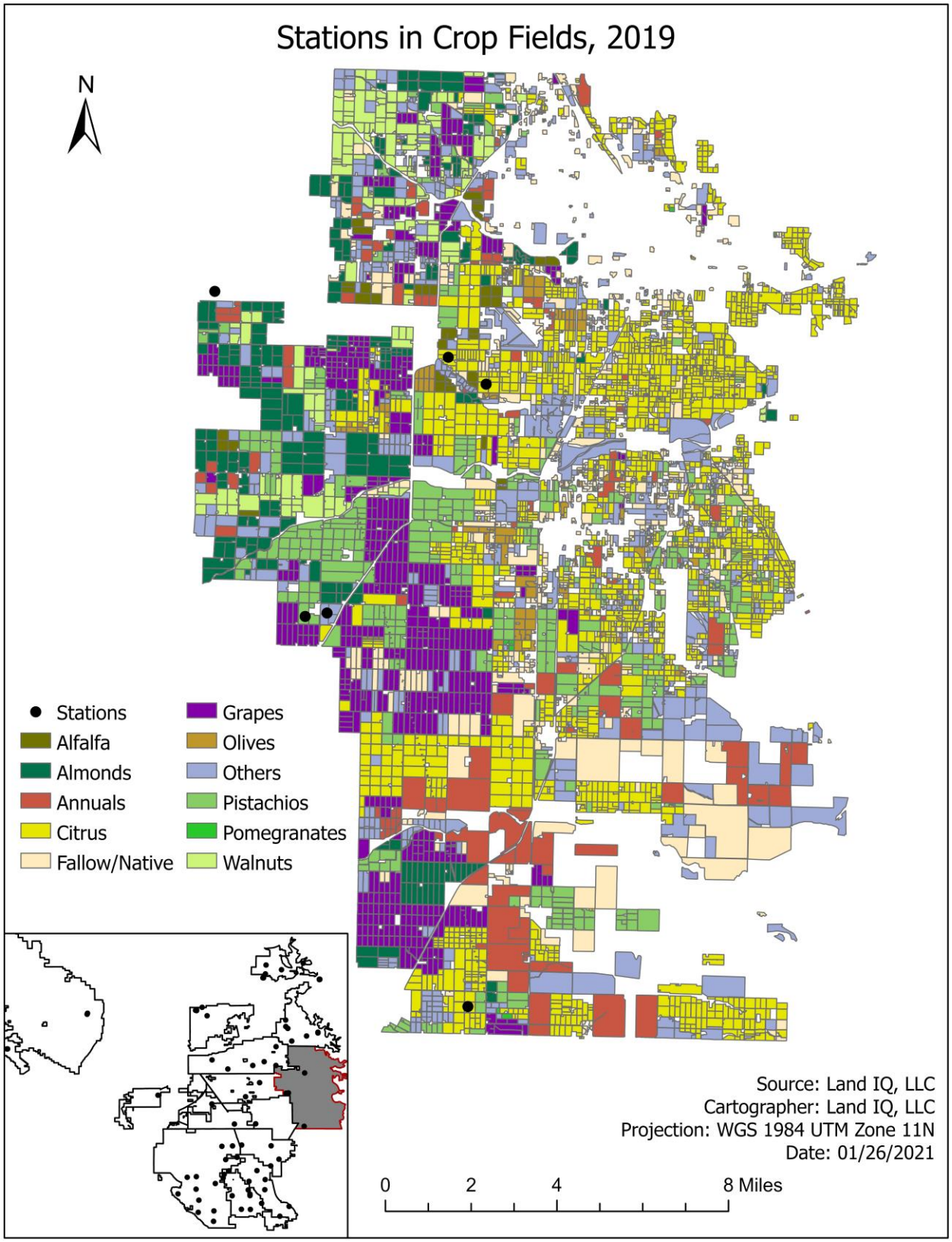

FIGURE 1. MAP OF CROP DISTRIBUTION AND STATION LOCATIONS

TABLE 2. PRECIPITATION MEASURED BY STATIONS

Date	Almonds (mm)	Murcotts (mm)	Walnuts (mm)	CIMIS #5: Shafter (mm)	CIMIS #54: Blackwells Corner (westside) (mm)	CIMIS #169: Porterville (mm)	CIMIS #182: Delano (mm)
Total	**12**	**11.2**	**13.1**	**8.7**	**8.6**	**11**	**6.6**

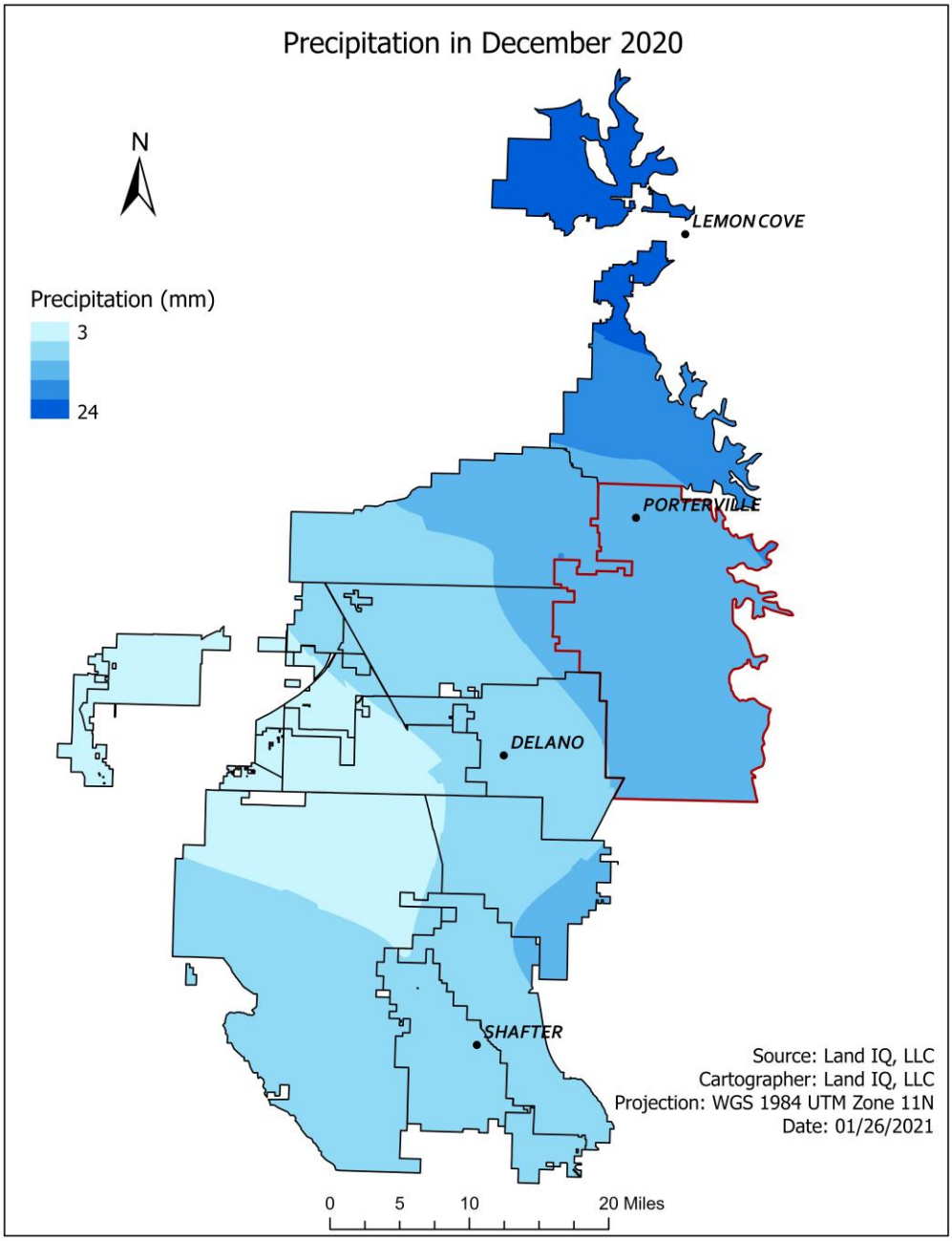

FIGURE 2. PRECIPITATION DURING THE MONTH WITHIN THE ENTIRE ANALYSIS AREA

REMOTE SENSING RESULTS

For this specific analysis, the image analysis dates and sources are shown in Table 3. Other imagery could not be used in the analysis because of cloud cover on the overpass dates. The actual ET image is shown in Figure 4. The monthly district-wide actual ET for the entire 161,257 acres, including depth and volume, is shown in Table 4. The monthly field actual ET is shown in Table 5. Monthly district-wide precipitation generated from the kriging interpolation is in Table 6.

TABLE 3. IMAGE DATES AND SOURCES

Date	Image Source
December 1, 2020	Landsat 8
December 2, 2020	Sentinel 2
December 7, 2020	Sentinel 2
January 1, 2020	Sentinel 2

TABLE 4. MONTHLY DISTRICT ACTUAL ET

	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Depth (mm)	103.7	78.7	87.8	70.1	49.4	32.5	14.9	6.2
Depth (inch)	4.1	3.1	3.5	2.8	1.9	1.3	0.6	0.2
Volume (AF)	54,875	41,644	46,462	37,106	26,118	17,199	7,873	3,275

TABLE 5. MONTHLY FIELD ACTUAL ET IN MM

	ACRES	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Maximum	***814.6***	189.6	211.2	195.0	178.4	118.4	82.3	43.0	27.5
Minimum	***0.1***	9.9	0.0	7.3	1.0	0.1	0.5	0.0	0.9
Average	***19.1***	117.7	95.5	104.7	85.1	59.7	42.9	19.5	7.8

TABLE 6. MONTHLY DISTRICT PRECIPITATION

	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Precipitation (mm)	2.1	0	0	0	0	0	4.5	11.4
Precipitation (inch)	0.1	0	0	0	0	0	0.2	0.5
Volume (AF)	1,132	0	0	0	0	0	2,392	6,030

Measured versus predicted monthly ETa is presented in Figure 3. Measured values represent data from field stations, whereas predicted values represented those generated by the LDDM. Stations are displayed as different symbols by crop types. For instance, all square symbols represent fallow/native stations. These stations are also symbolized in different colors by station type. Black symbols represent "Full" stations, green ones are "WIQ" stations, and red ones are "Tule Tech" stations. Therefore, green circle symbols represent measurements and predictions of WIQ citrus stations.

The R^2 value is the relative measure of fit of the observed data to the predicted result, where a value of 1 indicates a perfect fit. RMSE can be interpreted as the standard deviation, where a value of 0 mm would indicate perfect fit to the observed data. In this month, the big residuals were from some Tule almond stations (red diamond symbols), because these Tule stations over-measure daily ETa of young tree crops.

TABLE 7. MEASURED VS. PREDICTED MONTHLY ETa

R^2	RMSE (MM)
0.8	3.7

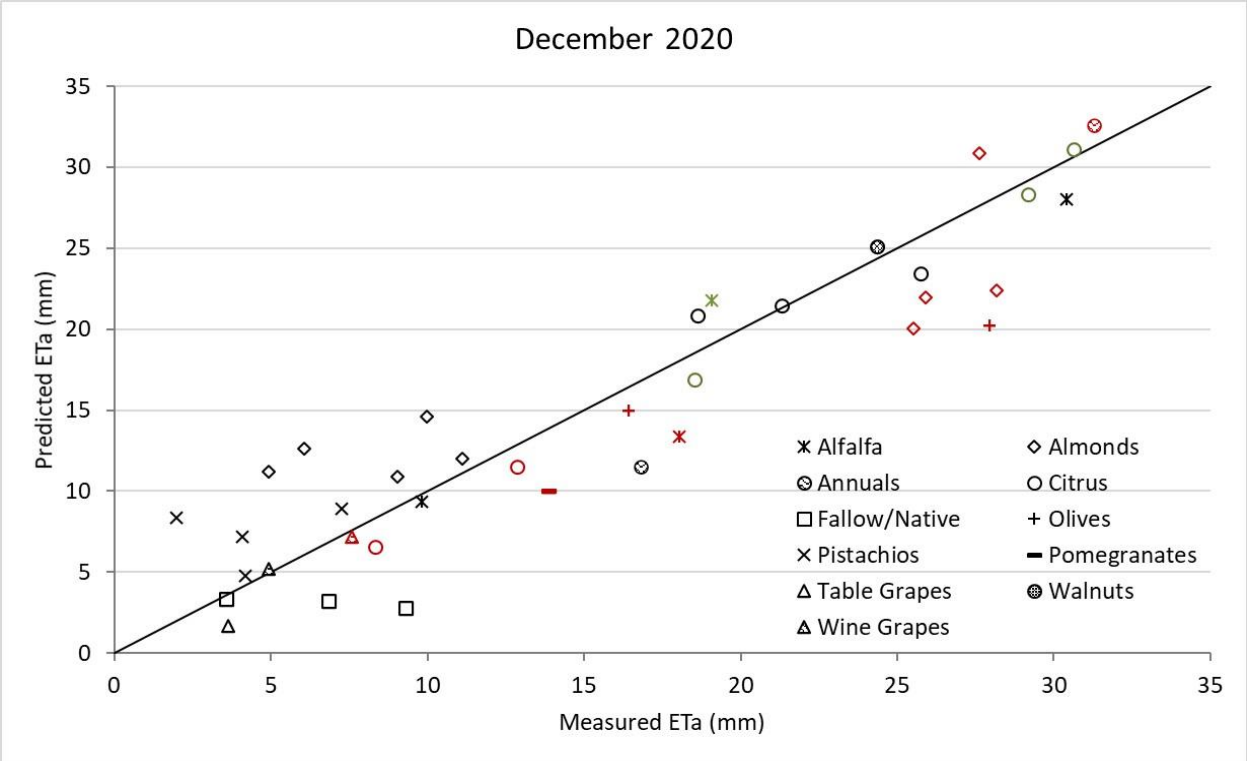

FIGURE 3. MEASURED VERSUS PREDICTED ETA FOR THE MONTH. SYMBOL COLORS REPRESENT THE STATION TYPES (BLACK = FULL, GREEN = WATER IQ (WIQ), RED = TULE TECH)

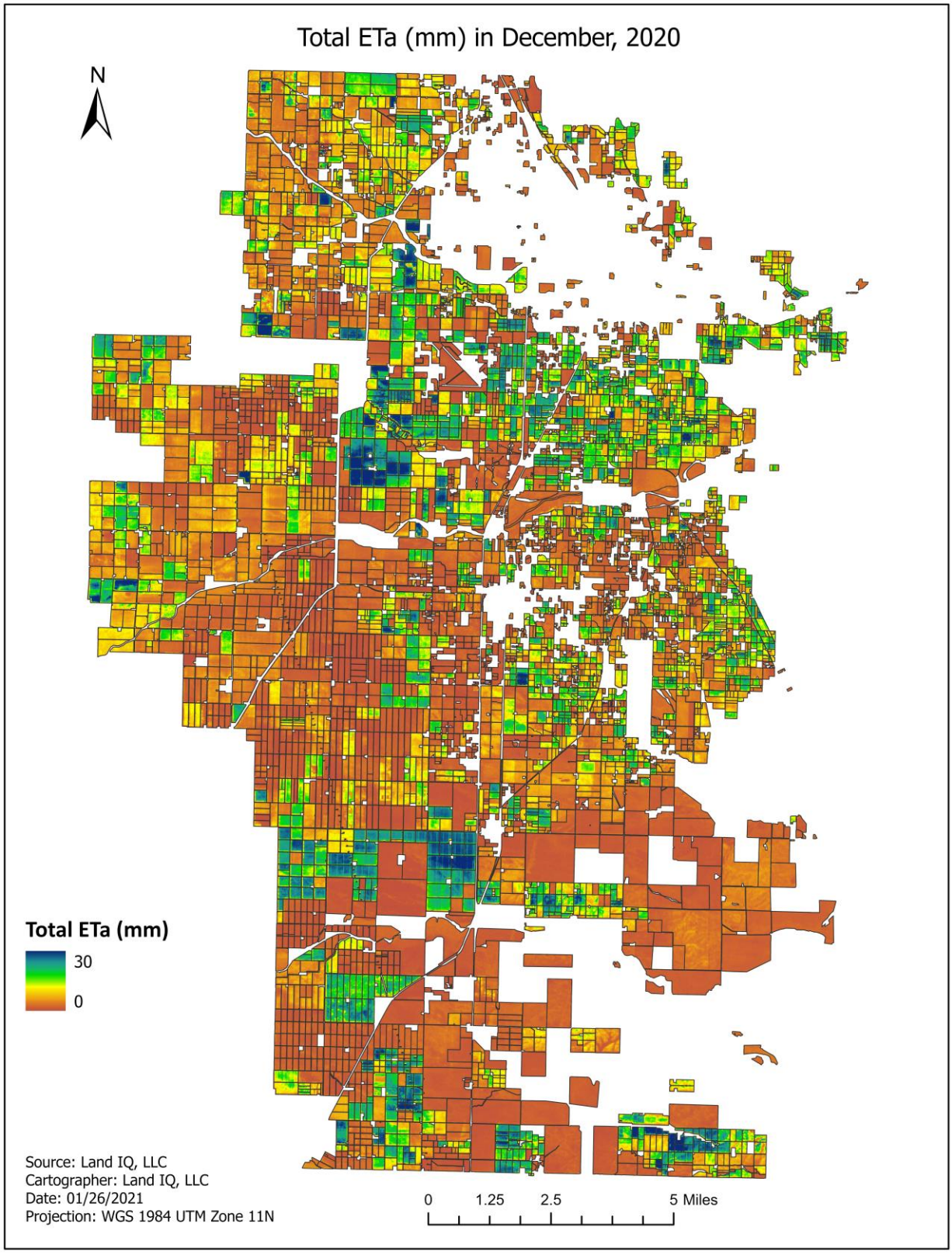

FIGURE 4. PIXEL LEVEL TOTAL ETA (MM) FOR THE MONTH