Correlation Between Strong El Niño Events (ONI > 2.0) and Kings River Flood Management in the Tulare Basin

Abstract

Strong El Niño events, defined by Oceanic Niño Index (ONI) values exceeding +2.0 for sustained periods, are strongly associated with extreme precipitation and snowpack in California's Sierra Nevada, leading to record or near-record runoff in the Kings River watershed. Historical analysis of qualifying events — particularly 1965–66, 1982–83, 1997–98, 2015–16, and 2023–24 — reveals a strong pattern with nearly all years consistently producing high annual runoff (often exceeding 4 million acre-feet), triggering significant use of the James Bypass for flood relief and, in the most extreme cases, substantial inflows that contribute to the reactivation and flooding of the historically dry Tulare Lake bed. This synopsis examines available KRWA Watermaster reports, USGS flow data, and Tulare Basin hydrology records to support the hypothesis that strong El Niño conditions (>2.0 ONI) dramatically elevate the probability of large-scale floodwater routing through the James Bypass and subsequent Tulare Lake inundation. The correlation has important implications for water management, flood control, and agricultural planning in the San Joaquin Valley.

Forecast

As of early July 2026, El Niño conditions are confirmed and strengthening. NOAA's Climate Prediction Center's July 9, 2026 update has moved the ENSO Alert System Status to El Niño Advisory, with El Niño confirmed to have strengthened over the past month — a large area of sea surface temperature anomalies exceeding +1.0°C now spans the central and eastern equatorial Pacific. The latest weekly Niño-3.4 index value stands at +1.2°C, with the westernmost Niño-4 region at +0.5°C and the easternmost Niño-1+2 region considerably warmer at +2.7°C. CPC's models now forecast El Niño to intensify through the remainder of 2026, with very high confidence, driven by strong atmosphere-ocean coupling across the Pacific and expected to continue through early 2027. There is now an 81% chance of a very strong El Niño during October–December, which would rank among the largest El Niño events in the historical record dating back to 1950, and a 97% chance El Niño will persist through early spring 2027. (courtesy of NOAA)

For California, this rapid strengthening reinforces the case for a wetter-than-average, more active winter — particularly across Central and Southern California — with an elevated subtropical jet, more frequent atmospheric rivers, and above-average Sierra snowpack potential. Given the 81% probability of a very strong event by October–December, water managers, farmers, and residents in flood-prone areas like the San Joaquin Valley should treat a strong wet-winter scenario as the higher-probability outcome rather than a tail risk, while still monitoring the CPC regularly for updates.

Introduction

The Kings River, one of California's major Sierra-fed waterways, drains into the Tulare Basin — an endorheic (closed) watershed with no natural outlet to the ocean. Managed primarily by the Kings River Water Association (KRWA) as Watermaster and supported

by Pine Flat Dam for flood control and storage, the system relies on the James Bypass (a man-made channel with design capacity around 4,750 cfs) to divert excess flows northward to the San Joaquin River when flooding exceeds channel capacities. Southward flows, when unmanaged or overwhelming infrastructure, can reach the Tulare Lake bed, historically one of North America's largest freshwater lakes before upstream water diversions largely eliminated it.

El Niño-Southern Oscillation (ENSO) phases can significantly influence California winter precipitation. Strong El Niño events enhance atmospheric river activity and Sierra snowpack, increasing flood risk. This synopsis focuses on events where ONI exceeded +2.0, evaluating their impact on Kings River runoff, James Bypass usage, and Tulare Lake inflows.

Over the past 90 years, parts of the Tulare Lake basin have subsided by more than 30 feet with more than 4 billion cubic yards of total land loss, resulting in an eastward shift of the historical bottom of Tulare Lake by more than 7 miles to the east with an elongated lake bottom now extending more than 12 miles to the southeast of the historical lake configuration (see Figure 1). This resulting shift has additionally altered the drainage characteristics of the Tule River as it enters the former limits of Tulare Lake with farm managers having to continuously raise canal banks in order to promote westerly flows for crop irrigation (see Figure 2). An analysis of subsidence data now show that if Tulare Lake were to receive 500,000 acre-feet of flood waters (or more), nearly ½ of the Town of Corcoran would be inundated at the 188 foot contour level and the California Department of Corrections – Corcoran would be flooded at depths ranging from 6 to 10 feet of water (see Figure 3).

Data and Key Findings

Analysis of strong El Niño years shows consistent patterns:

- **1965–66** (peak ONI ~+2.0): Above-average runoff (~1.2 million AF). Notable flood activity, including December 1966 events affecting the broader Tulare Basin, with moderate James Bypass use and some southern basin flooding.
- **1982–83** (peak ONI ~+2.2–2.3): Record runoff at the time (~4.476 million AF). Major sustained flood releases via James Bypass (estimated hundreds of thousands to over 500,000 AF in extreme periods) and significant Tulare Lake reactivation, with ~83,000 acres inundated and major inflows from Kings and tributary rivers.
- **1997–98** (peak ONI ~+2.3–2.4): Very high runoff (~3.4 million AF). Substantial Bypass flows and lake re-emergence (~20,000 acres at peak), with notable flooding impacts.
- **2015–16** (peak ONI ~+2.6–2.8): Average runoff with only 2 of 49 atmospheric rivers landing south of Monterey as the jet stream shifted further north with the primary beneficiaries of El Nino rainfall events being northern California, Oregon and Washington.
- **2023–24** (peak ONI ~+2.0): New record runoff (~4.5 million AF). High Bypass utilization and widespread Tulare Lake re-emergence (peaking over 100,000 acres), with coordinated flood management and diversions.

Historical Context

Over multi-decade periods (e.g., 1947–2009), surplus flood flows through the James Bypass have totaled approximately 7.35–8.5 million AF, with the largest volumes clustered during strong El Niño years. Tulare Lake inflows from Kings River (and basin tributaries) spike dramatically in these events, as seen in 1983 and 2023. Non-El Niño or weaker events rarely produce comparable extremes.

Hypothesis

There is a very strong correlation between strong El Niño events (ONI > 2.0) and the probability of (1) elevated Kings River runoff requiring large-scale routing through the James Bypass and (2) subsequent flooding or reactivation of Tulare Lake. In nearly all documented cases meeting the >2.0 threshold (exception being 2015-2016), flood management infrastructure was heavily utilized and Tulare Lake showed significant response in the most intense years. This relationship appears driven by enhanced atmospheric rivers and snowpack accumulation, though local management (Pine Flat releases, diversions, recharge) modulates final outcomes. While moderate El Niños (e.g., 1968–69, with ~4.386 million AF runoff) can also produce high flows, the strongest events (>2.0 ONI) show the most reliable and extreme outcomes.

Conclusion and Implications

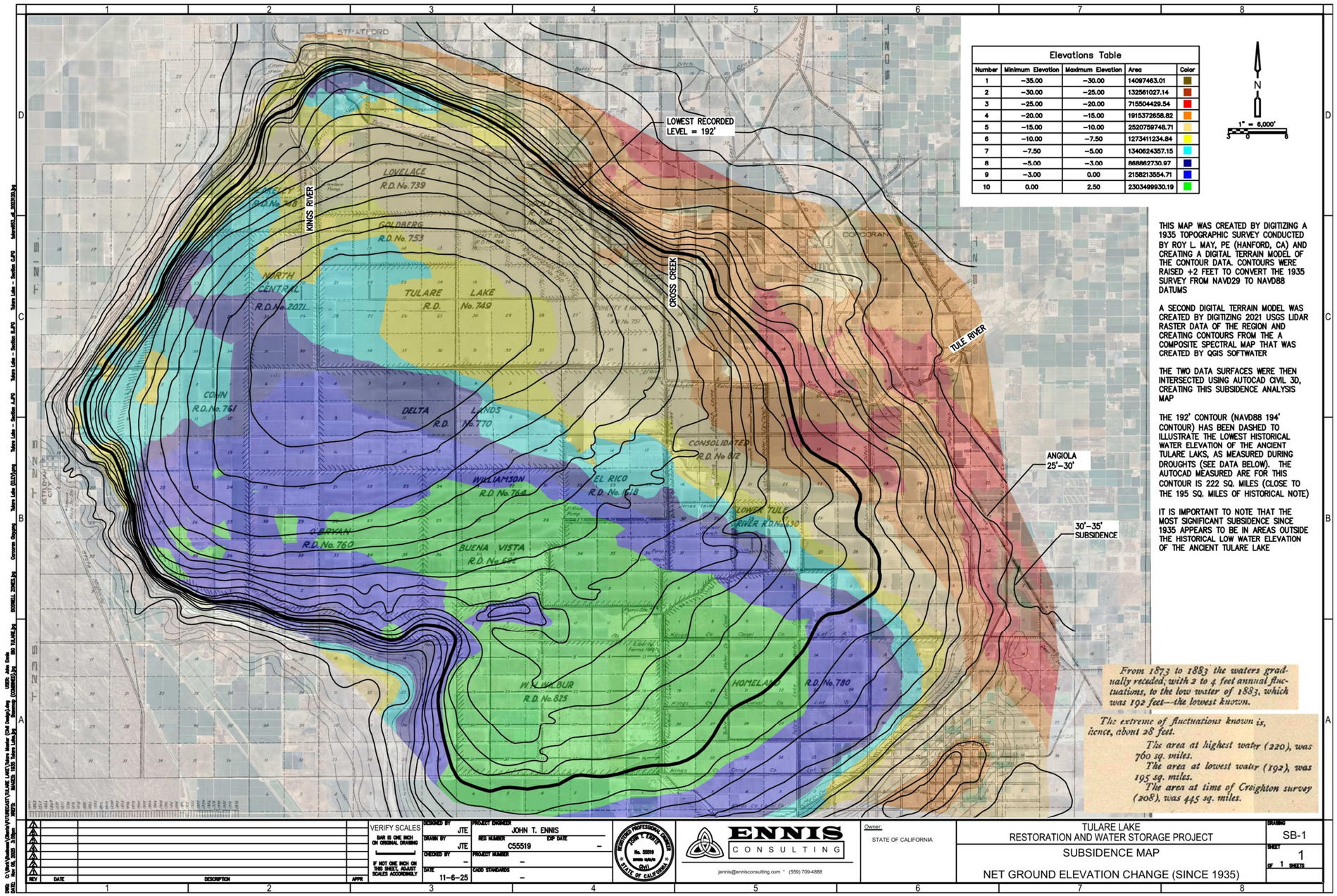
The data supports treating strong El Niño forecasts as a high-confidence signal for proactive flood preparedness in the Kings River and Tulare Basin. Enhanced monitoring, expanded recharge projects, and infrastructure improvements could better harness these surplus flows for groundwater sustainability while mitigating flood risks. As climate variability potentially influences ENSO intensity, continued analysis of KRWA reports and real-time data will be essential. This strong historical correlation underscores the value of seasonal ENSO forecasting for water managers, farmers, and communities in California's San Joaquin Valley.

Commentary/Opinion

The Tulare Lake basin is among the most severely subsided groundwater basins in the United States and it continues to be an unfortunate reality that extreme flood events are routed through the James Bypass and to the Pacific Ocean in lieu of being fully utilized in an off stream storage reservoir (i.e. Tulare Lake Restoration Project) and/or, with sufficient conveyance mechanisms in place, routed to south valley water banks for groundwater recharge via a California Aqueduct intertie.

While the JG Boswell Corporation and Reclamation District 749 (et. al) are able to pump and control flood flows through the Homeland Canal and into the South Wilbur and Hacienda storage zones, the total flow/pumping capacity of this canal and the total storage capacities of these two basins are largely unknown. As a result, flood planning for the Town of Corcoran and the CDC – Corcoran facility as well as other subsidence stricken land owners within the basin continue to be at the discretion of Boswell Corporation flood protection control measures.

Should the 2026-2027 El Nino become as strong as expected, it is recommended that all agencies and private land owners begin proactive planning sooner, rather than later.



Elevations Table				
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4	–20.00	–15.00	1915372858.82	
5	–15.00	–10.00	2520759748.71	
6	–10.00	–7.50	1273411234.84	
7	–7.50	–5.00	1340624357.15	
8	–5.00	–3.00	868862730.97	
9	–3.00	0.00	2158213554.71	
10	0.00	2.50	2303499930.19	

N

1" = 6,000'

THIS MAP WAS CREATED BY DIGITIZING A 1935 TOPOGRAPHIC SURVEY CONDUCTED BY ROY L. MAY, PE (HANFORD, CA) AND CREATING A DIGITAL TERRAIN MODEL OF THE CONTOUR DATA. CONTOURS WERE RAISED +2 FEET TO CONVERT THE 1935 SURVEY FROM NAVD29 TO NAVD88 DATUMS

A SECOND DIGITAL TERRAIN MODEL WAS CREATED BY DIGITIZING 2021 USGS LIDAR RASTER DATA OF THE REGION AND CREATING CONTOURS FROM THE A COMPOSITE SPECTRAL MAP THAT WAS CREATED BY QGIS SOFTWATER

THE TWO DATA SURFACES WERE THEN INTERSECTED USING AUTOCAD CIVIL 3D, CREATING THIS SUBSIDENCE ANALYSIS MAP

THE 192' CONTOUR (NAVD88 194' CONTOUR) HAS BEEN DASHED TO ILLUSTRATE THE LOWEST HISTORICAL WATER ELEVATION OF THE ANCIENT TULARE LAKS, AS MEASURED DURING DROUGHTS (SEE DATA BELOW). THE AUTOCAD MEASURED ARE FOR THIS CONTOUR IS 222 SQ. MILES (CLOSE TO THE 195 SQ. MILES OF HISTORICAL NOTE)

IT IS IMPORTANT TO NOTE THAT THE MOST SIGNIFICANT SUBSIDENCE SINCE 1935 APPEARS TO BE IN AREAS OUTSIDE THE HISTORICAL LOW WATER ELEVATION OF THE ANCIENT TULARE LAKE

From 1873 to 1883 the waters gradually receded, with 2 to 4 feet annual fluctuations, to the low water of 1883, which was 192 feet—the lowest known.

The extreme of fluctuations known is, hence, about 28 feet.

The area at highest water (220), was 760 sq. miles.

The area at lowest water (192), was 195 sq. miles.

The area at time of Creighton survey (208), was 445 sq. miles.

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

REV	DATE	DESCRIPTION	APPR
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DESIGNED BY JTE
DRAWN BY JTE
CHECKED BY –
DATE 11-6-25
PROJECT ENGINEER JOHN T. ENNIS
REG NUMBER C55519 EXP DATE –
PROJECT NUMBER –
CADD STANDARDS –

REGISTERED PROFESSIONAL ENGINEER JOHN T. ENNIS No. 55519 CIVIL STATE OF CALIFORNIA

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TULARE LAKE
RESTORATION AND WATER STORAGE PROJECT

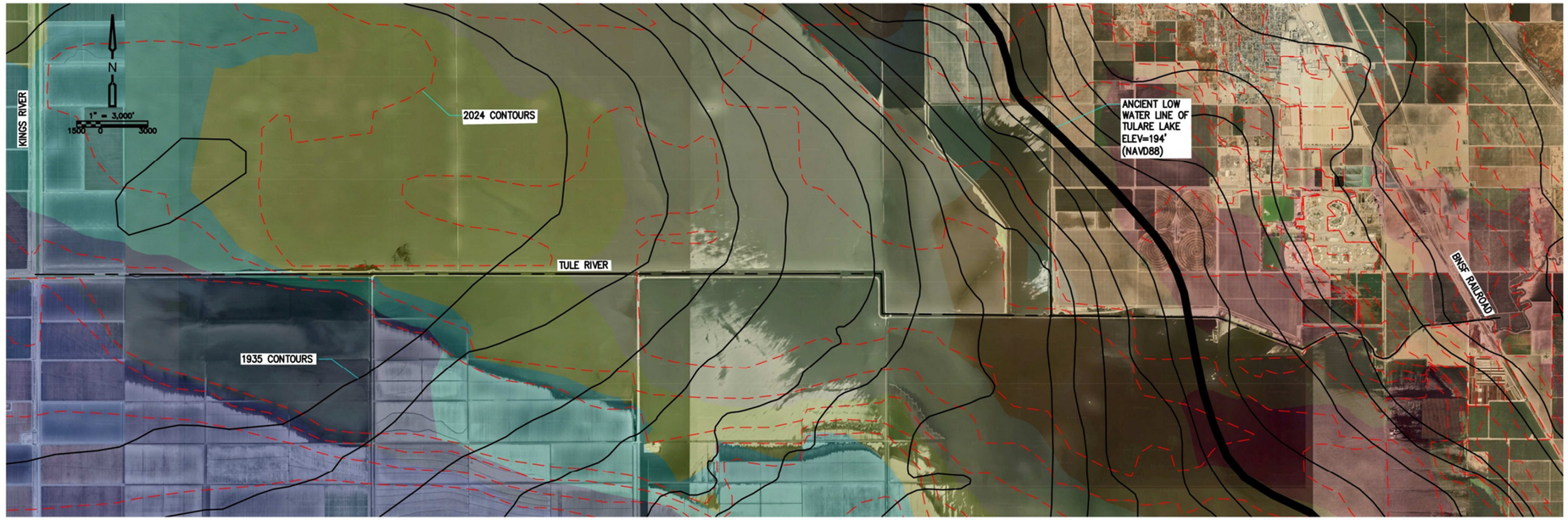
SUBSIDENCE MAP

NET GROUND ELEVATION CHANGE (SINCE 1935)

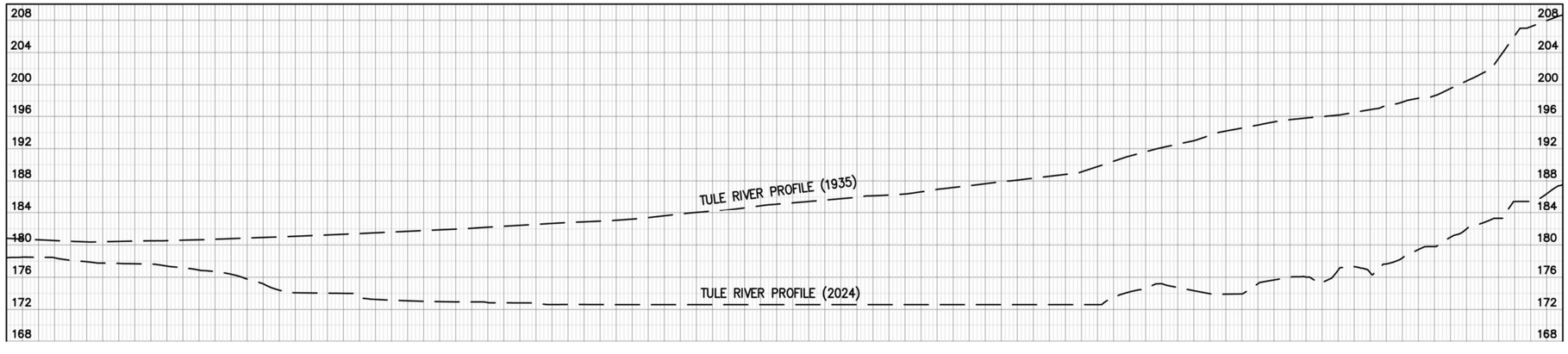
DRAWING SB-1
SHEET 1 OF 1 SHEETS

DWG: G:\Work\Businesses\Clients\TULARE LAKE\Tulare Master (Civil Design)\Tulare Lake (ELEV).dwg
DATE: Nov 06, 2025 3:39pm
XREFs: BASES 1935 Tulare Lake.jpg Basemap (CAMERA).jpg BB TULARE.jpg BORREL ZONES.jpg Common Designs

Figure 1



PLAN
SCALE: 1"=3,000 FEET



PROFILE
SCALE: 1"=3,000 FEET

REV	DATE	DESCRIPTION	APPR

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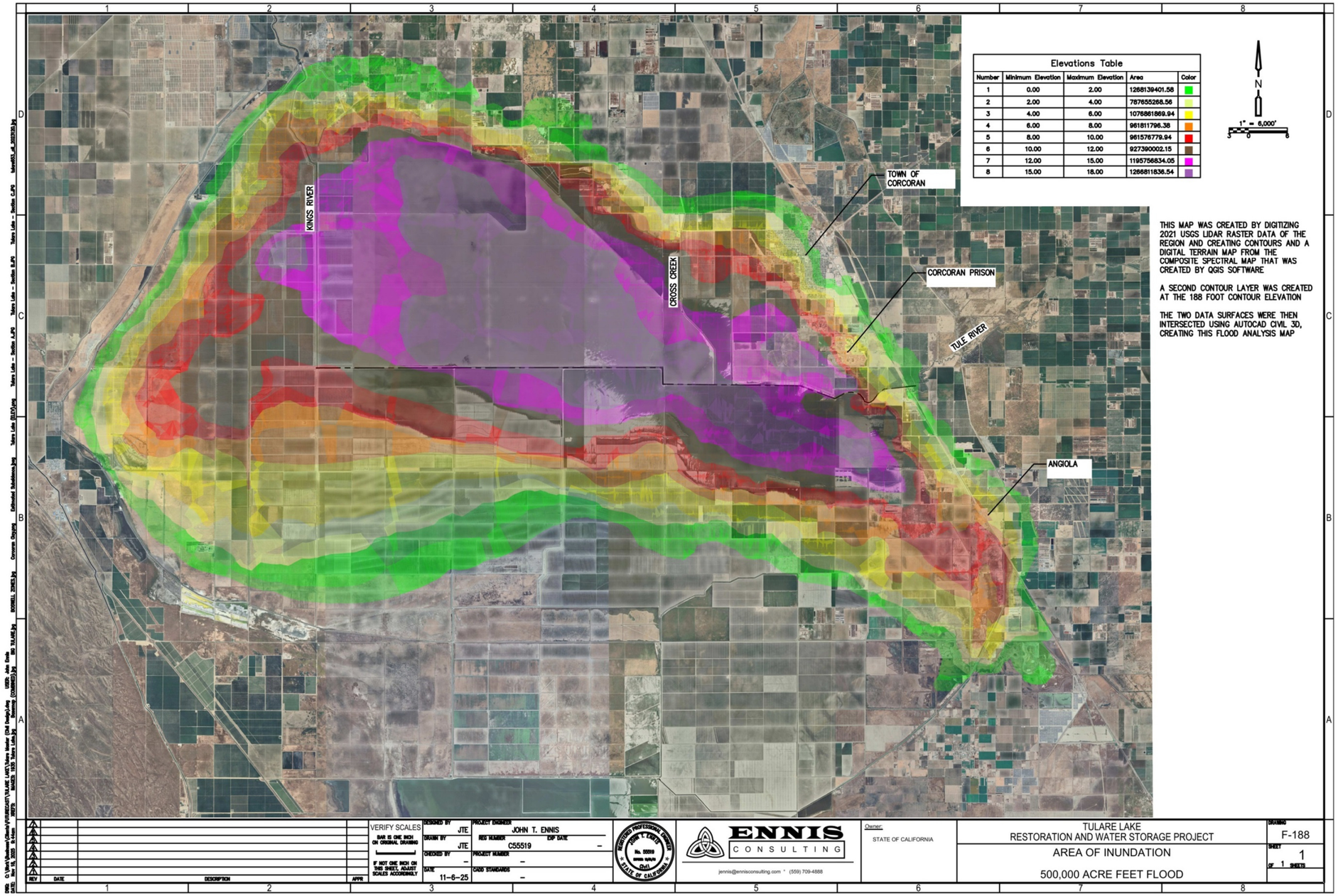
TULARE LAKE
RESTORATION AND WATER STORAGE PROJECT

TULE RIVER SUBSIDENCE - 1935 TO 2024

DRAWING LP-1
SHEET 1 OF 1 SHEETS

Figure 2


Elevations Table
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2 | 2.00 | 4.00 | 787655268.56
3 | 4.00 | 6.00 | 1076861869.94
4 | 6.00 | 8.00 | 961811796.38
5 | 8.00 | 10.00 | 961576779.94
6 | 10.00 | 12.00 | 927390002.15
7 | 12.00 | 15.00 | 1195756834.05
8 | 15.00 | 18.00 | 1266811836.54
N
1" = 5,000'
TOWN OF CORCORAN
KINGS RIVER
CROSS CREEK
CORCORAN PRISON
TULE RIVER
ANGIOLA
THIS MAP WAS CREATED BY DIGITIZING 2021 USGS LIDAR RASTER DATA OF THE REGION AND CREATING CONTOURS AND A DIGITAL TERRAIN MAP FROM THE COMPOSITE SPECTRAL MAP THAT WAS CREATED BY QGIS SOFTWARE
A SECOND CONTOUR LAYER WAS CREATED AT THE 188 FOOT CONTOUR ELEVATION
THE TWO DATA SURFACES WERE THEN INTERSECTED USING AUTOCAD CIVIL 3D, CREATING THIS FLOOD ANALYSIS MAP
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
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DRAWN BY JTE
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REG NUMBER C55519 EXP DATE –
PROJECT NUMBER –
CADD STANDARDS –
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TULARE LAKE
RESTORATION AND WATER STORAGE PROJECT
AREA OF INUNDATION
500,000 ACRE FEET FLOOD
DRAWING F-188
SHEET 1 OF 1 SHEETS

Figure 3