GROUNDWATER RESOURCES ASSOCIATION OF CALIFORNIA

HYDROVISIONS

VOLUME 19, NO. 3 FALL 2010

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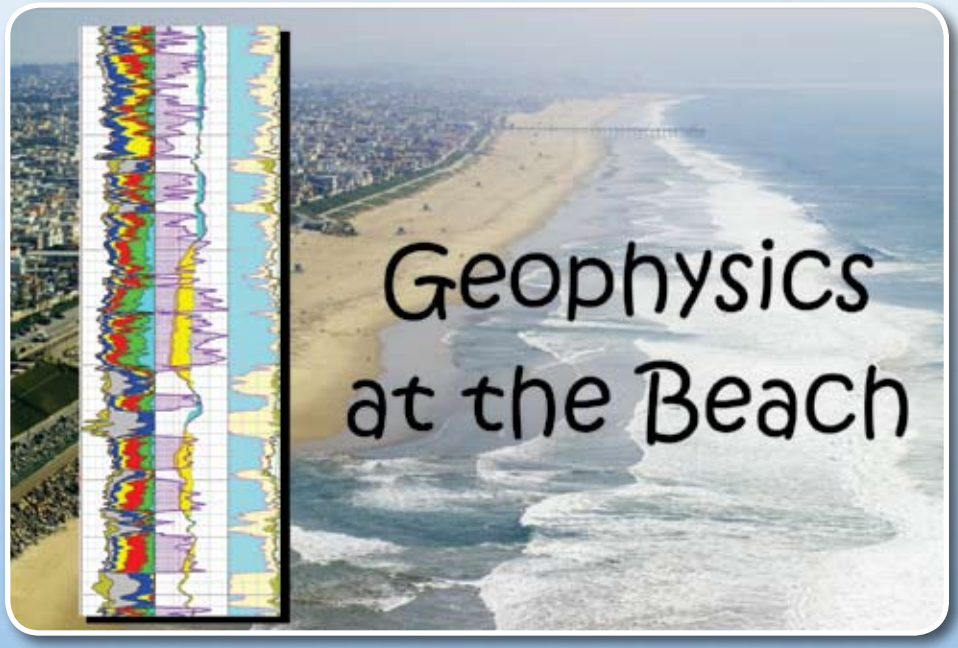
GRA Symposium – Geophysics at the Beach

By Ted Johnson, John Jansen, Tim Parker, and Ned Clayton



Groundwater is a critical resource that will increasingly be relied upon in the future to meet growing water demands in the face of changing climate, socio-economic pressures, and the decreasing availability and rising cost of surface water. More reliance on groundwater will drive the need for improved characterization of subsurface geohydrology and water quality, and improved tools for predicting the long-term viability of groundwater storage projects.

Geophysics is a discipline that utilizes a suite of high-resolution surface and downhole tools that play an important and increasing role in water resources investigations to obtain high-quality and cost-effective subsurface hydrogeologic information critical to making informed management decisions.

To provide a link between current and future groundwater problems and the latest in geophysical tools and technologies that can be applied to help solve these problems, GRA, in conjunction with the Environmental and Engineering Geophysical Society (EEGS), held a three-day symposium in Santa Ana and Newport Beach in May, 2010. A basic and advanced short course on borehole geophysics was held on May 24th; a symposium with 17 speakers and poster presentations was held on May 25th; and a field demonstration of geophysical equipment was held at the beach on May 26th.

About 60 people attended the three-day event; their varied backgrounds included technical professionals, public and regulatory agency staff, university staff, responsible parties, case managers, and others. Following is a summary of the information presented at the event.

May 24, 2010 – Basic and Advanced Borehole Geophysics Short Course

This one-day course provided the background information necessary for selecting appropriate geophysical logging technologies for various projects, and for interpreting and integrating geophysical logs into hydrogeologic investigations. Such investigations may include:

Continued on page 6…

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

The late Gene Luhdorff (left) standing in an irrigated field. See page 32.

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Columns & Corners

HYDROVISIONS is the official publication of the Groundwater Resources Association of California (GRA). GRA's mailing address is 915 L Street, Suite 1000, Sacramento, CA 95814. Any questions or comments concerning this publication should be directed to the newsletter editor at editor@grac.org or faxed to (916) 442-0382.

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Does GRA know where it's going?

By Bill Pipes

You've got to be very careful if you don't know where you're going, because you might not get there. –*Yogi Berra*

Does GRA know where it's going? You bet we do. We have a clear vision: "***…to be the leading groundwater resources advocate and educator of members and the public on resource management to protect and improve groundwater.***" We have a mission "***…dedicated to resource management that protects and improves groundwater through education and technical leadership.***" GRA has a ***strategic plan*** to realize our vision and to fulfill our mission. First developed in 2002, the Plan clearly communicates our direction to members and other important stakeholders in the groundwater resources community. You can find the Plan, last updated in May of this year, on the GRA website.

Dwight D. Eisenhower famously said "plans are nothing, planning is everything." The GRA Board of Directors believes this also – so every year we have an all-day strategic planning retreat to review where we have been, agree on where we are going, and to identify strategic initiatives for the coming 12 months that will help GRA achieve its vision, mission, and the goals and objectives laid out in the Plan.

This year's retreat was held in May at the USGS office in San Diego. Prior to the meeting, Board members were surveyed about key groundwater issues of the day, the current state of the association, and what they would suggest as strategic initiatives for the next 12 months. During the meeting, from a list of a dozen or so potential strategic initiatives, we identified 3 initiatives to focus on; we then broke into smaller groups and developed action plans for each initiative. The strategic initiatives for 2010-2011 are:

1. **Expand GRA's technical leadership on key groundwater issues.**

   Technical leadership is a bedrock principle of this organization. Under this initiative, GRA will take a lead in identifying key groundwater issues and will develop new events, publish technical white papers, sponsor legislation, and conduct surveys that focus on these issues.

2. **Strengthen GRA's Branch organizations.**

   GRA's Branches are an important benefit to our members and a key resource for the statewide organization. Under this initiative, GRA will help the Branches increase membership and become more of a local resource, and will aid in identifying potential speakers.

3. **Repackage events and web content.**

   Times, they are a-changin', especially in the realm of communication. Call it new media, social media, Web 2.0, but it all comes down to Twitter, Facebook, blogs, podcasts, etc. Under this initiative, GRA will be exploring these newer communication tools to enhance our outreach, respond faster, and be more efficient in the way we convey information and educate members and the public, especially when it comes to our events and website.

Task groups have been formed to champion these initiatives. If you are interested in helping with any of these initiatives, we welcome your involvement—please contact me at bill.pipes@amec.com (much to my teenagers' chagrin, no Twitter or Facebook accounts for me, yet) and I will put you in touch with the right people.

One of the pleasures of serving on the GRA Board of Directors is hanging out with some really nice and exceptionally bright people. Dr. Eric Reichard is one of those people; unfortunately, because of a potential conflict with his current position at the USGS and Board involvement, Eric recently had to resign his Board member position. Eric is the Director of the USGS California Water Science Center and has been with the Water Science Center for over 20 years, during which time he has served as a Research Hydrologist and the Program Chief for Coastal Projects. He brought to the GRA Board incredible insight into the key groundwater issues we face in California, creativity in the events he helped plan, and a steady and sure hand in helping to govern the organization. On behalf of the entire membership, thank you, Eric, for your hard work and dedication to GRA.

And thank you for reading *HydroVisions*! Until next time,

Bill Pipes

Bill Pipes, *GRA President*

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GUEST EDITORIAL

Society-Science Synergism in Santa Clara Valley, California

By T.N. Narasimhan

A century after the invention of the marvelous deep-well pump, the world finds itself in a crisis of groundwater over-production. World-wide, many shallow and deep aquifers are subjected to resource depletion with little prospect of natural replenishment. Evolving with experience, the groundwater profession has adapted its mindset from one of finding new groundwater sources to one of sustainable management. Yet, many groundwater users are reluctant to heed the plea for disciplined management. For various reasons, they would prefer unregulated access to groundwater. While science tells us that surface water and groundwater constitute a single resource, societal attitudes often treat groundwater as private property, as distinct from surface water, a regulatable public property.

However, individual communities, controlling their own destiny, have demonstrated the viability of conjunctive management of groundwater and surface water. An example is California's Santa Clara Valley, familiarly known as the Silicon Valley. Over the past century, the Valley's citizens have grown from identifying a phenomenon governed by natural forces to adapting to its attributes, and setting in place an admirable community-controlled integrated water management system. Central to this success is an evolutionary synergism of policy and science; the dictionary defines synergism as the interaction of discrete agents, elements, or constituents in such a way that the total effect is greater than the sum of the individual effects.

Below is a brief account of the Valley's water history, followed by an examination of how scientific knowledge of water is built into governance.

At the turn of the 20th century, Santa Clara Valley was a Garden of Eden, with fruit orchards and a canning industry supplying the entire nation, thanks to the birth of the railroad. The invention of the turbine pump around 1910 was a boon that enabled pumping of large quantities of water from the Valley's confined aquifers to boost irrigation and protect orchards from climatic vagaries. Within a decade, though, unintended technological consequences emerged. Well productivity and acreage per well plummeted (Figure 1).

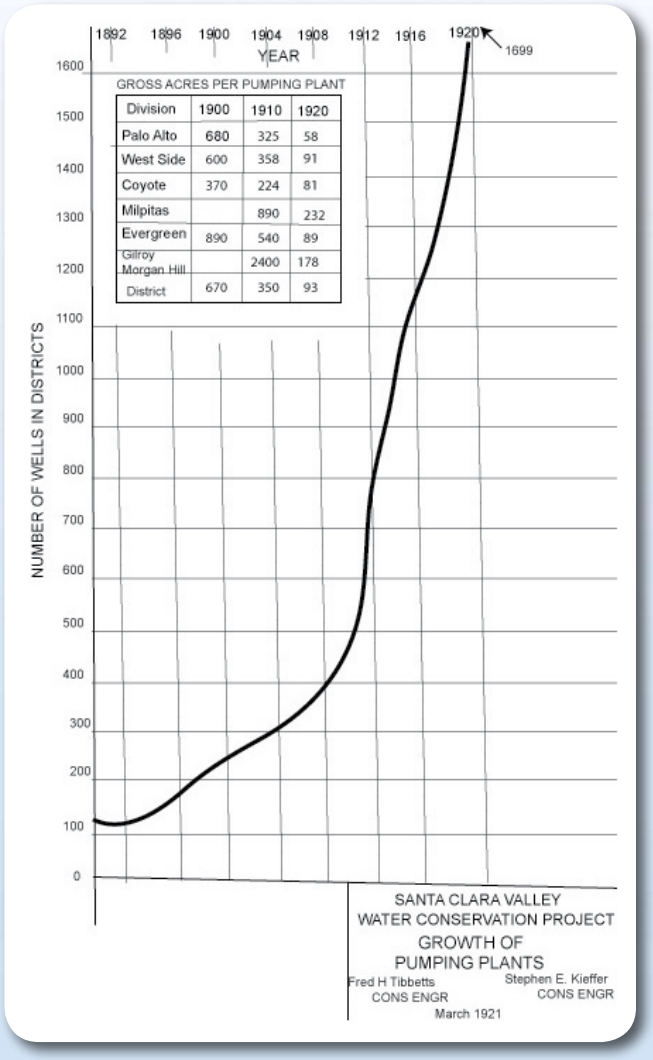

Figure 1: *Adapted from Tibbetts and Kieffer (1921), this figure shows dramatic increase of irrigation wells and decline in well productivity between 1910 and 1920.*

Over the next decade, the citizens initiated a remarkable process of self-education and adaptation. Fred Tibbetts, a civil engineer spearheading a 1921 report, found that the Valley's water demand exceeded natural replenishment, and that the demands could be met through coordinated groundwater extraction supported by 17 surface reservoirs, and a system of artificial recharge facilities. After much political debate, a Water District was formed for the northern part of the Valley to enable the citizens to take control of water. By 1935, a scaled-down version of the Tibbetts-Kieffer plan was implemented using six surface reservoirs. Immediate success was reflected in dramatic rises in water levels (Figure 2). However, this success ended early in the 1940s when irrigated orchards began gradually giving way to an incipient electronics industry and post-war urbanization. Water needs escalated.

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Society-Science Synergism in Santa Clara Valley, California – Continued

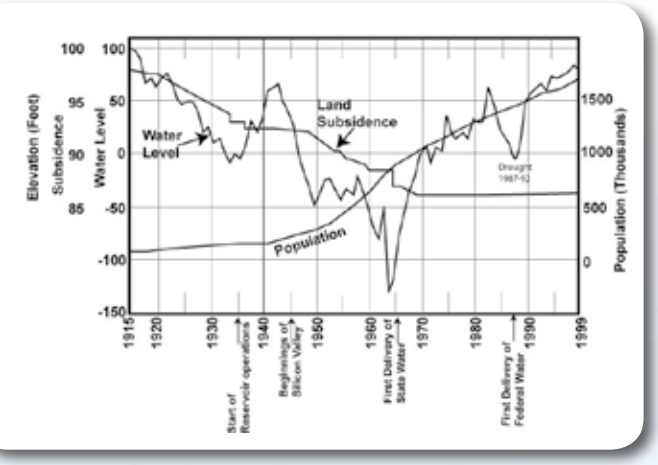


Figure 2: History of water levels and population growth in Silicon Valley. Rising water levels from 1936 to 1943 show the sufficiency of indigenous water resources to sustain pre-urbanization needs. Subsequent water-level decline and recovery show unsustainability without water imports. The trend of land subsidence versus water level is indicative of plastic deformation behavior of fine-grained sediments.

Since the 1960s, when water imports from the State Water Project, the Hetch Hetchy Aqueduct, and the Central Valley Project began, a little more than half of the Valley's needs are met from external sources. Although, from the perspective of conjunctive use, the Valley's integration of surface water and groundwater through artificial recharge is of very high standard, the sobering lesson is that the Valley's economic aspirations cannot be sustained by its indigenous resources.

Between the 1930s and the 1980s, the Valley's governance structure evolved to set in place the current Santa Clara Valley Water District with jurisdiction over the entire Valley. Governance is through an elected Board of citizens, with additional members representing the County administration. The Board makes policy decisions on water allocation, use, and management. Private retailers and municipalities buy water from the District, and provide it to users.

Storage space in the groundwater reservoir constitutes the nucleus around which the integrated water system is designed. Well-designed recharge facilities enable strategical partitioning of imported water and local runoff between direct distribution and artificial recharge. Each year, decisions are made on how water needs will be apportioned between surface water and groundwater. Overall, the goal is to moderate groundwater extraction during years of above-normal precipitation, and increase groundwater production during periods of below-normal rainfall. Crucial to this ongoing decision-making process is the District's technical staff of hydrologists, hydrogeologists, biologists, and other specialists, who, aided by permanent monitoring facilities, provide scientific information about water levels (indicating changes in groundwater reservoir storage) and potential climatic changes. Thus, science contributes actively to policy.

Clearly, here is an example of science and society constructively working together to make the best use of available water resources. This synergism started a century ago when the local citizens reached out to a thoughtful civil engineer, Fred Tibbetts. Ever since, science, policy and institutional development in the Valley have been inseparable.

To learn how the District's Board members perceive the role of science in governance, I sent a message on May 16, 2010 inquiring what the elected representatives' perception was. In response, the Board was kind enough to respond on June 18, 2010, stating,

> *"The application and integration of scientific understanding is essential to achieving the Board's goals and objectives, and is a critical component in the services we provide to the community. These means are defined in planning documents, project plans, and other documents that define the approach and methodologies to achieving the Santa Clara Valley Water District's (District) mission. As the work of District staff is directly linked to the Board's goals and objectives, application of scientific knowledge is implicitly integrated in the Board's policy framework. Board policies, as described in Board Policy (GP-2), are "broad written policies reflecting the Board's values and perspectives" with a focus on the intended results and do not describe the administrative or programmatic means of attaining those effects."*

Among the Board's Policies is the commitment,

> *"1.2 As an integral part of its comprehensive water management program, the District will conjunctively manage its groundwater basins to maximize water supply reliability. Critical aspects of this effort are to proactively and aggressively protect the basins from contamination and the threat of contamination as well as reflecting the District's stewardship of stream resources."*

From the Board's letter and its Policy commitment, it is clear that the Santa Clara Valley experience establishes the viability of making science integral to water policy. For water management elsewhere, the challenge is to extend this methodology to larger water-society systems involving more complex patterns of resource base, water use and demography.

Dr. T. N. Narasimhan is a Professor at the Department of Materials Science and Engineering, and the Department of Environmental Science, Policy and Management, University of California, Berkeley, CA, 94720-1760.

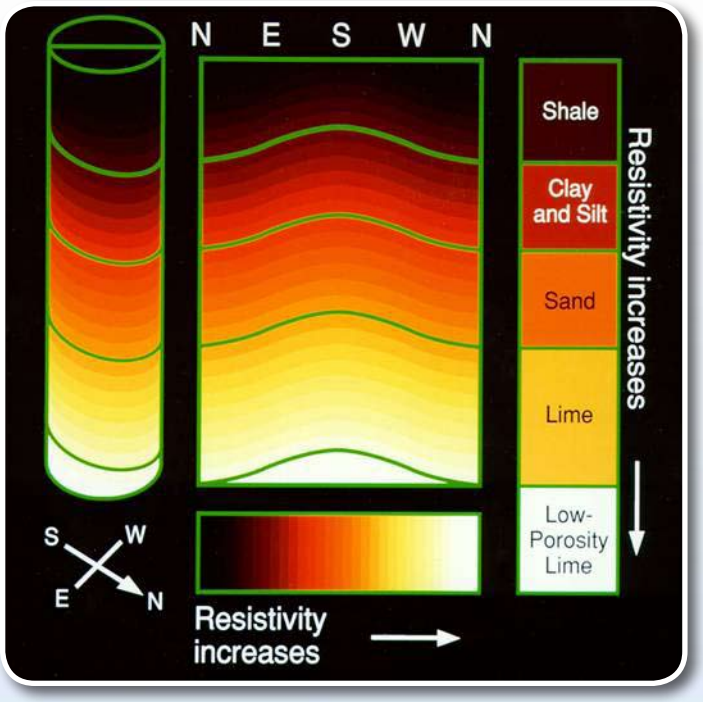
Tibbetts, F. H., and Kieffer, S. E. (1921) "Report to Santa Clara Valley Water Conservation Commission on Santa Clara Valley Water Conservation Project," Santa Clara Valley Water District, San Jose, California, 243 p.

GRA Symposium – Geophysics at the Beach – *Continued from page 1*

- Optimization of new or existing well design and performance
- Development of conceptual models
- Characterization of complex contaminated sites
- Characterization of fractured media
- Groundwater resource evaluation
- Aquifer storage and recovery design
- Regional groundwater monitoring
- Seawater intrusion assessment
- Mine water management
- Geotechnical analysis
- Well design for production, injection and monitoring.

The short course was divided into two parts: (1) basic borehole geophysical techniques, and (2) advanced borehole geophysical techniques. The first part focused on standard geophysical logging technologies used in the water industry, including e-logs (resistivity), SP, gamma ray, neutron, density, sonic, flow and fluid logging. The second part focused on logging technologies developed in the oilfield that are now being implemented in the water industry for hydrogeologic evaluation, including magnetic resonance for pore size distribution and hydraulic conductivity, electrical and acoustic imaging for geologic structure and fracture evaluation, dipole sonic for geomechanics and fractures, and neutron-gamma spectroscopy for geochemistry. In-well fluid flow logging (including dye fluid tracer logging) also was described during the advanced session. Course instructors introduced the physical principles of the logging technologies, discussed their respective limitations and applications, and challenged attendees to work through real-world data interpretation.

The instructor for part 1 was John Stowell of the Mount Sopris Instrument Company; Ned Clayton of Schlumberger Water Services led part 2. David O'Leary of the U.S. Geological Survey gave the presentation on dye fluid tracer logging.

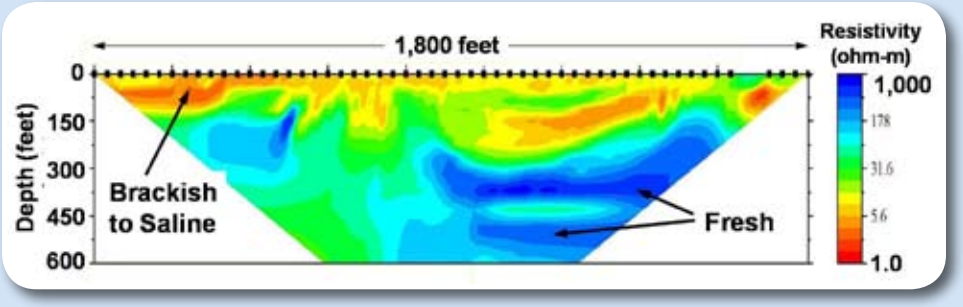


Borehole Electrical Imaging – Ned Clayton

May 25, 2010 – Symposium

This was GRA's 4th Symposium in its series on Tools and Technologies, and provided participants with a full day of exciting presentations, posters, and exhibitors on geophysical methods for groundwater resources. After breakfast and a welcoming speech by symposium co-chair **Tim Parker**, General Session 1 commenced with "The Basics and Global Perspectives of Geophysics." Session moderator Tim Parker of Layne Christensen Company introduced John Jansen of Entrix, who provided an introduction to geophysics for groundwater resource investigations, explaining that geophysics is a remote sensing method for evaluating the physical properties of the subsurface; in other words "a means to see through dirt!" Methods he discussed were electromagnetic, seismic (refraction and reflection), magnetometry, gravity surveys, and ground penetrating radar.

Following John was **Bill Alley** of the U.S. Geological Survey, who presented "Applications of Geophysics at the USGS." Bill described geophysical technique development and testing at a national scale, the importance of using multiple techniques to obtain higher confidence in the results, geophysical methods for monitoring, mobile geophysics (boat tows, airborne, and land streamers), and how geophysics is often used in support of groundwater modeling.



Ground Penetrating Radar Image - Matt Becker

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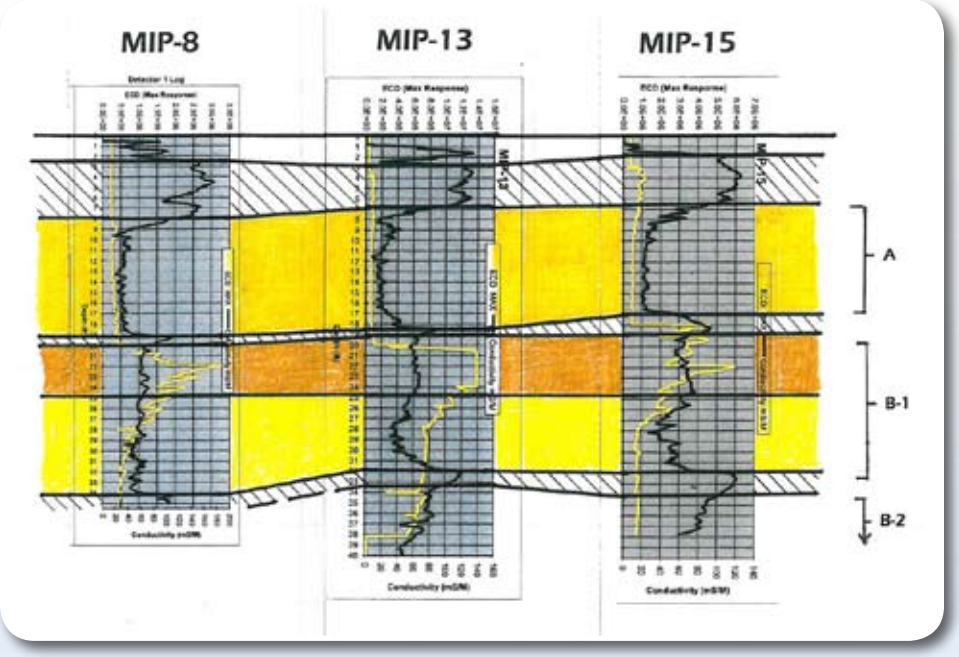
GRA Symposium – Geophysics at the Beach – *Continued*

Session 2, moderated by **John Jansen,** covered a broad category of groundwater geophysics. **Michael Rymer** of the USGS gave two presentations on using seismic methods for groundwater mapping, including mapping the water table and finding fault offsets. **Rob Sengebush** of Intera presented the use of geophysical logs in developing a groundwater flow and transport model of the Alamitos Gap area of Los Angeles and Orange Counties, which includes complex faulted geology, saltwater intrusion, and seawater barrier injection wells. **Roy Herndon** of the Orange County Water District presented the results of using electrical resistivity transects and time domain electromagnetic induction to map saltwater intrusion through the Sunset Gap in Orange County. **Peter Swarzenski** of the USGS concluded the first part of Session 2 by examining scales and physical drivers of submarine groundwater discharge using 222Rn and multi-electrode resistivity, including examples from Alaska, Washington and California.

Session 2 continued after lunch with Moderator **Martin Miele**, United Water Conservation District, who introduced **Leigh Wood Dudash,** consulting geophysicist, who conducted geophysical surveys to search for groundwater in the Nevada desert using controlled-source audiomagnetotellurics (CSAMT). **Ned Clayton** of Schlumberger Water Services discussed advanced borehole geophysical methods for logging hydrogeologic properties prior to completion of deep monitoring wells in Los Angeles County. In addition to the standard e-log suite of gross gamma, SP, and resistivity, the advanced suite included magnetic resonance, focused induction and micro-resistivity, spectral natural gamma, formation electrical imaging, and full waveform dipole sonic. **Matt Burgess** of the USGS closed Session 2 with a presentation on using geophysics for the characterization of a proposed groundwater recharge and recovery site in Antelope Valley, CA to help combat 200 feet of groundwater level declines over the past 50 years.



Subsurface Conductivity used for Stratigraphic Correlation – Brad Cross, ARCADIS

Session 3, moderated by **Ned Clayton**, was focused on geophysical site characterization. The use of high-resolution geophysical data for stratigraphic analysis and improved site conceptual models was presented by **Brad Cross** of ARCADIS. He emphasized the importance of applying stratigraphic principals and high-resolution tools for site characterization and adequate determination of aquifer heterogeneity, which drives solute transport. **Paul Stoppelmann** of the Sanitation Districts of Los Angeles County used seismic refraction to address the new Title-27 landfill gas monitoring requirements at the Scholl Canyon Landfill in Glendale, CA. Depth to bedrock was mapped using geophysics to significantly reduce the number of new soil vapor probes needed. The session closed with **Tom Fogwell** of Weiss Associates, who described the use of near-surface geophysics in the design of a subsurface water management system.

Session 4, moderated by **Roy Herndon**, was an in-depth review of the use of geophysics to detect fluid flow. **Martin Miele** presented "Geophysical Techniques for Assessing Critical Seepage Pathways in Earthen Levees," and provided an interesting review of the California Sacramento River Delta system, which consists of over 1,100 miles of old levees (built in the 1800s). Levee breaks occur every few years, and each costs hundreds of millions of dollars to fix. Electrical resistivity imaging and multi-channel analysis of surface waves were used at several sites to find potential weak zones or soil raveling, which may generate seepage pathways for levee failure. **Norm Carlson** of Zonge Engineering and Research Organization discussed using controlled- and natural-source audiofrequency magnetotellurics for groundwater exploration. Examples of techniques used to produce higher capacity water wells in Flagstaff, AZ were provided. The session concluded with **Jim Fink** of hydroGEOPHYSICS presenting dynamic monitoring of subsurface flow using electrical geophysics. He discussed a new way to determine quantitative volumes of contaminant leaks or injections, and to quantify the rate and direction of flow and estimate hydraulic permeability; two case studies were presented.

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GRA Symposium – Geophysics at the Beach – *Continued*

The final session was moderated by **Ted Johnson** of the Water Replenishment District of Southern California (symposium co-chair). Two papers were presented on Methods and Applications in Fractured Bedrock. **Matt Becker** of California State University Long Beach discussed hydrogeophysical characterization and monitoring of fractured bedrock, and focused on channelized flow. The Altona Flat Rock test site was described and subjected to packer tests, constant-rate pumping tests, and imaging of a saline tracer using ground penetrating radar (GPR) to determine flow channeling effects. **Seema Turner** of ENVIRON discussed the use of geophysical methods to characterize fractured granitic terrain with a focus on a southern California contamination site. Both surface and borehole geophysics were used to successfully map the complicated subsurface geology that included alluvium, decomposed granite, the water table, fractured bedrock, and massive bedrock.

Following the presentations, attendees viewed the posters and visited with the exhibitors. Posters were presented by **Chris Bonds** of the California Department of Water Resources (Borehole Spectral Gamma Ray Geophysical Logging), Tony Morgan of United Water Conservation District (Geophysics as a Component of a Groundwater Basin Conceptual Model), and **Steven Springhorn** of California Department of Water Resources (Use of Gamma Ray and Spectral Gamma Ray Data to Identify Primary Volcaniclastic Deposits in the Subsurface).

Exhibitors included Alpha Geoscience Proprietary Limited, Geometrics, GEOVision, NORCAL Geophysical Consultants, Schlumberger Water Services, Spectrum Geophysics and Legg Geophysical, Vista Clara, and Zonge Engineering & Research Organization. Instrumentations Northwest (Randy Lovell) was the sponsor for the reception held at the end of the day where socializing and networking went well into the evening.

Roger Henderson Demonstrating TEM

May 26, 2010 – Field Demonstration

The conference concluded with a fun and informative day of field demonstrations at Balboa Park on the turf and surf in Newport Beach. Participants spent 30–45 minutes with each vendor to learn the methodology behind the equipment, the applications it can be used for, and a live demonstration.

Douglas Groom of Geometrics, Inc., demonstrated the Stratagem Controlled Source Audio Frequency Magnetotelluric (CSAMT) instrument, a system that uses natural and transmitted electromagnetic energy to measure the electrical conductivity of the subsurface to a depth of 1,000 meters.

Roger Henderson and **Duncan Massie** of Alpha Geosciences came all the way from Sydney, Australia to demonstrate the terraTEM time domain electromagnetic induction instrument (TEM), a system that transmits a short pulse of EM energy to map the subsurface conductivity to depths of up to 500 meters.

Deborah Underwood of Geometrics, Inc., demonstrated the Multichannel Analysis of Surface Waves (MASW), a method that uses surface seismic waves from traffic noise or a sledge hammer to map the shear wave velocity of the subsurface to depths of up to 100 meters.

Bill Black of Norcal Geophysical Consultants demonstrated the Geometrics EM-57 Time Domain Electromagnetic Induction (TEM) instrument, a system that transmits a short pulse of EM energy to map the subsurface conductivity to depths of up to 500 meters.

Ned Clayton of Schlumberger Water Services demonstrated a geophysical logging truck used to collect the state-of-the-art Comprehensive Well Logging Suite, capable of mapping fine-scale geologic and hydrogeologic properties of the formations penetrated by a borehole.

GRA expresses its gratitude to all participants, speakers, moderators, symposium co-chairs, the organizing committee, sponsors, and GRA staff. Without everyone's efforts in these roles, this event would not have been such a success.

Dates & Details

GRA EVENTS & KEY DATES

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

GRA Short Course
Principles in Groundwater Flow and Transport Modeling
Sep. 13-15, 2010 | Redwood City, CA

GRA 19th Annual Conference
Thinking Outside the Pipe—Exploring Local Water Supplies
Sep. 15-16, 2010 | Burlingame, CA

GRA Course
Interpreting Non-Detect Data Correctly
November 2, 2010 | Ontario, CA

GRA Board Meeting
November 6, 2010 | Fresno, CA

Groundwater Resources Association of California Presents A Short Course:

Principles of Groundwater Flow & Transport Modeling

SEPTEMBER 13-15, 2010
SEAPORT CONFERENCE CENTER – REDWOOD CITY, CA

The use of computer modeling tools has become a standard practice in many groundwater investigations. Groundwater resources evaluation, groundwater quality assessment, contamination site assessment and remediation, environmental impact review, and other groundwater related activities frequently rely on computer models as a means of understanding groundwater flow and the fate of contaminants in the subsurface. This course introduces the conceptual principles and practical aspects of groundwater modeling in an intuitive yet comprehensive manner. The course objective is to demystify the use of groundwater models by providing solid understanding of the principles, methods, assumptions, and limitations of groundwater models, as well as hands on experience with the planning, preparation, execution, presentation, and review of a modeling project. The first half of the course reviews the concepts of groundwater flow and transport, and of finite difference and finite element methods. It provides an overview of various software programs for ground water flow and transport modeling and accompanying pre- and post-processing programs. The second half of the course features hands-on exercises based on the USGS MODFLOW flow model and a compatible transport model. Exercises include site-specific models as well as basin/watershed wide models. The course is taught by experienced instructors familiar with many aspects of groundwater modeling and California hydrogeology. At the end of the course, participants should be able to understand and actively engage in planning, supervision, and/or review of groundwater modeling projects.

The short-course is intended for professional consultants, technical personnel in engineering/geology firms and irrigation/water districts, regulatory agency specialists and managers, and those in the legal community specialized on groundwater issues. Participants should have a working knowledge of the principles of groundwater hydrology and be familiar with the PC Windows 95 (or Windows 2000) environment. No formal training in computer programming is necessary.

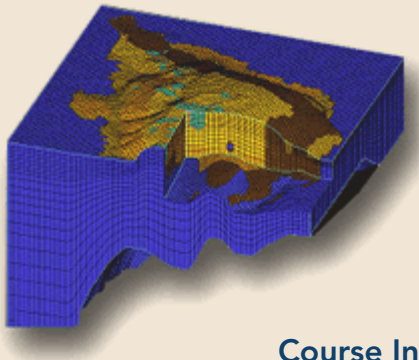

Image courtesy of HydroGeoLogic, Inc.

Course Topics (a partial list)

- principles and concepts of groundwater modeling
- conceptual model development
- data collection and preparation
- boundary conditions: concepts and application
- implementing rivers, lakes, recharge, drainage, and other special situations
- sensitivity analysis, model calibration and verification
- contaminant transport modeling

Course Instructors

Graham E. Fogg, Ph.D., is a professor of hydrogeology with the Hydrology Program of the Department of Land, Air, and Water Resources, University of California, Davis.

Thomas Harter, Ph.D., is a professor of hydrogeology with the Hydrology Program of the Department of Land, Air, and Water Resources, University of California, Davis.

Peter Schwartzman, M.S., is an associate at Pacific Groundwater Group in Seattle, Washington.

19th Annual Conference & Meeting: Thinking Outside the Pipe – Exploring & Protecting Local Water Supplies

Presented in Cooperation with Department of Toxic Substances Control & International Association of Hydrogeologists

SEPTEMBER 15-16, 2010
HYATT REGENCY AT THE SAN FRANCISCO AIRPORT, BURLINGAME, CA

SEPTEMBER 17, 2010
FIELD TRIP: LOCAL WATER AND GROUNDWATER PROJECTS

Co-Sponsors: Erler & Kalinowski, Inc. and MWH

Program Agenda | Field Trip Itinerary | Registration Form | Hotel Information

This two-day conference will provide the latest scientific, management, legal and policy information regarding sustainable use of our local water resources in urban regions. The conference will cover opportunities and solutions for increasing water use efficiency, integrating local and alternative supplies, reducing and capturing urban run-off, minimizing conveyance and energy costs, issues associated with the protection, enhanced recharge, and expanded use of local groundwater supplies.

Who Should Attend

Scientists, policymakers, planners, urban, rural, and environmental stakeholders, local, state and federal governmental officials, and consultants involved in water resources.

Program Focus

Surface water imported through large-scale water delivery projects is a primary drinking water source for many urban regions. However, as climatic and environmental impacts continue to reduce the yield of these surface water systems, local water suppliers and others are facing significant water management challenges. Such challenges include increasing the use of groundwater and other local water sources to meet local demands, protecting and enhancing the quality of the groundwater and other water sources, conjunctively managing surface and groundwater to improve supply reliability, and integrating water management with energy reduction strategies. Additional issues that pose water management challenges include nonpoint source pollution from stormwater, surface water impacts and TMDLs, water use efficiency, overdraft, groundwater salinity, industrial impacts to water supplies, water rights, and water quality and quantity policy conflicts.

Topics for Plenary and Technical Sessions Include

- Stormwater Capture and Reuse - permitting and water rights
- Urban Water Recharge – water quality and permitting
- Brackish water supplies – inland and coastal
- Recycled water – what are the remaining challenges
- Low Impact Developments for water
- Rainfall Rooftop Harvesting
- Graywater Permitting–Black & White, or Still a Lighter Shade of Pale?
- Water Conservation as a New Source
- Water Demand - Using Less and Growing More
- Conjunctive Use and Local Storage Potential – Addressing Related Issues
- Pollution Prevention and Protecting Local Supplies
- Hurdles to Contaminant Site Water Reuse
- Groundwater Policy and Data
- Recycled Water Reuse for Residential Areas
- Emerging Contaminants
- The use of Geographic Information Systems (GIS) to enhance and protect local supplies
- The role of non-traditional local water supply in Integrated Water Supply Plans.

Collegiate Groundwater Colloquium

GRA seeks to increase participation by university and college faculty and students in its programming. In pursuit of this goal, GRA launched a new annual meeting module in 2008 called the "Collegiate Groundwater Colloquium." The Collegiate Groundwater Colloquium presents students who are conducting highly relevant research in the general area of the conference theme. The Colloquium and reception provide students with an excellent opportunity to showcase their research and attendees an opportunity to learn from the frontier of groundwater science.

GRA Presents A Short Course:

Interpreting Non-Detect Data Correctly

NOVEMBER 2, 2010 • 8:30 AM – 4:30 PM • ONTARIO, CA

Instructor: Dr. Dennis Heisel
Approved 7 hours MCLE Credits

Register for this Event

Measurement of trace chemicals in environmental media (water, air, soils, biota) frequently results in values reported only as less-than the laboratory reporting limit ("nondetects", or "qualified values"). The most commonly-used method for incorporating nondetects is to substitute one-half the reporting limit and continue as usual. This produces invasive data that may obscure patterns and trends that are present, or create those that are not present in the original data. It is fraught with error. Standard methods for interpreting this type of data exist in medical and industrial applications, but have rarely been applied to environmental data. Methods are available for computing summary statistics, hypothesis tests, and regression equations. Their results are unequivocal, powerful, and accurate. This course introduces methods from the author's textbook ***Nondetects And Data Analysis: Statistics for censored environmental data***, published in 2005 by John Wiley.

Topics for the Session:

1. Why not use 1/2 the detection limit as a substitute for nondetect values—what are the problems? Are they serious? (yes, they are)
2. What better methods are out there, and how do they work?
3. What resources are available for the practical scientist (papers, software, etc.)?
4. How best to compute the mean and its UCL95 (as an example of a common analysis task) for data with nondetects?

Who Should Attend?

The only requirement is an interest in the correct interpretation of nondetect data. Though some familiarity with basic statistics will be helpful, there are no prerequisites.

Instructor:

Dr. Dennis Helsel (PhD, Environmental Science and Engineering, Virginia Tech) has 30 years experience applying statistics to environmental science. He is the lead author of the popular textbook Statistical Methods in Water Resources (USGS, 2002) and of Nondetects And Data Analysis (Wiley, 2005) and many technical articles. Dr. Helsel was the 2003 recipient of the Distinguished Achievement Award from the American Statistical Association's section on Statistics and the Environment, and of the Dept. of Interior's Distinguished Service Award in 2007. He has trained scientists in the U.S. and internationally since 1990, and does statistical consulting through his company, Practical Stats.

Wells and Words

By David W. Abbott, P.G., C.Hg., Todd Engineers

California Water Well Drillers' Report

Since about 1949, water-well drilling contractors have been required by the State of California—California Water Code (CWC) Section 13751—to complete the Water Well Drillers' Report for each newly constructed, modified, or destroyed well (with some exceptions). The legislature concluded that this information would be valuable for better management of the state's groundwater resources, including development of informed responses to groundwater pollution events. Since 1991, the drillers' report has been called the Well Completion Report (WCR), also commonly referred to as the "drillers' log." The report must be completed and signed by a contractor possessing a valid C-57 water well drilling contractor's license.

WCRs are submitted to local permitting agencies—the California Department of Water Resources (DWR) and the California Department of Public Health (DPH)—to comply with California law; similar reporting statutes exist for most of the United States. In California, the well confidentiality provision (CWC Section 13752) precludes unfettered public access to the reports unless specific permission and/or requirements are met; few other states, if any, have such a confidentiality clause. In fact, public access to drillers' logs in many states is easily obtained through the internet.

DWR has prepared a publication, *How to Fill Out a Well Completion Report: Instruction Pamphlet*, updated March 2007, that summarizes legal requirements and includes step-by-step instructions describing information required on the form. The pamphlet is accessible at http://www.water.ca.gov/pubs/groundwater/. Drilling contractors are encouraged to discuss with DWR staff any uncertainties in proper form completion.

The WCR consists of twelve sections summarized into five general categories: (1) well purpose, location, and owner; (2) subsurface geology encountered; (3) date, methods, and well construction details; (4) hydraulic information; and (5) certification statement. Drilling contractors are asked to attach additional relevant information to the WCR, including water quality and downhole geophysical data; however, these are rarely provided to DWR. The WCR form has evolved, but the requested information has not significantly changed since 1949.

The WCR allows for documentation of important subsurface and construction information often used in resolving water supply, environmental, and legal issues applicable to groundwater and surface water resources and well performance. Each boring or well provides a unique opportunity to evaluate subsurface geology and hydrology at a specific locality. When properly documented, information on the WCR can be used by drilling contractors, geologists, hydrogeologists, and engineers to interpret the hydrogeologic framework, assess groundwater resources sustainability, evaluate effective construction methods, estimate project costs, etc.

Accuracy of information on the WCR at the time of well construction is very important with respect to well and geologic log interpretation and evaluation of regional groundwater resources. I have reviewed many thousands of WCR forms for environmental and basin-wide government-sponsored studies, including those for the California Environmental Quality Act (CEQA) requirements. Some well logs I have reviewed contained complete and detailed information, while others were incomplete, missing information and data, and/or clearly inaccurate. Data inaccuracies can result from misinterpretation of the existing groundwater nomenclature; the following two examples illustrate improper usage.

The total depth of a well is 135 feet, the non-pumping or static water level (SWL) is 87 feet, and the total drawdown is 120 feet. This information suggests that the well is 207 (87 + 120) feet deep and clearly contradicts the stated depth of the well. In this case, I would assume that the 120 foot drawdown is expressed incorrectly as depth to water (DTW) and not as drawdown.

Continued on the following page…

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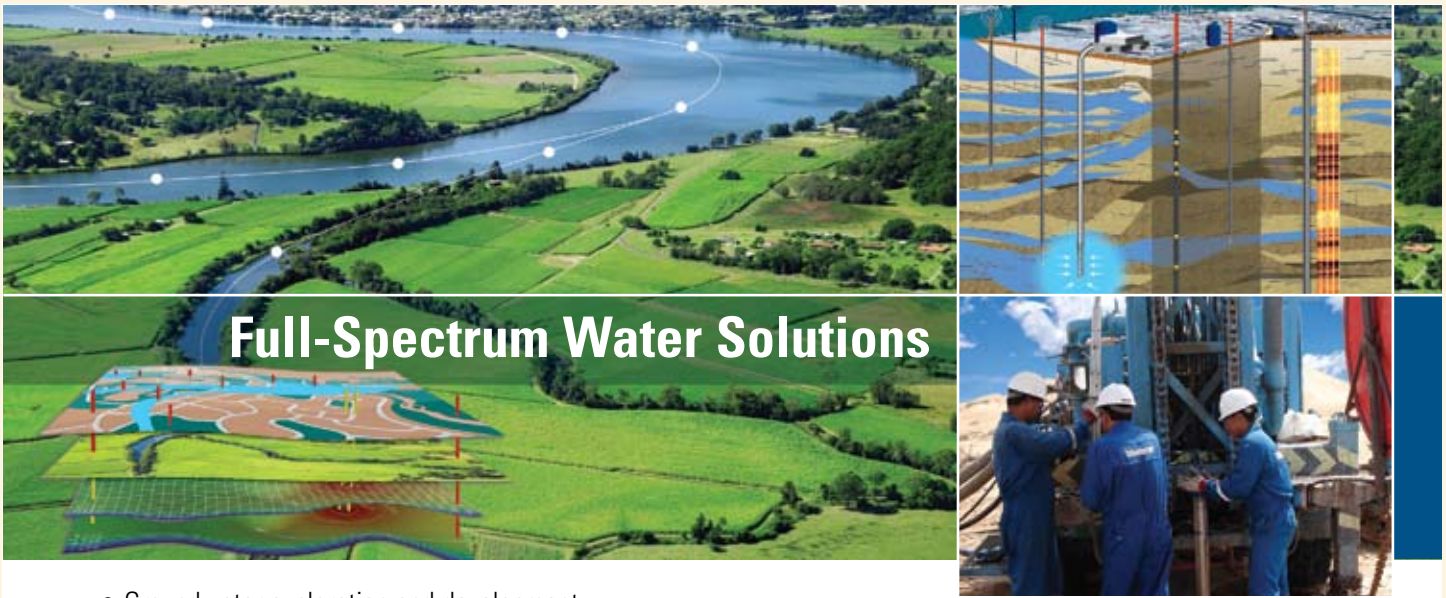
Wells and Words – *Continued*

A well installed in fractured rock has a depth of 635 feet. The pumping rate is 450 gallons per minute, the SWL is 52 feet, and the water level at the end of the pumping test is 52 feet. This suggests three possibilities: (1) a very prolific aquifer (with an extraordinarily large specific capacity!), (2) interception of a recharge boundary, or (3) a lack of understanding of the term "pumping test." Because this well was installed in a fractured rock aquifer and no identifiable recharge sources were nearby, it is probable that "end of the pumping test" was misunderstood. "End of the pumping test" refers to the end of the pumping period, not the end of the recovery period; together they form a pumping test (see Wells and Words, summer 2010 edition of *HydroVisions*).

Well location is one of the more important entries on the WCR; it is expressed using a variety of methods including: street address; city and county; assessor parcel number (APN); well location sketch; public land grid system (i.e., township, range, and section [640 acres], which can be divided into quarters [160 acres] or sixteenths [40 acres]); and latitude and longitude (lat-long) coordinates. Well locations are sometimes difficult to determine from WCRs because each location method has its own inherent shortcomings. Street addresses sometimes reflect that of a non-resident owner rather than the well location, and can change over time along with APNs and landmarks on location sketches; APN and land grid designations can be difficult to assign from county assessor maps; and instruments measuring lat-long, if not properly used or calibrated, can provide incorrect coordinates. I have reviewed well logs where the proverbial oak tree, barn, stream bank, or bridge landmark has been removed, and improper public grid designations indicate locations in the Pacific Ocean or another county. In addition, DWR continues to spend valuable state resources on re-entering data because currently there is no state requirement for electronic filing of the WCR.

GRA has recently formed a committee to work with our industry counterpart, California Groundwater Association (CGA), on several issues related to the WCR. The goal of this committee is to improve the type, quality, and completeness of information supplied by drilling contractors on the WCR forms; to improve the accessibility of, and transmittal of the WCR forms; and to support the intent and spirit of the CWC. If you are interested in participating in this committee, please email me at: dabbott@toddengineers.com.



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Legislative Update

By Tim Parker, GRA Legislative Committee Chairman, Chris Frahm and Duncan McFetridge, GRA Legislative Advocates

The past quarter has been an extremely busy time for GRA's Legislative Committee and advocates. The following is a recap of key events and issues now pending in Sacramento.

AB 2304 (Huffman)

GRA joined with the California Groundwater Coalition (CGC) to co-sponsor AB 2304 (Huffman), a bill aimed at increasing coordination between water supply and local land use agencies for the protection of recharge areas in California's groundwater basins. The bill passed out of two Assembly policy committees, off the Assembly floor, by a vote of 49-27; recently it was out of the Senate Natural Resources and Water Committee. GRA's Legislative Committee Chairman Tim Parker and GRA's legislative advocates have worked diligently with opponents of the bill to address concerns, and with the author and members of the Legislature to ensure its passage. AB 2304 is currently pending on the Senate floor and will be voted on sometime in August. We will be working hard to ensure that the Governor signs the bill into law.

Legislative Symposium and Lobby Day on April 28

GRA held its Annual Legislative Symposium and Lobby Day at the Citizen's Hotel in Sacramento and at the Capitol. This year's Symposium was once again presented in cooperation with the California Groundwater Coalition (CGC), and attracted key legislative leaders, including Fran Pavley and Jared Huffman, the respective Chairs of the Senate and Assembly water committees. Other presenters included key legislators and Administration officials that oversee groundwater programs. GRA members also spent time in the Capitol meeting with legislators and key staff. With its high caliber of speakers and presenters, the GRA Symposium continues to provide GRA and its members with tremendous credibility and goodwill within the Legislature and important state agencies.

State Budget

The Legislature is consumed with addressing the state budget, which is once again late; the deficit now stands at approximately $19 billion. Governor Schwarzenegger has reinstated three furlough days for most state employees. State Controller John Chiang has declared that California will run out of cash by October unless a budget agreement is reached. Legislative leaders and the Governor have stated that a budget agreement is still weeks away and may not occur until late fall, after the elections. The budget stalemate illustrates the persistent gridlock that has come to define the California Legislature.

Water Bond

The water bond also has been caught up in the budget stalemate. In early July, Governor Schwarzenegger and three of the four legislative leaders—Senators Steinberg and Hollingsworth and Assembly Republican Leader Martin Garrick—came out in favor of taking the bond off the 2010 ballot and delaying it until 2012. However, Assembly Speaker John Perez said that he would prefer to wait until August to make a decision. Interest groups that worked hard to craft the water bond, which includes $1 billion for groundwater programs, also support moving the bond to 2012 due to the poor economy and general antipathy toward Sacramento politics. At the same time, opponents of the water bond see this as an opportunity to kill the bond and/or significantly rewrite it to reduce its costs and eliminate surface storage projects. Given the fragile nature of the coalitions that helped pass last year's water package, and taking into account subsequent changes in the makeup of the Legislature, it is uncertain whether there will be sufficient support for the required 2/3 vote in each house. We believe the leadership and stakeholders will ultimately be able to secure the votes necessary to move the bond to the 2012 ballot before the Legislature adjourns in August—but stay tuned!

2010 State Elections

The political stakes in California's 2010 elections could not be higher. In addition to the hotly contested gubernatorial race between former Governor Jerry Brown and newcomer Meg Whitman, every state constitutional office is open and will feature closely contested races. The most recent PPIC poll shows the Governor's race in a dead heat, with Brown leading Whitman 37-34, and 23 percent undecided. All 80 Assembly seats and half of the Senate seats are open and will be decided in November. While we will see new faces, given the way the current legislative districts are drawn, the political composition of the Legislature itself will not change dramatically. This leaves the Governor's race and the other constitutional offices with the most potential for change in California government.

Looking Ahead

The Legislative Session adjourns on August 31. The Governor will have the month of September to take action on legislation passed by the Legislature and sent to his desk, which we believe will include AB 2304. With a new Administration and roughly 30% turnover in the Legislature next year, GRA will work hard to retain and continue to build on the momentum it has generated as a leading resource on California groundwater issues.

11th Annual Sacramento Drive-In is a Success

By Jim Jacobs

As part of the 11th Annual CCGO-CORE Sacramento Drive-In on June 22, 2010, several delegates met with regulatory agencies and legislators to discuss important issues. The California Council of Geoscience Organizations (CCGO), of which GRA is a member, joined forces again this year with CORE Environmental Foundation, which represents consultants, owners, regulators and enviro-vendors. CORE focuses primarily on funding issues associated with case closure and underground storage tank cleanup, which is of interest to many CCGO members. The delegates discussed environmental and professional issues with legislators, including the successful passage in 2009 of AB1188—the special fee to stabilize the California Underground Storage Tank Cleanup Fund.

Other CCGO and CORE delegates met David Brown, Executive Officer of the Board for Professional Engineers and Land Surveyors (BPELS), and Susan Christ (BPELS Staff Engineer) to discuss issues relating to BPELS' administration of the Geologist and Geophysicist Act resulting from passage of ABx4 20 in June, 2009.

- The April exam was cancelled because the former Office of Examination Resources determined that many of the exam questions may not have been psychometrically validated (despite the fact that the former BGG had been working with that office for years to ensure the validity of the exam questions).
- BPELS requested that all enforcement cases filed with the Attorney General be returned to determine if any of those cases could be processed as "cite and fine."
- BPELS' request to hire a PG staff person was rejected, but they were permitted to contract for services. They have since contracted with a "pool" of licensed geologists who are reviewing enforcement cases.
- Two or three members of the prior exam and technical advisory committees have been retained, but most are new members.
- Exam validation workshops have been established for the California Supplemental and specialty exams.
- BPELS plans to offer exams in both southern and northern California on the same day, rather than alternating each six months.
- BPELS will NOT raid the Geologist and Geophysicist Fund.
- Administrative functions of the Geologist and Geophysicist Act will remain separate from those of the Engineers Act such that should the BGG be reestablished as an independent board, the separation will be uncomplicated.
- When asked about the 1989 GETAC Fields of Expertise document, the reply was a very emphatic "that document is dead."
- The delegates were asked why the Geologist and Geophysicist Act has never been substantially revised (the engineers act is tweaked almost annually). Major revisions have been proposed.
- While discussing the nature of exam questions in general, we contrasted the practice of geology and engineering geology between California and the rest of the country, and between the northern and southern parts of the state. The delegates emphasized the need for exam questions to reflect all areas of practice regardless of the percentage of practitioners in a given field. This is important because although 70+% of geologists may be in the groundwater contaminant field, if 70% of the questions address that area of practice, those solely in classic engineering geology might never pass the exam.

Based on reviews from the delegates, it appears that BPELS is proactively trying to address professional issues and concerns. The delegates also met with Assemblymembers Jared Huffman and Ira Ruskin, who are key members interested in environmental issues. The delegates discussed a variety of issues, including the funding of environmental programs and the possibility of a California Dry Cleaner's Fund administered by the State Water Board, similar to the USTCF. Thirteen other states have similar funding mechanisms for dry cleaners remediation.

Other delegates met with Allan Patton and John Russell of the California Underground Storage Tank Cleanup Fund (USTCF); discussion topics included the solvency and funding of the USTCF and administrative issues. The delegates also met with Jay McKeeman of the California Independent Oil Marketers Association (CIOMA) to try to find ways of working with CIOMA on mutually beneficial areas such as environmental project funding and case closure issues. The delegation also met with John Parrish, State Geologist at the California Geological Survey and Stephen Testa, Executive Officer of the State Mining and Geology Board.

The California Council of Geoscience Organizations (CCGO; www.ccgo.org) is an advocate for the geology profession in the public interest. CORE Environmental Foundation (www.coreenvironmental.org) is a 501c3 non-profit focused on a thriving community of environmental stakeholders advocating effective, cost-efficient remediation for contaminated land and groundwater.

The Federal Corner

By John Ungvarsky, U.S. EPA

Guidance on the Ground Water Rule

The U.S. Environmental Protection Agency (EPA) has developed a series of placards to help systems understand monitoring and communication requirements under the federal Ground Water Rule (GWR). The placards target system types (i.e., community water systems, non-community water systems, wholesale and consecutive systems, etc.) and provide specific information regarding which GWR requirements must be met. EPA's goal is for operators to understand which GWR requirements must be met in the event that a total-coliform or fecal-coliform positive sample is identified, whether additional sampling is required, and what type of communication (e.g., special notice or public notification) is required in certain instances. For more information see: http://epa.gov/safewater/disinfection/gwr/compliancehelp.html.

USGS Groundwater Modeling Software: Making Sense of a Complex Natural Resource

Computer models of groundwater systems simulate the flow of groundwater, including water levels, and the transport of chemical constituents and thermal energy. Groundwater models afford hydrologists a framework on which to organize their knowledge and understanding of groundwater systems, and they provide insights water-resources managers need to plan effectively for future water demands. Building on decades of experience, the U.S. Geological Survey (USGS) continues to lead in the development and application of public-domain computer software that allows groundwater models to address scientific and management questions of increasing complexity. For more information, go to: http://pubs.usgs.gov/fs/2009/3105/ or contact Alden Provost.

Instant Information about Water Conditions

You can receive instant, customized updates about water conditions by subscribing to WaterAlert, a new service from the USGS. Whether you are watching for floods, interested in recreational activities or concerned about the quality of water in your well, you can receive daily or hourly updates about current conditions in rivers, lakes and groundwater. Sign up at http://water.usgs.gov/wateralert or contact Robert Mason at 703-648-5305 or Kara Capelli at 571-230-6601. The USGS operates an extensive, real-time water information network, involving 9,081 continuous- and partial-record streamgages plus 369 lake, 1,278 well and 3,632 precipitation gages. USGS Water Science Centers in each state can provide more detailed information on water conditions and USGS response to local events.

EPA Hosts Public Meetings on Hydraulic Fracturing Research Study

EPA hosted four public information meetings during July and August 2010 on the proposed study of the relationship between hydraulic fracturing and its potential impacts on underground sources of drinking water. Hydraulic fracturing is a process that increases production of natural gas or oil from shale and other geological formations. By pumping fracturing fluids (water and chemical additives) and sand or other similar materials into rock formations, fractures are created that allow natural gas or oil to flow from the rock through the fractures to an extraction well. Natural gas plays a key role in our nation's clean energy future and hydraulic fracturing is one way of accessing this vital resource. However, serious concerns have been raised about hydraulic fracturing's potential impact on drinking water, human health and the environment. For more information, go to: http://www.epa.gov/safewater/uic/wells_hydrofrac.html.

New Alternative Testing Methods Are Approved for Drinking Water

EPA has approved 12 new, alternative (and optional) testing methods for use in measuring the levels of contaminants in drinking water and determining compliance with national primary drinking water regulations. The Safe Drinking Water Act authorizes EPA to streamline approval of the use of alternative testing methods through publication in the Federal Register. This expedited approach provides public water systems, laboratories, and primacy agencies with more timely access to new measurement techniques and greater flexibility in the selection of analytical methods, thereby reducing monitoring costs while maintaining public health protection. These 12 alternative methods test for Dalapon; Radium-226; Uranium; Radioactive Cesium, Iodine and Gamma emitters; Tritium; and E. coli in drinking water. To view or download the complete text of the final action and fact sheet, see: http://epa.gov/safewater/methods/analyticalmethods_expedited.html.

John Ungvarsky is an Environmental Scientist at the U.S. Environmental Protection Agency, Region 9. He works in the Water Division's Ground Water Office and oversees source water protection efforts in CA, HI, and NV. For information on any of the above topics, please contact John at 415-972-3963 or ungvarsky.john@epa.gov.

Manganese

By Bart Simmons

Manganese (Mn) is both a required human nutrient and, in higher doses, the cause of manganism, a Parkinson's-like neurologic disease.

Mn is an essential element that is required by many enzymes, including Mn superoxide dismutase, pyruvate carboxylase, and various kinases and transferases.

Occupational inhalation exposures in adults have repeatedly been associated with neuromotor effects, specifically akinetic-rigid Parkinsonism, characterized by weakness, anorexia, apathy, slowed speech, emotionless facial expression, and slow movement of the limbs. Although exposure to Mn via inhalation has long been known to cause neurotoxicity in adults, relatively little is known about possible consequences of exposure via drinking water. Typically, dietary Mn intake greatly exceeds that from drinking water; however, manganese is apparently better absorbed from water than from food. This may be related to the oxidation state: Mn is primarily oxidized in food, but reduced in drinking water.

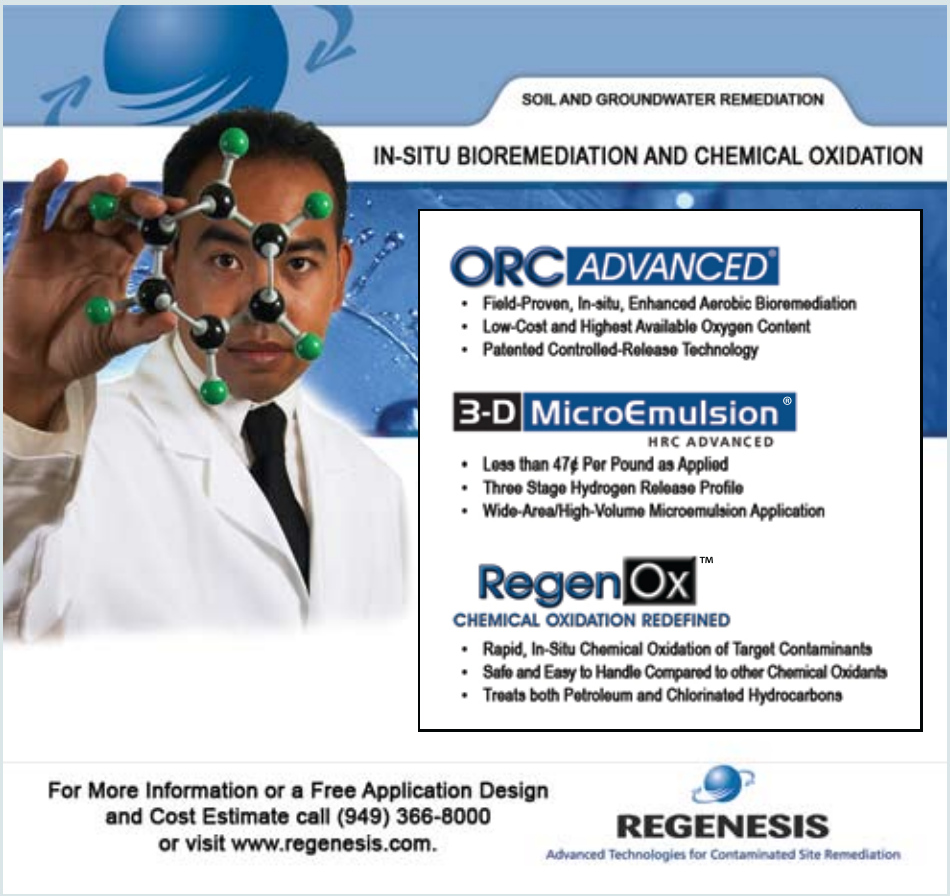
Epidemiological studies in Greece, Mexico, and Bangladesh have found correlations between Mn in drinking water and neurological problems. However, one study in northern Germany found no such correlation.

The U.S. EPA issued in 2004 a Drinking Water Health Advisory of 50 µg/L; this is the same as the Secondary Maximum Contaminant Level (MCL), which is based on staining and taste. The advisory stated: "The lifetime health advisory of 0.3 mg/L [300 µg/L] will protect against concerns of potential neurological effects." For comparison, the World Health Organization (WHO) health-based standard is 500 µg/L.

A study published in 2006 examined the relationship of Mn and neurologic effects. An earlier cross-sectional study of 201 10-year-old children in Bangladesh concluded that water arsenic exposure was adversely associated with intellectual function. In a follow-up study, 142 10-year-old children were selected who drank well water with relatively low arsenic (< 10 µg/L) but high manganese (*Environ Health Perspect*. 2006 January; 114(1): 124–129). The average concentrations in the well water were 793 µg Mn/L and 3 µg arsenic/L. Mn concentrations in urine were determined by High-Resolution Inductively-Coupled Mass Spectrometry (HR ICP-MS). Neurologic effects were measured by the Wechsler Intelligence Scale for Children. The investigators adjusted for known sociodemographic effects. This study showed that exposure to Mn in drinking water has a significant dose-response relationship with neurotoxic effects in children.

In the United States, roughly 6% of domestic household wells have Mn concentrations that exceed 300 µg Mn/L. Thus some children in the U.S., as in Bangladesh, may be at risk for neurological deficits from manganese in water. As studies continue on both the dietary requirements and toxicity of Mn, additional attention will likely be paid to Mn in water.

Bart Simmons can be reached at bartonps@aol.com.



Downscaling from Regional to Local Scales in Groundwater Flow and Transport Modeling

By Henieh Haeri, Laura Foglia, and Timothy R. Gunn

Introduction

The information requirements of regional groundwater modeling are well known, particularly with regard to the need for effective distributed parameter values at the scale of relatively large computational cells. However, such regional modeling tools are often called upon for characterization of groundwater hydraulics at considerably smaller scales. In this study, we quantified the groundwater hydraulics in the vicinity of "rockwells" (stormwater infiltration drains) installed in the City of Modesto, which is important to understand prior to selecting sites for monitoring wells.

To this aim, we used a USGS regional groundwater-flow model covering ~2,700 km2 in the northeastern San Joaquin Valley (Phillips et al., 2007) and refined the grid in a subset of this model (~ 220 km2 surrounding the City of Modesto). The combined groundwater-flow model is solved for steady-state conditions to provide estimates of the piezometric head and groundwater flow direction and magnitude at each model cell. Using the recently developed Local Grid Refinement (LGR) capability of the MODFLOW modeling suite affords the reduction of the regional-scale hydraulics to the identification of local-scale hydraulics through the linkage of boundary condition between the coarse and refined numerical grids. In this context of "downscaling," large-scale controls on groundwater behavior are incorporated in the analyses of hydraulics at effective "points" in the domain. The overall modeling approach is described with background on the tools developed at the USGS, the application and data collection to address the downscaling problem are summarized, and the groundwater hydraulics in the vicinity of the rockwells is estimated.

Study Area

The study area (referred to as "local model" herein) surrounds the City of Modesto, located at the northern part of the San Joaquin Valley (Figure 1). A detailed numerical model of the northeastern San Joaquin Valley aquifer (referred as the "regional model" here) has been developed by the USGS (Phillips et al., 2007). Based on the data presented in Phillips et al. (2007), in water year 2000 about 55 percent of Modesto's municipal and industrial water requirement was met with groundwater. We embed our "local model" within this regional model (Figure 1) to develop estimates of groundwater flow at the rockwell scale, as described in the next section. Our local model occupies about 220 km2 of the regional model.

Modesto Rockwells Studied

Locations of the rockwells studied are shown on Figure 1. The box outlined with navy blue in Figure 1 is the location of our refined groundwater model.

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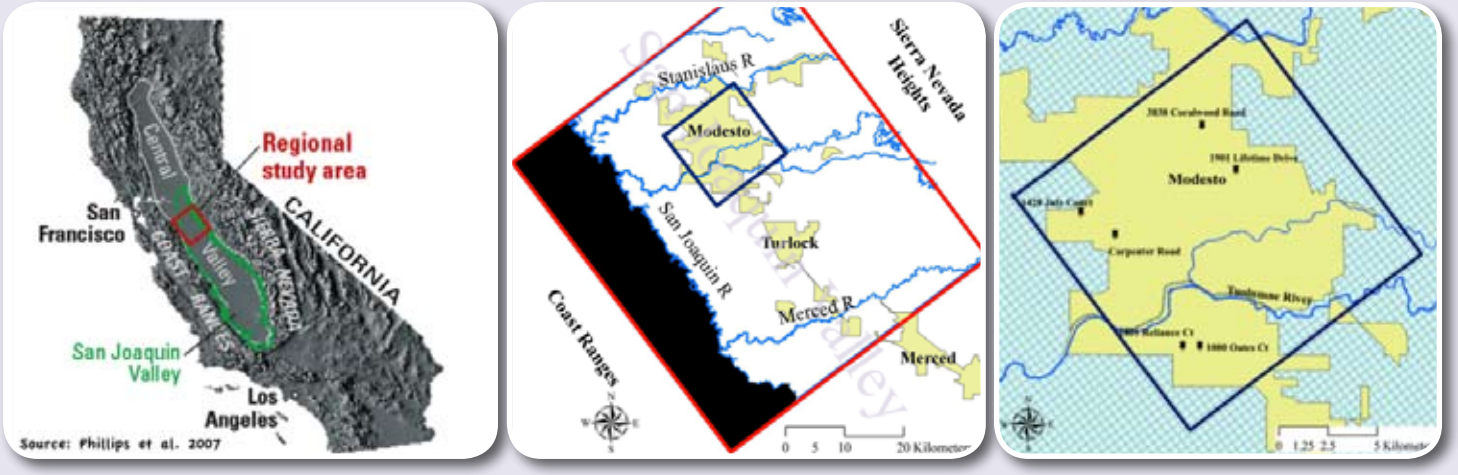

Figure 1. *(a) Locations of Central Valley, San Joaquin Valley and the regional study area within the state of California; (b) location of the regional and local study areas within the San Joaquin Valley of California; and (c) location of the six selected Modesto rockwells within the local study area.*

Downscaling from Regional to Local Scales in Groundwater Flow and Transport Modeling – *Continued*

Groundwater Flow Model

To quantify the hydraulics around the selected rockwells installed in the City of Modesto, we built a local groundwater-flow model for the boxed area in Figure 1c, and incorporated it into the existing regional model (Figure 1b). The combined groundwater-flow model is solved for steady-state conditions in order to provide estimates of the piezometric head and groundwater flow at each model cell; for those cells at the top of the saturated zone, the piezometric head is the water table. These results then provide the water-table elevations and flow direction near the selected rockwells.

Accurate specification of the boundary conditions of any embedded model is a critical issue and can have very important effects on the model results. For this study, the boundaries of the local model were generated through an iterative coupling along the interface between our refined local model and the regional, more coarsely discretized model previously published by USGS (Phillips et al., 2007). This was done through the recently developed (2005) Local Grid Refinement (LGR) capability of the MODFLOW modeling suite.

Simulated Water Table, Local Model

The depth to water table (depth to water table = ground surface elevation – water table elevation) increases to the northeast from about 0.5 m to 20 m, as shown in Figure 2. The water-table elevation (not shown) is lowest (~ 13 m) close to the northwestern corner of the domain and increases gradually eastward to a maximum of about 35 m. This is consistent with the regional hydraulic gradient.

Groundwater Hydraulics near Rockwells

The combined local-regional model results were analyzed to evaluate the flow magnitude and direction in the vicinity of selected rockwells shown on Figure 1. Table 1 summarizes pertinent simulation results at the location of each rockwell. It can be concluded from these results that the simulated head gradient is very low at the rockwells located at 1428 July Ct and Carpenter Rd., and is steepest at the rockwell located at 1901 Lifetime Dr. Simulated groundwater flow (expressed as flux) was lowest at 1428 July Ct. (0.56 m3/d) and greatest at 3838 Coralwood Rd. (16.83 m3/d). The minimum simulated depth to water table (2.82 m) was at 1428 July Ct.; the maximum was at 3838 Coralwood Rd.

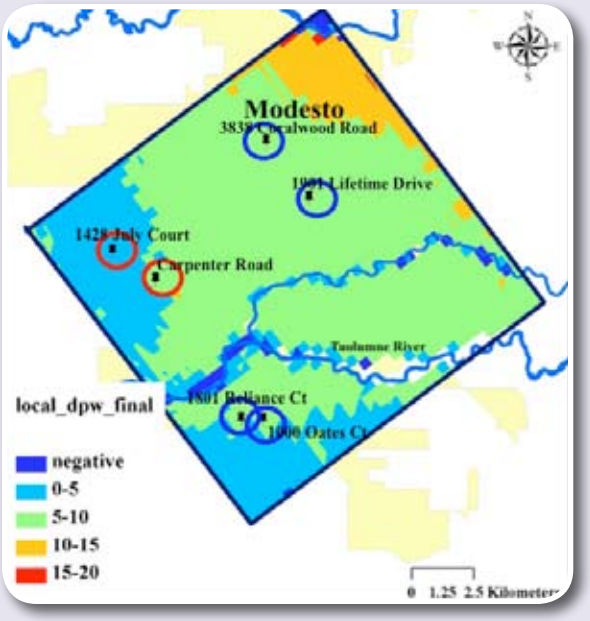

Figure 2. *Simulated depth from ground surface to the water table (in meters) in the local model*

Table 2 summarizes measurements made in the closest observation (state) well to each rockwell. Comparison of the simulation results presented in Table 1 and observations in Table 2 indicates some degree of simulation error, especially at rockwells located at 1000 Oates Ct. and 1801 Reliance Ct. This is expected given the approximations (e.g., ground surface elevation and boundary conditions) and assumptions (e.g., steady state) involved in the model, and the disparities in dates and locations of the simulated and measured values.

Table 1 – Simulated head gradient, flow magnitude, flow direction and depth to water table at each rockwell, using the local grid refinement.

Rock Well Address	*Head Gradient in x direction, Δh/Δx*	*Head Gradient in y direction, Δh/Δy*	*Flow magnitude in xy plane (m3/d)*	*Flow direction NE plane (angle in clockwise from north)*	*Depth to water table (m)*
Carpenter Rd	0.00E+00	0.00E+00	1.74	28.95	5.15
1901 Lifetime Drive	1.50E-03	7.50E-04	16.33	256.13	6.87
1428 July Court	0.00E+00	0.00E+00	0.56	180.62	2.82
1000 Oates Ct	3.75E-04	7.50E-04	14.89	298.40	5.57
3838 Coralwood Rd	1.31E-03	0.00E+00	16.83	233.77	8.94
1801 Reliance Ct	1.88E-04	9.38E-04	14.25	304.88	5.26

Continued on the following page…

Downscaling from Regional to Local Scales in Groundwater Flow and Transport Modeling – *Continued*

Table 2 – Observed water-table altitude and depth to water table at the closest state well to each rockwell.

Rock Well Address	*State Well Number (Closest to the Rockwells)*	*Agency*	*Measurement Date*	*Water Table Altitude (m)*	*Depth to Water table (m)*
Carpenter Rd	03S08E23H001M	Modesto Irrigation District	2/1/2008	16.28	7.07
1901 Lifetime Dr	03S09E09J001M	Modesto Irrigation District	11/1/1982	18.50	11.06
1428 July Ct	03S08E24C002M	Modesto Irrigation District	11/1/2006	17.25	5.94
1000 Oates Ct	04S09E09Q001M	City of Modesto	10/1/2007	10.97	15.24
3838 Coralwood Rd	03S09E08D001M	Modesto Irrigation District	2/1/2008	18.87	10.21
1801 Reliance Ct	04S09E09Q001M	City of Modesto	10/1/2007	10.97	15.24

Effects of Downscaling on Model Accuracy: Are Large-Scale Models Capable of Providing Accurate Results at Finer Resolutions?

To clarify the importance of the downscaling when information at fine scales is desired, the groundwater model was applied with and without grid refinement. The goal is to understand to what extent the regional model (without refinement) is accurate compared to the local-regional model (with local refinement). To this aim, the magnitude and direction of the flow at each rockwell was calculated for each model resolution and the results where compared. Figure 3 portrays the map of flow direction at each rockwell with and without refinement. Based on the results presented in Figure 3 and Table 3, the regional model provided good estimates of flow magnitude and direction in the vicinity of four rockwells (Coralwood Rd., Oats Ct., Lifetime Dr. and Reliance Ct.) but not in the vicinity of the other two rockwells (July Ct. and Carpenter Rd.).

The error in flow magnitude and direction is extreme for the rockwell at Carpenter Rd. Extreme errors in flow direction would alter the judgment on observation well placement. It should be noted that the July Ct. and Carpenter Rd. rockwells are in areas with lower head gradients compared to the other rockwells; this likely explains why the regional model simulated the flow pattern inaccurately. Consequently, the importance of downscaling is more pronounced when the piezometric head is relatively flat. To ensure that a groundwater model will yield accurate results at a given scale, the model resolution should be small enough to incorporate information at that scale.

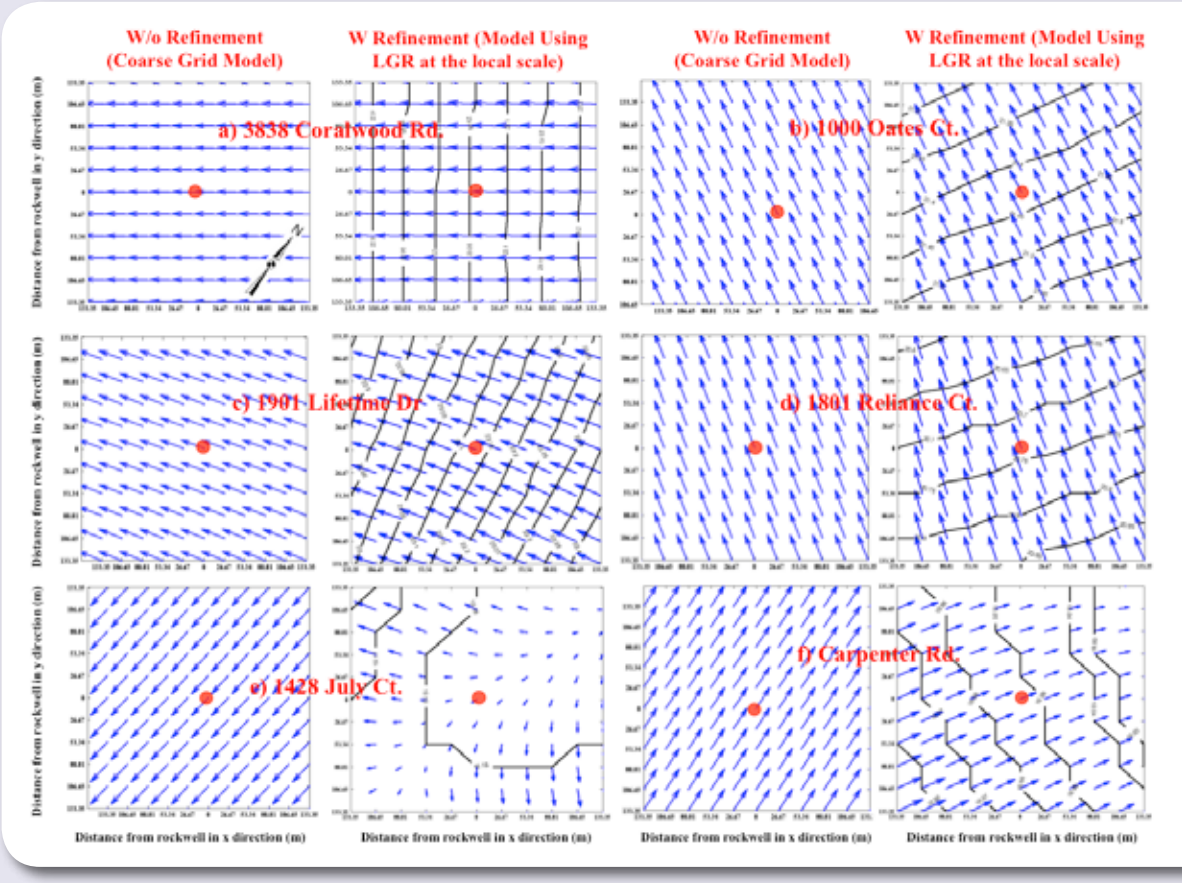

Figure 3. *Map of simulated flow direction at each rockwell with and without refinement.*

Continued on the following page…

Downscaling from Regional to Local Scales in Groundwater Flow and Transport Modeling – *Continued*

Table 3 – Flow magnitude and direction at each rockwell with and without refinement. The table also reports the error in flow direction and magnitude when the regional model was compared to the locally refined model.

Rockwell address	*Flow magnitude in xy plane*		*Flow direction in NE plane (angle clockwise from north)*		*Error in flow magnitude* $\frac{abs(w-w/o)}{w}$	*Error in flow direction*
	W/o Refinement	*With Refinement*	*W/o Refinement*	*With Refinement*		*abs(w/o - w) in angle*
3838 Coralwood Rd	17.93	16.83	234.28	233.77	7%	0.51
1000 Oates Ct	14.38	14.89	297.68	298.40	3%	0.72
1801 Reliance Ct	14.07	14.25	301.98	304.88	1%	2.90
1901 Lifetime Dr	16.52	16.33	256.13	252.06	1%	4.07
1428 July Ct	1.33	0.56	188.04	180.62	139%	7.42
Carpenter Rd	3.29	1.74	-6.64	28.95	89%	35.59

Summary and Conclusions

The groundwater hydraulics in the vicinity of six selected rockwells installed in the City of Modesto was characterized in this study to guide the installation of monitoring wells around them. The characterization was achieved by using a two-scale groundwater modeling approach with a steady-state approximation in order to bring the regional groundwater hydraulics to bear on the local boundary conditions for the groundwater hydraulics under the City of Modesto, and to depict the local conditions at the sites of the six selected rockwells.

The finer-scale model developed for this study was effective at depicting flow directions and magnitudes in the vicinity of rockwells. Figure 3 and Table 1 can be used to understand the direction of the flow and to guide the installation of monitoring wells upgradient and downgradient of each rockwell.

To examine the importance of downscaling (model refinement) for accurate simulation at fine scales, the groundwater model was applied with and without refinement. Based on the results presented in this paper, the regional model did not always provide accurate estimates of the flow pattern. This would result in erroneous judgment about the observation well placement. The error in flow pattern is more pronounced at locations with relatively low piezometric head gradient.

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UC Moves the Water Resources Center Archives to Southern California

By Linda Vida, Director, Water Resources Center Archives

Dear Friends, Colleagues, and Supporters of WRCA…

On Friday, July 16th, 2010, the University of California Division of Agriculture and Natural Resources (ANR) announced its decision regarding WRCA's future home. Following a thorough review of the three proposals that were submitted from UC Berkeley, Davis and Riverside to house WRCA, UC Riverside has been selected as the new academic home.

The Riverside campus will be partnering with CSU San Bernardino to provide continued access and development of this important collection. Although access points may change, virtual use of catalogs and digitized content will remain largely unaltered and available to the public.

ANR will appoint a transitional team to shepherd WRCA through the complex process of moving the collection. ANR's goal is to have WRCA's materials moved by October of this year.

WRCA's accessibility in the interim is unknown, but for the time being, we are open M-F from 10-5 and will continue to provide the same level of service you have come to expect. As we know more, we will provide updates through the WRCA blog, Facebook page, and listserv.

ANR's official announcement, plus links to the three proposals that were considered, can be found on ANR's public website: http://news.ucanr.org/newsstorymain.cfm?story=1313.

Thank you all for your continued support of WRCA. Although we are sad to be leaving the Berkeley campus that has been our home for the last 51 years, WRCA will continue to serve UC and the California water community for years to come from the UC Riverside campus.

WRCA website: http://www.lib.berkeley.edu/WRCA/
On Water blog: http://blogs.lib.berkeley.edu/wrca.php
Facebook: http://www.facebook.com/pages/Berkeley-CA/Water-Resources-Center-Archives/163647453707

California Groundwater Association Update

By Mike Mortensson, CGA Executive Director

Ask A Driller… Ask A Geologist

These might be the signs inviting attendees into the respective displays of the California Groundwater Association (CGA) and GRA at their annual conferences. Representatives of both associations have been meeting to discuss ways to improve interactions. One of the first actions is exchanging booths/table-top displays so that members of GRA can "Ask a Driller" questions at the CGA display at GRA's 19th Annual Conference and Meeting in Burlingame in September. John Kratz (CGA President) and others will be on hand to answer questions and provide information on various CGA programs. Likewise, GRA Director David Abbott and others will attend the CGA 62nd Annual Convention and Trade Show in Sparks, Nevada in November to answer questions on geology and other aspects of GRA's programs.

Other mutual opportunities being pursued are coordination on legislative efforts and Lobby Days, updating and revising Bulletin 74 (CA Well Standards), and a joint CGA-GRA Water Well Construction Workshop in 2011.

CGA has scheduled March 21-22 for its 2011 Day at the Capitol event. A legislative overview is scheduled for the 21st, followed by presentations by members of the Legislature, staff and Administration officials on the morning of the 22nd; legislative visits will occur in the afternoon.

CGA and the Water Well Technical Advisory Committee of CCDEH have begun work on potential revisions to Bulletin 74-81 & 74-90 and to establish standards for geothermal heat exchange wells (GHEW). Plans call for revisions to be developed for review by the WWTAC in late 2010–early 2011. GRA members already serve on the subcommittee that is chaired by Jeremy Wire of Geoconsultants, Inc.

Preliminary efforts are underway to develop a format for a joint Water Well Construction Workshop in 2011. The workshop will be designed to attract contractors, technical groundwater professionals, environmental health officials and others interested in well construction. Tentative workshop topics include well design, drilling methods, materials, other well construction aspects, well testing, energy savings, permitting process, well reports and relationships with contractors, geologists and regulatory officials. Tim Parker and Kathy Snelson are working with John Kratz and Mike Mortensson to continue the development process for such a workshop.

Unlicensed Contractor Faces Fines and Jail Time

It seems that every drought brings in those wanting to "make a buck" for whom following well construction standards is not a priority. Fortunately, CGA's efforts to halt drilling by unlicensed contractors in conjunction with local health departments, district attorneys and the Contractors State License Board have paid off! In a case that spanned several counties, a contractor has pled guilty on a misdemeanor charge stemming from unlicensed water well drilling. He faces jail time, fines and restitution of victims in a criminal court sentencing hearing this fall, and revocation of his contractors license (not a C-57) by the CSLB.

CGA urges any GRA member who may witness questionable well construction practices to contact CGA; a license check can be done at www.cslb.ca.gov. Everyone in the groundwater industry should be working together to insure proper well construction to avoid groundwater contamination!

CGA Supports Protect Your Groundwater Day

Protect Your Groundwater Day is Sept 14th! Building on the National Groundwater Awareness Week held in the spring, it's a day that you can ACT (Acknowledge, Consider, Take action) to protect California's groundwater and let the public know more about your business. You might offer to present a program for the local Lions, Rotary or other service organization. It's an easy way to also build recognition as a dedicated groundwater professional! Provide a company brochure to your local paper and talk with them for a few minutes about doing a follow-up story that would feature your business; getting your business recognized by others can lead to new clients!

Workshops, Seminars, Demos, Networking and Fun

Head to John Ascuaga's Nugget in Sparks, NV on Nov. 4-6 to mix with other groundwater professionals, see industry products and services, catch some short but informative demos, attend skill & knowledge building seminars and workshops, and take some time to relax with friends at the daily social events. It's the CGA Convention! Details and online registration are available at www.groundh2o.org.

For more information on any of these programs/activities, contact CGA at 707-578-4408; Fax: 707-546-4906 or email wellguy@groundh2o.org.

Promote September 14 "Protect Your Groundwater Day"

By Cliff Treyens

The National Ground Water Association is calling on organizations concerned about source water protection to promote "Protect Your Groundwater Day" on September 14. "Every person can do something to protect groundwater in their local area, from not polluting it to using water wisely. This day is designed to give every person an action step he or she can take," said Cliff Treyens, Public Awareness Director for NGWA, which created the recognition day.

This new event supplements NGWA's National Ground Water Awareness Week, which each March for more than a decade has raised public awareness about groundwater and water well stewardship. The 2010 edition of Ground Water Awareness Week was a record-breaker, with one measure of success being the more than 250 Web sites that helped promote it.

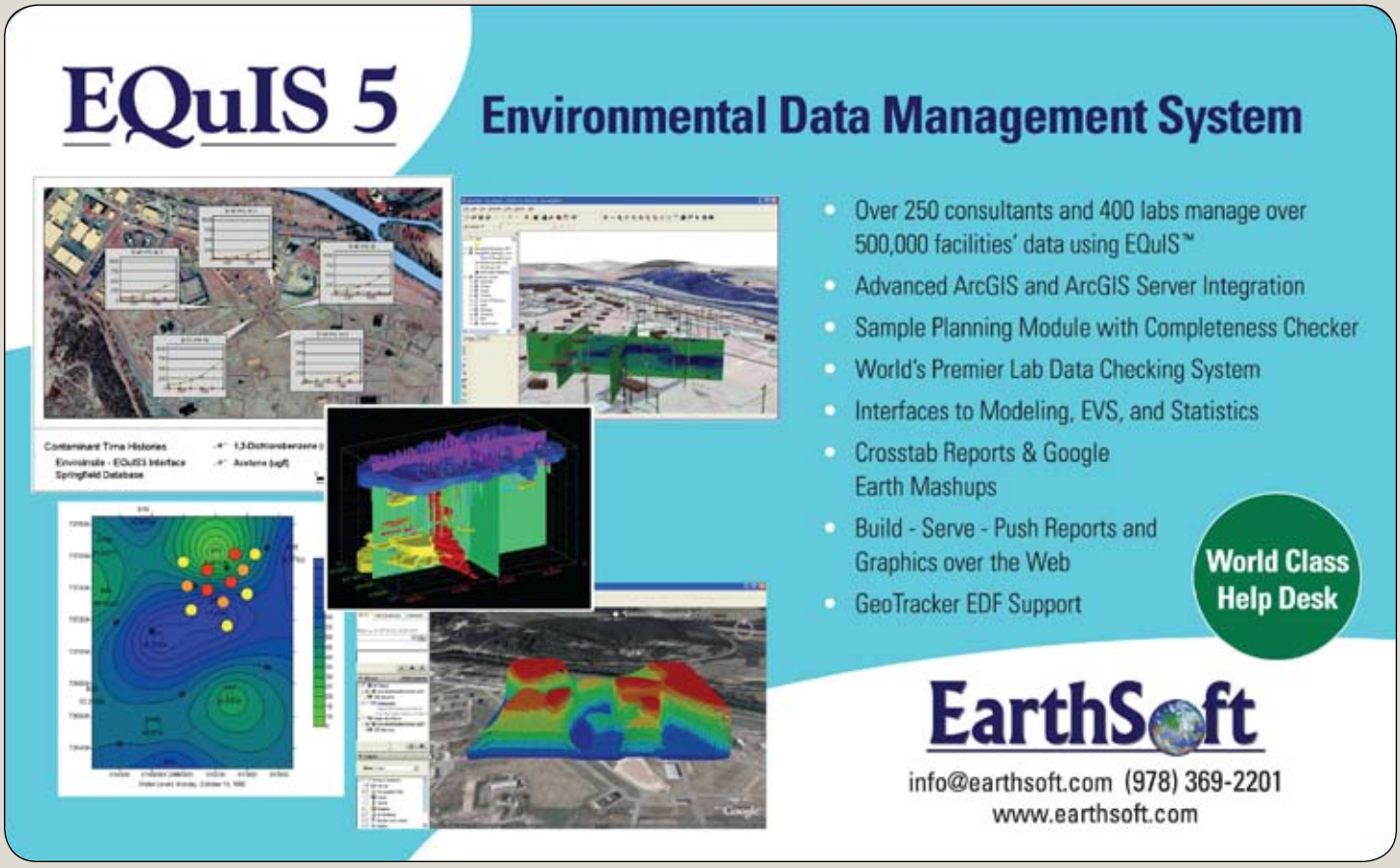
As the title suggests, Protect Your Groundwater Day focuses solely on groundwater protection. NGWA will emphasize preventing contamination and water conservation as ways to protect groundwater resources. NGWA believes that by focusing on actionable steps that every person can take, Protect Your Groundwater Day has the potential to spur record numbers of people to take those steps to protect this resource.

The Protect Your Groundwater Day Web page contains a variety of specific actions for members of the public who do not have a household well and private well owners.

NGWA encourages any organization with an interest in groundwater protection to promote Protect Your Groundwater Day. Here's how:

- Write an article on Protect Your Groundwater Day
- Use the event logo on your Web site, linking to NGWA's Protect Your Ground Water Day Web page
- Spread the word through social media or newsletters.

If you have any questions or additional ideas, please contact NGWA Public Awareness Director Cliff Treyens at 800.551.7379; 614.898.7791, ext. 554; or ctreyens@ngwa.org.



Call for Nominations for Director Seats Open in 2011

The Association is now soliciting nominations for GRA Board of Director candidates to run for five (5) seats that commence service January 1, 2011. The Nominating Committee has established the following criteria for nominating and selecting candidates for the final ballot that will be presented to the GRA membership for voting.

Minimum Qualifications for Director Nominees

- Active Regular Member of GRA at the time of nomination.
- Recognized leader in a groundwater-related field, which may include regulation, evaluation, development, remediation or investigation of groundwater, groundwater supplies or related technology; science education; and groundwater law or planning.
- Significant contributor to the field of groundwater resources in California.
- Prior contributions and leadership role in a GRA Branch, GRA committees or GRA program activities, or like experience with a similar organization.

Nominating Guidelines and Procedures

1. Directors and members of GRA may nominate themselves or another member as prospective candidates to run for the Board as described below.
2. Nominations must be submitted in writing to GRA and accompanied by:
   - A statement from the nominee addressing the following questions:
     - *Why are you interested in serving on the GRA Board of Directors?*
     - *What qualifications and experience do you have for serving as a Board member?*
     - *What specific skills or expertise do you bring to GRA and the GRA Board (e.g., leadership skills, fund-raising, financial management, etc)?*
     - *What experience do you have serving on similar boards of directors?*
     - *What level of time commitment can you make to GRA?*
   - Current curriculum vitae.
   - A letter of recommendation from a current Director or Regular Member.
3. The Nominating Committee will review all nominations and evaluate the nominees based upon on their response to the above questions and their qualifications. The Committee will conduct interviews, if deemed necessary.
4. The Nominating Committee shall recommend a slate of nominees for presentation to the GRA Board of Directors for approval. The recommended slate of nominees shall correspond to the number of available Director openings each year.
5. The approved slate of nominees shall be presented to the GRA membership in ballot form in accordance with the GRA bylaws.

To declare your desire to be nominated or to nominate someone other than yourself, please follow the guidelines in section number two above and forward the material to Kathy Snelson, GRA Executive Director, via email (executive_director@grac.org), fax (916-442-0382) or mail (915 L Street, Suite 1000, Sacramento, CA 95814) no later than October 8, 2010.

Should you have any questions or need additional information about the GRA Director Call for Nominations, please contact Kathy Snelson at (916) 446-3626.

GRA Welcomes the Following New Members

MAY 6, 2010 – AUGUST 10, 2010

Abbot, Rodney	CSUDH
Baquerizo, Ed	WorleyParsons
Conner, David	Battelle
Conran, Stephanie	Schaaf & Wheeler
Cook, Tim	Cook Environmental Services, Inc.
Davisson, M. Lee	
Edington, Dwaine	Geomega
Ellsbury, Katy	Haley & Aldrich, Inc.
Friedman, Jeffrey	Delta Consultants
Jordan, Robert	Golden State Water Company
Kalika, Sarah	Kleinfelder
Keir, Alison	Stantec Consulting Corporation
Kinaan, Michele	CDM
Koenigsberg, Stephen	Adventus Group
Lo, Ian	CDM, Inc.
Lombardo, Pio	Lombardo Associates
Nelmes, Sierra	Taber Consultants
Palomo, Monica	California State Polytechnic University Pomona
Rose, Michael	Haley & Aldrich, Inc.

2010 Contributors to GRA – Thank You

FOUNDER *($1,000 and up)*
Brownstein Hyatt Farber Schreck
Environmental Resolutions, Inc.
Nossaman LLP
Roscoe Moss Company
DrawingBoard Studios

PATRON *($500-$999)*

CORPORATE *($250-$499)*
David Abbott
AMEC Geomatrix
ARCADIS, U.S., Inc.
Luhdorff & Scalmanini
Consulting Engineers
MACTEC Engineering
& Consulting, Inc.
Malcolm Pirnie
Parker Groundwater
Bob Van Valer

CHARTER *($100-$249)*
Aegis Groundwater Consulting, LLC
Jeriann Alexander
Charles Almestad
Stanley Feenstra
Brian Wagner

SPONSOR *($25-$99)*
AECOM
Richard Amano
Cathy Aviles
Thomas Ballard
Jenifer Beatty
Duane Blamer
Richard Booth
Kevin J. Brown
BSK Associates
Michelle Buller
Steve Campbell
Bob Cleary
Nova Clite
Condor Earth Technologies, Inc.
Timothy Crandal
Roger Dockter
Jessica Donovan
EMAX Laboratories, Inc.
Martin Feeney
Geoff Fiedler
Fred Flint
John Fortuna
Alvin Franks
Scott Funas
Jacob Gallagher
Miguel Garcia
Mark Grivetti
Sarah Grossi
Gary Halbert
Thomas Harder
Hopkins Groundwater Consultants, Inc.
Kelly Houston
H2O Engineering, Inc.
HydroFocus, Inc.
Carol Kendall
Michele Kinaan
Jo Anne Kipps
Taras Kruk
Bruce Lewis
Robert Martin
John McAssey
Sally McCraven
Peter Mesard
Jean Moran
Alec Naugle
Joseph Oliver
Oliver Page
Tim Parker
PES Environmental, Inc.
Steven Phillips
Bryan Pilkington
Iris Priestaf
Eric Reichard
Craig Sandefur
William Sedlak
Pawan Sharma
Marc Silva
Linda Spencer
Phyllis Stanin
Versar, Inc.
Jon Wactor
Christopher Watt

GRA Extends Sincere Appreciation to the Co-Chairs and Refreshment Sponsor for its May 2010 Course, Symposium and Demo, *Geophysics at the Beach*

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Toward Sustainable Groundwater in Agriculture – An International Conference Linking Science and Policy

By Thomas Harter, University of California, Davis

On June 14 – 18, 2010 an international conference titled "Toward Sustainable Groundwater in Agriculture – An International Conference Linking Science and Policy" was held in Burlingame/San Francisco. The conference was organized by the University of California Davis and the Water Education Foundation (WEF) with help from GRA – including several enthusiastic GRA members on the conference council. The meeting brought together leading scientists, policy analysts, policy and decision makers, and agricultural and environmental stakeholder groups to define and highlight the science, challenges, and potential policy solutions in agricultural groundwater resources management and agricultural groundwater quality protection that will provide a sustainable future at regional, national, and global scales.

Groundwater is the lifeline for many rural and agricultural regions and their associated cultures around the globe, and a cornerstone of global food production. Groundwater constitutes nearly half the world's drinking water and much of the world's irrigation water supply. Population growth, overexploitation, salinization, nonpoint source pollution from agricultural activities (including animal farming, ranching, and forestry activities), impacts to surface water from groundwater depletion and degradation, and groundwater quality and quantity conflicts at the urban-rural interface have reached global dimensions and threaten the health and livelihood of this planet.

Yet, there are few—if any—conferences and workshops that attempt to bridge the multiple disciplinary and geographic divides between groundwater resources management and groundwater quality protection; between groundwater scientists working in agricultural regions, groundwater managers, and policy and decision makers governing agricultural groundwater basins; and between the people in California and in other parts of the world that struggle with assessing, managing, and regulating groundwater depletion and degradation. This conference attempted just that.

The three-day conference program was preceded by a full day of pre-conference workshops covering "Compliance Groundwater Monitoring in Agriculture: Monitoring Well Construction, Network Design, and Regulations for California Dairies," "Age-Dating, Geochemical Fingerprinting, and Emerging Contaminants in Animal Agriculture's Groundwater: California Dairy Case Studies," and "Learning how to Acquire Groundwater and Water Quality Data in California: GAMA, Geotracker, and IWRIS." A post-conference tour of lovely Sonoma Valley and its dairies and wineries featured a beautiful part of California, information about local groundwater issues related to agriculture, and time for networking. The tour was superbly facilitated by Rebecca Scott (WEF) and led by Tim Parker (Layne Christensen), Paul Martin (Western United Dairymen), and Marcus Trotta (Sonoma County Water Agency).

During the conference, each day began with a plenary session (summaries below) before dividing into four separate tracks. The conference wrapped up with a forward-looking plenary session offering lively discussion (see below). Altogether, 35 conference sessions, 135 speakers and 25 poster presenters were offered over the three days.

The over 250 attendees came from California (38 of them speakers), across the United States, and from around the globe—Asia, Africa, Europe, Latin America, and Australia. All had one thing in common—a shared interest in groundwater resources of agricultural regions and in agriculture's role in sustaining groundwater resources for future uses. A special journal issue on "Sustainable Groundwater in Agriculture," to be published in Water Resources Research, is in preparation.

As co-chair of the conference, I am deeply grateful to the conference program council for their enthusiasm, creativity, and tireless efforts in planning and putting together an impressive speaker list; to my executive conference committee, Rita Schmidt-Sudman and Sue McClurg from WEF and Cathryn Lawrence from UC Davis; to the wonderful folks at the Water Education Foundation (Jean Nordmann, Diana Farmer, Rebecca Scott, Robin Douglas, Susan Lauer, Beth Stern), and my students Katie Lockhardt, Reid Bryson, Tyler Hatch, Tomer Schetrit, and Vivian Jensen, for the hard work on organizing this conference; to the session chairs; to the speakers for their high quality presentations; to the conference sponsors for their financial support (U C Davis College of Agricultural and Environmental Sciences, Erler and Kalinowski Inc, Kings River Conservation District, and GEI Consultants, and—indirectly through travel support—UNESCO and FAO); and to the Groundwater Resources Association for their help in bringing exhibitors and visitors to the conference.

Continued on the following page…

Toward Sustainable Groundwater in Agriculture – An International Conference Linking Science and Policy – *Continued*

A summary of the talks would fill half of this issue of *HydroVisions*. But not to despair – a complete volume of abstracts is available at the post-conference website, as well as a copy of the final program. Videos and presentations will be posted later this summer for your perusal; the website will be publicly available, so please pass the link to those who may be interested. Also available is a blog by Michael Campana, one of our final panelists, about Day 1, Day 2, and Day 3 of the conference (thank you, Michael!). You can also find my personal—and much drier—"classroom notes" from the conference, covering about a quarter of the presentations. Mind that these are unedited and I am not guaranteeing completeness or accuracy! Vivian Jensen, one of the attending students, generously provided her notes as well. Below is a summary of the plenary and breakout sessions.

The discussion panel for the lively final plenary session was led by Margaret Catley-Carlson (right) with panel members (left to right): Jacob Burke, Jean Fried, Mark Giordano, and Michael Campana. (Photo courtesy of Rita Schmidt Sudman)

Plenary Session Summaries

Rita Schmidt-Sudman, Executive Director of the Water Education Foundation, led the opening plenary session on Day 1 titled "Global Groundwater in Agricultural/Rural Regions - Livelihoods and Use of Groundwater in Agriculture." **Dr. Thomas Harter**, U C Davis, presented "For Want of Food: Groundwater in Agriculture." With his talk, Harter provided one of many possible frameworks for this conference: the link between groundwater resources and global food security. At the same time, he provided a comprehensive context for the large diversity of topics to be covered. Worldwide food, feed, and fiber production needs will increase by 70% over the next 40 years, not including additional demands for biofuels. Nearly half of the world's crops are grown on irrigated lands, and many of the most groundwater-dependent agricultural regions have experienced significant overdraft. Additional challenges to managing groundwater use come from increasing demands for biofuel crops, a changing climate, subsidence, salinization and nitrate leaching from animal manure, and farm chemicals. The expansion of food production to feed the world's population in 2050 will be limited by land and water resources; groundwater will play an increasingly critical role in the stability of rural livelihoods and food economies against climate variability.

Paula Landis, Chief of the Division of Integrated Regional Water Management, California Dept. of Water Resources, highlighted "The Groundwater-Agriculture Nexus in California." Her talk focused on groundwater management and legislation in California, where control of groundwater is left to local agencies and individual groundwater users. She pointed out the lack of a comprehensive, statewide monitoring network to evaluate both groundwater quantity and quality, which impairs the efficient management of groundwater. Local monitoring and management efforts—if any at all—through local agencies or joint powers agreements, and in some case through court adjudications, vary widely, often dependent on water availability and demand. She asserted that the state's primary role will be in providing incentives and technical assistance to promote regional coordination, including the development of integrated regional water management plans, and effective groundwater management. She also saw the state playing a significant role in facilitating the sharing of data for effective and efficient groundwater management. To that end, Paula is leading the statewide groundwater monitoring initiative legislated through the 2009 Senate Bill x7-6. Her crew is currently in the process of establishing—with input from a wide range of stakeholders—statewide groundwater monitoring guidelines for local agencies. She emphasized that these guidelines will protect landowners from trespass by state or local entities, and that this program is not changing the water rights landscape, nor does it include monitoring of groundwater quality. She also pointed out that no funding is currently available either to DWR or to local agencies for running this program.

Dr. Tushaar Shah from the International Water Management Institute in Anand, Gujarat State in India, closed the first plenary session with an international perspective on Asian and African groundwater management in agriculture: "Groundwater Irrigation and Small-holder Agriculture: India's Experience and its Implications for sub-Saharan Africa." Dr. Shah discussed the possible implications of the Asian experience for Sub-Saharan Africa. Both regions feature low-yielding aquifers at a sub-continental scale. In India, these predominantly hard rock aquifers have recently become a resource to stabilize the livelihood of small-holder farms, although the resource is now becoming over-exploited by the high density of

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Toward Sustainable Groundwater in Agriculture – An International Conference Linking Science and Policy – *Continued*

these farms and associated wells. Dr. Shah suggested that a similar availability of well and pump maintenance resources would provide agriculture in Sub-Saharan Africa with a stable source of irrigation water and, thus, a much more stable livelihood. As population density and agricultural land fraction is much lower than in India, he suggested that this may not be a threat to groundwater sustainability in Africa.

For lunch, keynote speaker **Dr. Robert Glennon,** Morris K. Udall Professor of Law and Public Policy in the Rogers College of Law at the University of Arizona, entertained the audience with a tour of water and groundwater issues around the United States, as recently published in his book, *Unquenchable. America's Water Crisis and What to Do About It*. He began his talk with a quote from Edward Abbey: "There is no lack of water in the Mojave Desert unless you try to establish a city where no city should be." He followed with a photo tour of the amazing water features in desert-bound Las Vegas. Prof. Glennon did a thought-provoking and witty re-examination of how we use, value and often perceive water through the lens of history, showing that perhaps little has changed in a hundred years. His examples of water follies, ill will, and idiosyncrasies, but also innovation and creativity, came from throughout the country. Ideas for "fixing" the water problem—yet to be done—ranged from the century-old "don't put sewage in drinking water" (Teddy Roosevelt, 1910) to the newly innovative (e.g., changes in farming practices to cut down on unnecessary virtual water exports from water limited regions). Professor Glennon's blueprint for reform includes the familiar (conservation, abandoning of the old way of building more dams, and drilling more wells) to the innovative (using market incentives and price signals, recognizing the links between water and energy and the economy, incentives for water harvesting and reuse, alternative waste disposal, separation of storm water from sewer water, and others).

On Day 2, the plenary session on "Managing Groundwater Use and Groundwater Quality" was chaired by **Dr. Jacob Burke**, Food and Agriculture Organization in Rome, Italy. Dr. Burke opened with a few brief, but thought-provoking remarks to guide the morning. **Bill Alley**, Chief of the USGS Office of Groundwater, reviewed "Challenges in Groundwater Supply and Quality in the U.S." He began by pointing out that 90% of groundwater used in the U.S. comes from 20 aquifers, the largest being the High Plains and Central Valley aquifers. Total withdrawals there and in much of the west have been stable, while withdrawals in the eastern 31 states have recently been increasing. He reviewed national groundwater overdraft and geographic changes in its distribution; recent additions include the Dakotas, southwest of the Great Lakes, the southern Mississippi Valley and the Atlantic coastal plane, among others. Dr. Alley spoke of the need—at a national level—for providing more groundwater monitoring, driven by modeling efforts to identify the most effective monitoring approach (see http://acwi.gov/sogw/pubs). He identified better assessment of groundwater-surface water interaction as another key groundwater issue in agricultural regions across the U.S. The USGS is involved in the development of new modeling and measurement techniques (e.g., fiber-optic temperature sensing) to guide these efforts. On the groundwater quality side, he reviewed the efforts of the National Water Quality Assessment (NAWQA) Studies, which, when conceived in the early 1980s, almost missed the boat; initial discussions about the design of NAWQA considered excluding groundwater altogether. Many case studies have since been used to identify key groundwater quality issues and their geographic distribution. Other critical issues that the USGS is concerned with in the context of groundwater in agricultural regions include salinization, and the link between groundwater and energy.

Dr. Stephen Foster, former President of the International Association of Hydrogeologists and also former Director of the British Geological Survey, spoke on behalf of the World Bank on "The Global Boom in Groundwater Irrigation: Experience of Reconciling Resource Use and Sustainability." The World Bank's Groundwater Management Advisory Team (GW-MATE) has focused mostly on physical water scarcity; the diffuse pollution issues (nitrate, salts, etc.) are not currently addressed in developing countries. GW-MATE provides advice mostly to public administrations, but also to local, on-the-ground efforts in groundwater management. It is a small, international advisory team with access to very large programs within the World Bank, and therefore can affect groundwater management at national scales in developing countries. The Team embraces a top-down (central public administration) combined with a bottom-up (local) approach to groundwater management. Criteria for public administrations to intervene may include social inequity, negative effects on downstream users, viable exit strategy, and the risk for non-reversible damage such as subsidence or salinization. To be pragmatic, GW-MATE encompasses both hydrogeologic and socioeconomic elements. In Dr. Foster's experience, a certain "harmony" has to be found between the top-down and bottom-up approaches [reminiscent of the California experience]. Successfully addressing excessive groundwater use in agricultural regions involves hard work, an understanding of resource dynamics and use, user participation, a legal mandate or political backing for local government to be a groundwater guardian, and the "push" of a local groundwater champion. Dr. Foster also

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pointed out that higher irrigation efficiency does not always "save" water; rather, higher water productivity, integration of regulatory action, economic intervention, and technical innovation are needed for these programs to be successful in developing countries.

Bridget Scanlon, Univ. of Texas, Austin, provided a colorful overview of "Satellite and Ground-based Approaches for Monitoring Impacts of Agriculture on Groundwater Resources." Dr. Scanlon introduced the audience to the basic tools available for estimating water balance components of groundwater basins using remote sensing tools; she then focused in on the role of the two "GRACE" satellites, launched in 2002, in specifically estimating net changes in groundwater storage for large groundwater basins. Significant processing is involved in interpreting GRACE data, which are gravimetrically based and collected around the globe at weekly to monthly time intervals. Reasonable groundwater storage changes can be computed for basins on the order of 150,000 square miles or larger, though the technique also has been applied to smaller basins. Dr. Scanlon reviewed applications in the Ganges and Niger Basins, High Plains Aquifer, and California's Central Valley.

On the third day, **Vicki Kretsinger Grabert** of Luhdorff & Scalmani and **Chris Scott**, Professor at University of Arizona, presided over the plenary session covering "Law and Legal Policy in Groundwater Governance (Use and Quality)." **Dr. Jennifer McKay**, University of South Australia, opened the morning with a talk on "Sustainable Development Law Via Regional Plans for Groundwater in Australia." Dr. McKay reviewed groundwater management in Australia and led the audience through what she referred to as five epochs of water policies and water law. Groundwater users in Australia hold (defeatable) licenses to groundwater use, which the government may (and has) revoke during drought conditions. Initially resistant to groundwater metering, the Australian farming community has surprisingly embraced metering as a way to manage their groundwater, although much of the initial metering system was found to underestimate deliveries by 30%. In 1992, the federal environmental sustainable development law (ESD) took hold in Australia, which is based on four elements: sustainable use, intergenerational equity, intragenerational equity, and integration of environmental concerns into the decision making process. States use several policy instruments to apply the ESD to groundwater resources: buy-back of water and land, water allocation plans, infrastructure improvements to increase irrigation efficiency, and pay incentives for retirement of agricultural lands. Water markets have not worked in Australia as consumptive use increased above sustainable yields. Jennifer also concluded that community involvement and fair process is critical to successful water management.

Mike Wiremann of U.S. Environmental Protection Agency presented "A Summary of Laws and Regulations Related to Agricultural Chemicals and Groundwater." He defined groundwater sustainability as having sufficient quantity and suitable quality for designated beneficial uses. Groundwater quality in agricultural regions is affected by federal regulations on the registration and use of pesticides (FIFRA), pesticide tolerance on food and feed (FFDCA), public flow of information (PRIA), food production standards (FQPA), and endangered species (ESA). Fertilizer use is not regulated, but the largest animal farming operations will be required to prepare nutrient management plans. State regulations generally focus on best management practices, and are not always efficient in their implementation. Mike raised the question of whether nonpoint source loading must be limited through federal regulation, proposed numeric rather than narrative nutrient standards, and suggested that groundwater quality monitoring in agricultural regions must be implemented. He suggested that differential management concepts responding to hydrogeologic and soil conditions, especially through the land-use planning process, will be critical for success. EPA has initiated a nutrient initiative and is working with the states and agricultural stakeholders to further address nutrient management.

Dr. Stefano Burchi gave the final plenary session talk. He is with the International Association for Water Law and has written a book on groundwater in international laws around the world. His very enlightening talk, "The Maturing Law of Groundwater – A Comparative Perspective," touched on a variety of topics. He explored conjunctive use in China and India, where it is a matter of policy; in Jamaica and the United States, where it is a matter of domestic legislation; and in Spain, where interbasin water transfers are used to relieve groundwater stress. He considered land-use regulation and planning, mostly from the perspective of diffuse sources of groundwater pollution. The European Union has the Nitrate Directive, which instituted a number of controls on agricultural practices, mandated legislation of nitrate sensitive areas, and codified regional best management practices. Europe and North America have various regulations and policy guidelines for potable-well source areas. Land-use planning is not regulated anywhere with respect to groundwater, although in California, integrated water resources management plans offer the possibility of incorporating a strong land-use planning component. The role of groundwater in ecosystems is considered, where priority ranking is given to the ecosystem-support role of groundwater through resource allocation or via environmental impact

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reviews. South Africa reserves both surface water and groundwater for environmental conservation; in Australian New Wales, groundwater licenses are adjusted to maintain aquifer sustainability. Dr. Burchi observed that water legislation around the world remains surface-water centric, while groundwater is perceived globally as an intrinsically private source. Legal options disconnect groundwater and surface water not only in California, but in most countries, making it difficult for government to regulate groundwater, particularly policing of well production and monitoring of groundwater. He recommended a mix of regulatory and non-regulatory approaches to protect groundwater, including giving groundwater a legal status as a publicly/state-held resource, providing more opportunities for managing water within existing land-use regulations, and—as other speakers had mentioned—providing for economic incentives and structures to provide funding for groundwater management and quality protection measures.

The conference closed with an exciting panel discussion on "Toward Sustainable Groundwater in Agriculture: Challenges, Observations, and Key Outcomes." The discussion was facilitated by witty and sharp Margaret Catley-Carlson, Canadian Water Network and former chair of the Global Water Partnership, who quick-fired questions at her panel and the audience. The panel included **Mark Giordano**, International Water Management Institute and co-author of the recent book *The Agricultural Groundwater Revolution*; **Michael Campana**, aka "aquadoc," Oregon State University; prolific water-scene blogger **Jacob Burke**, Food and Agriculture Organization (FAO); and **Jean Fried**, UNESCO and University of California Irvine, who had organized a recent conference on water scarcity and groundwater management. The panel was excited about the conference theme and topical range, although some suggested coverage on linkages between agriculture and other groundwater users could have been more extensive. Margaret's questions included:

- Are we satisfied with the ability of measuring the impacts of agricultural practices?
- Does illiteracy have anything to do with how we can manage groundwater?
- Where does know-how need to be further developed?
- At what level should farms be regulated?
- How do we successfully manage groundwater?
- Do the international/national water players really make a local impact?
- How do we connect age-old cultures with novel engineering solutions?
- How do we best share ideas and move them forward, and where do we go from here?

Panelists and the audience responded in quick succession with succinct ideas and suggestions.

All of this can be seen on video, later this summer, at the conference website.

Acknowledgments: Thank you to Karen Burow, Vicki Kretsinger, and Steven Phillips for the critical reviews, suggestions, and editing of this article!

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OBITUARY

The Groundwater Industry Loses a Great Leader
Eugene E. (Gene) Luhdorff, Jr.
(1930-2010)

Fading light dims the sight
And a star gems the sky,
gleaming bright
From afar drawing nigh,
Falls the night.

(first verse of Taps)

On August 3rd, the groundwater industry lost a great leader. Eugene E. Luhdorff, Jr. (Gene) passed away following a 20-year battle with the debilitating effects of Guillain Barré Syndrome (GBS). Gene, a founding partner of the firm Luhdorff & Scalmanini, Consulting Engineers (LSCE), retired from LSCE in 1991 following the onslaught of this rare and debilitating illness. Still, he remained active with numerous pursuits even while wheelchair-bound, including several contributions to *HydroVisions*, serving as a church elder, and remaining active among Ham Radio enthusiasts (call sign AC6XQ-Extra Class).

In 1998, at its 7th Annual Meeting, GRA presented the very first Lifetime Achievement Award to Gene, "In recognition of his contributions to the Groundwater Industry." He later commented that his greatest honor was receiving this award, and that this award was the most cherished by him, because it was the first such award given by the Association.

The following is a brief summary of Gene's contributions to the groundwater industry.

Gene was born in San Jose (1930). His father, Eugene E. Luhdorff, Sr., worked for the John Bean Co., which later became the Peerless Pump Company, Division of the FMC Corporation. His father was involved in the early design and manufacture of the deep well

turbine pump. His family moved to Woodland (c. 1940) and established the family-owned E.E. Luhdorff Company pump and, later, well drilling business. Gene learned the well and pump business as a teenager, shoveling gravel into annular spaces, test-pumping wells, and repairing pumps. Gene ultimately enrolled in the University of California, Davis Irrigation Science program (now Hydrologic Sciences), where he graduated in the early 1950s.

After a stint in the Navy as an Officer serving aboard the destroyer U.S.S. Tingey, he joined his father in the E.E. Luhdorff Company where they grew it into a multi-disciplinary well drilling, pump and irrigation business in California and several western states (notably Washington and Arizona). Gene was possibly most noted in those times (1950s–1970s) for his aggressive acceptance and application of the principles of proper well design to achieve sand control, and in his marketing of such wells when many in the industry adamantly insisted that such could not be done (and certainly not guaranteed). He also developed an early understanding of the principles of well hydraulics and applied them to the proper design of pumps for installation in wells. In the irrigation field, Gene was a pioneer in the application of drip irrigation in the vineyards of the Napa Valley.

Gene often spoke of his volunteer work for the Peace Corp during 1968 to 1970 as a highlight of his career. It was Gene's usual practice not to let someone run a drilling rig unless they helped on the rig for at least five years. Somewhat overwhelmed with what he was being asked to do (i.e., teach drilling in six weeks), he agreed to help teach volunteers the basic principles of well drilling. Several of his graduates helped install wells in India and Africa where previously potable water was not available. Some of those volunteers were later hired by Gene to work for the family business after they returned from the Peace Corp.

Ultimately, Gene sold the family-owned business (150 employees in several western states) to the Layne Western Co. in 1976 and subsequently stayed on as Vice-President and Western Regional Manager for two years before leaving to begin consulting engineering on groundwater and wells. In late 1979, he and Joseph Scalmanini co-founded LSCE. The firm continues to bear his name and to reflect the type of work he conducted in groundwater, wells, pumps, and water resources engineering.

Gene was a multi-term President of the Associated Drilling Contractors of California (now known as the California Groundwater Association), a

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OBITUARY

The Water World Loses an Eminent Attorney and Conservationist – Anne M.J. Schneider

(1947-2010)

"…Anne Schneider became renowned for her dedication to water rights issues, specifically on the protection of existing rights and the establishment and acquisition of appropriative, riparian, and groundwater rights…"

Excerpt from a Resolution by the Honorable Lois Wolk, 5th Senatorial District

Anne Millar Jeffrey Schneider passed away peacefully on Friday July 30, 2010, surrounded by family, following a lengthy battle with ovarian cancer. On August 15, about 300 of Anne's circle of family, friends, neighbors, and professional colleagues gathered to pay tribute to her life, accomplishments, and legacy. Anne excelled as a cyclist, mountaineer, scholar, skier, water-law attorney, and conservationist, but was, above all, a completely devoted and loving mother to two sons, Charlie and Logan.

The wondrous feats of her life were displayed in a mosaic of photos, while Tibetan prayer flags formed a backdrop and a sampling of her bicycle jerseys (34 of them) was strung across the width of the greenbelt area where the celebration of her life occurred. Bike racing was one of the many things that Anne did with indescribable fortitude and passion. August 15 was a sad time, but it was also filled with the shared love and memories of the way that she touched so many lives. One thing resonated throughout the six hour celebration—she was deeply loved and will be greatly missed.

Born on December 31, 1947, in Berkeley, Anne grew up in Lafayette, Calif., the first child of William and Nancy Jeffrey and the eldest of three siblings. She graduated from Pomona

College in 1970 with a degree in philosophy and graduated from the UC Davis Law School in 1976, earning a jurisprudence degree with an emphasis in water law. In 1977, Anne and her husband, Bob, settled permanently in Davis in Village Homes, where they raised their sons Charlie and Logan. Anne and Bob remained dear friends after divorcing in 1993.

After law school, Anne began working as an attorney, but she could not be defined solely by her professional career. She made her children the center of her world, and they have known it every day of their lives. The following accomplishments are all the more extraordinary in light of this unwavering love.

As one of California's foremost water law attorneys, Anne's desire to find comprehensive and fair-minded solutions for the most intractable issues defined her practice. This trait was echoed on August 15; she was always keen on finding solutions to issues and problems—solutions that were in the interests of public trust. One can say it no better than one of her colleagues, who described Anne as one of the kindest and most ethical people he had ever met.

She began her career with the Governor's Commission to Review California Water Rights Law in 1977, where she wrote the seminal papers on groundwater rights and instream water uses. Anne became the first female partner at Downey, Brand, Seymour and Rohwer in Sacramento. She later co-founded the law firm of Ellison, Schneider and Harris and managed the firm's water law practice for nearly 20 years.

Anne represented many of the state's largest municipal water suppliers. In 2006, she received the Lifetime Achievement Award from the Water Education Foundation.

An active lifestyle was an integral part of Anne's being. She was at heart a competitor, and her love of sport ranged widely. Tennis was an early love, as were running and sailing. In grade school, an unbroken record of sailing races on Lake Merritt in Oakland initiated her competitive sports career. She played softball and basketball in high school and college, but after graduating she became enamored of the mountains, scaling Grand Teton and Mount Rainier.

In 1971, she met her future husband Bob while climbing, and they circled the globe as they scaled peaks in the Alps, New Zealand, Nepal and China, in addition to the Yosemite cliffs and Sierra spires that defined her home range. These mountains would remain a part of her soul, and she worked with the Yosemite Association for the rest of her life.

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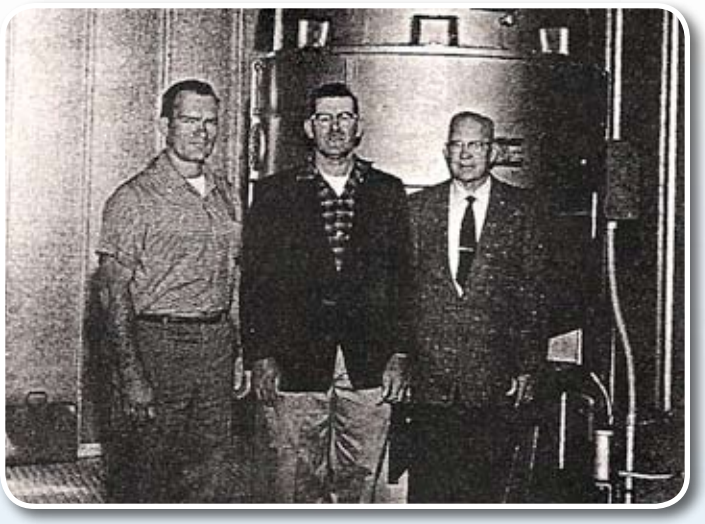
Eugene E. (Gene) Luhdorff, Jr. – *Continued from page 33*



Two 300 H.P., 400 R.P.M., 2300 Volt, Synchronous motors driving two fifty-four inch Peerless Hydrofoil Pumps installed for the Reclamation District 1000, in Northern California. Installation made by E. E. Luhdorff Company of Woodland. E. E. Luhdorff, Jr., pictured left. (The Drillagram, *September 1960*)

contributor and reviewer of the original Bulletin 74 Water Well Standards (and subsequent updates), and technical reviewer of the University of California's Bulletin on the Design, Construction, Operation and Maintenance of Wells and Pumps. He was also on the Board of Directors of the National Water Well Drillers Association (currently the National Ground Water Association) from 1967 through 1969, and the President of the California Irrigation Institute in 1971 and 1972. Gene had consulted and taught on the subject of well design and construction around the world, notably in Japan, South America, and India. He taught numerous individuals in the California Department of Water Resources, and later through the University of California Extension for 15 years.

Gene was uniquely educated (practically and theoretically). He interpreted and applied many principles of groundwater hydrology during a pioneering time, long before there was the current multitude of geologists, hydrologists, and engineers practicing in the general groundwater field. When GRA's Lifetime Achievement Award was presented to Gene in 1998, his business partner, Joe Scalmanini, reflecting back twenty years ago, said "When we started in business in 1979, no one was doing what Gene could do." Joe continued, "Looking back over the last twenty years, that remains largely true today."

Following memorial services and the luncheon held on August 9th, a Naval Flag Ceremony was held to honor Gene's service to the Country. Two honor guards representing the US Navy folded and presented the flag to his wife, Jan Luhdorff. Taps was played while slides reflecting Gene's life in its many and varied capacities rotated in the background. As a pioneer and contributor to the groundwater industry, Gene leaves us his legacy.

Then goodnight, peaceful night;
Till the light of the dawn
shineth bright.
God is near, do not fear,
Friend, goodnight.

(third verse of Taps)

Editor's note: GRA would like to thank Joe Scalmanini and Vicki Kretsinger Grabert for their help in preparing this article.

Anne M.J. Schneider
– Continued

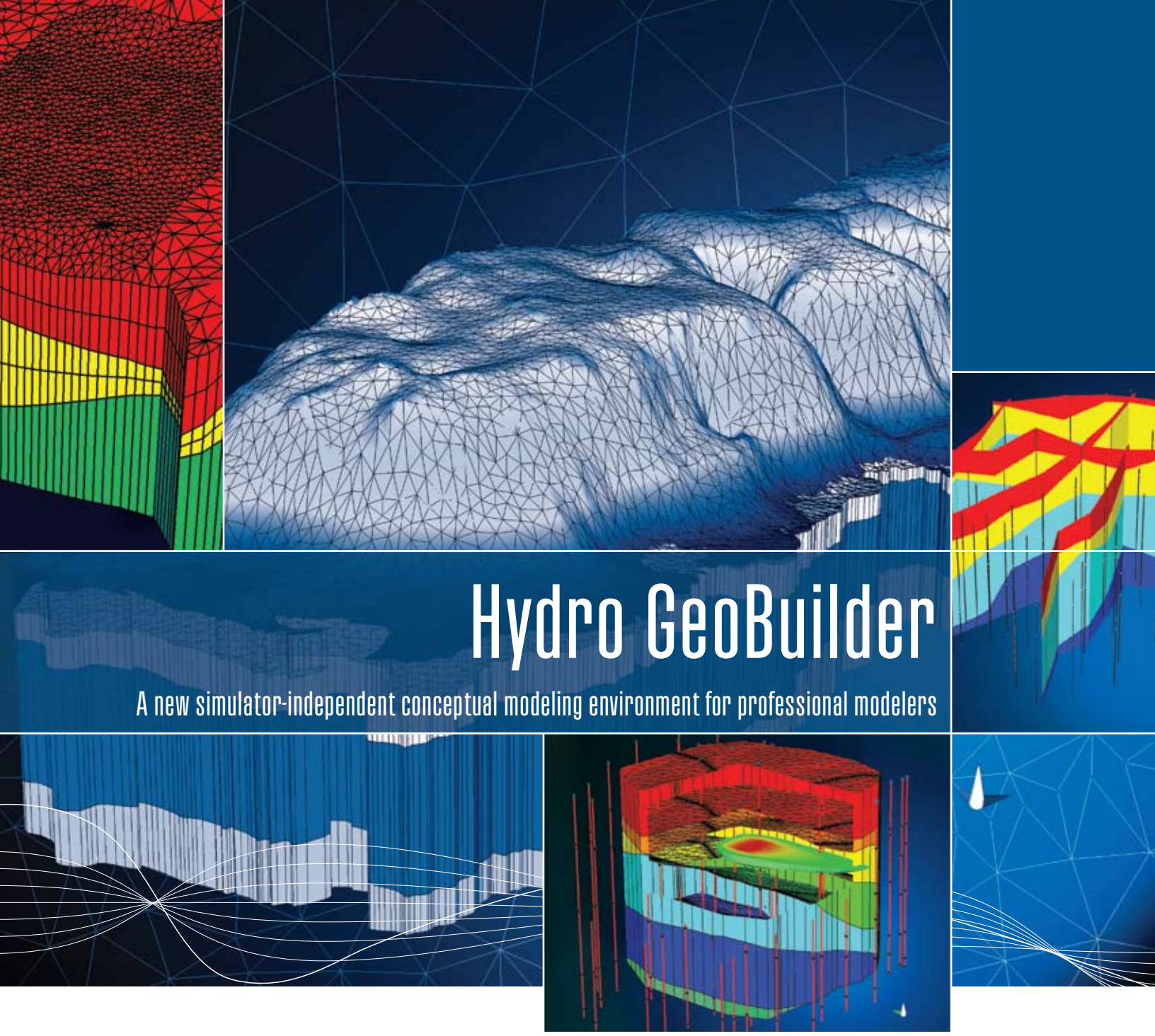
Anne ran marathons and later took up cycling, which she did with a passion. She raced in the velodrome, won masters' races, and rode extreme long distances. Her many riding accomplishments include the Paris-Brest-Paris (750 miles within a 90-hour period), PAC Tour (2,800 miles across the United States in 23 days), Ride Across Iowa, the Furnace Creek 508 (508 miles within a 40-hour period), and many Davis Double Centuries.

Anne loved skiing, which had roots in her mountaineering experience, most often at Royal Gorge Ski Resort, in all weather, preferably with friends. She was honored by the Pomona Sports Hall of Fame for basketball and fencing, and by the PAC tour Hall of Fame for her cycling. She loved the opera. For a time, she worked as a river guide.

Anne served on the boards of directors of the California Wilderness Coalition, the Yosemite Association and Tuleyome, an active local environmental group where she was instrumental in the designation of the Cache Creek State Wild and Scenic River. Tuleyome will soon build 'Annie's Trail' at its Cold Canyon Headwaters property.

Even in her last months and days, Anne continued to build her community of friends and loved ones. Memories of her vitality, extreme endurance, and dedication to the protection and preservation of irreplaceable wild and scenic areas will live on forever.

Editor's Note: Many thanks are extended to Anne's sons Charlie and Logan for their contributions to this article.



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Sacramento

By Tom Ballard,
Branch Secretary

The April 2010 meeting featured the annual California Department of Toxic Substances Control (DTSC) highlights and perspectives regarding current and upcoming groundwater-related issues. Sharing presentation duties were Charlie Ridenour, Performance Manager for the Site Cleanup Program, DTSC Sacramento; Dot Lofstrom, Geological Services Unit supervisor; and Brian Lewis, Chief of the Northern California Geological Services Unit in Berkeley and longtime GRA Board Member.

Charlie Ridenour, P. E., summarized programmatic issues related to groundwater cleanup at Brownfield and school sites, and included information on the new Revolving Loan Fund for brownfields cleanups. Dot Lofstrom, PG, provided an overview of the diverse projects being undertaken by staff in the Sacramento office and some background on the diverse experience of the geologic staff in the Sacramento office. Brian Lewis, PG, CEG, and CHG discussed emerging and broader issues such as green chemistry and nanotechnology. Emerging issues include toxics in consumer products, bio-monitoring, treated wood waste and pharmaceutical waste. An update was also provided on the progress on the Soil Gas Sampling Advisory document.

The May 2010 meeting featured Christopher Watt, a principal of LACO Associates in Ukiah, California, who presented "Funding UST Cleanups in California: What is the Standard of Performance?" The UST Cleanup Fund in California accounts for over $200M in annual revenues for environmental consultants and vendors. As of 2009, over $2.5 billion had been paid out by the UST Cleanup Fund on approximately 10,000 claims; about 350 claims are closed annually. The average expenditure per site is about $400,000. According to a recent audit, poor planning and financial mismanagement at the Fund has significantly delayed cleanup efforts and created concerns regarding funding cleanup at open sites. Given the history of poor coordination between state and local regulatory agencies on site-closure criteria, environmental consultants face uncertainty in identifying associated strategic and cost-effective cleanup plans. Mr. Watt's presentation concluded with a number of case studies, most of which were operated under the UST Cleanup Fund's now defunct pay-for-performance program.

The June 2010 meeting included a presentation by John M. Farr, Chief Engineer with Farr Associates of Granite Bay, California, on how enhanced in-situ bioremediation was successfully applied at a former industrial manufacturing facility in Willits, California. Prior to implementing remediation, groundwater at the former industrial manufacturing facility in Willits contained volatile organic compounds (VOCs) at concentrations of about 10 parts per million. The use of enhanced in-situ bioremediation reduced these concentrations by orders of magnitude. The remedial approach included subsurface injections of solutions containing sugar, emulsified oil, yeast extract, pH buffer, and vitamin B-12.

Initial pilot test monitoring data showed that total organic carbon (TOC) increased and pH and respiration rate decreased shortly after the injections, while methane production and declines in VOC concentrations lagged significantly behind these effects. Typical lag times ranged from 6 months to one year, with VOC concentrations in some injection-vicinity wells exhibiting lag times of up to 1.5 years. The remedial project included 198 injection locations covering about 2/3 acre; injection point spacing ranged from 10-15 ft. At each location, a short tool was used to inject at 1-ft depth intervals. In addition to diluted emulsified-oil and molasses, a pH buffer and vitamin B12 were added to the injection solutions. Results were more immediate than those from an earlier pilot study; rapid declines in VOC concentrations were observed. A subsequent large-scale injection program was completed using about 140 injection locations over a one-acre area.

San Francisco

By Abigail McNally,
Branch Secretary, and
John Karachewski,
Branch Vice President

John Karachewski, PhD, PG, HG with the Geological Services Unit of the Department of Toxic Substances Control (DTSC) presented "*Geology of the San Francisco Bay Region, 'Photographs That Didn't Make It into the Book,'*" on April 21, 2010. Mr. Karachewski has conducted geology and environmental projects throughout the western United States and is an accomplished photographer. His presentation explored the beauty and diversity of Bay Area landscapes with a focus on geologic, hydrologic, and environmental themes. Internationally renowned photographer Galen Rowell noted that the San Francisco Bay area holds the most extensive system of wild greenbelts of any major metropolitan area in the world, with more than 200 parks, preserves, and protected areas, that combined exceed the acreage of Yosemite National Park. Mr. Karachewski's presentation highlighted the geologic landscapes in familiar parks from a new perspective and introduced exciting discoveries from lesser known parks. Mr. Karachewski was the photographer for the UC Press book by Doris Sloan on the "Geology of the San Francisco Bay Region." Examples of his images can be viewed at: www.geoscapesphotography.com.

William E. Motzer, Ph.D., PG and Senior Geochemist with Todd Engineers, presented "Old and New Emerging Contaminants: 'Stuff You Haven't Thought About'" on May 18, 2010. Dr. Motzer provided a lively, thorough and informative presentation on emerging chemical contaminants (ECCs) with a particular emphasis on the potential for impacting groundwater. These ECCs include methyl-*tertiary* butyl ether (MTBE), perchlorate (ClO_4–), hexavalent chromium [Cr(VI)], N-Nitrosodimethylamine (NDMA), and 1,4-dioxane. Earlier investigated ECCs are now referred to as "post" emergent or "old" ECCs and parameters have been established for definition as post-emergent ECC. "New" emergent ECCs include: (1) Pharmaceuticals and personal care products (PPCPs), including hundreds if not thousands of complex chemicals from antidepressants, antiviral medication, antibiotics, pain relievers, detergents, cosmetics, etc.; (2) nanomaterials, including those derived from geogenic (natural) and anthropogenic sources; (3) platinum group metals (PGMs), which are being emitted in increasing quantities by erosion of automobile catalytic converters and may be impacting groundwater in urban and suburban areas, and (4) prions (misfolded proteins) that are environmentally persistent and recalcitrant and are responsible for amyloidal diseases including bovine spongiform enthalopathy (BSE) or "mad cow disease." Dr. Motzer discussed the detailed process of how ECCs are researched, analyzed and developed through academic interest, publications and method development. In most cases, media and environmental groups bring ECCs to public awareness and help encourage more government oversight and monitoring. An ever increasing population coupled with increased demand on our natural resources is increasing human health risks. It is important to consider the true lifecycle of "old" and "new" ECCs, including complex chemicals and personal care products. The potential long-term impacts to groundwater are not fully understood and may lead to more significant challenges in the future.

On March 23rd, Ms. Barbara Cook, PE, (Acting Assistant Deputy Director) and Mr. Brian Lewis, CEG, CHG, (Chief, Geological Services unit) presented the 5th Annual DTSC Regulatory Update. Cook described the reorganization of the Berkeley Cleanup Program into geographic areas with teams working on sites with similar hydrogeologic settings, and discussed the significant decrease in redevelopment of Brownfield sites over the past few years

due to the economic slowdown. Next, she summarized the DTSC Strategic Plan and the legislative performance measures, including elapsed time for decision making and remedy selection. Cook concluded with a case history and details of a $3 million grant that U.S. EPA awarded to DTSC for a "Revolving Loan Fund" to remove and abate environmental risk at Brownfield sites. Lewis highlighted new directions for the department in green chemistry and emerging issues with respect to toxics in consumer products, nanotechnology, and biomonitoring. Lewis also offered a vision in which California could influence worldwide manufacturing processes to reduce the generation and subsequent disposal or treatment of hazardous waste resulting in positive economic and environmental changes. Next, he presented an overview of DTSC Proven Technologies & Remedies documents (www.dtsc.ca.gov/SiteCleanup/PTandR.cfm), which were developed to streamline remedy selection, site cleanup, and preparation of workplans. Lewis concluded with a summary of vapor intrusion issues and documents, which can be accessed at: **www.dtsc.ca.gov/SiteCleanup/Vapor_Intrusion.cfm**.

Southern California

By Paul Parmentier,
Branch Secretary


Photo by John Karachewski

During the second quarter of 2010, the Southern CA Branch held two meetings focused on soil vapor intrusion: an initial dinner meeting on soil-gas sampling and vapor intrusion followed by a hands-on, field display of equipment and techniques related to soil-gas and vapor-intrusion testing and mitigation.

On May 20, 2010, Dr. Blayne Hartman presented a lively overview of the vapor intrusion (VI) issues. VI concerns have grown over the past few years due to increased levels of scrutiny regarding potential human health risks, which have generated multiple regulatory guidelines and industry standards. Dr. Hartman highlighted the state-by-state variations in technical approaches to the issue, despite a general US EPA guideline that any site within 100 ft laterally or vertically from VOC-contaminated groundwater should be further evaluated. In California, a soil gas sampling guidance document prepared by RWQCB and DTSC has been presented at multiple conferences sponsored by GRA, and a Vapor Intrusion Mitigation Advisory (VIMA) also has been published by DTSC. The ASTM Standard regarding VI also requires properties within specific distances of a site potentially contaminated with subsurface VOCs to be noted as presenting a "Vapor Intrusion Condition" (VIC).

Dr. Hartman highlighted the applicability of the VI issue by pointing out the low levels of indoor air measurements that would trigger a VI issue and that many common off-the-shelf commercial products contain VOCs, e.g., Perchloroethene (PCE) in brake cleaning products. The VOC 1,2 Dichloroethane (DCA) has been shown to be off-gassed from molded plastic objects. These non-subsurface VOC sources are sure to complicate any indoor air data interpretation. Dr. Hartman described a site where the backyard barbeque gas supply was found to be the culprit for unusual VOC concentrations. He also presented the range of analytical methods available; a few laboratories are able to analyze for VOC using Method TO-15 in mobile labs, but cheaper methods such as EPA Method 8021 may be just as applicable in some exploratory investigations. Dr. Hartman noted that radon surveys may be necessary at some sites to pinpoint the vapor intrusion pathway component of VOCs detected in indoor air.

On June 16th, the second part of the vapor intrusion event was held at Cal State Fullerton with support from Professor Richard Laton. The activities included vendor booths and live field demonstrations by equipment and service providers related to soil gas and vapor intrusion. Pizza and soft drinks were provided by the vendors, each of which also contributed to the Branch Scholarship Fund.

The vendors and technology representatives included:

- **H&P Mobile Geochem:** Soil Gas surveys, indoor air testing and Mobile Labs
- **Jones Environmental:** Soil gas sampling and Mobile Labs
- **Vironex:** Membrane Interface Probe investigations and Soil Gas Probe installations; Vironex also brought its new large Geoprobe well installation rig
- **Regenesis:** Sub-Building Membrane and Remediation services
- **Cetco:** Membrane design and installation, and remediation
- **Enviro Supply:** Environmental sampling and remediation equipment rental and services.

According to all participants, the ability to manipulate testing equipment, observe testing procedures and discuss remediation techniques in a field format provided a unique opportunity to learn and exchange information.

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Lassen Peak, Lassen Volcanic National Park

Lassen Peak (10,457 ft) and snow-clad Mount Shasta (14,162 ft) form the two southernmost volcanoes in the Cascade Range. Mount Shasta is a classic Quaternary composite volcano (stratovolcano) that began to erupt about 590,000 years ago. In contrast, Lassen Peak formed about 27,000 years ago when highly viscous lava erupted around a volcanic vent and constructed one of the world's largest dacite domes.

After a lengthy dormancy, Lassen Peak erupted once again on May 30, 1914 and continued to exhibit sporadic volcanic activity until 1921. Over 180 steam explosions occurred between 1914 and 1915; the steam blasts occurred when magma rose toward the surface of the volcano and heated shallow groundwater. The climactic May 1915 eruption created a new summit crater and generated lava flows, pyroclastic flows, lahars, mudflows, and an ash column that rose more than 30,000 feet into the atmosphere. For several years after the May 1915 eruptions, spring snowmelt percolating down into Lassen Peak triggered steam explosions, indicating that rocks beneath the volcano's surface remained hot.

The lava flow shown in the foreground of this photograph was erupted in May 1915. The summit of Lassen Peak can reached via a challenging but scenic 5-mile round-trip hike that gains 2,000 feet in elevation. Active hydrothermal features, including fumaroles (steam and volcanic-gas vents), mud pots, boiling pools, rare geysers, and steaming ground can be visited at the Sulphur Works, Bumpass Hell, Devil's Kitchen, and other remote areas of the park.

Photograph by John Karachewski, PhD (DTSC).