

# HYDRO VISIONS

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## DNAPL Source Zone Characterization and Remediation: An Ongoing Challenge

BY BETTINA LONGINO

On December 7 and 8, 2005, GRA held the 15th symposium of its very popular and successful Series on Groundwater Contaminants: DNAPL Source Zone Characterization and Remediation. The symposium drew over 170 attendees to San Francisco from across California, 14 other U.S. states, and seven countries to discuss the state-of-the-practice in characterizing and remediating DNAPL source zones. Symposium sponsors included ARCADIS, Daniel B. Stephens & Associates, Geomatrix Consultants, GeoSyntec Consultants, Locus Technologies, Malcolm Pirnie, Thermal Remediation Services, Liquid Boot®-LBI Technologies, and Precision Sampling. Due to space constraints, this article has been abbreviated. The full version has been posted on the GRA website, [www.grac.org/dnapl](http://www.grac.org/dnapl).

DNAPLs, or dense nonaqueous phase liquids, such as chlorinated solvents, PCB

*25,000 subsurface  
contaminant plumes  
attributable to  
DNAPL sources may  
exist nationwide*

oils, and creosote, are groundwater contaminants commonly encountered throughout industrial areas of North America as a result of their association with dry cleaning, metal degreasing, manufactured gas production, and wood preservation operations. It is currently estimated that as many as 25,000 subsurface contaminant plumes attributable to DNAPL sources may exist nationwide (NRC, 2005). Because DNAPLs are denser than water, they are able to migrate beneath the water table and will continue to move downward

in unconsolidated or fractured media until either pooling above a low permeability zone that cannot be penetrated or becoming immobilized as residual along the migration pathway. This residual and pooled DNAPL in the subsurface typically is termed the "source zone." Drinking water MCLs are generally orders of magnitude lower than DNAPL aqueous solubilities; as such, dissolved plumes associated with DNAPL source zones can cause pervasive and persistent contamination of drinking water aquifers.

Professionals involved in decision making for DNAPL sites are all too aware that effectively and efficiently addressing DNAPL source zones involves not only difficult technical issues, but also policy challenges. Since no DNAPL remediation technology has been proven to remove

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100% of the contaminant mass from a DNAPL source zone, partial mass removal is (and certainly proved to be at the symposium) a topic of intense debate among researchers, practitioners, and policy makers alike.

The two-day symposium opened in full gear with two superb introductory keynotes. Dr. Linda Abriola, Dean of Engineering at Tufts University and a leading researcher in DNAPL studies, set the stage for sessions to follow by describing the challenges of defining, monitoring, and modeling the behavior of DNAPL source zones. Dr. Abriola also initiated two important dialogues that carried through the symposium: the use of mass flux as a metric for source zone monitoring and regulation, and the potential benefits of partial mass

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



# President's Message

BY THOMAS MOHR

What does the New Year bring to GRA? We have much to look forward to in 2006, and we can look back on our many accomplishments in 2005 with pride. The State of the Association is sound. Our membership survey indicates you are quite satisfied with GRA as your professional association for groundwater interests. GRA offers a growing number of symposia, workshops, and courses, with improving balance among members' key areas of interest, and our legislative committee continues to engage legislative staff and elected officials on the importance of groundwater stewardship. Our financial picture is stable and continues to improve; GRA's branches continue to thrive and offer their own rich programs, as well as the all-important local opportunity to meet with your peers to discuss topics of mutual interest, make new contacts, and share in friendship and camaraderie.

To what or whom does GRA owe its success? I believe it is the intrinsically interesting nature of groundwater that motivates GRA's volunteer committee members, Branch Officers, and Directors to step up and get more involved in their profession than is required by their jobs. Ask any member who has served on a committee, helped run a branch, or otherwise contributed to making GRA's programs and activities happen, and you will hear that participation is its own reward. There are too many volunteers to name in this column; I will mention a few whose contributions are outstanding.

As GRA's new President, I have big shoes to fill. GRA's 2004/2005 President, the intrepid Tom Johnson, did a stellar job of providing focus for the Board and causing us to adopt a systematic approach to executing GRA's programs and activities. Tom led us to revitalize and strengthen our committees, and motivated us to get a lot done. The backbone of GRA is our Events Committee, which thrived last year under Sarah Raker's energy, enthusiasm, organization, and dedication.

We had new volunteers leading several successful programs last year: Elie Haddad of Locus Technologies led the Environmental Information Management Systems workshop, and he co-chaired the Vapor Intrusion to Indoor Air symposium with Jim Strandberg of Malcolm Pirnie. Eric Reichard of USGS led a workshop on Artificial Recharge, together with the tireless Tim Parker and several others, who also planned the Basin Yield and Overdraft workshop. Mr. Parker's 2005 accomplishments include leading the publication of the 2nd edition of GRA's California Groundwater Management book, and leading and teaching workshops designed around the book. Bill Pipes of Geomatrix, Vicki Kretsinger of Luhdorff Scalmanini, and Sarah Raker, formerly of RWQCB and now with MACTEC Inc., led GRA's contribution to the very successful GRA Annual Meeting held jointly with the UC Biennial Groundwater Meeting.

Bettina Longino of Geomatrix assembled the world's leading DNAPL experts for a

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# Nitrate in California's Groundwater: Are We Making Progress?

APRIL 4 & 5, 2006  
MODESTO, CA

17TH SYMPOSIUM IN GRA  
SERIES ON GROUNDWATER  
CONTAMINANTS

Nitrate contamination of surface and groundwater is a pervasive and growing problem in California, the nation, and the world. High levels of nitrate affect both human and ecosystem health: high levels in drinking water cause "blue baby syndrome;" high levels in surface and coastal waters lead to eutrophication. The U.S. EPA (1990) has estimated that about 1.7 million people (including 270,000 infants) or 8% of the population is exposed to water with nitrate concentrations in excess of the regulatory limit for drinking water. Groundwater nitrate contamination is commonly viewed as intractable because it is ubiquitous, it has multiple sources, and it is expensive to treat. In California, the activities that contribute nitrate to groundwater – animal operations, crop fertilization, wastewater discharge (including land application of food processing waste), and septic systems – are a legacy of commerce and growth over the last half-century, yet remain vital to the economic future of the State.

In California, about 10% of currently active public drinking water supply wells have reported maximum nitrate concentrations that exceed the regulatory drinking water standard. In 1988 the State Water Resources Control Board reported that the Metropolitan Water District of southern California was losing up to 4% of its drinking water supply to nitrate, as compared to

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# Upcoming Events

## Emerging Contaminants and Water Quality: Current and Future Challenges

18th Symposium in the Contaminants in Groundwater Series

JUNE 6 & 7, 2006 – CONCORD, CA  
DEADLINE FOR ABSTRACTS IS MARCH 20, 2006

Unregulated and emerging chemical contaminants present numerous technical and institutional challenges to society, and to environmental and public health professionals. Increasingly sensitive analytical techniques have recently chronicled the emergence of specific chemical, microbial and radiological agents in actual or potential sources of drinking water. As our ability to detect these agents has increased, the number of unregulated water contaminants has grown dramatically.

Starting on June 6, 2006, GRA will hold a one and a half day symposium in Concord, CA, on emerging water contaminants. This symposium will feature presentations on a range of emerging contaminants including pesticides/herbicides (1,2,3-TCP), pharmaceuticals and personal care products, disinfection byproducts (NDMA), industrial additives (1,4-dioxane), persistent organic compounds (PBDEs), etc. Technical sessions will provide information on chemical history of use, sources in the environments, nationwide occurrence, physical and chemical properties, analytical techniques, regulation in the United States and Europe, environmental fate and transport characteristics, and innovative and cost-effective remediation and treatment technologies for removal from soil and water. In addition, standard of care issues, and federal and state drinking water stan-

dards in the context of natural resource damages will be discussed.

Experts from academia, regulatory agencies, consulting, industry and the legal arena will participate in moderated speaker sessions, posters sessions and a closing panel discussion. The combination of invited speakers and experts from key areas, along with talks chosen from submitted abstracts, will make this an important event for all water quality professionals interested in emerging contaminants.

GRA welcomes submittals of abstracts for platform and poster presentations on the topics listed above. The deadline for submitting abstracts is March 20, 2006. Please feel free to contact Rula Deeb (510-735-3005), Elisabeth Hawley (510-735-3027) or Tom Mohr (408-265-2600) if you would like to discuss your topic for this Symposium before submitting your abstract, or if you have any questions. Guidelines for submitting an abstract for a platform or poster presentation can be found on GRA's website ([www.grac.org](http://www.grac.org)). If you are interested in exhibiting your organization's services or products, or being an event sponsor, please contact Mary Megarry at [mmegarry@nossaman.com](mailto:mmegarry@nossaman.com) or 916-446-3626. GRA welcomes co-sponsors, lunch, refreshment and reception sponsors. 💧

# Agriculture Sustainability Conference

ABSTRACTS DUE MARCH 1, 2006

The “International Conference on The Future of Agriculture: Science, Stewardship, and Sustainability” will be held August 7-9, 2006 at the Hyatt Regency in downtown Sacramento, California. The conference is sponsored by the USEPA ORD Hazardous Substance Technical Liaisons Program, the National Institute of Environmental Health Sciences, the Midwest Hazardous Substance Research Center--Kansas State University, and California EPA. Participants are invited to submit an abstract for an oral presentation or a poster presentation. The deadline for submissions is WEDNESDAY, MARCH 1, 2006. Complete information can be found at <http://www.dce.ksu.edu/dce/conf/ag&environment/>.

Questions about the conference or abstract submission, or about exhibiting or sponsoring an event or speaker at the conference, may be directed to Ellen Stauffer, Program Coordinator, at [ellen@ksu.edu](mailto:ellen@ksu.edu), or 785-532-2562, 8 am - 5 pm CST. ♪

## Mark Your Calendar!

### GRA 15th Annual Meeting and Conference

September 21-22, 2006  
Bahia Resort – San Diego, CA

Detailed information will be available soon at [www.grac.org](http://www.grac.org)

# Upcoming Events

## Principles of Groundwater Flow and Transport Modeling

MARCH 8-10, 2006 – UNIVERSITY OF CALIFORNIA, IRVINE LEARNING CENTER, ORANGE, CA

CO-SPONSORED BY UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION GROUNDWATER HYDROLOGY PROGRAM

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. 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.

### Course Topics (partial list)

- ♪ principles and concepts of groundwater modeling
- ♪ data collection and preparation
- ♪ model grid design
- ♪ boundary conditions
- ♪ modeling multiple aquifer systems
- ♪ sensitivity analysis, model calibration and verification
- ♪ contaminant transport modeling
- ♪ capture zone analysis

Course Instructors include Graham E. Fogg, Ph.D., Thomas Harter, Ph.D., and Peter Schwartzman, M.S. The

Course will be at the University of California, Irvine Learning Center, 200 S. Manchester Avenue, Orange, CA 92868, 714-456-8783. For more information, contact Mary Megarry at GRA, [mmegarry@nossaman.com](mailto:mmegarry@nossaman.com) or 916-446-3626, and visit GRA's Web site at [www.grac.org](http://www.grac.org). ♪

## Mark Your Calendar!

### GRA Legislative Symposium and Lobby Day

March 29, 2006  
At the Capitol – Sacramento, CA

### Groundwater Quantity, Quality and Quid Pro Quo – What Trade-offs will be Required to Ensure Funding for Vital Groundwater Programs?

Full agenda and detailed information at [www.grac.org](http://www.grac.org) or call 916-441-1232

# Wells and Words

BY DAVID W. ABBOTT, P.G., C.H.G.

## Aquifer tests in low-yield and fractured rock aquifers — Can they be successful?

One may hear from drilling contractors, regulators, or professional colleagues that aquifer tests conducted in fractured rock environments are somehow different, cannot be performed effectively, or require more sophisticated models (i.e., a double porosity model) to solve for aquifer parameters. The performance and analysis of hundreds of pumping tests in both alluvial and bedrock environments by the author has resulted in relatively few problems in applying simple and standard well and hydraulic equations to drawdown and discharge

testing methodologies, especially from over-pumping the well, which usually accounts for the cause of most logistical problems. For single well pumping tests, the analytical models available for analysis are the Cooper-Jacob (time-drawdown straight-line) method and the more rigorous Theis analysis (curve matching) using the well function. The Theis analysis and its variants (including the double porosity model and the Cooper-Jacob method) require measurement of water levels in observation wells if all aquifer parameters are to be defined during the pumping test. Indeed, it is rare to have a responsive observation well, particularly in fractured rock aquifers. Figure 1 shows such a rare example.

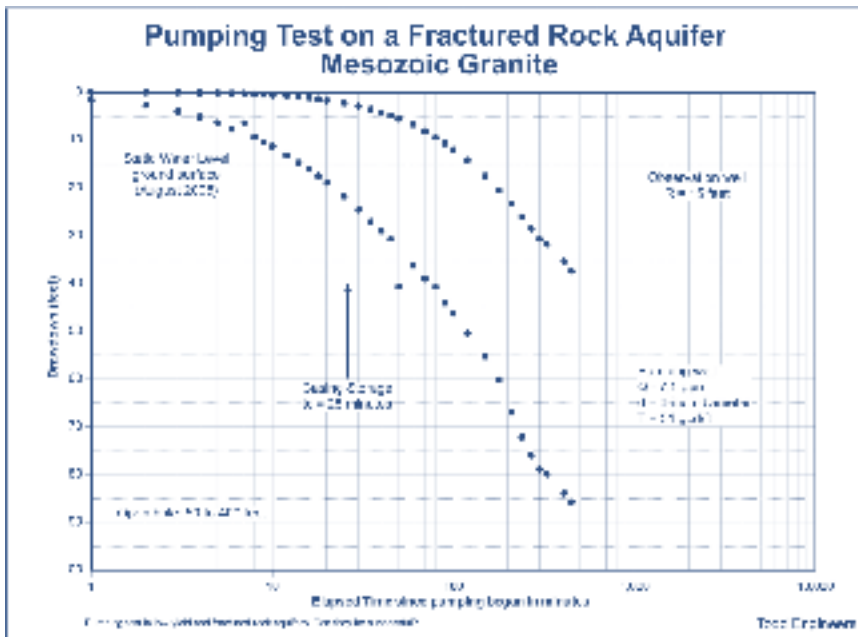


Figure 1.

data, particularly in low-yield aquifers. However, there can be plenty of logistical problems in conducting pumping tests in bedrock aquifers.

Most perceived problems encountered in the analysis of fractured rock test data are due to the improper and misunderstood application of field

Reconnaissance-level or preliminary pumping tests can be conducted in a variety of ways including bail, open bottom, constant drawdown on flowing artesian wells, and air-lift tests. These methods are inadequate for establishing long-term well yields, but are helpful in determining the proper size of a test

# Technical Corner

pump. All production wells that are planned for reliable and consistent use should be properly tested using methodical and standardized aquifer-testing methods. A recent study for eastern Madera County, California indicated that accurate discharge measurements from air-lifting methods in fractured rock aquifers are difficult to achieve, typically overestimating flow rates by 50 to 75 percent and thus overestimating the long-term well yields.

Formal aquifer testing is important because it provides estimation of aquifer parameters including the transmissivity (T-value), storativity (S-value), hydraulic conductivity (K-value), and leakage of the aquifer. These aquifer parameters describe mathematically the cone-of-depression surrounding the well, and predict long-term well yields and performance. A single well pumping test can only be used to estimate the T-value and K-value. The specific capacity (SC), affected by well efficiency, is used to independently assess the reliability of the measured T-value.

For example, during a pumping test, if the  $SC_{24 \text{ hour}}$  of the well is 2 gpm/ft of drawdown then the expected transmissivity should be roughly 3,000 gpd/ft for an unconfined aquifer to 4,000 gpd/ft for a confined aquifer (Groundwater and Wells, Driscoll, 1986). If independent calculations from the time-drawdown curve using Cooper-Jacob (or Theis) indicate that the T-value is 10,000 gpd/ft, one should suspect that either that the well is roughly 35 percent efficient or the cone-of-depression has intercepted a discharge (barrier) boundary (which should be recognizable on the time-drawdown curve). If, on the other hand, calculations from the drawdown curve indicate that the T-value is 500 gpd/ft, then the cone-of-depression has intercepted a recharge boundary. In

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## Water Well Log Poll

In October 2005, GRA conducted a poll of the membership consisting of three questions, all related to water well log information. Approximately 25 percent of the membership responded to the poll, which is the highest response GRA has ever had. Results of the poll are:

1. Should water well log information be considered confidential in California?

10% Yes  
89% No  
1% No response

2. In the future, should water well log reporting requirements be revised to require electronic reporting and accurate geographic position coordinates of the well location?

82% Yes  
18% No

3. Should reporting requirements and standards for water wells, cathodic protection wells, groundwater monitoring wells, and geothermal heat exchange wells in California be revised to improve the usefulness, quality and usability of the information being collected (hydrogeologic, location, etc)?

87% Yes  
11% No  
2% No response

Based on the results of the survey, the majority of the membership would support making water well log information available to the public, and standardizing and improving electronic reporting requirements. 💧

## California Legislative Corner

### Sacramento Legislative Update

BY CHRIS FRAHM AND PAUL BAUER, HATCH & PARENT

Welcome, Hydrovisions Readers, to this kick-off edition of the Legislative Corner for the second year of the 2005-2006 Legislative Session. A year ago, we doubt many people would have imagined the turn of events that would lead to Susan Kennedy's emergence as a power player in the Schwarzenegger Administration, or to the Governor's announcement of a \$220 Billion investment (or "spending," depending on your orientation) program. We live in "interesting times," to say the least. And, if the first 3 weeks of Session are any indication, 2006 promises to be a year of historic activity in Sacramento!

Due to space constraints in our newsletter, we have abbreviated this article; you are encouraged to read the full version on our website, [www.grac.org](http://www.grac.org).

#### Governor's Strategic Growth Plan and Proposed Budget, Water and Infrastructure Bonds

The Legislature reconvened on January 4; the next day, Governor Schwarzenegger delivered his State of the State address. Following the failure of his special election initiatives, the Governor struck a conciliatory tone, and pledged to cool the partisan rhetoric and work with the Legislature to resolve the problems facing California. The centerpiece of the Governor's speech was his announcement of a "Strategic Growth Plan." Among other things, the plan outlines the first 10 years of a 20-year vision to increase the state's water supply in order to serve an additional 8.5 million people. This ambitious, \$220 Billion

*Ten-Year Infrastructure Plan* calls for more schools, roads and investment in water supply reliability and flood protection.

The Governor's water bond proposals are contained in *AB 1839 (Laird)* and *SB 1166 (Aanestad/Machado)*. The legislation would place a \$3 billion general obligation (GO) bond before voters in 2006 and a \$6 billion GO bond on the ballot in 2010 to support integrated regional water management and for water and flood control improvements. The bills also create a controversial *Water Resource Investment Fund (RIF) to be collected by all retail service providers*, which is intended to provide a long-term stable funding source for investment in California's water infrastructure currently estimated to produce revenues of \$380 million per annum. "Subject matter" hearings began last week in the Senate Natural Resources and Water Committee (NRWC) and Assembly Water, Parks and Wildlife Committee (Assembly WPW); in this hearing process, the authors will not present bills and no formal amendments will be taken. Some of the significant areas of concern that have been expressed thus far by members of the Legislature and various stakeholders include issues of designating the RIF "fee" or "tax" (Republicans have vowed not to raise taxes), separation of powers (some of the programs may be enacted without explicit approval by the Legislature), oversight and transparency, and lack of clear responsibilities at the local, state and federal level.

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# Federal Legislative/Regulatory Corner

## US EPA Groundwater News

BY JOHN UNGVARSKY, EPA

### Case Studies of Local Source Water Protection Programs

EPA's Office of Ground Water and Drinking Water has compiled examples of good local source water protection programs, representing a variety of approaches to protecting diverse sources of drinking water supplies for a range of beneficiaries. To view the examples, go to <http://www.epa.gov/safewater/protect/casesty/index.html>.

### 2003 Drinking Water Infrastructure Needs Survey and Assessment

Every four years EPA conducts a survey of water utilities to determine investments needed to deliver safe drinking water, with the results then reported to Congress. The results are used to help determine the amount of funding each state receives for its Drinking Water State Revolving Fund program. EPA found that the nation's 53,000 community water systems and 21,400 not-for-profit noncommunity water systems will need to invest an estimated \$276.8 billion between 2003 and 2023! For more information, go to <http://www.epa.gov/safewater/needssurvey/index.html>.

### Drinking Water and Groundwater Statistics

Got groundwater statistics? Check out the latest version of *Drinking Water and Ground Water Statistics for 2004* (aka, Factoids) at [http://www.epa.gov/safewater/data/pdfs/data\\_factoids\\_2004.pdf](http://www.epa.gov/safewater/data/pdfs/data_factoids_2004.pdf).

### GAO Study of Remediation Technologies used by DOD

The U.S. Government Accounting Office (GAO) has released its study of remediation technologies used by Department of Defense (DOD) to clean up groundwater contamination at military sites. DOD has identified nearly 6,000 sites that require groundwater remediation, and invested \$20 billion over the past 10 years, relying primarily on "pump-and-treat" technologies; however, long cleanup times and high costs often make them expensive and ineffective for groundwater remediation. To view the study, go to <http://www.gao.gov/new.items/d05666.pdf>.

### Perchlorate Treatment Technology Update

A number of issues associated with perchlorate contamination are being discussed by interested parties; these issues include health effects and risks, regulatory standards and cleanup levels, degradation processes, and treatment technologies. EPA's Federal Facilities Forum has prepared an issue paper that provides information about technologies available for treatment of perchlorate contamination in environmental media. For more information, go to <http://www.epa.gov/tio/download/remed/542-r-05-015.pdf>.

### Roadmap to Long-term Monitoring Optimization

This EPA and the U.S. Army Corps of Engineers document focuses on optimization of established long-term monitoring programs for groundwater.

Tools and techniques discussed concentrate on optimizing the monitoring frequency and spatial distribution of wells. For more information, go to: [http://www.clu-in.org/download/tech-drct/td\\_ltmo\\_roadmap.pdf](http://www.clu-in.org/download/tech-drct/td_ltmo_roadmap.pdf).

### USGS Patents the Multifunction Bedrock-Aquifer Transportable Testing Tool

The U.S. Geological Survey has designed, constructed, and patented a Multifunction Bedrock-Aquifer Transportable Testing Tool (BAT3). BAT3 is designed to conduct tests that measure the permeability of fractures and collect water samples for geochemical analyses from fractured-rock aquifers. The BAT3 has the ability to conduct multiple types of hydraulic tests, geochemical sampling, and tracer tests; to monitor the operational integrity of tests; and to conduct real-time data analysis and visualization. View information at <http://toxics.usgs.gov/highlights/bat3/>.

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## EDB and EDC: Still Phasing Out After All These Years

BY BART SIMMONS

**1**, 2-Dibromoethane (EDB) and 1,2-Dichloroethane (EDC) have long received attention as environmental contaminants originating from gasoline or pesticide formulations. Although both uses have been phased out, the legacy contamination continues. EDB and EDC were routinely used as lead scavengers in leaded gasoline. Although they were eliminated with the phase-out of leaded gasoline in the 1980s, they still persist in groundwater. Lead in the form of tetraethyl lead or tetramethyl lead is still used in aviation gas, and EDB is still used as a lead scavenger.

Nationwide, EDB and EDC are among the most common contaminants in groundwater used as drinking water. EDB has been found associated with 1, 2-Dibromo, 3-chloropropane (DBCP), a fumigant mixture, which has contaminated groundwater through agricultural use as well as releases from burial of waste pesticides and container leaks. Nationally, however, >80% of the use of EDB was as a gasoline additive (Ref). EDC contamination resulted from leaks and disposal of waste industrial solvents.

Nevertheless, only a small percentage of leaking underground fuel tank (LUFT) sites tested nationally have been tested for EDB or EDC. Although most states typically require testing of LUFT-contaminated groundwater with EPA Methods 8021 or 8260, EDB and EDC are not necessarily included in the target list of analytes. As discussed here in a previous column, you only get what you ask for; commercial labs will generally only report compounds which

are explicitly on a target compound list. EPA 8260 uses gas chromatography-mass spectrometry (GC-MS) and can identify non-target compounds, but commercial labs typically won't report non-target compounds unless specifically requested. A common problem is that samples will be diluted to measure BTEX, and the detection limits for EDB and EDC will be raised as a consequence. Selected ion monitoring can lower detection limits in sites where necessary, if requested in advance.

In California, LUFT testing is dictated by the Regional Water Quality Control Boards, so testing may vary from Region to Region. However, since the early days of California LUFT testing, EDB and EDC were included as targets in the "LUFT Manual."

EDB and EDC both have significant water solubility, and can therefore partition into groundwater along with BTEX and other water-soluble gasoline components. A study done by the Lawrence Livermore National Labora-

tory concluded that LUFT plumes, as measured by benzene, tend to stay the same or shrink with time. However, the behavior of EDB and EDC plumes is less certain. Three sites in Massachusetts have EDB completely separated from the BTEX-defined plumes (1), raising concern that EDB may be more persistent than BTEX in LUFT-contaminated media. EDB and EDC are both considered probable human carcinogens, and EDB is a very potent animal carcinogen. EDB and EDC have maximum contaminant levels (MCLs) of 0.05 and 5 ug/L, respectively.

Although EDB and EDC releases have been identified for decades – particularly in California – a better understanding of EDB and EDC behavior is needed to assess the long-term risks.

(1) Falta, Ronald W. *et al*, "Leaded-Gasoline Additives Still Contaminate Groundwater," *Environ. Sci. Technol.*, Vol. 39, No 18, 2005, 379A-384A.

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



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## 2005 ACWA Fall Conference — Groundwater Highlights

BY MARTIN STEINPRESS,  
BROWN AND CALDWELL, AND  
JON ROHRER, KOMEX

Groundwater issues were prominent at the Association of California Water Agencies' (ACWA) Fall Conference and Exhibition in San Diego on November 29-December 2, 2005. More than 230 people attended the GRA co-sponsored pre-conference workshop, "Water Resources Management and Growth: California at a Crossroads." The workshop highlighted the linkage between population growth, land use and urban planning, and water supply and the growing need for planners and water suppliers to work together more, both for land-use planning and water supply planning. In particular, the critical role that groundwater serves as part of a strong and stable water-supply portfolio was analyzed. Additionally, the future of groundwater recharge and/or storage and the connection between land-use planning and water quality were discussed. It is hoped that versions of this workshop will be organized in conjunction with ACWA and GRA's co-sponsors (the League of California Cities and the California Chapter of the American Planning Association), at some of their group meetings.

The Groundwater Track included "Cleaning up without a Suit (A Lawsuit, That Is)" The session, moderated by Sanford Kozlen, Director, Carmichael Water District, focused on the approaches and lessons learned by the Carmichael and Fair Oaks Water Districts in dealing with chlorinated

*Continued on page 19*

## Alliance Corner

### Groundwater Professionals Fill Vital Role in Public Awareness

BY CLIFF TREYENS, DIRECTOR OF PUBLIC AWARENESS,  
NATIONAL GROUND WATER ASSOCIATION  
NATIONAL GROUND WATER AWARENESS WEEK / MARCH 12-18, 2006

You can hear desperation in the words of private well owners searching for information. That's a cue for groundwater professionals everywhere. As the experts, you can help educate private well owners and the public at large about important issues from groundwater protection to the importance of well maintenance and water testing. Consider helping in this effort during National Ground Water Awareness Week on March 12-18, 2006. If you've never been involved in promoting groundwater awareness before, here are some tips based on actual public inquiries to the NGWA through its consumer Web site, [www.wellowner.org](http://www.wellowner.org).

#### Awareness Week Tip 1:

**There are no dumb questions.**

*"Please don't think I'm stupid, but I don't know anything about wells."*  
– Terri to Wellowner.org.

Most consumers probably feel ignorant about groundwater and wells. Help inform them and find a way to share your expertise in your community. Visit a school. Submit a short article to your newspaper. Provide some tips about well maintenance and water testing on a local radio program. Give a talk to a local group.

#### Awareness Week Tip 2:

**Team up with other organizations or professionals to get the word out.**

*"I'm so grateful to have found your wonderful Web site. It's answered so many of my questions and, as a Realtor in an area where 99 percent of the homes I sell have well water, I now recommend it to practically all my customers."*  
– Kathy to Wellowner.org

There are many potential public awareness partners in your service area; consider providing them with NGWA's series of "Clip and Copy" articles, which provide practical well and groundwater information. These articles include a space where you can attach your business card. You can download them off the NGWA.org web site at this page address: <http://www.ngwa.org/publication/wwj/clip.cfm>.

#### Awareness Week Tip 3:

**Don't reinvent the wheel.**

*"What a great web site. It gives great information without too much technical jargon to wade through. It was so helpful in guiding me in what to look for in my well water tests and who to look for when attempting to correct our problems."*  
– Carla to Wellowner.org

*Continued on page 19*

# Organizational Corner

## GRA Extends Sincere Appreciation to its Co-Chairs and Sponsors for its December 2005 *Groundwater Contaminants Series Symposium*, "DNAPL Source Zone Characterization & Remediation"

### Co-Chairs

Bettina Longino,  
Geomatrix Consultants, Inc.  
Sarah Raker, MACTEC

### Co-Sponsors

ARCADIS

Daniel B. Stephens & Associates, Inc.  
Geomatrix Consultants, Inc.  
GeoSyntec Consultants  
Locus Technologies  
Malcolm Pirnie, Inc.  
Thermal Remediation Services, Inc.

### Luncheon Sponsor

Liquid Boot® - LBI Technologies, Inc.

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Precision Sampling, Inc.

## GRA Extends Sincere Appreciation to its Co-Chairs and Sponsors for its January 2006 *Groundwater Contaminants Series Symposium* "Perchlorate 2006: Progress Toward Understanding & Cleanup"

### Co-Chairs

Tom Mohr, Santa Clara  
Valley Water District  
Jon Rohrer, WorleyParsons Komex

### Co-Sponsors

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### Luncheon Sponsors

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Santa Clara Valley Water District

## GRA Requests Nominations for Lifetime Achievement Award and "Kevin J. Neese Award"

The purpose of the GRA Awards Program is to recognize noteworthy projects and unique individual contributions related to the protection and management of groundwater in California. Please send nominations for the awards to Brian Lewis: [admin@grac.org](mailto:admin@grac.org). Nominations should not exceed one page and include the justification for the award based on the criteria listed below. Nominations are due by June 1, 2006, and will be presented at GRA's 2006 Annual Meeting in September.

The objectives of the Annual Awards Program are:

1. To provide recognition to individuals who have demonstrated leadership

and continuous dedication in the field of groundwater management;

2. To provide recognition for unique contributions to the field of groundwater management in 2005-2006.

### Awards

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

*Continued on Page 22*

## Renew Your Membership Online - It's Quick and Easy

If you haven't already, it's time to renew your GRA membership for 2006. You can renew online via GRA's Web site, [www.grac.org](http://www.grac.org), or you can request a hard copy dues renewal invoice from Kevin Blatt at [kblatt@ihappi.com](mailto:kblatt@ihappi.com). To save time and effort, GRA recommends that you renew online as the process is secure and seamless. It will also help GRA to keep related expenses to a minimum.

With nearly 1,200 members at the end of 2005, the goal of having 1,350 members by the end of 2006 is attainable. To make this happen, please renew your membership and recruit one new member to GRA. Recruiting a new member is a way to introduce your colleagues to a credible, innovative organization that provides many benefits for only \$95.

Thank you for your interest and continued participation in protecting and improving California's groundwater resources. 💧

# 2006 Contributors to GRA — Thank You

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Hatch and Parent  
Roscoe Moss Company

## Patron (\$500 - \$999)

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Jerry Shilo  
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David Tompkins  
Susan Trager  
David Tucker  
Joe Wells  
William Zavora

# Organizational Corner

## Groundwater Extractions

BY MARTIN STEINPRESS, GRA COMMUNICATIONS CHAIR

### Dudley Makes Move

**T**occoy Dudley, formerly with the Department of Water Resources' Red Bluff office, is the new Director of the Butte County Water and Resource Conservation Department. While at DWR, he worked on groundwater projects in Butte, Glenn and Tehama counties, including studies of the deep Tuscan aquifer. He replaces Ed Craddock, who has retired.

### Professional Geologist Tasks

The electronic version of the National Association of State Boards of Geology (ASBOG publication: "Tasks of a Professional Geologist" is available at <http://www.asbog.org/documents/FINAL%20ASBOG%20TASK%20LISTING%20BROCHURE.pdf>.

### DTSC is Hiring

The Department of Toxic Substances Control is examining and hiring geologists with skills and knowledge in environmental cleanup, hydrogeology, geophysics, bioremediation, and faulting/seismic ground motion evaluations. For information, contact (916) 322-8669. After March 17, the exam announcement and state application (form 678) may be downloaded at <http://www.dtsc.ca.gov/Employment/> and the final filing date is April 7th, 2006 (Submitted by Brian Lewis: [blewis@dtsc.ca.gov](mailto:blewis@dtsc.ca.gov))

### Does Maine Get a Cut of Water Sales?

A Maine group has launched a citizen's initiative to impose what is believed to be a first-in-the-nation tax on the water that companies extract and sell from the state's aquifers. It's on pace to be placed on the ballot this fall. As the market grows for bottled water, already a \$10 billion industry, the group maintains that access to water is among the most pressing issues of this century, and that the windfall reaped by bottling companies should be more evenly distributed. After all, they say, water belongs to everyone, and more controls would ensure sustainability. But critics worry that the initiative unfairly targets Poland Spring, the largest bottler in the state (The Christian Science Monitor, December 14, 2005 edition - <http://www.csmonitor.com/2005/1214/p01s03-usec.html>). 💧

## GRA'S 2005 ANNUAL FINANCIAL STATEMENT IS NOW ONLINE.

TO REVIEW THE  
STATEMENT, PLEASE GO  
TO THE GRA WEB SITE at  
[www.grac.org/financials](http://www.grac.org/financials)

# GRA Welcomes the Following New Members

JULY 21, 2005 THROUGH JANUARY 31, 2006

Ackerman-Taylor, Lisa	ENVIRON	Jackson, Richard	INTERA Inc.
Albright, David	US EPA	Janowiak, Matt	ETIC Engineering, Inc.
Al-Ekabi, Hussain	Science & Technology Integration, Inc.	Jasper, Robert J.	Tehachapi-Cummings CWD
Angela, Liang Hanchih	URS Corporation	Jolitz, Kimberly	Johnson Wright, Inc.
Baker, Stephen J.	HydroSolutions of CA	Joyce, Bob	LeBeau-Thelen, LLP
Ball, Joanie	Iris Environmental	Jung, Warren	Sacramento Suburban Water District
Barnes, Michael	MACTEC	Kang, Jim	URS Corporation
Barton, Leonard	Autoliv	Karlstrand, Tim	Carollo Engineers
Beard, Mitchell	EarthSoft, Inc.	Kawakami, Brett	RMC Water and Environment
Berrington, Mike	ENSR International	Kenney, Christine	Bookman-Edmonston
Bowers, Karl	The Source Group, Inc.	Kim, B. Tilden	Richards, Watson & Gershon
Bradner, Graham	Bookman-Edmonston	Kresse, Don	Condor Earth Technologies, Inc.
Britt, Sanford	ProHydro, Inc.	Kubit, Owen	Provost and Pritchard Engineering Group, Inc.
Callahan, Dennis	The Source Group, Inc.		Metropolitan Water District
Cantwell, Alex	Technicon Engineering Services, Inc.	Kunysz, Kathy	Veolia Water
Carr, Melanie	West Yost & Associates	Lambeth, Jeff	Geomatrix Consultants, Inc.
Carroll, Daniel	Kleinfelder	Lauenroth, Mandy	CA Dept. of Water Resources
Cechini, Tim	WDC Exploration & Wells	Lee, Chang	Shaw E&I
Christensen, Kent	Ducommun AeroStructures	Leigh, Dan	The Source Group, Inc.
Cline, Martin	BSK Associates	Lizee, Ted	Lombardo Associates, Inc.
Colby, Norman	CGC Environmental, Inc.	Lombardo, Pio	URS Corporation
Cone, David	Kings River Conservation District	Louie, Stacy	Hanson Bridgett
Copeland, Teri		Makus, Eli	Kennedy/Jenks Consultants
Courtney, John	Girardi and Keese	Maley, Michael	SAIC
Crooks, John	TAM International	Manheimer, Kelly	ETIC Engineering, Inc.
Daniels, Marco	WDC Exploration & Wells	Mankad, Vibhav	Johnson Wright, Inc.
De Loera, Jose		Marsden, Michael	Briscoe Ivester & Bazell, LLP
Dihm, Henry	Earth Tech	Marsh, Christian	The Source Group, Inc.
Douglas, Rosalind	CDM	McCabe, Steve	Calgon Carbon Corporation
Duffy, Michael	Santa Clara Valley Water District	McClure, Andrew	The Source Group, Inc.
Filippi, David	Stoel Rives LLP	McGowan, Mark	LFR Levine-Fricke
Formosa, Ed	Sacramento Suburban Water District	McIlvaine, Lee	
Fostersmith, Ellen		McPherson, Michael	Leighton Consulting, Inc.
Fuerst, Darby	Monterey Peninsula Water Management District	Middleton, Greg	H2O Engineering, Inc.
	GeoSyntec Consultants	Moncrief, Robert	Iris Environmental
Gallinatti, John	Geomatrix Consultants	Montag, Mike	West Yost & Associates
Gandhi, Deepa	Mojave Water Agency	Nakano, Gerry	Dominion Environmental, LLC
Garcia, Anna	Los Angeles County Sanitation Districts	Newsom, Steven	MWH
Gasca, Monica	University of San Francisco	Nyquest, David	CDM
Giri, Sabina	ENSR International	Nyznyk, John (Yash)	PLANTECO Environmental Consultants, LLC
Goldsmith, Bill	Earth Tech	O'Niell, Walter	Richards, Watson & Gershon
Gonzales, Rangel	LFR Levine Fricke		GeoSierra
Greisler, James	Los Angeles County Sanitation Districts	Orr, Steven	FMC Corporation
Guerrero, Francisco	ENVIRON International Corporation	Ortman, James	
Haroun, Lynne	Principal Resource Group	Osborne, Linda	
Havard, Pat	Erler & Kalinowski, Inc.	Pacetti, John	
Hebert, Craig	Maxxam Analytics	Pardini, Chuck	LFR Levine-Fricke
Henige, Paul	Weber, Hayes and Associates	Parrott, Chip	U.S. Bureau of Reclamation
Hoban, Pat	CH2M Hill	Parton, Craig	Price, Postel & Parma
Hodges, Alan	Clayton Group	Payne, Fred	ARCADIS
Hoening, Dwight	Hokkanen Environmental LLC	Perini, Clifford	SOMA Environmental Engineering
Hokkanen, Gary		Pierno, Roger	Santa Clara Valley Water District

Potts, Dave  
Proctor, Genevieve  
Quinlan, Peter  
Quinn, Nigel W.T.  
Ragan, Brian  
Rahman, Khaled  
Rao, Kate  
Richards, Curt  
Sawyer, Gao  
Schmidt, Thomas  
Schnabel, Ron  
Sellers, Karen  
Share, David  
Shilo, Jerry  
Shipman, Dorinda C.  
Shively, Kelly  
Skaggs, Jonathan  
Smallbeck, Donald  
Smith, Shaun  
Smith, Jr., W. Richard  
Soo Cho, Jong  
Stelljes, Mark  
Sueker, Julie  
Swensen, Daniel  
Thorne, John  
Villeneuve, Thomas  
Vince, Robert  
Wang, Wenbin  
Warren, John  
Werner, Matt  
White, Dawn  
Wiegand, Bettina  
Williams, Dean  
Wilson, Bob  
Wincele, Demian  
Woolley, Sara  
Yeazell, Jeffrey  
Zimmer, Rick

Wayne Perry, Inc.  
Iris Environmental  
Dudek & Associates, inc.  
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Geomatrix Consultants, Inc.  
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Law Offices of Thomas P. Schmidt  
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Treadwell & Rollo, Inc.  
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MACTEC  
TSC Group, Inc.  
Robinson & Cole, LLP  
GGT Waste  
SLR International Corp  
Blasland, Bouck & Lee  
The Source Group, Inc.  
Capitolink LLC  
Tetra Tech, Inc.  
Brown & Caldwell  
Wildermuth Environmental, Inc.  
ENSR International  
Earth Tech  
Golden State Water Company  
GES - Stanford University  
WDC Exploration & Wells  
ENSR International  
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## 2006 Director Election Results

The election for GRA's 2006 Board of Directors is officially completed. Board incumbents Vicki Kretsinger, Brian Lewis and William Pipes were re-elected. Dr. Jean Moran was elected as a new member of the Board. All Directors elected in 2006 will serve three-year terms ending in 2008.

GRA extends its sincere appreciation and best wishes to Jim Carter who retired from the GRA Board of Directors at the end of 2005. 💧

removal. In the second keynote presentation, The DNAPL Source Remediation Challenge: Where are We Today?, Dr. Michael Kavanaugh of Malcolm Pirnie walked participants through six “phases” of evolution of the DNAPL remediation challenge, from “DNAPL denial” in the 1970s and 1980s, to realization of the myriad technical limitations in remediating source zones and the subsequent introduction of Technical Impracticability waivers, to the implementation of new technologies and metrics for source zone characterization and remediation. Looking to the future, Dr. Kavanaugh encouraged participants to continue efforts to quantify and reduce uncertainties regarding remediation effectiveness, risk, and cost-benefit relationships.

Presentations in the subsequent general sessions highlighted a number of ongoing challenges faced by practitioners attempting to characterize and remediate DNAPL source zones, including:

- time scales for formation and remediation of source zones;
- impact of heterogeneity on source zone architecture and persistence;
- appropriate metrics for field characterization and monitoring; and
- level of uncertainty in source zone conceptual models.

Session platform speaker Dr. Bernard Kueper of Queen’s University initiated the time scales discussion with a talk on remediation concepts in fractured rock. He presented compelling research findings on the importance of reverse diffusion in these settings, demonstrating the very long time scales required for remediation, even with short exposure to contamination. Dr. Jason Gerhard of the University of Edinburgh continued the time scales discussion with a very informative talk on factors affecting the length of time required for a DNAPL release to stop moving. He presented numerical model results demonstrating migration time scales of weeks to centuries in a sandy aquifer, depending on DNAPL type.

Moving from the site scale to the pore scale, Dr. Walt McNab of Lawrence Livermore National Laboratory spoke about the importance of a detailed understanding

and fine-scaled quantification of DNAPL mass transfer for accurately simulating flow and transport at the larger scale, and for predicting both plume source area persistence and cleanup times. Dr. Beth Parker of the University of Waterloo echoed the importance of scale of characterization in her information-packed evening keynote: Insights from Field Studies Regarding the Nature of Chlorinated Solvent Source Zones in Sandy Aquifers. She emphasized the importance of heterogeneity – especially permeability variations – in determining source zone architecture, spatial complexity, and plume evolution behavior, and demonstrated that spatial resolution of high concentration mass/flux “bull’s eyes” requires detailed characterization at a very small scale. As this scale of characterization is infeasible for most sites, source zone mass estimates will almost always carry a high degree of uncertainty.

Day 2 started with two talks focused on mass discharge, or flux, as a metric for field characterization and monitoring. Session platform speaker Murray Einarson of Geomatrix Consultants provided an overview of the practical aspects of measuring contaminant mass discharge in the field, including the use of transects of single and multi-level wells to provide mass discharge “snapshots” within the plume and the use of down-well flux meters capable of integrating local mass discharge over a period of time. Dr. Elizabeth Edwards of the University of Toronto also used mass flux as a metric for changes in a DNAPL source, in this case demonstrating enhanced DNAPL dissolution following bioaugmentation of a PCE source zone. Later in the day, Dick Jackson of INTERA summarized seven years of source zone characterization and remediation at Hill Air Force Base in Utah, again using mass flux as a metric for success. Carmen Lebrón of the Naval Facilities Engineering Service Center (NFESC) furthered the discussion of mass-based versus concentration-based metrics in her presentation of the results of an NFESC survey conducted to compare and evaluate performance of DNAPL source remediation technologies. The

survey identified mass removal, mass flux, rebound, and user perception as metrics of success, rather than MCLs or site closure.

Peter Mesard of Exponent underscored the importance of adopting an internally consistent and comprehensive conceptual site model at sites potentially containing a DNAPL source zone, especially when evaluating seemingly anomalous or inconsistent data results. Uncertainty in source

---

*Source zone mass estimates will almost always carry a high degree of uncertainty*

---

zone conceptual models also was addressed in two poster presentations focused on DNAPL delineation methodology. Lucas Goldstein of LFR Levine-Fricke presented results from lab-scale experiments in which X-ray-computed tomography (or “CT scan”) was used to visualize and quantify DNAPL in porous media. Dennis Goldman of TetraTech presented field-scale techniques for source zone characterization, including soil vapor surveys, soil core sampling, cone penetrometer testing, geologic logging, direct push technology, groundwater and soil sampling, groundwater monitoring well sampling, and in situ microbial testing.

The latter part of the symposium focused on remedial technologies and remediation performance assessment. Presenters introduced attendees to new tools and technologies for source zone remediation, and demonstrated evidence of successful applications of established dissolved-phase remediation technologies. Platform speaker Dr. Tom Sale of Colorado State University launched the third session with an informative talk on ZVI-Clay, a novel in situ remediation technology that involves the use of conventional soil mixing equipment to deliver an admixture of reactive media (ZVI) and stabilizing agents (clay) to impacted soil. Two field-scale demonstrations have shown significant depletion of chlorinated compounds in the treated zone, as well as reduced flux from the treated zone due to reduced hydraulic conductivity resulting from the soil mixing process. Suzanne O’Hara of GeoSyntec Consultants also discussed the application of ZVI (in this case emulsified ZVI, or EZVI) technology for reducing both

aqueous concentrations and DNAPL mass in DNAPL source zones. Dr. Julie Konzuk of GeoSyntec Consultants introduced a new remediation screening tool currently being developed under the Environmental Security Technology Certification Program (ESTCP). The tool is intended to aid users in determining a site-specific remedial approach by providing expected remedial performance data based on site characteristics, preference for remedial approach, and performance metrics.

The symposium included a number of talks and poster presentations describing specific remedial approaches for DNAPL source zones, including bioremediation, in situ chemical oxidation, and thermal technologies. To conclude the discussion, Gorm Heron of TerraTherm presented a critical review of the practical application of three thermal remediation technologies – electrical resistive heating (ERH), steam-enhanced extraction (SEE), and in-situ thermal destruction (ISTD) – and educated attendees on common mistakes to avoid when designing and implementing thermal remediation at sites with DNAPL source areas.

Dr. Fred Payne of ARCADIS fittingly concluded the symposium speaker presentations with a summary talk on sources of DNAPL persistence and post-treatment rebound, while the closing panel discussion focused on the value of partial mass removal. The panel was moderated by Avram Frankel of ARCADIS and included Dr. Payne, Richard Jackson, Dr. Beth Parker, Dr. Tom Sale (all symposium presenters), and Paul Hadley of the California DTSC. Although the title of the panel was Partial Mass Removal: Is It Worth It?, the discussion and question period encompassed many of the recurring topics of the symposium: remediation time-frames, performance metrics, evaluation of uncertainty, and the practicality of achieving MCLs. Participants discussed the definition of “success” in the restoration of a DNAPL-impacted resource, with particular emphasis on the regulatory context. This final discussion provided a perfect summation for the two-day symposium, reminding us all of the ongoing challenges facing DNAPL practitioners and of the importance of maintaining an open and

constructive dialogue among stakeholders. This symposium was certainly a step forward along that path.

A binder with copies of speakers’ slides and a list of references on various aspects of DNAPL behavior, characterization, and remediation was produced for the symposium. For a copy of the binder and information about other GRA programs, please go to [www.grac.org](http://www.grac.org) or call GRA’s main offices in Sacramento at (916) 446-3626.

*Bettina Longino is a Senior Consultant with Geomatrix Consultants, Inc., and is now based in Ontario, Canada. Prior to leaving the Bay Area in 2005, she served as a technical advisor for the San Francisco Bay Branch of GRA. ♪*

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## President's Message — Continued from Page 2

memorable conference in San Francisco. Bettina led the DNAPL team from her new home in Canada, and was assisted by the ubiquitous Sarah Raker. Our first event of the New Year, Perchlorate 2006, is also being run by a new leader – Jon Rohrer of Worley-Parsons-Komex. The omnipresent, if not omnipotent, Tim Parker also led GRA's Legislative Committee, with the sage advice of Hatch and Parent's Chris Frahm, whose peripatetic presence in the halls of the Capitol is daunting (start your jogging program now to keep up with her on GRA's March 29th Lobby Day!).

We are fortunate that the Editor of this fine publication, Floyd Flood, has agreed to continue for another year. GRA's website continues to grow under continuing and dynamic management by our Communications Chair, Martin Steinpress of Brown and Caldwell, and the able design and administration by our webmaster, Kevin Blatt. Our finances have been ably managed by Bob Van Valer of Roscoe Moss. GRA would not be half of what it is but for the excellent services provided

by our Executive Director, the insightful Kathy Snelson, and her stalwart Program Administrator, Mary Megarry.

We welcome Jean Moran of Lawrence Livermore Laboratories as GRA's newest Board member, and we are delighted that David von Aspern has agreed to serve as GRA's state-wide treasurer in 2006. I will be relying on the capable assistance of Jim Strandberg as Vice President, and the reliable support of Bill Pipes as Secretary, to help keep GRA thriving in 2006. We're also excited that GRA's San Diego members are opening a sixth branch of GRA, and we look forward to recruiting new members from the San Diego area to experience the benefits of participating in GRA.

Jim Carter, who served as GRA's President from 2002 through 2003, has opted to vacate his seat on the Board so that others may serve. We honor Jim for his fine leadership as GRA's 2002/2003 President, and his continuing contributions as a Director. We wish Jim well in his new pursuits, and we will continue to call on him for his insights.

Our programs for 2006 are described elsewhere in HydroVisions, and online. Keep checking our website at <http://www.grac.org> for the latest on our programs and schedules. As a volunteer organization, GRA is what you make it. I encourage you to get involved and participate in planning GRA's events, whether at the branch or statewide level, and I welcome your questions and suggestions. Please feel free to contact me at [tmohr@grac.org](mailto:tmohr@grac.org), or at 408-265-2607x2051. 💧

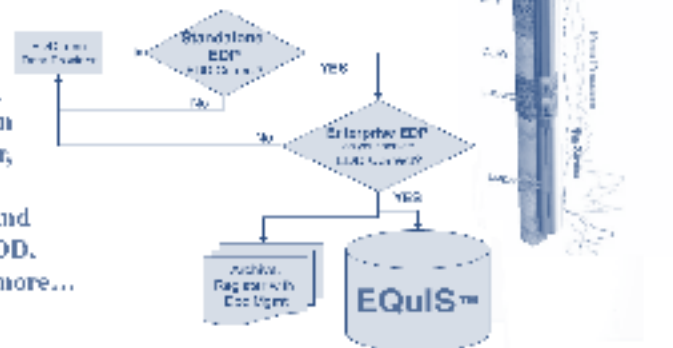
## EarthSoft

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less than 0.5% to solvent contamination, and that almost half of the groundwater contained in unconfined aquifers in Salinas Valley exceeded the drinking water MCL for nitrate. Perhaps even more alarming is the large fraction of public supply wells that do not exceed drinking water limits for nitrate, but nevertheless have elevated nitrate concentrations and can be considered to be “impacted” by anthropogenic activities. One-third of wells in the State, one half of wells in Santa Clara County, and two thirds of wells in Stanislaus County have reported maximum nitrate levels of between 18 and 45 mg/L as NO<sub>3</sub>, clearly impacted but below the MCL. How should these basins be managed to prevent loss of this water supply to nitrate contamination in the future?

Cities such as Fresno and Davis, which are in agricultural areas and rely solely on groundwater for their drinking water supply, manage nitrate contamination using a range of options from blending or treating water supplies to abandonment of wells. Onsite wastewater treatment systems, and municipal and industrial point sources, generally account for a small fraction of nitrogen inputs in most affected watersheds but may play a large role on a local scale. Regulators grapple with how best to influence the largest sources – fertilizer and manure applications. New waste discharge guidelines for irrigated agriculture and animal farming are being sought to better protect groundwater quality. Fertilizer use has not increased since the 1980s and averages approximately 600,000 tons per year with much of the fertilizer being used on 6 million acres of irrigated farm land in California. Land applications from animal farming are on the order of 60,000 tons per year. The agricultural community is improving irrigation and fertilizer management practices, particularly in crops with high nitrogen usage. Are current best management practices sufficient to protect groundwater? Should implementation of best management practices be monitored by the state or is local agency control or self-monitoring more efficient? How would such monitoring be best implemented and what are cost-effective reporting requirements?

In the meantime, scientists are employing new methods to characterize nitrate sources, including isotopic techniques and examination of co-contaminants, and are using sophisticated models for predicting nitrate fate and transport and assessing aquifer vulnerability. Is the current spread of nitrate the legacy of past management practices, or only the tip of the iceberg? For an in-depth update on these issues and questions, please join us in Modesto on April 4th and 5th where symposium topics will include:

- 💧 Nitrate occurrence in private domestic wells in shallow aquifers
- 💧 Impact of changes in land use (e.g., agricultural to urban) on nitrate source loading to aquifers
- 💧 Impact of artificial recharge on nitrate mobilization and denitrification
- 💧 Studies at the intersection of nitrate and salinity
- 💧 Watershed-based monitoring programs and TMDLs
- 💧 Best management practices for minimizing impacts to groundwater
- 💧 Optimal monitoring schemes
- 💧 Regional and long term risk assessment in deeper aquifers
- 💧 Implementation of Waste Discharge Requirements and Waivers for agricultural operations and irrigated lands
- 💧 Managing nutrients from food processing and dairy operations to minimize impacts to groundwater
- 💧 Advances in treatment technology and remediation of nitrate-impaired groundwater
- 💧 Nitrate management plan case studies & industry initiatives (e.g. California Dairy Quality Assurance Program)

For a complete agenda and information on registration, please go to [www.grac.org](http://www.grac.org). 💧

other words, the cone of depression has prematurely stopped expanding due to this recharge boundary, providing an SC<sub>24 hour</sub> that is greater than expected for the aquifer. It should be noted that an observation well is needed to accurately determine the pumping well efficiency.

Observation well and recovery data independently corroborate the results from the pumping well. The data collected from a properly situated and constructed observation well and recovery data from the pumping well are “cleaner” and less impacted by temporary (and sometimes uncontrollable) fluctuations in the discharge of the pumping well, especially for low-yield aquifers (see Figure 1). The time-drawdown curve for the pumping well on Figure 1 reflects small, but relevant, changes in discharge throughout the test ranging between 7.4 and 7.8 gpm, while the observation well does not “see” the fluctuations. The change in apparent slope between 100 and 300 minutes in the pumping well is likely due to a small incremental increase in discharge (from 7.5 gpm to 7.7 gpm) rather than an aquifer boundary.

Conducting a reliable and analyzable pumping test in low-yield aquifers with either primary or secondary porosity (i.e., fractures) requires that the aquifer be pumped at a realistic, constant, and measurable discharge for several hours, extending beyond casing storage. In addition, water level measurements during the pumping test must be collected systematically with a high degree of accuracy. Observation wells that respond clearly during a pumping test are highly desirable for a complete description of the aquifer parameters.

*David W. Abbott is with Todd Engineers in Emeryville.* 💧

In addition to the Governor's bond proposals, Senator Don Perata, President pro Tempore of the Senate, introduced **SB 1024** at the end of last year. It is a \$10.275 billion infrastructure bond measure that includes \$1 billion to evaluate, strengthen and improve designated levees and \$200 million for flood control, but contains no other water supply or infrastructure funding. Assembly Speaker Fabian Nunez has also introduced a bill for infrastructure financing, **AB 1783**, in an unspecified amount expressing his priorities for bond funding. Assembly Republican Leader Kevin McCarthy has introduced **ACA 27** which would constitutionally require that 1% of general fund revenues be spent on capital outlay. The Assembly Republicans introduced **ACA 27** to make the political statement that they believe that infrastructure should be funded on a pay as you go basis. The final work product will be the result of extensive negotiations between the Big 5 – the Governor and Leadership of the Senate and Assembly.

These bond measures are consistent with recent expressions of Legislative priorities and differ from those identified in the Governor's investment package. An *Infrastructure Bond Conference Committee* (Conference Committee) has been

established to deal with all facets of the bond proposal, chaired by Senator Murray and including Senators Chesbro and Hollingsworth and Assembly Members Laird, Chu and Keene.

Assembly WPW held two hearings last week on the subjects of flood management and parks and wildlife. Public testimony will be taken at the upcoming Senate NRWC, scheduled for four meetings in January and February; the Chair has requested that witnesses address the "big picture" and transmit "line item" issues separately in writing.

At this time the Legislature is working to have a bond proposal on the June 2006 ballot. However, while there is significant bipartisan support to move an infrastructure bond forward this year, the ultimate content of the measure that will emerge is highly uncertain. Of particular interest to GRA members is that the Governor's budget proposes an additional \$8.5 million (\$4.5 million in federal funds and \$4 million in Waste Discharge Permit funds) to enhance existing *water monitoring* efforts by the State Water Resources Control Board.

**Other Water and Groundwater Bills.**

**Well Log Legislation.** GRA met last week with Suzanne Reed, Chief of Staff to Assembly Member Carol Liu, on the subject of well log legislation. It was agreed that, rather than introducing legislation this year, Assembly Member Liu would facilitate ongoing discussions with CGA to determine areas of agreement with GRA. (See results of water well log poll on page 6.)

Given that this is the second year of the session, January has been spent addressing "two-year" bills (bills that were unable to move last year when they were introduced). The extensive, **FAST TRACK** hearings on the bonds have distracted legislators from working on bills from last year. *The deadline for introducing new legislation this year is February 24<sup>th</sup>*. One bill we are likely to see again this year is **SB 820 (Kuehl)**. One of the most watched bills of last year, SB 820 was vetoed by Governor Schwarzenegger, but Senator Kuehl has indicated that she intends to reintroduce the bill this year. Senator Kuehl is GRA's invited "focus" speaker at this year's *Legislative Symposium and Lobby Day on March 29, 2006* – mark your calendars and don't miss a great opportunity to learn more about this exciting year in the Capitol! Hatch & Parent will be monitoring closely all bills as they are introduced during February and report to GRA's Legislative Committee.

*Chris Frahm and Paul Bauer of the firm of Hatch & Parent are GRA's legislative advocates in Sacramento. If you would like to know more about any of these issues, please contact Chris or Paul at (916) 441-1232 or cfrahm@hatchparent.com or pbauer@hatchparent.com.* ♠

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solvent, perchlorate, and NDMA contamination from the Aerojet Facility in Sacramento County. Groundwater plumes have migrated beneath the American River, impacting the District's water supply wells. Having seen the years and high costs of litigation and failure of the Superfund process to adequately address water supply, the Districts instead built on the collaborative efforts of the regional Water Forum Agreement. The Districts and Aerojet have worked jointly to avoid litigation and find solutions to supply well impacts and avoid the export of the basin's groundwater for treatment and discharge south of the River.

The session on "Managing Salinity in California's Groundwater Basins" was moderated by Sargeant Green of Tranquility Irrigation District, and focused on a growing problem of many California groundwater basins (and the downfall of many prehistoric civilizations). The Livermore /Amador Valley, Santa Ana River Watershed, and San Joaquin Valley served as case studies of salinity problems and management approaches (both successful and unsuccessful).

The ACWA Groundwater Committee meeting focused on the groundwater sections of Senator Kuehl's mega-water bill, SB 820, which the California Legislature passed but was vetoed by Governor Schwarzenegger (the veto letter is available online at [www.grac.org/SB820\\_veto.pdf](http://www.grac.org/SB820_veto.pdf)). Dennis O'Connor, Committee Consultant, California Senate Natural Resources and Water Committee, solicited input from the Groundwater Committee on the bill, which will be reintroduced in the 2006 session. One objective of the bill was to identify basins in overdraft, but the bill's requirement for statewide groundwater extractions reporting contributed to its demise. Alternative methods to meet this objective, such as requiring water level monitoring and reporting, elicited heated debate from Committee members. Suggestions may be submitted to Dennis at [dennis.oconnor@sen.ca.gov](mailto:dennis.oconnor@sen.ca.gov).

Finally, the concluding session on "The Local Groundwater Management Assistance Grant Program: Case Studies of Success," highlighted some successes

of DWR's AB303 program in an attempt to build support for continuation of this beneficial program.

ACWA's Spring 2006 Conference is May 9-12 in Monterey.

*Martin Steinpress, P.G., C.H.G., is a GRA Director and the Communications Chair, and an ACWA Groundwater Committee Member ([msteinpress@brwncald.com](mailto:msteinpress@brwncald.com)).*

*Jon Rohrer, P.G., C.H.G., is a Senior Hydrogeologist with WorleyParsons Komex in Southern California ([jrohrer@losangeles.komex.com](mailto:jrohrer@losangeles.komex.com)).* ♠

## Groundwater Professionals Fill Vital Role in Public Awareness—

Continued from Page 9

If you'd like to try some public awareness but have little time, don't try to reinvent the wheel. A variety of tools and information are at [www.wellowner.org](http://www.wellowner.org) and [www.ngwa.org](http://www.ngwa.org). NGWA's Awareness Week Web page can be accessed through both sites. From this Web page, you can access radio spots, Clip and Copy articles, a sample news release, a sample letter-to-the-editor, a flier and a poster.

As groundwater professionals, consider the unique knowledge you possess and take to heart this challenge to share it; you can make a difference! ♠

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## Sacramento Branch Highlights

BY PAT DUNN, SACRAMENTO CHAPTER VICE PRESIDENT

In October, the Sacramento Branch had a special dinner meeting in association with the **25th Biennial Groundwater Conference**. Ms. Beth Parker presented a talk entitled “CHLORINATED SOLVENT SOURCE ZONES AND PLUMES IN SANDY AQUIFERS: OPENING THE BLACK BOX.” Organic contaminant plumes in sandy aquifers are common and are typically caused by immiscible-phase liquids, either LNAPLs or DNAPLs, residing below the water table in areas known as “source zones.” There are various reasons to acquire detailed subsurface information about these sources. This talk described examples from experimental and industrial sites where chlorinated solvent contamination is present in sandy aquifers. A suite of field investigation methods aimed at determining detailed subsurface contaminant distributions produces

thousands of samples from the groundwater zone at each study site and it is cost-effective because the field protocols are streamlined and rapid on-site quantitative contaminant analysis techniques are used. The field applications of the method reveal that sampling at such detailed scale is necessary in the source zones to locate and determine the thickness of DNAPL zones and also zones with large sorbed-phase mass, and in plumes to locate the high contaminant flux zones. The use of CPT and associated direct-push in situ chemical analysis techniques are helpful, but they require verification and calibration against the quantitative measurements on core samples.

In November, Michael Caurant of Dealey-Renton & Associates (DRA) delivered a very timely talk entitled “BUSINESS RISK MANAGEMENT.” Mr. Caurant presented the following topics: 1) Insurance for Professionals - Coverages and Needs, 2) What Clients Should Expect/Broker Services, and most importantly, 3) Your Contract - The First Line of Defense; Risk Management and Key Contract clauses. Due to the particular importance of contracts, the majority of the talk covered contracts (professional liability and indemnification clauses).

In December, GRA shared our branch meeting date with the Association of Environmental/Engineering Geologists (AEG). Mr. James Chatters of AMEC presented a talk entitled, “FIRST LOOK AT THE PALEOCOLOGY OF THE FAIRMEAD LOCAL FAUNA.” Paleontological salvaging has been ongoing at the Fairmead Landfill for 12 years, resulting in the recovery of an impressive array of mammalian, avian, and reptilian fossils. Approximately 800 of the more than 3500 identifiable specimens have been classified, leading to an initial understanding of the makeup of the mammalian community of Central California during Irvingtonian times. The sense one gets from this largely attritional, carnivore-mediated assemblage is of an American Serengeti, dominated by herds of horses, camels, and mammoths. These megafauna were preyed upon by dire wolves, scimitar cats and saber teeth, while cheetahs ran down early pronghorns. Giant sloths, like Africa’s rhinos, wandered at will, and dwarf pronghorns covered in the bush. **Jim Chatters** is currently Senior Archaeologist and Paleontologist with AMEC Earth and Environmental in Kirkland, Washington. 💧

The GRA Sacramento Branch and Director Brian Lewis are pleased to announce a recent contribution of \$1,000 to the CSU Sacramento College of Natural Sciences and Mathematics.

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## San Francisco Bay Branch Highlights

BY BILL MOTZER  
SF SECTION GRA SECRETARY

### November 2005 Meeting

Sixty-seven members, non-members and students attended the meeting. Dr. Driscoll's presentation topic was: *Protecting Your Professional Reputation in a Time of Decreasing Ethical Behavior: It is Up to You!* Dr. Driscoll, the author of *Groundwater and Wells*, gave several examples from his career of questionable behavior that greatly increased the time and expense of environmental cleanups and other projects.

### December 2005 Meeting

Dr. Beth L. Parker was our speaker for the December 7, 2005 meeting at the Ramada Plaza Hotel in San Francisco. Held in conjunction with GRA's *DNAPL Source Zone Remediation and Characterization Symposium*, it had the year's best attendance, with 160 members and non-members including participants from the People's Republic of China, Taiwan, New Zealand, Australia, and Canada. Dr. Parker currently is Research Associate Professor at the Department of Earth Sciences, University of Waterloo. Her talk, titled: *Nature of Chlorinated Solvent Source Zones in Sandy Aquifers: Insights from Field Studies*, was based on investigations that she and her graduate students have done in the past 10 years in chlorinated solvent dense non aqueous phase liquids (DNAPLs).

Dr. Parker's studies showed that almost all chlorinated solvent contamination to

groundwater can be attributed to DNAPL sources. Experiments, at the Borden, Ontario, Canada site and other industrial sites in the U.S. and Canada, involving complex DNAPL and dissolved solvent zones show that many can not be detected by conventional monitoring wells and sampling. Considerable solvent masses may remain as both sorbed and dissolved components in down gradient plumes decades after the main contaminant source has been removed. Many of the studied sites from the 1950s through 1970s have gone through considerable changes since initial contamination; this results in difficult identification of original DNAPL source zones and in more complex and expensive remediation methods.

The short space for this summary can not do justice to Dr. Parker's excellent slides. A few of her DNAPL-related publications are listed on her website, [http://www.waterloodnapl.com/dnapl\\_beth\\_parker.htm](http://www.waterloodnapl.com/dnapl_beth_parker.htm).

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# Seventh Annual CCGO Sacramento Drive-in!

California Council of Geoscience Organizations Delegates will drive, fly, and hitchhike (or at least share a ride) to our state capitol from all over California to attend the 7th Annual CCGO Sacramento Legislative Drive-in (Lobby Day) on Tuesday March 7, 2006. The purpose of the CCGO Drive-In is to bring attention to the need for regulations and laws requiring high-quality geologic work for public protection, and to fund the appropriate state and local programs that are needed or mandated by the government. As part of the outreach, CCGO plans to meet with many legislators, as well as policy makers. We request that interested parties contact Jim Jacobs (augerpro@sbcglobal.net) to arrange to be a part of the 7th Annual Sacramento Drive-In.

*Jim Jacobs is a hydrogeologist and principal of Environmental Bio Systems in Mill Valley, CA.*

## GRA Requests Nominations for Lifetime Achievement Award and "Kevin J. Neese Award" — Continued from Page 10

### Previous Lifetime Achievement Award winners:

- 2005 - Dr. Luna P. Leopold
- 2004 - Dr. John Bredehoeft
- 2003 - Rita Schmidt Sudman
- 2002 - Tom Dibblee
- 2001 - Carl Hauge
- 2000 - Joseph H. Birman
- 1999 - David Keith Todd
- 1998 - Eugene E. Luhdorff, Jr.

Kevin J. Neese: recognizes significant accomplishment by a person or entity within the most recent 12-month period that fosters the understanding, development, protection and management of groundwater.

### Previous Kevin J. Neese Award winners include:

- 2004 - California Department of Water Resources for publication in 2003 of its updated Bulletin 118: "California's Groundwater"

- 2002 - Glenn County Water Advisory Committee for formulating a significant groundwater management ordinance that was adopted by the Glenn County Board of Supervisors
- 2001 - American River Basin Cooperating Agencies and Sacramento Groundwater Authority Partnership for fostering the understanding and development of a cooperative approach to regional planning, protection and management of groundwater

Remember that nominations are due June 1 2006, so get them in early to Brian Lewis at [admin@grac.org](mailto:admin@grac.org)!

### Corrections to Winter 2005 HydroVisions

On page 1, the article on the Basin Recharge and Overdraft Workshop Highlights was actually written by Eric Reichard (it was incorrectly attributed to Tim Parker.) Eric is Research Hydrologist-Program Chief with the U.S. Geological Survey in San Diego (619) 225-6134) and a Director of GRA.

On page 5 of the Winter 2005 issue of HydroVisions, the last paragraph of Bill Motzer's Perchlorate Forensics article should have read: "Chlorine-oxygen isotope forensics has *now* differentiated anthropogenic  $\text{ClO}_4^-$  from solid rocket fuel sources and geogenic  $\text{ClO}_4^-$  in Chilean nitrate fertilizers and west Texas groundwater."

On page 13 of the Winter 2005 issue of HydroVisions, it was erroneously stated that the GRA Board elected 2006 officers at the November 12, 2005 meeting. The Board in fact selected the slate of nominees for the voting by all GRA members, which has since occurred.

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# Dates & Details

## GRA MEETINGS AND KEY DATES

(Please visit [www.grac.org](http://www.grac.org) for detailed information, updates, and registration unless noted)

GRA Course <i>Principles of Groundwater Modeling &amp; Transport Flow</i>	March 8-10, 2006 Irvine, CA	GRA Course <i>Vadose Zone Modeling</i>	May 10-12, 2006 Redwood City, CA
GRA Legislative Symposium	March 29, 2006 Sacramento, CA	GRA Symposium <i>Emerging Contaminants &amp; Water Quality: Current &amp; Future Challenges</i>	June 7-8, 2006 Concord, CA
GRA Symposium <i>Nitrate in California's Groundwater: Are We Making Progress?</i>	April 4-5, 2006 Modesto, CA	GRA 15th Annual Meeting	September 21-22, 2006 San Diego, CA



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