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Call to Action to Recharge California's Depleted Aquifers: October 2nd GRA-UC Water Roundtable

By John McHugh

Prior to GRA's Annual Conference on October 2, GRA and UC Water sponsored a one-day Roundtable to bring together leaders and experts to develop short- and long-term goals and actions to significantly increase managed aquifer recharge (MAR) in California. The Center for Collaborative Policy (CCP) provided facilitation services to make the discussion efficient and productive. The goal of the workshop was to write an action plan, a five-year strategy including potential actions. Participants included staff from ACWA, Bureau of Reclamation, California Department of Food and Agriculture, DWR, Environmental Defense Fund, Governor's Office of Planning and Research, Lawrence Berkeley National Laboratory, Public Policy Institute of California, SWRCB, Sustainable Conservation, water districts, groundwater consultants and other local agencies.

GRA-UC Water and the DWR are both in the process of producing follow up documents, the Action Plan and DWR's Flood MAR white paper. Both parties plan to coordinate on these efforts.

Below is the document GRA and UC Water produced to state the case why recharge should significantly increase and to stimulate discussion during the roundtable.

Background

A key to improving California's water security is to increase the total water storage in surface and groundwater reservoirs. Although the unused storage space in California groundwater basins is about three times the total surface reservoir storage capacity, there are significant technical, institutional, and economic challenges to more efficiently using it conjunctively with the surface water system. The current application of managed aquifer recharge (MAR) from existing and planned projects in the State, is not likely sufficient for future water scarcity considering projected demand growth and Sustainable Groundwater Management Act (SGMA) overdraft corrections. Therefore, a more dramatic shift in water storage strategies must be implemented.

CALL TO ACTION TO RECHARGE CALIFORNIA'S DEPLETED AQUIFERS

GRA-UC Water Roundtable
Oct 2, 2018 – Sacramento

With a long history of floods and droughts, California has the most extreme variability in yearly precipitation in the nation[1]. Most recently, water years 2012-2015 were the four driest consecutive years in statewide history[2], and well below average precipitation 8 of the last 10 years. The typical immediate response to droughts when less surface water is available is to increase groundwater pumping, along with implementing increased conservation and other management tools. The combination of less natural recharge and increased pumping during the recent drought led to record low groundwater levels in many of the state's 517 groundwater basins, land subsidence in some areas, and to a record number of wells going dry, leaving some communities without water. Observed decreases in surface water deliveries over the last two decades related to increasing environmental concerns associated with Delta exports (a result of recognized unsustainable Delta system management) has compounded the water storage problem. Furthermore, our understanding of climate variability indicates potentially more frequent and extreme dry periods and less frequent, but extreme wet periods. California is in a state of chronic groundwater depletion: simply put, we are living beyond our means.

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The Groundwater Resources Association of California is dedicated to resource management that protects and improves groundwater supply and quality through education and technical leadership.

Photo: Delta sunset, Sacramento River (upper) and San Joaquin River (lower) from Mount Diablo by John Karachewski, Ph. D.

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Groundwater Resources Association of California

New Directions and Opportunities – GRA in 2018

By Steve Phillips

As a long-time member and supporter, I am honored to be GRA's President for 2018–19! Exciting changes are under way in GRA, including Branch expansion and our approach to conferences. During the last two years, under Chris Petersen's skillful leadership, we have grown from five to eight Branches; the Northern Sacramento Valley, San Diego, and Inland Empire Branches were the new additions, and they are off to a great start! If you are a GRA member, and are not yet taking advantage of networking, speaking, and other opportunities at the Branch level, please look into the possibilities: see the Branches tab on https://www.grac.org for local meeting information and contacts.

The new approach to our conferences is to focus on fewer, but larger, events. Leading this charge is the inaugural Western Groundwater Congress, coming September 25–27, which replaces GRA's traditional two-day, dual-track Annual Groundwater Conference with a three-day, quad-track event of broader scope that includes enhanced workshop and networking opportunities. We are building on GRA's momentum in providing timely and relevant events related to the Sustainable Groundwater Management Act (SGMA) by developing the first annual Groundwater Sustainability Agency (GSA) Summit. The GSA Summit will be held in Sacramento on June 6–7; a one-day technical workshop on Groundwater Sustainability Plans (GSPs) is being developed as a pre-Summit option on June 5. To ensure the relevancy and availability of the GSA Summit, we have included GSA representatives in the planning process, and will be offering discounted registration to this event for GSA representatives whose GRA membership is current.

Also, on the event docket for 2018 is the 16th Biennial Symposium on Managed Aquifer Recharge (BSMAR) and the 2018 Legislative Symposium. BSMAR comes to CA every four years, generally alternating with Arizona, and covers a topic near and dear to our state as SGMA kicks into gear. Although this event (March 5–7 in San Diego) will likely be over when this issue of *HydroVisions* is released, if you missed it, GRA members will have access to presentations given at the event; this is the case for all GRA events! There will still be time to register for GRA's popular Legislative Symposium, to be held on March 21 in Sacramento, so take advantage of this unique opportunity to engage with those involved in developing the state's groundwater-related legislation.

To give you a sense of my background, I started as a Hydrologist with the USGS in Menlo Park in 1985 to help with modeling work related to selenium poisoning of waterfowl in what was Kesterson Reservoir. Working with Ken Belitz, we developed a complex texture-based model (for that era) to explore alternatives to agricultural drains, the discharge from which was laden with naturally-occurring selenium leached from the soils by irrigation. I moved in 1989 to the USGS California Water Science Center, where I continue to be involved in a variety of groundwater projects, and serve as the Center's lead in the realm of SGMA.

I joined GRA in the late 90s after I started to attend Sacramento Branch meetings and was very impressed with the speakers and other attendees. I soon became a Member-at-Large for the Branch, and ultimately served as Branch President from 2006–7. During that tenure, I helped spawn the Branch's Scholastic Program owing to inspiring impetus from Brian Lewis, a founding member of GRA, and

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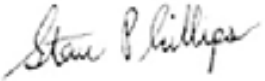
a great idea from a fellow Branch officer, Julie Friedman, who suggested seeking scholastic sponsors for each Branch meeting to make such a program sustainable – and followed through! Since then, this scholastic-program model has spread to the other Branches, and to the statewide level through GRA's Education committee, which—thanks to the efforts of Thomas Harter and Lisa O'Boyle—developed a mechanism for raising matching funds to support the Branch efforts, and of course ultimately to support students in the field of groundwater. Simple ideas can go a long way—we just have to recognize their potential and act on them. This is something that GRA does well; we are always open to your ideas!

While I was Branch President, I was invited to attend the quarterly meetings of GRA's Board of Directors; up until that point, the Board, and its function, was somewhat mysterious to me. The Board, and various associated committees, have recently taken steps to include Branch representatives, recruit non-Board committee leadership, and reach out to the membership for interest in committee participation. In that spirit, if you are reading this, and have an interest in getting more involved in GRA, please go to the website, browse the Committee, Branch and Board information, and contact us if you see things that match your interests.

I also edited *HydroVisions* for 10 years (my great appreciation to John McHugh for accepting the passed torch last spring), and have served as a GRA Director, Secretary and Vice President since 2011. Over that time, I've had the opportunity to collaborate and socialize with a truly amazing group of dedicated people from all walks of the groundwater field. I want to acknowledge and welcome two new Board members that I look forward to working with more closely—both have been active participants in GRA events, so although they are new Directors, they are not new to us: Christy Kennedy of Woodward & Curran; and Rob Gailey, who is a Consulting Hydrogeologist finishing his PhD at UC Davis. Also, R.T. Van Valer of Roscoe Moss, who has been GRA's Treasurer for a few years, was voted in as a fully-fledged Director. In his euphoria, R.T. took on the role as Chair of the Western Groundwater Congress, for which we are eternally grateful!

Finally, if you are a GRA member and have not renewed your membership in 2018, please do so. If you are not a member, please consider becoming one; it was one of the best decisions I've ever made!



Cheers,
Steve

Call to Action to Recharge California's Depleted Aquifers – *Continued from Page 1*

Expanding Conjunctive Use Will Improve Supply Reliability

At present, water year 2017 may become the wettest year on record, with statewide precipitation at 175% of average to date[3], runoff at 240% of average to date[4], surface reservoir storage at 115% average to date[5], and the statewide snowpack at 196% of average[6]. Unfortunately, California does not have the physical systems, policies, and institutional means to maximize replenishment of our depleted aquifers when water is available in wet years like 2017. While SGMA may provide the institutional means and policies for maximizing replenishment, our infrastructure of reservoirs and conveyance was designed based on 19th and 20th century demands and hydrology. Our state policies can be improved to enhance MAR and conjunctive use when opportunities arise. These improvements should include streamlining regulatory processes and creating economic incentives to align with and leverage the new management paradigm SGMA provides. As we consider our current need to address statewide flood control and damage reduction, update, and repair infrastructure, and construct new reservoirs, we should also invest by modifying existing or build new infrastructure for conveyance and recharge to expand our ability to capture and recharge flood flows when they are available. In addition to investments in infrastructure, the time has come to coordinate more effectively among local, state, and federal agencies. Lastly, we can improve dam operation to recharge groundwater, while capture floodwaters, and addressing environmental benefits.

Improved Conjunctive Use is Necessary for the Goal of SGMA to Succeed

Without significant increases in groundwater recharge, the main alternative for complying with the Sustainable Groundwater Management Act (SGMA) will likely be large scale pumping reductions in most overdrafted high- and medium-priority basins. SGMA provides the regulatory mechanism and authorities to the new Groundwater Sustainability Agencies (GSAs) to develop projects and take actions to correct chronic groundwater depletion. GSAs will have the tools and authorities that other local agencies have used to successfully reverse overdraft through replenishment and conjunctive management. We believe there is an opportunity and obligation to act now to ensure the new framework SGMA provides is leveraged to improve conjunctive use and stabilize our natural underground reservoirs for increased supply reliability and resiliency. Achieving this objective will require a strategy to 1) coordinate these new local GSAs with existing local, state, and federal agencies involved in the management of surface and groundwater, 2) remove barriers, and 3) define necessary actions and financing. Groundwater will be managed by locals, but achieving the objective to recharge California's chronically depleted aquifers and increase storage statewide will require state and federal action to support local groundwater sustainability statewide.

Call to Action Focuses on Opportunity, Obstacles, and Strategies for Expanding Conjunctive Use

The Groundwater Resources Association of California and UC Water Security and Sustainability Research Initiative are sponsoring a short series of Roundtables to bring together academic, agricultural, private sector, local, state and federal agency leaders and experts to have an open dialogue on possible short- and long-term options to significantly increase conjunctive use capabilities in California. The goal is to expand on the excellent work already conducted by the DWR and State Water Resources Control Board on this topic and to build a coalition of influential advocates for change. The desired outcome of this effort is to take diverse voices and interests and produce a unified framework of potential actions for a five-year strategy, similar in format to the California Water Action Plan, informed by Roundtable discussions on the following topics:

- How can conjunctive use be expanded while satisfying water rights permits?
- How does the timing and location of available water affect recharge?
- What are the best tools and methods to conduct studies that can be done quickly and cost effectively on a large-scale basis?
- What role does infrastructure play and how can it be improved?
- How should we modernize our reservoir operations to provide flood protection and increased groundwater replenishment?
- What economic incentives could be established to drive the large-scale expansion of distributed groundwater recharge (e.g. recharge net-metering)
- Is new legislation needed?
- What are the perceived benefits of designating recharge as a beneficial use and do GSAs believe the issue is relevant given their new tools and authorities?
- What are the potential limitations for managed irrigation recharge (field flooding, etc.) due crop health and potential water quality changes?
- What are the environmental and permitting constraints that must be considered in the siting new recharge facilities (footprint considerations)?

Continued on the following page…

We will report back on the results once we have had the opportunity to summarize our discussions. Hopefully we find some solutions to increase recharge capabilities and conjunctive use significantly so that we can capture and store significantly more surface water when it is available.

SUGGESTED READING

System Reoperation Study, Phase III Report, DWR

http://www.water.ca.gov/system_reop/docs/System%20Reoperation%20Study%20Phase_III%20Report_20170821.pdf

Draft Water Available For Replenishment Report, DWR

http://www.water.ca.gov/groundwater/sgm/pdfs/Draft_Water_Available_For_Replenishment_Report.pdf

ACWA Water Storage Integration Study, MBK Engineers

https://www.acwa.com/wp-content/uploads/2017/06/2017-06-05-ACWA-Integrated-Storage-Final-Report.pdf

Availability of high-magnitude streamflow for groundwater banking in the Central Valley, California, Tiffany N Kocis and Helen E Dahlke 2017 Environ. Res. Lett. 12 084009 http://iopscience.iop.org/article/10.1088/1748-9326/aa7b1b/meta;jsessionid=61EEE3EDE9BB10235DF8330B6843A3AD.ip-10-40-1-105

Legal Risks and Timeline Associated with Increasing Surface Water Storage in California, UCLA Law

https://law.ucla.edu/centers/environmental-law/emmett-institute-on-climate-change-and-the-environment/publications/surface-water-storage/

REFERENCES

1. DWR webpage https://www.water.ca.gov/What-We-Do/Water-Storage-And-Supply accessed on May 5, 2017.
2. DWR webpage http://water.ca.gov/waterconditions/docs/a3065_Drought_8page_v9_FINALsm.pdf accessed on May 5, 2017.
3. DWR webpage http://cdec.water.ca.gov/cgi-progs/reports/EXECSUM accessed on May 5, 2017.
4. DWR webpage http://cdec.water.ca.gov/cgi-progs/reports/EXECSUM accessed on May 5, 2017.
5. DWR webpage http://cdec.water.ca.gov/cgi-progs/reports/EXECSUM accessed on May 5, 2017.
6. DWR webpage https://www.youtube.com/watch?list=PLeod6x87Tu6exgDY_RFTzeEsG4msO1s2B&v=TCtXEq1qzo0 accessed on May 5, 2017.

2018 David K. Todd Distinguished Lecturer Series

The eighth year of GRA's David Keith Todd Distinguished Lecture Series is now underway! Dr. Jeffrey Mount (northern California) and Mr. Kirby Brill (southern California) will be delivering their lectures to GRA Branches and academic institutions throughout the spring. This Series furthers a key GRA objective: to develop scientific educational programs that promote the understanding and effective implementation of groundwater assessment, protection, and management.

The Winter 2017 *HydroVisions* included biographical introductions of this year's lecturers. Further details on these lectures can be found on the GRA website. Look for the lecture schedule to be posted online to attend an event near you!

Jeffrey Mount, Ph.D.
(Northern California)

Senior Fellow, Public Policy Institute of California Water Policy Center

Professor Emeritus, Department of Earth and Planetary Sciences at University of California, Davis

Lecture: Consequences of Groundwater Sustainability in California

Abstract:

In 2014 California enacted the Sustainable Groundwater Management Act (SGMA) to address impacts associated with groundwater pumping. This act mandates areas dependent upon groundwater achieve sustainability by 2040. To meet the requirements of this act there will need to be a net reduction in groundwater overdraft of more than 2 million acre-feet per year. The social, economic, and environmental consequences—intended or otherwise—of this change in water policy

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are vast. Opportunities to augment supplies are limited, although new storage, conveyance, and groundwater recharge will help. In areas connected to the state's water supply systems—particularly the federal Central Valley Project and the State Water Project--there will be increased pressure to transfer water. This will impact on-going efforts to address water supply reliability and ecosystem issues in the Sacramento-San Joaquin Delta. However, sustainability will be achieved principally though reductions in demand. In the San Joaquin Valley—the region accounting for most overdraft—this will involve permanent or temporary fallowing of hundreds of thousands of acres of farmland, with consequences for the farm economy in the valley and rural communities dependent upon farm labor. There will also be wide ranging environmental consequences. How land is fallowed, including the quality of soils, will affect air quality, water quality and terrestrial habitat. Demand reduction will also increase conflicts over the use of surface water to support aquatic habitat and wetlands as well as groundwater-dependent ecosystems. California needs to take a comprehensive look at what it is going to take to achieve groundwater sustainability and develop pathways that minimize or mitigate unwanted effects.

Kirby Brill. P.E.
(Southern California)

Former General Manager,
Mojave Water Agency

Lecture: Building Bridges to a New World in Water Resource Management

Abstract:

- The world of water resource management is undergoing radical changes that will increasingly require new tools, skillsets and approaches due to challenges of population growth, climate change, and new regulations such as with SGMA—these factors create more uncertainty, but with uncertainty are opportunities to raise our game. This new world that we are facing in water resource management requires us to rethink past strategies and to invent new ones. Three fundamental areas necessary when developing a portfolio of water management actions are: (1) "science-based" evaluations; (2) "market-driven" policies; and (3) robust outreach with the local community. These fundamental cornerstones pave the way towards economic and water resources sustainability. Examples of approaches and methods for employing these three key cornerstones for success include:
- Manage stakeholder expectations by providing clearly defined "rules" for credible water transactions and regulatory compliance
- Early outreach to allow glide paths towards "cultural" transition of resource management and ultimately sustainability
- Develop and maintain a strong underlying science platform to enable public trust and realistic valuations of the water as a resource and an asset
- and the marketability of the groundwater production right so that groundwater users can maintain a certain nimbleness to meet their needs without depleting the resource, and in turn reducing risk of disputes.

In this new world, today's leaders will need to look ahead to the horizon for developing new leadership with fresh ideas to carry the ball forward for the next several decades. These new leaders must have a solid science-based platform with the ability to analyze complex systems and must be excellent communicators that will allow them to convert information into knowledge to share with the public and other decision-makers. In doing so, our new leaders must have inherent values enabling them to earn the trust of the communities they are operating in so that they can create partners in the collective pursuit of the resource management objectives. With these ambitious cornerstones and methods comes heavy investment of time and resources, with the return on investment being water sustainability through development of well-equipped future leaders with multi-disciplinary training and perspectives who can build bridges with technical, social, economic, and political skills to find solutions embedded within the complex systems that are now part of our operating environment.

Letter from the Western Groundwater Congress Chair

Dear GRA Members,

Over the past 8 years I have watched talented GRA volunteers produce countless events with incredible groundwater education. As an Executive Officer, I also read numerous comments and member surveys. So, when the Board of Directors decided to embark on an ambitious plan to offer a larger annual conference, and asked me to be the Chair, I saw a perfect opportunity to incorporate the great education GRA always provides and respond to your suggestions. We quickly formed a team, and decided this three-day event, would have four concurrent tracks while allocating time for workshops, panel discussions, and multiple networking events. We also felt it was important to include issues relevant to surrounding states so we, can have an opportunity to learn from our neighbors. We decided to rebrand the event as the **1st Annual Western Groundwater Congress**!

Currently, the WGC team is working diligently to put together an exceptional program. The WGC three-day program will consist of four tracks (Water Resources, SGMA, Contaminants, and Special Topics). Within those tracks you will find world class technical presentations, panel discussions, practical hands-on workshops, the Collegiate Colloquium, and GRA's signature DKT Lecturers. The topics we are currently focusing on are:

- 1,4 – Dioxane
- Advanced Geologic Analysis
- Alternative Closure Metrics
- Agriculture Policy and Regulation
- Forensic Evaluation
- Groundwater Tools & Tech
- GW Law and Legislation
- Oil, Gas & Groundwater
- Prop. 1 Funding
- SGMA Modeling
- SGMA Data and Planning
- SGMA Modeling

Panel discussions will feature experts in their field, talking with a moderator who will guide conversation and elicit audience questions, with the goal of being informative and entertaining.

Finally, I have seen many requests from GRA members for "more time to network," during events. I truly believe this is important to our members, so the WGC has a specific Social/Networking Team who has created over 7 hours of social/networking time, including an hour and a half networking event (that likely will include another common member request…free wine/beer).

My goal is that the 2018 Western Groundwater Congress will be packed full of everything anyone could ever want from a GRA event. The WGC team will work throughout the year to create a combination of education and fun that will make the Western Groundwater Congress the premier technical conference focusing on western groundwater quality and groundwater resources! Please lookout for event information as we continue to build this exciting program in the coming months. In the meantime, thank you to everyone who is dedicating their time in 2018 to making this an amazing event!

Best,

R.T. Van Valer
2018 WGC Chair

Groundwater Resources Association of California in Cooperation with the **California Groundwater Coalition** *Presents*

2018 GRA'S ANNUAL LEGISLATIVE SYMPOSIUM

Replenishing California's Thirsty Aquifers

MARCH 21, 2018 – SACRAMENTO, CALIFORNIA

After suffering the four driest years on record followed by the second wettest year on record, groundwater managers are struggling to find long term solutions to recharge California's thirsty aquifers. Managed aquifer recharge is an essential component to meet SGMA sustainability goals, but questions remain where will the water come from and at what cost? Join us as we explore answers to these and other key questions at this action-packed day in the State Capitol!

Invited Symposium speakers include:

State Water Resources Control Board Member Joaquin Esquivel, California Water Commission Chairman Armando Quintero, CalEPA Undersecretary Gordon Burns, Senator Robert Hertzberg, Senator Bill Monning, Senator Bill Dodd, Senator Mike McGuire, Senator Nancy Skinner, Senator Henry Stern, Senator Jim Nielsen, Assemblymember Marc Levine, Assemblymember Blanca Rubio, Assemblymember Richard Bloom, Assemblymember Al Muratsuchi, Assemblymember Eduardo Garcia, Assemblymember Matthew Harper, Assemblymember Cristina Garcia, Jerry Meral, Taryn Ravazzini and Paul Massera from the Department of Water Resources.

All speakers for the 2018 Symposium are not yet confirmed and always subject to change.

Questions: Contact Rosanna Carvacho at 916-594-9700 or email GSetoudeh@bhfs.com.

The Anne J. Schneider Lecture 2018 Featuring Kevin O'Brien

APRIL 4, 2018 – SACRAMENTO, CALIFORNIA

This year's distinguished lecturers are Kevin O'Brien (Downey Brand) and Maurice Hall (Environmental Defense Fund), will discuss: ***Can California successfully integrate groundwater and surface water under SGMA?***

State Water Resources Control Board member DeeDee D'Adamo will lead the discussion and questions.

The lecture will be **Wednesday, April 4, 2018** at the Crocker Art Museum in Sacramento. Check-in begins at 3:30pm with the lecture starting at 4:00pm. A reception with hors d'oeuvres and drinks will follow beginning at approximately 5:30pm.

The event and reception are **free to participants** and are being brought to you by sponsorships for the Anne J. Schneider Lecture Series. Please **RSVP below by Wednesday, March 28, 2018.** If you have any questions, please contact Danyella Herrera at dherrera@norcalwater.org or (916) 442-8333.

For more information and registration: https://www.eventbrite.com/e/anne-j-schneider-lecture-2018-feat-kevin-obrien-and-maurice-hall-tickets-42649818756

Wells and Words

By David W. Abbott, P.G., C.Hg., Consulting Geologist

The Hydrologic Budget – Part 4

INFLOW = OUTFLOW ± CHANGE IN STORAGE. Part 1 discussed some of the definitions of the hydrologic budget and provided common URLs for various sets of raw or processed precipitation data (INFLOW); Parts 2 and 3 provided URLs for raw or processed evapotranspiration (ET) and stream flow data, respectively (OUTFLOW). Part 4 will discuss one of the elements for CHANGE IN STORAGE – groundwater levels.

Groundwater (GW) levels are probably one of the most fundamental measurements and properties of an aquifer system or GW Basin. Long-term measurements and access to GW levels are important to evaluate the general health and character of an aquifer system or GW basin and they provide a qualitative (sometimes quantitative) measure of the CHANGE IN STORAGE for GW reservoirs. GW levels during pumping tests provide direct hydraulic information and characteristics of an aquifer system (for example the Transmissivity and Storativity) and, specifically, on well performance (i.e., well efficiency); these will not be discussed here. In most cases, GW level data are used to calibrate GW flow models[1].

The *groundwater level* is the elevation of the water table or another potentiometric surface at a particular place or in a particular area, as represented by the level of water in wells or other natural or artificial openings or depressions communicating with the saturated zone[2]. The *water table* is the upper surface of the saturated zone of an unconfined aquifer at which the pore water pressure is one atmosphere and is sometimes referred to as the phreatic surface or free surface[2]. The *potentiometric surface* is an imaginary surface representing the total head (i.e., pressure) of groundwater and defined by the level to which water will rise in a tightly cased well tapping an artesian (confined or pressurized) aquifer (a.k.a. piezometric head, isopotential level, or pressure surface)[3].

GW level data from wells (presented both as hydrographs, GW elevation maps, or depth to water [DTW] maps) are another important element of the hydrologic budget that is related to changes in GW storage of an aquifer caused by artificial (i.e., recharge projects and pumping) or natural (i.e., springs, contributions to stream base flows, and even ET) GW recharges and discharges which produce these seasonal and long-term trends in GW level fluctuations. GW level data can be presented on hydrographs as either the DTW from some convenient and consistent reference point (RP) or converted from DTW to a common elevation usually from mean sea level (msl).

In general, two kinds of GW levels can occur in a well, the non-pumping or static water level (SWL) or the pumping water level (PWL). The *SWL* (a.k.a. standing water level or static head) is not affected by the withdrawal or injection of GW while the *PWL* (a.k.a. dynamic water level) is the water level in the well when pumping or injection occurs[3]. The PWL can be caused by the operation of a pump in the well that is measured and also in a non-pumping well that is affected by the operation of a pump in an adjacent well. Usually, the GW level is measured from a standard RP such as the top of casing (TOC). Various calibrated tools are used to measure the GW levels in a well[4].

GW level data should be collected on a consistent and regular basis (daily is ideal, weekly, or monthly) or at least twice per year (once after the rainy season and once after the dry season). Measurements should be collected to the nearest tenth (0.1) or hundredth (0.01) of a foot (ft; preferred); although the accuracy of the measurements is probably to the nearest 0.1 ft depending on the measuring equipment (i.e., chalk tape, single or coaxial cable sounders, airline, acoustic, and others) and the well design and engineering appurtenances in the well[5]. The date, time, and whether the pump in the well was operating or idle should also be logged in a permanent notebook. Sometimes this data is recorded on paper attached to a clip board and hung in the pump house, or simply scribbled on pump house walls. I recall one such site in WA State where the drilling contractor was dismantling a small pump house to gain access for well re-development. One of the walls of the pump house was just covered with notes on GW level and pumpage data; I salvaged the wall and returned to the office so that I could properly record the data in a field book. If the discharge line that conveys the water to the water system is equipped with a totalizing volumetric meter[6], then this too should be recorded in a field book.

Historical (up to about 1981) GW level measurement stations in CA can be identified in our old friend, the Department of Water Resources (DWR) Bulletin 230-81[7]. Table 5 of that publication (pages 285 to 402) lists the station names by Township, Range, and Section (T/R-Sec); and corresponding DWR areal codes which then can be used in cross referencing to Table 6 (pages 403 to 514) which lists the DWR stations by the alpha-numeric number areal codes. Tables 5 and 6 provide basic location information in the first two columns; while the last three columns summarize the period of record information, number of measurements, and number of wells used for measuring GW levels with this

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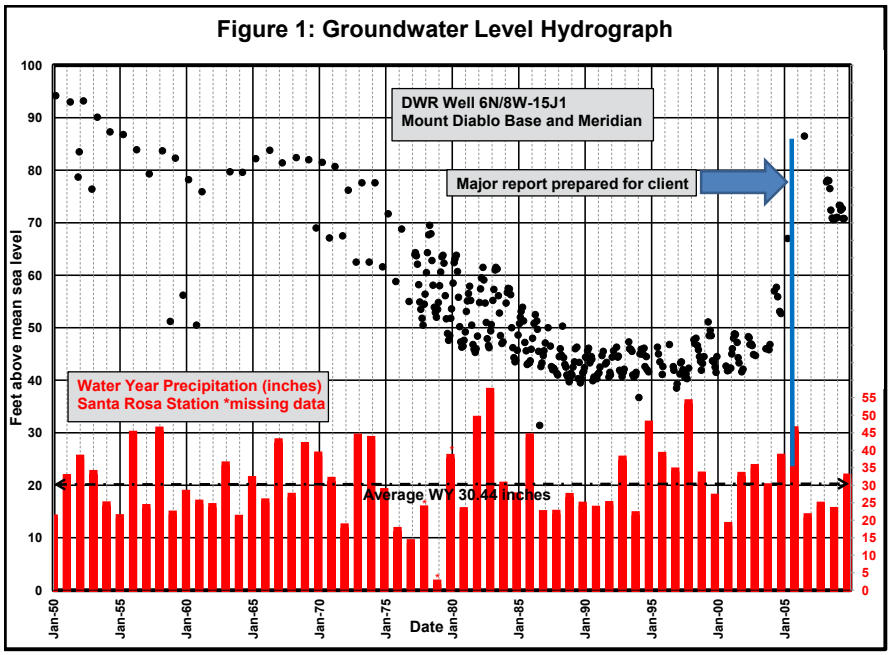

Figure 1: Groundwater Level Hydrograph

Figure 1 shows a hydrograph of GW elevations that were downloaded in Excel format from the WDL site for a specific well (6N/8W15J1) in the southern portion of the Santa Rosa Plain, Sonoma County, CA. The total annual Water Year (WY) precipitation from a nearby long-term (1905 to present) station (Santa Rosa) is also plotted on this graph. The average WY precipitation is 30.44 inches for this 60-year (yr.) record (28.76 inches for a 95-yr. record). Clearly, there have been extreme and variable changes of GW level elevations in this area. These changes range from decades of lowering GW elevations of about 50 ft msl (95 ft msl – 45 ft) to smaller seasonal fluctuations of about 10 ft. In addition, there have been changes to the monitoring frequencies which can confuse the overall interpretation of the data.

state program. The DWR areal designation for CA stations telescopes down from Hydrologic-Basin, -Unit, -Area, and -Subarea. Hence, relevant, and nearby GW level records can be easily identified for a study area in Table 6. Bulletin 230-81 does not include the digitized or raw data which may be stored in boxes, older computer formats, or microfiche.

Accessible and free digital and electronic sources of GW level data for CA include a DWR data base at the Water Data Library[8] (WDL) and the USGS Groundwater Ambient Monitoring and Assessment (GAMA[9] and USGS[10]) Program which is linked to GeoTracker[11] and implemented by the CA Regional Water Quality Control Board. The USGS maintains a data base of GW levels in the National Water Information System (NWIS[12]) and the State of California has another data base in the CA Statewide Groundwater Elevation Monitoring (CASGEM[13]) Program. The WDL is relatively easy to use and only requires a location of the T/R-Sec; WDL also can plot hydrographs and water elevation maps for an area of interest. As of October, 2015[14], GeoTracker contains more than 3.6 million DTW measurements from Water Board cleanup sites and the WDL. Other sources of historical GW level data may include private records from well owners, water districts, and other GW purveyors; USGS reports, DWR Well Completion Reports (drillers' reports), consultant reports on well construction or basin hydrogeology, GW Basin Water Masters, etc. Caution 1: the interpretation of the water levels collected and reported from a well depends upon the construction specifications of the well in relationship to the geologic units that is (are) screened. Caution 2: verify that the local water level elevation referencing systems are consistent with the systems that are used in these portals and watch for translation typos.

Between 1950 through 1976, the total numbers of GW level measurements (about 40 or 1.5 measurements/yr. [meas/yr.]) were collected mostly in the Spring with a few measurements collected after the pumps were turned on or at the end of the irrigation season. Between 1977 through 2004 measurements were collected more frequently (about 265 or 10 meas/yr.); and from 2005 through 2010 measurements again were taken less frequently (18 or 3 meas/yr.). The greater the frequency of the measurements (including both pump-on and pump-off cycles) provides for a more complete understanding and more robust interpretation of the data.

In the mid-1970s a major change in land-use application patterns occurred, and pumping GW was ramped up to supply a planned community. This led to the SWL dropping from an elevation of about 95 ft msl in 1950 to about 47 ft msl in about 1987 or about 48 ft of *permanent deepening*. The hydrograph flattens around 1988 until about 2000 which indicates that the aquifer had re-established an equilibrium (i.e., pump out ≈ aquifer recharge). The GW recharge probably came from permanent dewatering of the over-lying finer grained sediments and increased recharge from surface water (like reduced flows for rivers or creeks). A major GW study was conducted for this area in 2004. Based on the hydrograph, either pumping was reduced, or community projects were implemented to protect the natural recharge areas in order to increase the GW recharge (this was one of the recommendations in the report). Between 2000 and 2010, GW levels rose about 30 ft to an elevation of about 75 ft msl; this is still 20 ft short of the 1950 GW elevation for this well.

Continued on the following page…

Every well report I have prepared includes a concise recommendation directive to regularly and frequently monitor GW levels in a well and volumes of water removed from the aquifer. Most GW purveyors and GW monitoring programs start out with a meaningful program but often GW level measurements are simply ignored or are later eliminated because of operating budget constraints. GW elevations are dynamic, and they are not static. Implementers of GW monitoring programs become bored because of the appearance that the GW level has *stabilized*. Because GW systems are hidden from public view (unlike surface water streams), GW is often ignored until a noticeable adverse effect occurs (i.e., subsidence or salt water intrusion) which brings groundwater to the forefront. Paraphrasing here: 'We cannot know (*and manage groundwater systems*) what we do not measure.' (modified from quotes by Lord Kelvin)[15].

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14. California Water Boards, October 2015, GeoTracker GAMA Fact Sheet from the Office of Public Affairs.
15. http://www.azquotes.com/author/7873-Lord_Kelvin "I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre [sic] and unsatisfactory kind." and "If you can not measure it, you can not improve it."

The Federal Corner

By Jamie Marincola, U.S. EPA

EPA Proposes to Add Orange County North Basin to Superfund's National Priorities List

The Orange County North Basin, which includes parts of Fullerton, Anaheim, and Placentia and is part of the larger Orange County Groundwater Basin, has been proposed for addition to the NPL by the U.S. Environmental Protection Agency (EPA). Seventy percent of the water served in Orange County is from groundwater, making the basin a critical water resource for 2.4 million residents in 22 cities. The groundwater plume is contaminated with chlorinated solvents and other contaminants covering over five square miles. All drinking water currently served by water purveyors meets federal and state drinking water standards. The Superfund Task Force Recommendations can be viewed at: https://www.epa.gov/superfund/superfund-task-force-recommendations.

USDA Investing Millions in Wildfire Mitigation and Water Quality Projects

The U.S. Department of Agriculture (USDA) will invest nearly $32 million this year through the Joint Chiefs' Partnership to mitigate wildfire risk, improve water quality and restore healthy forest ecosystems in 24 states and Puerto Rico. More than $4.2 million of this year's funding will support three ongoing forestry projects in California that focus on wildfire protection and mitigation, improving forest health and enhancing habitat for at-risk species. Project locations include the Los Angeles County area, the front country of the Sierra National Forest east of the San Francisco Bay metro area, and Trinity County near Eureka in northern California. To read more about USDA's wildfire mitigation efforts, go to: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ca/newsroom/releases/?cid=NRCSEPRD1377840.

U.S. Senate Confirms David Ross to Lead EPA Water Office

In December, the Senate confirmed David Ross to serve as the assistant administrator for EPA's Office of Water. Mr. Ross previously served as Wisconsin assistant attorney general and director of the Environmental Protection Unit for the Wisconsin Department of Justice and in the Wyoming Attorney General's Office as senior assistant attorney general.

EPA Selects Three California Sites for the Superfund Redevelopment Focus List

Focus List. EPA released its initial list of Superfund National Priorities List (NPL) sites with the greatest expected redevelopment and commercial potential, which included thirty-one sites nationwide and three in California. The sites selected in California were the Aerojet General Corp, a former rocket propulsion development and testing facility in Rancho Cordova, MGM Brakes, a former aluminum brake manufacturing and casting facility in Cloverdale and Operating Industries Inc. Landfill in Monterey Park. For more information please visit: https://www.epa.gov/superfund-redevelopment-initiative/superfund-redevelopment-focus-list.

EPA Publishes Article on Relationship Between Total Dissolved Solids (TDS) and Total Suspended Solids (TSS) in a Mining-Influenced Watershed

The U.S. EPA Office of Research and Development published a journal article entitled *Evaluating Relationships Between Total Dissolved Solids (TDS) and Total Suspended Solids (TSS) in a Mining-Influenced Watershed*. Measurement of total suspended solids (TSS) and total dissolved solids (TDS) loadings in streams is often used to assess potential impacts from mining on surface water quality within a drainage basin. It has been suggested that TSS could be used as an indicator to estimate TDS loading using a TDS/TSS ratio. The reliability of this approach was tested by examining empirical linear relationships between TSS and TDS loads at three locations within a mining-influenced watershed in Colorado. View the article at: http://rdcu.be/vcio.

Jamie Marincola is an Environmental Engineer at the U.S. Environmental Protection Agency Region 9 Water Division. For more information on any of the above topics, please contact Jamie at 415-972-3520 or marincola.jamespaul@epa.gov.

Which Test Method is Acceptable?

By Bart Simmons, Ph.D., retired DTSC

This question, of course, has no general answer, but generates additional questions:

1) Acceptable to whom?
2) For what kind of sample?
3) For what testing purpose?

Environmental regulatory agencies typically specify test methods when mandating a new monitoring program. In the past I have argued (unsuccessfully) that perhaps the agencies should not specify test methods, but more on that later.

U.S. EPA specifies methods differently in different programs. The Clean Water Act programs, for example, have listed acceptable test methods in 40CFR Part 136 (see https://www.epa.gov/cwa-methods). However, state agencies may implement the CWA with their own lists of methods. For example, the methods for storm water testing are listed by the California water board in "General Permit for Storm Water Discharges Associated with Industrial Activities", Table 2. The State Board recognizes that other methods are acceptable and expects to add methods to the list.

The EPA hazardous waste management and Superfund programs have a compendium of test methods known as Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, also known as SW-846. At one time, a member of the regulated community was required to use a method from SW-846. However, EPA then promulgated a "de-reg reg" as part of a government-wide deregulation effort. SW-846 is still maintained, but EPA generally allows any reliable test method to be used by the regulated community. As is typical today, the SW-846 exists essentially in the cloud, but can be accessed from the above link. The California Department of Toxic Substances Control (DTSC) generally refers to SW-846 for test methods. However, DTSC has produced guidance (not regulations) for the use of significantly different methods, e.g. EPA 3052, (a digestion method using hydrofluoric acid), for determining total metals content for consumer products testing.

As if that weren't enough, another set of test methods is specified for the accreditation of environmental laboratories. The Environmental Laboratory Accreditation Program (ELAP), which now resides in the State Water Board, is moving to a system of accrediting a laboratory based on the analyte and test method. Ideally, the list of methods used for accreditation would be identical to those specified by the regulatory agencies for a sample and a regulatory program. In practice, it is infeasible to keep the lists current and comparable.

In a previous column, I discussed the legal defensibility of environmental test data. To summarize, the courts have their own standards for test methods. For example, in *people v. Sangani*, the appeals court found that it was not necessary to follow "every jot and tittle of SW-846" to produce acceptable evidence.

Using an official test method is no guarantee that the method in fact produces acceptable data for a certain sample. For example, in Columbia Falls Aluminum Company vs. EPA, the federal court found that EPA had been arbitrary and capricious in specifying the use of the Toxicity Characteristic Leaching Procedure (TCLP) for de-listing spent aluminum pot waste. The TCLP had shown that arsenic was extracted below the Toxicity Characteristic limit, but the waste did in fact leach considerable arsenic and fluorides into groundwater.

What to do? Commercial testing labs will generally do what their client requests. Regulated industries may need assistance to select the appropriate methods for a compliance question. The regulatory agencies need to clarify their requirements and attempt to establish consistency among programs when possible and recognize when different methods give different results.

As Gurtrude Stein wrote,

"A difference, to be a difference, must make a difference."

Bart can be reached at bartonps@aol.com.

GRA Requests Nominations for the 2018 "Lifetime Achievement" and "Kevin J. Neese" Awards

The purpose of the GRA Awards Program is to recognize noteworthy projects and exceptional individual contributions related to the understanding, protection, and management of groundwater resources. The objectives of the annual GRA Awards Program are:

1. To provide recognition to individuals who have demonstrated leadership and continuous dedication in groundwater hydrology
2. To provide recognition for recent unique contributions to groundwater hydrology.

All nominations for the Lifetime Achievement and Kevin J. Neese Awards must be received by David W. Abbott (dabbottgw@gmail.com or 607 Chetwood Street, Oakland, CA 94610-1433) no later than **Friday, June 22, 2018**.

Nominations should be completed using the nomination forms available on the GRA website at Lifetime and KJNeese. Nominations should not exceed one page, identify the award for which the nomination is made, and include justification for the award based on the criteria listed below. Additional documentation and support documents are welcome.

The GRA Awards will be presented to the recipients selected by the GRA Board of Directors during the First Annual Western Groundwater Congress (27th GRA Annual Meeting) in Sacramento, CA, September 25–27, 2018.

Awards

Lifetime Achievement:

Presented to individuals for their exemplary contributions to the groundwater industry, and contributions that have been in the spirit of GRA's mission and organization objectives. Individuals that receive the Lifetime Achievement Award have dedicated their lives to the groundwater industry and have been pioneers in their field of expertise.

Previous Lifetime Achievement Award recipients include:

- 2017 – Dr. Daniel B. Stephens
- 2016 – Dr. Miguel A. Mariño (1940-2016)
- 2015 – Dr. John A. Izbicki
- 2014 – Dr. David Huntley (1950-2015)
- 2013 – Dr. Shlomo P. Neuman
- 2012 – Anne J. Schneider, Esq. (1947-2010)
- 2011 – Joseph C. Scalmanini, P.E. (1945-2014)
- 2010 – Dr. John A. Cherry
- 2009 – Dr. T.N. Narasimhan, P.G. (1935-2011)
- 2008 – Dr. Perry L. McCarty
- 2007 – Dr. Herman Bouwer (1927-2013)
- 2006 – Glenn A. Brown, PG, CEG (1924-2015)
- 2005 – Dr. Luna B Leopold, P.G. (1915-2006)
- 2004 – Dr. John D. Bredehoeft
- 2003 – Rita Schmidt Sudman
- 2002 – Thomas W. Dibblee, Jr., PG (1911-2004)
- 2001 – Carl J. Hauge, P.G., CEG
- 2000 – Dr. Joseph H. Birman, PG, Gp, CEG, CHg (1924-2015)
- 1999 – Dr. David Keith Todd, P.E. (1923-2006)
- 1998 – Eugene E. Luhdorff, Jr., P.E. (1930-2010)

Kevin J. Neese:

Recognizes a recent significant accomplishment by a person or entity that fosters the understanding, development, protection, or management of groundwater.

Previous Kevin J. Neese Award recipients include:

- 2017 – Center for Groundwater Evaluation and Management (GEM) of Stanford Univ. School of Earth, Energy, and Environmental Sciences for the application of groundbreaking surface and airborne geophysical work that is being done by this group to the application of groundwater characterizations
- 2015 – California Department of Water Resources for its significant contributions to local agencies to advance groundwater planning, management, and conjunctive use with Regional Partnerships, Integrated Regional Water Management, and Drought Grant programs
- 2014 – Governor Edmund "Jerry" G. Brown for his leadership in developing sustainable groundwater management legislation and shepherding it through the legislative process
- 2013 – Santa Clara Valley Water District for its implementing its unique Domestic Well Testing Program
- 2012 – David L. Orth, General Manager of the Kings River Conservation District for his leadership and dedication to the collaborative initiatives to develop the Upper Kings River Basin Integrated Regional Water Management Plan
- 2011 – Sacramento County Environmental Management Department for its Abandoned Well program, the first of its kind in California

Continued on the following page…

- 2010 – Senator Fran Pavley for her leadership in the enactment of the comprehensive, statewide groundwater level monitoring legislation in California
- 2009 – U.S. Geological Survey, California Water Science Center for its development of a new 3-dimensional groundwater-modeling tool for California's Central Valley and report "Groundwater Availability of the Central Valley Aquifer," Professional Paper 1766
- 2008 – Orange County Water District for its Groundwater Replenishment System (GRS), a new water purification plant that became operational last January
- 2007 – University of California Cooperative Extension Groundwater Hydrology Program for its efforts to engage scientists, regulators, farm advisors, dairy industry representatives, and dairy farmers to better understand the effects of dairy operations on water quality
- 2006 – Senator Sheila Kuehl for her work to improve the production and availability of information about California's groundwater resources
- 2004 – California Department of Water Resources for its publication in 2003 of its updated Bulletin 118: "California's Groundwater"
- 2002 – Glenn County Water Advisory Committee for its formulating a significant groundwater management ordinance that was adopted by the Glenn County Board of Supervisors
- 2001 – American River Basin Cooperating Agencies and Sacramento Groundwater Authority Partnership for fostering the understanding and development of a cooperative approach to regional planning, protection, and management of groundwater
- 2000 – Board of Directors of the Chino Basin Watermaster for delivering a remarkable OBMP that created a consensus-based approach for making water supplies in the Chino Basin more reliable and cost effective
- 1999 – Governor Gray Davis for his work and leadership in addressing MTBE.

2018 Directors Election Results

The election for GRA's 2018 Board of Directors is officially completed. Board incumbents Murray Einarson, Abigail Madrone and Brett Wyckoff were re-elected. Robert Gailey, Christy Kennedy, and R.T. Van Valer were elected as new directors. Ted Johnson, Lisa O'Boyle, and Emily Vavricka retired from the board at the end of 2017. GRA appreciates the years of service from Ted, Lisa, and Emily.

GRA Communications

GRA keeps you informed on member benefits, groundwater news, legislation, and events in a lot of ways, but the primary method is email. If you're subscribed to the email list and are not receiving messages, try reconfirming your email subscription. If the confirmation doesn't come through, please contact your IT department, and ensure they whitelist emails from @grac.org

If you're not subscribed to our email list, sign up today!

National Groundwater Awareness Week (#GWAW2018)

March 11-17, 2018

An annual observance established to highlight the responsible development, management, and use of groundwater. Groundwater awareness is consistent with GRA's mission to resource management that protects and improves groundwater supply and quality through education and technical leadership.

The National Ground Water Association (NGWA) would like to invite your organization to be a "Groundwater Advocate." Being a Groundwater Advocate is easy. Just commit as an organization to promote groundwater awareness in connection with Groundwater Awareness Week. Then ask to be an advocate in an email to Aaron Martin at amartin@ngwa.org, with 'I want to be a Groundwater Advocate' in the subject line, and provide your organization's name and website or Facebook page address.To help you with your communication you may use the Groundwater Awareness Week landing page. Here you will find a press release template, social media toolkit, communication toolkit, and FAQs.

PLANNING FOR SUSTAINABILITY OF CALIFORNIA'S GROUNDWATER
HOW GEOPHYSICS CAN ASSIST

California is faced with the challenge of making use of groundwater sustainable. The future of California's economy and agricultural communities and livelihoods depends on this. Under the Sustainable Groundwater Management Act, Groundwater Sustainability Agencies have the stewardship task of developing Groundwater Sustainability Plans. How does one manage a groundwater system? One starts with mapping and understanding the hydrogeology of the groundwater system because it is difficult for groundwater managers, on behalf of the groundwater user community, to sensibly and sustainably manage a system that has not been scientifically mapped and understood.

Hydrogeophysical methods integrated with hydrogeological approaches are a proven method of scientifically characterizing groundwater basin systems and underpinning planning for sensible groundwater measurement, monitoring, modelling and management.

The Environmental and Engineering Geophysical Society (EEGS), with the assistance of the Groundwater Resources Association (GRA) of California, the National Groundwater Association (NGWA) and US, Australian, Danish and African hydrogeophysics specialists, has as a service to the California groundwater stakeholder community, produced a Special Edition of EEGS FastTIMES quarterly magazine (Vol. 22, 3 2017), raising awareness of the intelligent use and benefits of hydrogeophysics integrated into hydrogeological investigations for California groundwater management planning (see Contents below).

The Special Issue of FastTIMES can be downloaded as an interactive PDF document and freely distributed as a low resolution PDF (Click here) or high resolution PDF (Click here). The download option is in the ... (More) drop-down menu in the top-right part of the download screen, left of the Bell icon. Page 7 of the document has instructions on how to use the interactive features of the interactive PDF.

We trust this Special Edition encourages understanding and adoption of greater use of hydrogeophysics in groundwater investigations and planning for SGMA and GSA sustainable groundwater management.

California and Hydrogeophysics

Environmental and Engineering Geophysical Society

http://www.eegs.org/

GRA Welcomes the Following New Members

OCTOBER, 2017 - FEBRUARY, 2018

Alan Becker
Anna Schiller
Araceli Serrano
Berry Hecht
Brad Gooch
Burton Gilpin
Caryn O'Neil
Catherine Borrowman
Christina Hanson
Christine Pham
Chuck Dunning
Cristobal Loyola Agnosto
Dana McCarthy
David Cameron
Don Lee
Donovan Parker
Erica Key
Grant Ohland
Gregory Bartow
Heidi Bauer
Jacob Gallagher
Jana Marquez
Jennifer Pensky
Jessica Rodriguez
Jillian Brown
John Freim
John Wharff
Jon Gamble
Joseph Kingsbury
Joshua Sobolew
Julie Randol
Kathryn Oehlschlager
Kent O'Brien
Kiersti Ford
Lee Knudtson
Linda Dorn
Luisa Buritica
Maile Gee
Matthew Mayry
Mauritz Botha
Meng Ma
Michael Bombard
Paul Nelson
Peter Corral
Peter Dillon
Ralf Junghanns
Rebecca Smith
Rob Tribble
Sage Montenero
Sandi Potter
Sarah Acker
Shawn Agarwal
Stephen Bradbury
Sunny Grunloh
Tara Rolfe
Thomas Mohr
Wendy Bagnasco
Wesley Henson

Dates & Details

GRA EVENTS & KEY DATES

(Please visit www.grac.org for detailed information, updates and registration unless noted)

2018 Legislative Symposium
March 21, 2018 | Sacramento, CA

First Annual Groundwater Sustainability Agency Summit
June 6-7, 2018 | Sacramento, CA

First Annual Western Groundwater Congress
September 25-27 | Sacramento, CA

For information on how to sponsor or exhibit at an upcoming event, please contact Sarah Erck at serck@grac.org.

Thank You to Our 2017 Contributors

PATRON ($500-$999)
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NORTHERN SACRAMENTO VALLEY

By Todd Greene

President:	**Eddy Teasdale**, Luhdorff and Scalmanini, eteasdale@lsce.com
Vice-President:	**Steffen Mehl**, CSU, Chico, smehl@csuchico.edu
Treasurer:	**Scott Dressler**, AECOM, scott.dressler@aecom.com
Secretary:	Todd Greene, CSU, Chico, tjgreene@csuchico.edu
Member-at-large:	**Christina Buck**, Butte County DWRC, cbuck@buttecounty.net

The Northern Sacramento Valley (NSV) Branch is still thriving as the youngest GRA branch in California. NSV has recently hosted two excellent talks given to a diverse audience of students, consultants, faculty, and community members from around the North State (20-30 in attendance). Dr. Rosemary Knight (Stanford University), a GRA David Keith Todd Lecturer, delivered a fantastic summary of a relatively new geophysical technique called Airborne Electromagnetic (AEM) mapping that is spreading quickly throughout California groundwater basins. We also just hosted a talk on the latest isotopic data interpretations of recharge in Butte County delivered by Dr. Andrew Kopania from EMKO Environmental, Inc. Both talks are very current and relevant to SGMA planning throughout California. Paul Gosselin, Director of Butte County's Department of Water and Resource Conservation, is scheduled to give an update on SGMA in Butte County in April. We will continue to host speakers that relate directly to SGMA's mandate to avoid "undesirable results" in aquifer conditions, so please stay tuned in for more announcements.

President Eddy Teasdale introduces Dr. Andy Kopania (wearing baseball cap) at the NSV Branch meeting in February.

SAN DIEGO

By Patrick Rentz

President:	**Trey Driscoll**, Dudek, tdriscoll@dudek.com
Vice-President:	**Doug Roff**, AECOM, Douglas.Roff@aecom.com
Treasurer:	**Scott Snyder**, Snyder Geologic, scott@snydergeologic.com
Secretary:	**Pat Rentz**, Dudek, prentz@dudek.com

The San Diego Branch hosted its first "Blue Couch Series" event of 2018 on February 8, 2018, with Lindsay Swain, senior hydrogeologist at Dudek, as the featured speaker presenting an overview of the history and applications of groundwater modeling. The event was sponsored by Dudek and was hosted at their office in Encinitas. The event had approximately 20 attendees comprised of students, government, and private sector employees.

Prior to the presentation, Branch Officer elections were held according to GRA Bylaws. All four incumbent officers were voted to retain their positions for the 2018 year. Mr. Swain's presentation Groundwater Modeling for the Water Manager was educational and well-received. It provided a good summary of different types of groundwater models and their historical development. It included model calibration, refining the input dataset and model uncertainty. Additionally, we learned about the comparison between predictive models and actual basin conditions. Following the presentation, the Q&A portion of the event allowed for a relevant group discussion regarding SGMA modeling efforts and how to present models with their results to stakeholders and the public.

The next San Diego branch meeting is scheduled on March 5th, at the GRA BSMAR 16 event in San Diego. The event is titled "IAH Commission on Managing Aquifer Recharge – a global rescue mission!" and the speakers will be Peter Dillon, co-founder of IAH Commission on managed aquifer recharge and David Pyne, president of ASR Systems.

Senior Hydrogeologist Lindsay Swain presenting at SD Branch's Q1 2018 "Blue Couch Series" event.

The Parting Shot

Anza-Borrego Desert State Park is located within the Colorado Desert of southern California. The park takes its name from 18th century Spanish explorer Juan Bautista de Anza and from "Borrego," the Spanish word for bighorn sheep. At 600,000 acres, it is the largest state park in California, and includes one-fifth of San Diego County.

From its beginnings almost half a billion years ago, the Anza-Borrego region has experienced a complex geologic history. Paleozoic marine deposition along the western edge of the ancient North American continent eventually gave way to an extended period of Mesozoic plate subduction, which produced vast volumes of granitic rock and transformed older sedimentary rock into metamorphic rock. Within the last 30 million years, a complex transform-divergent plate boundary has developed within the region, creating towering mountain ranges, deep basins, and thick deposits of fossil-bearing sedimentary rock representing ancient seas, deltas, rivers, and lakes.

After decades of excessive pumping, the Borrego Groundwater Basin is critically over drafted and dramatic reductions in water consumption by current and future water users are needed for the basin to become sustainable. A 2015 USGS study calculated the overdraft of the Borrego Basin to be approximately 13,000 acre-feet or 4.2 billion gallons per year, equal to approximately 70% of the water demand for municipal, recreational, and irrigation/agricultural uses. The 2015 USGS study also concluded that on average 5,700 acre-feet of inflow comes into the Borrego Groundwater Basin annually. The County of San Diego and the Borrego Water District, in cooperation with stakeholder groups, are currently developing the Borrego Basin Groundwater Sustainability Plan.

Photographed on February 19, 2017 during a period of powerful winter storms. GPS coordinates of the photograph are 33.156667° -116.345278°. Information for visiting Anza-Borrego Desert State Park is available at: http://www.parks.ca.gov/?page_id=638. Information on the Anza-Borrego Desert Natural History Association is at: http://www.abdnha.org/index.html.

By John Karachewski, Ph.D.