Committee Members
Leticia Gonzalez
Robert Macaulay

Any individual with a disability may request special assistance by contacting the chief clerk to the board of supervisors (acting on behalf of the Madera County GSAs).

Madera County
Groundwater Sustainability Agency
(in the Madera, Chowchilla, and Delta-Mendota Subbasins)
Committee Meeting
July 1, 2025
1:30 p.m.

Meeting Location
Madera County Government Center
200 W. 4th Street, Madera CA 93637
Board of Supervisors Chambers

REMOTE PARTICIPATION
https://zoom.us/j/83035126482

Supporting documents relating to the items on this agenda are available through the County of Madera websites at www.maderacounty.com and maderacountywater.com. These documents are also available at the Office of the Clerk of the Board of Supervisors (acting on behalf of the Madera County GSAs), 200 West 4th Street, 4th Floor, Madera, CA 93637. Supporting documents relating to the items on this agenda that are not listed as 'Closed Session' may be submitted after the posting of the agenda and are available at the Office of the Clerk of the Board of Supervisors (acting on behalf of the Madera County GSAs). Please visit the Office of the Clerk of the Board of Supervisors (acting on behalf of the Madera County GSAs) for updates.

1. Flag Salute

2. Public Comment – This is an opportunity for comment on items not on this agenda. This is also a place to suggest topics for future meetings. Comments can be five minutes or less.

Committee Members
Leticia Gonzalez
Robert Macaulay

3. Action Item: Approval of the Madera County Groundwater Sustainability Agency Committee Meeting Minutes from June 3, 2025.

4. Informational Item: Measurement Method and/or Groundwater Platform Presentations:
    a. Hydrosat (Measurement data)
    b. Land IQ (Measurement data)
    c. California Water Data Consortium (Measurement data + platform)
    d. 4 Creeks with Basinsafe (platform)
    e. Davids Engineering and H2oTech with RemoteTracker (platform)
    f. MLJ with Watermark (platform)
    g. United Water Tracking Systems with the Water Dashboard Accounting Platform (platform)

Recess

5. Action Item: Consideration and Recommendation to the Board of Directors to approve a resolution amending Resolution 2022-086 and repealing and replacing resolution 2022-198 establishing revised fees for Domestic Well Mitigation Program for the Madera Subbasin.

6. Action Item: Consideration and Recommendation to the Board of Directors to approve a resolution repealing Resolution No. 2025-004 and reinstating Resolution No. 2022-072 which outlines procedures for the review of new or altered groundwater wells and verification of consistency with adopted groundwater sustainability plans.

7. Directors' Reports

8. Adjourn

Committee Members
Leticia Gonzalez
Robert Macaulay

ITEM 3

Madera County
Groundwater Sustainability Agency
(in the Madera, Chowchilla, and Delta-Mendota Subbasins)
Committee Meeting
June 3, 2025 @ 1:30 p.m.

Meeting Location: Madera County Government Center
200 W. 4th Street, Madera CA 93637
Board of Supervisors Chambers

REMOTE PARTICIPATION
https://zoom.us/j/84338107787

Attendance:

County GSA Directors: Leticia Gonzalez, Robert Macaulay
County GSA Staff: Jeannie Habben, Allison Medley, Leticia Tapia, Tukta Phetasa, Aleta Allen, Emily Garcia
County staff attending on behalf of the GSA: Angela Grandov, Regina Garza

30 members of public in person; 33 members of the public on Zoom

1. Flag Salute – This was led by Director Gonzalez

2. Public Comment – Two public comments were made.

3. Action Item: Approval of the Madera County Groundwater Sustainability Agency Committee Meeting Minutes from May 6, 2025. – Amended minutes were approved with a minor correction in spelling.

Result: Motion passed with correction
Moved: Director Macaulay
Second: Director Gonzalez
Ayes: Director Gonzalez; Director Macaulay

4. Request for Feedback: Review of domestic well mitigation fee for Madera Subbasin, Madera County Groundwater Sustainability Agency, Groundwater Sustainability Project – Ms. Habben introduced the topic and Mr. Kevin Kostiuk of Raftelis gave a presentation on rates for domestic well mitigation. There were seven comments from the public.

5. Action Items: Consideration and Recommendation to the Board of Directors to enter into LandFlex-related contract amendments for land repurposing:
    a. Kamal Jawad
    b. C&J Ranch, LLC
    c. RRR Ranch Trust

Ms. Habben introduced the topic and Ms. Letty Tapia presented. There were no comments on the item.

Result: Motion passed, unanimously
Moved: Director Macaulay
Second: Director Gonzalez
Ayes: Director Gonzalez; Director Macaulay

6. Action Item: Consideration and Recommendation to the Board of Directors to enter into a Cost Sharing Memorandum of Understanding (MOU for the Madera Subbasin Joint Groundwater Sustainability Plan (GSP) Five-Year Evaluation and Plan Amendment – Ms. Habben introduced the topic and Ms. Aleta Allen presented. There was one comment from the public.

Result: Motion passed, unanimously
Moved: Director Macaulay
Second: Director Gonzalez
Ayes: Director Gonzalez; Director Macaulay

7. Action Item: Consideration and recommendation to the Board of Directors to approve Transfer of Appropriations No. 24-148 in the amount of $35,633.00 from Water & Natural Resources – County GSAs – Interfund Revenue to Intrafund Revenue for Fiscal Year 2024-2025 to reimburse the County GSAs Budget from the Drought budget for staff time spent on Drought activities – Ms. Habben introduced the topic and Ms. Emily Garcia presented. There were no comments.

Result: Motion passed, unanimously Moved: Director Macaulay Second: Director Gonzalez Ayes: Director Gonzalez; Director Macaulay

8. Directors' Reports
   Ms. Habben presented for the GSA

9. Adjourn: 2:38 pm

Committee Members
Leticia Gonzalez
Robert Macaulay

ITEM 4

Date: June 27, 2025

To: Madera County Groundwater Sustainability Agency (GSA) Committee
Leticia Gonzalez, Robert Macaulay

From: Stephanie Anagnoson, Director of Water and Natural Resources

Subject: Informational Item: Measurement Method and/or Groundwater Platform Presentations:

a. Hydrosat (Measurement data)
b. Land IQ (Measurement data)
c. California Water Data Consortium (Measurement data + platform)
d. 4 Creeks with Basinsafe (platform)
e. Davids Engineering and H2oTech with RemoteTracker (platform)
f. MLJ with Watermark (platform)
g. United Water Tracking Systems with the Water Dashboard Accounting Platform (platform)

DISCUSSION:

Background

Madera County Groundwater Sustainability Agency (Madera County GSA) tracks water use for irrigated acres within its boundaries using satellite measurement or meters. The choice of measurement is by grower decision. Two separate existing contracts for satellite measurement expire in 2025 at the end of the calendar year. The Madera County GSA has discussed looking for options for satellite measurement repeatedly at the GSA Committee level as well as Board of Directors level.

On May 15, 2025, staff issued a request for proposals (RFP) for measurement method(s) as well as an accounting platform to operate in conjunction with measurement methods. Questions on the RFP were due on May 30, 2025. Over 30 questions were received and responded to by June 3, 2025 primarily related to measurement methods.

Seven proposals were received and are summarized below (in no particular order).

a. Hydrosat (Measurement data) – This is a satellite measurement method, which provides an online portal and daily ET measurement and ETAW calculation. The effective precipitation is calculated using the IDC model. Annual costs for 2026 are $182,600 with discounts for longer subscriptions. Hydrosat is used internationally in more than 50 countries.
b. Land IQ (Measurement data) – This is a satellite measurement method with an optional online portal. The service provides ET and precipitation measurements. It includes on-ground weather stations. Annual costs for 2026 are $131,393 plus an online portal fee of $66,368 (optional) with discounts for longer subscriptions. Land IQ is used in 40 GSAs.
c. California Water Data Consortium with Groundwater Accounting Platform (Measurement data + platform) – This is a grower-facing platform for accessing data that can integrate Open ET or other measurement data sources. This would be a total cost in the first year of $123,000 with reduced rates at years two and three. This platform was originally developed for Rosedale-Rio Bravo Water Storage District.
d. 4 Creeks with Basinsafe (platform) – This is grower-facing platform for accessing data that can integrate different measurement sources. The platform currently serves six GSAs and seven water districts. Costs for year one are $156,500 with a reduced rate at years two and three.
e. Davids Engineering and H2OTech (platform) – This is a grower-facing platform for accessing data that can integrate different measurement sources. This platform was originally developed for surface water accounting with Richvale Irrigation District and Reclamation District No. 108. Costs for one year are $100,000 with discounted rates at years two and three.
f. United Water Tracking Systems with the Water Dashboard Accounting Platform (platform) – This is a grower-facing platform for accessing data that can integrate different measurement sources. Private meter data can be accepted through a structured appeals process. Costs for one year are $122,415.
g. MLJ with Watermark (platform) – This is a grower-facing platform for accessing data that can integrate different measurement sources. This is used by North Fork Kings GSA, South Fork Kings GSA and El Rico GSA. Costs for one year are $121,709 with a discounted rate at years two and three.

Committee Members
Leticia Gonzalez
Robert Macaulay

ITEM 4

Presentations will be conducted at the GSA Committee on July 1, 2025, with questions collected afterward in writing. Questions will be emailed to the vendors and their responses will be posted on-line on maderacountywater.com/measurement. The plan is to send a questionnaire to growers on their preferences after the July 1, 2025, GSA Committee meeting, and then bring a staff recommendation back in September.

FISCAL IMPACT:

There is significant fiscal impact with awarding a contract or contracts for measurement methods and a groundwater accounting platform. An estimate of costs is somewhere between $125,000 - $500,000 depending on number of measurement methods and accounting platform.

ATTACHMENTS:

Vendor Proposals

a. Hydrosat (Measurement data)
b. Land IQ (Measurement data)
c. California Water Data Consortium with Groundwater Accounting Platform (Measurement data + platform)
d. 4 Creeks with Basinsafe (platform)
e. Davids Engineering and H2oTech with RemoteTracker (platform)
f. MLJ with Watermark (platform)
g. United Water Tracking Systems with the Water Dashboard Accounting Platform (platform)

SA

Hydrosat

Proposal: Hydrosat remote sensing services for the Groundwater Sustainability Plan (GSP) of Madera County

Cover Letter

To: Madera County GSA(s)

Date: June 12th, 2025

The Californian Sustainable Groundwater Management Act (SGMA) is an excellent vehicle to reduce groundwater withdrawals. By defining allocations on the basis of Evapotranspiration from Applied Water (ETAW), two great steps forward are achieved: (i) only the amount of groundwater that has physically left the river basin will be accounted for (not gross withdrawals that includes recoverable water to other users) and (ii) ETAW is measurable from satellites. Hydrosat is therefore pleased to submit herewith a proposal with an action plan for 2025 and beyond. We believe that together with Madera County GSA(s) we can build on continuation of our experiences in the region and work closely with Davids Engineering on presentation of the results to the client and compare the results with field measurements.

Several Governments and Development Agencies outside the USA have expressed interest in copying what's now become internationally known as 'the Madera solution' to reduce groundwater withdrawals. It is with great pleasure we submit this proposal to continue our work with Madera County GSA(s) towards the implementation of their Groundwater Sustainability Plan (GSP) by providing data on water use for the County and its affiliated growers.

Over the past 5 years, we have closely worked with Madera County GSAs to provide our satellite measurement services for calculation of water use based on evapotranspiration from applied water (ETAW). This concept has been tailored to respond to the requirement of the county

Throughout the past few years, we have tailored our product, web portal, and API output to best serve the requirements of Madera County GSA(s) and its growers. In the early years of the program, we made model improvements and aligned the methodologies to make sure the different measurements methods for growers are comparable. In addition, we have revamped our web portal to make it simpler and easier to navigate.

Starting in 2025, the IrriWatch product has access to additional high resolution satellite imagery from Hydrosat which helps improve the accuracy of satellite measurements. Our first thermal satellite was launched in August 2024 and the second is scheduled to launch in June, 2025. Afterwards, additional satellites will be launched in 2026, 2027, and beyond. Access to proprietary high-resolution satellite data ensures more frequency and higher accuracy in the product.

The Hydrosat Team leverages its experience, project understanding, and lessons learned offering the following:

1. Experience in energy balance modeling to provide actual evapotranspiration at 10m pixel resolution.

2. Experience and knowledge about water balance modeling and calculations of evapotranspiration from applied water (ETAW) and from precipitation (ETPR).
3. Quick access to the data and irrigation portal in real-time daily timesteps: IrriWatch provides in addition to the data layers, an online platform at County level as well as at grower level to monitor water use, have access to budget tables for allocations, ETAW, remaining amounts of water, etc.
4. Irrigation scheduling information and crop monitoring is available from the IrriWatch portal for growers with daily updates.

The Hydrosat team is highly experienced and uniquely qualified to provide water use measurements from satellites. We look forward to the opportunity to continue working with Madera County GSA(s) toward sustainable groundwater management.

With kind regards,

Hydrosat Team

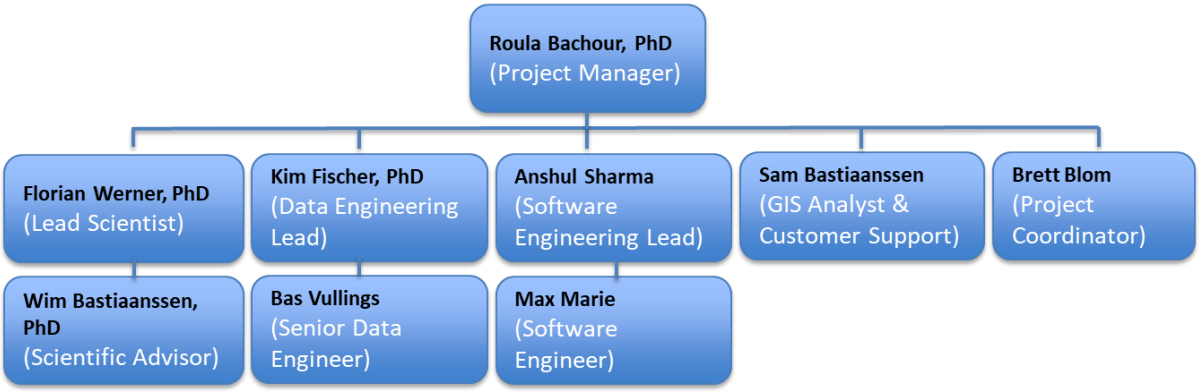
Table of Content

Organization Chart

Hydrosat is the proposed Primary Consultant to provide satellite measurement services.

Hydrosat will work under the administrative direction of Madera County GSA(s)' project manager. The team will be led by Roula Bachour, the Director of Customer Success at Hydrosat. Key tasks leaders include: Florian Werner (Lead Scientist), responsible for the science and modeling of ET and ETAW and water balances; Wim Bastiaanssen will be serving as a scientific advisor for the team; Kim Fischer and Bas Vullings will be ensuring data pipelines and processing of all output are delivered on time and water use estimates are generated both on daily and monthly basis; Anshul Sharma will be leading the portal development and any adjustments required including reporting and data at pixel level, API and graphs.

The proposed key personnel from Hydrosat and organization of the team for this project are presented on the organization chart below:



Qualifications

A short bio of the team members that will be involved in the project is presented below along with their involvement in the project.

Roula Bachour

Roula is the Director of Customer Success at Hydrosat, leading the clients' technical support including understanding of the remotely sensed data provided by the IrriWatch product. She is also coordinating Hydrosat's projects in the MENA region, Asia and USA. She has a PhD in Irrigation Engineering from Utah State University and has over 15 years of professional experience working in agriculture, irrigation and remote sensing. Roula has managed the Madera County GSA(s) project the last two years and she will be leading the project moving forward.

Florian Werner

Florian is Lead Scientist at Hydrosat, leading scientific research and development of Hydrosat's analytics. Florian has expertise in thermal infrared satellite data processing and crop stress detection. He will be leading the quality assessment of the data along with any related research activity at Hydrosat for the project ensuring alignment between the project's technical goals and overall strategy. Dr. Werner holds a Ph.D. in Physics from Leibniz University Hannover and Institute for Solar Energy Research Hamelin, Germany.

Wim Bastiaanssen

Wim is a globally renowned expert in remote sensing and water resource management, with an emphasis on water productivity. He developed remote sensing algorithms for water productivity with his PhD students and conducted over 20 studies for Asian Development Bank and World Bank to identify water productivity gaps in several countries. He helped UN-FAO with various remote sensing studies on water productivity at the global scale for wheat, rice and corn. The global standard framework on Water Productivity Score was developed jointly by Prof. Bastiaanssen and Prof Steduto from FAO. Among his most notable achievements is the development of the Surface Energy Balance Algorithm for Land (SEBAL), which revolutionized remote sensing by enabling the precise estimation of evapotranspiration and energy fluxes at field and regional scale. In addition to his role as Ambassador at Hydrosat, he is a Professor of Earth Observations for Water Resources Management at Delft University of Technology. He has also founded multiple remote sensing companies, including WaterWatch, eLEAF, CropZoomer, and IrriWatch. Dr. Bastiaanssen holds a Ph.D. in Agro-hydrology, Soil Physics, and Groundwater Management from Wageningen University. He has over 26,000 citations to internationally peer reviewed journal papers (as of January 2025). He will be serving as a scientific advisor for this project.

Kim Fischer

Kim is Data Engineering manager at Hydrosat. Kim has 8 years of experience in applied AI, data science, and data engineering. He has worked with Terabyte scale data processing (Real Impact Analytics), created classical and deep learning algorithms for yield forecast, and developed geospatial data pipelines. He has experience in AI and time-series classification, which aligns with project requirements for seasonal crop productivity monitoring. At Hydrosat, Kim is responsible for the architecture and implementation of the large-scale data processing pipelines. He will develop and maintain the large-scale data processing and model training pipelines. Before joining Hydrosat, Kim worked as a Lead Data Scientist at Ferrero, where he managed Ferrero's Agri Competence Center Data Science team. Before that, he held the position of Data Engineer at Ferrero, where he developed yield prediction using predictive analytics techniques as well as precision farming using satellite-, airborne- and UAV-data. Kim holds a double Master's degree in applied geoinformatics and environmental sciences by the University of Trier.

Bas Vullings

Bas is a data engineer at Hydrosat. Within Hydrosat, he mainly works with Python-based models that leverage satellite imagery for irrigation and crop growth management. His primary responsibilities revolve around the design, development, and test of highly scalable and automated data pipelines. He has been working on the pipelines for the Madera County GSA(s) project for the past two years and have made a lot of improvements to ensure stability and scalability of the IrriEngine. Bas holds a Master's degree in biosystems engineering and a Bachelor's degree in agrotechnology from Wageningen University.

Anshul Sharma

Anshul is Software Engineering Manager at Hydrosat, where he leads a team of software engineers developing web and mobile applications. Before joining Hydrosat, Anshul worked at Ankorstore where, as a Software Engineering Manager, he defined and executed the company's

API and integration strategy, enabling third-party partnerships that now drive over 25% of Ankorstore's annual revenue. He also recruited and built four remote engineering teams across Europe. Prior to this role, he held several Software Engineer positions. At Open Assessment Technologies, he developed a large-scale online assessment platform used by Education Ministries across Europe for nationwide school exams and led a team to build an open-source human marking system. At Docler Holding, he designed and implemented highly distributed systems for a live video streaming platform serving over 20 million monthly active users. Anshul holds a Bachelor of Technology in Computer Science from Amity University.

Max Marie

Max is a Software Engineer at Hydrosat, where he develops highly scalable backend and frontend services and designs and implements both customer-facing and internal applications. Before Hydrosat, Max worked at Devoteam where, as a Senior Software Engineer, he implemented and maintained multiple apps for global companies. Prior to this role he held positions at Finalcad as a backend developer, launching and running a cross-platform SaaS in the construction tech, and as a fullstack engineer at CoverGo, an InsurTech, a startup. Max holds a Masters of Engineering (specializing in IT and networking) from INSA Lyon (the National Institute of Applied Sciences of Lyon).

Sam Bastiaanssen

Sam is the Customer Success Manager at Hydrosat leading active user engagement, ensuring users utilize the full potential of Hydrosat's satellite data services by providing dedicated support and being on standby for users' needs with 5+ years' experience as a geospatial data analyst in the international agricultural sector. In this project Sam will support the on-boarding of field boundaries and field information, such as crop type, irrigation method, or soil type into the IrriWatch portal. Besides that, Sam will ensure the administrative parcels and personal privacy data are all safely separated by each individual user.

Brett Blom

Brett is the VP for Sales & Business development at Hydrosat, leading the go-to-market team and ensures coordination with all Hydrosat's client base as well as delivering feedback and recommendations to the company based on customer feedback. Brett has worked in the remote sensing space for almost 10 years and is based in Ripon, California where his family farms almonds. In this project, he will be coordinating the client interactions with the Madera County GSA(s) team.

Project Understanding and Approach

Hydrosat understands that the purpose of Madera County GSA(s) desired measurement program is to contribute to achieving reduction in groundwater water use by providing information to the GSA's, landowners, and growers on field level crop water use from irrigation. Additionally, measurement of crop water use will allow the GSAs to monitor groundwater use relative to sustainability targets. Beyond these two main purposes of the measurement program, Hydrosat envisions additional potential uses of the IrriWatch platform by growers for daily monitoring of water use via graphics and budget tables to compare their consumption to allocations. The

IrriWatch platform also helps growers with irrigation scheduling and crop monitoring throughout the season, which can provide an additional incentive for growers to use the portal and optimize their water use.

Hydrosat's technical approach is described below with more technical details attached in Annex 1.

Land use

Land use maps of the Madera County GSA(s) will be acquired from publicly available maps especially from the Department of Water Resources (DWR). These land use maps are updated every couple of years by LandIQ. Hydrosat's approach will be to update these maps on annual basis based on 1) fallow analysis that will be done during summer to detect fallowed land that has moved into cropping systems and cropped areas that have turned into fallow. This will affect the ETAW of these fields; and 2) throughout the season, growers also indicate the change of crop, by informing the County about these changes. We will coordinate with the County team to access the changelog from the data management system to implement the crop changes as well as ownership changes, parcel moves and measurement methods changes.

Actual Evapotranspiration and Actual Evapotranspiration from Applied Water

Hydrosat uses energy balance modeling, specifically its proprietary version of the SEBAL algorithm to calculate consumptive use based on thermal and VNIR satellite measurements. SEBAL (Surface Energy Balance Algorithm for Land) was developed by Dr. Wim Bastiaanssen of The Netherlands (Bastiaanssen et. al., 1998a, 1998b and 2005). SEBAL uses spectral radiances recorded by satellite-based sensors, plus ordinary meteorological data, to solve the energy balance at the Earth's surface. SEBAL computes actual evapotranspiration (ETa) for each pixel in a multispectral satellite image by applying radiative, aerodynamic and energy balance physics in 25 computational steps.

SEBAL offers distinct advantages compared to the generally accepted "Kc x ETo" method for computing ET including 1) computing actual evapotranspiration (ETa), inherently accounting for the effects of salinity, deficit irrigation, disease, poor plant stands, and other factors, on crop ET. These influences in the standard Kc x ETo computation requires considerable additional data (typically unavailable) as well as substantial time and effort; and 2) the acreage of water-using land is observed directly from the satellite image, so accurate irrigated area is implicit to the process. This feature avoids the typical difficulty of assembling accurate records of irrigated areas and cropping patterns; and 3) SEBAL does not need crop type to solve the energy balance, however, cropping patterns are important for the water balance and calculation of ETAW as the root depth plays an important role in the water storage computations.

The latest version of SEBAL includes an integration between the surface energy balance and soil water balance where actual ET is the common denominator for both. Because ET is a large component of the water balance, it provides great insights in the magnitude of the various terms. The soil water balance model has been employed to acquire a spatially distributed estimation of every term of the balance for every pixel. The soil water balance computes surface runoff Rs following a soil moisture deficit and presence of roots. This is a modified version of the Soil Conservation Service equation that has fixed infiltration capacities described by means of Curve Numbers. Water that percolates from the root zone is no longer available for ET and reduces soil water storage. In line with Darcian flow in unsaturated soil, the mathematical expression for

percolation is a non-linear function of the degree of soil moisture saturation. In California, it is common to allocate groundwater on the basis of ET from Applied Water or ETAW. Hydrological background studies have determined the maximum volume of ETAW to realize a new equilibrium situation with zero-overdraft for different sub-aquifers. To accommodate ETAW as a basis for allocation and compliances, the IDC model (https://data.cnra.ca.gov/dataset/idc-version-2015-0-77/resource/238d3e2b-a985-4db7-9793-933ba6d525af) is used for the assessment of ETAW from ET. More technical details about the SEBAL methodology, the water balance modelling and IDC model are presented in Annex 1.
It is important to note that Hydrosat will implement on annual basis, initialization of soil moisture and root depth based on previous years data (water years) to ensure the "rainfall and soil moisture storage buckets for each parcel-field is correctly set.
While the proposal indicates monthly timesteps of ET and ETAW, Hydrosat will be calculating the data on daily timesteps using daily thermal satellite measurements. This will improve the accuracy of ET calculations and avoids challenges of interpolating between two satellite imagery acquired every 8 days (from Landsat). Hydrosat has developed a fusion model to provide 10m resolution daily thermal imagery which has been validated in several countries over the past 4 years. Hydrosat's new constellation of thermal satellite will also be integrated into the modelling to improve the accuracy more.

Precipitation maps

One of the main components into the IDC model to get ETAW is the precipitation. Hydrosat uses global weather services to get the precipitation maps. For this project, the weather data including rainfall will be acquired from the National Weather Service (NWS). NWS precipitation maps do rely on data from a network of weather observation stations across the U.S., including in California. These stations include Automated Surface Observing Systems (ASOS), Cooperative Observer Program (COOP) stations, Remote Automated Weather Stations (RAWS), California Irrigation Management Information System (CIMIS), Airport weather stations, other specialized sensors and radar systems.

Precipitation maps will be acquired on an hourly basis, which are then integrated into daily timesteps and precented on our web portal. At the end of each month, Hydrosat will generate Monthly precipitation maps at 10m pixels to share with the Madera County GSA(s).

Deliverables

The project deliverables will include the following:

1. Annual update of the land use raster files which will be also aggregated to parcel-field level to determine the majority crop of each parcel-field.

2. Daily ET and ETAW raster files at 10-meter spatial resolution (real-time via portal and API).

3. Monthly ET and ETAW raster files at 10-meter spatial resolution (provided within 1 week of the end of each month).

4. Daily precipitation data provided at field level (real-time via portal and API).

5. Monthly precipitation maps at 10-meter spatial resolution (provided within 1 week of the end of each month).

6. Full implementation of a tailored version of the IrriWatch platform including the following:

- irriwatch.hydrosat.com platform with viewer access to all fields individually. The fields will be displayed at the County level to monitor all the fields as well as at farmers' level. Hierarchy structure will be created when needed for master accounts (See Annex 2 for more details on how the portal shows the data).
- Setting up the revised shapefiles and crop maps at the beginning of every year and setting the farmers accounts, farm units and master accounts.
- Delivery of all IrriWatch parameters, including irrigation performance and crop production indicators
- Daily monitoring actual evapotranspiration (ET) based on energy balance modelling and calculating actual evapotranspiration from applied water (ETAW)
- Updated IDC model for actual evapotranspiration from precipitation (ETPR) model
- Initialization of soil moisture and root depth based on previous years data (water years)
- Portal customization including farm unit zones layer, aggregation of field-parcels to parcels and farm units and master accounts.
- Customized portal tables for parcel water budgets and farm unit budgets updated monthly
- Customized reporting on monthly basis at parcel level and farm unit level downloadable from the portal
- Regularly updating the County database with changes at farmers level (e.g. change of crops) in coordination with the County
- In-season change of parcel ownerships in coordination with the county
- Mid-season check of fallow fields and assisting in defining the fields that needs on-ground verification
- Crop production and daily irrigation schedule advice for farmers
- IrriWatch trainings and outreach
- Assist the County during technical discussions with farmers

Project Experience and Success

Hydrosat services to Madera County GSA(s) providing water monitoring data from satellite based on surface energy balance modeling. From 2021 to 2025, Hydrosat is providing ET and ETAW daily data for the County along with access to its growers to its IrriWatch online platform to monitor their water use, monitor their fields and access data on soil moisture, irrigation scheduling and more parameters.

Hydrosat services to Madhya Pradesh Water Resources Department in India for the project "Operational Remote Sensing-based Information for Daily Irrigation Management" covering 130,000 ha of irrigated land. The accuracy of the models was measured by flowmeters and soil moisture sensors. The ET daily data and irrigation scheduling was used in SCADA systems to operate the irrigation systems. (2021-2024; a proposal for extension is now approved and the project will continue soon).

Hydrosat services to Water Resources Department in Kyzylorda, Kazakhstan to develop solutions that leverage remote sensing and geospatial analytics to improve water management, ensuring that available resources are used more effectively and sustainably. The project is in collaboration with Geobox and it covers over a 250,000 hectare of irrigated land. Hydrosat was monthly ET, ETAW, Applied Water and several more parameters on a monthly basis for the whole area. The

project continues now for the 3rd year. The accuracy of the models was measured with flowmeters.

Hydrosat services to the Punjab Irrigation Department (Pakistan) that is responsible for 22.5 million acres irrigated land. Diagnosing their irrigation performance in the Lower Bari Doab Canal including equity, adequacy, reliability and productivity for 2017 and 2018. The analysis is based on the spatio-temporal patterns of consumptive use. The project is funded by the Asian Development Bank for detecting whether modernized irrigation systems function better and discharge measurements are accurate. Building on this project, a new project was approved in June 2025 to reinitiate the services to measure water use and water sustainability metrics from remote sensing in Balochistan.

Hydrosat service to Grupo Magdalena sugarcane plant in Guatemala with 75,000 acres of land and over 1,250 farmers on soil moisture monitoring, the need to irrigate and the amount of water to apply. In addition, to access to the IrriWatch platform, Hydrosat provides additional analytics to Grupo Magdalena including harvest planning, sugar content estimation, yield estimation and performance of crop compared to references. Model and data accuracy has been tested using soil moisture sensors, soil sampling for gravimetric moisture, yield and sugar data measurement. Grupo Magdalena is a current client of Hydrosat for the 4th year.

IrriWatch service to the Government of Kazakhstan for monthly reporting on consumptive use in an 82,000-ha irrigation scheme in Turkistan for a period of 4 years (2016 to 2019), and provision of suggestions to improve land and water management operations. Fields with low on-farm efficiencies and low crop water productivity are detected for provision of more governmental support. Best practices are copied from well performing fields.

Further to projects, IrriWatch provides operational information to farmers, commodity traders, investors and banks in more than 50 countries globally.

References

SEBAL has been widely tested in USA by various independent research organizations including University of California Davis, California State University Fresno and the USDA. In addition to that, validation experiments have been conducted by private companies including Jain Irrigation (currently Rivulis), Vinduino and Davids Engineering.

These validations have been focusing mainly on almonds, pistachios, grapes, alfalfa, lettuce among others that represent California's main irrigated crops. The validation experiments are described in research papers and reports that are peer reviewed:

- Allen, R.G., W.G.M. Bastiaanssen, M. Tasumi and A. Morse, 2001. Evapotranspiration on the watershed scale using the SEBAL model and Landsat images, ASAE Meeting Presentation, paper number 01-2224, Sacramento, California, USA, July 30-August 1, 2001
- Allen, R.G., A. Irmak, R. Trezza, J.M.H. Hendricks, W.G.M. Bastiaanssen and J. Kjaersgaard, 2011. Satellite-based ET estimation in agriculture using SEBAL and METRIC, Hydr. Processes 25(26): 4011-4027
- Bastiaanssen, W.G.M., E.J.M. Noordman, H. Pelgrum, G. Davids and R.G. Allen, 2005. SEBAL for spatially distributed ET under actual management and growing conditions, ASCE J. of Irrigation and Drainage Engineering 131(1): 85-93

- Bastiaanssen, W.G.M., R.G. Allen, H. Pelgrum, A.H. de C. Texeira, R.W.O. Soppe and B.P. Thoreson, 2008. Thermal-infrared technology for local and regional scale irrigation analyses in horticultural systems, Acta Horticultae792 (Mildura Special Issue) ISHS:33-46
- Clark, B., D. Lal, W. Bastiaanssen, R. Soppe, B. Thoreson and G. Davids, 2007. Variability of crop coefficients in space and time – examples from California, Proceedings USCID conference, Sacramento, September 2007
- Ghorbanpour, A.K., S. R. Peddinti, T. Hessels, W.G.M. Bastiaanssen and I. Kisekka, 2025. Enhancing evapotranspiration estimates in composite terrain through the integration of satellite remote sensing and eddy covariance measurements, Science of The Total Environment, Volume 963, 1 February 2025, 178530
- Kisekka, I.,S. Rao Peddinti, W.P. Kustas, A.. McElrone, N. Bambach-Ortiz, L. McKee and W.G.M. Bastiaanssen, 2022. Spatial–temporal modeling of root zone soil moisture dynamics in a vineyard using machine learning and remote sensing, Irrigation Science https://doi.org/10.1007/s00271-022-00775-1
- Thoreson, B., S. Zwart, W.G.M. Bastiaanssen and G. Davids, 2004. Actual crop evapotranspiration without crop classification, USCID, Symp. Salt Lake City, October 2004
- Thoreson, B., B. Clarke, R. Soppe, A. Keller, W.G.M. Bastiaanssen and J. Eckhard, 2009. Comparison of Evapotranspiration Estimates from Remote Sensing (SEBAL), Water Balance, and Crop Coefficient Approaches, World Environmental and Water Resources Congress 2009: Great Rivers, Proceedings of World Environmental and Water Resources Congress 2009

Costs

The financial proposal for IrriWatch data services is based on 220,000 ac.

Our goal with this proposal is to eliminate additional amendments and budget requests as we make necessary adjustments and enhancements to the product delivered. With this proposal, we have offered a discount on the standard IrriWatch subscription costs with a multi-year commitment.

Description	**Price ($/ac/yr)**	**Acreage**	**Total Price**
IrriWatch Subscription / yr	$ 0.83	220,000	$ 182,600
	Total price / yr		**$ 182,600**
	2 yr discount (5%)		-$ 9,130
	3 yr discount (10%)		-$ 18,260
	Total 2 yr price / yr		$173,470
	Total 3 yr price / yr		$164,340

This subscription also includes professional services costs; we have built in the expected hours and time allotment needed to deliver exceptional custom service to Madera County GSA(s) along with its growers. There will be no additional bills or charges, and applicable insurance requirements are included in the cost as well.

Annex 1: Surface Energy Balance Algorithm for Land (SEBAL) Methodology

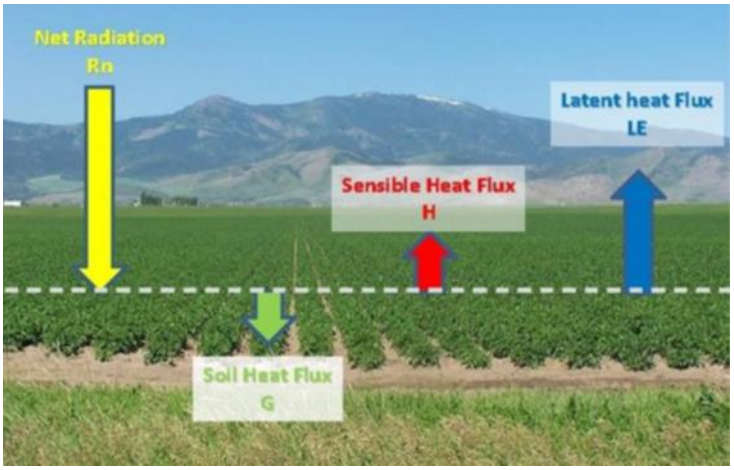
Land Surface Energy Balance Modelling

The Surface Energy Balance Algorithm for Land (SEBAL) computes the actual crop evapotranspiration, soil moisture of the rootzone and the crop dry matter production for every individual pixel (Bastiaanssen et al., 1994; 1998; 2005). Related water flows can be inferred from that, once rainfall is taken from other sources (that source can also be a satellite product). The determination of irrigation water flows will be described in following section "soil water balance modelling".

SEBAL accurately estimates the amount of water evaporated by water and soil, as well as transpired by plants, which is the **actual evapotranspiration** (ET). The principle of a simple residual energy balance is applied. The revolution comes from the fact that crop type, age of crop, soil type, irrigation applications and agronomic management information is no longer needed because ET is based on λE (see later) and λE is determined from other energy and heat fluxes, so not from soil and crop information:

$$\lambda E = Rn - G0 - H$$

> *(**Rn**): **Net Radiation** – The total incoming shortwave (solar and longwave radiation) minus the reflected and emitted radiation from the surface. It represents the energy available for processes like heating the air, soil, and evapotranspiration.*
>
> *(**G0**): **Soil Heat Flux** – The portion of energy used to heat or cool the soil.*
>
> *(**H**): **Sensible Heat Flux** – The energy used to heat the air above the surface.*
>
> *(**λE**): **Latent Heat Flux** – The energy used in the evapotranspiration process (water vapor flux from soil and plant surfaces)*

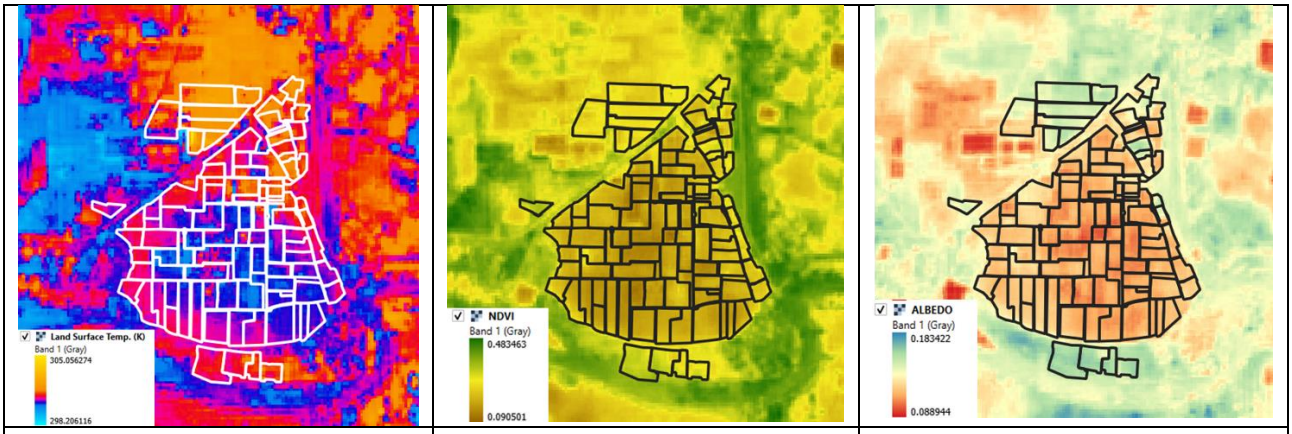


SEBAL uses (geostationary) satellite measurements of solar radiation, Land Surface Temperature (LST), Normalized Difference Vegetation Index (NDVI) and Surface Albedo (see Figure 1) to determine Rn, G0 and H. The source of satellite data is EcoStress, VIIRS, Landsat, Sentinel, MSG and Jacob Van Zyl-1. The data from these satellites is fused and used to generate daily imagery with a spatial resolution of 10m x 10m. The absolute value of Land Surface Temperature (LST) depends on the magnitudes of Rn, G0, H and λE. Solar radiation for instance increases Rn and evaporative cooling increases λE. The latter on return depends on soil water potential in the root zone in combination with a certain canopy development.

A relative cold crop with LST being equal to air temperature will have an ideal soil water potential in the root zone and maximum sapflow leading to maximum evaporative cooling and high λE value. Colder fields in Figure 1 will have a LST of 298 K (25 °C). The fields in the Northern part of the image are in the 305 K range (32 °C) and are thus suffering from access to water. There might

be water stored in the root zone at 32°C, but this moisture is retained by soil minerals and not all water are easily available for uptake by roots. In such situation, part of the Rn energy will be converted into H.

The surface albedo has a large impact on the absorption of solar radiation. Darker surfaces absorb more radiation, which increases net radiation values (see Figure 3). Ponded water is a typical example of a surface having a low albedo. More net radiation implies that more energy is available for the phase transition of water from liquid to vapor. The NDVI is another essential crop input parameter to describe leaf development. Pixels with higher NDVI have a higher fractional vegetation cover, a higher Leaf Area Index (LAI) and a higher fraction of Photosynthetically Active Radiation fPAR.



Land Surface Temperature (K)	NDVI	Surface albedo

Figure 1: Example of satellite measurements used as input into SEBAL energy balance model. The data is from Odisha State acquired on 27 January (2024)

SEBAL computes the partitioning into sensible and latent heat for every pixel using anchor points for LST, representing groups of hot and cold pixels. Sensible heat H is very sensitive to LST and SEBAL has an internal calibration procedure with the anchor points to scale H between minimum (cold pixel) and maximum H values (hot pixel). These cold and hot pixels are selected in an automatic manner from the combination of input data demonstrated at Figure 2.

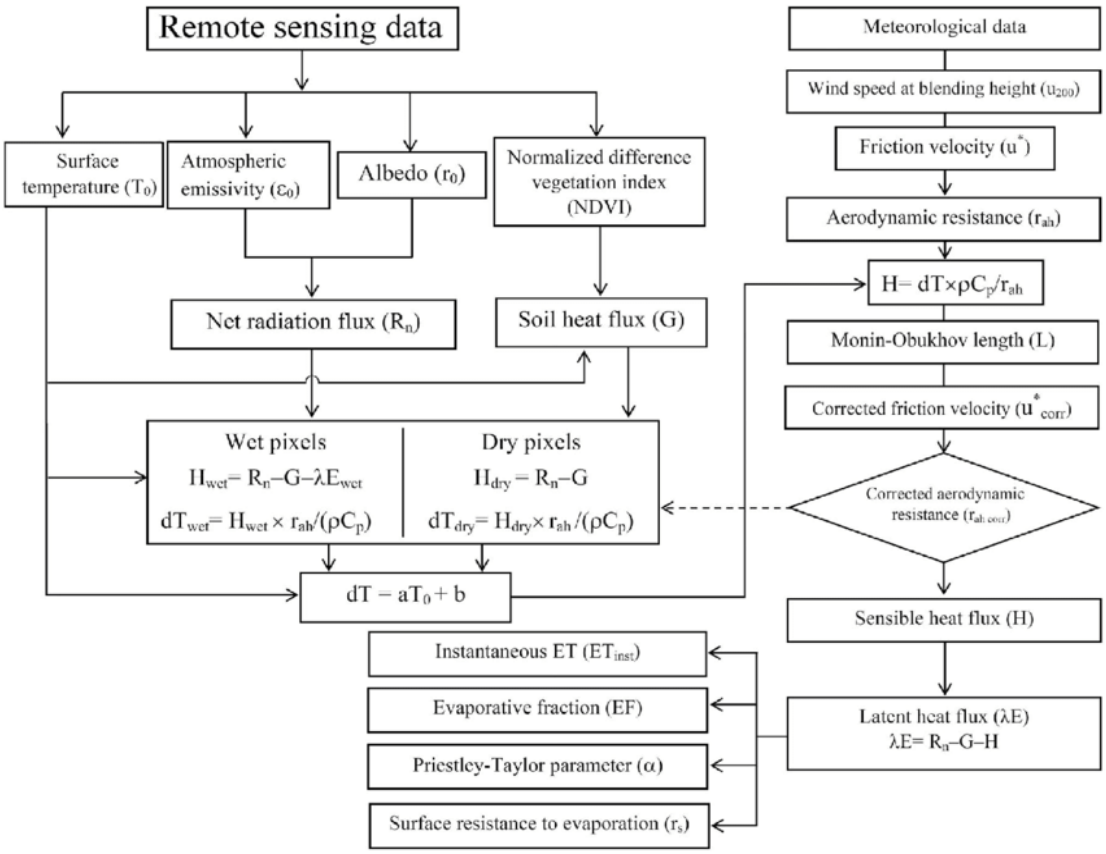
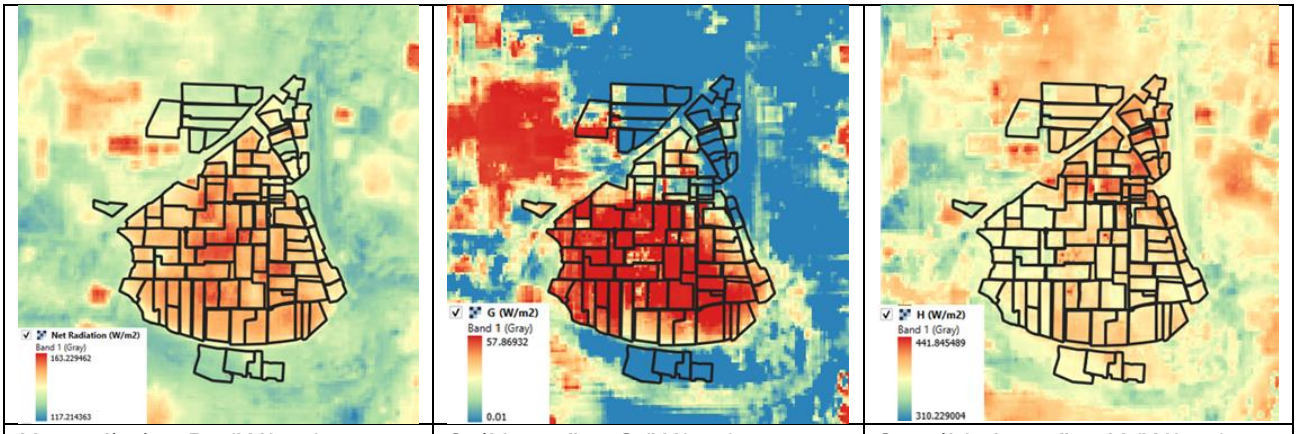


Figure 2: Flow chart of the SEBAL calculation scheme with extreme endpoints of hot (dry) and cold (wet) pixels that forms the basis of self-calibration. LST, surface albedo and NDVI are the major input parameters

This "self-calibration" of SEBAL eliminates propagation of errors on the energy balance partitioning. Simultaneously, the need for radiometric and atmospheric correction of surface temperature becomes less relevant because instantaneous ΔT and H values are forced to certain values at specific hot and cold pixels. The absolute values of thermal imagery LST (or T_0) do not matter. A systematic error of 2K or more in LST is thus not causing any problem. The relative value of LST is much more important. This aspect makes SEBAL very popular because the results are no longer dependent on accurate LST calibrations, atmospheric corrections and available air temperature records. Consumptive use of irrigated crops can be determined without information on the irrigation schedule.



Net radiation Rn (W/m2)	Soil heat flux G (W/m2)	Sensible heat flux H (W/m2)

Figure 3: Example SEBAL energy balance outputs that create the basis for ET mapping. The data is from Odisha State acquired on 27 January (2024)

The **latent heat flux** (λE) forms the basis for determining actual evapotranspiration rate (ET) expressed in mm/d using the following conversion factors:

$ET = 86.4\ 10^6\ \lambda E_{24} / (\lambda\ \rho_w)$

> *Where **λ** is the latent heat of vaporization (approximately 2.45 MJ/kg for water at typical temperatures) and ρ_w is the density of water (approximately 1000 kg/m^3). In case the 24-hour average value of λE is considered (λE_{24}), the factor 86.4 10^6 is used to convert λE_{24} directly into an ET rate expressed in mm/d.*

The Surface Energy Balance Algorithm for Land (SEBAL) is developed by Prof. Wim Bastiaanssen from Hydrosat (www.hydrosat.com). Professor Bastiaanssen is also engaged to Delft University of Technology (Netherlands) for continuous updates and improvements of the model. The earlier work at the DLO Winand Staring Centre, Wageningen University, International Water Management Institute IWMI and UNESCO-IHE contributed significantly to the development of SEBAL versions 1.0 to 3.0. The most important co-workers are Prof. Massimo Menenti, Prof. Yasir Mohamed, Ir. Tim Hessels and Dr. Roula Bachour.

A model is never finished. IrriWatch and Hydrosat developed a propriety version (SEBAL4.0) that has several new features being introduced since 2019. They are related to new procedures for hot and cold pixel selection, separation of ET into T and E, soil moisture in the root zone, besides a new routine to describe the behaviour of stomates, being essential to determine the dry matter production

Crop growth modelling

Figure 4 demonstrates that the Transpiration rate T is proportional to daily crop production because T exhalation and CO_2 inhalation occurs via the same stomates. The stomatal aperture is the key regulator for the intake of CO_2. The CO_2 flow is mathematically defined by the stomatal resistance r_s and the difference of CO_2 concentration in air and inside the stomatal cavity. So, knowledge on the λE flux can be thankfully used to determine stomatal aperture and the assimilation of atmospheric carbon. Together with data on the Photosynthetically Active Radiation (PAR) - being also a SEBAL input - it becomes feasible to compute crop dry matter produce from photosynthesis (see Figure 4). More photosynthates are being produced if the crop

is relatively cool, being expressed as parameter Ts in Figure 4. Sensible heat flux H is small, and more CO2 is taken by the crop for expansion of roots, stems, leaves and grains.

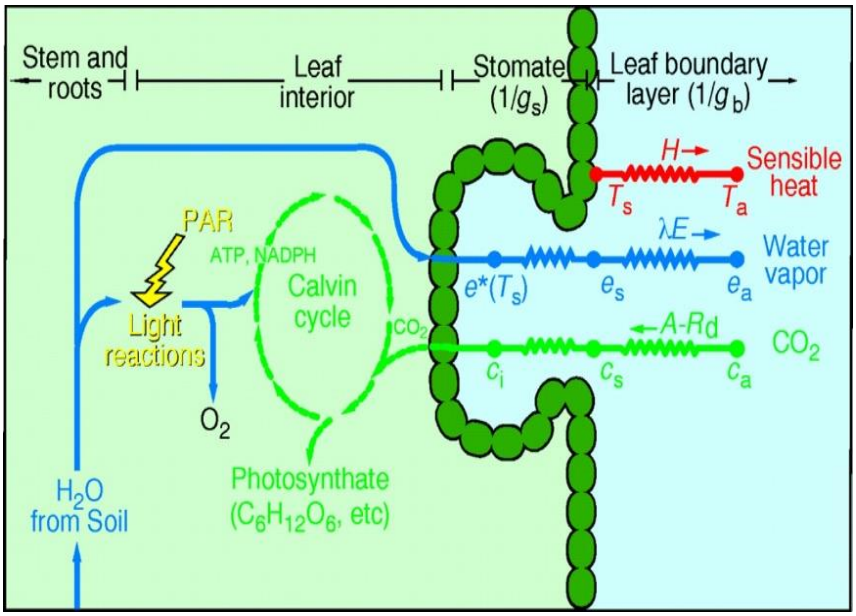


Figure 4: Schematic diagram of the exhalation of water vapour into the atmosphere (λE) as a function of sensible heat flux H and the Inhalation of CO_2 for the generation of photosynthates ($C_6H_{12}O_6$)

Soil Water Balance Modelling

The latest version of SEBAL includes an integration between the surface energy balance and soil water balance where actual ET is the common denominator for both. Because ET is a large component of the water balance, it provides great insights in the magnitude of the various terms. For instance, if ET is high and Precipitation P is low, then there must be another source of water, otherwise large ET rates cannot be explained. Another fact is that if λE is a large fraction of Rn, most available energy goes to ET so the root zone must be moist. This section describes how information on spatial ET can be utilized to infer irrigation water applications.

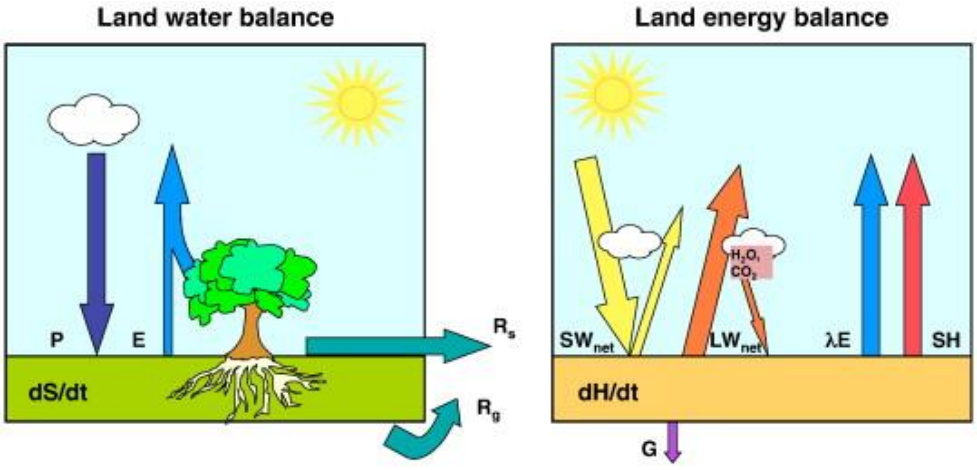


Figure 5: Integrated surface energy and soil water balance modelling. The evapotranspiration process λE and E is part of both balances.

The soil water balance model in Figure 5 has been employed to acquire a spatially distributed estimation of every term of the balance for every pixel. The soil water balance computes surface runoff Rs following a soil moisture deficit and presence of roots. This is a modified version of the Soil Conservation Service equation that has fixed infiltration capacities described by means of Curve Numbers. Water that percolates from the root zone is no longer available for ET and reduces soil water storage. In line with Darcian flow in unsaturated soil, the mathematical expression for percolation q is a non-linear function of the degree of soil moisture saturation. The monthly application of irrigation from the farm gate or pumping house express as Applied Water AW can be approximated as:

$$AW = ET + R + q_{\downarrow} + \Delta S - P$$

> *where P is precipitation, AW is Applied Water, ET is actual evapotranspiration, R is surface runoff, $q_{\downarrow}$ is the percolation from root zone and ΔS is the change in storage of water in the root zone. The latter describes the difference between all inflows and all outflows. Applied Water can thus be approximated from remotely sensed ET and ΔS values, in combination with soil moisture (θ) dependent values of $R(\theta)$ and $q_{\downarrow}(\theta)$.*

In California, it is common to allocate groundwater on the basis of ET from Applied Water or ETaw. Hydrological background studies have determined the maximum volume of ETaw to realize a new equilibrium situation with zero-overdraft for different sub-aquifers. To accommodate ETaw as a basis for allocation and compliances, the IDC model (https://data.cnra.ca.gov/dataset/idc-version-2015-0-77/resource/238d3e2b-a985-4db7-9793-933ba6d525af) is used for the assessment of ETaw from ET. In short this can be expressed as:

$$ETaw = ET - ETpr$$

Where ETpr is the ET that is related to precipitation values only. While SEBAL provides the storage in the root zone from real world conditions with a mixture of rainfall and irrigation i.e. storage S, IDC model is applied to any pixel of 10m x 10m to compute the storage in the root zone without irrigation Spr. Values for ETpr are approximated from the ratio of the two storages:

$$ETpr = \alpha\ ET$$

with

$$\alpha = Spr / S$$

When the storage from antecedent rainfall is getting negligible small, α reduces to zero and ETpr will fade away. Under that condition all the ET can be ascribed to ETaw. ETaw is a very appealing parameter for the calculation of on-farm irrigation efficiency (ETaw/AW x 100%), but a bit complicated to get to it. The schematic below provides an illustration of how ETpr from rainfall and ETaw from irrigation are computed in parallel. Basically 2 parallel soil moisture buckets for every pixel are parameterized.

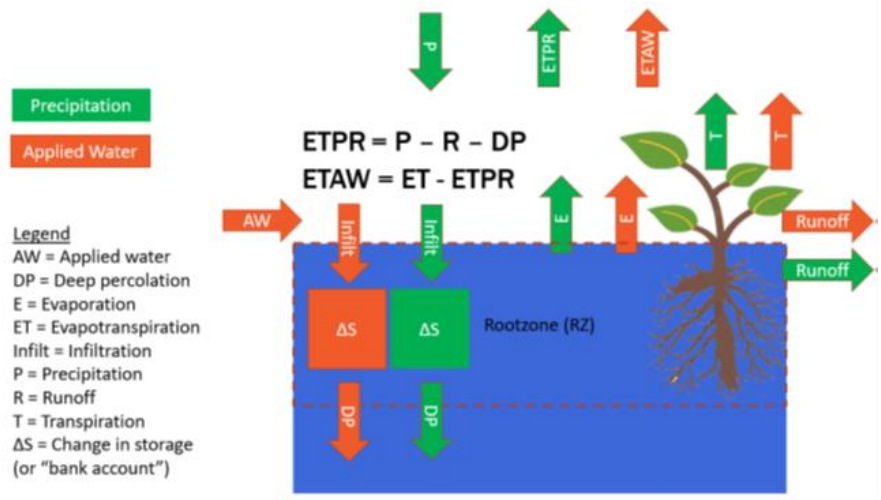


Figure 6: Illustration of how Precipitation P and Applied Water AW have their own impact on ETaw and ETpr calculations (courtesy: J.C. Davids)

Annex 2: IrriWatch Portal Overview

The IrriWatch portal (irriwatch.hydrosat.com) of Hydrosat provides daily monitoring of all the fields within the county. Our energy balance and water balance algorithms are run every day and provide data for every field at 10 m by 10 m spatial resolution.

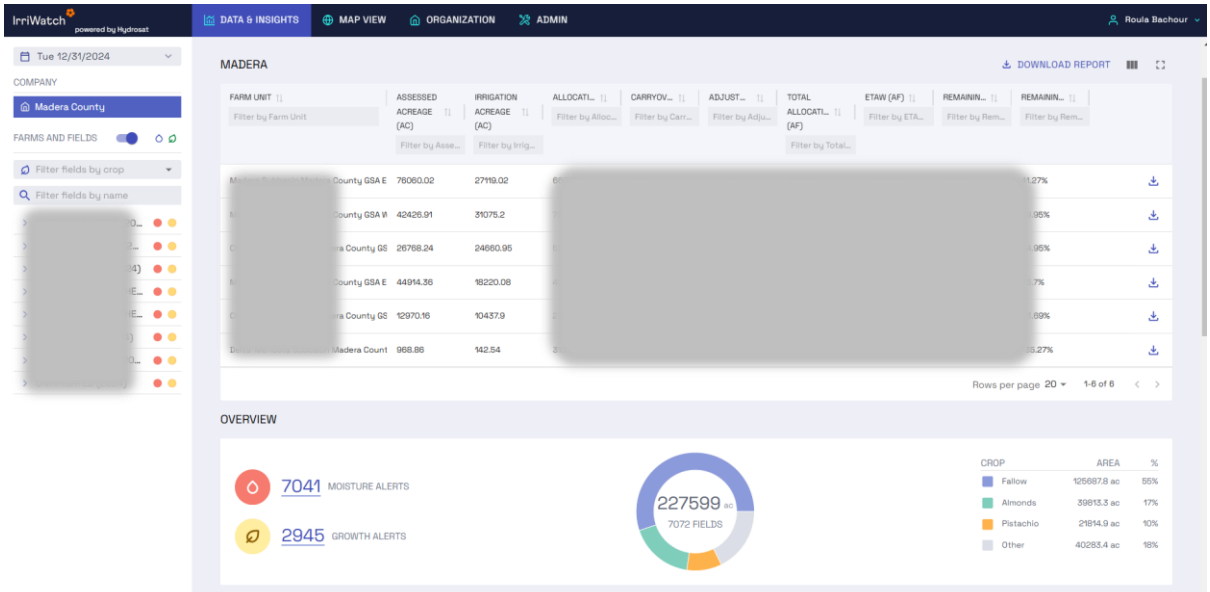
The portal allows data access for the Madera County GSA(s) to see and monitor all fields, while also allowing individual growers or companies to have access to their own parcels and fields.

The standard IrriWatch portal is tailored to farmers to be used for irrigation scheduling, soil moisture, and crop monitoring. However, for water allocation monitoring we have tailored our portal to provide more insights into the actual evapotranspiration from applied water (ETAW) vs Allocations and monitor the remaining allocations. For this budget tables are presented for each farm unit, each sub-basin etc. At the same time, monthly reports are generated at parcel level, farm unit level and master account level allowing maximum flexibility and visibility about data.

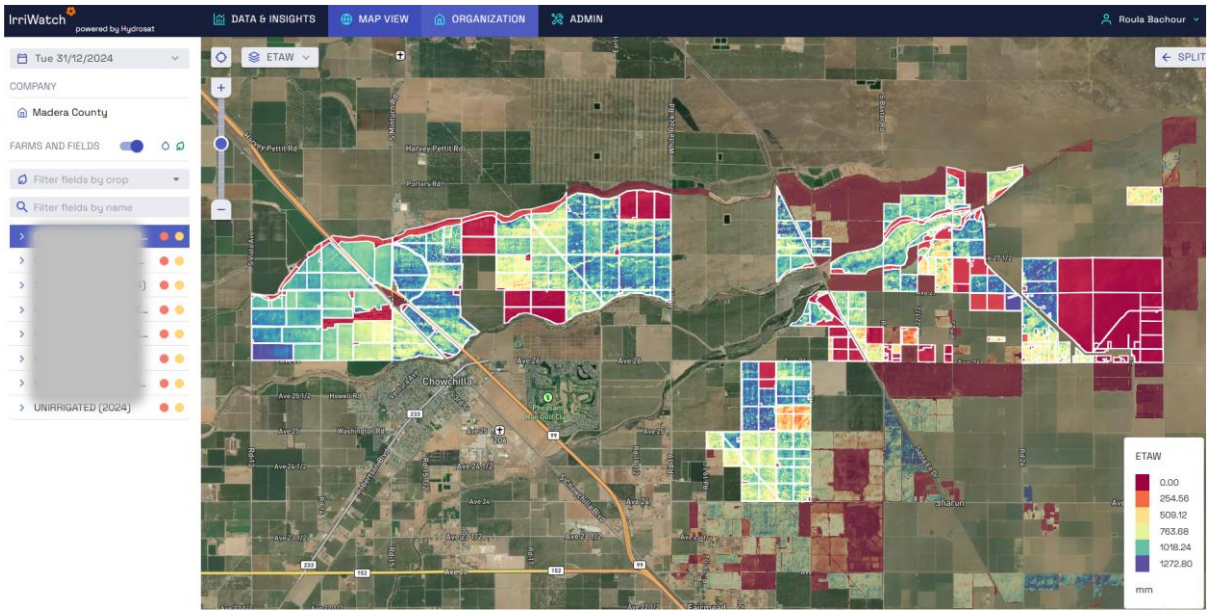
In addition to our web portal, data is also delivered via an API, excel downloads, PDF reports and Mobile App.

In the following screenshots we show examples from our web portal from Madera County (some names/values are blurred out for privacy).

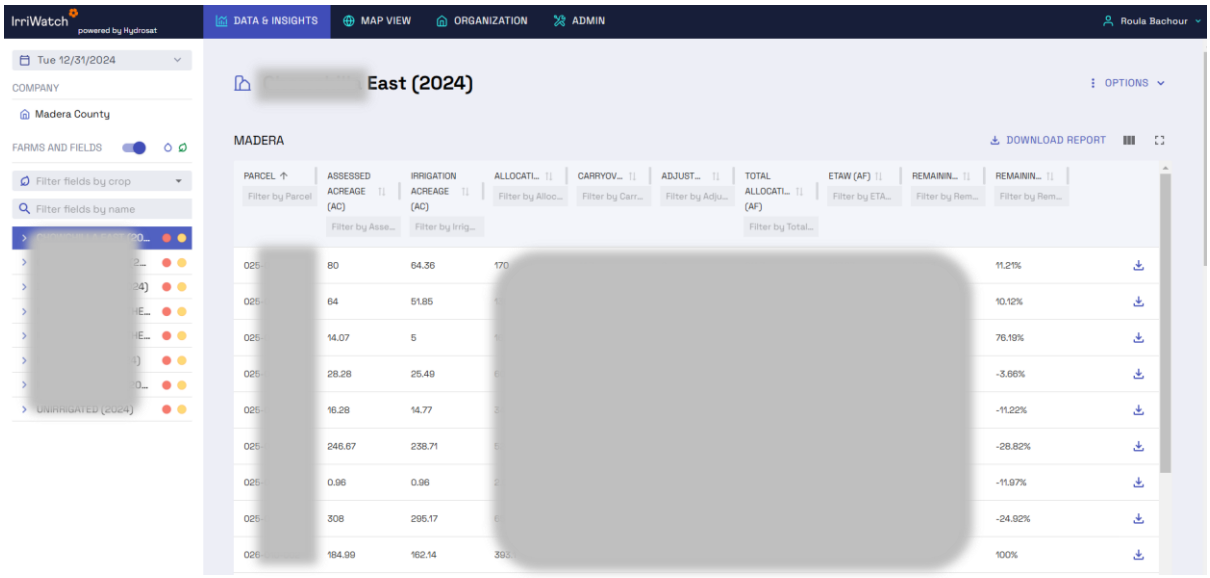
Overview of All County sub-basins and the budget tables



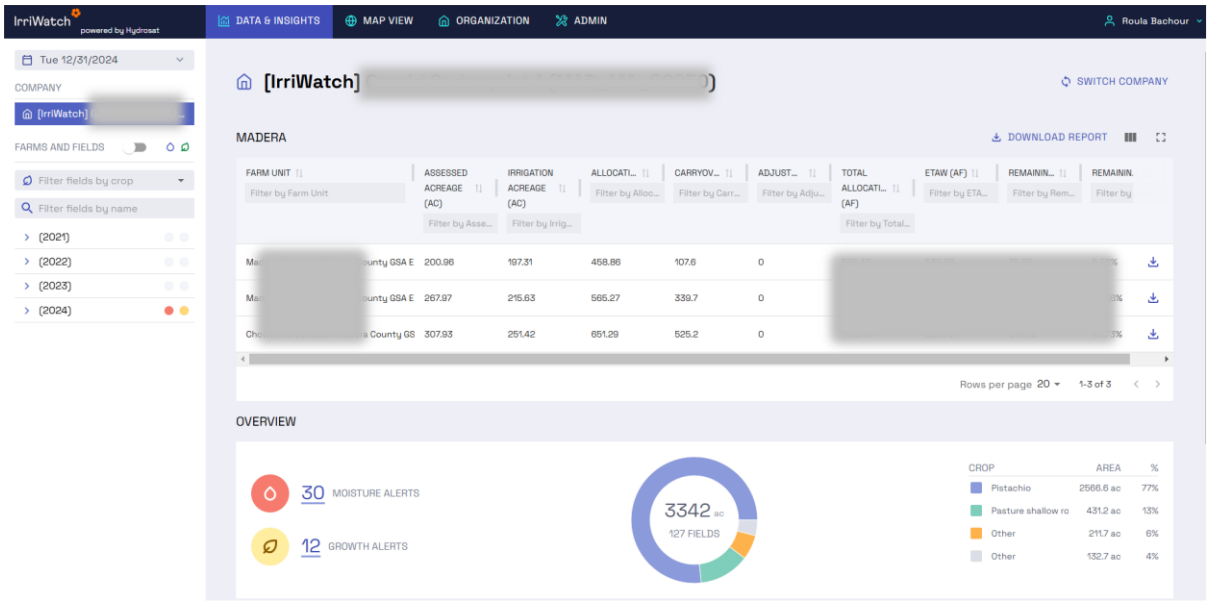
Overview of one sub-basin from the County level (pixel maps showing the ETAW)



Overview of each sub-basin with Budget tables updated on daily basis (Downloadable PDF reports for each parcel generated at the end of each month)



Individual accounts for each grower including their farms units and parcels



Daily monitoring of ETAW vs. Allocation available for each parcel

Thank you!

Hydrosat Team

Response to Request for Proposal

Madera County Groundwater Sustainability Agency

Measurement Services

June 16, 2025

PREPARED FOR:

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559-831-7166
Aleta.Allen@maderacounty.com

PREPARED BY:

LAND IQ

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Sacramento, CA 95811

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June 16, 2025

Madera County Groundwater Sustainability Agency
200 West Fourth Street
Madera, CA 93637

Subject: RFP/Proposal for Madera County Groundwater Sustainability Agency Measurement Services

Dear Ms. Allen:

Land IQ, LLC appreciates the opportunity to provide the attached proposal for your consideration in response to the solicitation for Madera County Groundwater Sustainability Agency Measurement Services.

Land IQ is a private technology and consulting firm that specializes in integrating agronomic sciences with spatial sciences and technologies to address large-scale land management and landscape analysis challenges. Specifically, we integrate rigorous ground truthing, advanced remote sensing approaches, data management, agricultural sciences, and web-based tools to understand agricultural management at the field-scale and to effectively disseminate that information to necessary stakeholders. This unique combination of expertise in agriculture and regulatory compliance aligns well with the needs of this project, as do some of the base data that we have developed and have available for your use, covering the entire state of California.

Staff expected to work on this project from Land IQ have been involved in various aspects of Groundwater Sustainability Plan (GSP) implementation and overall Sustainable Groundwater Management Act (SGMA) regulatory compliance support since the inception of the program, and in agricultural remote sensing and geospatial analysis and large-scale data management for the last 20 years. Additionally, our team has spent more than 28 years working in agriculture in California. Our team members are parts of family farming operations, which brings an additional level of understanding and care.

We are dedicated to working collaboratively with the Madera County Groundwater Sustainability Agency (GSA) to assist in the on-going compliance and GSP implementation as required by the SGMA by providing satellite measurement services. For the last three years, Land IQ has provided monthly, field-by-field evapotranspiration (ET) and precipitation measurements, as well as annual land use and permanent crop age. We also provide unlimited access to our agronomic and spatial scientists for any questions related to overall or specific grower results. We are confident in our ability to continue providing quality services for the purposes of your GSA.

Land IQ has been providing ET measurements to Irrigation Districts and GSAs since 2016. Throughout this process we have continuously sought ways to be more efficient and accurate in our analyses, as well as provide GSAs and growers with the tools they need to better manage resources. As such, we have listened to growers and designed a daily irrigation management tool to allow growers to track their daily water consumption in relation to a district-, GSA-, or grower-defined threshold. This will allow the grower to adjust water management decisions during the year on a real time basis to achieve, and hopefully not exceed, this threshold.

LAND IQ
2020 L Street, Ste 210
Sacramento, CA 95811
(916) 265-6330
www.LandIQ.com

While Land IQ is not proposing on the groundwater accounting platform, our data is currently being utilized by all known platforms including Basin Safe (developed by 4 Creeks and used in the Tule Subbasin), Watermark (developed by MLJ Environmental and used in the Kings Subbasin), the Groundwater Accounting Platform (developed by California Water Data Consortium, Environmental Science Associates & Environmental Defense Fund and used in the Kern Subbasin), and the Water Dashboard (developed by Agri Tracking and used in the Kaweah Subbasin).

We greatly look forward to the potential opportunity of leveraging our multiple decades of experience through this critical effort. Please feel free to contact us at any time with any questions or clarifications needed while reviewing this proposal.

Sincerely,

Joel Kimmelshue, PhD, CPSS
Principal Scientist and Owner
(916) 517-2482
jkimmelshue@landiq.com

Mica Heilmann, CPSS
Principal Scientist and Owner
(916) 517-2483
mheilmann@landiq.com

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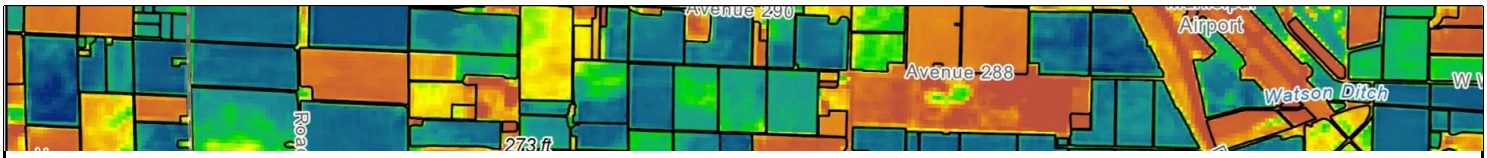


1 Organizational Chart

Land IQ is a specialized Agricultural Science and Remote Sensing firm that pairs scientific knowledge of agronomic, native plant, and land systems with advanced remote sensing technologies, custom modeling, and analytical methods to develop powerful and cost-effective client solutions. For over two decades we have focused on large scale land systems and management solutions. Currently we provide field-by-field ET for 40 GSAs or Irrigation Districts in nine different Subbasins. Our personnel are equipped with extensive experience in remote sensing and spatial analysis, crop production systems, irrigation management and technologies, soil and agricultural sciences, native ecosystems, large scale data management, image processing, agroclimatology and water resource modelling, and scientific and regulatory issues related to land and water resources. We are a Central Valley firm, with boots on the ground.

Land IQ's remote sensing techniques are derived from and informed by our understanding of agricultural and natural systems. We have consciously built our firm in a fashion that marries both land-based scientists (e.g. agricultural, soil, native systems) and spatial scientists (e.g. remote sensing, GIS, photogrammetry). This has been done purposefully to facilitate a multidisciplinary approach to accurately estimate land use change and water consumption as influenced by all variations of surface land use with the most advanced remote sensing and spatial analysis methodologies informed by our California-specific knowledge of cropping systems. We leverage our understanding of landscape processes, plant communities, land management, production systems, and plant phenology to inform and guide our analytical remote sensing approaches. The results are practical, applicable, and accurate work products including traditional formats, as well as online interactive maps allowing our clients to make objective, informed, and strategic decisions.

The following organization chart identifies the Land IQ staff expected work on this project. The key staff identified have been involved in various aspects of evapotranspiration modeling, agricultural remote sensing, and agronomic regulatory support for the last 3 to 28 years, and are listed below. Other appropriately qualified staff may also participate to facilitate completion of any tasks approved by Madera County.

Principal In Charge
Principal Agricultural Scientist
Joel Kimmelshue, PhD, CPSS

Project Controls
Assistant Project Manager
Casey Gudel, MS

Project Manager
Principal Agricultural Scientist
Mica Heilmann, BS, CPSS

Agronomics

Soil & Agricultural Scientist
Cody Fink, MS, CPSS, CCA

Soil & Irrigation Scientist
Adriana Joosep, BS, CCA, CAIS

Agricultural Scientist
Sadie Keller, MS

Agroclimatology

Biometeorologist
Frank Anderson, MS

Biometeorologist
Jenae Clay, PhD Candidate

Atmospheric Scientist
Danial Azman, BS

Spatial Scientists

Senior Remote Sensing Scientist
Diya Chowdhury, MS

Remote Sensing Scientist
Atsushi Tomita, PhD

Remote Sensing Scientist
Zhehan Tang, PhD

Geospatial Analyst
Justin Sitton, BS

2 Qualifications

Land IQ specializes in integrating agronomic sciences with spatial sciences to address large-scale land management and landscape analysis challenges. Specifically, we integrate GIS, data mining, and remote sensing tools to understand agricultural management at the field-scale. We also build specific, web-based interactive data management tools and solutions. This unique combination of expertise aligns well with the needs of Madera County GSA, as do some of the base data that we have developed for the entire state of California. We bring our field-level spatial data to 40 GSAs or Irrigation Districts, in nine Subbasins, covering over 3.5 million acres in Butte, Fresno, Kern, Kings, Madera, San Luis Obispo, Santa Barbara, Stanislaus, Sutter, and Tulare Counties in order to help address data management and reporting needs.

Staff expected to work on this project from Land IQ have been involved in agricultural remote sensing, geospatial analysis, and large-scale data management, as well as various aspects of regulatory compliance programs for the nearly three decades. All staff resumes are included in the Appendix. Our team have lifetimes of working in agriculture in California, with many members part of family farming operations, which brings an additional level of understanding and care.

- **Principal in Charge and Agricultural Scientist**
  Joel Kimmelshue, PhD, CPSS (28 years experience)
- **Project Manager and Principal Agricultural Scientist**
  Mica Heilmann, BS, CPSS (25 years experience)
- **Project Controls & Assistant Project Manager**
  Casey Gudel, MS (18 years of experience)
- **Soil & Agricultural Scientist**
  Cody Fink, MS, CPSS, CCA (12 years experience)
- **Soil & Irrigation Scientist**
  Adrianna Joosep, BS, CAIS, CCA (8 years experience)
- **Agricultural Scientist**
  Sadie Keller, MS (5 years of experience)
- **Biometeorologist**
  Frank Anderson, MS (24 years experience)
- **Biometeorologist**
  Jenae Clay, PhD Candidate (10 years experience)
- **Atmospheric Scientist**
  Danial Azman, BS (4 years experience)
- **Senior Remote Sensing Scientist**
  Diya Chowdhury, MS (12 years of experience)
- **Remote Sensing Scientist**
  Atsushi Tomita, PhD (8 years of experience)
- **Remote Sensing Scientist**
  Zhehan Tang, PhD (8 years experience)
- **Geospatial Analyst**
  Justin Sitton, BS (12 years experience)
- **Support Staff – Various as needed**

3 Project Understanding and Approach

Satellite Evapotranspiration Measurement

Consumptive use of water by crops, often referred to as evapotranspiration (ET), is often the largest outflow of water within an agricultural region's water balance. The calculation of ET can be performed using several methods, all of which have differing levels of complexity, cost, and accuracy. Land IQ fully understands that Madera County GSA relies heavily on consistent and accurate ET for overall water management, grower use, fee structures, and regulatory compliance. This is similar to many other GSAs in which Land IQ provides ET. It is our main goal to work directly with growers and Madera County GSA for this purpose.

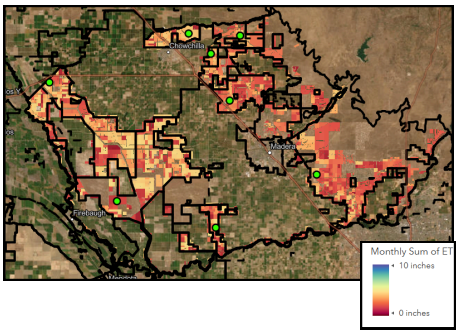
Having worked with various ET approaches and models for a number of years, Land IQ realized the need for accurate land use and calibration of ET estimates to actual cropped fields, centered on rigorous ground truthing and data-driven approaches. As such, over the past 10 years, Land IQ has developed a refined method for determining consumptive use of crops at a field or regional scale. The outcome of this method, when compared against other non-data-driven approaches, results in the most consistent and accurate estimates of ET available. The results of these efforts are being used for decision support by approximately 40 GSAs and Irrigation Districts across 3.5 million acres for grower communications, to inform demand management programs including allocations, regulatory compliance, internal water markets, fee structures, fallowing programs, or other agricultural water management incentive programs.

Land IQ ET was developed for detailed, field-scale water use tracking by Irrigation Districts, Groundwater Sustainability Agencies, and sub watersheds. Land IQ ET is used to interpret image data and leverages robust ground station data with direct image analysis. The approach can utilize a variety of image and ground data sources and yields more accurate results because ground calibration data are consistently driving model results.

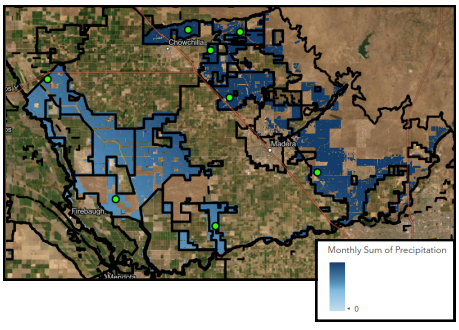
Land IQ ET is differentiated from other models and approaches by the following:

- Primary unit of analysis is at the field scale
- Integrates repeated and rigorous ground truthing eddy covariance and surface renewal environmental stations and historical results for similar crop and canopy types
- Incorporates Land IQ field-level crop mapping at 98+% accuracy
- Differentiates permanent crop age in the analysis process
- Integrates other agronomic features of modern cropping systems
- Allows for unlimited feed-back and optimization for any grower or management organization
- Results are ingested and used by all four known water accounting platforms based on their desired unit of analysis, whether it is at the field scale, parcel level, or farm unit

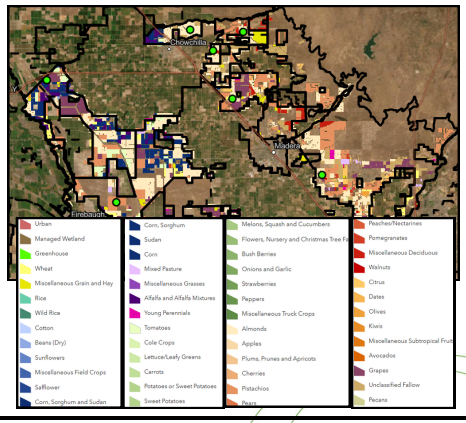
Field-level Evapotranspiration



Field-level Precipitation



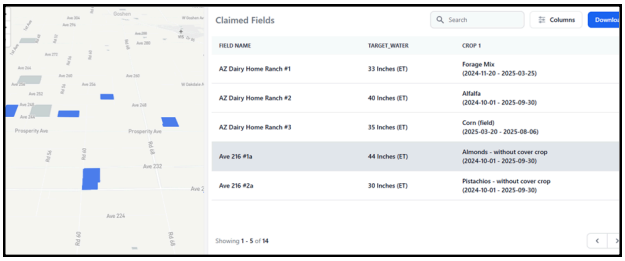
Field-level Crop Type

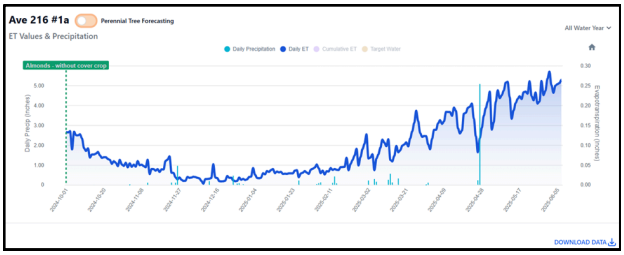


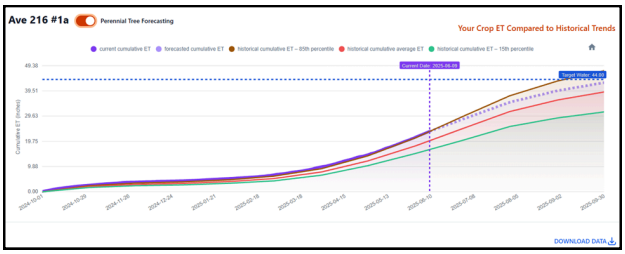
Daily Irrigation Management Tool

Land IQ listens and responds to grower and GSA priorities. For example, feedback from growers over the past few years indicated that they trust the accuracy of our current 30-day results, delivered 30 days later. That said, growers expressed an interest in daily ET and precipitation results delivered near-real time. In response, Land IQ has developed a grower-level, field-by-field, daily ET product portal in which a grower/operator can only view their fields. We have also developed a manager level-portal, that allows the GSA/District manager to view all fields. The full operational capability of this tool will be rolled out in the fall of 2025. For consistency, the results of this daily product will match the proven results of the 30-day ET results that are currently provided to Madera County GSA and its growers, and as proposed here. The goal is to allow growers to track their water use on a daily basis in relation to a district-, GSA-, or grower-defined threshold. The grower can then adjust water management actions during the year on a real time basis to approach, but not exceed this threshold. Visual examples of the tool are provided below.

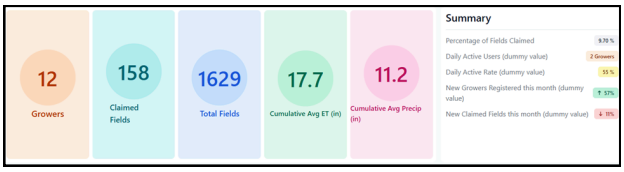
Grower Portal Visualizations

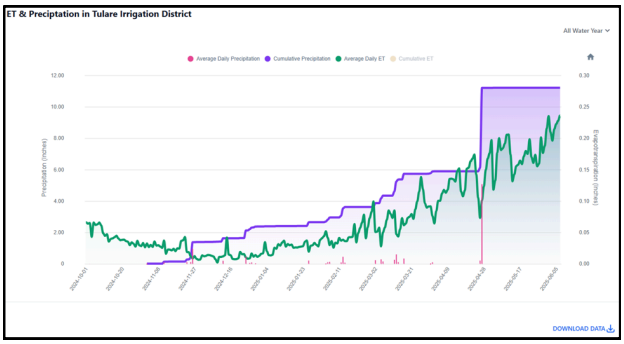






Additional Administrator Portal Visualizations





Accuracies

Land IQ has utilized multiple methods for evaluating model accuracy. One method is an independent validation of model results, using the data from two stations per month for the past 3.5 years. The stations are randomly selected for exclusion from model calibration data. See figure on next page.

The second method of evaluating model accuracy was by comparison of model results to growers' applied water records. Grower irrigation flowmeter data was obtained for over 170 orchards (almonds, citrus, and pistachios) in the Southern San Joaquin Valley for WY 2022 – 2024 and was compared to ET model results. To evaluate accuracy, the total received water for the orchard (irrigation plus precipitation) was compared against model ETa.

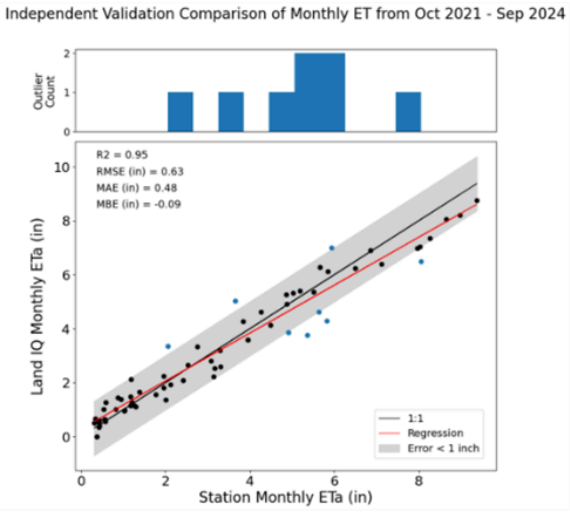
4 Project Experience and Success

Field Level Consumptive Use Estimates

Regulatory requirements associated with the implementation of and compliance with SGMA, require GSAs to understand the annual consumptive use or evapotranspiration (ET) in relation to annual water supply allocations when developing water budgets. At the grower level, it is important for the GSA water users to understand ET at their individual field level to facilitate water management practices and water use efficiency, for improving irrigation scheduling and to assist with crop selection.

Land IQ has developed and refined our remotely sensed Data Driven Model for determining crop ET since 2016. Satellite data are ideally suited for deriving spatially continuous ET surfaces that can be pared down to the field scale because of their temporal and spatial characteristics. However, the most accurate use of RS models requires calibration to surface measurements at the field level. For these reasons, Land IQ uses a combined approach to calculating ET by implementing comprehensive "ground truthing" for calibration and validation, a spatial approach to recognize field-by-field differences, the integration of crop type for improved results, and knowledge of agronomic systems.

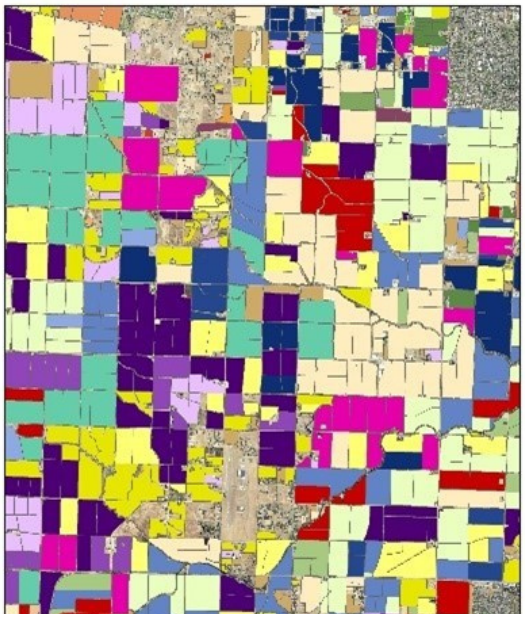
Analysis is conducted every 6 to 8 days every month to characterize ET and calibrate daily, time-resolved analysis for the year. Currently, Land IQ is incorporating the use of Sentinel-2/SAR image resources to enhance the consumptive use estimates with more frequent image resources coupled with Landsat. The resulting analyses are overlaid with Land IQ derived cropping information to determine field-by-field and crop-by-crop ET results. This allows our approximately 40 individual clients to integrate the data into groundwater models, develop groundwater allocations, and invoice their water users based upon actual water use rather than delivered or applied water.



Land IQ utilizes multiple methods for evaluating model accuracy. These include independent validation of model results, utilizing data from randomly selected climatic stations each month, as well as a comparison of applied water versus consumed water.

With the implementation of SGMA and execution of GSPs, more Irrigation Districts and GSAs are looking for ways to quantify the amount of water used for irrigated agriculture. Since 2016 approximately 40 GSAs or Irrigation Districts, covering over 3.5 million acres in Butte, Stanislaus, Madera, San Luis Obispo, Santa Barbara, Fresno, Kings, Tulare, and Kern Counties are using Land IQ ET. Land IQ is contracted with these entities on a project basis with a per acre charge.

Statewide Land Use Mapping



Land use data is critically important to the work of the Department of Water Resources (DWR) and other California public agencies. Understanding the impacts of land use, crop location, acreage, and management practices on environmental attributes and resource management is an integral step in the ability of GSAs to execute GSPs and implement projects to attain sustainability. As a result, Land IQ was contracted by DWR to develop a comprehensive and accurate spatial land use database beginning with the 2014 crop year, covering over 9.4 million acres of irrigated agriculture on a field scale and additional areas of urban extent.

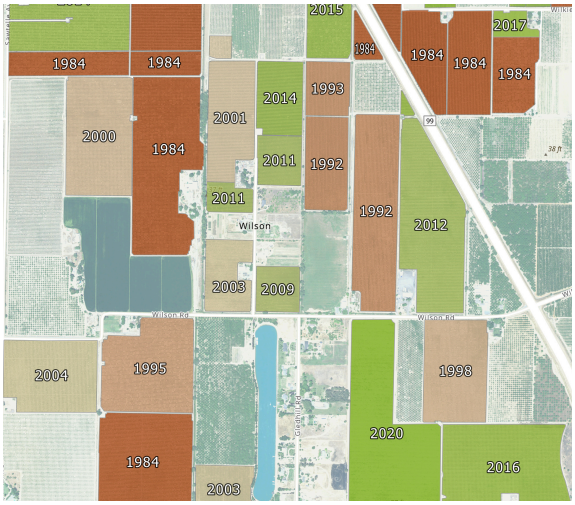
The primary objective of this effort was to produce a spatial land use database with accuracies exceeding 95% using remote sensing, statistical, and temporal analysis methods. Over the past nine years, Land IQ has conducted statewide land use mapping for 2014, 2016, and then annually from 2018 - 2023, which classified over 15 million acres of land annually into agriculture and urban areas on a water year (WY) basis. Unlike the 2014 and 2016 datasets, the WY 2018 through 2023 datasets include multi-cropping. WY 2024 is currently being developed.

Land IQ integrates crop production knowledge with detailed ground truth information and multiple satellite and aerial image resources to conduct remote sensing land use analysis at the field scale. Land IQ provides the following:

- Individual field boundaries of homogeneous crop types representing true cropped area, rather than legal parcel boundaries.
- Individual fields are classified using a supervised classification algorithm. Fields are classified into two legends, a crop category legend (DWR) and a more specific crop type legend (Land IQ).
- To determine frequency and seasonality of multiple-cropped fields, peak growth dates and percentage of the field cropped are determined for annual crops. Time-series statistics are also developed to better define planting, peak vigor and crop termination dates for annual crops.

The Land IQ mapping process takes approximately 20 months to complete. The first 12 months is spent collecting ground truth data, the crops that are in the ground during the water year. The next 8 months are spent classifying the crops. Land IQ does perform advanced mapping for clients who are contracted to receive field-level consumptive use estimates. These data are delivered within 4-5 months of the end of the water year.

Land IQ's land use mapping was the first statewide account of land use developed for DWR and beginning in 2018, the first continuous land use set spanning over five years. Land IQ is contracted with DWR through the 2028 water year, on a project basis with a per acre charge.



5 References

1.	**Client Name:**	Tulare Irrigation District Mid Kaweah Groundwater Sustainability Agency
	Address:	6826 Avenue 240 Tulare, CA 93274
	Contact Name & Phone Number	Aaron Fukuda (559) 707-8928 akf@tulareid.org
	Description of Services Provided:	Provide field-level monthly consumptive use estimates and land use data. Performed retrospective analysis to complete Water Year 2021 (October 2020 - June 2021). Currently beta testing the Daily Irrigation Management Tool.
	Dates of Services:	July 2021 - present

2.	**Client Name:**	East Kaweah Groundwater Sustainability Agency
	Address:	315 E Lindmore St Lindsay, CA 93247
	Contact Name & Phone Number	Chris Hunter (559) 967-5617 chunter@lindmoreid.com
	Description of Services Provided:	Provide field-level monthly consumptive use estimates and land use data. Performed 5-Yr historical evapotranspiration analysis.
	Dates of Services:	May 2020 - present

3.	**Client Name:**	Semitropic Water Storage District
	Address:	1101 Central Avenue Wasco, CA 93280
	Contact Name & Phone Number	Jason Gianquinto (661) 565-5384 jgianquinto@semitropic.com
	Description of Services Provided:	Provide field-level monthly consumptive use estimates and land use data.
	Dates of Services:	January 2017 - present

4.	**Client Name:**	California Department of Water Resources
	Address:	715 P Street, 6th Floor Sacramento, CA 95814
	Contact Name & Phone Number	Stanley Mubako (916) 873-4784 Stanley.Mubako@water.ca.gov
	Description of Services Provided:	Provided annual land use for crop years 2014 and 2016. Provided land use for the water year beginning in 2018 and continuing through 2023. Water year 2024 is currently being classified. Land IQ current contract is through water year 2028.
	Dates of Services:	July 2016 - present

6 Cost

Land IQ is providing the following cost table for review by the GSA. The costs outlined below are all inclusive of the following deliverables and support:

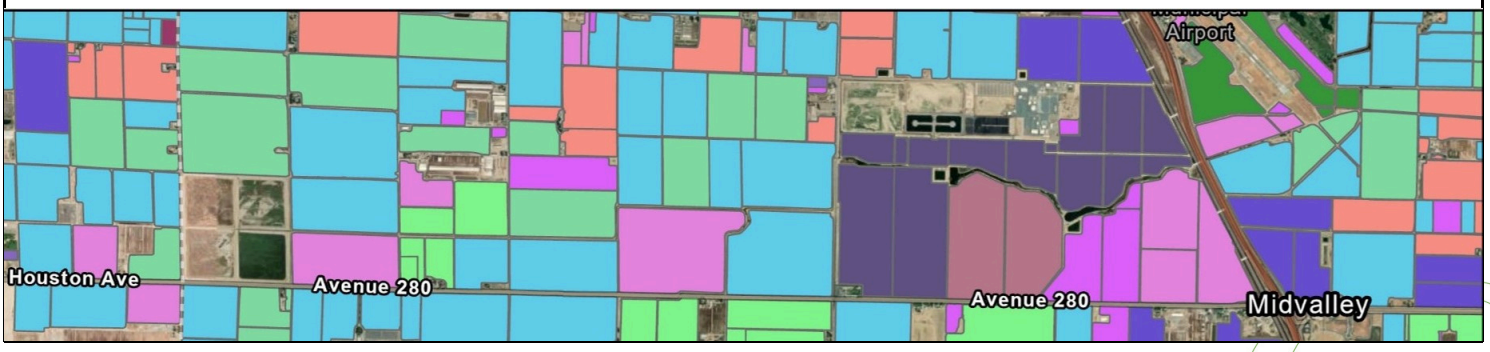
- Monthly and Daily (optional) Field Scale Evapotranspiration
- Monthly and Daily (optional) Field Scale Precipitation
- Annual expedited crop mapping
- Annual expedited field boundary updates
- Annual expedited permanent crop age mapping
- Monthly and annual summary reporting
- Unlimited grower support for answering questions/web tool functionality
- Unlimited GSA support for results summaries, regulatory compliance, public meeting presentations, workshops, stakeholder communications, etc.

Monthly ET, Precip, Annual Crop Type, Annual Age, Unlimited Agronomic Support

	Current			Escalation		
				3%	3%	
	Jan-Dec, 2023	Jan-Dec, 2024	Jan-Dec, 2025	Jan-Dec, 2026	Jan-Dec, 2027	Jan-Dec, 2028
Cropped Area (Acres)	121,622	121,622	121,622	120,669	120,669	120,669
Cost ($/Acre/Year)	$ 1.20	$ 0.98	$ 0.76	$ 0.81	$ 0.83	$ 0.86
Annual Cost ($/Year)	$ 145,946	$ 119,190	$ 92,433	$ 97,742	$ 100,674	$ 103,694
Non-Cropped Area (Acres)	88,872	88,872	88,872	83,543	83,543	83,543
Cost ($/Acre/Year)	$ 0.53	$ 0.45	$ 0.38	$ 0.40	$ 0.41	$ 0.43
Annual Cost ($/Year)	$ 47,102	$ 39,992	$ 33,771	33,651	34,661	35,700
Total Cost ($/Year)	**193,049**	**159,182**	**126,204**	**131,393**	**135,335**	**139,395**
Total Cost ($/Month)	**16,087**	**13,265**	**10,517**	**10,949**	**11,278**	**11,616**

Optional: Daily ET, Daily Precipitation and Irrigation Management Tool

	Current			Escalation		
				3%	3%	
	Jan-Dec, 2023	Jan-Dec, 2024	Jan-Dec, 2025	Jan-Dec, 2026	Jan-Dec, 2027	Jan-Dec, 2028
Cropped Area (Acres)	N/A	N/A	N/A	120,669	120,669	120,669
Cost ($/Acre/Year)	N/A	N/A	N/A	$ 0.55	$ 0.57	$ 0.58
Annual Cost ($/Year)	**N/A**	**N/A**	**N/A**	**$ 66,368**	**$ 68,359**	**$ 70,410**
Monthly Cost ($/Month)	**N/A**	**N/A**	**N/A**	**5,531**	**5,697**	**5,867**



APPENDIX

Joel Kimmelshue, PhD, CPSS
Agricultural Scientist

Years of Experience
28

Education
Ph.D., Soil Science (Water Concentration), North Carolina State University, 1996

M.S., Soil Science, (Ag Engineering Concentration), North Carolina State University, 1992

B.S., Soil Science (Crop Science Concentration), California Polytechnic University, SLO, 1990

Professional Registrations and Affiliations
- Certified Professional Soil Scientist (#18204)

Distinguishing Qualifications
- Land use assessments and crop identification
- Soil/water/plant relations in arid climates
- Irrigation and drainage management
- Crop consumptive use estimates
- Soil and land use evaluations for the implementation of irrigation systems and crop production
- Water resources
- Soil nutrient interactions and environmental issues in soils
- Water quality for irrigated agriculture
- Regulatory support and negotiation for agriculture
- Policy, regulatory, and environmental influences on agricultural production systems

Dr. Kimmelshue is a Principal Soil and Agricultural Scientist for Land IQ. Dr. Kimmelshue is also a founding Owner in the firm. He has experience in agricultural and water resources consulting in the western United States (especially California), and agricultural research and crop production throughout the United States. This experience stretches to various locations in Europe and the Middle East. Dr. Kimmelshue has performed technical leadership and/or managed numerous projects and tasks worth nearly $40 million dollars over the past 28 years.

Dr. Kimmelshue's consulting experience includes practical and applied solutions for development of water/soil management systems and agricultural systems, specifically with irrigated agriculture. This technical expertise also includes expert witness testimony, crop consumptive use estimates, erosion and dust control, regulatory support and negotiation, water resources science and planning, land reclamation, soil/plant nutrient dynamics, irrigation and drainage in arid and humid climates, soil classification, crop production, land application of municipal and agricultural wastes, and revegetation/reclamation efforts.

Predominantly, the objective scientific work that Dr. Kimmelshue performs is driven by ever-changing policy, legislative and environmental pressures on production agricultural systems. Dr. Kimmelshue thoroughly understands these drivers and applies sound scientific results to help his clients address these challenges.

REPRESENTATIVE PROJECT EXPERIENCE

LAND USE MAPPING

Principal in Charge and Technical Lead – Statewide Crop and Land Use Mapping – California Department of Water Resources. Land IQ is contracted by the state of California to conduct statewide crop mapping of approximately 50 different crop types on over 9.4 million acres of agricultural land for fields of 2.0 acres and larger (sometimes smaller depending on crop type – (e.g. avocados)). The entire dataset amounted to

over 450,000 individual polygons and an average field size of 34 acres. The mapping spanned the entire state from the Mexico, Nevada, and Arizona borders to the Pacific Ocean. The ultimate accuracy of the 2014 mapping based on thousands of miles of ground truthing was 96.6%. The 2023 statewide accuracy was 98%. Land IQ is now mapping multi-cropping systems throughout the state in addition to the main season cropping systems. The mapping provided the first ever statewide crop map and since 2018, has now provided over five years of continuous mapping.

AGRICULTURAL WATER RESOURCES

Principal in Charge and Project Manager – Monthly Remotely Sensed Crop Consumptive Use – Over 40 Groundwater Sustainability Agencies (GSAs) and Irrigation Districts. As a part of the California Sustainable Groundwater Management Act (SGMA) regulatory requirements, highly accurate and timely evapotranspiration measurement are a key input to hydrologic models and overall efficient water management. Land IQ ET covers approximately 3.5 million acres, across GSAs and Irrigation Districts in Butte, Sutter, Stanislaus, Madera, Fresno, Kings, Tulare, Kern, and San Luis Obispo Counties. A monthly remotely sensed ET field-by-field measurement is performed and delivered to the districts within 30 days following the end of the previous month. The results are created with a remotely sensed regression approach that integrates nearly 100 climatic ground truthing stations that measure the climatic variables necessary to calculate actual ET. These calibration points are then used in the model to estimate ET from every irrigated and non-irrigated field, as well as native areas. The ground truthing stations are also used for validation datasets.

Project Manager and Technical Lead–Demand Reduction Strategies - Vina Subbasin Groundwater Sustainability Agencies. This project utilizes Land IQ's expertise in spatial data analysis and crop consumptive water use (evapotranspiration or ET) to conduct two pilot studies in the Vina Subbasin. The Extend Orchard Replacement Program will first estimate, using resources from ongoing ET work conducted in California, water savings from extending the fallow period between orchard removal and replant by one to two years. A field-by-field, subbasin-wide monitoring program will be developed that will include collecting and analyzing data-driven, ground-calibrated, remotely sensed evapotranspiration, measured precipitation, crop type, block boundaries, irrigation method, and permanent crop age in a 2-year pilot study. Based on the results of the pilot project, a final long-term action plan for the program will be developed, including exploration of sustainable funding options.

The Agricultural Irrigation Efficiency Pilot Program also uses ground-truthed ET and crop data to determine practices that optimize beneficial ET and minimize non-beneficial ET. The Land IQ team is working with engagement and outreach consultants to receive grower feedback, preferences, barriers to adoption, and metrics for success. This program leverages education and outreach, a feasibility study piloting innovative technologies, and development of a precision irrigation implementation plan to improve ET-based water management at a broader scale in the Vina Subbasin.

Mica Heilmann, CPSS
Principal Scientist

Years of Experience
25

Education
B.S., Soil Science, California Polytechnic State University, San Luis Obispo, 2000
Minors: Water Science and Viticulture

Fellow, California Agricultural Leadership Foundation Program, 2009

Professional Registrations and Affiliations
- Certified Professional Soil Scientist (#30230)
- Board Member, Placer County Resource Conservation District

Distinguishing Qualifications
- Agricultural systems and crop production
- Remote (satellite/aerial) land evaluation
- Land use and soil evaluation and classification
- Irrigation and drainage management and systems
- Water resource evaluation, planning and conservation
- Agroclimatology and consumptive use analysis/modelling
- Nutrient and salinity management in soil and water systems
- Soil, plant and water interactions
- Large-scale land stabilization and sediment control
- Project management and stakeholder coordination extent

Ms. Heilmann is a Principal Scientist and founding partner with Land IQ. She specializes in large-scale land surface mapping and land and water resource evaluation and management. Ms. Heilmann is a technical lead of the team that developed Land IQ's remote land use mapping capabilities over the last 15 years, integrating agronomic knowledge with remote sensing and geospatial analytical techniques. She has over 25 years of experience providing scientific expertise on large-scale land classification, agricultural systems, native vegetation systems, water resource management, irrigation management and agroclimatology and soil-plant-water interactions. An experienced project manager, Mica works closely with clients and stakeholders in evaluating land systems and applying that knowledge in decision making and business systems. Mica leverages a wide range of science and technology advancements to provide innovative, practical, and sustainable solutions for clients.

REPRESENTATIVE PROJECT EXPERIENCE

LAND USE MAPPING

Technical Project Manager – Statewide Crop and Land Use Mapping – California Department of Water Resources. Developed and implementation ongoing annual remotely sensed land mapping using advanced remote sensing analysis and ground truthing techniques. Statewide data are detailed to the field scale and highly accurate, exceed 97% accuracy and have become the standard for broad, multi-agency decision science and planning. Resulting data products are public and accessed by over 100 public and private agencies for improved decision science and foundational resource analysis. Several derivative remote sensing analyses are also performed including crop age determination, irrigation method determination, evapotranspiration analysis, and other time series change detections.

Mica Heilmann, CPSS
Principal Agricultural Scientist

Project Manager - Sacramento-San Joaquin Delta Comprehensive Land Use Mapping, California Department of Water Resources, Sacramento, CA. Performed comprehensive remote sensing land use classification for the Sacramento-San Joaquin Delta for 2015, 2016, and 2017. Classification included agricultural crops, native areas, open water, urban areas, farmsteads and semi-agricultural areas, and floating vegetation. The detailed legend for agricultural crops was aligned with DWR standard legend and provided additional detail in both permanent and annual crop categories. This work was informed by and validated against independent, in-season ground truth data collected throughout the delta. Both supervised and unsupervised classification techniques were used to digital image resources including Landsat (30 m) and Pleiades (2 m) satellite imagery. Results were over 96% accurate and will be used to inform both remote sensing and empirical evapotranspiration models.

AGRICULTURAL WATER RESOURCES

Agricultural Scientist - Sacramento-San Joaquin Delta Bouldin Island Evapotranspiration Analysis – Semitropic Water Storage District, Bouldin Island, CA. Evaluated reduction in ET from the land surface as a result of fallowing efforts in support of potential water transfer action in the Sacramento-San Joaquin delta. Supported site placement and installation of surface renewal monitoring instrumentation for real time data collection at three sites in the Delta. Assisted in calculation of actual ET and relating to remotely sensed ET models to generate comprehensive spatial ET for the island. Results provided an approach to defining the water savings that could be used in water transfer agreements.

Technical Lead and Project Manager – Remotely Sensed Crop Mapping and Consumptive Use Analysis Supporting Crop Land Fallowing Program; Yuma Mesa Irrigation and Drainage District, Yuma Arizona. Managed a 5-year remote sensing crop mapping and consumptive use analysis supporting a cropland fallowing program in coordination with the Arizona Department of Water Resources.

Project Manager - Sacramento-San Joaquin Delta Comprehensive Land Use Mapping and fallow ET Assessment; San Luis Delta Mendota Water Agency. Coordinated with landowners, Delta interests, UC Davis and State Water Resources Control Board to lead a collaborative study of fallow and agricultural water use in the California Delta. Performed comprehensive remotely sensed land use classification for agricultural, native and water areas. Assisted with installation of telemetered monitoring system and detailed data QAQC and analysis. Lead multi-stakeholder meetings, providing scientific and study guidance and implementation.

Technical Lead and Project Manager - Demand Management for Sonoma County Groundwater Sustainability Agencies, Sonoma County, CA. Performed an assessment of groundwater demand from agricultural and outdoor residential and commercial properties. Created a tool that leverages existing spatial data and water use efficiency measures that landowners can use to identify demand reduction strategies specific to their parcels.

Casey Gudel, MS
Client Relations & Project Manager

Years of Experience
18

Education
M.S., Agriculture, California Polytechnic University, San Luis Obispo, 2007

B.S., Animal Science, California State University, Chico, 2001

Professional Registrations and Affiliations

- Advisor, California/Nevada Junior Hereford Association
- Project Leader, Sloughhouse Alta Mesa 4-H Beef

Distinguishing Qualifications

- Ability to communicate complex issues to general public in easy to understand language.
- Ability to manage multiple projects simultaneously and under pressure.
- Strong attention to detail and focus on task completion.
- Extensive hands-on experience in the agriculture industry

Ms. Gudel is a Project Manager at Land IQ. Casey received her MS in Agriculture from California Polytechnic University, San Luis Obispo. She manages multiple projects and implements project controls across both land and spatial disciplines at Land IQ. Casey provides comprehensive project support including work scope planning, schedule and deliverable management, project implementation, document coordination, QAQC, cost control and project compliance and reporting. She brings an extensive background in agriculture and project management having previously worked for the California Farm Bureau Federation as their Political Affairs Manager. In that role, she managed the political action committee for the organization, including the raising and distributing funds, execution of grassroots advocacy program and planning of events. Casey and her husband also own and operate Gudel Cattle Company, raising Angus and Sim-Angus cattle and helping to manage thousands of acres of grazing land in California and Oregon.

REPRESENTATIVE PROJECT EXPERIENCE

Project Management/Client Relations – Department of Water Resources, Sacramento, CA. Assist with the development of statewide land use mapping that is produced for the use of Groundwater Sustainability Agencies in complying with the Sustainable Groundwater Management Act. Responsibilities include coordinating trainings and developing materials for DWR staff, drafting technical reports, attending working group meetings and organizing staff resources.

Project Management/Client Relations – Groundwater Sustainability Agencies, Southern San Joaquin Valley, CA. Assist with delivery of monthly field-by-field evapotranspiration results to over twenty Groundwater Sustainability Agencies and Irrigation Districts in the Kings, Tulare and Kern Counties. Serve as a point of contact for client questions.

Casey Gudel, MS
Client Relations & Project Manager

LAND IQ

Project Management/Client Relations – San Joaquin River Restoration Program Seepage Management Project, United States Bureau of Reclamation, San Joaquin Valley, CA. Conduct budget tracking, invoicing and document formatting for Seepage Management project. Responsibilities include coordinating with subcontractors on documentation.

Project Management/Client Relations – Almond Board of California, Modesto, CA. Conduct day to day communications with staff at ABC, manage project teams, draft technical documentation and oversee mapping, spatial analyses and web mapping tools created for helping the almond industry make informed decisions on water resources, land use and marketing.

Project Management/Client Relations – Walnut Handler Tool, California Walnut Board, Folsom, CA. Serve as main contact for updates to online tool used by handlers to report walnut marketing activities. Responsibilities include coordinating with development team on requested updates and fixes to tool.

Project Management/Client Relations – Statewide Rice Mapping, CA. Oversee statewide mapping of rice acreage, communicate with clients, ensure delivery of mapping and derivative products that are valuable to the rice industry for the planning and marketing of the rice crop on an annual basis.

Project Management/Client Relations – Cold Water Rice, Butte County, CA. Assist with a joint water resources project between the Department of Water Resources and four Irrigation Districts to quantify and compensate growers for the impacts cold water has on rice yield. Responsibilities have included assisting with price of rice determination, annual payment calculations, annual reporting and grower, technical panel and advisory group meetings.

Project Management/Client Relations – Sacramento Valley Water Quality Coalition, CA. Coordinate the needs of six subwatersheds in the development of a data management tool for grower reporting and member tracking for the Irrigated Lands Regulatory Program. The tools allow for the tracking of member related information and spatial data on a field-by-field basis, and allows for seamless generation of data analyses, summaries and reports to serve the needs of the subwatershed.

Project Management/Client Relations – California Avocado Commission, Irvine, CA. Primary contact for the CAC staff in developing acreage and condition assessments of avocado groves statewide. This annual assessment helps the CAC in making important decisions related to land resource management as well as the planning and marketing of available crop.

Project Management/Client Relations – California Walnut Board, Folsom, CA. Oversee the development of an online application for handlers to report six types of forms at different frequencies over the course of a crop year, in addition to administrative capabilities to run summary reports on a monthly frequency. This application helped CWB move away from paper submissions to online reporting.

Cody Fink, MS, CPSS, CCA
Soil and Agricultural Scientist

Years of Experience
12

Education
M.S., Soil Science, Pennsylvania State University, 2013

B.S., Soil and Crop Science, Purdue University, 2011

Professional Registrations and Affiliations
- Certified Professional Soil Scientist (#332146)
- Certified Crop Adviser (#332146)

Distinguishing Qualifications
- Soil fertility
- Salinity management
- Dust and erosion control
- Regulatory support
- Geospatial analysis
- Soil morphology and classification

Mr. Fink is a Soil and Agricultural Scientist with Land IQ. His work has focused on providing technical support for management of nutrients, water, and dust control. He has helped lead vegetation establishment efforts for native vegetation dust control areas on the Owens Lake playa which included tracking reclamation of saline soils, development of fertilizer and irrigation recommendations, and satellite-based estimation of vegetation cover. He has provided regulatory support related to nitrogen management and reporting of grower nitrogen data for the Irrigated Lands Regulatory Program (ILRP). Mr. Fink is also experienced in GIS, geospatial analysis, and remote sensing, integrating this into project efforts.

REPRESENTATIVE PROJECT EXPERIENCE

LAND USE MAPPING

Agricultural Scientist – Statewide Crop and Land Use Mapping – California Department of Water Resources, Sacramento, CA. Collected GT data for field-level crop mapping model and performed heads up QA/QC of crop classification, peak dates, and removed orchards for low confidence model results using aerial and satellite imagery.

Agricultural Scientist - Statewide Avocado Mapping - California Avocado Commission, Irvine, CA. Performed heads up crop classification of avocados in California, including an evaluation of planting/removal dates and condition (i.e. stumped, abandoned, young, producing).

Agricultural Scientist - Statewide Small Farms Mapping - California Department of Water Resources, Sacramento, CA. Developed methodology to map small farming operations less than 80 acres using publicly available information from the state ILRP and pesticide use reporting (PUR) programs. Collaborated with programming team to develop automated procedure for matching names with spelling differences and identify duplicate records.

Cody Fink, MS, CPSS, CCA
Soil and Agricultural Scientist

Agricultural Scientist - Vegetation Cover Mapping - Los Angeles Department of Water and Power, Owens Lake, CA. Led compliance assessment to estimate percent cover in vegetation dust control areas on Owens Lake. Led field collection of ground truthing (GT) photos, digital classification of percent cover for GT data, and evaluation and reporting of model results. Determined the acreage of reseeding and/or sod transplanting recommended to achieve compliance cover levels.

AGRICULTURAL WATER RESOURCES

Agricultural Scientist - Land IQ Data Driven Evapotranspiration Modeling - California. Perform monthly agronomist review of Land IQ's 30-meter actual evapotranspiration (ETa) model results for the Groundwater Sustainability Agencies and Irrigation Districts throughout Butte, Sutter, Stanislaus, Madera, Fresno, Kings, Tulare, Kern and San Luis Obispo Counties. Worked with growers to investigate and address model discrepancies with irrigation flowmeters. Performed independent validation assessment of model accuracy.

Agricultural Scientist - Nitrogen and Irrigation Management - Los Angles World Airports, Palmdale, CA. Estimated historic nitrogen loading rates and land use for agricultural land with nitrate impacted groundwater. Monitored and developed recommendations for agronomic rates of application and nitrogen and irrigation water to limit future contributions of nitrate to groundwater.

Agricultural Scientist - Soil Fertility and Irrigation Management - Los Angeles Department of Water and Power, Owens Lake, CA. Evaluated and developed recommendations for soil reclamation, fertilization rates and appropriate fertilizers, and irrigation scheduling for managed vegetation dust control areas to support establishing and maintaining compliant cover levels.

Agricultural Scientist - Soil Fertility and Irrigation Management - Rio Tinto Mining, Queen Creek, AZ. Monitored soil fertility for fields receiving treated mine wastewater to assess if there were potential impacts to agricultural productivity from mine operations.

Agricultural Scientist - Dryland Grape Farming Index - California Sustainable Winegrowing Alliance, California. Collaborated with project team to develop criteria and GIS methodology for rating suitability of existing vineyards in California for dryland farming.

Agricultural Scientist - Irrigated Lands Regulatory Program - Sacramento Valley Water Quality Coalition, California. Managed nitrogen reporting efforts for Sacramento Valley growers in the Irrigated Lands Regulatory Program (ILRP). Coordinated import of historic data into web tool, collection of new data from growers, automation of QA/QC and statistical analysis, identification of outliers for nitrogen applied, and reporting.

LAND IQ

Adriana Joosep, CCA, CAIS
Soil and Irrigation Scientist

Years of Experience
8

Education
B.S., Environmental Soil Science, California Polytechnic University SLO, 2017

Minor: Water Science, specializing in irrigation

Professional Registrations and Affiliations

- Certified Agricultural Irrigation Specialist (CAIS)
- Certified Crop Advisor (#490209) with Nitrogen Management Certification

Distinguishing Qualifications

- Irrigation systems, scheduling and maintenance
- Irrigation water supply reliability and quality
- Crop production systems
- Remotely sensed crop evapotranspiration (ET)
- Soil survey and characterization
- Crop photo (aerial imagery) interpretation
- Geographic Information Systems (GIS) analysis
- Project management

Mrs. Joosep is a Soil and Irrigation Scientist at Land IQ with over nine years of experience in agricultural systems, land use analysis, and remotely sensed evapotranspiration. Her work spans crop production systems, irrigation water supply and quality, and geospatial mapping. She has led and contributed to projects involving crop and urban landscape mapping, as well as remote sensing applications for water use estimation and land use change detection.

In addition to her technical expertise, Mrs. Joosep brings practical agricultural insight through active involvement in her family's farming operation in Stockton, California, where they produce almonds, walnuts, alfalfa, corn, and wheat.

REPRESENTATIVE PROJECT EXPERIENCE

LAND USE MAPPING

Program Manager – Statewide Crop and Land Use Mapping Ground Truth Data Collection – California Department of Water Resources, Sacramento, CA. Lead and managed ground-truth data collection for state-wide California, Arizona, and Australia crops. This included data and route preparation, scheduling, staffing, training, data management, and data cleaning efforts on approximately 24,000 miles of route taking place over the course of 17 weeks, 22 distinct trips, and collecting over 90,000 point features annually.

Project Manager - Cuyama Valley Basin Crop Mapping - Cuyama Valley Groundwater Sustainability Agency (GSA), New Cuyama, CA. Managed annual crop mapping of the Cuyama Valley Basin to support groundwater management efforts for 14 years of cropping. Mapping included both water year and calendar year mapping as well as irrigation status determinations.

Adriana Joosep, CCA, CAIS
Soil and Irrigation Scientist

Agricultural Scientist - Statewide Crop and Land Use Mapping – California Department of Water Resources, Sacramento, CA. Works on a company-wide team responsible for classifying each crop produced, permanent crop age, and crop timing identification on over 9.4 million acres of total cropped area in the state of California on an annual basis. Performs accuracy assessment across to quantify the probability of the dataset correctly classifying crops across 10 hydrologic regions and 56 crop types. This highly accurate dataset ranges between 96 – 98% accuracy annually.

AGRICULTURAL WATER RESOURCES

Project Manager - Consumptive Use Comparisons in the Southern San Joaquin Valley - California. Lead the development of a multi-year assessment of Land IQ's remotely sensed evapotranspiration and precipitation work. Overseeing collaboration among 20+ contributors, including authors, technical reviewers, editors, and peer advisors, to ensure scientific accuracy, clarity, and consistent theme in the publication.

Assistant Project Manager - Land IQ Data Driven Evapotranspiration Modeling - Multiple GSAs and Irrigation Districts, California. Manage a project team of 15+ staff members to deliver monthly, field level actual evapotranspiration (ET) data on over 3.5 million acres of farmland to support groundwater sustainability efforts. This project leverages a network of nearly 100 eddy covariance and surface renewal ET stations, crop mapping, Landsat and Sentinel imagery, and web development to efficiently and accurately track agricultural water use across nearly one-third of California's most productive agricultural regions.

GIS Analyst - Summarization of Actual Evapotranspiration (ETa) of Almonds, Citrus, Pistachios, and Walnuts - Southern San Joaquin Valley, California. Utilized geographic information systems, spatial crop mapping and age data, and remotely sensed ETa to identify the relationship between ETa and orchard age among varying permanent crop types.

Project Lead – California Water Supply Reliability Evaluation; California Walnut Commission, Almond Board of California, American Pistachio Growers, Blue Diamond Growers, AgIS Capital, Select Harvests, Kern Machinery; Central Valley, California. Lead the characterization of California water districts to identifying the source, strength of water rights, state of their groundwater basin, reliability on surface water, use of recycled water, and water storage capacity. This allowed water districts with large agricultural acreages to be compared to one another given a relative score of water reliability. This analysis assisted the clients in their ability to better plan for budgeting purposes, areas of anticipated growth or decline, and to support their growers.

LAND IQ

Sadie Keller, MS
Agricultural Scientist

Years of Experience
5

Education
M.S., Horticulture, Oregon State University, 2023

B.S., Agriculture, California State University Stanislaus, 2020

A.S., Interdisciplinary Studies, Math and Science, San Joaquin Delta College, 2019

Professional Registrations and Affiliations

- Remote Pilot Certification – Part 107, Small Unmanned Aircraft Systems (#4779642)
- California Certified Crop Advisor (CCA) – Expected 2025/2026

Distinguishing Qualifications

- Crop production systems
- Plant physiology and plant-water relations
- Nursery production systems
- Crop photo (aerial imagery) interpretation
- Geographic Information Systems (GIS) analysis

Ms. Keller is an Agricultural Scientist at Land IQ. She began working in the agriculture industry in San Joaquin County in 2017 where she gained valuable experience in crop scouting and crop protection. This work inspired her to obtain her Bachelor of Science in Agriculture from California State University Stanislaus. Ms. Keller then obtained her Master of Science in Horticulture from Oregon State University where her research focused on plant and water relations in nursery production systems. Her graduate school experience sharpened her skills in crop management, plant physiology, data collection, and data analysis.

REPRESENTATIVE PROJECT EXPERIENCE

AGRICULTURAL WATER RESOURCES

Agricultural Scientist - Land IQ Data Driven Evapotranspiration Modeling - Multiple GSAs and Irrigation Districts, California. Assists in the installation and maintenance of nearly 100 agroclimatology stations where the active area of analysis currently spans over one million acres. This data is used to guide a remote sensing modeling process that quantifies the evapotranspiration of the remainder of the landscape monthly. This project work is ongoing.

Grower Relations Lead - Land IQ Data Driven Evapotranspiration Modeling - Multiple GSAs and Irrigation Districts, California. Primary responsibilities include coordination of field site selection, grower engagement, and daily oversight of evapotranspiration (ETa) data reporting to station hosts. Serve as the main point of contact for station installation, maintenance, and in-season adjustments, particularly during critical periods such as harvest or chemical application. Contribute to the development of standardized documentation for station siting and initial grower outreach to ensure consistency and effective communication.

Sadie Keller, MS
Agricultural Scientist

LAND IQ

LAND USE MAPPING

Project Lead – Statewide Crop and Land Use Mapping Ground Truth Data Collection – California Department of Water Resources, Sacramento, CA. Works on a team responsible for photointerpretation and identification of the peak normalized difference vegetation index (NDVI) for each crop produced within the total cropped area (>9.4 million acres). Also part of the team responsible for the collection of ground truth data to identify and analyze state-wide California crops. Data collection includes crop identification, irrigation method identification, relative age of perennial crops, and planning of crop season observation timing.

Project Lead - Chino Basin - Quarterly Crop Mapping and Fill In Mapping; West Yost & Associates; Davis, California. Leads quarterly crop mapping and annual assessments of irrigation methods and non-agricultural land use to support the Chino Basin Watermaster. Delivered actionable data to inform basin-wide water demand planning and resource management decisions.

Project Lead – Cuyama Valley Basin - Water Year and Calendar Year Mapping & Verification of Irrigation Status; Woodard and Curran; Sacramento, California. Crop classification and irrigation status verification across the Cuyama Basin for the water and calendar years. Conducts all remote sensing analysis, agronomic interpretation, and field-scale mapping to identify irrigated land use. Integrated multi-source imagery, crop phenology, and semiannual ground truth data—to achieve ≥95% classification accuracy. Results support identification of water use patterns and land use changes critical to basin-scale water resource management.

URBAN WATER RESOURCES

Agricultural Scientist - Urban Landscape Classification and Demand Analysis; San Juan Water District, Granite Bay, California. Worked on a team responsible for providing a technical review of urban landscape mapping previously performed by the California Department of Water Resources for SJWD service areas to verify that there were no data gaps and detect the magnitude of any data gaps identified. The mapping efforts helped categorize land area within residential parcels as 1) Irrigated, Irrigable (II); 2) Irrigable, but not currently Irrigated (INI); or 3) Not Irrigable (NI).

REGULATORY COMPLIANCE

Agricultural Scientist - Digital Point Frame Vegetative Cover Assessment; Owens Lake Dust Mitigation Project; Keeler, CA. Assessed vegetative cover to identify compliance levels of managed vegetation dust control practices using photographs collected by Land IQ. Utilized GIS to perform virtual pin counting, resulting in a quantitative measure of vegetative cover to use in a remote sensing approach of vegetative cover measurement. This assessment spans thousands of acres within the Owens Lake Dry Lakebed.

Frank Anderson, MS
Biometeorologist

Years of Experience
24

Education
M.S., Atmospheric Science/Biometeorology, University of California Davis, 2007

B.S., Atmospheric Science, University of California Davis, 2001

Distinguishing Qualifications

- Atmospheric energy and greenhouse gases fluxes
- Eddy covariance and chamber-based measurements
- Meteorological instrumentation and datalogging
- Telemetry and real-time data acquisition
- Agricultural crop and reference evapotranspiration
- Soil, plant, and water processes
- Python: scientific data processing, analysis, and gap-filling techniques
- Regional weather patterns and climatology
- Irrigation management and systems
- Water quality and sensors
- Wetland restoration and management
- Native and invasive plant species

Mr. Anderson is a Biometeorologist with Land IQ. He has over 24 years of experience in micrometeorology measurements from agricultural and natural systems using multiple approaches: eddy covariance, surface renewal and plant-soil chambers. Mr. Anderson has gained a significant amount of experience working throughout California measuring evapotranspiration rates from various agricultural crops including alfalfa, almonds, corn, cotton, pistachios, walnuts, and rice, as well as quantifying carbon fluxes from wetland systems ranging from fresh to saline. His collaborations are both national, working with university scientists and farmers in California to wetland ecologists in the Florida Everglades and Washington State's Puget Sound, as well as international, working with scientists from Italy, Egypt, Brazil and China. His work over the years has required both innovative approaches for sensor deployment, real-time data acquisition, data processing and troubleshooting, and problem-solving techniques. His research interests include agricultural water use and climatology, atmosphere-plant-soil interactions, remotely sensed evapotranspiration rates and energy budget processes, carbon cycling, responses to irrigation practices due to changes in atmospheric conditions, and machine learning data processing.

REPRESENTATIVE PROJECT EXPERIENCE

ACTUAL CROP AND FIELD CONSUMPTIVE USE

Lead Biometeorologist - Land IQ Data Driven Evapotranspiration Modeling - Multiple GSAs and Irrigation Districts, California. To deliver accurate monthly ET rates over this large region, Land IQ developed a remote sensing model, the Land IQ Data Driven Method (LDDM), that incorporates Earth's surface information from multiple satellite imagery and over 100 ground-based calibration stations. These ground-based stations use eddy covariance and surface renewal methodology to measure changes in atmospheric conditions to calculate ET rates on a half-hour basis. Mr. Anderson works with other Land IQ scientists to install and maintain these

ground-based stations. Mr. Anderson is the lead scientist in the delivery of monthly results to the remotes sensing modelers. His duties include raw data telemetry, python-based half-hour calculations of energy fluxes, data analysis and quality control, and a monthly summary presentation to a senior advisory committee. Mr. Anderson also works with companies and contractors to find new ways to measure and calculate rates of ET and reference evapotranspiration rates – increasing the station density in the region.

Lead Biometeorologist - Updating and Sharing Crop Coefficient (Kc) Information to Enhance Agricultural Water Demand Estimations and Irrigation Scheduling in the Water-limited Context of California. Mr. Anderson is responsible for supporting the on-going data collection for annual and perennial crops through remote troubleshooting and instrument maintenance of existing University of California, Davis evapotranspiration towers (approximately 20 towers) in the San Joaquin Valley. Activities and responsibilities include overall support for team members to reach project goals, provide continual remote access to evapotranspiration stations, troubleshooting and maintaining station instrumentation, calculate and analyze station data for energy balance fluxes, and provide quality control assessment.

Lead Biometeorologist - Alternative Evapotranspiration Zones for the Las Posas Valley Basin. Mr. Anderson prepared a technical memorandum for Judge Patrick Walsh to document the estimation of alternative crop evapotranspiration (ETc) zones for the Las Posas Valley Basin (LPVB) using reference evapotranspiration (ETo) rates and crop coefficients (Kc). Using available meteorological information, Mr. Anderson concluded that there were potentially three different zones that could affect the ETo rates in the region. Further, he provided a general range of ETc rates that might be found within these three different ETo zones using Kc values from avocados and citrus.

Biometeorologist - Updating information on evapotranspiration (ET) and crop coefficients (Kc) of micro-irrigated almond production orchards grown in California for use in water resource management and irrigation scheduling decisions. Mr. Anderson supports this multi-collaborative effort through data retrieval, inventory, organization, quality control and analysis for the provision of proprietary field ET datasets collected from mature almond orchards in commercial production setting. In addition, he supports the project by updating information on almond water use with existing tools for modeling water demand and scheduling irrigation for mature almond and the development of the Digital Almond Water Demand Map.

Project Scientist – Evapotranspiration Field Measurements in the Sacramento/San Joaquin Delta; Westlands Water District. Mr. Anderson supported the development and construction of an atmospheric monitoring station for an irrigated pasture in the western delta. The data collected from the stations guided a remote sensing effort that mapped the actual evapotranspiration of the ranch which then dictated water transfer decisions.

Jenae Clay, PhD Candidate
Biometeorologist

Mrs. Clay, Ph.D. Candidate, is a Biometeorologist with Land IQ, and she has been working in the field of biometeorology since 2015. Her research experience includes using surface renewal, eddy covariance, and energy budget residual methods to measure evapotranspiration in California's agricultural ecosystems. She also has experience evaluating the performance of low-cost meteorological sensors, conducting soil sampling, performing stem water potential measurements, and collecting fPAR measurements using ceptometry. She enjoys working with colleagues from across the globe as well as teaching others about meteorological sensors, biometeorology, and atmospheric science in the classroom or through public outreach.

Years of Experience
10

Education
Ph.D. Candidate, Atmospheric Science, University of California Davis, Expected Ph.D. Defense by Winter 2026

B.S., Atmospheric Science, University of Louisiana at Monroe, 2013

Professional Registrations and Affiliations

- American Meteorological Society member since 2011
- American Geophysical Union member since 2015

Distinguishing Qualifications

- Atmospheric energy budget fluxes
- Eddy covariance sensor calibration and maintenance, sensor installation, and data analysis
- Meteorological and micrometeorological instrumentation and datalogging
- Low-cost meteorological sensor development and testing
- Telemetry and real-time data acquisition
- Agricultural crop and reference evapotranspiration
- Regional weather patterns and climatology
- R and Python

REPRESENTATIVE PROJECT EXPERIENCE

ACTUAL CROP AND FIELD CONSUMPTIVE USE

Biometeorologist - Micrometeorological Field Measurements for Land IQ Data Driven Evapotranspiration Modeling - Multiple GSAs and Irrigation Districts, California. Mrs. Clay works with other Land IQ scientists to install and maintain these field-based stations as well as processing daily and monthly data. She assists with python-based half-hour calculations of energy fluxes, data analysis and quality control that are provided to remote sensing scientists and a monthly summary presentation to a senior advisory committee. She also assists with monthly precipitation data analysis, preparing the station-based data to provide to remote sensing scientists for use in statewide precipitation analysis.

Biometeorologist - Updating and Sharing Crop Coefficient (Kc) Information to Enhance Agricultural Water Demand Estimations and Irrigation Scheduling in the Water-limited Context of California. Mrs. Clay helps support the ongoing data collection for annual and perennial crops through remote troubleshooting and instrument maintenance of existing University of California, Davis evapotranspiration stations (approximately 20 stations) in the San Joaquin Valley of California. Activities and responsibilities include overall

support for team members to reach project goals, provide continual remote access to evapotranspiration stations, troubleshooting and maintaining station instrumentation, calculate and analyze station data for energy balance fluxes, and provide quality control assessment.

PREVIOUS EXPERIENCE

Prior to joining Land IQ in 2024, Mrs. Clay served as a Graduate Student Researcher and Teaching Assistant at the University of California, Davis, while earning her Ph.D. in Atmospheric Science. Examples of projects and tasks completed while in those roles are provided below.

Graduate Student Researcher – Investigating the Effects of Winter Cover Cropping on the Radiation Balance, Soil-Water Dynamics, and Productivity of Mature, Micro-Irrigated Pistachio Orchards and Vineyards in the California Central Valley. Under the advisory of Dr. Daniele Zaccaria and Dr. Kyaw Tha Paw U from 2020 to 2024, deployed solar radiation sensors above and below the canopy at sixteen pistachio sites and two vineyard sites to evaluate differences in reflected solar radiation from cover-cropped and clean-cultivated rows. Coordinated with lab team members, Kearney Agricultural Research Center employees, and maintained communication throughout project. Performed regular data analysis in R.

Graduate Student Researcher – Examining the Ecological and Water-Use Benefits of Winter Fallowing or Alternative Crops in Rice Fields in California. Under the advisory of Dr. Kosana Suvočarev from 2019 to 2022, deployed and maintained around three evapotranspiration-estimating stations in fallow, wheat, and cover crop fields. Coordinated with lab team members and landowners throughout the project.

Graduate Student Researcher – Studying water use (ET_c) and crop coefficients (K_c) of mature pistachio orchards with salinity-affected soils and pilot study of varying cover crop conditions in the San Joaquin Valley. Under the advisory of Dr. Daniele Zaccaria and Dr. Kyaw Tha Paw U in 2019, deployed solar radiation sensors above and below the pistachio canopy at four sites to evaluate differences in reflected solar radiation Hanford and Coalinga, CA. Performed routine maintenance to existing energy budget residual based ET stations in three pistachio orchards and assisted with harvest duties.

Graduate Student Researcher – Sacramento-San Joaquin Delta Fallowing Pilot Evapotranspiration Monitoring Program. Under the advisory of Dr. Kyaw Tha Paw U from 2017 to 2019, deployed and maintained 18 evapotranspiration-estimating stations and three solar radiation stations in fallow, alfalfa, and tomato fields in the Sacramento-San Joaquin River Delta during the 2018 Water Year. This provided in situ measurements with which to compare estimates of actual evapotranspiration (ET_a) with METRIC-based evapotranspiration estimates derived by Land IQ. Utilized surface-renewal, energy residual methods and direct eddy covariance methods to estimate ET_a. Took bulk density and loose soil samples. Coordinated with lab team members to select sites and maintained communication throughout project. Performed data analysis in R. Prepared main report and field measurement appendix.

LAND IQ

Danial Azman
Atmospheric Scientist

Years of Experience
4

Education
B.S., Biological Systems Engineering, University of California Davis, 2021

A.S., Biological Sciences, Foothill College, 2018

Professional Registrations and Affiliations

- American Society of Agricultural and Biological Engineers (ASABE).
- Engineer-In-Training (EIT) – Expected 2025

Distinguishing Qualifications

- IoT sensors: Arduino/Raspberry Pi/ESP 32
- Instrumentation, Control and Modeling: Simulink/COMSOL Multiphysics
- Precision agriculture systems with energy balance integration.
- Programming languages (Data Science): Python/R/C++
- Computer Aided Design: SOLIDWORKS/FreeCAD.
- Electronic Design Automation: KiCad

Mr. Azman is an Atmospheric Scientist with Land IQ. He has over 8 years of experience in the development of custom systems for the purpose of data acquisition (DAQ) in environmental sciences. His 4 years in Land IQ emphasized data analysis on meteorological equipment, the development of DAQ pipelines and various spatial programming. Mr. Azman's academic background includes agricultural engineering, precision agriculture, and hydrology.

REPRESENTATIVE PROJECT EXPERIENCE

ACTUAL CROP AND FIELD CONSUMPTIVE USE

Atmospheric Scientist - Land IQ Data Driven Evapotranspiration Modeling - Multiple GSAs and Irrigation Districts, California. Point of contact for precipitation data (tabular and raster) along with general data telemetry for internal teams; developed various scripts to streamline data process/analysis and took over as lead for custom flux tower builds. Assists in flux tower installations and monthly station maintenance.

Project Lead - Applied Water Study - San Joaquin Valley, California. Developed and installed a fleet of custom IoT loggers along with backend architecture for real time observation on irrigation events. Deliverables include monthly applied water calculations and comparisons to field-based spatial ET to verify model outputs.

LAND USE MAPPING

Staff Scientist – Statewide Crop and Land Use Mapping Ground Truth Data Collection – California Department of Water Resources, Sacramento, CA. Assist in the collection of ground truth data to identify and analyze state-wide California crops.

Danial Azman
Atmospheric Scientist

LAND IQ

GEOSPATIAL ANALYSIS

Staff Scientist – Statewide Land Use Mapping - California Department of Water Resources, Sacramento, CA. Develop and update various spatial scripts to enable multi county pre-processing checks.

Staff Scientist - Water Supply Reliability Study; California Walnut Board; Folsom, CA. Conducted a spatial and tabular analysis to determine the walnut acres in each Irrigation District for water supply scoring.

REGULATORY COMPLIANCE

Associate Scientist - Digital Point Frame Vegetative Cover Assessment; Owens Lake Dust Mitigation Project; Keeler, CA. Collection of high-resolution photographs for the assessment of vegetative cover to identify compliance levels of managed vegetation dust control practices.

PREVIOUS EXPERIENCE

Prior to joining Land IQ in 2021, Mr. Azman worked as a Research Engineer (Volunteer) for the University of California, Davis. Projects include elementary machine learning for evapotranspiration prediction, NLP systematic reviewing for agricultural papers, and decision analysis dashboard for local growers. His engineering senior design project consisted of a smart irrigation prototype- a precision agriculture system that encompassed LANDSAT acquisition, evapotranspiration mapping and prediction (SEBAL and PTSEB), autonomous data management and IoT instrumentation.

LAND IQ

Years of Experience
12

Education
M.S., Geology, University of California Los Angeles, 2013

B.S., Geology & Physics, University of Pune, 2010

Distinguishing Qualifications

- Proficient in software and programs such as Python, GDAL/OGR, R, IDL, ENVI, QGIS, ArcGIS, ERDAS IMAGINE, ASF Mapready, ESA Toolboxes, GAMMA SAR and Interferometry, ROI_PAC, ADORE-DORIS, etc
- Familiar with software and programs such as Perl, Javascript, and PolSARpro.
- Highly skilled at time series analysis, spatial analysis, object and pixel based image classification, raster and vector processing, machine learning, deep learning and data science.
- Extensive experience in quantitative and qualitative analysis of geospatial data as well as technical writing.
- Expert with Unix, Mac and Windows operating systems.

Diya Chowdhury, MS
Senior Remote Sensing & Data Scientist

Ms. Chowdhury is a Senior Remote Sensing/Data Scientist at Land IQ, LLC. Diya brings an extensive background in remote sensing applications as it relates to agriculture, forestry and geology. brings an extensive background in remote sensing applications as it relates to land use, geology, vegetative systems, and forestry with a focus on sustainability and has been working in this field for 12 years. She is highly skilled at time series land use and vegetation analysis, raster and vector manipulation, spatial analysis and image classification. Diya is also skilled in programming, where she has assisted in large dataset management and QAQC and writing of scripts for automated data integration.

REPRESENTATIVE PROJECT EXPERIENCE

REMOTE SENSING

Remote Sensing Scientist - Statewide Crop Mapping - California Department of Water Resources (DWR), CA. Spatio-temporal supervised crop classification in California for the California Department of Water Resources and the State Water Resources Control Board (Delta Watermaster) using Landsat-8 and Sentinel-2 imagery. The results are used to monitor state wide water consumption, land use change and prediction of future consumption.

Remote Sensing Scientist - Urban Landscape Mapping - Regional Water Authority, Sacramento, CA. Classification of high resolution optical imagery into irrigated, irrigable and un-irrigable landscapes using semantic segmentation. These results are used to quantify outdoor urban water demand for participating agencies.

Remote Sensing Scientist - Statewide Rice Mapping - Multiple Confidential Clients. Processing and analyzing Sentinel-1 SAR data to estimate in-season California state-wide rice acreage. These results are used for market intelligence, water use and management, crop production support and yield forecasting.

Diya Chowdhury, MS
Senior Remote Sensing & Data Scientist

LAND IQ

Remote Sensing Scientist - Spatial Evapotranspiration - Semitropic Water Storage District, Wasco, CA. Quantifying and reporting monthly spatial evapotranspiration using Landsat-8, Sentinel-2 and RapidEye data. These results are used to charge growers for their water consumption rather than their land area as was traditionally used.

STATISTICAL ANALYSIS

Scientist - Owens Lake Dust Mitigation Program; Los Angeles Department of Water and Power (LADWP); Owens Valley, CA. Modeling vegetation cover in Owens Lake, California using Pleiades imagery as part of the LADWP Science team. The results of these analysis are used to test for regulatory compliance of vegetation cover in each dust control area.

Scientist - San Joaquin River Restoration Program - US Bureau of Reclamation; Central Valley, CA. Aggregating spatial and temporal in-situ and modelled data to update the current seepage prioritization map as part of the San Joaquin River Restoration Program. This map identifies areas vulnerable to seepage effects associated with the implementation of restoration flows.

Scientist - Irrigated Lands Regulatory Program - Sacramento Valley Water Quality Coalition; Sacramento, CA. Statistical analyses and representation of data as well as development of tools to automate nitrogen management report generation for individual growers.

PROGRAMMING

Scientist - Evapotranspiration Modeling, California DWR, Sacramento-San Joaquin Delta. Bulk processing climate data to calculate crop evapotranspiration, based on the Penman-Monteith method, to quantify consumptive use of water for the Department of Water Resources.

Scientist - Irrigated Lands Regulatory Program; Sacramento Valley Water Quality Coalition; Sacramento, CA. Cleaning and formatting farm management data provided by each sub-watershed for use by a Data Management Tool. This tool improves the management of reporting and invoicing for every parcel of land in the sub-watershed.

Scientist - Irrigated Lands Regulatory Program; Sacramento Valley Water Quality Coalition; Sacramento, CA. Generating annual Nitrogen Management Practices (NMP) summary report and grower reports for every grower in the participating sub-watersheds.

PREVIOUS EXPERIENCE

Prior to joining Land IQ in 2017, Ms. Chowdhury had worked as a Research Scientist at Applied Geosolutions in Newmarket, NH. She also served as a Researcher and Teaching Assistant at the UCLA Department of Earth, Planetary and Space Sciences as well as the Institute of Environment and Sustainability.

LAND IQ

Atsushi Tomita, PhD
Remote Sensing Scientist

Years of Experience
8

Education
Ph.D., Earth and Environmental Sciences, The Graduate Center of the City University of New York, 2017

M.A., Science and Environmental Reporting, New York University, 2003

M.S., Physics, Keio University, Yokohama, 1995

B.S., Physics, Keio University, Yokohama, 1992

Distinguishing Qualifications

- Remote Sensing methodological development
- Remote Sensing image processing: geo-referencing historical aerial images, special color-adjustment/fitting for visual recognition of crops
- Remote Sensing image classification with Machine Learning algorithms
- Python scientific computing for Remote Sensing data processing and methodological development

Dr. Tomita is a Remote Sensing Scientist at Land IQ, LLC. Dr. Tomita has eight years of experience in remote sensing as it relates to agriculture and forestry. He is particularly skilled at developing robust systems for detecting land cover change, intuitive approaches to crop mapping, time segmentation methods for multi-cropping classification, synergetic uses of quantitative and qualitative methods, and developing graphical approaches for crop mapping that combines time-series data and images.

REPRESENTATIVE PROJECT EXPERIENCE

EVAPOTRANSPIRATION

Remote Sensing Scientist - Land IQ Data Driven Evapotranspiration Modeling, California. Conduct remote sensing modeling utilizing image analysis and ground truth data from climatic stations to determine field-level actual evapotranspiration for over 3.5 million acres in Butte, Fresno, Kern, Kings, Madera, San Luis Obispo, Stanislaus, Sutter, and Tulare Counties.

CROP MAPPING

Remote Sensing Scientist - Statewide Crop Mapping - California Department of Water Resources (DWR), California. Spatio-temporal supervised crop classification in California for the California Department of Water Resources using Landsat-8 and Sentinel-2 imagery for the counties of Imperial, Riverside, Ventura, Santa Barbara, San Luis Obispo, Sacramento, Solano, Yolo, Sutter, Yuba, Colusa, Glenn, Butte, and Tehama. Overall dataset is comprised of over 9.4 million acres of agricultural land.

Remote Sensing Scientist - Near Real-time Crop Mapping; Groundwater Sustainability Agencies. Perform near real-time crop mapping twice a year for Kern, Tulare, Kings, and parts of Fresno County to serve multiple Groundwater Sustainability Agencies in complying with the Sustainable Groundwater Management Act.

Atsushi Tomita, PhD
Remote Sensing Scientist

LAND IQ

DATA ANALYSIS

Remote Sensing Scientist -Time Series Analysis for Land Use Mapping, Research and Development. Developed an innovative time series plot method utilizing NDVI, for the use in multi-crop classification and peak date determination.

Remote Sensing Scientist - Classification Method for Multi-Cropping, Research and Development. Developed an object-based crop detection and classification method for multi-cropping based on time series analysis. Developed a time-segmentation method for detecting individual cropping.

Remote Sensing Scientist - Crop Time Series Library, Research and Development. Developed an innovative crop time-series library that can serve multiple purposes in crop mapping and beyond.

IMAGERY PROCESSING

Cold Water Rice Yield Loss Calculation via Remote Sensing; California DWR; Butte County, California. Responsible for pre-processing meter-class satellite (Pleiades or equivalent) imageries such as geometric correction, radiometric correction, color-matched seamless mosaicking, and calculation of soil line and PVI for the remote sensing analysis to determine rice yield loss in cold water affected areas.

Owens Lake Dust Mitigation Program; Los Angeles Department of Water and Power (LADWP); Owens Valley, California. Responsible for geometrically correcting meter-class satellite (Pleiades or equivalent) imageries for managed vegetation assessments.

PREVIOUS EXPERIENCE

Dr. Tomita has extensive experience in Remote Sensing. Prior to joining Land IQ in 2019, he had seven year's work experience as a technical officer at the Japanese Ministry of Agriculture, Forestry, and Fisheries, where he was involved/engaged in research activities in Agricultural Climatology, Remote Sensing, and Landscape Science. He continued to enrich his experiences in Remote Sensing, image processing, and land use/land cover (LULC) change analysis in the United States. He worked as part time researcher at Panthera, where he was engaged in delineating wildcats' habitats and their historical changes using satellite imageries. He led multiple research projects at the City University of New York (CUNY). At the CUNY, he developed a monitoring system of LULC change in tropical Asia using long-term Landsat observation data. After graduating from the CUNY, he continued to develop a monitoring system of long-term LULC changes in tropical Asia and the United States and taught an advanced Remote Sensing course at the CUNY.

LAND IQ

Years of Experience
8

Education
Ph.D., Geography, University of California Davis, 2022

B.S., Agricultural Science, Cornell University, 2016

B.S., Agronomy, Zhejiang University, 2014

Distinguishing Qualifications

- Remote Sensing method development: develop robust and innovative methodologies to acquire, process and analyze remote sensing data from different sources.
- Machine learning and deep learning: proficient in applying machine learning and deep learning frameworks to solve complex problems of image segmentations, crop type classification, time series classification, etc.
- Python and R programming: highly skilled in using Python and R for remote sensing image and GIS data processing, quantitative data analysis, and model building.

Zhehan Tang, PhD
Remote Sensing Scientist

Dr. Tang is a Remote Sensing Scientist at Land IQ, LLC. Dr. Tang has eight years of experience in remote sensing as it relates to agriculture monitoring. He is passionate about applying remote sensing and data science technology to improve agricultural productivity and sustainability. He is skilled in developing models to develop evapotranspiration predictions and crop classifications.

REPRESENTATIVE PROJECT EXPERIENCE

EVAPOTRANSPIRATION

Remote Sensing Scientist - Land IQ Data Driven Evapotranspiration Modeling, California. Built monthly data-driven model to map evapotranspiration in San Joaquin Valley, based on station data, crop information, satellite imagery and weather data; Streamlined and automated the data processing steps; analyzed trends and relationships of historical evapotranspiration and precipitation data.

Remote Sensing Scientist - Sonoma County Water Use Efficiency Assessment; Sonoma County Groundwater Sustainability Agencies, Sonoma County, California. Estimated vegetation evapotranspiration of all irrigated fields in the area using cloud computing; Segmented NAIP image to identify unclassified irrigated fields using state-of-art computer vision model.

Remote Sensing Scientist - Irrigation Scheduling Tool; San Joaquin Valley, California. Designed and developed an automatic satellite image and weather data processing tool to provide daily evapotranspiration estimate to help with irrigation scheduling.

Zhehan Tang, PhD
Remote Sensing Scientist

CROP MAPPING

Remote Sensing Scientist - Statewide Crop Mapping - California Department of Water Resources (DWR), California. Spatio-temporal supervised crop classification in California for the California Department of Water Resources using Landsat-8 and Sentinel-2 imagery for multiple counties in Northern California**.**

Remote Sensing Scientist - Automatic Detection of Tree Removals - Research and Development, California. ·Designed and developed an SAR-based algorithm to identify tree removal in almond and walnut orchards in early stages.

YIELD PREDICTION

Remote Sensing Scientist - ·Cold Water Rice Yield Loss Prediction; California DWR; Butte County, California. Processed high-resolution satellite image from Pleiades and PlanetScope; Applied image segmentation on rice fields in high-resolution satellite image to identify yield objects measured by harvester; Built machine learning model to predict yield loss due to cold water.

PREVIOUS EXPERIENCE

Prior to joining Land IQ in 2022, in his PhD study, Zhehan Tang conducted multiple research projects about building machine learning models to detect water stress of different variety of crops using data from satellite, UAV imagery and proximal sensors, mapping tomato fields and predict tomato yield with time series of satellite and weather data in California.

LAND IQ

Justin Sitton
Geospatial Analyst

Years of Experience
12

Education
B.S., GIS/Computer Cartography, University of Maryland, 2013

Distinguishing Qualifications

- Geographic Information Systems (ArcGIS for Desktop and ArcGIS Online)
- Data analysis and revision
- Data collection
- Data Management
- Cartography

Mr. Sitton is a Geospatial Analyst with Land IQ. He has over twelve years of professional experience working with Geographic Information Systems. Mr.Sitton is skilled in collecting and processing spatial land use and environmental data, managing and analyzing data to divulge meaningful insights, and creating maps to display complex information and analysis that suits clients' specific needs. He has managed broad aspects of land surface imagery, topography, parcel data, irrigation district boundaries, urban footprints, agricultural field boundaries, and numerous regulatory boundaries to inform analyses and data management tools for client's needs.

REPRESENTATIVE PROJECT EXPERIENCE

LAND USE MAPPING

Statewide Crop Mapping - California Department of Water Resources (DWR), California. Responsible for digitizing field boundaries and completing metadata for the final deliverable. Created several maps to illustrate yearly datasets. Responsible for managing team of interns and ensuring project stayed on schedule.

Almond Orchard Removals - Almond Board of California; Modesto, California. Responsible for determining the amount of almond acreage removed annually, beginning in 2014. Error for the project was 1.75%.

Urban Area Delineation - Confidential Client. Responsible for digitizing urban areas within Mesilla and Rincon for 1936 – 2016, when data was available, to determine water usage in Mesilla Valley, Texas.

Almond Age Classification - Almond Board of California; Modesto, California. Responsible for age classifying the almond dataset annually. Analysis was conducted using the prior year almond dataset and determining the NDVI for each field to identify which orchards have been replaced or removed.

Justin Sitton
Geospatial Analyst

LAND IQ

GEOSPATIAL ANALYSIS

Unimpaired River Flows Analysis - Almond Board of California; Modesto, California. Responsible for compiling California county, groundwater basins, detailed analysis units, and DWR Irrigation District boundary spatial data. Conducted spatial analysis to determine almond acreage within each layer for the given study area. Create mapping products to display the almond acreage that existed within and outside the borders of Irrigation Districts that fell within the study area.

Almond and APN Analysis - Almond Board of California, Modesto, California. Responsible for combining the almond mapping developed by Land IQ and County Assessor information, to overlay the two resources and create a list of APNs and acreages for annual surveys conducted by the United States Department of Agriculture – National Agricultural Statistics Service.

Coalition Membership Layer - Colusa-Glenn Subwatershed Program; Willows, California. Responsible for updating the Colusa Glenn membership parcel layer. The goal was to create a more accurate layer for CGSP web mapping tool, utilizing agricultural commissioner and the county parcel layers.

Schools and Day Care Proximity Analysis - Pistachio Research Board; Fresno, California. Responsible for finding the number of pistachio acres within 1.5 miles of private/public schools and day care centers. The study was created by using a multi-ring buffer starting at a quarter mile and finishing at 1.5 miles at quarter mile intervals, and each level had an associated acreage.

Water/Irrigation District Layer – Research and Development; Land IQ; Sacramento, California. Responsible for creating a layer that depicts all of the water and Irrigation Districts in California that serve agriculture.

DATA MANAGEMENT & WEB APP DEVELOPMENT

Web Map Layers Update - Almond Board of California; Modesto, California. Responsible for creating layers to be added to the Almond Board of California's internal and external web maps. Deliverables included layers such as School Proximity, Almonds Orchard Nitrates, Almond Orchard Age, Almond Orchard Ground water recharge Suitability, and Almond Orchard High Vulnerability Areas.

Web Map - Wonderful Orchards; Lost Hills, California. Responsible for compiling GIS layers regarding county parcels and agricultural commissioner fields dataset, as well as California Pesticide Use Report Data.

Statewide Avocado Mapping - California Avocado Commission; Irvine, California. Responsible for management of data and compiling final layers, acreages, and maps for the California Avocado Commission.

June 10, 2025

To:
Aleta Allen
Madera County GSA
200 West Fourth Street Madera, CA 93637
Aleta.Allen@maderacounty.com

Subject: RFP: Measurement Services for Madera County GSA – Groundwater Accounting Platform Collaboration Opportunity

Dear Ms. Allen and the Madera County GSA Committee,

Thank you for the opportunity to review the Request for Proposal (RFP) for Measurement Services dated May 15, 2025. We commend the Madera County Groundwater Sustainability Agencies (GSAs) for their proactive and thoughtful approach to water measurement and data transparency, and for their vision to support growers with timely, accessible information to manage groundwater sustainably.

Given the primary RFP deliverables for remote-sensed data products, the California Water Data Consortium (Consortium) and our Groundwater Accounting Platform (Platform) partners have elected not to lead a formal proposal in direct response to the current RFP. However, the Platform can integrate with several remote-sensed data providers, and you may see members of the Platform team responding to the RFP as sub-consultants or value-added additions to other proposals you will be reviewing. In addition to these collaborations, we want to share directly with you the relevance and compatibility of our existing open-source Platform with the goals and optional deliverables described in the RFP.

The Groundwater Accounting Platform is a collaborative, open-source software initiative developed to support SGMA compliance by empowering growers, water managers, and GSAs with robust, up-to-date data tools. Initially deployed in the Rosedale-Rio Bravo Water Storage District and now supporting multiple GSAs statewide, including deployments in Merced, Turlock, Kern, Yolo, and Colusa basins, the Platform offers the following:

- **Data Integration**: Seamlessly incorporates data from any satellite-based ET (e.g., Land IQ, OpenET, IrriWatch) or metered measurement provider to present farm-level usage data.

- **User Dashboards**: Provides growers with secure, personalized dashboards that display allocations, usage, and remaining balances—functioning like a “water bank account.”
- **Management Tools**: Offers water managers district-wide views, billing support, scenario modeling (via the optional Groundwater Evaluation Toolbox), and a trading module to facilitate local water markets.
- **Open Architecture**: As an open-source tool, it avoids vendor lock-in, allows local customization, and is sustained by a committed, collaborative user community with quarterly input on feature development.

More detailed information about the Platform, including typical expected costs for deployment to Madera GSAs, is included as part of this submittal.

For the past several years, we have maintained open and collaborative discussions with Madera County GSA staff and stakeholders regarding potential alignment of the Platform with your long-term data and stakeholder engagement goals. With this letter, we wish to reaffirm our interest in continuing those conversations and exploring how the Groundwater Accounting Platform might complement your selected measurement vendor(s) and overall groundwater sustainability strategy—either now or in the future.

Please do not hesitate to reach out if you would like a demonstration of the Platform, user case studies from other GSAs, or technical insights regarding system integration.

We appreciate your leadership and vision, and we look forward to continuing our partnership in support of sustainable groundwater management in Madera County.

Warm regards,

Hannah Ake Senior Program Manager, Groundwater Accounting Platform
California Water Data Consortium
hake@cawaterdata.org

OPENET

ALETA ALLEN
Madera County GSA
A: 200 West Fourth Street
Madera, CA 93637
E: aleta.allen@maderacounty.com

Date: June 12, 2025

Subject: OpenET Support for High-Quality, Transparent, Reproducible ET Data in support of Water Measurement for Madera County

Dear Ms. Allen and Selection Committee,

On behalf of OpenET Inc., we would like to express our commitment and support for providing high-quality, open-source, transparent, and reproducible field-scale evapotranspiration (ET) data in support of water measurement and groundwater sustainability goals in Madera County. Our ongoing mission is to produce and make these important datasets available in a way that allows Madera and any of its partners the ability to easily incorporate them into user-centered tools (e.g., dashboards, reporting) and other products. This data is publicly available at ETData.org and through an API, and would serve many of the existing needs articulated in the RFP. We currently provide ET and precipitation raster data on a monthly timestep.

Notably, we have been working with the California Department of Water Resources over the past year to further develop and refine our data and API access for use broadly across the state of California. Through this partnership, we are able to offer these data freely to users statewide, including Madera County. We have also collaborated with partners such as the California Water Data Consortium and the Groundwater Accounting Platform initiative to implement projects similar to those described in your RFP, with successful outcomes in terms of greater transparency and trust in water measurement data amongst GSA stakeholders. We would be happy to discuss additional services related to the data's use and integration with Madera's programs. Please let us know if you have any questions or would like to discuss these collaborative opportunities further.

Sincerely,

Sara Larsen

CEO, OpenET Inc.

2600 Capitol Avenue, Suite 200
Sacramento, CA 95816

esassoc.com

June 11, 2025

Aleta Allen
Madera County GSA
200 West Fourth Street, Madera, CA 93637

Subject: Service Model and Pricing for the Groundwater Accounting Platform

Dear Aleta Allen and Madera County Committee Members:

Environmental Science Associates (ESA) is sending this Letter of Interest regarding deploying the Groundwater Accounting Platform as a potential solution for Madera County's user-facing groundwater tracking and allocation interface.

Over the past several years, ESA has led the development, configuration, and deployment of the Groundwater Accounting Platform for GSAs across California. This open-source software solution, developed in collaboration with the California Water Data Consortium, Environmental Defense Fund, and Olsson, has been successfully deployed or demonstrated in the Merced, Turlock, Yolo, Pajaro, and Kern subbasins.

ESA is available to provide the following professional services to support deployment of the Platform for Madera County GSAs:

1. Up-front Configuration

This service includes the full setup of a dedicated instance of the Platform for Madera County, including:

- Initial configuration of the Merced sub-basin in the cloud hosted environment;
- Configuration of grower facing dashboards, including display of accounts, farm units, water accounting logic, and APN-level display features;
- Integration with Madera County's existing Data Management System, leveraging pre-existing schema;
- Import of historical and current water accounts, fields, allocation and usage data.

This phase has a typical cost range of $25,000–$100,000 depending on policy complexity and data readiness. For Madera County's scale and complexity, ESA recommends budgeting **$75,000** for initial implementation.

2. Customization (Optional, Project-Based)

The Platform is designed to meet most GSA needs out-of-the-box. However, should Madera County identify new functional needs (e.g., integration of unique billing workflows, automated data integrations, or enhanced scenario tools), ESA can scope and deliver additional development on a time-and-materials basis.

Customization efforts are **not required** for base deployment, and any additional feature development would be estimated separately based on detailed functional requirements.

3. Platform Subscription

Once deployed, ESA offers a hosted, managed Platform environment for Madera County on a subscription basis. This includes:

- Secure cloud-based hosting;
- Regular software maintenance and feature upgrades;
- 6 hours/month of technical support and help desk access;
- Real-time monitoring, cloud infrastructure, and service level guarantees;
- Unlimited user accounts and data storage.

Per ESA's pricing tiers, Madera County qualifies as a High Tier Geography (over 120,000 acres and/or complex policy logic), with a standard Platform Management Fee of $4,000 / month.

Looking Ahead

ESA invites Madera County to join the growing Groundwater Accounting Platform user community. Please review the attached datasheet for more details about the benefits of this full-featured platform. We look forward to the possibility of supporting implementation efforts and exploring alignment with your selected measurement services and data management teams.

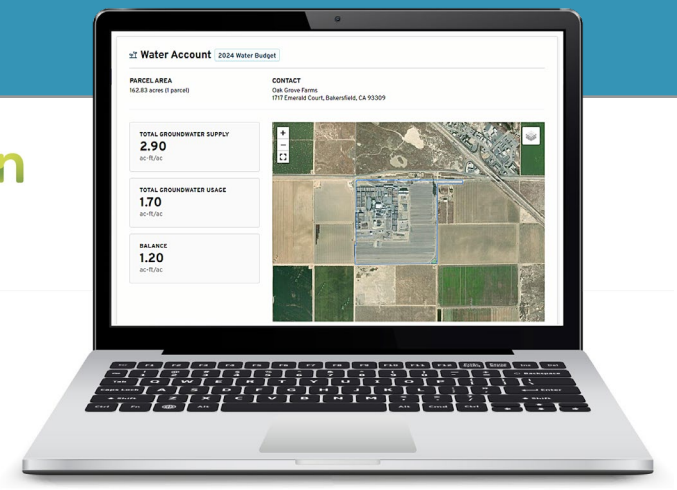
Should the County wish to review a live demonstration of the Platform, request a draft scope of work, or receive references from peer GSAs using the system today, please do not hesitate to reach out.

Sincerely,

John Henry Burns, Technology Services Manager
Environmental Science Associates
jburns@esassoc.com | 503-805-1245

GROUNDWATER
ACCOUNTING PLATFORM

Environmental Defense Fund | California Water Data Consortium | ESA | olsson



Groundwater Accounting Platform

Leverage Data to Better Understand and Manage Water Supply, Usage, and Trading

Climate change and population growth are driving many communities to make tough decisions about water use. It is more important than ever that water managers and agricultural water users have access to the best possible data to balance supply and demand. ESA is deeply involved in the challenge to chart a sustainable future for water resources. The Groundwater Accounting Platform is the result of a partnership with Environmental Defense Fund, California Water Data Consortium, Olsson, and ESA. The platform was initially created for the Rosedale-Rio Bravo Water Storage District in California and is now being deployed to other markets.

The Groundwater Accounting Platform enables water managers, landowners, and water users to track water budgets and usage in near real-time. The platform includes modules for supply and demand modeling and water trading, providing a complete set of tools for local water districts to better manage allocations over time. Because it is open-source software, this platform provides a springboard for water districts everywhere to launch and customize their own solutions.

Benefits

- **Measure**
  Enable water managers and agricultural users to understand their water use and available supply in near real-time
- **Manage**
  Empower well-informed decision making with advanced modeling
- **Plan**
  Create and manage Allocation Plans and evaluate management scenarios
- **Support Sustainability**
  Meet regulatory objectives for your region

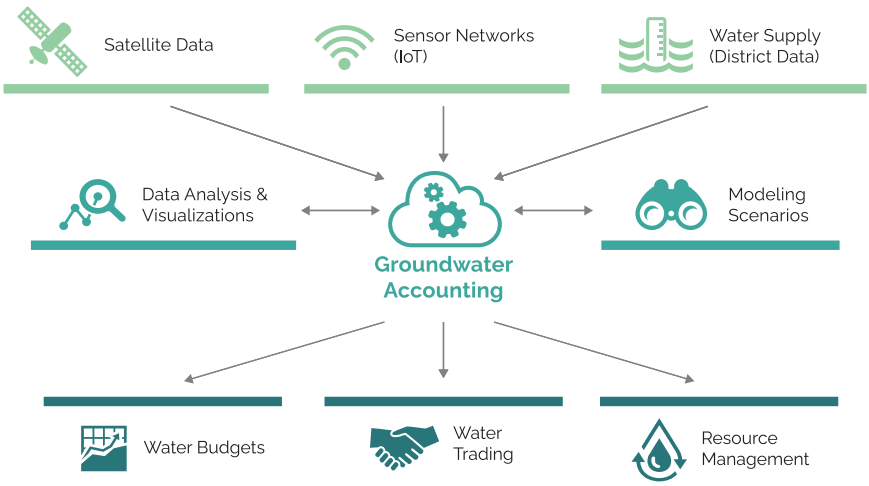
"We developed this accounting and trading platform because we want to provide landowners and growers with as many tools as possible to manage their water more sustainably and balance their water budget."

— Eric Averett | Former General Manager, Rosedale-Rio Bravo Water Storage District

Data Driven Decisions

Manage Water Supply and Demand

The Groundwater Accounting Platform accepts water supply data from a variety of sources including satellite, flow meters, and sensor networks. This software combines water supply and use data to help track water budgets at the field scale for water users. The platform also features a water manager dashboard to track and account for water across a district or region, which informs management decisions such as billing and allocation planning.



Key Platform Functionality

- Track water usage from any remote sensed and metered data source
- Account for available water supply, including allocations, recharge, and other credits
- Visualize water usage at the field, parcel, and account scales with grower-facing dashboards
- Generate mail-ready Usage Statements and bills
- Well inventory and grower-facing Well Registration workflow
- API for flexible integration with existing tools
- Configurable Zones for flexible analysis and reporting
- Integrate with remotely-sensed raster data files from any provider
- Integrate with meter data via CSV, allow growers to manually upload or telemetrically upload meter data
- Model the hydrological impacts of various allocation, usage, trade, and recharge scenarios with the optional Groundwater Evaluation Toolbox (GET) from Olsson
- Facilitate pooling, transfers, and recharge credits according to local policies

Key Clients and Partners

Rosedale-Rio Bravo Water Storage District

Merced Irrigation-Urban Groundwater Sustainability Agency

Pajaro Valley Water Management Agency

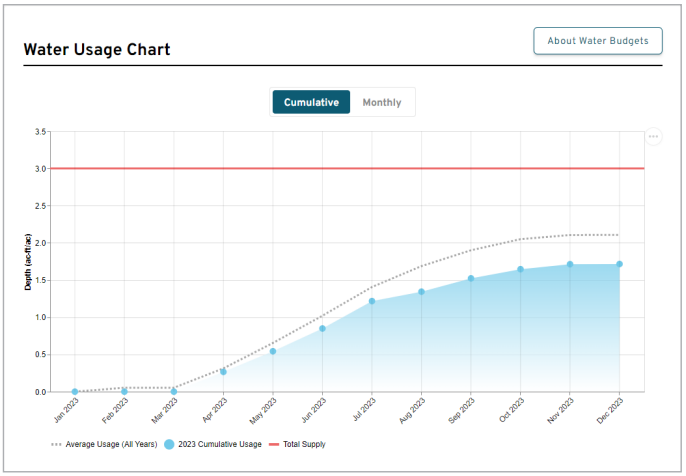
Yolo County Flood Control and Water Conservation District

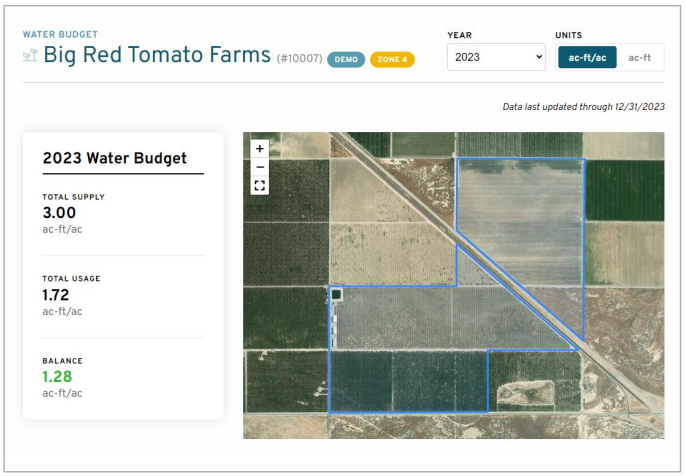
Merced Subbasin Groundwater Sustainability Agency

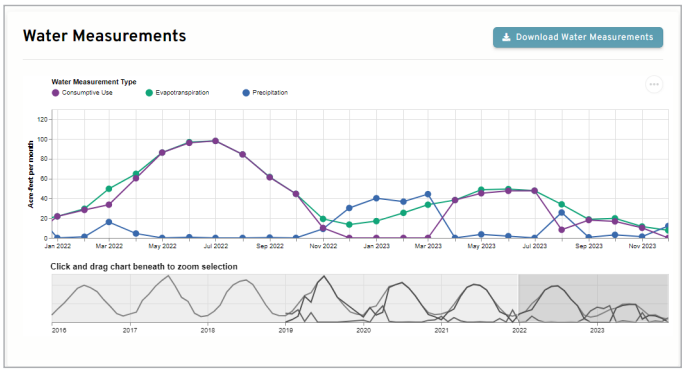
East Turlock Subbasin Groundwater Sustainability Agency

Groundwater Accounting Platform
groundwateraccounting.org

Groundwater Accounting Features







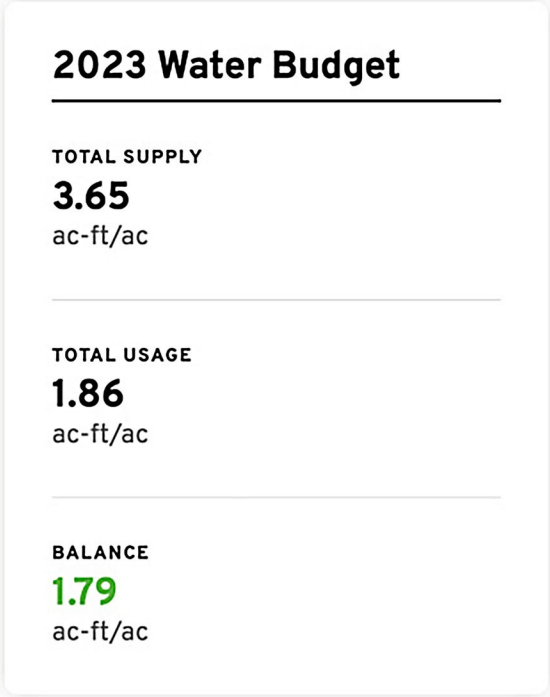
Landowner Dashboard

Key Benefits

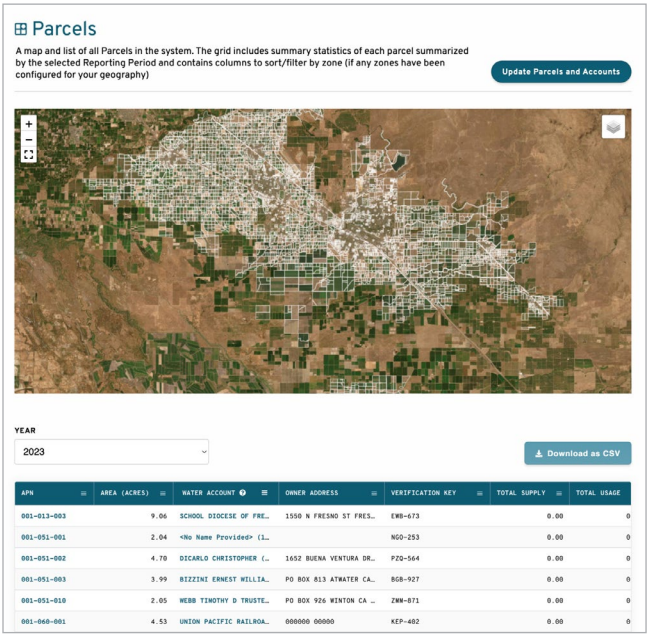
- Landowners can understand usage and supply in real time to make better informed decisions
- Users can manage allocations month over month and create data-driven water budgets
- Growers can analyze water usage by parcel

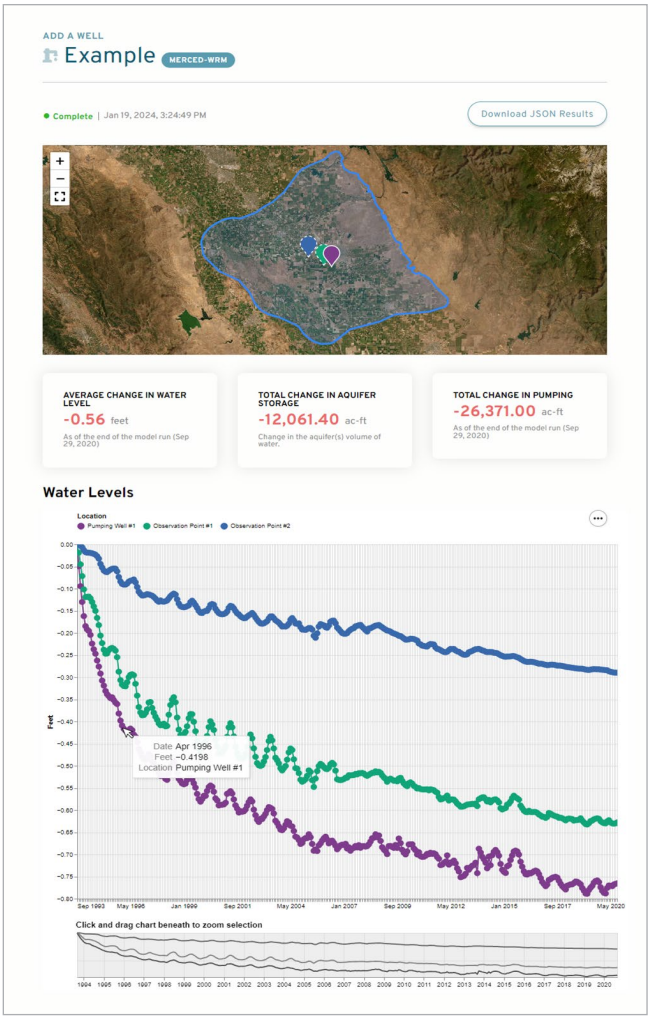
Features

- Review water allocation
- Review water usage to date and current available supply, just like a bank account
- Track cumulative water usage over time, and monitor monthly usage trends
- Review water use data specific to each parcel
- Review buying and selling activity for your account (with the optional Trading Module)
- Review water usage via interactive map tool
- Secure login to individual landowner accounts



Groundwater Accounting Features





Water Manager Dashboard

Key Benefits

- Water managers can monitor groundwater use and account for customers' water usage
- Real time data empowers adaptive management to achieve compliance with water supply regulations

Features

- Review water allocations and usage for every parcel and water account managed on the platform
- Review cumulative supply and usage data across your region/jurisdiction
- Track usage over time, by account and district-wide
- Review district trading activity (with the optional Trading Module)

Scenario Planning

This feature leverages the Groundwater Evaluation Toolbox (GET) designed by Olsson

Key Benefits

- Scenario modeling helps users evaluate the hydrological impacts of groundwater pumping
- Potential management decisions can be evaluated in advance for long-term benefits and impacts
- Automated groundwater model integration with water accounting framework allows evaluation of actual and hypothetical allocation and trading scenarios

Features

- Leverage fully integrated geospatial data to model a wide variety of scenarios including trading, recharge, drawdown, etc.

Trading Module

Key Benefits

- A managed local marketplace gives water users a viable economic alternative to "use it or lose it" model

Features

- View posting details from water buyers and sellers
- Create postings with offers to buy or sell water
- Post counter-offers and negotiate online
- Register completed trades
- Track market metrics

Join the Groundwater Accounting Platform Community

Designed to Help California Water Users Meet SGMA Goals

In 2019, Environmental Defense Fund (EDF) joined forces with California Water Data Consortium (Consortium) to commission a software solution to help California water users meet their goals for sustainable groundwater usage under the State's SGMA legislation. Environmental Science Associates (ESA) and Olsson worked together to build the Platform and manage the first deployment to Rosedale-Rio Bravo Water Storage District in California's Central Valley. The success of that deployment has cultivated a robust network of new users and supporting resources. Platform development has been supported by the California Department of Water Resources and the Platform user community.

Licensed as Open-Source Software to Facilitate Adoption and Collaboration

Open source software avoids vendor lock-in and is available for anyone to modify, enhance, and update over time. Because the Groundwater Accounting Platform is open source, upgrades and new features added by one organization will benefit all organizations. Open-source software additionally encourages users to participate in an open user-community. The Groundwater Accounting Platform User Community meets quarterly to prioritize new feature development, guide the product roadmap, and share best practices.

Supported by a Collaborative Product Team

Four organizations work together to support and fund ongoing development and deployments for the Platform. EDF, the Consortium, ESA, and Olsson share a commitment to help new users adopt this software and join the user group community. Users benefit from the collective knowledge and resources of these four organizations serving as product advocates.

Learn More:

Visit the Platform

https://www.groundwateraccounting.org

See the Introductory Video

https://www.youtube.com/watch?app=desktop&v=Wwwf_R28EPk

Contact the Product Team:

- *Platform Demos and Pricing Information*
- *Coordination and Community Outreach*
- *Technical Information and Specifications*

info@groundwateraccounting.org

4CREEKS

Madera County

Groundwater Sustainability Agency Measurement Services

Prepared For:
Madera County GSA
Attn: Aleta Allen
200 W. Fourth Street
Madera, CA 93637
aleta.allen@maderacounty.com

Monday, June 16, 2025 3PM

4Creeks, Inc.
324 S. Santa Fe Street
Visalia, CA 93292
(559) 802-3052

Table of Contents

Cover Letter

Honest
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Monday, June 16, 2025 3PM
Madera County GSA
Attn: Aleta Allen
200 W. Fourth Street
Madera, CA 93637
aleta.allen@maderacounty.com

Madera County Groundwater Sustainability Agency Measurement Services

Dear Ms. Allen,

We are pleased to submit our proposal for Measurement Services issued by the Madera County Groundwater Sustainability Agency (GSA). Our team brings extensive experience supporting GSAs with software solutions that enhance access to and management of evapotranspiration of applied water (ETAW) and related datasets. **While we are not the source of the remote sensing data, we specialize in hosting and integrating these datasets within our secure, user-friendly platform, Basinsafe™. Tailored for GSA and landowner needs, Basinsafe™ currently serves six GSAs and seven water districts across the Central Valley.**

Our Basinsafe™ software enables seamless hosting and visualization of ETAW, precipitation, and land use data—delivered by third-party providers—through an intuitive interface designed to support SGMA compliance and groundwater accounting. This platform allows landowners and GSA staff to clearly view ET visual charts, graphs, and maps. Tools are available to view annual land use, manage allocations, and track credits and penalties with ease.

The 4Creeks team offers a proven track record of performance with groundwater agencies, sophisticated technical capabilities, and a deep understanding of SGMA compliance frameworks. Basinsafe™ was built specifically for GSAs with the help of GSA staff. The tools available are designed for each GSA's specific needs. Reports, landowner portals, water market boards, graphs, and visuals are customizable and flexible to adjust as ongoing policies change.

We appreciate the opportunity to partner with the Madera County GSA and contribute to its continued leadership in sustainable water management. Thank you for considering our proposal. We look forward to the opportunity to build a strong working relationship.

Thank you,

David De Groot, P.E.
Principal-In-Charge

Don Tucker
Water Department Manager

Firm Overview

4Creeks, Inc. is dedicated to providing progressive civil engineering, planning, architecture, land surveying, and construction management and inspection services with logical solutions and designs. Many of our principals and staff have significant work experience with local municipalities as well as federal and state agencies. Our multiple disciplines within the company allow our teams to gather all levels of review efficiently and with a high level of knowledge for our clients. These specialties are a great resource to have and collaborate on for all projects. We currently have a staff of over 200 professionals working in Visalia, Hanford, Tulare, Clovis, San Luis Obispo, and Denver. Our experience and services include:

- **On-Call Contract Services**
- **Municipal Engineering & Planning**
- **Water Resources**
- **Software Development**
- **Project Management**
- **Street Rehabilitation**
- **ADA Design & Compliance**
- **Parks and Recreation Engineering & Planning**
- **Residential, Commercial, Industrial, Educational Design & Planning**
- **Land Surveying**
- **Utility Design & Coordination**
- **Environmental Planning, Design, & Compliance**
- **Geographic Information Systems**
- **Architecture**
- **Structural Engineering**
- **Construction Administration & Management**
- **Public Works Inspection**

Economical design considerations, environmental stewardship, and resource efficiencies are tenets of every project we undertake. We pride ourselves on pioneering innovative solutions for our clients that enhance the value of their projects, keep their costs in check, and deliver lasting results.

We build our reputation one project at a time with consistent, high-quality products, and time-sensitive delivery. Our goal on every project is open communication, honesty, and integrity.

Corporate Headquarters:
324 S. Santa Fe Street
Visalia, CA 93292

Clovis Office:
1275 N. Willow Avenue
Clovis, CA 93619

Phone: (559) 802–3052
Fax: (559) 802–3215
Email: info@4-creeks.com
Website: 4-creeks.com

Point of Contact:
Don Tucker
don.tucker@4-creeks.com

Business Type:
S-Corporation

Tax ID:
4Creeks, Inc.: 26-2565232

Department of Industrial Relations Registration No.:
1000012032

Sureties:
4Creeks, Inc. carries standard policies for a professional firm, including General and Automobile Liability, E/O, and Worker's Compensation.

Principal Staff:
David De Groot, PE #70992
Randy Wasnick, PLS #8163
Matthew Ainley, PE #66233
Matt Razor, PE #81897
David Duda, AICP #29216
Karl Schoettler
Will Ruoff, AIA #C-36886
Doug Janzen #C-14260
Lisa Wallis Dutra, PE, TE, PTOE, RSP_1 #71262 #TR 1888
Kyle McDonald, PE, QSD, MBA #82531
Mark Sorhouet, SE, PE #71479 #6308
Jason Margraf, PE #37782

Organization Chart

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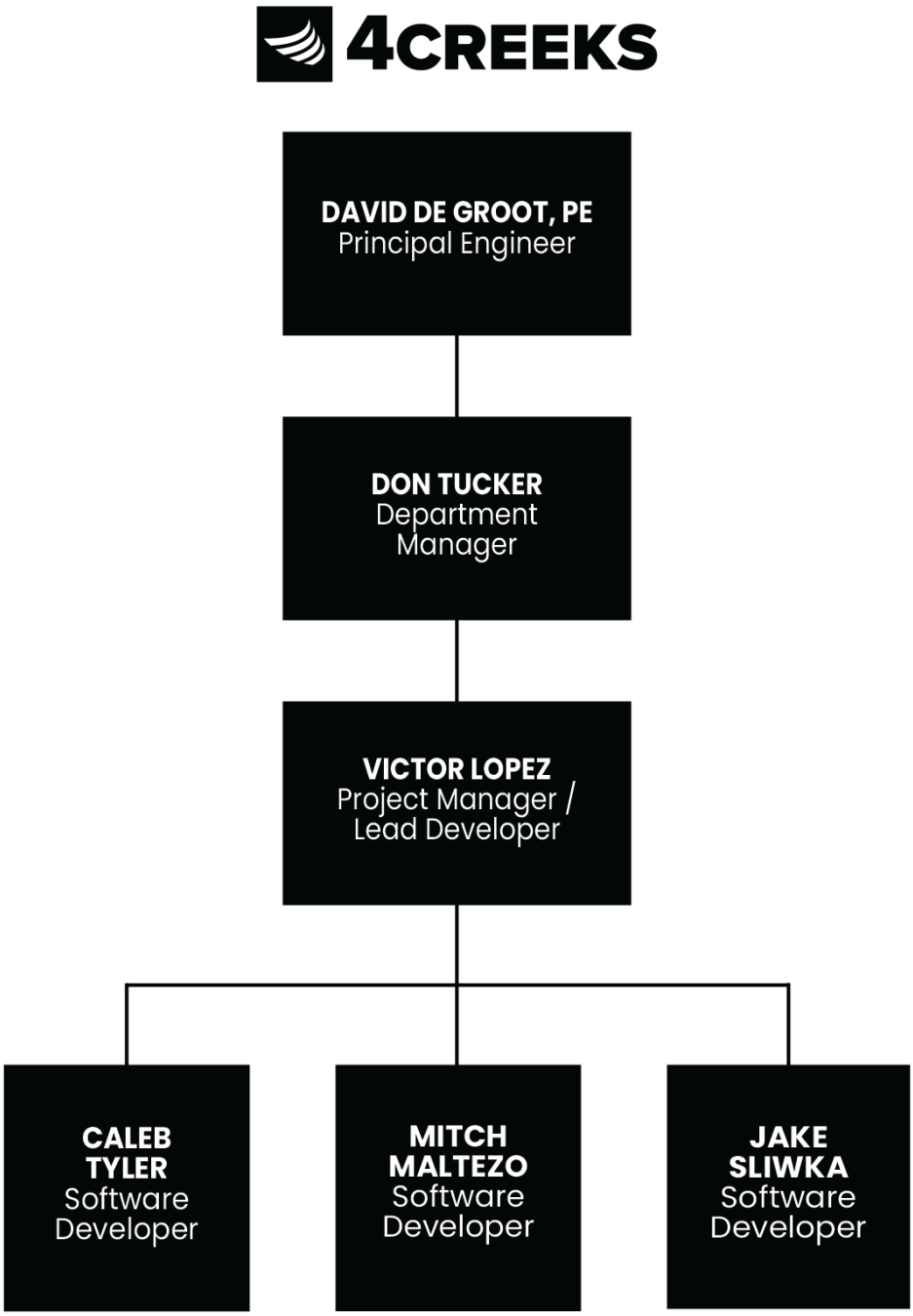
Organization Chart

The proposed project team are shown on the organization chart below. Further qualifications for key personnel, including resumes, can be found in the Qualifications section of the proposal.



Qualifications

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Don Tucker

Water Department Manager

8+ Years Experience
P: (559) 802-3052
E: don.tucker@4-creeks.com
A: 324 S. Santa Fe Street
Visalia, CA 93292

EDUCATION

B.S. - Civil Engineering
CSU Fresno
Fresno, CA

AREAS OF EXPERTISE

Project Due Diligence
Feasibility Studies
Water Resources Engineering
Permitting & Compliance
Environmental Planning & Permitting
Regulatory Program Compliance & Management
Software Development

EMPLOYMENT

4Creeks, Inc. - Visalia, CA
Water Department Manager
03/16 - Present

EXPERIENCE

Tule Subbasin Basinsafe™
Project Manager
Assisted Groundwater Sustainable Agencies (GSAs) during policy development and translated policy decisions to software team to build customized Basinsafe™ software for implementation of policies. Coordinated with LandIQ on ET data as basis for measuring groundwater use. Manage administrative staff for providing landowner support relating to Basinsafe™ accounts.

Tule Subbasin Sustainable Groundwater Management Act
Technical Project Manager
Assisted Tule Subbasin Plan Manager and Hydrogeologist in preparing technical data for developing Tule Subbasin GSPs, Coordination Agreements, and GSP Annual Reports. Managed Proposition 1 and Proposition 68 grants awarded to the Tule Subbasin including grant components such as the Tule Subbasin Data Management System and installation of monitoring wells.

Consultant for Eastern Tule GSA, Lower Tule River ID GSA, Pixley ID GSA on development of GSPs and adoption of policies to achieve groundwater sustainability. Prepared GSPs based on board direction. Prepare regular technical updates on the progress of GSP implementation.

Tule Basin Water Quality Coalition
Technical Project Manager
Developed and managed implementation of monitoring programs under supervision of Technical Coalition Lead to comply with the Irrigated Lands Regulatory Program (ILRP) general order. Prepared Annual Monitoring Reports, Groundwater Quality Trend Monitoring Plan, and oversaw monitoring efforts.

Tule Basin Management Zone
Technical Project Manager
Developed and managed implementation of Preliminary / Final Management Zone Proposals, Early Action Plan, and Management Zone Implementation Plan for the Tule Subbasin Management Zone compliance with the CV-Salts Nitrate Control Program.

Victor Lopez

Lead Developer

5+ Years Experience
P: (559) 802-3052
E: victor@4-creeks.com
A: 324 S. Santa Fe Street
Visalia, CA 93292

EDUCATION

B.S. - Computer Science
CSU Fresno
Fresno, CA

AREAS OF EXPERTISE

C#, .NET Framework, & .NET Core
ASP.NET MVC
MSSQL & Entity Framework
HTML, CSS, & Java Script
REST API's
UI/UX Designer
DB Schema & Diagrams
Client Relations & Support
Software Development

EMPLOYMENT

4Creeks, Inc. - Visalia, CA
Lead Developer
06/19 - Present

EXPERIENCE

Basinsafe™ Groundwater
Lead Developer
Engineered bespoke features for GSAs to align with specific regulatory requirements and policies, incorporating advanced billing systems for groundwater usage and robust tracking systems for accurate water data analysis. Led the initial deployment and adoption of Basinsafe™ software with Lower Tule River ID GSA, Pixley ID GSA, and Tri-County Water Authority GSA demonstrating the software's effectiveness in managing water resources and facilitating the transition towards fee-based groundwater usage tracking.

Basinsafe™ Surface Water
Lead Developer
Developed and launched additional features to meet the evolving surface water reporting requirements for GSAs, including a real-time water delivery management interface, customized allocations, tracking for Special Management Areas, and a comprehensive suite of water delivery management tools. Led the onboarding processes for five unique surface water entities.

Irrigated Lands Regulatory Program
Lead Developer
Responsible for the project transition into new management while maintaining reporting deadlines and client interaction for continued development and pre-established feature additions. Produced various reporting analysis via programming language and SQL. Assisted with annual landowner data rollover requirements.

California Citrus Mutual
Lead Developer
Assisted in the designing and deploying of a bespoke software application to assist a non-profit association in their efforts to advocate for California citrus growers, by providing management tools for membership, crops, and political action committee's funding efforts.

Grimmius Cattle Co.
Lead Developer
Migrated a classic ASP application from a remote server to an on-premises server that utilizes an FTP management system.

Project Understanding and Approach

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Project Understanding and Approach

About Basinsafe™

Basinsafe™ software is an integrated Groundwater Management platform built specifically to manage GSA's in California. This robust web-based platform was created within the Tule Subbasin, from the ground up, to optimize and simplify life for agency staff and the landowners impacted by SGMA. Basinsafe™ takes the guessing game out of your groundwater use and is built with flexibility to grow with the evolving water market. Basinsafe™ puts the necessary tools in your hands to effectively track, report, bill, and manage your GSA.

- Transparency for landowners
- Single system for agency staff
- Ease of use
- Up-to-date information
- Built for expansion
- Safe and secure data storage
- Configurable to fit GSA regulations

Sustainable groundwater management is one of California's most pressing issues for landowners today. With implications that reach from farm to family room, access to a system that manages your data, billing, tracking, and reporting is vital. As GSAs move toward implementing their sustainability plans, Basinsafe™ is the next step towards peace of mind.

Core Basinsafe™ Features

Tracking: Access to timely water tracking information to stay up to date on your water balance.
Consumption: Gain insights into your crop, field, and parcel data to monitor your groundwater consumption so that you can accurately plan your water use and prepare for the future.
Billing: Built-in invoicing tools streamline the billing process so you can keep your operations and finances in view and on track within a single system.
Reporting: Provide stakeholders and government agencies with pertinent information in an easy-to-compile format that can be customized to meet your needs.
Management: Powerful tools to manage individual accounts and agency-wide activities, so your staff can simply and easily manage hundreds of accounts and thousands of ac/ft.

Project Understanding

The Madera County Groundwater Sustainability Agencies (GSAs) operate within a uniquely challenging and critical groundwater management framework encompassing the Madera, Chowchilla, and partially the Delta-Mendota subbasins. With approximately 120,000 acres of irrigated land and 100,000 acres of non-irrigated terrain, the GSAs have implemented a forward-thinking groundwater allocation system based on evapotranspiration of applied water (ETAW). All acreage is subject to water use monitoring, emphasizing the need for high-resolution, defensible, and accessible remote sensing methodologies to support effective water accounting and policy enforcement.

4Creeks can deliver accurate, scalable, and verifiable satellite-derived datasets on a monthly basis—specifically:

- Annual land use raster files
- Monthly evapotranspiration (ET/ETAW) raster files
- Monthly precipitation raster files

—all with spatial resolution at or finer than 30 meters. We understand that although the GSAs have an existing data management system in place, a gap remains in the availability of an integrated online user interface for stakeholders (including growers) to visualize and engage with farm-specific water allocation data, usage, and associated penalties or credits.

Project Approach

Rooted in precision, transparency, and accessibility, our approach centers on hosting evapotranspiration (ET) and related land-use data within a secure, user-friendly database platform called Basinsafe™. The Basinsafe™ system allows landowners and GSA administrative staff to easily view, access, and manage data collected by the GSA's selected satellite-based remote sensing provider. Scalable across the entire 220,000-acre jurisdiction, the database is designed to support multi-year data storage while maintaining consistency in accessibility, reporting, and integrity.

4Creeks will provide Madera County GSA with Basinsafe™ software to give landowners a portal to track consumption against allocations.

Data Integration Approach

We understand Madera County GSA will contract a separate ET provider consultant to provide data. 4Creeks will work directly with the selected consultant to import the ET data into Basinsafe™.

4Creeks has experience working with firms specializing in remote sensing, geospatial analysis, and soil science. We have worked with LandIQ for five years on water consulting services throughout the Central Valley.

System Set-Up Process

Our typical system set-up process is broken out into the following three phases. It's important to note that these timelines are estimates and can be updated based on the GSA's needs.

Phase 1: Discovery Phase (Week 1)

4Creeks and agency staff will meet to review Basinsafe™ core application features and the specific needs and wants of the agency. For any customized features not included in the core application, 4Creeks will develop an updated scope and fee to be provided to the agency.

Phase 2: Agency Specific Application Development and Deployment (Weeks 2-10)

4Creeks will develop an agency-specific Basinsafe™ domain, create agency administrative login accounts, and work with the agency to collect and format pertinent landowner data.

Agency staff is provided a system overview and training period for verifying accuracy of data within the system. Once the ET data is imported into the system, 4Creeks will work with agency staff on customized landowner and administration views and reporting tools desired, followed by opening the system up for landowner access.

Phase 3: Annual Licensing and Subscription Fee and On-Call Support Services (Week 11 – On-Going)

Upon completion of Phase 2, Phase 3 will commence for the on-going support services, licensing, and subscription fees. On-call support services are billed on a time and material basis. Licensing and subscription fixed fees are acreage-based fees covering the continued system and hardware maintenance, data management and storage, core application bug fixes, and improvements. Agency specific upgrades or changes to the system will be billed as "customization" on a time and material basis with approval before customization work begins.

Setup includes:

- Grower imports
- Parcel imports
- Administrative account setup
- Feature setup and permissions
- Base reports

On-going implementation includes:

- Allocation imports
- ET imports
- Well registry
- Meter data collection
- Allocation consumption / extraction
- Reports

Project Experience and Success

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Project Experience and Success

01 Lower Tule River Irrigation District GSA

CONTRACT TYPE: ANNUAL PROJECT-BASED FEE CONTRACT

Lower Tule River Irrigation District was one of the first GSAs to use Basinsafe™ and partnered with 4Creeks in the development of the software. LTRID deployed the software as a pilot program to landowners in 2020 and began collecting fees for groundwater use in 2021. The agency utilizes groundwater and surface water Basinsafe™ tools to account for landowner surface water deliveries, sending annual assessments and invoicing landowners for groundwater use and surface water deliveries.

02 Pixley Irrigation District GSA

CONTRACT TYPE: ANNUAL PROJECT-BASED FEE CONTRACT

Pixley Irrigation District was one of the first GSAs to use Basinsafe™. PID partnered with 4Creeks in the initial development of the software. The GSA deployed the software as a pilot program to landowners in 2020 and began collecting fees for groundwater use in 2021. The agency utilizes groundwater and surface water Basinsafe™ tools to account for landowner surface water deliveries, sending out annual assessments and invoicing landowners for groundwater use and surface water deliveries.

03 Eastern Tule GSA

CONTRACT TYPE: ANNUAL PROJECT-BASED FEE CONTRACT

Development of the Eastern Tule GSA Basinsafe™ account began in 2020 and was deployed for landowner groundwater allocations and usage in 2021 to the diverse group of landowners in the GSA. ETGSA consists of one incorporated city, incorporated community, multiple irrigation districts / private water companies, and groundwater dependent irrigated lands. 4Creeks assisted with administrative landowner support services being that the ETGSA was a new governing agency. ETGSA utilizes groundwater Basinsafe™ tools with add-on features including the Water Market Board, a Craigslist-type group for landowner communication trading groundwater credits, and customized allocations and groundwater tracking for Special Management Areas. The ETGSA Basinsafe™ account covers 149,318 acres and supports 1,483 landowner accounts.

04 Tri-County Water Authority GSA

CONTRACT TYPE: ANNUAL PROJECT-BASED FEE CONTRACT

Development of TCWA GSA Basinsafe™ began in 2020 and was deployed for managing 439 landowner groundwater allocations and usage in 2021. TCWA rules and regulations implemented an extraction-based credit deduction system utilizing a hybrid of LandIQ's ETc, precipitation, and field/crop data. This unique approach required the additional feature add-ons within Basinsafe™ for individual field management along with various reporting capabilities and our groundwater Basinsafe™ tools. TCWA also paved the way for the Basinsafe™ addition of a well registry management tool along with domestic well reporting features.

05 Porterville Irrigation District

CONTRACT TYPE: ANNUAL PROJECT-BASED FEE CONTRACT

Porterville Irrigation District serves 424 landowner accounts across 16,677 acres. PID began onboarding into the Basinsafe™ program in 2022, utilizing surface water Basinsafe™ tools, when GSA reporting requirements became more stringent on their surface water districts. The objective for the district was to assist with replacing an outdated pen and paper accounting system to a streamlined digitized solution. PID is contained within the ETGSA boundary which allows for direct cross-database profile linking at the request of an administrator on either side of the system. PID utilizes the invoicing features for both surface water deliveries and annual assessments.

06 Saucelito Irrigation District

CONTRACT TYPE: ANNUAL PROJECT-BASED FEE CONTRACT

Saucelito Irrigation District encountered similar growing pains to PID due to GSA reporting requirements. The hurdles of overcoming the flexibility of SID's policies ultimately led to the creation of a more advanced, yet streamlined version of the Basinsafe™ surface water delivery system. The limited staffing at SID encouraged further updates to the software that made day-to-day tasks more efficient. SID utilizes surface water Basinsafe™ tools and invoicing features for surface water deliveries, annual assessments, and standby charges. SID serves 174 landowner accounts across 19,890 acres.

07 Consolidated Peoples Ditch Company

CONTRACT TYPE: ANNUAL PROJECT-BASED FEE CONTRACT

Onboarding Consolidated Peoples Ditch Company began in 2022 along with multiple new feature requirements for their unique management practices. CPDC internally manages 15 different share companies by using individual landowner share management tools that were created for the purpose of tracking share transfers and leases along with annual water allocation disbursements. In addition to the base functionality of the surface water tracking system, CPDC staff and landowners utilize a water credit transferring tool that allows their 458 landowners to designate water credits to their specified lands for groundwater accounting purposes. CPDC oversees 66,421 acres.

08 Vandalia Water District GSA

CONTRACT TYPE: ANNUAL PROJECT-BASED FEE CONTRACT

Vandalia Water District has been utilizing Basinsafe™ groundwater and surface water tracking components since 2020 along with LTRID, PIXID, and TPD. In 2024, VWD departed from ETGSA and became their own GSA. The software team assisted in the migration from one database to another, along with all of the grower's historically available credits and data records. In early 2025, software modifications were made to the system to comply with new GSA policies. VWD manages 1,300 acres of farm and domestic lands.

09 Tea Pot Dome Water District GSA

CONTRACT TYPE: ANNUAL PROJECT-BASED FEE CONTRACT

Tea Pot Dome Water District has been utilizing Basinsafe™ groundwater and surface water tracking components since 2020 along with LTRID, PIXID, and VWD. In 2024 TPD departed from ETGSA and became their own GSA. The software team assisted in the migration from one database to another, along with all of the grower's historically available credits and data records. In early 2025, software modifications were made to the system to comply with new GSA policies. TPD manages 3,500 acres of farm and domestic lands.

References

References

JAMES SILVA

CONSOLIDATED PEOPLE'S DITCH

(559) 747-1177

jsilva@cpdc1874.org

JOEL KIMMELSHUE

LANDIQ

(916) 265-6330

jkimmelshue@landiq.com

JOHN-MICHAEL DOMONDON

LOWER TULE RIVER IRRIGATION DISTRICT

(559) 686-4716

jdomondon@ltrid.org

Costs

Cost Proposal

Task	Description of Activities	Fee
Phase 1: Discovery Phase		
Phase 1	• In depth review with GSA staff of the "off the shell" application features and current district operations • Recommendations on framework configuration and best use of system • Updated scope and fee for Phase 2	**T&M (Estimated Budget Varies Upon Needs) $3,500**
Phase 2: Agency Specific Application Development & Deployment Preliminary Fees		

Core Application Development & Configuration Fee	• Contract initiation - GSA signs and agrees to software setup and one-time development set up fee
	  • **Development fees included in this task: $55,000 (Fixed Fee)**
	• System server requisition
	• Configuration and setup of server
	• GSA database and core Basinsafe™ framework configuration
	  • **Configuration fees included in this task: $2,500**
	• Deploy software
	• Setup staff accounts and administrative access
		$57,500

Onboarding	• System capabilities review with staff – in-depth software overview meeting • Data review with recommendations on formatting data appropriately • Provide input to staff that can support data preparation efforts	**T&M (Estimated Budget Varies Upon Needs) $7,500**
User Account Setup & Verification	• Receive formatted landowner (user) data from GSA staff • 4Creeks to prepare data for user account importation • Setup staff accounts and administrative access, GSA to provide initial landowner (user) data audit • Import final landowner (user) data into system	**T&M (Estimated Budget Varies Upon Needs) $13,000**
Testing & Staff Training	• Test system with specific data • Deploy "Beta" version of the application for administrative testing period • GSA's final data audits in system • Three (3) 2-hour staff training sessions	**T&M (Estimated Budget Varies Upon Needs) $10,000**
Launch for Member Access	• Work with GSA staff to develop a software launch plan • Provide appropriate, useful on-boarding materials • Dispense user ID / login information • Launch software for member access	**T&M (Estimated Budget Varies Upon Needs) $8,500**
Customization	Includes updates requested to the existing core application that would require substantial reconfiguration efforts to launch for member access (i.e. custom billing and invoicing features, custom reports, staff training beyond 3 meetings, etc.). Customization efforts will be agreed upon by both GSA and 4Creeks and a T&M proposal will be provided for approval before work is started.	**Varies**
One-Time Development & Configuration Fee		**$57,500**
Tasks 1-5 Implementation Service Time & Material Estimate		**$39,000**
Total Estimated Cost		**$96,500**

Task	Description of Activities	Fee
Phase 3: Annual On-Going Support Services		
On-Call Support	• Support services will be provided by high-quality, local staff • Support will be provided during standard business hours • Support services are offered on an hourly basis where support tasks are identified by complexity, length of time to complete, and immediacy • Support rates are valued at $120/hr Example: Support during agency assessments or billing cycles	**T&M** **(Estimated Budget Varies Upon Needs)** **$15,000**

Annual Licensing & Subscription Fee
Includes: Web-based Access & Data Hosting
	• Agency-specific enterprise-level server configuration for data retention and optimization performance
	• Data confidentiality and encryption
	• Fully supported hardware to ensure uptimes of 98% or greater
	• Low latency, high throughput, and highly redundant data access and storage
	• Built and managed to ensure decades of data is secure and accessible
	• Hardware maintained and replaced at regular/specific intervals to ensure uptime and data security
	• Platform license fee to be billed monthly upon operational setup of system
	• Includes:
	  • Software optimization (base code management/optimizing)
	  • System upgrades (upgrades to system performance/ux/ui)
	  • Weekly data backup services
	  • Maintaining software documentation / training resources
	  • Platform debugging and troubleshooting (Platform critical support)
		Fixed Fee
		$45,000/yr
		(Annual Fixed Fee)

Customization as Requested	Upon request, scope and fees to be provided to client for approval before customization work begins	**T&M**
Annual On-Going Support Fees		**$60,000**

Effective June 1, 2025

4Creeks, Inc. Fee Schedule – Professional

Fees are based on the median hourly pay rate for employees in each classification, plus, indirect costs, overhead, and profit. These rates are effective for one year from the contract execution date.

Classification	Charges Per Hour	Classification	Charges Per Hour
Architectural Services		**Planning Services**	
Associate Architect	**$160**	Assistant Planner	**$108**
Architect	**$185**	Associate Planner	**$129**
Senior Architect	**$221**	Planner	**$149**
Principal Architect	**$252**	Senior Planner	**$180**
		Principal Planner	**$216**
Civil Engineering Services			
Assistant Engineer	**$149**	**Project Manager**	
Associate Engineer	**$165**	Associate Project Manager	**$124**
Engineer	**$180**	Associate Project Manager - Design	**$149**
Senior Engineer	**$215**	Project Manager	**$149**
Principal Engineer	**$252**	Project Manager – Design	**$175**
		Senior Project Manager	**$196**
GIS Services		**Public Outreach Coordination**	
GIS Technician	**$108**	Associate Outreach Coordinator	**$108**
GIS Analyst/Developer	**$124**	Outreach Coordinator	**$129**
GIS Manager	**$149**		
Drone Pilot	**$180**	**Software Engineering Services**	
		Assistant Software Engineer	**$93**
Expert Witness		Associate Software Engineer	**$113**
Expert Witness	**$309**	Software Engineer	**$139**
		Senior Software Engineer	**$170**
Land Surveying Services		**Structural Engineering Services**	
Assistant Surveyor	**$124**	Associate Structural Engineer	**$149**
Associate Surveyor	**$155**	Structural Engineer	**$170**
Land Surveyor	**$175**	Senior Structural Engineer	**$196**
Senior Surveyor	**$200**	Principal Structural Engineer	**$221**
Principal Land Surveyor	**$235**		
Senior Survey Manager	**$165**	**Technical Services**	
1-Man, Survey Crew *	**$185**	Project Technician I	**$98**
2-Man, Survey Crew *	**$268**	Project Technician II	**$113**
3-Man, Survey Crew *	**$361**	Project Technician III	**$129**
		Project Technician IV	**$144**
1-Man, Survey Crew – Fresno/Tulare/Tuolumne	**$245**		
1-Man, Survey Crew – Kern/Kings	**$245**	**Utility Design Services**	
		Associate Utility Designer	**$129**
2-Man, Survey Crew – Fresno/Tulare/Tuolumne	**$400**	Utility Designer	**$160**
2-Man, Survey Crew – Kern/Kings	**$400**	Senior Utility Designer	**$201**
3-Man, Survey Crew – Fresno/Tulare/Tuolumne	**$585**	**Water Consulting Services**	
3-Man, Survey Crew – Kern/Kings	**$585**	Associate Water Consultant	**$118**
		Water Consultant	**$144**
		Senior Water Consultant	**$175**

Direct Charges

At cost plus fifteen percent (15%):

- *Transportation and per-diem expenses (auto mileage @ current IRS rate, off-road charges $50.00/day)*
- *Printing and reproduction: $0.03 per b/w copy, $0.12 per color copy, $0.80 per sq. ft. large printing*
- *Equipment rentals, subcontractors, laboratory analyses*

*Prevailing wage rates are subject to change based on the DIR updates.

4CREEKS

4Creeks, Inc.
324 S. Santa Fe Street, Visalia, CA 93292
(559) 802-3052
4-creeks.com

Response to Request for Proposals for Madera County Groundwater Sustainability Agency Measurement Services

June 2025

Prepared By:

DAVIDS ENGINEERING, INC

H2Otech water technology specialists

Section 1 – Cover Letter

June 16, 2025

Aleta Allen
Madera County GSA
200 West Fourth Street
Madera, CA 93637
Email: Aleta.Allen@maderacounty.com

Subject: Response to Request for Proposals for Madera County Groundwater Sustainability Agencies (GSAs) Measurement Services

Dear Ms. Allen,

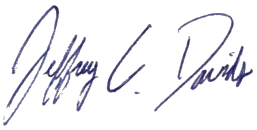
On behalf of Davids Engineering, Inc. (DE) and H2oTech, LLC (collectively the DE-H2oTech Team), we are pleased to submit this proposal in response to Madera County GSAs' Request for Proposals (RFP) for measurement services. **Specifically, we are responding to the expressed desire within the RFP for the implementation of an online platform that would enable growers to view and interact with their groundwater allocation and measurement data** (not the provision of measurement data)**.**

The DE-H2oTech Team brings over 30 years of experience in agricultural water management, water accounting, remote sensing, flow measurement, data management, and groundwater sustainability plan development and implementation across California, with a long-standing commitment to technical excellence and client success. H2oTech complements this expertise with nearly 20 years of flow measurement, data management, and online platform development and implementation experience. Together, the DE-H2oTech Team has successfully implemented water accounting and allocation management systems for over 800,000 acres in California.

We believe that the combined technical capabilities and regional experience of the DE-H2oTech Team uniquely positions us to deliver a high-performing, cost-effective solution aligned with Madera County GSA's goals. Our proposed approach couples a deep understanding of the Madera County GSAs' Allocation Program with the ability to integrate allocation measurement data from any source to implement a user-friendly groundwater accounting platform that supports parcel, farm unit, and account-level insights into allocations, carryover, adjustments, evapotranspiration of applied water (ETAW), remaining, credits, and penalties.

Thank you for your consideration. We look forward to the opportunity to present our approach and work collaboratively to support sustainable groundwater management in Madera County.

Sincerely,



Jeffrey (Jeff) C. Davids, Ph.D., P.E.
Proposed Project Manager
Vice President and CTO, Davids Engineering, Inc. and President, H2oTech, LLC

Section 2 – Table of Contents

Section 3 – Organizational Chart

Under the direction of Stephanie Anagnoson, Director of Water and Natural Resources for the Madera County Groundwater Sustainability Agencies (Madera County GSAs), Jeff Davids will serve as the DE-H2oTech Team project manager (Figure 1). Jeff will seamlessly integrate H2oTech's online platform development and implementation experience with DE's deep knowledge and hands on experience with the Madera County GSAs allocation program. John Davids, who has essential insights into the local context due to his leadership role with Groundwater Sustainability Plan (GSP) revisions and implementation for the Chowchilla and Madera Subbasins, will serve as an on-call strategic advisor. Daniel Smith will serve as the DE Team leader, providing oversight for integration of the online platform with the existing data management system, measurement data from remote sensing and flowmeters, and periodic updates to base data layers including crops, parcels, and fields and the linkages between these and grower accounts. Finally, Jeff will serve as the H2oTech Team leader, organizing efforts for online platform requirements, development, refinement, implementation, and support.

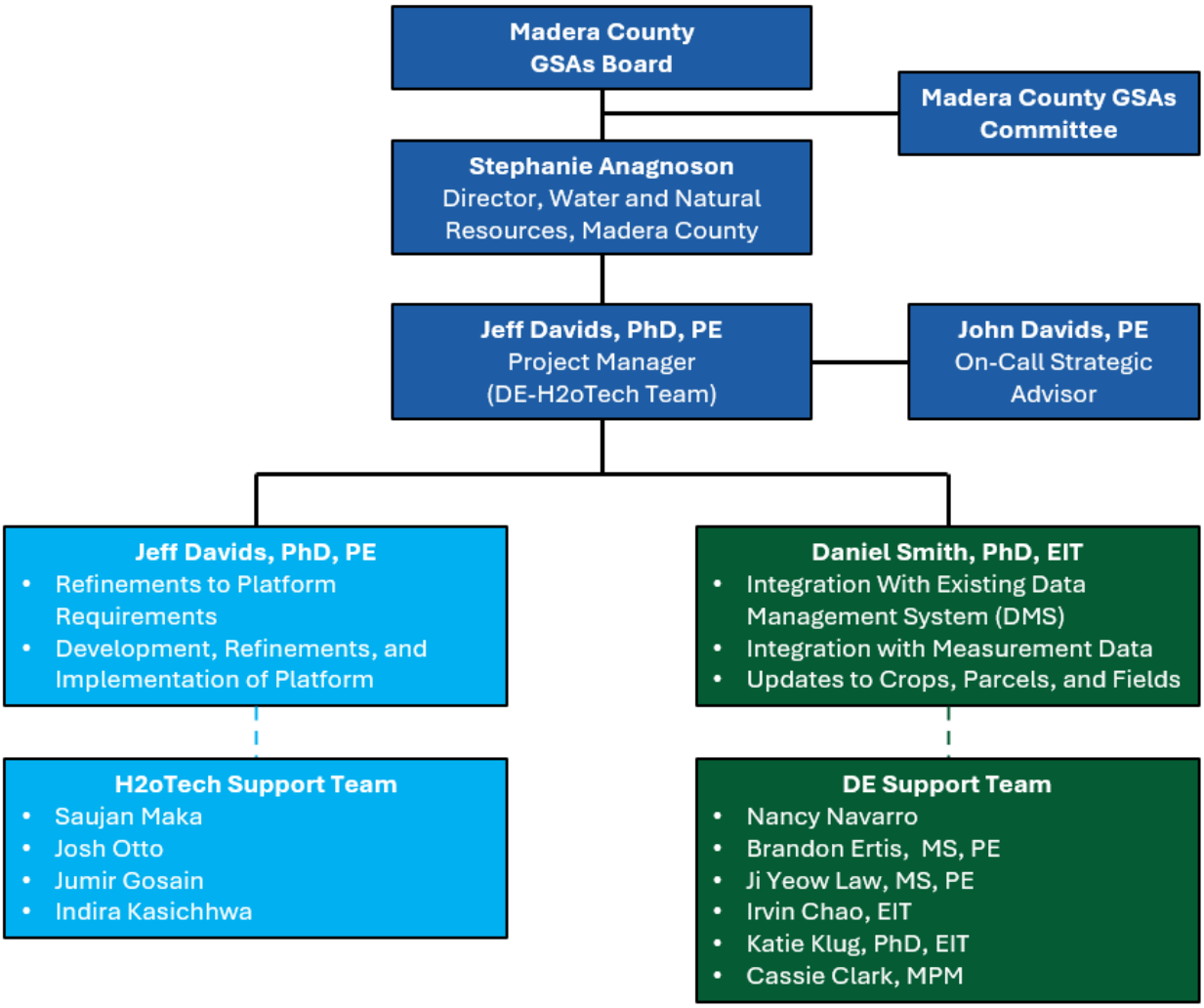


Figure 1. DE-H2oTech Team organizational structure.

Section 4 - Qualifications

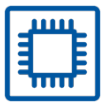
DE Overview – Agricultural Water Management

Since 1993, DE has provided professional engineering and scientific services to public agencies, private entities, and individual landowners responsible for managing water resources in the Western United States. We are founded on a commitment to the highest standards of professional integrity and intellectual honesty, and have successfully completed projects in Arizona, California, Nebraska, Nevada, Oregon, Washington, and in a handful of developing nations. We are proud of the fact that the large majority of our work comes by word-of-mouth or through repeat work for past clients.

DE is organized into three tightly integrated solutions that work together to support our clients' surface water and groundwater management initiatives:

Water: Solutions for agricultural water management, environmental water stewardship, and sustainable groundwater management.

Infrastructure: Solutions for infrastructure modernization planning, assessment, design, and construction.



Technology: Solutions for environmental monitoring, GIS and remote sensing, and data management and modeling.

Some of DE's projects employ professional services from just one solution, while others (typically larger, more complex projects) employ professional services from two or three solutions to creatively and seamlessly tailor our solutions to meet the unique needs of each project and each client. The online platform implementation project would leverage professional services and expertise from both the Water and Technology solutions and would draw on team members from all three of DE's offices in California's Central Valley (Chico, Davis, and Oakdale).

H2oTech Overview – Water Measurement and Accounting

Since 2006, H2oTech has been a leader in flow measurement and water accounting in California. H2oTech's Founder and President, Jeff Davids, has led the development and implementation of flow measurement plans for over 1,000,000 acres of irrigated agriculture within California. From 2017 through 2020, Dr. Davids worked on a series of national-scale remote sensing water accounting efforts with the United Nations Food and Agriculture Organization in Afghanistan and Myanmar. Additionally, for the past decade, Jeff has led SmartPhones4Water (S4W) - an international network of hundreds of young researchers and citizen scientists focused on improving our understanding and management of water resources (www.smartphones4water.org) in places like Nepal, Afghanistan, Vietnam, and the Middle East.

RemoteTracker Water Measurement and Accounting System

For over a decade, the DE-H2oTech Team has developed, implemented, and supported the RemoteTracker Water Accounting System. Initially adopted in 2012 as the preferred water measurement and accounting system by the Richvale Irrigation District and Reclamation District No. 108, RemoteTracker is now being used at over 8,000 delivery points providing irrigation water to over 600,000 acres in California. The RemoteTracker System includes: (1) custom field-data collection software, (2) a wireless acoustic doppler velocimeter flow measurement device, (3) a centralized database for data aggregation, quality control, and reporting, and (4) an online-grower portal.

SGMA Implementation and Experience

Since passage of the Sustainable Groundwater Management Act (SGMA) in 2014, DE has had the privilege of either leading or supporting development and/or implementation of 22 GSPs, including the Chowchilla and Madera Subbasins. Through these efforts, DE has developed extensive knowledge of SGMA and the regional, working landscapes within which sustainable management plays out. Coupled with an understanding of the unique, often complicated, political factors characterizing each groundwater subbasin, we have developed a renewed appreciation for the old adage: *one size doesn't fit all*. As we look to the future of sustainable groundwater management in California, we recognize that in all cases, sustainability will either need to be attained or maintained through the implementation of projects and management actions. Organization of DE's professional services into the three solutions, as described above, was a deliberate action in support of GSP implementation, and ultimately sustainable groundwater management in California.

Groundwater Demand Management

The DE-H2oTech team has been deeply involved in the planning and implementation of Groundwater Demand Management (GDM) efforts in California. Most recently, DE, together with Dr. Robyn Grimm, CEO of the California Water Data Consortium, and Dr. Isaya Kisseka, Director of the UC Davis Agricultural Water Center, formed the Groundwater Demand Management Network (www.gdmnetwork.org). DE has led the implementation and support of the Madera County GSAs' allocation program since 2021. This has included the development of a custom database schema (i.e., architecture) to support the unique aspects of the Madera County GSAs groundwater allocation program, creation of a platform for the collection and quality control of grower-supplied flowmeter data, and the generation of periodic allocation reports at the account, farm unit, parcel, and parcel-field scale. Most recently, DE has led the GDM planning efforts for over 700,000 acres in the Colusa Subbasin in Northern California.

Resumes for the key DE-H2oTech Team members featured in the organizational chart (Figure 1) are presented in Appendix B. Resumes for additional support staff are available upon request.

Madera County GSAs Allocation Program

The objective of SGMA and implementation of GSPs in Madera County is to achieve groundwater sustainability in each of the subbasins underlying the County by 2040. The Madera County GSAs[1] are currently responsible for GSP implementation in the "white areas"[2] of the Chowchilla, Madera, and Delta-Mendota Subbasins. Other GSAs in Madera County are responsible for GSP implementation in the respective areas they manage in the subbasins. In most years, groundwater is the sole source of water for irrigation of agricultural lands in the Madera County GSAs, although surface water is available for some lands in wet years, such as 2023. Where necessary, an important component of GSP implementation and achieving sustainability is reducing consumptive use[3] of groundwater, which may be accomplished through implementation and enforcement of a groundwater allocation.

On December 15, 2020, the Madera County Board of Supervisors adopted Resolution 2020-166 describing the groundwater allocation approach to be used for GSP implementation in the Madera County GSAs. The resolution describes two designations of groundwater: (1) sustainable yield of native groundwater that represents the baseline, stable volume of groundwater in storage that is replenished from natural sources, and (2) transitional water that represents continued overdraft of the Chowchilla, Delta-Mendota, and Madera subbasins that will be incrementally reduced over the GSP implementation period (2020 through 2040), culminating in sustainable groundwater conditions. Importantly, the adopted allocation approach is based on the quantity of groundwater consumed, not pumped. This distinction recognizes that the consumption of groundwater causes subbasin depletion (and therefore affects sustainability), while groundwater that is pumped but not consumed returns to the groundwater system (as deep percolation) and does not cause depletion[4]. Further, recognizing that crops consume precipitation (P) as well as applied water (AW) stored in the root zone, it is important for purposes of groundwater allocation and accounting to distinguish crop evapotranspiration (ET) of applied water (ETAW) – which largely results from groundwater consumption within the Madera County GSAs – from crop ET of precipitation (ETPR). Thus, ETAW was adopted as the quantitative accounting metric at the parcel scale for measuring and monitoring groundwater consumption against groundwater allocations within the Madera County GSAs.

[1] The Madera County GSAs are the three GSAs managed by Madera County in the Chowchilla, Delta-Mendota, and Madera Subbasins, respectively.
[2] "White areas" represent lands outside of the boundaries of cities and surface water district service areas (i.e. areas not governed or managed by another local agency).
[3] Consumptive use refers to "that part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment" (ASCE, 2016).
[4] Because pressurized drip and micro-sprinkler on-farm irrigation systems are dominant in the three Madera County GSAs, the assumption was made that there is negligible surface runoff from the GSAs that could cause groundwater depletion. The limited nature of runoff from AGW was reviewed during 2022 and 2023 field data collection activities, providing evidence to support this assumption.

Section 5 – Project Understanding and Approach

As of 2023, growers in the Madera County GSAs have three options for tracking ETAW against their allocations: (1) Flowmeters (ground-based measurement method), (2) IrriWatch/Hydrosat (satellite-based ETAW measurement method), and (3) Land IQ (satellite-based ETAW measurement method).

Project Understanding and Approach

As articulated in the RFP, the DE-H2oTech Team understands that there is a desire by some growers to implement an online platform that would enable growers to view and interact with their groundwater allocation and measurement data. In response to this desire, and not the request for measurement data, the DE-H2oTech Team proposes to develop and implement an online platform that integrates all aspects of the allocation program. The platform will be developed to work seamlessly with any measurement method selected by the grower under a simple, secure, and user-friendly portal. Specifically, the following approach is proposed:

- Deploy a customizable web-based platform that includes:
  - Secure unique logins for growers and/or their account managers
  - Each login would be tied to one or more Madera County GSA allocation accounts (MAD_MA_XXXXX) associated with one or more Assessor Parcel Numbers (APNs)
  - Account, farm unit, parcel, and field-level summaries of allocations, adjustments, credits, ETAW, and remaining allocation
  - Access to existing allocation reports regardless of grower selected measurement method
  - Timeseries plots of ETAW for current year and available historical years
  - Automated penalty/credit notifications at predefined ETAW threshold levels
  - GSA administration view of all accounts
  - GSA administration view of all farm unit zones
- Facilitate critical data integrations:
  - Integrate raster data pipelines via automated application programming interface (API) or manual upload
  - Leverage existing partnerships (as required) with Land IQ, IrriWatch/Hydrosat, and OpenET using open and reproducible methods aligned with DWR and GSA best practices
  - Integrate flowmeter data from grower-supplied flowmeter readings and optional integration with telemetered flowmeter data via API
  - Integrate account-parcel, field-crop, field-flowmeter, etc. data managed with existing DMS via API
- Create a pathway for single DMS and grower platform:
  - Incorporate essential create, read, update, and delete (CRUD) operations with existing DMS
  - Incorporate essential GSA administration reporting functions (e.g., summary of penalty and carryover volumes, pending penalty amounts, payments received, etc.)
  - Streamline DMS interactions for complex datasets like field-flowmeter relationships

RemoteTracker Water Measurement and Accounting System

Jeff Davids and Josh Otto led the development, piloting, and implementation of the RemoteTracker water measurement and accounting system now in use on over 600,000 irrigated acres. While initially focused on surface water accounting, the RemoteTracker concepts of managing fields, parcels, measurement points (canal turnouts or wells), places of application (relationship between measurement points and fields), customer/accounts, land ownership and/or management (relationship between customers and parcels), cropping, and financial charge rate structures over time readily extends to groundwater accounting as well. For each district, the DE-H2oTech team has inventoried district distribution systems, established standardized naming conventions, developed custom database applications for quality controlling and managing turnout flow data, and supported implementation for over a decade. The RemoteTracker System was pivotal in equitably and efficiently managing curtailments to water allocations during the most recent 2014-2015 and 2020-2022 droughts.

- Length of contracts:
  - Reclamation District No. 108 (2012 to present)
  - Richvale Irrigation District (2012 to present)
  - Biggs-West Gridley Water District (2012 to present)
  - Western Canal Water District (2015 to present)
  - Princeton-Codora-Glenn and Provident Irrigation Districts (2018 to present)
  - Sutter Mutual Water Company (2021 to present)
  - South Sutter Water District (2022 to present)
  - Glenn-Colusa Irrigation District (2022 to present)
  - Reclamation District No. 1004 (2023 to present)
  - Dunnigan Water District (2025 to present)
  - Orland-Artois Water District (2025 to present)
  - Colusa County Water District (2025 to present)
- Scope of professional services provided:
  - Agency-wide flow measurement and water accounting solution
  - Field data collection training
  - Online grower portal training
  - Preparation and management of geospatial datasets of fields, measurement points, field-customer, field-crop, field-measurement point relationships
  - Development and management of water invoices, payments, and adjustments
- Type of contracts:
  - Annual fees and on-call time and materials support
- Specific accomplishments:
  - Development and implementation of an innovative, cloud-connected flow measurement and water accounting solution designed primarily for agricultural and water management applications on over 600,000 acres for over 8,000 water measurement points

- Senate Bill x7-7 and Senate Bill 88 flow measurement compliance
- Development and implementation of an online portal for viewing and interacting with water measurement and allocation tracking data

Madera County GSA's Groundwater Allocation Program Support

The DE-H2oTech Team developed accounting methodology, implementation logic, and data collection and management protocols and procedures in coordination with Madera County GSA staff to administer the Madera County GSAs groundwater allocation resolutions. This work included conceptual development and Python coding for monthly groundwater allocation reports including tabular summaries, mapping, and data visualizations. The DE-H2oTech Team led the creation of a Django PostGIS web-based database allowing the Madera County GSAs' staff real-time concurrent access to a central repository of data about their grower accounts, parcels, fields, crops, measurement points, adjustments, penalties and payments, and other relevant metadata. The DE-H2oTech Team also led the development of a mobile data collection platform that enables growers to submit flowmeter readings from their smartphones, including GPS coordinates, text and numerical entries, and photographs.

- Length of contracts:
  - Madera County Water and Natural Resource (2021 to present)
- Scope of professional services provided:
  - Translation of Madera County resolutions into a database schema
  - Development of spatial hydrology processes to translate ET and precipitation data to ETAW
  - Development of process for partitioning recharge between in-lieu and direct components
  - Training of Madera County GSA staff on water accounting principles and allocation program management and administration
  - Preparation and management of geospatial datasets of accounts, fields, measurement points, field-account, field-crop, field-measurement point relationships
  - Development and management of water invoices, payments, and adjustments
- Type of contracts:
  - On-call time and materials support
- Specific accomplishments:
  - Custom flowmeter mobile data collection platform development and implementation
  - Concurrent flowmeter data review with traceable editing and quality control status
  - Integration of measurement data from three sources: flowmeters, IrriWatch/Hydrosat, and Land IQ
  - Three years of comparisons between flowmeters and remote sensing methods (i.e., IrriWatch/Hydrosat, Land IQ, and OpenET) via the Verification Project

Additional project descriptions are included in Appendix A.

Section 7 – References

Sutter Mutual Water Company and Reclamation District No. 1500

- Contact Name: Roger Cornwell, General Manager
- Phone Number: 530.681.5227
- Email: rcornwell@sutterbasinwater.com
- Scope of Professional Services:
    - RemoteTracker system implementation (including FLOW grower portal)
    - Water distribution system modernization
    - Pump station modernization
    - Infrastructure mapping and asset management system support
    - Water and salinity budget analyses

Reclamation District No. 108

- Contact Name: Jordon Navarrot, Deputy Manager
- Phone Number: 530.682.4205
- Email: jnavarrot@rd108.org
- Scope of Professional Services:
    - RemoteTracker System implementation (including FLOW grower portal)
    - Water distribution system modernization
    - Water budget analyses
    - Lateral and recycle pump flow measurement and accounting

Colusa Subbasin Glenn Groundwater Authority

- Contact Name: Lisa Hunter, Water Resource Coordinator and Program Manager
- Phone Number: 530.934.6540
- Email: lhunter@countyofglenn.net
- Scope of Professional Services:
    - Groundwater Sustainability Plan (GSP) development, revision, and implementation
    - GSP Annual Report development
    - Domestic Well Mitigation program design
    - Groundwater Demand Management program design
    - Telemetered groundwater extraction monitoring pilot project

Section 7 – References

Richvale Irrigation District

- Contact Name: Sean Earley, General Manager
- Phone Number: 530.882.4243
- Email: searley@richvaleid.com
- Scope of Professional Services:
    - RemoteTracker system implementation (including FLOW grower portal)
    - Water distribution system modernization
    - Infrastructure mapping and asset management system support
    - Agricultural water management planning

Glenn-Colusa Irrigation District

- Contact Name: Ed Henderson, Water Operations Superintendent
- Phone Number: 530.934.8881
- Email: ehenderson@gcid.net
- Scope of Professional Services:
    - RemoteTracker system implementation (including FLOW grower portal)
    - Water distribution system modernization
    - Agricultural water management planning

Butte County Department of Water and Resource Conservation

- Contact Name: Christina R. Buck, Ph.D., Assistant Director
- Phone Number: 530.552.3595
- Email: cbuck@buttecounty.net
- Scope of Professional Services:
    - Groundwater Sustainability Plan (GSP) development and implementation
    - GSP Annual Report development
    - Groundwater Demand Management program design
    - Technical Advisory Committee (TAC) support

Section 8 – Costs

Background

As previously mentioned, the DE-H2oTech Team is specifically responding to the expressed desire within the RFP for the implementation of an online platform that would enable growers to view and interact with their groundwater allocation and measurement data (not the provision of measurement data). Since the RFP is primarily focused on soliciting responses for the provision of measurement data, the details regarding the specific requirements for an online platform are not comprehensively provided. Therefore, the costs provided below should be considered reconnaissance-level and inclusive of the features outlined in Section 5 – Project Understanding and Approach under the heading "Deploy a customizable web-based platform…". Future work to implement the concepts listed under "Facilitate critical data integrations" and "Create a pathway for single DMS and grower platform" can be performed as mutually agreed upon between the Madera County GSAs and the DE-H2oTech Team.

Cost Estimate

As requested in the RFP, costs are summarized for a one-year, two-year, and three-year contract period, along with the resulting costs per year (Table 1).

Table 1. Summary of DE-H2oTech Team costs.

Period	Cost ($)	Cost Per Year ($ / YR)
One Year (2026)	$100,000	$100,000 / YR
Two Years (2026 - 2027)	$170,000	$85,000 / YR
Three Year (2026 - 2028)	$210,000	$70,000 / YR

Rate Sheet

DE's rate sheet is provided below as requested in the RFP. H2oTech charges on a lump sum annual basis. The costs provided above in Table 1 include both the estimated H2oTech lump sum annual charges together with estimated DE time and materials charges at the charge rates then in effect at the time work is performed.

2025 Rate Schedule

Labor Rates (Effective January 1, 2025)

Labor Classification	Hourly Rate [1]
Engineering Team	
Senior Principal Engineer	$272
Principal Engineer	$259
Supervising Engineer	$237
Senior Engineer	$217
Associate Engineer II	$207
Associate Engineer I	$196
Staff Engineer II	$183
Staff Engineer I	$170
Assistant Engineer II	$145
Assistant Engineer I	$126
Specialist Team [2]	
Supervising Specialist	$213
Senior Specialist	$195
Associate Specialist II	$186
Associate Specialist I	$176
Staff Specialist II	$165
Staff Specialist I	$153
Assistant Specialist II	$131
Assistant Specialist I	$113

Labor Classification	Hourly Rate [1]
Technical Team	
Supervising Technician	$181
Senior Technician	$166
Associate Technician II	$158
Associate Technician I	$150
Staff Technician II	$140
Staff Technician I	$130
Assistant Technician II	$111
Assistant Technician I	$96
Intern Team	
Intern II	$82
Intern I	$57
Client Intern [3]	$38
Support Team	
Senior Project Manager	$200
Communications Specialist	$175
Senior Project Assistant	$149
Associate Project Assistant	$135
Staff Project Assistant	$117
Other	
Expert Witness	Market Rate [4]
Strategic Advisor	Market Rate [4]

Vehicle, Equipment, and Material Rates (Effective January 1, 2025)

Item		Rate [1]
Current IRS Mileage ($ / mile)		$0.700
Field Vehicle (4 x 4) ($ / mile)		$1.34
Meals ($ / person / day)	Meals charged at actual cost, not to exceed U.S. GSA M&IE Standard Rate Total	$68
Hotel ($ / person / day)	Daily lodging charged at actual cost, not to exceed U.S. Daily Lodging Rate for Sacramento County	$150
Pressure Transducer ($ / month)		$100
Fuji Portaflow Transit Time ($ / day)		$100
Timeseries Data Management ($ / site / month)		$125
SonTek FlowTracker (ADV) ($ / day)		$125
EMLID Real Time Kinematic (RTK) Survey ($ / day)		$250
SonTek RiverSurveyor with RTK GPS ($ / day)		$325
SonTek RiverSurveyor with Remote Control ($ / day)		$550
Motor Boat 18 ft. with jet engine ($ / day)		$600
Monitoring and control equipment and materials ($ / item)		Unit Costs

Notes:

[1] Labor and equipment rates are subject to revision at the beginning of each calendar year.

[2] Specialist Team includes, but is not limited to Data Scientists, Hydrologists/Hydrogeologists, etc.

[3] DE team member working under direct client supervision.

[4] Market rates subject to negotiation.

Appendix A – Supplemental Project Descriptions

Colusa Subbasin Groundwater Sustainability Plan Revisions

Summary

In fall 2023, Davids Engineering, Inc. (DE) was contracted by the Colusa Groundwater Authority (CGA) and the Glenn Groundwater Authority (GGA) to support their revisions to the Colusa Subbasin Groundwater Sustainability Plan (GSP) in response to comments received from the California Department of Water Resources (DWR). In DWR's October 2023 "incomplete" determination for the Colusa Subbasin GSP, DWR identified three deficiencies pertaining to (1) the overdraft estimate and overdraft mitigation strategy for the Colusa Subbasin, (2) the sustainable management criteria (SMC) and mitigation strategy for chronic lowering of groundwater levels, and (3) the SMC, monitoring approach, and mitigation strategy for subsidence.

Over the remainder of the 180-day period from December 2023 to April 2024, DE supported the GSAs in developing and implementing a strategy for the GSP revisions and consulting with DWR staff to discuss and verify that the revisions were on track toward approval. DE led and supported the GSAs in navigating the revisions process through biweekly coordination meetings, monthly Technical Advisory Committee and Board meetings, five formal consultation meetings with DWR, and other touchpoints to work through the many technical and policy decisions involved in the GSP revisions. DE also teamed with West Yost Associates to complete various technical analyses and revisions to the GSP document related to these discussions and decisions.

During the GSP revisions process, DE supported the GSAs in the initial development of a demand management program and domestic well mitigation program to address and mitigate sustainability concerns in the Colusa Subbasin related to overdraft, groundwater level decline, and subsidence. As an

Project(s)

1173.04

Client

Colusa Groundwater Authority and Glenn Groundwater Authority

Funder

Clients

Location

Colusa Subbasin, Colusa and Glenn Counties, CA

Date

2023-2024

Budget

$233,177 *(including ~$97k for West Yost and Associates)*

Contacts

Lisa Hunter, Program Manager
Glenn Groundwater Authority
lhunter@countyofglenn.net
530.934.6540

Carol Thomas-Keefer, Program Manager
Colusa Groundwater Authority
cthomaskeefer@rgs.ca.gov
650.587.7300 x17

outcome of this work, the GSAs have developed and signed an agreement for each program that outlines the terms and approach for implementing the programs over the next several years. DE's efforts also helped to create a clear timeline and strategy for GSP implementation over the next five years to ensure that the GSAs remain on track to reaching sustainability in the Colusa Subbasin.

Tehama County Groundwater Sustainability Plan Implementation

Summary

As a key partner in the Luhdorff and Scalmanini Consulting Engineers (LSCE) team, Davids Engineering, Inc. (DE) is currently supporting the Tehama County Flood Control and Water Conservation District (TCFCWCD) and the Corning Subbasin Groundwater Sustainability Agency (CSGSA) in their Groundwater Sustainability Plan (GSP) implementation efforts. GSP implementation efforts are supported under Sustainable Groundwater Management Act (SGMA) Implementation Round 2 grants awarded for the Red Bluff, Los Molinos, Antelope and Corning Subbasins.

As part of these efforts from 2023-2026, DE is supporting:

- **Developing and implementing a policy framework** for demand management, and/or water and land use restrictions, and/or well permitting in the Corning Subbasin.
- **Planning and implementing a synoptic stream gage study** to evaluate interconnected surface water, including work plan development, data collection and field work, as well as data analysis, evaluation, and reporting.
- **Planning and implementing various multi-benefit, direct, and in-lieu recharge projects** across the Red Bluff and Corning Subbasins, including:
    - Planning, design, and documentation related to feasibility studies and evaluations.
    - Identifying potential recharge sites, in coordination with growers, landowners, and agencies.
    - Identifying potential water supplies, recharge techniques, and recharge infrastructure, as appropriate.

Project(s)

1139.14

Client

Luhdorff and Scalmanini Consulting Engineers (LSCE) – TCFCWCD is LSCE's client

Funder

DWR (SGMA Round 2 Prop 68Grant)

Location

Corning, Red Bluff, Antelope, and Los Molinos Subbasins (Glenn and Tehama Counties, CA)

Date

2023-2026

Budget

$2,235,700

Contact

Lisa Hunter, Water Resources Coordinator
Glenn Groundwater Authority
lhunter@countyofglenn.net
530.934.6540

    - Creating design materials and documents for recharge infrastructure and site preparation.
    - Supporting project permitting efforts and CEQA documentation, as appropriate.
    - Developing implementation plans, monitoring and efficiency evaluation strategies, and related documentation.
- **Creating and implementing a planning, design, and implementation study** to facilitate regional water transfers to support enhanced use of available surface water for in-lieu recharge in the Corning Subbasin.
- **Supporting SGMA reporting efforts**, including GSP periodic evaluations and annual reports for the Red Bluff, Los Molinos, Antelope, Corning, and Bowman Subbasins (as applicable).
- **Developing and updating a regional integrated surface water-groundwater model**.
- **Revising GSPs for the Red Bluff, Los Molinos, Antelope, and Corning Subbasins** in response to the incomplete determinations by DWR.

Through these many efforts, DE is supporting the TCFCWCD and CSGSA in their endeavor to achieve and maintain sustainable groundwater conditions in the Red Bluff, Los Molinos, Antelope and Corning Subbasins by 2042.

Chowchilla Subbasin Groundwater Sustainability Plan Revisions

Summary

In winter 2021/2022, Davids Engineering, Inc. (DE) was contracted by Chowchilla Water District on behalf of the four Groundwater Sustainability Agencies (GSAs) with the Chowchilla Subbasin to support their revisions to the Chowchilla Subbasin Groundwater Sustainability Plan (GSP) in response to comments received from the California Department of Water Resources (DWR). The Chowchilla Subbasin GSP was developed jointly by four GSAs that cover the entirety of the Chowchilla Subbasin (Subbasin): the Chowchilla Water District (CWD) GSA, the County of Madera GSA – Chowchilla Subbasin, the Triangle T Water District (TTWD) GSA, and the Merced County GSA – Chowchilla Subbasin. In DWR's January 2022 "incomplete" determination for the Subbasin GSP, DWR identified three deficiencies pertaining to (1) insufficient information to support the selection of chronic lowering of groundwater levels sustainable management criteria, (2) insufficient information to support the selection of land subsidence sustainable management criteria, and (3) insufficient information to support the determination that interconnected surface water or undesirable results related to depletions of interconnected surface water are not present and are not likely to occur in the Subbasin.

Over the 180-day period from January 2022 to July 2022, DE supported the Joint GSP GSAs in developing and implementing a strategy for the GSP revisions and consulting with DWR staff to discuss and verify that the revisions were on track toward approval. DE led and supported technical revisions to the GSP through weekly and biweekly technical coordination meetings, several formal consultation meetings with DWR, and other touchpoints to work through the many technical and policy decisions involved in the GSP revisions. DE also teamed with Luhdorff & Scalmanini Consulting Engineers (LSCE) to complete various hydrogeologic technical analyses and revisions to the GSP document related to these discussions and decisions.

Project(s)

1183.04

Client

Chowchilla Water District

Funder

DWR SGMA Grant

Location

Chowchilla Subbasin, Madera County, CA

Date

2021 - ongoing

Budget

$336,306 (in partnership with LSCE)

Contact

Doug Welch, Water Resources Manager
Chowchilla Water District
dwelch@cwd.com
559.479.6050

Chowchilla Subbasin Groundwater Sustainability Plan Revisions

During the GSP revisions process, DE supported the GSAs in the initial development of a domestic well mitigation program Memorandum of Understanding (MOU) to address and mitigate domestic well impact concerns in the Subbasin related to groundwater level decline. As of summer 2023, the Domestic Well Mitigation Program in the Chowchilla Subbasin is funded and up and running in the Chowchilla Subbasin. To the best of DE's knowledge this is the only fully developed, GSA led, and up and running domestic well mitigation program in the San Joaquin Valley.

In March 2023, DWR determined that the Revised GSP for the Subbasin was inadequate. Once DWR determines that a GSP is inadequate, primary jurisdiction shifts from DWR to the State Water Resources Control Board (SWRCB). Immediately after DWR's inadequate determination, DE and the GSAs began formal consultations with the SWRCB. Those discussions concluded in the submission of a draft set of GSP revisions on May 5, 2023. Since submission of the draft revised GSP, DE as the technical lead has worked extensively with the SWRCB on next steps. To date, the Subbasin is at the bottom of the SWRCB's priority list for the six subbasins that have been sent to DWR and DE is optimistic that the Subbasin won't have to proceed with a Probationary Hearing.

Appendix B – Key Staff Resumes

Jeffrey C. Davids, Ph.D., P.E.

Vice President, Chief Technology Officer

DAVIDS ENGINEERING, INC

EDUCATION

Ph.D., Civil Engineering, Water Management, Delft University of Technology, Delft, Netherlands

M.S., Hydrology and Hydrogeology, Graduation with Distinction, California State University, Chico, CA

B.Sc., General Engineering, California Polytechnic State University,
San Luis Obispo, CA

REGISTRATION

Civil Engineer
No. C75656

YEARS OF EXPERIENCE

20+ Years

DISTINGUISHING QUALIFICATIONS

- Innovative methods for measurement and data management of hydrologic fluxes (*e.g.*, remote sensing and citizen science)
- Stakeholder capacity building and communication of complex materials to diverse audiences
- Spatial hydrology, data science, database development, quality control, data visualization, and data communication

SUMMARY

Dr. Davids's keenness for water resources and food production blossomed amongst the vast agricultural lands of California's Great Central Valley and pristine streams of the Sierra Nevada Mountains. His educational background, broad consulting experience, and dedication to the development of human resources from diverse backgrounds demonstrate his commitment to improved and sustainable management of the Earth's limited natural resources through appropriate applications of engineering and technology, education, and research. Dr. Davids is a licensed Professional Engineer (PE) in the State of California and has a Ph.D. in Civil Engineering (Water Management) from Delft University of Technology, an M.Sc. from California State University Chico in Geosciences and Hydrogeology, and a B.Sc. in General Engineering from California State University San Luis Obispo.

Jeff's interest and experience focus on how sustainable management of water, energy, and food are supported by innovative sources of data (e.g., low-cost sensors, remote sensing, citizen science), education, integrated systems thinking, modeling tools, social engagement, storytelling, and outreach. Jeff has consulted for a variety of water managers and suppliers (local, state, and federal) in all the major irrigated regions of California, including the Imperial, San Joaquin, Sacramento, and Shasta Valleys. Dr. Davids also consults for the UN Food and Agriculture Organization (FAO) in Afghanistan, Myanmar, and China, along with various clients in Nepal, Ghana, Thailand, and the Netherlands. Jeff has managed diverse international teams and large projects, including the design, installation, calibration, and maintenance of several large flow measurement and data acquisition networks in the US and abroad.

RELEVANT EXPERIENCE

Madera County Groundwater Sustainability Agency Groundwater Allocation Program Implementation Support. Madera County GSA, Madera County, CA.
Dr. Davids developed accounting methodology, implementation logic, and data collection and management protocols and procedures in coordination with County staff to administer Madera County's groundwater allocation resolutions. This work included the conceptual development and Python coding for monthly groundwater allocation reports including tabular summaries, mapping, and data visualizations (e.g., histograms). Dr. Davids worked with a team of remote sensing experts (IrriWatch) to develop an online platform for growers to view and interact with crop evapotranspiration data and groundwater allocations. Dr. Davids supervised the creation of a Django PostGIS web-based database allowing the Madera GSAs real-time concurrent access to a central repository of data about their growers, parcels, fields, crops, wells, etc. Dr. Davids also led the development of a mobile data collection platform that enables growers to submit flowmeter readings from their smartphones, including GPS coordinates, text and numerical entries, and photographs. The data collection platform also

facilitates concurrent review from County staff of the submitted flowmeter readings and keeps an auditable record of all corrections made to the grower-supplied data. The data collection platform also includes a map-based interface for viewing single grower submissions, or an aggregation of submissions over time from a single site. Finally, data can be exported from the platform to Excel. In addition to grower-supplied flowmeter readings, the Madera County GSAs use the data collection platform to collect, view, and store other field data including inspections of fallowed fields and on-site evaluations of flowmeters.

Colusa Subbasin Groundwater Sustainability Plan Revisions. Colusa Groundwater Authority and Glenn Groundwater Authority, Colusa and Glenn Counties, CA.

Together with his colleague Dr. Klug, Dr. Davids co-led the Groundwater Sustainability Plan (GSP) revisions for the Colusa Subbasin. On October 26, 2023, DWR completed its evaluation of the Initial GSP and transmitted a letter to the Colusa Groundwater and Authority and Glenn Groundwater Authority (GSAs) communicating its determination that the Initial GSP was "incomplete." As noted in DWR's October 26, 2023 letter, the GSAs had 180 days, the maximum allowed by GSP Regulations, to address three identified deficiencies and submit the Revised GSP to DWR by April 23, 2024. A summary of the three deficiencies identified in DWR's letter is as follows: (1) DWR found that the Initial GSP did not include a reasonable assessment of overdraft conditions and a reasonable means to mitigate overdraft, (2) DWR found that the sustainable management criteria (SMC) for chronic lowering of groundwater levels were not substantially compliant with the GSP regulations, and (3) DWR found that the SMC for subsidence were not substantially compliant with the GSP regulations. Dr. Davids worked closely with the GSAs, West Yost and Associates, other DE team members to develop a Revised GSP, and met with DWR five (5) times from December 2023 through March 2024 to ensure the revisions were on track. The revised GSP included the following elements: Memorandums of Understanding (MOUs) for domestic well mitigation and demand management, revisions to sustainable management criteria (SMCs) associated with groundwater levels and subsidence, analysis of critical infrastructure, quantitative reassessment of overdraft conditions in the Colusa Subbasin, and development of a five-year workplan for implementation of the Revised GSP.

Corning, Red Bluff, Antelope, and Los Molinos Subbasins Groundwater Sustainability Plan Implementation Support. Tehama County Flood Control and Water Conservation District and Corning Subbasing Groundwater Sustainability Agency, Tehama and Glenn Counties, CA.

As a key partner in the Luhdorff and Scalmanini Consulting Engineers (LSCE) team, Dr. Davids is leading GSP implementation efforts in the Corning subbasin related to maximizing use of existing surface water supplies in support of sustainable groundwater management. This involves quantification of available surface water supplies, and identification, evaluation, selection, design, and implementation of projects that increase surface water applications for irrigation within the Subbasin. Additionally, Dr. Davids supports identification of project concepts and piloting designs for a number of direct recharge efforts in the Corning, Red Bluff, Antelope, and Los Molinos Subbasins. Direct recharge projects include: (1) multi-benefit recharge projects, (2) Thomes Creek recharge projects, (3) stormwater recharge projects, (4) recharge through unlined canals, (5) recharge through dedicated basins, (6) recharge on the California Olive Ranch, and (7) Stony Creek recharge projects.

North and South Yuba Subbasins Groundwater Sustainability Plan Implementation Support. Yuba Water Agency, Yuba County, CA. Davids Engineering is supporting the Yuba Water Agency (YWA) with GSP implementation related to: (1) the characterization of interconnected surface waters, (2) implementation of improved subbasin surface water boundary flow monitoring, and (3) ongoing development, calibration, and application of the Yuba Groundwater Model (YGM; in a supporting role to Woodard & Curran) in support of sustainable groundwater management in the North and South Yuba Subbasins. Dr. Davids is leading ongoing synoptic streamflow measurements on the Feather River, Yuba River, Bear River, and Honcut Creek in efforts to improve characterization of stream-aquifer interactions and numerical modeling of these processes. Dr. Davids is also supporting improvements to a number of subbasin surface water boundary flow monitoring sites that will be used to improve confidence in the partitioning of unused applied water between deep percolation and

surface water outflow. Together with Dr. Klug on the DE team, Dr. Davids is supporting various refinements to the YGM, including moving from a monthly to daily timestep. Dr. Davids has also led the development of various processes to integrate spatially explicit evapotranspiration (ET), precipitation, and land use land cover (LULC) datasets into the monthly and daily YGMs.

Teaching Spatial Hydrology, Irrigation, GIS and Remote Sensing, and Water Resources Engineering. California State University, Chico, Butte County, CA.
Dr. Davids served as an assistant professor for three years, and is currently an adjunct professor, with the California State University, Chico. During his time at Chico State, Dr. Davids developed new curriculum and taught courses on Spatial Hydrology (CIVL 564), Water Resources Engineering (CIVL 461), GPS and GIS in Agriculture and Natural Resource Management (AGET 340), and Irrigation (AGET 360). During this time, he also continued research on the applications of citizen science in water resources management and agriculture. Dr. Davids secured $1 million in funding from the U.S. Bureau of Reclamation (USBR) as the Principal Investigator for the Irrigation Training Facility at the California State University, Chico Farm, and two grants from the California Agricultural Research Initiative (ARI) related to monitoring of the soil-plant-water-atmosphere continuum and using videos to measure surface flows in stream and canals.

Idled Rice Habitat Evapotranspiration (ET) Study. The Nature Conservancy, Yolo and Colusa Counties, CA.
Dr. Davids led the implementation of eddy covariance (EC) and remote sensing methods for quantifying incremental evapotranspiration from brief shallow flooding of fallowed rice fields. This included the comparison of evapotranspiration results from eddy covariance measurements, simplified surface renewal, and remote sensing to determine strengths and weaknesses of each approach. Dr. Davids developed recommendations to the California Department of Water Resources (DWR) and the United States Bureau of Reclamation (USBR) for methods to estimated incremental evapotranspiration of applied water (ETAW) and resulting adjustments to land-idling transferable water due to shallow flood events on fallowed rice fields.

Water Accounting Training and Implementation. Food and Agriculture Organization of the United Nations (UN-FAO). Afghanistan and Myanmar.
Dr. Davids served as the development team member for open-source pixel-based water balance software called Scalable Water balances from Earth Observations (SWEO). Additionally, Dr. Davids was the lead author for the development of comprehensive curricula for water accounting training including packages on: the water cycle; water balances; agricultural water use; environmental data acquisition; spatial and temporal domains; fluxes and changes in storage; geographical information systems (GIS); remote sensing (RS); hydrological modeling; green, blue, and grey water; crop physiology and transpiration processes; crop yields; consumptive vs. non-consumptive water uses; water productivity; climate change; Water Accounting Plus (WA+); interpretation of WA+ fact sheets; UN sustainable development goals; and development of appropriate water sector intervention packages. This included leading a diverse teaching team of international specialists from the Netherlands, Nepal, Thailand, UK, Afghanistan, the US, and the UAE. Water accounting training packages were implemented via an eight series training for 3o water resources specialists from three different Afghan water related ministries spread out over two years and a three series training for 25 water managers and researchers in Myanmar over the course of 6 months.

Citizen Science Based Hydrological Monitoring. SmartPhones4Water (S4W). Nepal, Vietnam, Ghana, Israel, Palestine, Afghanistan, and Myanmar.
Dr. Davids is the founder and president of SmartPhones4Water (S4W), a California-based 501(c)(3) non-profit organization focused on mobilizing young researchers and citizen scientists to quantitatively tell their water stories. These stories generally include versions of the three toos of water management: too little, too much, or too dirty. For three years, Dr. Davids lived and worked in Nepal to help launch a sister non-profit organization in Nepal (S4W-Nepal). S4W sees water data gaps as educational opportunities. S4W uses smartphones to collect data about water with citizen scientists led by young researchers. Over the last decade, S4W has successfully complete projects in Nepal, The Netherlands, Vietnam, Ghana, Israel, Palestine, Afghanistan, and Myanmar.

Flow Measurement Improvement Project. Reclamation District No. 108, Colusa County, CA.
Since 2008, Dr. Davids has worked with Reclamation District No. 108 to improve their flow measurement, data management, and decision support systems. This work has included drain pump calibrations, testing of alternative turnout flow measurement options, training of water system operators, database development, and development of a wireless acoustic doppler flow measurement device. Dr. Davids led the pilot testing of alternative measurement methods that were potentially capable of achieving heightening regulatory standards, including: existing orifice gates, weirs set in precast boxes, and a recently introduced portable acoustic Doppler flow measurement device. The pilot program included (1) customization of the portable measurement device for District needs, (2) selection and inventory of a test reach, (3) calibration of upstream and downstream measurement devices, (4) development of an automated data transfer process and (5) development of a Water Information System for water accounting and billing.

Flow Measurement Plan Development and Implementation., South San Joaquin Irrigation District, San Joaquin County, CA.
Dr. Davids supported the development and implementation of a Flow Measurement Plan (Plan) for the South San Joaquin Irrigation District (SSJID). The goals of the Plan are (1) to provide cost-effective service to customers; (2) generate improved operational records for planning and analysis, and; (3) comply with recently passed California legislation (SBx7-7). As part of this effort, Dr. Davids has designed a range of flow measurement methodologies and site improvements for SSJID involving standard critical depth structures (e.g. flumes and weirs) and acoustic Doppler flow measurement devices. Dr. Davids also participated in the field testing of acoustic Doppler devices.

Turnout Flow Measurement Program Piloting and Implementation. Glenn-Colusa Irrigation District, Princeton-Codora-Glenn Irrigation District, Provident Irrigation District, Sutter Mutual Water Company, South Sutter Water District, Reclamation District 1004, Richvale Irrigation District, Biggs-West Gridley Water District, and Western Canal Water District, Reclamation District No. 108, Glenn, Yolo, Colusa, Butte, and Sacramento Counties, CA.
Dr. Davids led the development, piloting, implementation of an innovative turnout flow measurement solution for the irrigation which is now in use on over 600,000 acres. Dr. Davids has conducted various training sessions with district operators in the basics of open channel flow measurement, critical flow devices, and hydroacoustics. For each district, Dr. Davids has inventoried district distribution systems, established standardized naming conventions, pilot tested alternative measurement devices, selected preferred measurement alternatives, and developed custom database applications for quality controlling and managing turnout flow data.

Stream and Canal Flow Measurement Improvements and Environmental Data Acquisition. Shasta County, CA.
Over the last 20 years, Dr. Davids has designed, installed, commissioned, and maintained dozens of flow monitoring stations in natural and man-made channels in the Shasta Valley. The flow monitoring stations have employed a range of technologies from low-cost solutions like using temperature to monitor the operation of wells, to higher cost hydroacoustic technologies for measuring water velocities directly. Dr. Davids has also employed a variety of techniques to characterize stream-aquifer interactions. Dr. Davids has been involved in hydrogeologic quality investigations looking at stable isotopes and bulk chemical constituents. Stable isotopes of oxygen were used to delineate apparent recharge elevations. Samples were also plotted on the meteoric water line to determine water rock interactions and degree of re-evaporation.

Measurement Improvement Plan Development and Implementation. Yuba Water Agency, Yuba County, CA.
In 2013, The Yuba Water Agency (YWA) developed an agricultural water management plan (AWMP) in 2012 as required by the Water Conservation Act of 2009. As part of the larger AWMP effort, Dr. Davids led the development of a Measurement Improvement Plan to improve customer delivery measurement and quantification of key boundary inflows and outflows. Development of the Measurement Improvement Plan included an inventory and inspection of existing open channel and pipe flow measurement sites, in-situ verification measurements to assess existing measurement site accuracy, in addition to development of designs and cost estimates for improvements required to ensure that YCWA is

compliant with the Agricultural Water Measurement Regulation (CCR §597). Part of the implementation included the construction of two concrete lined sections. Dr. Davids led the design, bidding, and construction management process.

Orifice Gate Coefficient Analysis. Imperial Irrigation District, Imperial County, CA.
Colorado River water has transformed the Imperial Valley landscape from a barren desert to one of the most agriculturally productive regions in the country. Dr. Davids developed the flow verification methodology for a study aimed at aiding in the verification of historical water use records. Dr. Davids provided training and oversight for field personnel tasked with the collection of verification flow measurement data. The effort was part of a larger project involving the 2003 Quantification Settlement Agreement.

Customer Delivery Measurement Plan. Turlock Irrigation District, Stanislaus County, CA.
Dr. Davids developed and implemented Customer Delivery Measurement Plan (Plan) to ensure compliance with the Agricultural Water Measurement Regulation (CCR §597). Dr. Davids reviewed and refined spot flow measurement protocols for performing current metering measurements of farm-gate flows. Led the development of customized procedures for gate/parcel specific ratings, in addition to the field testing of acoustic Doppler velocimeters.

Montague Weir Flow Measurement and Fish Passage Alternatives. AquaTerra Consulting, Siskiyou County, CA.
Dr. Davids assessed existing weir structure from fish passage and measurement perspectives. Developed alternatives for modification of the weir to satisfy the identified co-equal fish passage and flow measurement goals. Presented results to US Geological Survey, US Fish and Wildlife, Shasta Valley Resource Conservation District and others and worked with stakeholders to identify a preferred alternative.

SELECTED PUBLICATIONS

Metzger, S., Burba, G.G., Davids, J.C., Desai, A.R., Durden, D., Jones, P., Paleri, S., and Papale, D., 2025. Footprint Meets Energy Balance: Real-World Continuity with 4D Virtual Control Volume Flux Mapping, Chapman Conference on the Energy Balance Closure Problem, Boulder, CO, USA.

Hessels, T., Davids, J.C., Bastiaanssen, W., 2021. Scalable Water balances from Earth Observations (SWEO): results from 50 years of remote sensing in hydrology, Water - Special Issue in memoriam of Tony Allan, Water International, 47(6), 866-886.

Prajapati, R., Talchabhadel, R., Thapa, B.R., Upadhyay, S., Thapa, A.B., Ertis, B., and Davids, J.C., 2021. Measuring the unseen: mobilizing citizen scientists to monitor groundwater in Nepal. Environmental Monitoring and Assessment, 193(9), pp.1-21.

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Davids, J.C., Rutten, M.M., Pandey, A., Devkota, N., Oyen, W.D.V., Prajapati, R. and van de Giesen, N., 2019. Citizen science flow–an assessment of simple streamflow measurement methods. Hydrology and Earth System Sciences, 23(2), pp.1045-1065.

Davids, J.C., 2019. Mobilizing Young Researchers, Citizen Scientists, and Mobile Technology to Close Water Data Gaps - Methods Development and Initial Results in the Kathmandu Valley, Nepal, Delft University of Technology, Netherlands, PhD Dissertation.

Davids, J.C., Rutten, M.M., Shah, R.D.T., Shah, D.N., Devkota, N., Izeboud, P., Pandey, A. and van de Giesen, N., 2018. Quantifying the connections—linkages between land-use and water in the Kathmandu Valley, Nepal. Environmental monitoring and assessment, 190, pp.1-17.

Davids, J.C. and Mehl, S.W., 2015. Sustainable capture: Concepts for managing stream-aquifer systems. Groundwater, 53(6), pp.851-858.

John B. Davids, P.E.

President, Principal Engineer

EDUCATION

B.S., BioResource and Agricultural Engineering
California Polytechnic University, San Luis Obipso

REGISTRATION

Civil Engineer, CA
No. C73036

YEARS OF EXPERIENCE

23 Years

DISTINGUISHING QUALIFICATIONS

- Building and fostering relationships with stakeholders, outside agencies, and representatives to deliver best possible professional solutions.
- Proficient at coordinating multi-disciplinary projects, communicating changes and progress, and completing projects on time and within budget.
- Aptitude to navigate dynamic regulatory and legislative climate.

SUMMARY

Mr. Davids joined Davids Engineering (DE) in June of 2021 and currently serves as a Principal Engineer, working across all three of DE's solutions – Water, Infrastructure, and Technology. Mr. Davids has 20 years of progressive experience in public policy, FERC relicensing, water resources master planning, irrigation system modernization, permitting, design, construction, and groundwater management. Mr. Davids is an active member of the United States Committee on Irrigation and Drainage, past member of the Association of California Water Agencies Groundwater Committee and Agriculture Committee, past Chair of the Stanislaus and Tuolumne Rivers Groundwater Basin Association Groundwater Sustainability Agency, and past member of the Oakdale Rotary Club where he served as the Sergeant at Arms.
Prior to joining DE, Mr. Davids worked for Modesto Irrigation District (MID) as one of their Assistant General Managers overseeing MID's Water Operations (ag water and domestic water), Federal Energy Regulatory Commission (FERC) relicensing of Don Pedro Reservoir, Voluntary Agreement negotiations with the State of California related to Phase I of the Bay-Delta Water Quality Control Plan and Chair of the Stanislaus and Tuolumne Rivers Groundwater Basin Association Groundwater Sustainability Agency. From 2004 to 2013, Mr. Davids managed Oakdale Irrigation District's (OID) Engineering Department coordinating all department functions including, subdivision/parcel map review, California Environmental Quality Act (CEQA) compliance, master planning and capital project design. Prior to OID, from 2002 to 2004, Mr. Davids worked for a large international consulting firm, working on a wide variety of water resources projects in the Western United States including projects for irrigation districts, various municipalities and the Los Angeles Department of Water and Power.

RELEVANT EXPERIENCE

Madera Subbasin Groundwater Sustainability Plan Revisions. County of Madera, Madera, CA.

The Madera Subbasin Joint Groundwater Sustainability Plan (GSP) was developed jointly by four GSAs that represent approximately 94% of the Subbasin area: the City of Madera GSA, the County of Madera GSA – Madera Subbasin, the Madera Irrigation District (MID) GSA, and the Madera Water District (MWD) GSA. In September 2022, the Department of Water Resources (DWR) issued an "incomplete" determination for the Joint GSP and the other three GSPs in the Madera Subbasin. Over the 180-day period from September 2022 to March 2023, Mr. Davids led a multi-disciplinary team that supported the Joint GSP GSAs in developing and implementing a strategy for the GSP revisions and consulting with DWR staff to discuss and verify that the revisions were on track toward approval. Serving on behalf of and at the direction of the Joint GSP GSAs. Further, Mr. Davids facilitated coordination across all technical

consultants supporting technical revisions across all GSPs (Joint GSP and the other three GSPs) through weekly and biweekly technical coordination meetings, several formal consultation meetings with DWR, and other touchpoints to work through the many technical and policy decisions involved in the GSP revisions. During the GSP revisions process, Mr. Davids advised and guided the GSAs in the initial development of a domestic well mitigation program Memorandum of Understanding (MOU) to address and mitigate domestic well impact concerns in the Subbasin related to groundwater level decline. In December 2023, DWR formally approved the revised GSPs for the Madera Subbasin.

Chowchilla Subbasin Groundwater Sustainability Plan Revisions. Chowchilla Water District, Chowchilla, CA.

The Chowchilla Subbasin GSP was developed jointly by four GSAs that cover the entirety of the Chowchilla Subbasin (Subbasin): the Chowchilla Water District (CWD) GSA, the County of Madera GSA – Chowchilla Subbasin, the Triangle T Water District (TTWD) GSA, and the Merced County GSA – Chowchilla Subbasin. In January 2022, the DWR issued an "incomplete" determination for the Chowchilla GSP. Over the 180-day period from January 2022 to July 2022, Mr. Davids led a multi-disciplinary team that supported the Chowchilla GSAs in developing and implementing a strategy for the GSP revisions and consulting with DWR staff to discuss and verify that the revisions were on track toward approval. In March 2023, DWR determined that the Revised GSP for the Subbasin was inadequate. Immediately after DWR's inadequate determination, DE and the GSAs began formal consultations with the SWRCB. Those discussions concluded in the submission of a draft set of GSP revisions on May 5, 2023. Since submission of the draft revised GSP, Mr. Davids as Project Manager has worked extensively with the SWRCB on next steps. To date, the Subbasin is at the bottom of the SWRCB's priority list for the six subbasins that have been sent to DWR and DE is optimistic that the Subbasin won't have to proceed with a Probationary Hearing.

Madera County Recharge Study. County of Madera, Madera, CA.

Mr. Davids is serving as Team Leader of a multi-firm and multi-disciplinary team of professional and has successfully expedited the preliminary development of 10 recharge projects – 5 in the Chowchilla Subbasin and 5 in the Madera Subbasin. In general, the projects include a mix of dedicated recharge basins and Flood-MAR and range in total recharge capacity at full build-out from 8,000 acre-feet (AF)/year to nearly 30,000 AF/year. Collectively, the total recharge potential in wet years is approximately 80,000 AF in the Chowchilla Subbasin and nearly 116,000 AF in the Madera Subbasin. Stemming from this planning work, Madera County has been successful at receiving 4 grants for early implementation of recharge projects, totaling more than $12 million dollars.

Madera/Chowchilla Recharge Projects, County of Madera, Madera, CA.

Mr. Davids is serving as Team Leader of a multi-firm and multi-disciplinary team of professionals designing, permitting, and constructing recharge projects in both the Madera and Chowchilla Subbasin. To date, both projects are approaching 60% design and construction is expected to commence on at least one of the projects during the summer of 2024. Collectively, the projects will be designed to have a recharge capacity of approximately 15,000 AF per year when flood flows are available. Completion of the projects is being funded by a grant from the Department of Water Resources (DWR) and a local cost share. DE prepared the successful grant applications for these two projects.

Non-District East Groundwater Recharge Project Development and Ranking, L.F. Brichetto, Oakdale, CA.

In an effort to prepare for upcoming grant funding opportunities and on behalf of approximately 15,000 acres of privately developed agricultural in the white area of the Modesto Subbasin, Mr. Davids led the DE Team tasked with completing a Groundwater Recharge Project Development and Ranking Project. Tasks for this project included acquisition of GIS data, completion and distribution of a recharge survey interest form, completion of GIS base mapping, completion of a recharge suitability analysis, water supply negotiations, and conceptual project development and ranking. A ranking of the projects developed has served as a "menu" of recharge options as funding becomes available. It is contemplated that further design, environmental permitting, construction management, and monitoring and assessment will be performed as part of subsequent work activities following successful grant award.

Executive Director of Water Resources, Modesto Irrigation District, Modesto, CA.
In a contract capacity, Mr. Davids currently serves as the Executive Director of Water Resources for Modesto Irrigation District (MID). In Mr. Davids' capacity as the Executive Director of Water Resources, Mr. Davids' oversees and manages a multi-disciplinary team (engineers, scientists, and attorneys) focused on MID's relicensing of Don Pedro Reservoir and Voluntary Agreement development, negotiations, and early implementation of the Tuolumne River Voluntary Agreement. This includes oversight and co-management of more than $80 million in proposed habitat restoration on the lower Tuolumne River. Mr. Davids' reports directly to and serves at the pleasure of the MID Board of Directors.

Assistant General Manager, Water Operations, Modesto Irrigation District, Modesto, CA.
As Assistant General Manager, it was Mr. Davids' responsibility to plan, organize, direct and review the activities and operations of the Water Operations Division including civil engineering, water use, planning and conservation, irrigation services, construction management, domestic water operations, and to coordinate assigned activities with other divisions and outside agencies and provide highly responsible and complex administration support to the General Manager and the Board of Directors. Mr Davids was responsible for transparent development and implementation of the Water Operations Division annual budget – approximately $40M (2020).

District Engineer, Oakdale Irrigation District, Oakdale, CA. As District Engineer, it was Mr. Davids' responsibility to manage and direct all Engineering Department activities. During Mr. Davids decade at Oakdale Irrigation District, Mr. Davids lead the implementation of the Comprehensive Water Resources Plan and the subsequent design and construction of over $50M in capital improvements.

REPRESENTATIVE PROJECTS

- Don Pedro and La Grange Federal Energy Regulatory Commission Relicensing and Licensing, Modesto Irrigation District
- Main Canal Regulating Reservoir, Modesto Irrigation District
- Water Operations Cost of Service Model, Modesto Irrigation District
- Development and implementation of volumetric billing, Modesto Irrigation District
- Development and implementation of special drought programs and drought surcharge, Modesto Irrigation District
- Creation, development and implementation of Water Resources Planning Department, Modesto Irrigation District
- Annual revisions to Rules and Regulations Governing the Distribution of Irrigation Water with the Modesto Irrigation District, Modesto Irrigation District
- 2015/2020 Agricultural Water Management Plans, Modesto Irrigation District
- Successful introduction and use of new aquatic herbicides in irrigation conveyance infrastructure, Modesto Irrigation District
- Modesto Regional Water Treatment Plant Phase II construction activities, contract closeout and commissioning, Modesto Irrigation District
- Oral testimony to State Water Resources Control Board at December 20, 2016 public hearing regarding revisions to the Water Quality Control for the Bay-Delta, Modesto Irrigation District
- Successful coordination and operation of 2017 flood management operations, Modesto Irrigation District
- Development and implementation of 2017, 2018 and 2019 Groundwater Replenishment Plan, Modesto Irrigation District (1st place award in the 2020 CMUA Resource Efficiency & Community Service Awards)
- Creation of Stanislaus and Tuolumne Rivers Groundwater Basin Association Groundwater Sustainability Agency, Modesto Irrigation District
- Successful good faith negotiation of Tuolumne River Voluntary Agreement, Modesto Irrigation District
- Settlement Agreement with the U.S. Bureau of Land Management regarding Don Pedro Relicensing, Modesto Irrigation District

- Revised 10(j) conditions with U.S. Fish and Wildlife Service regarding Don Pedro Relicensing, Modesto Irrigation District
- Memorandum of Understanding with U.S. Fish and Wildlife Service regarding early implementation of habitat improvement projects on the Lower Tuolumne River, Modesto Irrigation District
- Water Resources Plan, Oakdale Irrigation District
- North Side Regulating Reservoir, Oakdale Irrigation District (2009 ASCE Project of Merit)
- Honolulu Bar Habitat Restoration Project on the Stanislaus River, Oakdale Irrigation District
- Cashman Dam Rehabilitation Project, Oakdale Irrigation District
- Little Johns Creek Diversion, Oakdale Irrigation District
- Fairbanks Crossing at South San Joaquin Irrigation District, Oakdale Irrigation District
- 2012 Standard Details, Oakdale Irrigation District
- System-wide GIS Mapping, Oakdale Irrigation District
- Numerous automation projects, Oakdale Irrigation District
- Numerous flow measurement projects, Oakdale Irrigation District
- Numerous pipeline replacement projects, Oakdale Irrigation District
- Numerous canal rehabilitation projects, Oakdale Irrigation District
- Total Channel Control Pilot Program, Oakdale Irrigation District
- 2012 Agricultural Water Management Plan (SBx7-7 Measurement and Volumetric Billing Sections), Oakdale Irrigation District
- Glenn Colusa, Canal Enlargement Study, CH2MHill (now Jacobs)
- Orland Unit, Modernization Analysis, CH2MHill (now Jacobs)
- L.A. Department of Water and Power, Owens Lake Mitigation Project, CH2MHill (now Jacobs)

Saujan Maka, M.Eng.

Lead Developer

SUMMARY

Saujan Maka has completed a bachelors in Computer Engineering from Institute of Engineering (IOE), one of the best engineering colleges of Nepal and is currently pursuing a masters in Computer Engineering from Nepal College of Information Technology located in Nepal. Saujan possesses a good foundation of knowledge in software development but does not limit himself to it. Saujan is actively involved in researching new technologies and trends in the fields. By staying updated, Saujan continuously expands his knowledge beyond his formal education. Saujan applies his research to solve real world problems through innovative software development. His approaches combine theoretical knowledge with experience skills.

Saujan has gained valuable experience by working in Rooster Logic Pvt. Ltd. as a Data Analyst and web developer in Nepal. Saujan also worked as a remote developer at Whitehat Engineering (US based IT Company), where Saujan held the position of Lead Developer. In this role, Saujan was responsible for managing projects and guiding a team of developers. Working remotely required him to be highly organized and self-disciplined. His time at Whitehat significantly improved his professionalism and communication skills. Leading a distributed team helped him understand how to collaborate effectively across different time zones and cultures. This experience has made him a more confident and capable leader in the field of software development.
These opportunities have helped him build strong technical and professional skills. After years of dedicated work, Saujan is now working full time with the H2oTech, LLC development team.

RELEVANT EXPERIENCE

H2oTech FLOW Web Application

Saujan is currently working full-time at H2oTech, LLC as a Lead Developer. In this role, Saujan leads a team of developers and oversees the entire software development process. Saujan is primarily focused on developing the FLOW Web Application, an innovative application designed to support sustainable water measurement and accounting in the Western US and beyond. The FLOW App helps monitor water usage, track water quality, and provide valuable insights for conservation efforts to support sustainable water measurement and accounting in the Western US and beyond. By leveraging modern technologies and efficient coding practices, Saujan ensures that the app is reliable, user-friendly, and scalable. His responsibilities include designing the system architecture, writing clean and maintainable code, and guiding junior developers. Saujan also collaborates closely with environmental experts to make sure the app addresses real-world water management challenges.

EDUCATION

M.Eng., Computer Engineering, Nepal College of Information Technology (NCIT), Kathmandu, Nepal
Bachelors, Computer Engineering, Institute of Engineering of Tribhuvan Engineering, Kathmandu, Nepal

REGISTRATION

Computer Engineer
No. 16314

YEARS OF EXPERIENCE

10 Years

DISTINGUISHING QUALIFICATIONS

- Strong leadership, project management, and collaboration skills essential for leading an interdisciplinary development team
- proven track record of building and managing complex systems through hands-on experience in software development, data analysis, and web technologies
- Actively researches emerging technologies and applies that knowledge to develop real-world software solutions, blending academic theory with practical implementation

Through his work at H2oTech, LLC, Saujan aims to contribute to the long-term sustainability and preservation of our vital water resources.

WhiteHat Engineering (US based Company) and LeaveLogic WebApp

Saujan worked as a Lead Developer at WhiteHat Engineering, a US-based company, for 6 years. During this time, Saujan primarily contributed to the development and maintenance of the LeaveLogic WebApp, a robust leave management solution. Saujan became highly proficient in using the Ruby on Rails framework and advanced SQL queries to build and optimize application features. Working with an international team helped him adapt to a professional global work culture, improving his collaboration and communication skills. This experience not only strengthened his technical expertise but also shaped him into a responsible team leader capable of delivering high-quality software solutions. About Product: https://leavelogic.com/

S4W-Nepal and QA control WebApp

Saujan worked with S4W-Nepal, where Saujan was involved in developing and maintaining the Data Portal and its associated platforms. The Data Portal is an online platform designed to make water-related data easily accessible through interactive visualizations and maps. This portal enables researchers, policymakers, and the public to explore information about rainfall, soil moisture, and other hydrological parameters. In addition to the Data Portal, Saujan also worked on the Admin Portal, which serves as a backend platform for managing data quality control and user access. Through the Admin Portal, users can review, validate, and manage measured data such as rainfall and soil data to ensure accuracy and reliability. For these projects, Saujan primarily used Django for backend development and React for building dynamic, user-friendly interfaces. Saujan also configured and managed the necessary web servers and database servers to ensure smooth deployment and stable performance. This experience greatly enhanced his skills in full-stack web development, server management, and building practical solutions for environmental data management. Data Portal: https://data.smartphones4water.org

Rooster Logic Pvt. Ltd. and its product Remo WebApp

Saujan worked at Rooster Logic Pvt. Ltd., where Saujan contributed as a senior Python Developer. During his time there, Saujan was actively involved in developing and maintaining Remo WebApp, one of the company's flagship products. This role allowed him to gain in-depth experience with professional web development practices and workflows. Saujan became proficient in using industry-standard tools and frameworks such as Git, Django, Python, Pandas, and SQLite. Working with these technologies helped him strengthen his skills in writing efficient code, managing databases, and performing complex data processing tasks. Overall, his experience at Rooster Logic played a vital role in shaping him into a capable and detail-oriented software developer. About Remo WebApp: https://roosterlogic.com/product/remo

ACADEMIC PROJECTS

3D Solar System

Saujan developed a 3D Solar System Project using advanced 3D projection system techniques. In this project, a realistic model of the solar system was created, featuring nine planets revolving smoothly around the sun. The system simulates the orbital motions to help users visualize the dynamics of planetary movement. Users can interact with the simulation by pressing the up, down, left, and right keys to change the viewport or adjust the camera position. This project not only demonstrates his skills in 3D graphics and simulation but also serves as an engaging educational tool for learning about the solar system.

Sudoku Game

Saujan developed a Sudoku Game as a desktop application using Java. The game provides users with an interactive platform to play and solve Sudoku puzzles on their computer. It features an intelligent solver that uses the Depth First Search (DFS) algorithm to find solutions efficiently. This algorithm explores possible number placements systematically until the puzzle is solved correctly. Through this project, Saujan demonstrated his understanding of algorithms, problem-solving techniques, and Java-based desktop application development.

Website analytics

Saujan developed a Website Analytics tool to help website owners gain valuable insights into user behavior. This tool measures overall website traffic and provides detailed reports on visitor counts and trends. It includes a heatmap feature that visually shows which parts of the content were most popular and received the most attention. It also tracks which URLs were clicked by users and how far each page was scrolled. All this information is presented clearly to the website owner through an easy-to-understand dashboard. Based on these analytics, the owner can make informed decisions to customize and optimize the page content. This helps improve user engagement, enhance navigation, and increase overall website performance. By developing this tool, Saujan showcased his skills in web tracking, data visualization, and user experience enhancement.

AI and Image Processing

Saujan is currently conducting research on AI implementation in image processing to explore innovative ways to analyze and interpret visual data. His focus is on applying advanced machine learning and deep learning algorithms to improve the accuracy and efficiency of image recognition tasks. This includes developing models that can detect patterns, classify objects, and extract meaningful information from complex images. Saujan is experimenting with techniques such as convolutional neural networks (CNNs) and image segmentation to handle various real-world scenarios. Through this research, Saujan aims to create intelligent solutions that can be applied in fields like medical imaging, environmental monitoring, and automated visual inspections. By integrating AI with image processing, Saujan seeks to contribute to cutting-edge technological advancements that solve practical problems and enhance decision-making.

TECHNICAL TOOLS

- Python programming language
- Pandas and Geopandas Python modules
- React programming language
- Django framework
- GeoDjango framework
- Ruby On Rails framework
- SQL queries and Spatial SQL queries and MongoDB
- Git, Postman, Jira

Daniel Smith, Ph.D., E.I.T.

Staff Engineer I

DAVIDS ENGINEERING, INC

EDUCATION

Ph.D., Biological Systems Engineering
Virginia Polytechnic Institute and State University

B.S., Civil and Environmental Engineering, minor in Soil Science
University of Maryland

REGISTRATION

Engineer in Training
No. 53251

AFFILIATIOINS

Member – American Geophysical Union

Member – Soil Science Society of America

YEARS OF EXPERIENCE

3 Years

DISTINGUISHING QUALIFICATIONS

- Spatial data processing, analysis, and visualization in R and Python.
- Multivariate statistics and regression analysis.
- Assembly and interpretation of soil morphological datasets
- Authored and presented various planning documents, technical reports, and grant applications for diverse clients and audiences.

SUMMARY

Dr. Smith's love for water and soil expanded when he took his first Introduction to Soil Science course in college. That experience, combined with his passion for applied science, propelled Dr. Smith to pursue a B.S. in Civil and Environmental Engineering with a specialization in Soil Science while at the University of Maryland, College Park. Following his B.S., Dr. Smith sought to work on an interdisciplinary research project that combined his passion for both water and soil. This desire led him to complete a Ph.D. in Biological Systems Engineering from the Virginia Polytechnic Institute and State University in Blacksburg, VA. This degree has given Dr. Smith a strong foundation in soil biogeochemistry, hydrology and hydrological modeling, and data analysis/visualization in Python. Dr. Smith's specific interest focuses on understanding how water, soil, and plants interact to influence the transfer of water and/or sediment from one location to another.

RELEVANT EXPERIENCE

Management and Processing of the Soil Survey Geographic (SSURGO) Database. Multiple Locations, CA.

Dr. Smith led the development of a California wide, 30m raster product based on the existing SSURGO dataset. Dr. Smith used his knowledge of soil morphological properties to extract relevant information from the SSURGO database and calculated weighted-average soil property values based on horizon thickness. The SSURGO-based dataset includes percent sand, silt, and clay content, hydraulic conductivity, depth to a restrictive layer (e.g., bedrock), soil water holding capacity, and more. The SSURGO 30m raster product has supported a variety of DE projects, including the Madera County Allocation Support and El Dorado County applied water model refinement projects.

Madera County Groundwater Sustainability Agency Allocation Program Implementation Support. Madera County Groundwater Sustainability Agencies (GSAs), Madera County, CA.

The GSAs managed by Madera County are currently implementing Groundwater Sustainability Plans (GSPs) for the "white areas" of the Chowchilla, Madera, and Delta-Mendota Subbasins, which are solely dependent on groundwater for irrigation of agricultural lands in most years. An important component of GSP implementation and achieving sustainability is reducing consumptive use of groundwater, which may be accomplished through implementation and enforcement of groundwater allocation. In 2024, Dr. Smith took leadership of this allocation support program. Dr. Smith modified or developed new allocation reports, participated in field inspections of established irrigation units, and mentored junior team members in completing necessary priority tasks. In addition, Dr. Smith led the development of updating the land use land cover,

parcel, and parcel-field coverage for all Madera County GSA growers. This work included the conceptual development and spatial data processing in Python to generate tabular summaries, maps, and visualizations of updated datasets. Dr. Smith also supervised a major update to a Django PostGIS web-based database that allows the Madera County GSAs real-time concurrent access to a central repository of data about their growers, parcels, fields, crops, wells, etc. Lastly, Dr. Smith anticipates and plans for future work needed to continue the successful implementation of the allocation support program.

Verification Project to Quantify Groundwater Use per Groundwater Allocations, Madera County Groundwater Sustainability Agencies (GSAs), Madera County, CA.

The Madera Verification Project was developed to configure, implement, and test the methods Madera County selected to monitor groundwater extraction and consumptive use prior to the enforcement of allocations and penalties. Allocation methods included measuring groundwater extraction directly via flowmeters and two remotely-sensed methods of groundwater consumptive use by crops (IrriWatch and Land IQ). In 2023, Dr. Smith led the effort to wrangle, clean, analyze, and visualize all the data collected for the Verification Project. Dr. Smith set up an automated data processing workflow using Python to ensure all results were high quality and reproducible. Dr. Smith's automated data analysis process led to the identification of errors and necessary refinements of the remotely-sensed datasets. Dr. Smith also performed multivariate statistical analysis to statistically compare the three measurement methods and expand on the results highlighted by DE during the 2022 Verification Project. Lastly, Dr. Smith was one of the main contributors to the final 2023 Verification Project report. This report outlined all results, conclusions, and recommendations that will be used by the Madera County GSAs to guide management decisions for the allocation program.

Presidential Postdoctoral Fellow, School of Plant and Environmental Sciences. Virginia Tech, Blacksburg, VA (September 2022 – October 2023).

Dr. Smith independently developed and funded a multidisciplinary project that investigated how the application of different types of soil organic matter could influence soil stability and erodibility for engineering and agricultural purposes. Throughout the duration of this project, Dr. Smith secured $120,000 in funding and mentored three additional undergraduate and graduate students on various subsets of this project. Additional tasks included experimental design, data collection and analysis, project management and budgeting, and project publication and presentation to interested stakeholders.

Graduate Research Assistant, Biological Systems Engineering Department, Virginia Tech, Blacksburg, VA (August 2017 – August 2022).

Under the direction of an advisor, Dr. Smith developed an interdisciplinary and externally funded research project that investigated how the interaction between water, plants, and soil organic matter influenced the erodibility of streambank soils. To complete this project, Dr. Smith deployed an Acoustic Doppler Profiler and developed new/modified existing code to analysis the data produced. In addition, Dr. Smith secured $140,000 in grant funding spread over three years from the National Science Foundation to perform this work. Lastly, Dr. Smith was broadly trained in modeling hydraulic flows and the analysis of remotely sensed/geospatial datasets for water resources and environmental applications.

SELECTED PUBLICATIONS

Smith D.J., Ph.D.; Abdelaziz S.L., Ph.D., P.E., A.M.ASCE; and Badgley B.D., Ph.D. (2024). Short-term changes in soil aggregate stability in biopolymer-amended, coarse-grained soil. In IFCEE 2024 (pp. 208-215). https://ascelibrary.org/doi/abs/10.1061/9780784485415.022.

Smith, D. J., Duston, S., Barney, J. N., Strahm, B. D., Agarwal, P., Mangru, A., & Badgley, B. D. (2024). Dissolved organic carbon characteristics are associated with changes in soil microbiome under different plant species. Applied Soil Ecology,

196. https://doi.org/10.1016/j.apsoil.2024.105313.

Smith, D.J., Wynn-Thompson, T.M., Stremler, M.A., Hession, W.C., Williams, M.A., & Seiler, J.R. (2023). Root Reinforcement and Soil Microbial Glue Reduce Streambank Fluvial Erosion. Science of The Total Environment, 896, 165125. https://doi.org/10.1016/j.scitotenv.2023.165125.

Smith, D. J., Snead, M*., & Wynn-Thompson, T. M. (2022). Soil amended with organic matter increases fluvial erosion resistance of cohesive streambank soil. Journal of Geophysical Research: Biogeosciences, 127, e2021JG006723. https://doi.org/10.1029/2021JG006723. *Undergraduate mentee

Smith, D.J., Wynn-Thompson, T.M., Williams, M.A., Seiler, J.R. (2021). Do Roots Bind Soil? Comparing the Physical and Biological Role of Plant Roots in Fluvial Streambank Erosion: A Mini-JET Study. Geomorphology 375, 107523. https://doi.org/10.1016/j.geomorph.2020.107523

Muerdter, C.P., Smith, D.J. and Davis, A.P. (2019). Impact of vegetation selection on nitrogen and phosphorus processing in bioretention containers. Water Environ Res., 92(2), 236-244. https://onlinelibrary.wiley.com/doi/10.1002/wer.1195.

Nancy Navarro

Staff Specialist I

EDUCATION

B.S., Computer Science and Engineering
University of California, Merced

YEARS OF EXPERIENCE

3 Years

DISTINGUISHING QUALIFICATIONS

- Programming Languages:
  - Python
  - C++
  - C
  - Java
- Geospatial data analysis using Python and APIs
- Experience in training teams in developing python skills for cutting edge tech development.
- Experience in training clients in data analysis and quality assurance/control procedures.

SUMMARY

Ms. Navarro received her bachelor's degree in computer science and engineering at University of California, Merced. Prior to joining DE in January 2024, Ms. Navarro worked at Turlock Irrigation District (TID) in the Hydrology department. Her primary scope of responsibility consisted of applying cutting edge data science and analysis to past, current, and future water operation strategies. The list of tasks included watershed modeling, water accounting, creation of specialty tailored software programs, database navigation tools, spatial hydrology, drought/flood operations, and Delta operations. Ms. Navarro's background in hydrology and agriculture further drives her passion in working with Davids Engineering clients to develop cutting edge water resources technology, with the goal of ensuring long-term water resource sustainability. In her free time, Ms. Navarro enjoys knitting, painting, and taking long walks in the parks with her family.

RELEVANT EXPERIENCE

Designed and implemented a Dynamic Report Engine. Multiple locations, CA.

Ms. Navarro designed and implemented a dynamic report engine that streamlined the report creation process by developing a structured template that automatically formats and organizes data, making reports faster to produce and easier to read. Ms. Navarro has also provided training for team members on its usage for seamless adoption. This dynamic report engine has been incorporated amongst many DE projects to help clients analyze key metrics and drive strategic decisions.

Designed and implemented a Dynamic Email Automation System. Multiple locations, CA.

Ms. Navarro designed and implemented a dynamic email automation system that customizes messages and includes individualized file attachments. This system has been deployed for both DE clients and the public they work alongside, enabling them to monitor and create strategic decisions.

Madera County Groundwater Sustainability Agency Allocation Program Implementation Support. Madera County GSA, Madera County, CA.

The GSAs managed by Madera County are currently implementing Groundwater Sustainability Plans (GSPs) for the "white areas" of the Chowchilla, Madera, and Delta-Mendota Subbasins, which are solely dependent on groundwater for irrigation of agricultural lands in most years. An important component of GSP implementation and achieving sustainability is reducing consumptive use of groundwater, which may be accomplished through implementation and enforcement of groundwater allocation. Ms. Navarro has modified and developed new reports related to the allocation program, alongside these reports she also oversaw the delivery of these reports through the dynamic

email automation system. Ms. Navarro supported junior team members to develop cutting edge technology for the implementation of groundwater allocation. Ms. Navarro has also collaborated with DE team members in designing and updating the Django PostGIS web-based database that contains the agricultural data for the Madera County GSA's.

Verification Project to Quantify Groundwater Use per Groundwater Allocations, Madera County Groundwater Sustainability Agencies (GSAs), Madera County, CA.

The Madera Verification Project was developed to configure, implement, and test the methods Madera County selected to monitor groundwater extraction and consumptive use prior to the enforcement of allocations and penalties. Allocation methods included measuring groundwater extraction directly via flowmeters and two remotely-sensed methods of groundwater consumptive use by crops (IrriWatch and Land IQ). Ms. Navarro assisted with the development of ODK forms used to help Madera County in their flowmeter verification efforts. Ms. Navarro integrated the dynamic report engine along with the ODK forms to design and deliver study reports, presenting critical data insights for the study. Ms. Navarro also provided training and guidance to clients on data analysis and quality assurance/control procedure, enabling them to independently manage and validate data. Ms. Navarro also provided on-call support, addressing client inquiries and offering timely assistance for any questions or issues.

RemoteTracker Support for Delivery Measurement and Data Management. Richvale Irrigation District, Western Canal Water District, Biggs-West Gridley Water District, Reclamation District No. 108, Sutter Mutual Water District, South Sutter Water District, Butte, Glen, Colusa, and Sutter Counties, CA.

Ms. Navarro worked alongside DE team members to generate real-time monitoring reports using the dynamic report engine for RemoteTracker clients to use to track their water delivery measurements on a weekly basis, delivered by the dynamic email automation system. She developed a custom app leveraging the Dropbox DBX console to facilitate data downloads and integrate Python for automated retrieval.

Brandon Ertis, M.S., P.E.

Senior Engineer

DAVIDS ENGINEERING, INC

EDUCATION

M.S., Environmental Science
California State University, Chico

B.S., Civil Engineering
University of California, Davis

REGISTRATION

Civil Engineer, CA
No. C84037

YEARS OF EXPERIENCE

10+ Years

DISTINGUISHING QUALIFICATIONS

- Assembly and analysis of historical land and water use data for water budget development.
- Development of water management tools for agricultural water suppliers, including tool implementation and staff training.
- Geographic Information Systems – mapping and spatial analyses.

SUMMARY

Mr. Ertis has provided a variety of water and environmental management services to clients in California for over 10 years. These services include environmental data acquisition; designing and completing detailed water budgets; utilizing GIS techniques for a variety of mapping and spatial analysis procedures and processes; development of water management tools for agricultural water suppliers (including tool design, implementation and staff training, and ongoing support); presenting technical information orally to stakeholders and the public, and preparation of technical reports and documents. He has been involved in dozens of successful projects for a variety of clients.

RELEVANT EXPERIENCE

Sustainable Groundwater Management Act (SGMA) Groundwater Sustainability Plan (GSP) Development. Multiple Locations, CA.

Mr. Ertis has both led and assisted with multiple components of Groundwater Sustainability Plan (GSP) development in multiple groundwater basins in California including the Madera, Chowchilla, Solano, Colusa, Corning, Red Bluff, Los Molinos, Antelope, Bowman, Butte, Vina, and Wyandotte Creek Subbasins. His contributions include preparing draft and final GSP documentation, preparing draft and final Annual Report documentation, reviewing and editing all GSP documentation to ensure SGMA compliance, coordination and planning with Groundwater Sustainability Agency (GSA) representatives, reviewing and responding to public comments, developing water budgets, evaluating sustainable management criteria, developing projects and management actions, evaluating projects and management actions, developing maps and figures, and preparing and presenting information to GSA Boards, stakeholders, and the public. Multiple GSPs that he has worked on have been approved by the California Department of Water Resources (DWR).

Feather River Regional Agricultural Water Management Plan, Northern California Water Association. Sacramento, CA.

The Northern California Water Association (NCWA) engaged Davids Engineering to develop the Feather River Regional Agricultural Water Management Plan (FRRAWMP). A detailed plan for the 470,000 acre region was developed, including extensive consultation with nine water suppliers, several refuge and wildlife area managers, and representatives of Butte County and the California Department of Water Resources. The FRRAWMP includes a detailed inventory of surface water and groundwater supplies and uses and, through multiple water budget analyses spanning scales of individual suppliers to the region as a whole, characterizes the interaction between surface water and underlying groundwater systems in the region. Mr. Ertis was involved for the duration of

the project in a supporting role, developing maps and completing spatial analyses in GIS, assembling supplier infrastructure inventories, identifying potential system improvement projects, preparing conceptual cost estimates for improvement projects, assisting in the preparation and calculation of water balances, drafting sections of the report, analyzing datasets, and meeting with agricultural water suppliers in the region. Mr. Ertis has also led state-mandated periodic updates to AWMPs for individual water suppliers included in the FRRAWMP region.

Implementation of Delivery Measurement, Data Management and Accounting, and Volumetric Billing. Reclamation District No. 108 (RD108), Richvale Irrigation District (RID), Biggs-West Gridley Water District (BWGWD), Butte, Colusa, and Sutter Counties, CA.

According to California Water Code Section 597 (CWC §597), agricultural water providers over 25,000 acres are required to measure the volume of water delivered to customers with sufficient accuracy to: (1) report aggregated farm-gate delivery data to the state and (2) adopt a pricing structure based at least in part on the volume of water delivered to each field. Mr. Ertis performed surveys of farm-gate deliveries to evaluate existing conditions, supported an effort to test alternative measurement methods that are potentially capable of satisfying the accuracy requirements of CWC §597 by performing flow measurements and data acquisition in the field and completing a water balance using different measurement methods on a specific canal reach, processing and analyzing datasets, estimating costs for flow measurement improvements, and developing a report detailing existing conditions and presenting various options of improving flow measurement in order to comply with the accuracy standards presented in CWC §597.

Following this effort, Mr. Ertis assisted in the development and implementation of a customer delivery measurement program that will satisfy the requirements of CWC §597. This included design and development of customer delivery measurement and water management tools used by district staff to record and manage deliveries and volumetric billing, specification and in-field review of infrastructure improvements required for delivery measurement, implementation of tools and training with district staff members, and ongoing support for the customer delivery measurement program.

Water Budget Development and Water Management Planning. Oakdale Irrigation District, Oakdale, CA.

Mr. Ertis prepared the 2020 Agricultural Water Management Plan (AWMP) update for submittal to the California Department of Water Resources. This preparation included drafting and/or editing all document text; communicating with Oakdale Irrigation District (OID) staff to identify District efforts to implement Efficient Water Management Practices (EWMPs); presenting updated AWMP results to the OID Board; and updating the OID system-wide water budget. The water budget updates involved quantifying agricultural water demand and water use using a daily root zone water balance model on the basis of cropping, soil characteristics, weather (evaporative demand and precipitation), and crop coefficients developed from remotely-sensed surface energy balance results. In addition to meeting state-mandated requirements, the AWMP is used by OID to review the ongoing implementation of their Water Resources Plan.

Agricultural Water Management Plan and Measurement Improvement Plan Development and Implementation. Yuba Water Agency, Yuba County, CA.

Mr. Ertis assisted with development of the original Agricultural Water Management Plan (AWMP) for the Yuba Water Agency (YWA) and led preparation of the 2020 AWMP update for submittal to the California Department of Water Resources. This preparation included drafting and/or editing document text; communicating with YWA staff to identify Agency efforts to implement Efficient Water Management Practices (EWMPs); and updating the YWA system-wide water budget (which included quantification of water demand and use).

The YWA also moved forward to implement measures described in the Agency's AWMP. This effort included the installation of multiple permanent flow measurement stations and the construction of conveyance system infrastructure. Mr. Ertis led the surveying and design of infrastructure improvements, participated in measurement station installations, and contributed to the construction management and inspection of the new infrastructure. Mr. Ertis also performed discharge measurements for velocity indexing purposes at the permanent flow measurement stations.

Agricultural Development Feasibility Assessment. El Dorado County Water Agency, El Dorado County, CA.
The El Dorado County Water Agency (EDCWA) engaged Davids Engineering and ERA Economics to complete an agricultural development feasibility assessment by developing baseline data regarding historical cropping trends, spatial distribution of crops, and irrigation practices and evaluating historical, current, and projected future cropping and water demands within El Dorado County. This effort informs an evaluation of the feasibility of developing additional water supplies to expand irrigated agriculture in the County. Mr. Ertis assisted in this project through assembly and evaluation of datasets (including assembly and review of inputs for and results of the water demand model), developing maps and completing spatial analyses in GIS, drafting sections of the report, and presenting project results to an Agricultural Advisory Group comprised of local stakeholders formed to provide feedback and inform the feasibility assessment process.

Verification Project to Quantify Groundwater Use per Groundwater Allocations, Madera County Groundwater Sustainability Agencies (GSAs), Madera County, CA.
The GSAs managed by Madera County are currently implementing Groundwater Sustainability Plans (GSPs) for the "white areas" of the Chowchilla, Madera, and Delta-Mendota Subbasins, which are solely dependent on groundwater for irrigation of agricultural lands in most years. An important component of GSP implementation and achieving sustainability is reducing consumptive use of groundwater, which may be accomplished through implementation and enforcement of a groundwater allocation. Mr. Ertis led an effort to evaluate the accuracy of the method chosen by the GSAs to quantify groundwater use for the allocation. This effort included identification of and close coordination with participating growers within the GSAs, extensive field data collection by a team of Davids Engineering field staff, collection and aggregation of additional data sources, coordination with Madera County GSA staff, data analysis, development of a final report, and dissemination of results. The report and its conclusions and recommendations have been used by the GSAs to guide management decisions, and a continuation of the project has been funded.

Boundary Outflow Monitoring. Sacramento Valley, CA.
Mr. Ertis has both led and assisted in multiple boundary outflow measurement projects for multiple agricultural water suppliers in the Sacramento Valley. These data provide suppliers with an improved understanding of boundary outflows and overall flow through their distribution and drainage systems. They can be used to make operational changes, improve water budgets (which are often used to make long-term planning decisions, such as capital improvement projects), or meet regulatory requirements. Mr. Ertis has assisted with identification of boundary outflow monitoring sites, development of monitoring plans and specification of monitoring equipment, coordination with clients' operational managers and staff, equipment installation and maintenance, data processing and analysis, and development of technical reports (including recommendations) that summarize monitoring results.

Groundwater Risk Assessment. Tehama County, CA.
Mr. Ertis assisted in a high level risk assessment of SGMA undesirable results, assessing localized groundwater declines, subsidence risks, overdraft, and impacts due to climate change. He prepared maps and figures for public presentation showing historical and recent trends in groundwater conditions using publicly available information provided by state and local agencies.

Western Canal Implementation of Computer-Based Customer Delivery Measurement Data Collection and Accounting. Western Canal Water District, Butte and Glenn Counties, CA.
According to California Water Code Section 597 (CWC §597), agricultural water providers over 25,000 acres are required to measure the volume of water delivered to customers with sufficient accuracy to: (1) report aggregated farm-gate delivery data to the state and (2) adopt a pricing structure based at least in part on the volume of water delivered to each field. Since its inception in 1984, WCWD has measured volumetric water deliveries and utilized volumetric billing. However, only recently have they transitioned from a paper-based data collection and accounting system to a computer-based system. Mr. Ertis assisted in the effort to implement computer-based measurement tools and methods for

customer delivery measurement in the field and automated data processing and accounting in the office through the design and configuration of data communication protocols and processes, development of a districtwide inventory and accounting database, training of staff members, and ongoing support during implementation.

Colusa and Yolo Counties In-Lieu Groundwater Recharge Investigation. Reclamation District No. 108, Grimes, CA.

Mr. Ertis assisted with an analysis of the potential to use RD108 surplus water, when available, to supplement available water supplies in Colusa County Water District and in Dunnigan Water District (Yolo County). An operations model spanning a 65-year planning horizon quantifying water demands, water supplies, and associated costs was developed that simulated the purchase of water by growers in each district. Mr. Ertis assisted in the project effort with data analysis and development of maps and figures using GIS and other software. Based on the model results, the parties have moved forward with a multi-year water transfer pilot program to test the water transfer concept and terms.

Snake Marsh Hydromonitoring and Water Budget Analysis. The Nature Conservancy, Sacramento County, CA.

The Nature Conservancy (TNC), as a partner of the Cosumnes River Preserve, hired Davids Engineering to design and implement an environmental monitoring and data collection program for Snake Marsh, a 160-acre freshwater perennial wetland, and complete a water budget for the Marsh for the monitoring period. Mr. Ertis led the field data collection effort to characterize surface water hydrology and surface water-groundwater interactions, with particular emphasis on characterizing water sources for the marsh and relative inflows, as well as evaluating marsh water quality as it relates to Giant Garter Snake health and invasive plant growth through strategic sampling of important water quality parameters. He performed flow measurements, bathymetric surveys, surface water and groundwater level measurements, water level surveys, water quality testing, and other types of data acquisition and analysis. After the monitoring period was complete, under the supervision and guidance of a principal engineer, he completed a water balance for the marsh and summarized the results in a final report. As an added component, TNC staff were trained in the collection of flow measurement data using standard stream gaging procedures as well as collecting water quality samples and performing laboratory analysis of the samples for purposes of continued monitoring.

South San Joaquin Flow Measurement Plan Development and Implementation. South San Joaquin Irrigation District, Manteca, CA.

Mr. Ertis assisted in the development and implementation of a Flow Measurement Plan (Plan) for the South San Joaquin Irrigation District (SSJID). The goals of the Plan are (1) to provide cost-effective service to customers; (2) generate improved operational records for planning and analysis, and; (3) comply with recently passed California legislation (SBx7-7). As part of this effort, Mr. Ertis installed data collection equipment at a series of sites to estimate flow measurement accuracy and performed flow measurements at existing measurement sites within the district in order to develop corresponding flow ratings for each specific site.

Analysis of Cardoza Diversion on Parks Creek. AquaTerra Consulting, Siskiyou County, CA.

Davids Engineering performed an analysis of alternate modifications to the Cardoza Diversion on Parks Creek in the Shasta Valley, which involved a data collection program including monitoring equipment, flow measurement, and a ponded seepage test. Mr. Ertis assisted with the project effort through preparation of monitoring equipment and configuration of data loggers and sensors, performing flow measurements and data acquisition during visits to the field, and completing a ponded seepage test with his colleagues. He analyzed the results of the ponded seepage test, and helped process the results of the data collection program and develop a document for transmittal to the client.

June 15, 2025

Aleta Allen
Madera County GSA
200 West Fourth Street
Madera, CA 93637

Re: RFP – Madera County Groundwater Sustainability Agency Measurement Services

Dear Selection Committee,

MLJ Environmental is pleased to submit our proposal to provide a groundwater-accounting platform that integrates the measurement datasets procured under Deliverables 1-3 (updated land-use designations, parcel-level ET/ETAW totals, and parcel-level precipitation totals) of the RFP, Madera County Groundwater Sustainability Agency Measurement Services, into an online platform providing a single, grower-facing system. We appreciate the opportunity to help Madera County GSA turn high-quality measurements into actionable water-management tools.

MLJ Environmental is a California-based environmental consulting firm with 25 years of experience in water quality, regulatory compliance, and groundwater data systems. We are the developers of Watermark, a cloud-native accounting platform built expressly for GSAs implementing SGMA. Our Watermark online platform ingests vendor-supplied parcel tables (e.g., LandIQ, Irriwatch/Hydrosat, meter telemetry, or others) and links them to allocations, credits, and penalties in a user-friendly interface. Watermark is already deployed resulting in successful landowner use within the North Fork Kings, El Rico, and South Fork Kings GSAs.

For the Madera County GSA, Watermark will:

- Ingest the County's land-use, ET/ETAW, and precipitation datasets by APN or field boundary.
- Join each record to farm units, apply existing allocation rules established by the County, and automatically calculate credits, penalties, and remaining balances.
- Present results in a secure online portal using grower specific login credentials and an administrator dashboard that supports QA/QC, compliance exports, and manual adjustments; all actions are preserved in a full audit trail.

We have assembled a seasoned and capable team for this work:

- Robert Cima will serve as Project Manager and County liaison.
- Roop Singh, Technical Lead, will oversee data architecture and integration.
- Tara Khan and Jennifer Sanchez will lead implementation, onboarding, and outreach (as needed).
- Priye Albert-Sogules will manage data support and quality control.

- Caleb Kinsella will oversee AWS cloud infrastructure and system security.

Our track record of quickly delivering locally controlled, vendor-agnostic systems, combined with our understanding of Madera County GSA's SGMA objectives, positions us to provide a robust, scalable, and easy-to-use solution. We look forward to discussing our approach in greater depth during the interview phase.

Sincerely,

MLJ Environmental

Robert Cima

Vice President & Project Manager

rcima@mljenvironmental.com

Melissa Turner

President

mturner@mljenvironmental.com

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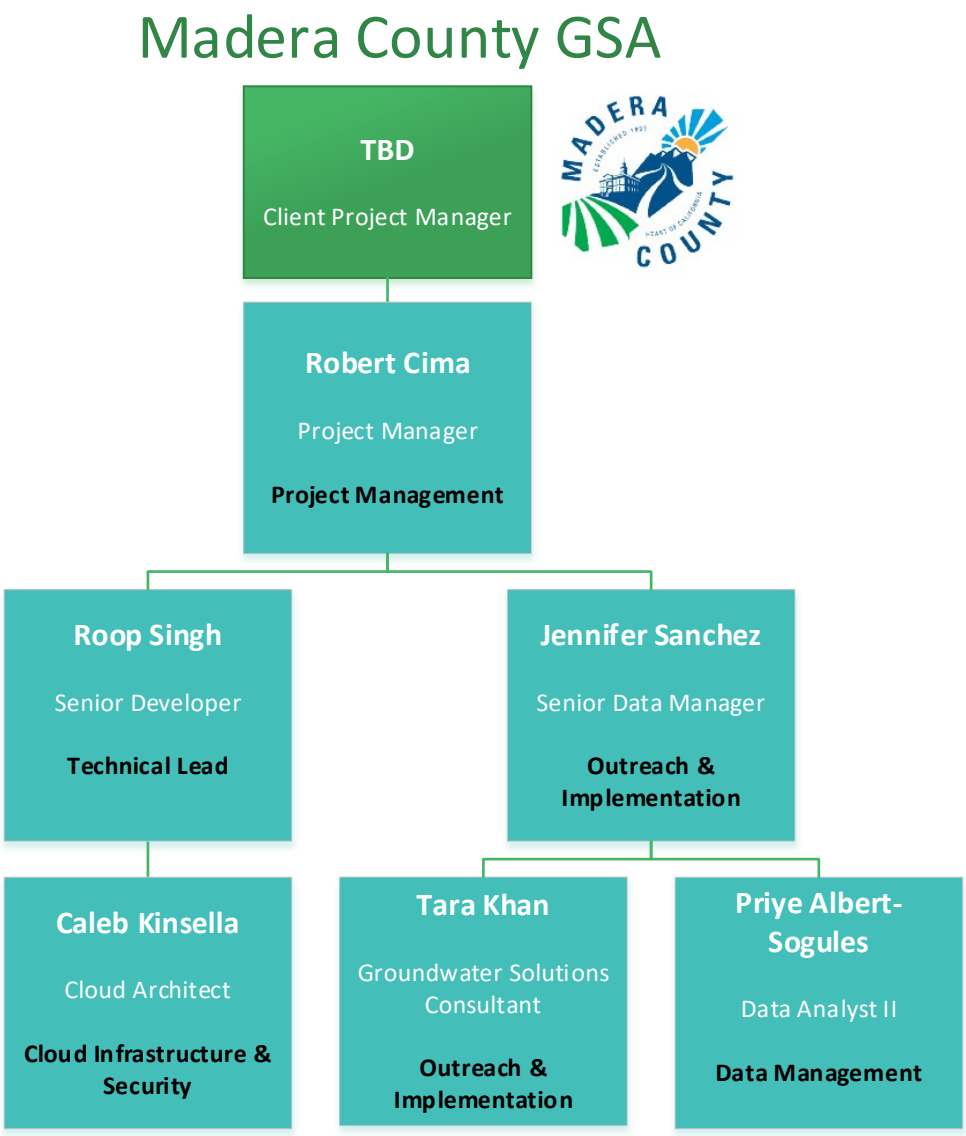
Organization Chart

The organization chart shows the proposed team management structure, key personnel associated with each firm, and their relevant roles and responsibilities. Our team does not include any sub-consultants.

Figure 11. MLJ Environmental Project Organization Chart



Qualifications

Robert Cima

PROJECT MANAGER

DEGREE(S)

B.S., Environmental Urban Planning, University of Utah, Salt Lake City

Relevant Experience

1. *Successful deployment of SGMA-compliant water accounting systems*
2. *GSA well registration and parcel management*
3. *Stakeholder outreach and grower onboarding*
4. *Data Management and Documentation*

BACKGROUND

Robert serves as the Vice President of MLJ Environmental and is the lead architect behind the Watermark platform. With over 15 years of experience in environmental consulting, regulatory compliance, and cloud-based data systems, he brings a practical and strategic lens to GSA support. Robert has successfully led software rollouts, stakeholder engagement efforts, and long-term support for GSAs including North Fork Kings, El Rico, and South Fork Kings. His strength lies in translating complex regulatory requirements into user-friendly digital workflows that meet SGMA compliance and grower needs alike. He will be the primary point of contact for Madera County GSA and will ensure the overall success of the project.

Jennifer Sanchez

SENIOR DATA MANAGER

DEGREE(S)

B.A., Mass Communication, California State University, Fresno.

Relevant Experience

1. *Membership Database Management*
2. *Best Management Practices Survey Implementation*
3. *Community Outreach*
4. *Report Generation and Compliance Tracking*
5. *Data Quality Assurance and Documentation*

BACKGROUND

Jennifer leads grower outreach and data coordination for the Watermark platform. With a strong background in environmental services and a sharp ability to translate technical data into clear messaging, Jennifer has successfully guided hundreds of growers through onboarding, reporting, and compliance workflows. In addition to running outreach events and handling direct stakeholder communications, Jennifer oversees data operations for Watermark projects, including supervision of QA/QC workflows and the coordination of incoming datasets. She brings both clarity and consistency to the user experience and will serve as a key bridge between growers, GSA staff, and technical teams throughout the project.

Roop Singh

SENIOR DEVELOPER

DEGREE(S)

B.S., Computer Science, University of California, Davis.

Relevant Experience

1. *Remote sensing and telemetry integration*
2. *Cloud architecture and system scaling*
3. *GSA allocation and recharge tracking*
4. *Data pipeline and API integration*

BACKGROUND

Roop is MLJ's Chief Technical Officer (CTO) and a highly experienced technology leader specializing in data integration, cloud systems, and scalable software platforms. As the Technical Lead for Watermark, Roop has overseen the ingestion of remote sensing data (LandIQ, Irriwatch), telemetry, and grower-submitted inputs into our groundwater accounting engine. He has architected integrations for allocation management, recharge project tracking, and reporting systems tailored to GSA-specific needs. Roop will lead the configuration of Watermark to align with Madera County's measurement data, ET/ETAW rasters, and precipitation inputs, ensuring seamless platform performance and reliability.

TARA KHAN – POLICY, OUTREACH AND IMPLEMENTATION

Tara specializes in outreach and implementation, helping GSAs translate technical requirements into clear, grower-facing materials. She will support Madera County by driving user adoption and ensuring successful Watermark rollout.

PRIYE ALBERT-SOGULES – DATA MANAGEMENT & SUPPORT

Priye supports Watermark's backend by validating datasets, processing usage data, and troubleshooting anomalies. She will manage data workflows to ensure consistent performance and compliance in Madera County.

CALEB KINSELLA – CLOUD ARCHITECT

Caleb oversees Watermark's AWS infrastructure, focusing on stability, scalability, and security. For Madera County, he will align the cloud environment with County requirements and maintain high system performance.

Project Understanding & Approach

The following proposal highlights the approach MLJ Environmental will take to integrate the fully functioning groundwater accounting platform (Watermark) with Deliverables 1, 2, and 3 outlined in the RFP along with farm unit, allocations, credits, and penalties.

The Madera County GSA already operates a data-management system and allocates groundwater based on inches of ETAW. In the next SGMA phase, the GSA needs a practical way to integrate three new data feeds: updated land-use designations, monthly ET/ETAW totals, and monthly precipitation totals (Deliverables 1–3), all of which will arrive from satellite vendors as parcel- or field-level tables keyed to assessor parcel numbers (APNs). Those tables must be merged with existing meter data and displayed in a portal that growers will actually use.

By using Watermark, Madera County GSA will have a clear understanding of annual costs for implementing and using Watermark retaining control over provider specific data and a reliable online dashboard for growers. Building on this understanding, our approach translates the County GSA's objectives into a six-task implementation plan which will be billed on a time and material basis for the first year; it is not anticipated that additional consulting fees will be needed in Year 2 and Year 3 unless the Madera County GSA wishes to contract with MLJ Environmental for additional services after the implementation phase. The Watermark SaaS fees incorporate ongoing assistance and maintenance in a single yearly or monthly fee.

Success requires that every data point be:

- *Tied to specific parcels and farm units*
- *Aligned with current allocation rules*
- *Understandable and accessible to growers*
- *robust enough to support future reporting, enforcement, and trading frameworks.*

TASK 1 – PROJECT MANAGEMENT

A joint kick-off will be initiated once Madera County contracts with MLJ Environmental to confirm success metrics, file-exchange protocols, and a six-week timeline. This will be followed by weekly Project Manager check-ins that track scope, budget, and SGMA reporting cycles. This governance keeps every downstream activity aligned with the GSA's existing data-management system and allocation calendar.

TASK 2 – GIS & MAPPING SETUP

Our team will ingest the GSA's parcel layer, reconcile assessor and farm-unit records, flag discrepancies for GSA resolution, and publish a QA-checked shapefile to Watermark's map component. A clean spatial layer guarantees that each ET/ETAW and precipitation record attaches to the correct APN and farm unit associated with land use.

TASK 3 – DATABASE SETUP

MLJ Environmental will load validated parcels, create owner-verification codes, provision administrative accounts for GSA staff, and configure an online well-registration form that mirrors GSA rules. Additional tables capture monthly ET/ETAW and precipitation values, allocations, credits, and penalties—establishing a ledger foundation that mirrors current policy and scales for future needs.

TASK 4 – WATER ACCOUNTING SETUP

Through two configuration workshops, MLJ Environmental will translate Board-adopted rules into Watermark's ledger logic. The Watermark platform then posts monthly ET/ETAW and precipitation totals (Deliverables 2–3), applies precipitation offsets where required, converts meter data to ETAW, and records each action in a full audit trail, creating a rule-driven engine trusted by both growers and the GSA.

TASK 5 – CLIENT TRAINING

A four-hour sandbox session will be held to walk GSA staff through parcel claiming, well registration, ledger overrides, and grower-portal workflows. Post-launch, a dedicated support queue (≤ 36 hrs/yr) ensures rapid resolution of questions and keeps Madera County GSA's team self-sufficient.

TASK 6 – ET DATA INTEGRATION

Watermark will have a repeatable upload/API pipeline for the monthly ET/ETAW and precipitation tables supplied by the satellite vendors. Evapotranspiration integration is not contingent on the vendor and can be applied to any vendor that Madera County GSA contracts with. Automated QA checks validate APN keys, date ranges, and allocation over-runs; grower dashboards will be updated by the fifth business day each month, placing Deliverables 1–3 and meter data in a single portal, without duplicating the measurement services already procured by the GSA.

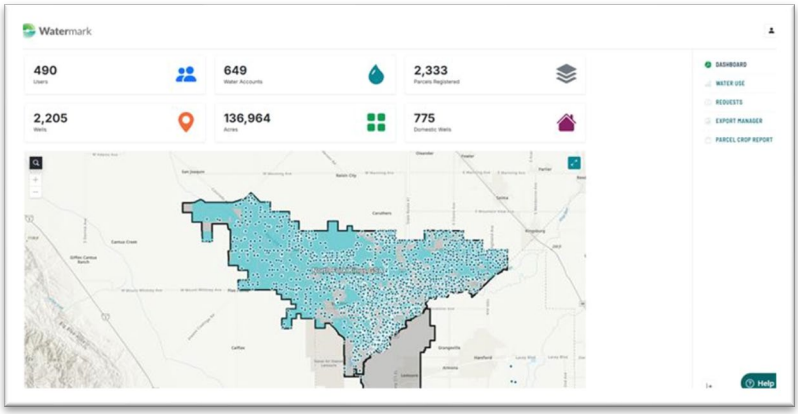
A: Compare ET data to self-reported pumping
B: View monthly ET usage

WATERMARK (SOFTWARE AS A SERVICE)

As a result of this approach, Madera County GSA will have a fully implemented Watermark system that is hosted, secure, and ready for day-to-day use. Because the platform is vendor-agnostic, it can ingest any parcel-level ET/ETAW and precipitation tables, whether they come from LandIQ, Irriwatch, Hydrosat, or future providers, alongside meter telemetry, all without code changes. Each monthly data drop is automatically joined to the correct APNs and farm units, run through the rules-driven ledger that applies allocations, precipitation offsets, credits, and penalties, and then surfaced in two purpose-built interfaces. Growers will log in to a portal that displays their ETAW for each month, the allocation they have remaining, and any credits or penalties that have been applied. GSA staff will work from an administrator dashboard that lets them export compliance reports, perform QA/QC comparisons, and make manual adjustments, with every action captured in a comprehensive audit trail. MLJ manages the entire pipeline—from data import and validation to nightly backups and ongoing support—so the GSA receives not just software but a turnkey service that remains transparent, traceable, and easily expandable for future SGMA reporting, enforcement, or water-trading initiatives. Fees for Watermark are based on estimated GSA acreage translated into an annual service fee applied (see Costs).

Project Experience & Success

North Fork Kings GSA



North Fork Kings GSA Watermark Admin Dashboard

CONTRACT DETAILS:

- 3 years (2022–present)
- Software as a service fee
- Time & materials for implementation and ongoing support

SCOPE OF SERVICES:

MLJ Environmental implemented the Watermark platform for North Fork Kings GSA, providing modules for well registration, parcel claiming, surface water delivery tracking, recharge project integration, and groundwater accounting. The implementation included stakeholder outreach, user onboarding, system configuration, and ongoing data management and support. Robert Cima, Roop Singh, Jennifer Sanchez, and Priye Albert-Sogules were all directly involved in the project's success.

SPECIFIC ACCOMPLISHMENTS:

- Integrated surface water delivery records with Watermark to allow growers to see both applied and estimated usage.
- Enabled growers to claim parcels, register wells, and track water usage through a personalized dashboard.
- Supported compliance with annual reporting requirements and allocation tracking.
- Conducted outreach events and developed training materials in coordination with GSA staff.
- North Fork Kings GSA has over 600 user accounts, 2,200 wells registered, and 136,000 acres of their GSA claimed and accounted for.

El Rico GSA

CONTRACT DETAILS:

- 3 years (2022–present)
- Software as a service fee
- Time & materials for implementation and ongoing support

SCOPE OF SERVICES:

El Rico GSA uses Watermark for well registration, parcel claiming, groundwater accounting, and grower reporting. The project also included robust messaging support, outreach, and technical assistance for both growers and GSA staff. El Rico GSA also uses Watermark's custom report generation feature to assist with billing and assessing fees. This enables administrative staff to easily identify water accounts that need attention and more outreach efforts. Robert Cima, Roop

Singh, Jennifer Sanchez, and Priye Albert-Sogules were all directly involved in the project's success.

SPECIFIC ACCOMPLISHMENTS:

- Configured a custom reporting module to streamline compliance reporting and grower communications.
- Implemented secure grower dashboards with visibility into allocations, usage, and credits/penalties.
- Managed complex parcel and account structures to accommodate shared ownership and operator access.

South Fork Kings GSA

CONTRACT DETAILS:

- 3 years (2022–present)
- Software as a service fee
- Time & materials for implementation and ongoing support

South Fork Kings GSA Watermark Grower Outreach and Training (2024/2025)

SCOPE OF SERVICES:

For South Fork Kings GSA, MLJ implemented Watermark to support SGMA compliance through well registration, parcel claiming, and groundwater accounting. MLJ's team worked closely with GSA staff to ensure proper system configuration and effective grower outreach. Robert Cima, Roop Singh, Jennifer Sanchez, Tara Khan, and Priye Albert-Sogules were all directly involved in the project's success.

SPECIFIC ACCOMPLISHMENTS:

- Supported large-scale outreach events with over 100 attendees to explain platform use and GSA goals.
- Configured parcel-level dashboards to align with the GSA's accounting structure and policies.
- Delivered a streamlined workflow for registering wells and assigning them to user accounts.
- Provided monthly system support, data management, and feedback loops for ongoing improvements.

References

The following references are for the three projects described above and represent projects of similar scope and objectives. All three projects have been implemented within the last 3 years, are ongoing with services, and have accomplished similar goals as outlined by the RFP including integrating ET data into an online dashboard (Watermark) accessible to growers where they can see their allocations, credits, and penalties.

NORTH FORK KINGS GSA

Contact Name, Title: Justin Mendes, General Manager

Phone Number: (559) 240-4281

Email: jmendes@northforkkings.org

EL RICO GSA

Contact Name, Title: Chantall Ouellet, Controller

Phone Number: (559) 730-8591

Email: ChantalO@tlbwsd.com

SOUTH FORK KINGS GSA

Contact Name, Title: Johnny Gailey, General Manager

Phone Number: (559) 906-6229

Email: johnny@southforkkings.org

Costs

The costs associated with this effort include time and material for the implementation of the software followed by annual subscription fees (Software as a Service). MLJ Environmental is prepared to commit to a three-year agreement, which would lock in the per-acre pricing detailed below for the full term of the contract. This ensures cost stability for Madera County GSA while providing continued access to platform enhancements, support, and services. Included with the Watermark platform functionality discussed in the Project Approach:

- Secure Cloud Hosting
- Up to 36 Hours/Year Customer Support
- Up to 36 Hours/Year Account Management

The $0.41 per-acre pricing provided in this proposal is based on the total acreage listed for Madera County GSA in the 2025 Madera Subbasin Joint GSP (177,800 acres), plus the total acreage listed for the Madera County GSA in the 2025 Chowchilla Subbasin GSP (45,100 acres) for a **total of 222,900 acres**. All annual fees and estimates are calculated using this acreage figure, unless otherwise noted.

Table 12. Total Costs for Watermark SaaS and Implementation Services

Task	Watermark SaaS + Implementation Services Yearly Breakdown		
	Year 1 Cost	Year 2 Cost	Year 3 Cost
Watermark Software as a Service ($0.41/acre)	$91,389	$91,389	$91,389
SaaS Subtotal	***$91,389***	***$91,389***	***$91,389***
Implementation Task 1 – Project Management	$9,960	$0	$0
Implementation Task 2 – GIS & Mapping Setup	$7,616	$0	$0
Implementation Task 3 – Database Setup	$3,864	$0	$0
Implementation Task 4 – Water Accounting Setup	$3,648	$0	$0
Implementation Task 5 – Client Training	$720	$0	$0
Implementation Task 6 – ET Data Integration	$4,512	$0	$0
Implementation Services Subtotal	***$30,320***	***$0***	***$0***
	$121,709	**$91,389**	**$91,389**

MLJ Environmental Rate Sheet (2025)

The rate sheet below are the rates used to build the Task 1–6 implementation services budget presented in Table 1. They also serve as the basis for any future time-and-materials work that Madera County GSA may request outside the fixed-scope items already priced.

MLJ Environmental will submit monthly invoices by the 15th of each month for the work performed in the prior month.

LABOR CLASSIFICATIONS	RATE PER HOUR
Principal	235
Senior Cloud Architect	235
Senior Developer	225
Senior Program Manager	225
Program Manager	216
Cloud Architect	207
Database Administrator	180
Senior Data Manager	180
Product Manager	180
Data Manager	166
Project Manager/Senior Staff	160
Business Analyst	155
QA Officer	155
Product Designer	149
GIS Specialist	144
Web Developer	144
Staff Scientist III	140
Junior Project Manager	138
Data Analyst II	138
GIS Analyst	130
Staff Scientist II /Data Analyst	129
GIS Technician	118
Data Associate	115
Staff Scientist	111
Administrative Assistant	96

OTHER DIRECT CHARGES

Personal Vehicle Mileage	$0.70/mile*
Travel and Subsistence	Actual Cost
4-Wheel Drive Truck Rental	$135.00 per day
Truck Rental Less than 6 hours	$22.50 per hour
Meter Rentals	$30 - $90 per day
Black and White Printing	$0.05 each
Color Printing	$0.50 each
Scanning	$0.50 each
• Large Document Reproduction, Binding, *etc.* Subcontracted	Actual Cost + 10%
• Rented Vehicles, Tools, and Other Equipment (including fuel, *etc.*)	Actual Cost + 10%
• Express Delivery and Courier Services for Projects	Actual Cost + 10%
Online Database Access for Projects	Actual Cost + 10%

*Based on current IRS 2025 rates. May be adjusted per IRS notifications.

UNITED TRACKING SYSTEMS

Groundwater Accounting Platform

Madera County Groundwater Sustainability Agency

Submitted to:
Aleta Allen
Madera County Groundwater Sustainability Agency
200 West Fourth Street
Madera, CA 93637

United Tracking Systems

Dear Ms. Allen,

On behalf of United Tracking Systems, I am pleased to express our interest in partnering with the Madera County Groundwater Sustainability Agency (GSA) to provide a robust and proven solution for groundwater accounting and compliance. As a California-based company with deep roots in both agriculture and software innovation, we have developed the most advanced Groundwater Accounting Platform available, purpose-built to support GSA operations under the Sustainable Groundwater Management Act (SGMA).

Our Water Dashboard Accounting Platform offers a comprehensive suite of tools that empower GSAs and growers alike. Designed with usability and adaptability at its core, the system supports real-time water usage tracking, precise credit accounting, and transparent billing processes. It also enables your agency to implement custom rules and adapt quickly to evolving policies or basin-specific needs.

Currently in use across several GSAs in California, the platform facilitates end-to-end groundwater management—from parcel-level usage and credit allocation to grower-facing dashboards, appeals processing, and detailed reporting. It incorporates private metering, real-time ET data, precipitation data, and land use tracking into a single integrated interface. This streamlines operations while maintaining full audit compliance and supporting proactive outreach to stakeholders.

What truly sets us apart is the level of partnership and support we provide. Our team works closely with GSA staff to tailor the system to your operational structure and governance policies. We offer direct consultation, responsive support (with typical resolution within 24 hours), and monthly feature updates based on user feedback. Our goal is to serve as an extension of your team, providing the technology and guidance necessary to meet your goals efficiently and transparently.

Our team has a long track record of success. We have supported over 6,500 grower accounts, facilitated tens of thousands of credit transactions, and maintained 99.9% platform uptime. More importantly, we have built lasting relationships with GSAs through open communication, trusted technology, and a shared commitment to sustainable groundwater management.

We believe United Tracking Systems is uniquely qualified to support Madera County GSA with a solution that is powerful, flexible, and built for long-term success. We appreciate your consideration and would welcome the opportunity to present our platform in more detail.

Sincerely,
Scott Steinbeck
Chief Technology Officer
United Tracking Systems

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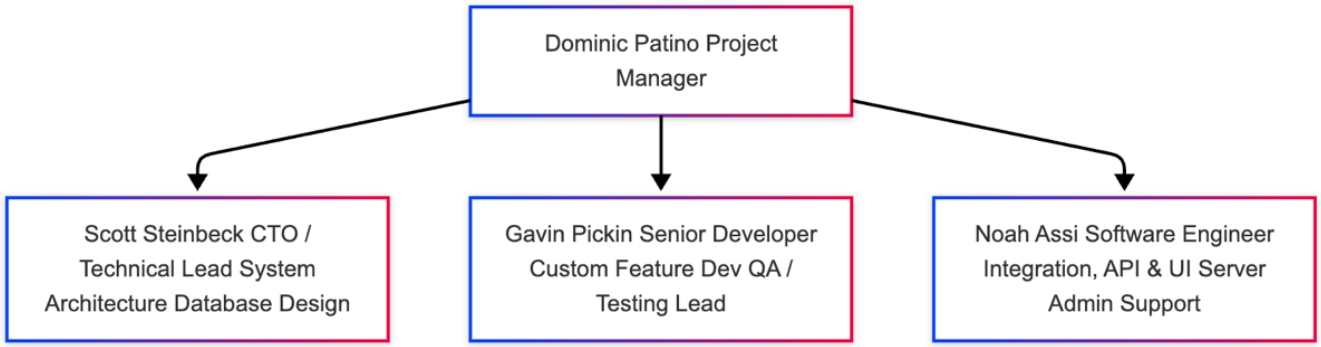
1. Organization Chart



2. Qualifications

Dominic Patino, CEO and Project Manager

Dominic brings innovative leadership to the team, challenging outdated norms in agriculture with practical, forward-thinking solutions. He is a licensed Pest Control Advisor with over 28 years of experience, a Certified Crop Advisor for 15 years, and a licensed Custom Pesticide Applicator for 10 years. His commitment to improving agricultural practices led him to assemble a highly skilled team to develop the programs described above. A hands-on leader who lives and works within the agricultural community, Dominic believes teamwork and local insight are key to lasting success.

Scott Steinbeck, MBA, CTO, Lead Software Engineer

Scott oversees all software development and leads the engineering team with precision and vision. With more than 22 years of experience, he has built over 100 applications—many of them centered around field tracking, irrigation, compliance, and GIS mapping. Scott also has over 10 years of mobile development experience, incorporating features like mapping, offline access, and push notifications. Whether personally coding or managing tasks, Scott ensures every technical solution meets the specific needs of the agriculture industry.

Gavin Pickin, Senior Software Engineer

Gavin is a seasoned full-stack developer with more than 22 years of experience creating robust web applications. His expertise spans MySQL, ColdFusion, JavaScript, HTML/CSS, responsive design, ecommerce platforms, DevOps, and server infrastructure. As a senior engineer, Gavin focuses on the design, development, and testing of key modules, ensuring scalable and secure performance across all systems. His depth of knowledge strengthens both frontend functionality and backend reliability.

Noah Assi, Software Engineer

Noah is a versatile full-stack developer and systems administrator with 6+ years of experience. He is proficient in JavaScript, ColdFusion, C++, Java, MySQL, and PostgreSQL. Noah also manages and maintains servers across multiple platforms including AWS, VMware, Solr, Windows Server, and Linux. His ability to bridge application development with infrastructure management ensures smooth, dependable operation across our services and deployments.

3. Project Understanding and Approach

The Water Dashboard Accounting Platform is a powerful and user-friendly system built specifically for GSA's to meet the challenges of groundwater regulation, compliance, planning, and billing. The platform combines cutting-edge technology with practical features to support accurate tracking, efficient billing, and strategic oversight. It delivers timely insights and robust tools for growers, GSA staff, and stakeholders alike.

Core Data Integration -To ensure accurate water usage management, the platform integrates vital datasets:

- High-resolution (30-meter or finer) annual land use data.
- Monthly evapotranspiration (ET and ETAW) data primarily from LandIQ.
- Monthly precipitation raster data.
- Private metering data accepted through a structured appeals process.
- Built-in tools to update and validate parcel boundaries and land classifications.

Farm-Level Analytics - Enables growers to manage their operations with clarity:

- Intuitive field and crop mapping tools.
- Analytics to review historical data and compare water usage.
- Real-time field-level tracking across multiple parcels.

Credit and Allocation Management - Simplifies complex credit and allocation workflows:

- Automated management of Native, Transitional, Surface Supply, and Penalty credits.
- Automatic Carryover Credit Rules and Credit Transfer Management.
- Custom penalty and late fee tracking with configurable rules.
- Customizable allocation logic for native & transitional water per GSA.
- Tools to define, manage, and publish annual allocation tables with historical context.
- Grower controlled Adjustments/Appeals with GSA review including long-term and seasonal fallowing.
- Priority-of-use management growers to prioritize which credits get used to satisfy usage.
- Purchase election to give growers the opportunity to pre purchase carryover credits for future use.

Meter Integration and Appeals - Promotes transparency and fair reporting:

- Structured process to appeal and verify private meter submissions.
- Integration of accepted meter readings with full traceability.
- Appeal process and decision logs available for audit and reference.

Automated Invoicing and Payments - Streamlines financial management for GSAs and growers:

- Auto-generated invoices with QuickBooks integration.
- Supports historical corrections via credit memos and rebilled or corrected invoices.
- Online or Mail-in payments with automatic syncing between platforms
- Billing & invoice dashboards for growers to easily access updated account charges.
- GSA customizable payment options for credit reservation or pay-on-use terms.

Real-Time Dashboards - Delivers actionable insights at a glance:

- Personalized dashboards for growers, showing allocations, credits, and usage.
- GSA-level dashboards summarizing water usage, parcel data, and account metrics.
- Interactive filters and sorting to identify trends, outliers, or compliance issues.

Detailed Reporting - Facilitates planning, compliance, and board-level review:

- Prebuilt and custom report generation for key metrics.
- GIS parcel data exports for integration with mapping and spatial tools.
- Full audit trail of credit issuance, usage, and transfers.
- Scheduled report delivery to board members and key stakeholders.

Data Integrity and Management - Maintains trust in the data and workflow:

- Water Year based accounting down to the parcel level but managed at the account level.
- Automated handling of APN changes, credit transfers, and parcel updates.
- Parcel management tools for splits, mergers, and ownership shifts.
- Role-based permissions and full edit histories for system transparency.

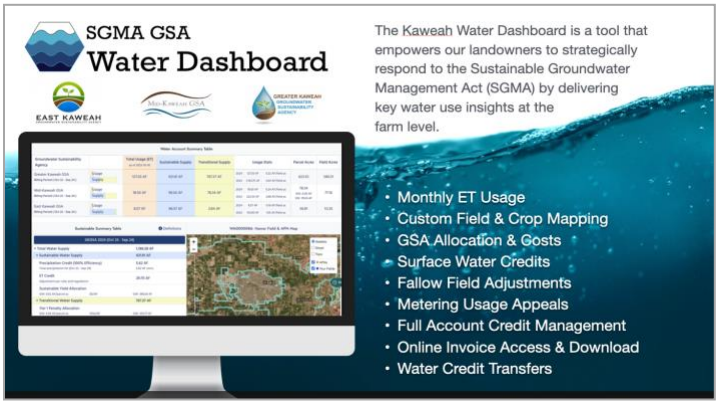
Technical Excellence and Support - A reliable platform backed by seasoned experts:

- 40+ years of combined experience in agriculture and software development.
- 99.9% platform uptime ensures stability.
- Rapid-response customer support.
- Regular updates and new features based on user and GSA feedback.

The Groundwater Accounting Platform supports GSAs in meeting SGMA compliance with confidence. It reduces staff workload, eliminates manual reporting, and improves transparency with growers. By combining smart automation, customizable logic, and comprehensive reporting, it ensures water data is always accurate, up to date, and actionable. With flexible configuration and continuous support, this platform is built to evolve alongside changing policies, practices, and environmental needs.

4. Project Experience and Success

Every project we build is custom-tailored to the specific needs of our clients across agriculture, water, and related industries. Because each operation presents unique challenges, we typically begin with a time-and-materials approach to maintain flexibility, then transition to a long-term support contract once the solution is proven and in place.

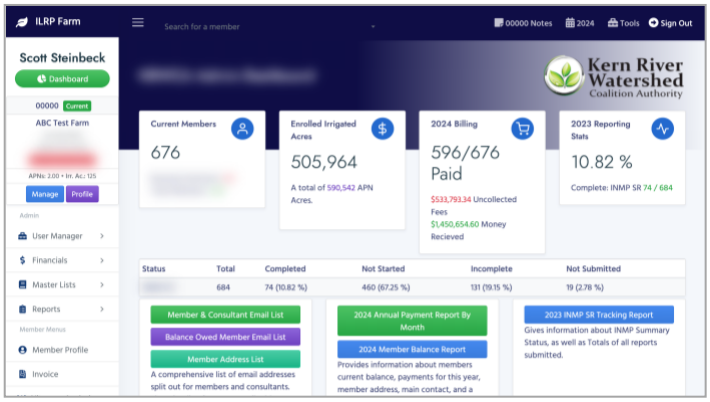


GSA Water Dashboard

Water Tracking, Analysis, & Accounting Platform

Monthly Subscription + Custom Development T&M

GSA Water Dashboard is a full featured tracking and accounting platform. The system is capable of using ET (Land IQ) and Direct meter usage information to Give GSA's and Growers insight and control over water usage.



Irrigated Lands Reporting Software

Regulatory Nitrogen Crop Reporting & Tracking

Monthly Subscription + Custom Development T&M

ILRP Farm is a custom reporting platform that allows growers to submit annual reports of farming practices, irrigation practices, nitrogen practices, cropping information, harvest yields, and applied nitrogen sources.

Agri Tracking Systems

Agricultural Tracking & Analysis

Monthly Subscription

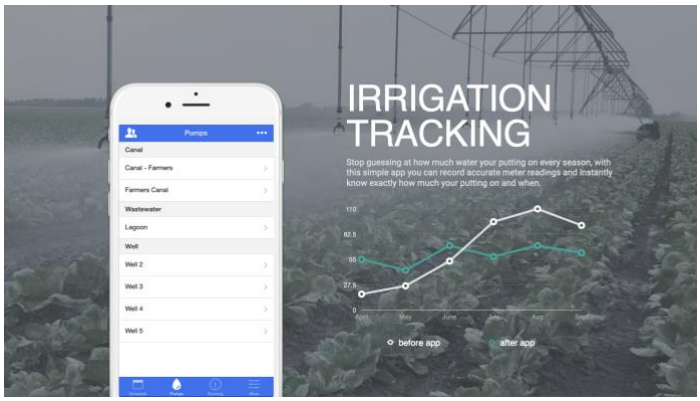
Agri Tracking Systems is a farm management tool that keeps track of your farms, fields, crops, nutrient samples, and budgets within your farm and daily operations.

Agri Mapping

Online Mapping Software

Monthly Subscription

Agri Mapping makes it simple to build your maps without having to read through tons of help guides. We provide all the information and tools you need, and none of the ones you don't.



ATS Irrigation Tracking

Mobile on Farm Irrigation Tracking

Monthly Subscription

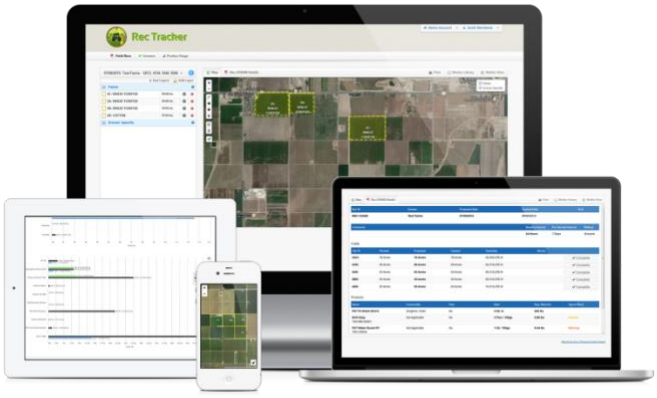
Stop guessing at how much water your putting on every season, with this simple app you can record accurate meter readings and instantly know exactly how much your putting on and when. Set up all your well location and field sets and within minutes you can start receiving up to date information on pump status and usage.

Crop Cast

Hyper Local Weather and Pest Forecasting

Free w/ Upgraded Monthly Subscription

Crop Cast utilizes state of the art software to bring together data from multiple local weather stations and forecasts weather, degree days, chill hours, and location based pest cycle prediction based on highly researched pest models to equip you to anticipate

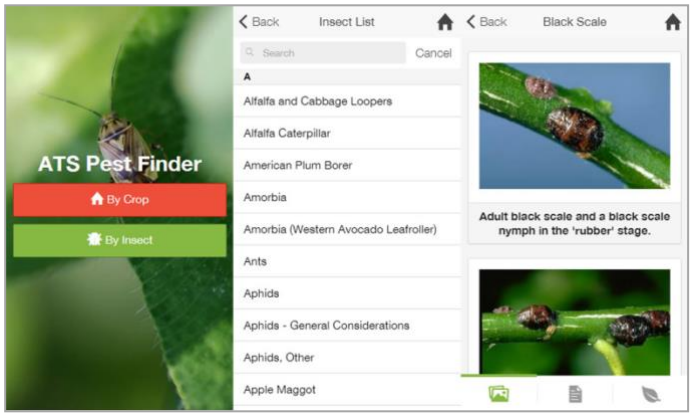


Rec Tracker

Recommendation Manager

Monthly Subscription

Rec Tracker is a management tool for chemical applicators to automatically import and track pesticide and fertilizer recommendations. The application allows users to generate maps and notes associated with recommendations. Additionally, the program comes with a mobile app that allows for mapping directions and completing of jobs.



ATS Pest Finder

Insect/Pest Finder

Free

ATS Pest Finder is a mobile application created to help identify insects by name, images, or associated crops. Each insect is displayed with a number of pictures, detailed information, and the crops it may be found in. The mobile application allows insects to be found by name or associated crop.

5. References

- **Reference 1:** Nicole Bell, nbell@krwca.org, 916-717-2179
- **Reference 2:** Becky Ortiz, bortiz@semitropic.com, 661-337-9595

6. Cost Proposal

Subscription Fee: (Includes essential support, regular software updates, system maintenance, and comprehensive security monitoring)

Our fee structure is based on irrigated acreage and includes a base fee which will is assessed annually. Given the current GSA structure with Madera, Chowchilla, and Delta Mendota Subbasins our system is designed in a way that allows growers to manage ground in all 3 subbasins while Subbasin allocations, fees, & policies can be customized to the needs of the subbasin. Here is the pricing breakdown on a annual basis based on irrigated acreage:

Subbasin	Irrigated Acres	Annual Fee
Madera Subbasin	**81,473.00**	**67,957.45**
Chowchilla Subbasin	**35,872.00**	**38,316.80**
Delta-Mendota Subbasin	**1,755.00**	**16,140.75**

Additional Services: (Custom development, enhancements, and strategic consulting)

- **Hourly Rate:** $225/hour, with detailed estimates provided prior to project initiation.

Travel and Other Direct Costs:

- All actual travel and related expenses transparently billed at cost, with full documentation and receipts provided upon request.

Thank you for considering United Tracking Systems. We eagerly look forward to the opportunity to work closely with Madera County GSA, supporting your ongoing efforts toward groundwater sustainability and effective resource management.

Committee Members
Leticia Gonzalez
Robert Macaulay

ITEM 5

Date: June 27, 2025

To: Madera County Groundwater Sustainability Agency (GSA) Committee
Leticia Gonzalez, Robert Macaulay

From: Stephanie Anagnoson, Director of Water and Natural Resources

Subject: Action Item: Consideration and Recommendation to the Board of Directors to approve a resolution amending Resolution 2022-086 and repealing and replacing resolution 2022-198 establishing revised fees for Domestic Well Mitigation Program for the Madera Subbasin.

DISCUSSION:

Background

Building on outreach during development of groundwater sustainability plans from 2017-2020, in 2021 and 2022, the Madera County Groundwater Sustainability Agencies (County GSAs) in the Madera, Chowchilla, and Delta-Mendota subbasins engaged in further outreach, including massive education and rate study efforts related to potential projects identified in the respective groundwater sustainability plans (GSPs) that growers had indicated an interest in funding.

In June of 2022, after many public meetings and workshops, the County GSAs held public hearings for proposed fees in the Madera, Chowchilla and Delta-Mendota subbasins. Fees were adopted in the Madera and Delta-Mendota subbasins, but not in the Chowchilla Subbasin where a majority protest prevented the fee from being adopted. The fees for Madera and Delta-Mendota subbasins were intended to fund projects for land repurposing, recharge, water purchases, and to mitigate harm to domestic wells. The fees were placed for collection on property tax bills.

However, in December of 2022, a court order enjoined collection of the fees in the Madera and Delta-Mendota subbasins. The County GSAs in those subbasins refunded the fees that were paid in 2022 prior to the Court's order and were enjoined from collecting fees in 2023 and 2024, leaving projects unbuilt and unfunded.

The Court dissolved the injunction on March 4, 2025, allowing the County GSAs to resume collecting the fees. Fees for Fiscal Years 2022/2023 through 2024/2025 are currently uncollected. Instead of seeking to collect the full fees including for past years in Fiscal Year 2025/2026, the County GSAs are proposing to collect a reduced rate for Fiscal Years 2025/2026 through 2029/2030, which will fund only domestic well mitigation.

Current Situation

As of April 2025, there are 247 de-watered wells in the Madera Subbasin that are on interim solutions administered from Self-Help Enterprises. Current estimates indicate an additional 601 domestic wells are expected to be impacted by decreasing water levels from 2026-2030. Mitigation efforts for these wells need to be funded as part of a Domestic Well Mitigation Program. This means there will be approximately 850 domestic wells in need of mitigation by 2030. Based on contribution to overdraft in the subbasin, those in the County GSA areas are expected to fund mitigation efforts for 73% of the wells, or approximately 621 wells over the next five years. If that number of 621 is divided over 5 years, it is 124 wells per year, on average.

Costs for this program are based on the installation of a domestic well at an estimated cost of $35,000. This proposed cost of $35,000 does not include paying for additional electrical work or a pump. A property will be eligible for the program only after it is determined that the well was de-watered due to overdraft. Administration of the program is estimated at 10%. The proposed fee is based on the Madera County GSA cost share, which is approximately 73% based on contribution to overdraft.

If the wells on interim solutions are funded over three years, assuming $35,000/well and adding additional wells that will go dry, the rate is approximately $65-70/acre within the farm unit depending on the year, decreasing to approximately $42-43/acre when the interim solutions are addressed after three years. If the County GSA were to issue bonds to fund the cost of the backlog of de-watered wells, the initial rate could be lowered to approximately $50/acre. However, bonds are not an option while litigation is ongoing.

Feedback Received

On June 3, 2025, staff requested feedback on the draft rate for domestic well mitigation for assessment on fall 2025 property tax bills. Feedback included a desire to credit penalties

towards the new proposed rate for domestic well mitigation as well as a way to “Opt Out” of fees if growers had not contributed to groundwater overdraft.

To give credit for the funds collected for penalties in the Madera Subbasin, County GSA so far, two new rates are proposed:

$65/acre in the current fiscal year using an averaged rate over three years (consistent with the approach of the rate study) or $59/acre in the current fiscal year using an unaveraged rate; rates in the second and third year would initially increase to $67/acre and $69/acre respectively, but would be reevaluated and reduced based on penalties collected in the prior year.

Staff also proposes allowing growers to “Opt Out” if they are under the base sustainable yield of 6 inches for the past 10 years. An “Opt Out” would result in no allocation of transition water.

FISCAL IMPACT:

There is a direct fiscal impact to those within the Madera County Groundwater Sustainability Agency, Madera Subbasin, who would be subject to the rate.

ATTACHMENTS:

1. Draft Resolution for Domestic Well Mitigation Program Fee Adoption

Water and Natural Resources
200 West Fourth Street • Madera, CA 93637 • 559.662.8015 • maderacountywater.com • maderacounty.com

BEFORE
THE BOARD OF DIRECTORS
OF THE COUNTY OF MADERA
GROUNDWATER SUSTAINABILITY AGENCY
FOR THE MADERA SUBBASINS

In the Matter of	)	Resolution No.: 2025 - _____
	)	
GROUNDWATER SUSTAINABILITY AGENCY	)	RESOLUTION AMENDING RESOLUTION 2022-086 AND REPEALING AND REPLACING RESOLUTION 2022-198 ESTABLISHING REVISED FEES FOR DOMESTIC WELL MITIGATION PROGRAM FOR THE MADERA SUBBASIN
	)	
	)	
	)	
_____	)	

RECITALS

WHEREAS, the Sustainable Groundwater Management Act, Water Code sections 10720-10737.8 ("SGMA") was signed into law on September 16, 2014;

WHEREAS, SGMA requires that each groundwater basin be managed by a Groundwater Sustainability Agency ("GSA"), or multiple GSAs, and that such management be pursuant to an approved Groundwater Sustainability Plan ("GSP"), or multiple GSPs;

WHEREAS, the County of Madera ("County") is the exclusive GSA for the portions of the Madera Subbasin that are in unincorporated areas of Madera County, and not otherwise covered by another public agency (hereinafter referred to in the singular as the "County GSA"), and the Board of Supervisors is the ex officio Board of Directors (hereinafter "Board of Directors") for the County GSA;

WHEREAS, on December 17, 2019, the County GSA, along with the Madera Irrigation District GSA, the City of Madera GSA, and the Madera Water District GSA, adopted a GSP (the "Joint GSP") for the portions of the Madera Subbasin within the

control of these GSAs that described a “sustainable yield” (“SY”) of native groundwater (water that naturally exists in the Madera Subbasin from seepage and percolation) of approximately 0.5 acre-feet per acre for the Madera Subbasin;

WHEREAS, in the Joint GSP the GSAs agreed to implement a Domestic Well Mitigation Program;

WHEREAS, on December 15, 2020, the Board of Directors adopted Resolution No. 2020-166 adopting an approach to allocating groundwater (the “Allocation Approach”) in the Subbasin, allowing parcels meeting certain criteria (hereafter “eligible parcels”) to have access to groundwater classified using two designations:

a. The SY of native groundwater; and

b. “Transitional water” (“TW”) that is continued overdraft of the Subbasin but will incrementally decrease during the GSP implementation period;

WHEREAS, in furtherance of the Allocation Approach, on June 8, 2021, the County GSA Board of Directors adopted Resolution No. 2021-069, providing for a per-acre allocation of SY and TW for enrolled eligible parcels within each County GSA based on best available data, to be limited to the use within the eligible parcel, or within a County GSA approved farm unit, that represents a combination of eligible parcels;

WHEREAS, the amount of groundwater available to properties under the Allocation Approach is calculated based on the overall acreage in the eligible enrolled parcel or approved farm unit;

WHEREAS, on August 17, 2021, the Board of Directors adopted Resolution No. 2021-113, establishing groundwater allocation refinements;

WHEREAS, Water Code section 10730.2, subdivision (a), provides that a GSA

that has adopted a GSP "may impose fees on the extraction of groundwater from the basin to fund costs of groundwater management, including, but not limited to, the costs of the following:

(1) Administration, operation, and maintenance, including a prudent reserve.

(2) Acquisition of lands or other property, facilities, and services.

(3) Supply, production, treatment, or distribution of water.

(4) Other activities necessary or convenient to implement the plan(;)"

WHEREAS, Water Code section 10730.2, subdivision (d), provides that "[f]ees imposed pursuant to this section may include fixed fees and fees charged on a volumetric basis,"

WHEREAS, Water Code section 10730.2, subdivision (c), provides that "[f]ees imposed pursuant to this section shall be adopted in accordance with subdivisions (a) and (b) of Section 6 of Article XIII D of the California Constitution,";

WHEREAS, Article XIII D of the California Constitution imposes certain procedural and substantive requirements for property related fees and charges (as defined);

WHEREAS, the County GSA will not have adequate funds for its share of the Domestic Well Mitigation Program without implementing a fee;

WHEREAS, under subdivision (a)(1) of Section 6 of Article XIII D of the California Constitution, "[t]he agency shall provide written notice by mail of the proposed fee or charge to the record owner of each identified parcel upon which the fee or charge is proposed for imposition, the amount of the fee or charge proposed to be imposed upon

each, the basis upon which the amount of the proposed fee or charge was calculated, the reason for the fee or charge, together with the date, time, and location of a public hearing on the proposed fee or charge;"

WHEREAS, under subdivision (a)(2) of Section 6 of Article XIII D of the California Constitution, "[t]he agency shall conduct a public hearing upon the proposed fee or charge not less than 45 days after mailing the notice of the proposed fee or charge to the record owners of each identified parcel upon which the fee or charge is proposed for imposition," and "[a]t the public hearing, the agency shall consider all protests against the proposed fee or charge, and "[i]f written protests against the proposed fee or charge are presented by a majority of owners of the identified parcels, the agency shall not impose the fee or charge;"

WHEREAS, on April 12, 2022, the Board of Directors, at a duly noticed public meeting, authorized staff to commence a proceeding under Proposition 218, as required by SGMA, for the proposed rate as set forth in the Report prepared by Raftelis;

WHEREAS, on May 2, 2022, notices for the proposed fee were sent by mail to all identified affected property owners within the County GSA for the Madera Subbasin, providing the proposed rate, the basis for the rate, the affected property owner's right to protest the rate, and the time, place, and location of the public hearing on June 21, 2022;

WHEREAS, in the above-referenced Proposition 218 notice, affected property owners were informed that to protest the rate, they would either need to send a letter to the Chief Clerk of the Madera County Board of Supervisors, 4th floor, 200 West Fourth Street, Madera, CA, 93637, which would include the property owner's name, property owner's signature, and assessor's parcel number (APN), or appear in person on June 21,

2022, at Board of Supervisors' Chambers, 200 W. 4th Street, Madera, CA, 93637, at 10:30 a.m. to deliver the protest in person;

WHEREAS, on June 21, 2022, the Board of Directors conducted a duly noticed public hearing for the proposed fee to (1) determine whether there was a majority protest for the fee, and if not, (2) to consider whether to adopt the fee;

WHEREAS, at the hearing, the Chief Clerk to the Madera County Board of Supervisors, on behalf of the Board of Directors, received and tabulated all protests of the proposed fee made both prior to and during the hearing, and the protests did not amount to a majority of the affected parcels where notice of the proposed fee was provided;

WHEREAS, on June 21, 2022, having not received a protest from the majority of affected parcels, the Board of Directors adopted Resolution No. 2022-086, establishing a fixed fee (the "Project Fee") of $246 per acre of land enrolled in the Allocation Approach ("Enrolled Acre"), to provide funds sufficient for the County GSA to cover the costs of implementing GSP projects—i.e., groundwater recharge, participation in the proposed Sites Reservoir, land repurposing, and domestic well mitigation;

WHEREAS, in December 2022, the Madera County Superior Court enjoined collection of the Project Fee;

WHEREAS, following the Court's ruling, on December 20, 2022, the Board of Directors adopted Resolution No. 2022-198 removing the GSP Project Fee-Madera Subbasin from the 2022-2023 tax year secured property tax bills, until such time as the Court's injunction was lifted;

WHEREAS, the Court dissolved the injunction on March 4, 2025, allowing the

County GSA to resume collection of the Project Fee, but leaving the County GSA in a multi-year funding shortfall for the projects;

WHEREAS, the County GSA is mindful of the hardship that would result from immediately collecting back-fees in excess of $60 million to fill the funding shortfall created by the Court's injunction;

WHEREAS, the County GSA has proposed to repeal and replace Resolution NO. 2022-198 and amend Resolution No. 2022-086 to revise the Project Fee ("Revised Fee") downward to collect funds sufficient for the County GSA to cover the costs of implementing a portion of the Domestic Well Mitigation Program only, while maintaining the ability to further the amend fee in the future, through an increase to what was previously approved or a further decrease, if conditions require;

WHEREAS, an updated study report ("Supplemental Report") to determine the amount of revenue required for the Domestic Well Mitigation Program for the Fee was conducted by Raftelis, an independent consulting firm;

WHEREAS, agriculture water use represents the majority of water use in the Madera Subbasin;

WHEREAS, the proposed Revised Fee will fund the Domestic Well Mitigation Program, as stated in the Supplemental Report, Exhibit "A," attached hereto and incorporated herein by reference, at the rate of $_____ per Enrolled Acre. The Fee was calculated per Enrolled Acre and rounded to the nearest whole dollar;

WHEREAS, the proposed Revised Fee in the Supplemental Report of $_____ per Enrolled Acre per year beginning with the 2025 property tax year represents the average annual cost of service and does not include the collection of more revenue than

the cost of providing service for the Domestic Well Mitigation Program. The Revised Fee will be reviewed annually to ensure it continues to represent the average annual cost of service and does not include the collection of more revenue than the cost of providing service;

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors for the County GSA, as follows:

1. The recitals set forth above are found to be true and correct and are incorporated herein by reference.

2. The Supplemental Report is hereby received and approved.

3. The previously approved Fee of $246 per Enrolled Acre is hereby amended to the Revised Fee on the terms and conditions set forth in Exhibit "A," attached hereto and incorporated herein by reference, with the ability to further amend the fee in the future, through an increase or decrease, if conditions require.

4. The Director of the County Department of Water and Natural Resources ("Department Director") is authorized and directed to annually request the County Treasurer-Tax Collector, on behalf of the Board of Directors, to collect the Revised Fee in the same manner as ad valorem property taxes and provide the County Auditor-Controller, with the required information no later than August 1 of each year.

5. If the Revised Fee is not able to be collected in the same manner as ad valorem property taxes for any reason, the Department Director is hereby authorized and directed to cause the direct billing of the Revised Fee.

6. The Department Director is hereby authorized and directed to take further actions as may be necessary to implement the intent and purposes of this Resolution.

7. This Resolution hereby amends Resolution No. 2022-086, and repeals and replaces Resolution No. 2022-198.

8. This Resolution is exempt from the requirements of the California Environmental Quality Act (CEQA) pursuant to California Public Resources Code section 21080(b)(8) and CEQA Guidelines section 15273(a) because it concerns the establishment of operational rates and charges. Further, this Resolution is exempt from CEQA requirements pursuant to CEQA Guidelines section 15061(b)(3) because it can be seen with a certainty that this action will not have a significant effect on the environment. This Resolution is also exempt from CEQA requirements pursuant to CEQA Guidelines section 15378(b)(5) because it involves administrative activities that will not result in direct or indirect physical changes in the environment. The Board of Directors therefore directs that a Notice of Exemption be filed with the County Clerk in accordance with the CEQA Guideline.

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The foregoing Resolution was adopted this _____ day of _____, 2025, by the following vote.

Director Warmhoff voted: ____

Director Rogers voted: ____

Director Poythress voted: ____

Director Gonzalez voted: ____

Director Macaulay voted: ____

_____
Chair, Board of Directors

ATTEST:

_____
Clerk, Board of Directors

Approved as to Legal form:
COUNTY COUNSEL

By_____

Committee Members
Leticia Gonzalez
Robert Macaulay

ITEM 6

Date: June 27, 2025

To: Madera County Groundwater Sustainability Agency (GSA) Committee
Leticia Gonzalez, Robert Macaulay

From: Stephanie Anagnoson, Director of Water and Natural Resources

Subject: Action Item: Consideration and Recommendation to the Board of Directors to approve a resolution repealing Resolution No. 2025-004 and reinstating Resolution No. 2022-072 which outlines procedures for the review of new or altered groundwater wells and verification of consistency with adopted groundwater sustainability plans.

DISCUSSION:

On March 28, 2022, the Governor of California signed an executive order N-7-22, which included a requirement, 9a. for groundwater sustainability agencies (GSAs) to provide written verification for new or altered wells. GSAs are required to verify that the well is not inconsistent with any groundwater management program in a groundwater sustainability plan (GSP) and would not decrease the likelihood of achieving sustainability goals of the applicable GSPs.

The criteria for the GSA to be used for determining compliance with N-7-22, 9a., is described below. If the well is: a.) within the County GSA; b.) has been assigned an allocation that decreases over time; and c.) is monitored with satellite measurement to calculate the evapotranspiration of applied water, then the well or altered well can be verified. Using the above criteria ensures that the water demand that this well represents is already included within the GSPs and that it will decrease over time.

On September 5, 2024, the Governor of California signed an executive order N-3-24 that removed drought restrictions including the GSA responsibility to verify wells in multiple counties throughout California. Madera County responded with a Resolution #2025-004 in January of 2025 rescinding the previous rules put forth by Resolution #2022-072.

Unfortunately, Madera and other counties in the San Joaquin Valley were not included in the termination of the Drought State of Emergency removing these responsibilities from the

Committee Members
Leticia Gonzalez
Robert Macaulay

ITEM 6

GSA. This Resolution is to re-instate the responsibility of the GSA Verification of Wells Rules until further notice.

FISCAL IMPACT:

While there is a fiscal impact in terms of an increase in workload, this work will be done with existing staff whose salaries are paid for with the County GSA Admin Fee.

ATTACHMENTS:

1. Resolution Reinstating RES NO. 2022-072
2. RES NO. 2025-004
3. RES NO. 2022-072
4. GOV EO N-7-22
5. GOV EO N-3-24

JH

BEFORE
THE BOARD OF DIRECTORS
OF THE COUNTY OF MADERA
GROUNDWATER SUSTAINABILITY AGENCIES
FOR THE MADERA, CHOWCHILLA, AND DELTA-MENDOTA SUBASINS

In the Matter of	)	Resolution No.: 2025 - _____
	)	
GROUNDWATER SUSTAINABILITY AGENCIES	)	RESOLUTION REPEALING RESOLUTION NO. 2025-004 AND REINSTATING RESOLUTION NO. 2022-072 REGARDING WELL VERIFICATION
	)	
	)	
	)	
_____	)	

WHEREAS, the Sustainable Groundwater Management Act, Water Code sections 10720-10737.8 ("SGMA") was signed into law on September 16, 2014;

WHEREAS, SGMA requires that each groundwater basin be managed by a Groundwater Sustainability Agency ("GSA"), or multiple GSAs, and that such management be pursuant to an approved Groundwater Sustainability Plan ("GSP"), or multiple GSPs;

WHEREAS, the County of Madera ("County") is the exclusive GSA for the portions of the Madera Subbasin, Chowchilla Subbasin, and Delta-Mendota Subbasin that are in unincorporated areas of Madera County, and not otherwise covered by another public agency (hereinafter referred to in the singular as, "County GSA"), and the Board of Supervisors is the ex officio Board of Directors ("Board") for the County GSA;

WHEREAS, the Director of the County Department of Water and Natural Resources manages the day-to-day operations of the County GSAs ("GSA manager");

WHEREAS, on March 28, 2022, the Governor of the State of California signed Executive Order ("EO") N-7-22 requiring a GSA to provide written verification that a new or altered well within the management area or basin that the GSA is responsible for is not

inconsistent with any sustainable groundwater management program established in the applicable GSP and would not decrease the likelihood of achieving a sustainability goal for the basin covered by such GSP;

WHEREAS, the Board established, by Resolution No. 2022-072, the procedures for the County GSAs to follow when processing groundwater well permit applications that require a GSA verification pursuant to EO N-7-22;

WHEREAS, Resolution No. 2022-072 provided the Madera County GSAs with fixed procedures and standards for the review of all new applications for groundwater wells within the portions of the Madera, Chowchilla, and Delta Mendota Subbasins for which the County of Madera GSA is the responsible agency;

WHEREAS, on September 5, 2024, the Governor of the State of California signed Executive Order ("EO") N-3-24 which terminated EO N-7-22;

WHEREAS, the Board repealed and rescinded Resolution No. 2022-072 in Resolution No. 2025-004;

WHEREAS, the County has received clarification that the Governor's termination of EO N-7-22 applied only to nineteen (19) counties listed in the order;

WHERAS, the termination of EO N-7-22 does not apply to Madera County; and

WHEREAS, it is the desire of the Board of Directors to repeal and resind Resolution No. 2025-004 and reinstate Resolution No. 2022-072.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors for the County GSA, as follows:

1. The recitals set forth above are found to be true and correct and are incorporated herein by reference.

2. Resolution No. 2025-004 is hereby rescinded and repealed in its entirety effective immediately.

3. Resolution No. 2022-072 is hereby reinstated in its entirety effective immediately and attached hereto as Exhibit "A."

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The foregoing Resolution was adopted this _____ day of _____, 2025, by the following vote:

Director Wamhoff voted: _____

Director Rogers voted: _____

Director Poythress voted: _____

Director Gonzalez voted: _____

Director Macaulay voted: _____

_____
Chair, Board of Directors

ATTEST:

_____
Clerk, Board of Directors

Approved as to Legal Form:
COUNTY COUNSEL

By Rebecca Wilson Digitally signed by: Rebecca Wilson DN: CN = Rebecca Wilson email = rwilson@lozanosmith.com C = US O = LOZANO SMITH Date: 2025.06.05 14:56:24 -07'00'

4925-8131-2587, v.1

EXHIBIT A

RESOLUTION NO. 2022-072

AN RESOLUTION OF THE BOARD OF DIRECTORS OF THE COUNTY OF MADERA GROUNDWATER SUSTAINABILITY AGENCIES ESTABLISHING PROCEDURES FOR THE REVIEW OF NEW OR ALTERED GROUNDWATER WELLS AND VERIFICATION OF CONSISTENCY WITH ADOPTED GROUNDWATER SUSTAINABILITY PLANS

RECITALS

WHEREAS, the Sustainable Groundwater Management Act, Water Code sections 10720-10737.8 ("SGMA") was signed into law on September 16, 2014.

WHEREAS, SGMA requires that each groundwater basin be managed by a Groundwater Sustainability Agency ("GSA"), or multiple GSAs, and that such management be pursuant to an approved Groundwater Sustainability Plan ("GSP"), or multiple GSPs.

WHEREAS, the County of Madera ("County") is the exclusive GSA for the portions of the Madera Subbasin, Chowchilla Subbasin, and Delta-Mendota Subbasin that are in unincorporated areas of Madera County, and not otherwise covered by another public agency (hereinafter referred to in the singular as "County GSA"), and the Board of Supervisors is the ex officio Board of Directors (hereinafter "Board") for the County GSA.

WHEREAS, the Director of the County Department of Water and Natural Resources manages the day-to-day operations of the County GSAs (hereinafter the "GSA manager.")

WHEREAS, on March 28, 2022, the Governor of the State of California signed Executive Order ("EO") N-7-22 requiring a GSA to provide written verification that a new or altered well within the management area or basin that the GSA is responsible for is not inconsistent with any sustainable groundwater management program established in the

applicable GSP and would not decrease the likelihood of achieving a sustainability goal for the basin covered by such GSP.

WHEREAS, the Board desires to establish by resolution procedures for the County GSAs to follow when processing addressing groundwater well permit applications that require a GSA verification pursuant to EO N-7-22.

WHEREAS, the purpose of this Resolution to provide the Madera County GSAs with fixed procedures and standards against for the review all new applications for groundwater wells within the portions of the Madera, Chowchilla, and Delta Mendota Subbasins for which the County of Madera GSA is the responsible agency.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors for the County GSA, as follows:

1. The recitals set forth above are found to be true and correct and are incorporated herein by reference.

2. For any groundwater well permit application received by the County of Madera Environmental Health Department that is within the jurisdiction of a County GSA, other than those excluded in Section 9 of EO N-7-22, County GSA staff will review the permit application to determine if the GSA can provide a written verification that the proposed well would not be inconsistent with any sustainable groundwater management program established under the respective GSPs for the GSAs in each subbasin, and would not decrease the likelihood of achieving a sustainability goal for the basin covered by the GSPs.

3. To determine whether a proposed groundwater well can be verified to comply with Section 9 of EO N-7-22, County GSA staff will evaluate the components of

the well permit application with respect to the following criteria:

a. The proposed well is located within the boundaries of a County GSA.

b. The proposed well is located on a parcel that has been assigned an allocation of groundwater, which decreases over time.

c. The proposed well is located on a parcel that is monitored by the measurement program currently utilized by the County GSA for monitoring the evapotranspiration of applied water ("ETAW").

4. Should all three of the above-referenced criteria be met, County GSA staff shall denote on the adopted "Well Permit Verification Form" (Attachment A) by denoting, with a check mark, that all three criteria have been met, and by initialing on the "Staff Initials" section. Following the review by County GSA staff, the GSA manager shall sign the "Well Permit Verification Form" and return the form to the well permit applicant.

5. Should the above-referenced criteria not be met, County GSA staff will denote on the "Well Permit Verification Form" which, if any, of the criteria were met and provide the incomplete verification to the GSA manager. The GSA manager shall then provide a letter to the well permit applicant outlining why the well permit application cannot be verified by the County GSA.

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6. The GSA manager is hereby authorized and directed to take all measures in furtherance of, and consistent with, this Resolution.

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The foregoing Resolution was adopted this 17 day of MAY, 2022, by the following vote.

Director Frazier voted: Yes

Director Rogers voted: Yes

Director Poythress voted: Yes

Director Gonzalez voted: Yes

Director Wheeler voted: Yes

Chairman, Board of Directors

ATTEST:

Clerk, Board of Directors

Approved as to Legal form:
COUNTY COUNSEL

By Michael R. Linden

Digitally signed by: Michael R. Linden
DN: CN = Michael R. Linden email = mlinden@lozanosmith.com C = US O = LOZANO SMITH
Date: 2022.04.28 13:47:04 -07'00'

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Exhibit A
Verification Form

State of California Executive Order N-7-22 #9a.

9. To protect health, safety, and the environment during this drought emergency, a county, city, or other public agency shall not:

a. Approve a permit for a new groundwater well or for alteration of an existing well in a basin subject to the Sustainable Groundwater Management Act and classified as medium- or high-priority without first obtaining written verification from a Groundwater Sustainability Agency managing the basin or area of the basin where the well is proposed to be located that groundwater extraction by the proposed well would not be inconsistent with any sustainable groundwater management program established in any applicable Groundwater Sustainability Plan adopted by that Groundwater Sustainability Agency and would not decrease the likelihood of achieving a sustainability goal for the basin covered by such a plan.

.....

Pursuant to Resolution _____, the following conditions been met, for the parcel on which the proposed well is located:

☐ The parcel is located within the boundary of the Madera County GSAs

☐ The parcel has received a groundwater allocation that decreases over time

☑ The parcel is registered in the evapotranspiration measurement program

If all three conditions are met, the GSA acknowledges the proposed Ag well adheres to the State of California Executive Order N-7-22 item #9 a.

Staff Review: Date: Click or tap to enter a date. Initial: Click or tap here to enter text.
☐ Conditions met
☐ Conditions not met

Assessor Parcel Number (APN): _____ Date: _____

Subbasin: _____

GSA: _____

_____ _____
GSA Manager (print name) GSA Manager (signature)

BEFORE
THE BOARD OF DIRECTORS
OF THE COUNTY OF MADERA
GROUNDWATER SUSTAINABILITY AGENCIES
FOR THE MADERA, CHOWCHILLA, AND DELTA-MENDOTA SUBASINS

In the Matter of	)	Resolution No.: 2024-5-004
	)	
GROUNDWATER SUSTAINABILITY AGENCIES	)	RESOLUTION REPEALING RESOLUTION NO. 2022-072 REGARDING WELL VERIFICATION

WHEREAS, the Sustainable Groundwater Management Act, Water Code sections 10720-10737.8 ("SGMA") was signed into law on September 16, 2014;

WHEREAS, SGMA requires that each groundwater basin be managed by a Groundwater Sustainability Agency ("GSA"), or multiple GSAs, and that such management be pursuant to an approved Groundwater Sustainability Plan ("GSP"), or multiple GSPs;

WHEREAS, the County of Madera ("County") is the exclusive GSA for the portions of the Madera Subbasin, Chowchilla Subbasin, and Delta-Mendota Subbasin that are in unincorporated areas of Madera County, and not otherwise covered by another public agency (hereinafter referred to in the singular as, "County GSA"), and the Board of Supervisors is the ex officio Board of Directors ("Board") for the County GSA;

WHEREAS, the Director of the County Department of Water and Natural Resources manages the day-to-day operations of the County GSAs ("GSA manager");

WHEREAS, on March 28, 2022, the Governor of the State of California signed Executive Order ("EO") N-7-22 requiring a GSA to provide written verification that a new or altered well within the management area or basin that the GSA is responsible for is not

inconsistent with any sustainable groundwater management program established in the applicable GSP and would not decrease the likelihood of achieving a sustainability goal for the basin covered by such GSP;

WHEREAS, the Board established, by Resolution No. 2022-072, the procedures for the County GSAs to follow when processing addressing groundwater well permit applications that require a GSA verification pursuant to EO N-7-22;

WHEREAS, Resolution No. 2022-072 provided the Madera County GSAs with fixed procedures and standards against for the review all new applications for groundwater wells within the portions of the Madera, Chowchilla, and Delta Mendota Subbasins for which the County of Madera GSA is the responsible agency;

WHEREAS, on September 5, 2024, the Governor of the State of California signed Executive Order ("EO") N-3-24 which terminated EO N-7-22; and

WHEREAS, it is the desire of the Board of Directors to repeal and rescind Resolution No. 2022-072.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors for the County GSA, as follows:

1. The recitals set forth above are found to be true and correct and are incorporated herein by reference.

2. Resolution No. 2022-072 is hereby rescinded and repealed in its entirety effective immediately.

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The foregoing Resolution was adopted this 7TH day of JANUARY, 2024, by the following vote:

Director Wamhoff voted: Yes

Director Rogers voted: Yes

Director Poythress voted: Yes

Director Gonzalez voted: Yes

Director Macaulay voted: Yes

Chair
Board of Directors

ATTEST:

Clerk, Board of Directors

Approved as to Legal Form:
COUNTY COUNSEL

Laurie Avedisian-Favini

Digitally signed by: Laurie Avedisian-Favini
DN: CN = Laurie Avedisian-Favini email = lfavini@lozanosmith.com C = US O = Lozano Smith
Date: 2024.11.21 16:48:00 -08'00'

By _____

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RESOLUTION NO. 2022-072

AN RESOLUTION OF THE BOARD OF DIRECTORS OF THE COUNTY OF MADERA GROUNDWATER SUSTAINABILITY AGENCIES ESTABLISHING PROCEDURES FOR THE REVIEW OF NEW OR ALTERED GROUNDWATER WELLS AND VERIFICATION OF CONSISTENCY WITH ADOPTED GROUNDWATER SUSTAINABILITY PLANS

RECITALS

WHEREAS, the Sustainable Groundwater Management Act, Water Code sections 10720-10737.8 ("SGMA") was signed into law on September 16, 2014.

WHEREAS, SGMA requires that each groundwater basin be managed by a Groundwater Sustainability Agency ("GSA"), or multiple GSAs, and that such management be pursuant to an approved Groundwater Sustainability Plan ("GSP"), or multiple GSPs.

WHEREAS, the County of Madera ("County") is the exclusive GSA for the portions of the Madera Subbasin, Chowchilla Subbasin, and Delta-Mendota Subbasin that are in unincorporated areas of Madera County, and not otherwise covered by another public agency (hereinafter referred to in the singular as "County GSA"), and the Board of Supervisors is the ex officio Board of Directors (hereinafter "Board") for the County GSA.

WHEREAS, the Director of the County Department of Water and Natural Resources manages the day-to-day operations of the County GSAs (hereinafter the "GSA manager.")

WHEREAS, on March 28, 2022, the Governor of the State of California signed Executive Order ("EO") N-7-22 requiring a GSA to provide written verification that a new or altered well within the management area or basin that the GSA is responsible for is not inconsistent with any sustainable groundwater management program established in the

applicable GSP and would not decrease the likelihood of achieving a sustainability goal for the basin covered by such GSP.

WHEREAS, the Board desires to establish by resolution procedures for the County GSAs to follow when processing addressing groundwater well permit applications that require a GSA verification pursuant to EO N-7-22.

WHEREAS, the purpose of this Resolution to provide the Madera County GSAs with fixed procedures and standards against for the review all new applications for groundwater wells within the portions of the Madera, Chowchilla, and Delta Mendota Subbasins for which the County of Madera GSA is the responsible agency.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors for the County GSA, as follows:

1. The recitals set forth above are found to be true and correct and are incorporated herein by reference.

2. For any groundwater well permit application received by the County of Madera Environmental Health Department that is within the jurisdiction of a County GSA, other than those excluded in Section 9 of EO N-7-22, County GSA staff will review the permit application to determine if the GSA can provide a written verification that the proposed well would not be inconsistent with any sustainable groundwater management program established under the respective GSPs for the GSAs in each subbasin, and would not decrease the likelihood of achieving a sustainability goal for the basin covered by the GSPs.

3. To determine whether a proposed groundwater well can be verified to comply with Section 9 of EO N-7-22, County GSA staff will evaluate the components of

the well permit application with respect to the following criteria:

a. The proposed well is located within the boundaries of a County GSA.

b. The proposed well is located on a parcel that has been assigned an allocation of groundwater, which decreases over time.

c. The proposed well is located on a parcel that is monitored by the measurement program currently utilized by the County GSA for monitoring the evapotranspiration of applied water ("ETAW").

4. Should all three of the above-referenced criteria be met, County GSA staff shall denote on the adopted "Well Permit Verification Form" (Attachment A) by denoting, with a check mark, that all three criteria have been met, and by initialing on the "Staff Initials" section. Following the review by County GSA staff, the GSA manager shall sign the "Well Permit Verification Form" and return the form to the well permit applicant.

5. Should the above-referenced criteria not be met, County GSA staff will denote on the "Well Permit Verification Form" which, if any, of the criteria were met and provide the incomplete verification to the GSA manager. The GSA manager shall then provide a letter to the well permit applicant outlining why the well permit application cannot be verified by the County GSA.

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6. The GSA manager is hereby authorized and directed to take all measures in furtherance of, and consistent with, this Resolution.

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The foregoing Resolution was adopted this 17 day of MAY, 2022, by the following vote.

Director Frazier voted: Yes

Director Rogers voted: Yes

Director Poythress voted: Yes

Director Gonzalez voted: Yes

Director Wheeler voted: Yes

Chairman, Board of Directors

ATTEST:

Clerk, Board of Directors

Approved as to Legal form:
COUNTY COUNSEL

By Michael R. Linden

Digitally signed by: Michael R. Linden
DN: CN = Michael R. Linden email = mlinden@lozanosmith.com C = US O = LOZANO SMITH
Date: 2022.04.28 13:47:04 -07'00'

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Exhibit A
Verification Form

State of California Executive Order N-7-22 #9a.

9. To protect health, safety, and the environment during this drought emergency, a county, city, or other public agency shall not:

a. Approve a permit for a new groundwater well or for alteration of an existing well in a basin subject to the Sustainable Groundwater Management Act and classified as medium- or high-priority without first obtaining written verification from a Groundwater Sustainability Agency managing the basin or area of the basin where the well is proposed to be located that groundwater extraction by the proposed well would not be inconsistent with any sustainable groundwater management program established in any applicable Groundwater Sustainability Plan adopted by that Groundwater Sustainability Agency and would not decrease the likelihood of achieving a sustainability goal for the basin covered by such a plan.

.....

Pursuant to Resolution _____, the following conditions been met, for the parcel on which the proposed well is located:

☐ The parcel is located within the boundary of the Madera County GSAs

☐ The parcel has received a groundwater allocation that decreases over time

☑ The parcel is registered in the evapotranspiration measurement program

If all three conditions are met, the GSA acknowledges the proposed Ag well adheres to the State of California Executive Order N-7-22 item #9 a.

Staff Review: Date: Click or tap to enter a date. Initial: Click or tap here to enter text.
☐ Conditions met
☐ Conditions not met

Assessor Parcel Number (APN): _____ Date: _____

Subbasin: _____

GSA: _____

_____ _____
GSA Manager (print name) GSA Manager (signature)

EXECUTIVE DEPARTMENT
STATE OF CALIFORNIA

EXECUTIVE ORDER N-7-22

WHEREAS on April 12, 2021, May 10, 2021, July 8, 2021, and October 19, 2021, I proclaimed states of emergency that continue today and exist across all the counties of California, due to extreme and expanding drought conditions; and

WHEREAS climate change continues to intensify the impacts of droughts on our communities, environment, and economy, and California is in a third consecutive year of dry conditions, resulting in continuing drought in all parts of the State; and

WHEREAS the 21st century to date has been characterized by record warmth and predominantly dry conditions, and the 2021 meteorological summer in California and the rest of the western United States was the hottest on record; and

WHEREAS since my October 19, 2021 Proclamation, early rains in October and December 2021 gave way to the driest January and February in recorded history for the watersheds that provide much of California's water supply; and

WHEREAS the ongoing drought will have significant, immediate impacts on communities with vulnerable water supplies, farms that rely on irrigation to grow food and fiber, and fish and wildlife that rely on stream flows and cool water; and

WHEREAS the two largest reservoirs of the Central Valley Project, which supplies water to farms and communities in the Central Valley and the Santa Clara Valley and provides critical cold-water habitat for salmon and other anadromous fish, have water storage levels that are approximately 1.1 million acre-feet below last year's low levels on this date; and

WHEREAS the record-breaking dry period in January and February and the absence of significant rains in March have required the Department of Water Resources to reduce anticipated deliveries from the State Water Project to 5 percent of requested supplies; and

WHEREAS delivery of water by bottle or truck is necessary to protect human safety and public health in those places where water supplies are disrupted; and

WHEREAS groundwater use accounts for 41 percent of the State's total water supply on an average annual basis but as much as 58 percent in a critically dry year, and approximately 85 percent of public water systems rely on groundwater as their primary supply; and

WHEREAS coordination between local entities that approve permits for new groundwater wells and local groundwater sustainability agencies is important to achieving sustainable levels of groundwater in critically overdrafted basins; and

WHEREAS the duration of the drought, especially following a multiyear drought that abated only five years ago, underscores the need for California to redouble near-, medium-, and long-term efforts to adapt its water management and delivery systems to a changing climate, shifting precipitation patterns, and water scarcity; and

WHEREAS the most consequential, immediate action Californians can take to extend available supplies is to voluntarily reduce their water use by 15 percent from their 2020 levels by implementing the commonsense measures identified in operative paragraph 1 of Executive Order N-10-21 (July 8, 2021); and

WHEREAS to protect public health and safety, it is critical the State take certain immediate actions without undue delay to prepare for and mitigate the effects of the drought conditions, and under Government Code section 8571, I find that strict compliance with various statutes and regulations specified in this Proclamation would prevent, hinder, or delay the mitigation of the effects of the drought conditions.

NOW, THEREFORE, I, GAVIN NEWSOM, Governor of the State of California, in accordance with the authority vested in me by the State Constitution and statutes, including the California Emergency Services Act, and in particular, Government Code sections 8567, 8571, and 8627, do hereby issue the following Order to become effective immediately:

IT IS HEREBY ORDERED THAT:

1. The orders and provisions contained in my April 21, 2021, May 10, 2021, July 8, 2021, and October 19, 2021 Proclamations remain in full force and effect, except as modified by those Proclamations and herein. State agencies shall continue to implement all directions from those Proclamations and accelerate implementation where feasible.

2. To help the State achieve its conservation goals and ensure sufficient water for essential indoor and outdoor use, I call on all Californians to strive to limit summertime water use and to use water more efficiently indoors and out. The statewide Save Our Water conservation campaign at SaveOurWater.com provides simple ways for Californians to reduce water use in their everyday lives. Furthermore, I encourage Californians to understand and track the amount of water they use and measure their progress toward their conservation goals.

3. By May 25, 2022, the State Water Resources Control Board (Water Board) shall consider adopting emergency regulations that include all of the following:

    a. A requirement that each urban water supplier, as defined in section 10617 of the Water Code, shall submit to the Department of Water Resources a preliminary annual water supply and demand assessment consistent with section 10632.1 of the Water Code no later than June 1, 2022, and submit a final annual water

supply and demand assessment to the Department of Water Resources no later than the deadline set by section 10632.1 of the Water Code;

b. A requirement that each urban water supplier that has submitted a water shortage contingency plan to the Department of Water Resources implement, at a minimum, the shortage response actions adopted under section 10632 of the Water Code for a shortage level of up to twenty percent (Level 2), by a date to be set by the Water Board; and

c. A requirement that each urban water supplier that has not submitted a water shortage contingency plan to the Department of Water Resources implement, at a minimum, shortage response actions established by the Water Board, which shall take into consideration model actions that the Department of Water Resources shall develop for urban water supplier water shortage contingency planning for Level 2, by a date to be set by the Water Board.

To further conserve water and improve drought resiliency if the drought lasts beyond this year, I encourage urban water suppliers to conserve more than required by the emergency regulations described in this paragraph and to voluntarily activate more stringent local requirements based on a shortage level of up to thirty percent (Level 3).

4. To promote water conservation, the Department of Water Resources shall consult with leaders in the commercial, industrial, and institutional sectors to develop strategies for improving water conservation, including direct technical assistance, financial assistance, and other approaches. By May 25, 2022, the Water Board shall consider adopting emergency regulations defining "non-functional turf" (that is, a definition of turf that is ornamental and not otherwise used for human recreation purposes such as school fields, sports fields, and parks) and banning irrigation of non-functional turf in the commercial, industrial, and institutional sectors except as it may be required to ensure the health of trees and other perennial non-turf plantings.

5. In order to maximize the efficient use of water and to preserve water supplies critical to human health and safety and the environment, Public Resources Code, Division 13 (commencing with section 21000) and regulations adopted pursuant to that Division are hereby suspended, with respect to the directives in paragraphs 3 and 4 of this Order and any other projects and activities for the purpose of water conservation to the extent necessary to address the impacts of the drought, and any permits necessary to carry out such projects or activities. Entities that desire to conduct activities under this suspension, other than the directives in paragraphs 3 and 4 of this Order, shall first request that the Secretary of the Natural Resources Agency make a determination that the proposed activities are eligible to be conducted under this suspension. The Secretary shall use sound discretion in applying this Executive Order to ensure that the suspension serves the purpose of accelerating conservation projects that are necessary to address impacts of the drought, while at the same time

protecting public health and the environment. The entities implementing these directives or conducting activities under this suspension shall maintain on their websites a list of all activities or approvals for which these provisions are suspended.

6. To support voluntary approaches to improve fish habitat that would require change petitions under Water Code section 1707 and either Water Code sections 1425 through 1432 or Water Code sections 1725 through 1732, and where the primary purpose is to improve conditions for fish, the Water Board shall expeditiously consider petitions that add a fish and wildlife beneficial use or point of diversion and place of storage to improve conditions for anadromous fish. California Code of Regulations, title 23, section 1064, subdivisions (a)(1)(A)(i)-(ii) are suspended with respect to any petition that is subject to this paragraph.

7. To facilitate the hauling of water for domestic use by local communities and domestic water users threatened with the loss of water supply or degraded water quality resulting from drought, any ordinance, regulation, prohibition, policy, or requirement of any kind adopted by a public agency that prohibits the hauling of water out of the water's basin of origin or a public agency's jurisdiction is hereby suspended. The suspension authorized pursuant to this paragraph shall be limited to the hauling of water by truck or bottle to be used for human consumption, cooking, or sanitation in communities or residences threatened with the loss of affordable safe drinking water. Nothing in this paragraph limits any public health or safety requirement to ensure the safety of hauled water.

8. The Water Board shall expand inspections to determine whether illegal diversions or wasteful or unreasonable use of water are occurring and bring enforcement actions against illegal diverters and those engaging in the wasteful and unreasonable use of water. When access is not granted by a property owner, the Water Board may obtain an inspection warrant pursuant to the procedures set forth in Title 13 (commencing with section 1822.50) of Part 3 of the Code of Civil Procedure for the purposes of conducting an inspection pursuant to this directive.

9. To protect health, safety, and the environment during this drought emergency, a county, city, or other public agency shall not:

    a. Approve a permit for a new groundwater well or for alteration of an existing well in a basin subject to the Sustainable Groundwater Management Act and classified as medium- or high-priority without first obtaining written verification from a Groundwater Sustainability Agency managing the basin or area of the basin where the well is proposed to be located that groundwater extraction by the proposed well would not be inconsistent with any sustainable groundwater management program established in any applicable Groundwater Sustainability Plan adopted by that Groundwater Sustainability

Agency and would not decrease the likelihood of achieving a sustainability goal for the basin covered by such a plan; or

b. Issue a permit for a new groundwater well or for alteration of an existing well without first determining that extraction of groundwater from the proposed well is (1) not likely to interfere with the production and functioning of existing nearby wells, and (2) not likely to cause subsidence that would adversely impact or damage nearby infrastructure.

This paragraph shall not apply to permits for wells that will provide less than two acre-feet per year of groundwater for individual domestic users, or that will exclusively provide groundwater to public water supply systems as defined in section 116275 of the Health and Safety Code.

10. To address household or small community drinking water shortages dependent upon groundwater wells that have failed due to drought conditions, the Department of Water Resources shall work with other state agencies to investigate expedited regulatory pathways to modify, repair, or reconstruct failed household or small community or public supply wells, while recognizing the need to ensure the sustainability of such wells as provided for in paragraph 9.

11. State agencies shall collaborate with tribes and federal, regional, and local agencies on actions related to promoting groundwater recharge and increasing storage.

12. To help advance groundwater recharge projects, and to demonstrate the feasibility of projects that can use available high water flows to recharge local groundwater while minimizing flood risks, the Water Board and Regional Water Quality Control Boards shall prioritize water right permits, water quality certifications, waste discharge requirements, and conditional waivers of waste discharge requirements to accelerate approvals for projects that enhance the ability of a local or state agency to capture high precipitation events for local storage or recharge, consistent with water right priorities and protections for fish and wildlife. For the purposes of carrying out this paragraph, Division 13 (commencing with section 21000) of the Public Resources Code and regulations adopted pursuant to that Division, and Chapter 3 (commencing with section 85225) of Part 3 of Division 35 of the Water Code and regulations adopted pursuant thereto are hereby suspended to the extent necessary to address the impacts of the drought. This suspension applies to (a) any actions taken by state agencies, (b) any actions taken by local agencies where the state agency with primary responsibility for the implementation of the directives concurs that local action is required, and (c) permits necessary to carry out actions under (a) or (b). The entities implementing these directives shall maintain on their websites a list of all activities or approvals for which these provisions are suspended.

13. With respect to recharge projects under either Flood-Managed Aquifer Recharge or the Department of Water Resources Sustainable

Groundwater Management Grant Program occurring on open and working lands to replenish and store water in groundwater basins that will help mitigate groundwater conditions impacted by drought, for any (a) actions taken by state agencies, (b) actions taken by a local agency where the Department of Water Resources concurs that local action is required, and (c) permits necessary to carry out actions under (a) or (b), Public Resources Code, Division 13 (commencing with section 21000) and regulations adopted pursuant to that Division are hereby suspended to the extent necessary to address the impacts of the drought. The entities implementing these directives shall maintain on their websites a list of all activities or approvals for which these provisions are suspended.

14. To increase resilience of state water supplies during prolonged drought conditions, the Department of Water Resources shall prepare for the potential creation and implementation of a multi-year transfer program pilot project for the purpose of acquiring water from willing partners and storing and conveying water to areas of need.

15. By April 15, 2022, state agencies shall submit to the Department of Finance for my consideration proposals to mitigate the worsening effects of severe drought, including emergency assistance to communities and households and others facing water shortages as a result of the drought, facilitation of groundwater recharge and wastewater recycling, improvements in water use efficiency, protection of fish and wildlife, mitigation of drought-related economic or water-supply disruption, and other potential investments to support short- and long-term drought response.

IT IS FURTHER ORDERED that as soon as hereafter possible, this Order be filed in the Office of the Secretary of State and that widespread publicity and notice be given of this Order.

This Order is not intended to, and does not, create any rights or benefits, substantive or procedural, enforceable at law or in equity, against the State of California, its agencies, departments, entities, officers, employees, or any other person.

IN WITNESS WHEREOF I have hereunto set my hand and caused the Great Seal of the State of California to be affixed this 28th day of March 2022.

GAVIN NEWSOM
Governor of California

ATTEST:

SHIRLEY N. WEBER, PH.D.
Secretary of State

EXECUTIVE DEPARTMENT
STATE OF CALIFORNIA

EXECUTIVE ORDER N-3-24

WHEREAS on April 21, 2021, May 10, 2021, July 8, 2021, and October 19, 2021, I proclaimed States of Emergency to exist across all counties in the State due to drought conditions; and

WHEREAS the drought emergency has required a dynamic and flexible response from the State, and several provisions in my prior Proclamations and Orders have already been terminated or superseded; and

WHEREAS drought conditions have improved substantially, and lingering effects of the drought have largely abated in several areas of the California coast, Southern California, and the eastern Sierra Nevada; and

WHEREAS today I have therefore terminated the drought State of Emergency in the Counties of Imperial, Inyo, Los Angeles, Marin, Mendocino, Mono, Monterey, Orange, Riverside, San Bernardino, San Diego, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Sonoma, and Ventura; and

WHEREAS the multi-year nature of this drought, which began three years after the record-setting drought of 2012-2016, continues to have ongoing, significant impacts on the Sacramento and San Joaquin River basins, the Tulare Lake basin, the Scott, Shasta, and Klamath River watersheds, and the Clear Lake watershed, which include many communities with vulnerable water supplies, farms that rely on irrigation to grow food and fiber, and fish and wildlife that rely on stream flows and cool water; and

WHEREAS improved conditions have helped rehabilitate surface water supplies, but have not eliminated the effects of the drought that remain in the Sacramento and San Joaquin River basins, the Tulare Lake basin, the Scott, Shasta, and Klamath River watersheds, and the Clear Lake watershed, and many groundwater basins remain depleted from overreliance and successive multi-year droughts; and

WHEREAS continued action by the State is needed to address ongoing consequences of the drought emergency in the Sacramento and San Joaquin River basins and the Klamath River and Clear Lake watersheds, including groundwater supply shortages, domestic well failures, and drought-related harm to native fishes; and

WHEREAS improved conditions even in the counties where the drought State of Emergency remains in effect warrant a more targeted State response, and certain provisions in my prior Proclamations and Orders provide authority that is no longer needed to mitigate the effects of the drought conditions, or direct actions by state agencies, departments, and boards that have already been completed; and

WHEREAS notwithstanding the rescission of certain emergency authorities for emergency drinking water action, state agencies have existing legal authority and funding to continue expedited work to advance the human right to water, and state agencies will continue all ongoing drought resilience

planning work, including through coordination with local agencies and tribes; and

WHEREAS the coming winter's hydrology is uncertain and the most efficient way to preserve the State's improved surface water supplies is for Californians to continue their ongoing efforts to make conservation a way of life; and

WHEREAS on March 1, March 8, March 12, March 14, March 28, April 20, May 15, and June 16, 2023, I proclaimed a State of Emergency to exist in 53 counties, cumulatively, as a result of a series of winter storms that initially struck California beginning in late February 2023; and

WHEREAS on March 31, 2023, and May 17, 2023, respectively, I issued Executive Orders N-6-23 and N-7-23 to further bolster the emergency response to the 2023 Late Winter Storms, particularly in the Tulare Lake Basin; and

WHEREAS improved conditions in the Tulare Lake Basin and other regions affected by the 2023 Late Winter Storms warrant a more targeted emergency response to the effects of those storms.

NOW, THEREFORE, I, GAVIN NEWSOM, Governor of the State of California, in accordance with the authority vested in me by the State Constitution and statutes, including the California Emergency Services Act, and in particular, Government Code sections 8567, 8571, and 8627, do hereby issue the following Order to become effective immediately:

IT IS HEREBY ORDERED THAT:

1. The orders and provisions contained in my State of Emergency Proclamations dated April 21, 2021; May 10, 2021; July 8, 2021; October 19, 2021; March 1, 2023; March 8, 2023; March 12, 2023; March 14, 2023; March 28, 2023; April 20, 2023; and May 15, 2023, and Executive Orders N-10-21 (July 8, 2021), N-7-22 (March 28, 2022), N-3-23 (February 13, 2023), N-4-23 (March 10, 2023), N-6-23 (March 31, 2023), and N-7-23 (May 17, 2023), remain in full force and effect, except as modified by those Proclamations and Orders, Executive Order N-5-23, my Proclamation Terminating the Drought States of Emergency in 19 counties dated today, and this Order. State agencies shall continue to implement all directions from those Proclamations and Orders and accelerate implementation where feasible.

2. The following provisions of my State of Emergency Proclamation dated May 10, 2021, are terminated:

    a. Paragraph 8; and
    b. Paragraphs 11–13.

3. The following provisions of my State of Emergency Proclamation dated October 19, 2021, are terminated:

    a. Paragraphs 6–7;
    b. Paragraph 9; and
    c. Paragraph 12.

4. The following provision of Executive Order N-10-21 is terminated:

    a. Paragraph 2.

5. The following provisions of Executive Order N-7-22 are terminated:

    a. Paragraph 4;
    b. Paragraphs 7–8; and
    c. Paragraph 10.

6. The following provisions of Executive Order N-3-23 are terminated:

    a. Paragraph 2; and
    b. Paragraphs 4–5, except to the extent that Paragraph 4 withdraws Paragraph 9 of Executive Order N-7-22.

7. The following provisions of Executive Order N-4-23 are terminated:

    a. Paragraphs 2–7.

8. The following provisions of Executive Order N-6-23 are terminated:

    a. Paragraphs 7–10.

9. The following provisions of Executive Order N-7-23 are terminated:

    a. Paragraphs 2–11, except to the extent that they withdraw provisions of prior Executive Orders.

IT IS FURTHER ORDERED that as soon as hereafter possible, this Order be filed in the Office of the Secretary of State and that widespread publicity and notice be given of this Order.

This Order is not intended to, and does not, create any rights or benefits, substantive or procedural, enforceable at law or in equity, against the State of California, its agencies, departments, entities, officers, employees, or any other person.

IN WITNESS WHEREOF I have hereunto set my hand and caused the Great Seal of the State of California to be affixed this 5th day of September 2024.

GAVIN NEWSOM
Governor of California

ATTEST:

SHIRLEY N. WEBER, PH.D.
Secretary of State