

HYDRO VISIONS

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GROUNDWATER RESOURCES ASSOCIATION
OF CALIFORNIA

Winter 2002

Highlights from GRA's Fifth Symposium on "Biological Treatment of MTBE Contamination in Groundwater: Ex-Situ and In-Situ Challenges"

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MALCOLM PIRNIE, INC., EMERYVILLE, CA
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The Groundwater Resources Association of California (GRA), in conjunction with the Santa Clara Valley Water District (SCVWD), and in cooperation with the American Petroleum Institute and the National Water Research Institute, recently presented its Fifth Symposium in its Series on Groundwater Contaminants. The symposium, titled "Biological Treatment of MTBE Contamination in Groundwater: Ex-Situ and In-Situ Challenges," was co-sponsored by Malcolm Pirnie, Inc. The event was held at the DoubleTree Hotel in San Jose, California on October 17, 2002, and attracted over 180 participants and exhibitors. The program featured world-



recognized experts on MTBE bioremediation from universities, national laboratories, regulatory agencies and industry.

MTBE (methyl tert-butyl ether) has received nationwide attention as a groundwater contaminant in recent years, especially in California due to highly publicized impacts to drinking water supply wells in Santa Monica and South Lake Tahoe. While MTBE was initially thought to be resistant to biodegradation in groundwater aquifers, this perception has changed dramatically over the past five years. Recent and ongoing studies indicate that MTBE is subject to biodegradation under a range of environmental conditions. In fact, a number of innovative treatment technologies that have been tested at both

INSIDE

President's Message	2
Upcoming Events	3
Technical Corner	4
California Legislative Corner	6
California Regulatory Corner	7
Federal Legislative/Regulatory Corner	8
Chemist's Corner	9
Alliance Corner	10
Organizational Corner	12
Education Corner	14
Editorial Page	15

bench-scale and pilot-scale levels, and applied successfully in the field, rely exclusively on biological principles for the removal of MTBE from contaminated soil and water.

The Fifth Symposium in GRA's Series on Groundwater Contaminants showcased experts who discussed experimental results as well as case studies on ex-situ and in-situ MTBE bioremediation. The symposium was organized into four sessions, which are discussed in some detail below, one of which featured a panel of national experts on natural attenuation processes.

Continued on page 16

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 JIM CARTER

As I write the President's Message for this edition of HydroVisions, I cannot help to reflect back on the Annual Meeting that we held in September, and to the Lifetime Achievement Award we gave to Mr. Tom Dibblee. For those of you that attended, you know it was uplifting to hear of Tom's incredible contribution to the understanding of much of California's geology and to hear him speak. Tom has personally mapped over 600 quadrangles, and over 100 of those were on a voluntary basis. And to hear Tom say, "he was just doing his job," well, it made me think of the work that we all do, and if we do it with skill, dedication and commitment we too can all make a contribution. Maybe not on the large scale that Tom made, but we can make a difference.

If you are interested to learn more on his life and his work, I suggest you go to the Dibblee Foundations' web site (<http://dibblee.geol.ucsb.edu>). The Foundation is currently looking for support to publish at least one hundred of Tom's most important geologic quadrangles.

On top of the inspiration from Tom, I am pleased to report that the Annual Meeting was the most successful meeting we have had so far. Big thanks to Vicki Kretsinger, Director and Annual Committee Chair, and the rest of her committee on the great meeting. I heard

many positive comments from attendees and if you were not able to attend I encourage you to keep your calendar open for our 2003 Annual Meeting.

By press time, you all would have already voted and hopefully have considered GRA's support of the Proposition 50. Thanks to Tim Parker and the rest of the Legislative Advocacy Committee, GRA drafted a position, polled the Board of Directors and the membership with over 77% voted in favor, and issued a press release with our endorsement of Proposition 50. Although we would like to see more specifically related to groundwater resource protection, this Proposition is at least a positive step in that direction. In 2003 look forward to more efforts in the legislative advocacy area, as we assist our legislators make sound decisions related to our groundwater resources.

I appreciate your support of GRA as we continue to grow the total membership, maintain the large number of GRA sponsored activities, and to expand the areas of GRA's influence. I am excited to be your President and I hope you find it is an exciting and rewarding time to be a GRA member. Thanks! 💧

Jim Carter
GRA President



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GRA Events for 2003

BY TOM MOHR

GRA will continue its wide-ranging symposia and workshop programs in 2003, with a strong list of offerings shaping up at press time. First up, in March, GRA will team with USGS to hold a Workshop on Groundwater Recharge and Conjunctive Use in Sacramento. A tentative workshop outline will be posted on GRA's website in early December.

A one-day class on Low Yield Aquifer Testing will be held in northern and southern California in March or April. This class will feature theory and methods, with a focus on field techniques and equipment as well as interpretation of test results.

In April, GRA will team with the California Department of Toxic Substances Control to hold a symposium on Indoor Air Risk from VOC Plumes, focusing on EPA's decision to lower the Preliminary Remediation Goal for TCE. The Symposium will focus on modeling, measurement, toxicology, mitigation, and legal and policy aspects of indoor air risk. This symposium is tentatively slated for Oakland in mid-April.

In May, GRA will team with NASA to hold a Field Workshop on Field Data Collection & Management at Moffett Federal Airfield in Mountain View. This workshop will focus upon use of PDA's for field data collection, web-based database software for field and laboratory data management, and remote control of groundwater treatment systems. NASA's Earth Sciences Division will also exhibit their projects.

May is also the time for GRA's annual Legislative Lobby Day, at which GRA members are given the opportunity to participate in discussions and Q&A sessions with California's legislators in Sacramento.

Continued on page 23

Upcoming Events

GRA's 11th Annual Meeting 2002 - Sustaining Groundwater Resources: The Critical Vision - Conference Summary, Upcoming White Paper and Thank You's

BY VICKI KRETSINGER, LUHDORFF AND SCALMANINI, CONSULTING
ENGINEERS AND CONFERENCE CHAIR

The Groundwater Resources Association of California (GRA) wishes to thank attendees, presenters, co-sponsors (Roscoe Moss and Geomatrix), cooperating organizations, the planning committee (including moderators), exhibitors, California State University Long Beach for demonstrating interactive educational tools from its mobile lab, field trip organizers (Orange County Water District, Tony Maggio, and other GRA Southern California Branch representatives) and sponsors, and especially GRA support staff for a successful 11th Annual Conference and Meeting. Cooperating organizations included the International Association of Hydrogeologists (IAH), National Ground Water Association (NGWA), American Water Works Association (AWWA) Water Education Foundation (WEF), California Groundwater Association (CGA), Professional Environmental Marketing Association (PEMA), and California State Bar Association — Natural Resources Section. During the course of the September 18-19, 2002 Conference, we had the opportunity to hear 47 presentations in the Plenary Assembly, concurrent, and poster sessions on local, regional, as well as global groundwater management strategies that are currently being implemented to ensure sustainable groundwater supplies. Conference sessions included the following:

- Groundwater as a Component of the Natural Resources Infrastructure (Moderators: Vicki Kretsinger and Carl Hauge)
- Recharge Management: In-Lieu Programs, Direct Recharge and Injection (Moderators: Martin Steinpress and Steve Phillips)
- Reclaimed Water Management (Moderators: Tony Maggio and Tracy Moran)
- Water Supply Assessment, Conjunctive Use Management and Optimization Strategies: Evaluating California's Groundwater Management Needs (Moderators: Tim Parker and Iris Priestaf)
- Wastewater Management and Emerging Contaminants: Pharmaceuticals, Endocrine Disruptors, and Other Off-The Shelf Compounds (Moderators: Robert Traylor and Tom Mohr)
- Comprehensive Approaches to Groundwater Quality Characterization (Moderators: Greg Bartow and Brian Lewis)

Sustainability - Conference Working Definition

Those who have been employing groundwater management programs for literally decades may wonder why the term "sustainability" is getting so much attention. As also elaborated elsewhere

Continued on page 18

MTBE in South Lake Tahoe Groundwater

BY RICHARD BOOTH, RG, CHG,
CALIFORNIA REGIONAL WATER
QUALITY CONTROL BOARD,
LAHONTAN REGION

Introduction

Methyl tertiary butyl ether (MTBE) is present in the groundwater beneath the South Lake Tahoe area, primarily a result of underground storage tank (UST) gasoline releases. MTBE's presence has prompted the shutdown of 15 municipal supply wells, either because MTBE was detected in the well water or because MTBE plumes threatened to impact the well water if the wells continued pumping. The MTBE situation at South Lake Tahoe is not unique, but there is a twist—the local water purveyor has a policy that they will serve only MTBE-free water to its customers. In addition, the South Lake Tahoe case, one among dozens throughout the United States suing over MTBE contamination, set a precedent as the first time that a jury has ruled that gasoline containing MTBE was a defective product, and was recently settled for just over \$69 million.

I will present some background on MTBE in South Lake Tahoe groundwater and discuss a specific case where MTBE concentrations in the groundwater proximal to a municipal water supply

well are detectable, but are below the current water quality objective.

Hydrogeologic Setting

The South Lake Tahoe Groundwater Sub-basin (Basin) is a sedimentary groundwater basin within the south portion of the Lake Tahoe Hydrographic Area. The Basin occupies an area of approximately 29,000 acres within a structural asymmetric half-graben

Tahoe to more than 7,000 feet asl where glacial moraine deposits contact bedrock on the mid-slopes of the Sierra Nevada along the western margins of the Basin.

The Basin bedrock consists of metamorphic, granitic, and volcanic rocks. The principal source of groundwater in the South Lake Tahoe portion of the Tahoe basin is basin-fill deposits consisting of unconsolidated glacial, lake, and stream sediments.

Snowmelt is the primary source of recharge to the Basin and generates, on average, more than 80 percent of the annual runoff within the watershed. Other sources of groundwater recharge include stream-flow seepage and groundwater inflow from the surrounding bedrock.¹ This is a small basin susceptible to contamination from numerous leaking USTs.

South Lake Tahoe Groundwater Use

South Lake Tahoe is almost entirely dependent on groundwater. Only a small association of landowners is served by surface water. The City of South Lake Tahoe and the surrounding community (known locally as the "South Shore") is restricted from using water directly from Lake Tahoe as a result of complex water rights and water allocation legislation and court rulings. The Bi-State Compact of 1968 regulates South Shore water use and allows for Lake Tahoe water usage, but the Bi-State Compact cannot be fully implemented until another pact, the Truckee River

Continued on page 20

Technical Corner



between the Sierra Nevada on the west and the Carson Range on the east. Land surface elevations across the Basin range from approximately 6,230 feet above sea level (asl) along the south shore of Lake

Problems Abound in Lining the All American Canal

BY TAMLYN HUNT, HATCH & PARENT

The All American Canal extends 82 miles from the Imperial Dam on the Colorado River, at the stretch where it forms the border between Arizona and California, to the Imperial Valley in southern California. The Canal was built pursuant to the Boulder Canyon Project Act of 1928, which also authorized the building of the Hoover Dam. The waterway skirts the Mexico-US border over its entire length. The region and canal are shown on the map, which is used by permission of Imperial Irrigation District (IID), and more information on IID and water issues in the area can be viewed at: <http://www.iid.com/water/works-allamerican.html>.

The Canal has generated considerable controversy in the last decade, ever since the IID first began running into trouble over the use of its approximately three million acre-foot (af) entitlement of Colorado River water. In 1988, the State Water Resources Control Board concluded that IID was not using its water in a “reasonable and beneficial” manner and ordered IID to conserve and transfer 100,000 af per year. (Order WR 88-20.)

As noted, the IID gets its water from the All American Canal. En route from the Colorado River to the Imperial

Technical Corner

Valley, the Canal, which is currently not much more than a large ditch dug in the dirt, loses approximately 70,000 af per year of water. River water becomes groundwater as it leaches from the Canal.

One of the means by which IID plans to conserve water is to line the Canal with concrete, stopping a large amount of water from leaching

into the groundwater basin. Lining the Canal was originally authorized by the federal government through the San Luis Rey Indian Water Rights Settlement Act. In cooperation with the federal government, California state legislation subsequently authorized \$126 million to finance the lining project.

This water “savings” will allow IID to transfer the conserved water to the

IID satisfies the mandate to use water in a “reasonable and beneficial” manner.

However, one man’s savings is another man’s loss—at least when it comes to water.

“One man’s savings is another man’s loss – at least when it comes to water... Mexico, is crying foul over the loss of the groundwater seepage.”

Accordingly, Mexico, which happens to be down gradient from the All American Canal, is crying foul over the loss of the groundwater

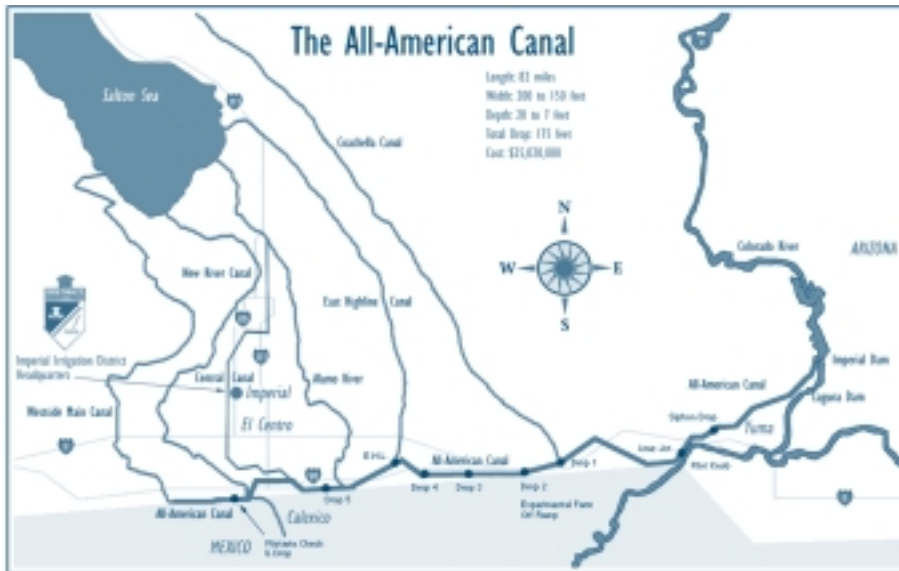
seepage. Mexico claims that without the 70,000 af per year of groundwater from Canal seepage, the Mexicali Valley, a \$3 billion per year agricultural area, will dry up. Removing this source of water could also increase salinization of more than 200,000 hectares of agricultural land in the Mexicali Valley, according to Steve Cornelius of the Sonoran Institute, an Arizona-based

environmental organization. And therein lies the rub.

Surface water rights between Mexico and the US are governed by the 1944 Mexican Water Treaty. This treaty states that the US will produce 1.5 million af per year of Colorado River water to the Mexican border. The US has supplied its 1.5 million af per year – and up to 1.7 million af per year when surplus is

available. The US is entitled to 15 million af per year.

The treaty does not ostensibly involve groundwater. However, Mexico has argued that under this treaty, it has rights



Metropolitan Water District, as part of the Quantification Settlement Agreement, one of many inter-related water agreements designed to avoid California’s loss of a significant amount of Colorado River water. This transfer will take place while, at the same time,

Continued on Page 22

Progress continues in the legislative arena - in a very active year

BY TIM PARKER, LEGISLATIVE COMMITTEE CHAIR

First hearing of the Select Committee on Groundwater Quality

The first hearing of the Select Committee on Groundwater Quality was held October 2, 2002 at the Ranch Cucamonga Water District in Ranch Cucamonga. The first hearing on Groundwater 101 was opened by Chair, Assembly Member Carol Liu, who provided an overview of the committee mission and purpose. The following presented:

- Barbara Evoy, Division Chief Clean Water Programs, State Water Resources Control Board presented on California's Current Investment in Groundwater Monitoring
- Carl Hauge, Chief hydrogeologist, California Department of Water Resources, gave an overview of California's water and groundwater system and groundwater basics
- Tim Parker, Groundwater Resources Association of California Director and Legislative Chair, provided an overview of the some of what we face in the future in California water challenges
- Bruce Mowry, General Manager of the Water Replenishment District of Southern California gave an overview of the WRD program, groundwater monitoring efforts and tools, treatment facilities and future programs
- John Rossi, General Manager of the Chino Basin Watermaster, presented an overview of the Chino Basin, issues and optimum basin management program.

California Legislative Corner

The hearing was well attended by a total of approximately 80 members of the public and State Assembly. The next hearings are tentatively scheduled for December 5 and 18 in Sacramento. The focus of the December 5th hearing is planned to be the life cycle of a contaminant and maximum contaminant level development. Groundwater law and management will be the focus of the December 18th hearing. GRA will send out email notification to GRA members once the dates and agendas are finalized.

Update on AB 599 (Liu) - The Groundwater Quality Monitoring Act of 2001

The interagency task force and public advisory committee have been continuing to meet since February 2002 to meet the requirements of the Act. These requirements include that the State Water Resources Control Board shall integrate existing monitoring programs and design new program elements, as necessary, for the purpose of establishing a comprehensive monitoring program capable of assessing each groundwater basin in the state and, to create an interagency task force to identify measures to increase coordination among state and federal agencies that collect groundwater contamination information. One of the ways the committees have decided groundwater data collected by agencies will be better coordinated is through the use of GeoTracker as a data warehouse. The specific means and schedule by which data will be collected from other agencies and input into GeoTracker has yet not been discussed. For more information, see the previous Hydrovisions at www.grac.org, or visit the SWRCB website below.

The AB599 work elements in progress include:

- The US Geological Survey (USGS), under contract to the State Board, is continuing work on two pilot area basin evaluations: (1) the West and

Central Coast Basins of Los Angeles (a developed area with considerable available data), and (2) a portion of the eastern part of the San Joaquin Valley (agriculture).

- The USGS has developed and introduced to the committees a detailed basin prioritization approach, the rationale to be utilized to prioritize and select basins for evaluation.
- The specific cost and sources of funding for a statewide comprehensive groundwater monitoring plan has not yet been developed, although up to \$50 million has been identified for this program in Proposition 50.
- The Report to the Legislature is being drafted. An SWRCB internal draft is planned to be completed by the end of December 2002, and to the Legislature by the beginning of March 2003.

For more information on AB599, visit the SWRCB website at <http://www.swrcb.ca.gov/cwphome/land/gama/webpages/ab599hom.htm>

Outcomes of Select Committee Hearings and AB599 Report

The outcomes of the Select Committee Hearings and AB599 Report recommendations will be reviewed by the State Legislature and considered during the next legislative session, starting in January 2003. It should be very interesting to see what comes of these two processes, and what recommendations result in actual legislation. In a time of significant budget shortfalls, legislation that requires any funding will be difficult or impossible to pass.

Proposition 50: Clean Water and Coastal Protection Bond of 2002

The GRA membership was emailed last month on Proposition 50, for a response of support, no decision, or opposition.

Continued on page 19

Perchlorate - is it all rocket science?

BY THOMAS K.G. MOHR AND
JIM CROWLEY

On September 3rd, the California Department of Health Services (DHS) released updated results for the Unregulated Contaminant Monitoring Requirements (UCMR) perchlorate monitoring program for public water systems on their web page (<http://www.dhs.ca.gov/ps/ddwem/chemicals/perchl/updateforweb.xls>). A total of 397 water sources in 114 water systems within 18 California counties reported perchlorate concentrations in excess of California's 4 ug/L advisory Action Level. Six wells had detections in excess of 40 ug/L, the level above which DHS

asks water suppliers to turn the pumps off, while 276 wells had detections above the action level of 4 ug/L but below 40

ug/L. These counts should be considered approximations, as the authors can't discern which wells actually supply drinking water. All wells labeled 'inactive', 'standby', or with other notation suggesting they're not actively used for supplying drinking water, were excluded from these counts. Many of these systems are impacted by known industrial sources of perchlorate, such as solid rocket motor production facilities; however, a number of detections have not been attributed to a known source.

What are the other sources of perchlorate? The authors have pondered unexplained detections of perchlorate in Santa Clara County, and have identified the following as possible sources or explanations:

1) **Unknown industrial sources:** Without too much investigative work, three additional potential industrial

sources of perchlorate in groundwater were identified that had not previously been considered, including an old match factory, a propellant research facility, and a defense industry production facility. It is likely there are more past and present users of perchlorate that have escaped our notice, including small businesses. Other potential industrial sources not commonly examined for perchlorate include tanneries, aluminum refining and processing, explosive bolts, electroplating, and landfills.

2) **Chilean 'bulldog soda' brand sodium nitrate fertilizer:** Mineral caliche deposits in Chile's Atacama Desert contain naturally occurring perchlorate at <2% w/w. SQM Corporation, the main provider of bulldog soda, has been

exporting this variety of fertilizer to the United States since 1840, initially to the southeast to fertilize tobacco

crops. Bulldog soda has been used primarily for cotton, citrus, and tobacco, but it has recently been favored by the organic food industry because it is not produced by chemical methods. Overall, Chilean sodium nitrate fertilizer makes up only a small percentage of American fertilizer consumption, and most growers avoid it because of its high sodium content. SQM has reportedly modified their refining process to control perchlorate to less than 1 mg/g. The historical use of bulldog soda was significant, particularly in the late 1800's and early 1900's, after supplies of bird guano were exhausted and before the advent of the Nobel-prize winning Haber-Bosch process, in which atmospheric nitrogen is converted to solid fertilizers. We are not aware of any documented cases where land application of bulldog soda has resulted in perchlorate contamination of groundwater; however we are

California Regulatory Corner

researching the historical use of bulldog soda fertilizer in Santa Clara County. The occurrence of perchlorate tainted wells in counties known for their agricultural production (Monterey, Tulare, Merced, Fresno, Imperial, and Kern) is noteworthy.

3) **Highway Safety Flares:** Highway safety flares and some railway flares may contain up to 10% potassium perchlorate, and up to 70% strontium nitrate. The solubility of this mixture is reportedly 300 mg/L. Often, CHP will stub out flares after an accident has cleared to keep traffic moving, leaving the unburned portion of the flare on the roadway. Many freeway and highway drainages are designed to drain to percolation ponds or even dry wells, thereby avoiding costly grading and culverts. The juxtaposition of circumstances (a sufficient mass of flares over time and a direct route to groundwater coupled with a short migration path to a well screen or well construction defects) could result in detectable concentrations of perchlorate arriving at a production well. The Santa Clara Valley Water District ("District") is performing laboratory analysis of flares used by public safety agencies in Santa Clara County to test the assumptions inherent to this scenario, and to gauge whether stormwater testing for perchlorate is warranted.

4) **Methamphetamine Labs:** "Meth labs" are a growing societal problem, both in the human wreckage of drug abuse and the dumping of hazardous wastes used in the production of meth. Discussions with agents from the Bureau of Narcotics Enforcement (BNE) have revealed that large quantities of unburned highway flares and unburned matches have been found at several meth lab waste sites. Red phosphorous is used as a catalyst in the production of meth. To get the red phosphorous, small independent meth

Continued on page 23

Get Involved

BY CHRIS REIMER, NGWA
GOVERNMENT AFFAIRS

Legislators will be sworn in early January 2003, and now is the time for groundwater professionals to connect and reconnect with their representatives and senators. All politics is local; policy is based on public need, but this alone will not get the job done. Congressmen have a vast number of issues facing them every day, and base their priorities on protecting and helping the public, i.e. you, the constituent. It is up to you to educate your governmental representatives.

The National Ground Water Association's government relations department is continually collecting information that can be used as tools to educate politicians on the importance of protecting our national ground water resources and the water industry at large. NGWA subcommittees work hard to

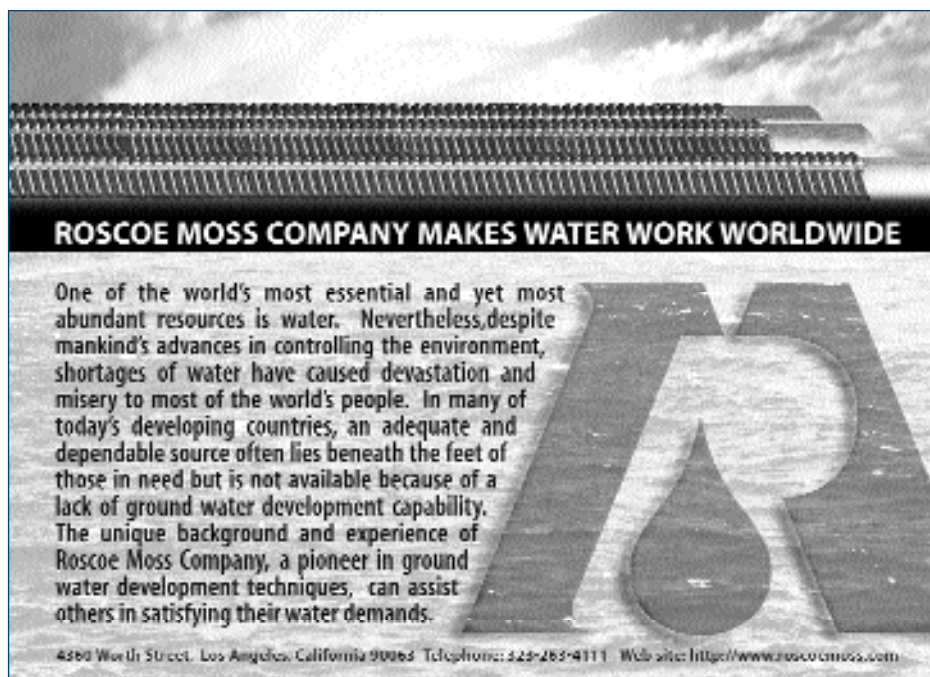
Federal Legislative/Regulatory Corner

prepare policy papers on different issues to aid in delivering your message (see NGWA web site at <http://www.ngwa.org/govaffairs/index.html>). The Association's Washington, D. C. lobbyists visit regularly with representatives, senators, and staffers on key committees who work on your issues to ensure you are represented on the legislative front. But the real strength behind all of these activities is and always will be you, the groundwater professional, and your participation at the local level.

Congress will be returning after the election for a "lame duck" session focused. The session will focus on finalizing federal government funding for FY 2003. Other legislation, however, may be considered. NGWA members have been working closely with Congress on the energy bill's provisions related to the prevention and remediation of contamination, including MTBE, from

underground storage tanks. NGWA members have provided insights and technical data based on field experience, although tax, electricity, and ethanol provisions remain sticking points in the overall bill. Some are holding out hope that differences can be resolved and an energy bill can be passed during the lame-duck session. The election outcome may play a role in the level of interest in passing a bill yet this Congress.

The members of NGWA have an excellent history of participating at the local and national level. It is because of this activism that NGWA continues to build its reputation as a reputable highly regarded and valuable resource in Washington, D.C. Your vote matters and your voice counts as lawmakers make decisions that affect groundwater and your profession. 💧



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Oxygenate Testing Update

BY BART SIMMONS

With the phase-out of MTBE and the transition to ethanol as the major gasoline oxygenate, new questions have been raised on the analysis for oxygenates. Accurate MTBE measurements are needed to determine the extent of existing plumes and also to determine the extent of biodegradation, whether intrinsic or engineered. With the increasing use of ethanol, conflicting action levels and required quantitation limits have arrived.

Hydrolysis of MTBE to t-butylalcohol (TBA)

A current controversy involves the potential hydrolysis of MTBE to TBA and methanol. If this happens during sample transportation, storage, or analysis, it would lead to an under estimate of MTBE concentration and an overestimate of TBA concentration. This in turn may lead one to conclude that biodegradation of MTBE was occurring to a greater extent than was actually occurring in the field.

The rate of MTBE hydrolysis depends on pH, temperature and potentially salt content. For each lowering of one pH unit, reaction will increase ten-fold. For each increase of 100 C, the reaction will increase 2.5 fold. Thus in highly acidic conditions and at high temperature, MTBE will hydrolyze appreciably to methanol and TBA. One study¹ measured rate constants at 260 C and 370 C. But how relevant is this to typical analysis for oxygenates?

Typical practice is to collect ground water samples and to add a few drops of 1+1 hydrochloric to ensure a pH < 2. Since only one drop is needed to lower the pH to less than 2, the majority of preserved samples probably have a pH between 1 and 2². Samples are typically kept cool (near 40 C - the National

Chemist's Corner

Environmental Lab Accreditation Conference [NELAC] specifies 0-6 0 C.), and analyzed within a specified holding time, often 14 days. The most common testing technique is purge and trap gas chromatography (GC) or gas chromatography - mass spectrometry (GC-MS). Typically the purge is done at 40-45 0 C.

A draft EPA sheet described the hydrolysis problem as significant, and recommended changing preservatives from acids to a base, trisodium phosphate, TSP. However, the evidence to date does not show a major problem with oxygenate analysis as it is typically performed. Additional studies are needed to determine the extent of the hydrolysis in typical practice, and to determine what changes are needed to sample preservation and analysis techniques.

Ethanol

As California phases out the use of MTBE in favor of ethanol, testing for ethanol has become more of an issue. Ethanol is miscible with water (they mix in any volumes), but believed to biodegrade quickly. Nevertheless, a concern is how low a concentration can be measured, e.g. the method detection limit (MDL) or quantitation limit (QL). The principal measurement techniques are: 1) gas chromatography-flame ionization detection (GC-FID, EPA 8015; or 2) Purgeable organics by gas chromatography-mass spectrometry (GC-MS, modified EPA 8260). 8015 is a cheaper technique, but does have a higher potential for mis-identification. GC-MS is a more robust technique, which can identify compounds by mass spectra, and can also identify non-target compounds (if requested). For both techniques, the sample is introduced with direct injection, purge and trap, or headspace analysis. Detection limits can be lowered by salting the sample with sodium chloride or using GC-MS

Selected Ion Monitoring (SIM). Some research studies have used solid phase micro extraction (SPME), although that does not appear to be popular today in commercial labs. A major issue, as always, is how low a detection level is needed. Generally labs will report a detection level about 40 to 150 ug/L (ppb) in water, although levels in the mg/L (ppm) level may also be reported.

Oxygenate testing is done with modifications of methods originally designed for other volatile organics. Additional modifications may be needed to ensure the reliability of oxygenate data. For the MTBE hydrolysis issue, some additional studies are needed to understand the extent of the effect on existing and new data, but the option of a heated head space analysis may be withdrawn. Alternately, the use of another preservative like trisodium phosphate (TSP) may be adopted. For the ethanol issue, an agreement among regulatory agencies is needed to have more uniform guidance the needed Quantitation Limits for ethanol analysis.

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Pressing Groundwater Management Issues to be Addressed at NGWA's Southwest Focus Conference

BY JULIE SHAW, NGWA

The National Ground Water Association (NGWA) heads to Phoenix in February to tackle some of the Southwest region's most pressing groundwater issues. The Association's Southwest Focus Conference, set for February 20-21 at the Hyatt Regency and co-sponsored by GRA, IAH and others, will bring together top environmental scientists, engineers and regulators to address the latest developments in perchlorate and dioxane contamination, artificial recharge and water banking, salt management for irrigation, and much more. Perchlorate "hot spots" dot the nation from California to Cape Cod, where the compound was used as rocket fuel and has closed municipal wells. Now on tap in Las Vegas water, perchlorate concerns could drastically push up the costs of water treatment. 1, 4 Dioxane, a solvent stabilizer is showing up at numerous TCE and PCE sites and is proving very challenging to clean up.

Conference sessions will be devoted to:

- Artificial and natural recharge,
- Innovative remediation technologies,
- Emerging contaminants 1,4-dioxane and perchlorates,
- Groundwater modeling, and
- Water supply planning.

Two plenary sessions will cover a range of topics, including the effects of

Alliance Corner

forest fires on aquifers, water rights administration, and California's groundwater monitoring plan. Conference advisors are Herman Bouwer, retired chief engineer for the U.S. Water Conservation Lab in Phoenix, William Mullican of the Texas Water Development Board, Patrick Longmire of the Los Alamos National Laboratory, and Neven Kresic of Malcolm Pirnie. Herman Bouwer will give the keynote presentation, "*Accumulation and Management of Salt in South Central Arizona*". He will discuss some of the potential problems associated with the use of municipal sewage effluent for irrigation water and its possible impact on ground water.

Other presenters include Michael A. Palmer, RG, CHG of Hargis and Associates Inc., who will review findings related to "Seasonal and Long-term Storage and Recovery of Reclaimed and Raw Water Using Injection Wells in a Coastal Groundwater Basin near Rancho Santa Fe, California." Shane Snyder of the Southern Nevada Water Authority will discuss "Aquatic Impact of Perchlorate: A Thyroid Endocrine Disruptor."

A pre-conference field trip also will be offered from 1-5 p.m. February 19 on the subjects of trichloroethylene (TCE) remediation and artificial recharge. Participants will travel to Scottsdale to tour a remediation project site where TCE-contaminated ground water is being treated by air stripping. The group also will travel to an area east of Mesa to tour the Granite Reef Underground Storage Project, one of the artificial recharge facilities of the Salt River Project. Poster sessions also will be held.

For more information on the conference, contact NGWA at (800) 551-7379, or visit the Web site at <http://www.ngwa.org/e/conf/030220508.0.shtml>.

Report on the 4th International Symposium on Artificial Recharge (ISAR4)

BY PETER DILLON,
IAH COMMISSION CHAIR

'Management of Aquifer Recharge for Sustainability' was the theme of the 4th International Symposium on Artificial Recharge held in Adelaide, 22-26 September 2002. The Symposium was attended by 200 people, from 27 countries, with 100 from Australia and large contingents from The Netherlands, Germany, USA and India, where intentional recharge enhancement is widely practiced.

The keynote paper by Bill Mills (former General Manager of Orange Country Water District, in California) outlined a 25 year history of the operation of a highly constrained water supply in an arid area. The four papers that followed the keynote speaker covered several sites with from 20 to 50 years of operating experience of intentional recharge; the remaining sessions covered various topics including water quality changes in the subsurface, water reuse via aquifers, geochemistry of aquifer recharge, and other important water issues. In addition to the 50 oral papers, 50 poster papers were presented.

One of the invited papers, given by Takashi Asano, the 2001 Stockholm Prize Winner, was on health risk management of groundwater recharge

Continued on page 11

Report on the 4th International Symposium on Artificial Recharge -

Continued from Page 10

with reclaimed water, using three trace organic compounds to exemplify the issues in assessing risks. Peter Fox of Arizona State University presented the other invited paper, on an assessment of sustainability of soil-aquifer treatment of treated sewage effluent.

Pieter Stuyfzand of KIWA in The Netherlands won the Herman Bouwer Award for best paper for his presentation on the quantification of hydrogeochemical impact and sustainability of artificial recharge systems.

The Ivan Johnston Award for best poster paper was given to Corrine Le Gal La Salle of Flinders University for her paper on isotope evaluations of aquifer storage and recovery (ASR). ASR was a feature of the mid-conference field trip where stormwater and reclaimed water ASR sites were inspected, along with wetlands used to improve urban stormwater quality. Best paper from a young scientist went to Stephanie Rincke-Pfieffer for a paper on clogging processes, and best paper from a developing country was awarded to Surene Zeelie of Namibia Water Corp. for her paper on the Omdel dam recharge system in the Namib Desert.

Papers from the Conference are recorded in Proceedings, which are available from Balkema: www.balkema.nl - (click on IAH under specialist organisations) - for IAH members a 60% discount applies - and can be ordered on-line.

The conference concluded with a post conference tour on Friday, 27 September to a scenic area near Adelaide with lunch at a winery and lots of laughter. The next symposium (ISAR5) will be held in June 2005 in Berlin; current research on water quality changes during bank filtration in Berlin will be a feature of the conference.

Alliance Corner

The organisers wish to thank the sponsors of ISAR4 and/or the workshop and 20 developing country delegates: UNESCO, AWWARF, AusAID, Government of South Australia, Bolivar ASR Research Project, City of Salisbury, Centre for Groundwater Studies, Volkswagen Foundation, and the endorsing organisations: IAH, ASCE, IWA, AWA, IE Aust, GSA and Hydrological Society of SA for supporting this event. 💧

implement artificial recharge plans, and limit overexploitation.

Efforts to date have not solved all the problems, and more work needs to be done. The International Association of Hydrogeologists (IAH) and the USNC are contributing to this effort. We convened the special session on "Groundwater Depletion and Overexploitation: A Global Problem" at the October GSA meeting in Denver (web site: <http://www.geosociety.org/meetings/2002/>) to highlight the latest developments and concerns. An IAH co-sponsored Symposium on "Intensive Groundwater Use: Challenges and Opportunities (SINEX)" will be held in December in Spain to gather a world-wide forum of scientists, stakeholders, sociologists, and decision makers with experience on groundwater intensive use issues (web site: <http://www.fcih.org/SINEX.HTM>). The Symposium is timed to allow its findings to be reported to the World Water Forum, Kyoto, in March 2003.

Sustainable Development

BY L. F. KONIKOW
PRESIDENT, IAH/USNC

"Sustainable Development" has become a rallying point for environmentalists around the world. A U.N.-sponsored World Summit on Sustainable Development concluded last month in Johannesburg was considered by many to be a success. U.N. Secretary-General Kofi Annan said, "This summit makes sustainable development a reality." It was reported that commitments were made to increase access to clean water and proper sanitation, among many other goals.

But "Sustainable Development" is not a new idea to ground-water specialists, who have long recognized the effects and limitations of ground-water mining or intensive development of ground-water resources. This is the driving force for increased efforts in many states (California is one of the leaders) during the past decade or so to improve management of ground-water resources, optimize development,

A new UNESCO report, "Intensively exploited aquifers: Main concepts, relevant facts and some suggestions" by Ramon Llamas (Past President of IAH) and Emilio Custodio (Current president of IAH) includes ideas on how to improve water management in regions where there is intensive use of groundwater. Copies of the report can be downloaded (in English or in Spanish) from the IAH web site at: <http://www.iah.org/News/2002/027.html>

A broad perspective on sustainable development is maintained by the Forum on Science and Technology for Sustainability, which seeks to facilitate information exchange and discussion among the growing and diverse group of individuals, institutions, and networks engaged in the field of science and technology for sustainability. The Forum's web site can be accessed at: <http://sustainabilityscience.org> 💧

GRA 2002 Lifetime Achievement Award Presented to Thomas W. Dibblee

BY JOE BIRMAN

On September 18, 2002, the Groundwater Resources Association of California presented to you, Thomas Wilson Dibblee, its Lifetime Achievement Award for your contributions to the groundwater industry. Remarkably, you are the first recipient of this award who is not a groundwater professional. The Association recognizes that you have described for us that which controls the occurrence, the movement, and the production of underground water throughout a vast region: you have mapped the geology of more than a quarter of the State of California. You have mapped an area larger than nine of our states taken individually, and you have done this mostly by yourself.

For those of us who dedicate our careers to the ground water industry, what you have contributed increases our effectiveness in exploring for groundwater resources in much of California, and in protecting the water resources that are still underground. "Has Tom been here?" is what many of us ask when we begin a new project. If so, with your help, we find and protect a lot of water.

To the people of California the benefits that you help us to provide are enormous. And as our industry continues to use your geologic maps, the effect of what you have contributed will continue far into the future.

In your own words:

"Geologic mapping during my lifetime has been a sustained routine effort driven by scientific curiosity. I did nothing glamorous, I have been

Organizational Corner

trying to provide as much basic field data as I can on California geology to the geologic community."



Thomas Dibblee, Jr. (left) receives the GRA 2002 Lifetime Achievement Award from Joe Birman, GRA 2000 Lifetime Achievement Award recipient.

Hutton said, "Look at the rocks and the surface of the Earth, and they will tell us our history." You have looked at the rocks and the surface of the Earth, and they have told us the history of much of California. And thus you have continued the grand tradition of the founders of our profession in sound, measured observations in the field – without which the power of the computer cannot be relied on to tell us the truth.

So, Thomas Dibblee, descendant of two cultures: ancestor Ebenezer Dibblee, entering the New World in 1635, fifteen years after the Mayflower and whose descendants arrived in California in 1859; and ancestor Capitan Jose Antonio de la Guerra Y Noriega, in 1800 Comandante del Presidio de Santa Barbara y Generale Residente de Alta y Baja California.

For whom a scientific foundation was formed in order to preserve and continue to publish the work that you have done. And now, also to carry on your work, a newly developing relationship with a distinguished museum in a West Coast city well known for its ties to higher-level academia.

Continued on page 22

2002 Kevin J. Neese Award Given to the Glenn County Water Advisory Committee

BY CARL HAUGE

The 2002 Kevin J. Neese Award was presented to the Glenn County Water Advisory Committee at GRA's 11th Annual Meeting and Conference in Newport Beach, CA September 18-19, 2002.



Scott Slater, GRA Director (left) and Bob Van Valer, GRA Director (right) present the Kevin J. Neese Award to Bill Menke, Assistant General Manager of the Glenn-Colusa Irrigation District.

In 2000, the Glenn County Board of Supervisors adopted an ordinance that outlined how the County was going to manage groundwater resources within the County. The ordinance and the processes specified by the ordinance were developed in stakeholder meetings that took place over a six-year period. Stakeholders included water agencies in the County, and landowners in the County that were not within a water agency boundary. This group was named the Glenn County Water Advisory Committee (WAC).

Continued on page 22

Executive Director's Message

At the recent GRA Board of Director's meeting, time was spent on reviewing 2002 strategic initiatives and identifying strategic initiatives for 2003. (Long-range planning will occur at the Annual Board Retreat in January 2003.)

During the review of GRA's 2002 strategic initiatives, it became obvious very quickly that GRA's volunteers (Directors and members) and contract staff accomplished many GRA goals and objectives that were identified at the 2002 Annual Board Retreat. For example:

- membership increased by nearly 15%;
- a new informational brochure was created and published;
- HydroVisions was expanded to provide additional categories of information and redesigned for easier reading;
- GRA worked closely with the CA Legislature to establish the Select Committee on Groundwater and the official recognition of a Groundwater month;
- involvement and effort increased on specific issues and legislation (e.g., AB 599, Proposition 50 and MTBE);

GRA Extends Sincere Appreciation to its 2002 Biological Treatment of MTBE Contamination in Groundwater Symposium...

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Organizational Corner

- a joint GRA/IAH membership program was established;
- a variety of programs were offered that included three Symposiums in the Series on Groundwater Contaminants, GRA's 11th Annual Meeting and Conference, three Drinking Water Source Assessment & Protection Courses, two Principles of Groundwater Modeling Courses, and one Environmental Statistics Short Course;
- the Web site was enhanced to include Ask A Groundwater Specialist and a relational database and membership directory, and
- GRA increased by twofold its alliances with other organizations with similar objectives.

Wow...and the year is not over yet! I believe the primary reason that so many projects and programs were attempted and achieved is that the GRA leadership focused on GRA's true strategic competencies and what it and the membership could be passionate about and support. This kind of focus, discipline, and collaboration is rare when we are living in a time when it is so easy to be distracted by fads and crises.

Imagine what GRA will look like at its 20th Anniversary celebration after it has constantly "innovated" and demonstrated incremental successes year after year. GRA is a truly collaborative-minded organization. Volunteer your time and expertise now so you aren't asking "why didn't I" when the glasses are lifted to toast GRA's 20th Anniversary!

GRA Establishes Special Recognition Award

GRA awarded its first Special Recognition Award to William (Bill) R. Mills, Jr., recently retired General Manager of the Orange County Water District (OCWD), for overseeing OCWD's innovative groundwater management programs, which advocated the use of reclaimed wastewater and improved the District's extensive groundwater recharge system. The award was presented at GRA's 11th Annual Meeting and Conference in Newport Beach, CA on September 18, 2002.

California Senator Jim Costa also received a GRA Special Recognition Award for demonstrated leadership and dedication to the principles of groundwater resource protection and management in California. The Senator received his award at GRA's Symposium, Nitrate in Groundwater, in Fresno, CA on November 13.

GRA established the Special Recognition Award to officially recognize outstanding contributions to groundwater resource protection and management in California that might not be recognized via GRA's Lifetime Achievement Award and Kevin J. Neese Awards.

GRA 2003 OFFICERS ELECTED

The election for GRA's 2003 Officers was conducted at the November 2, 2002 GRA Board meeting in Sacramento. GRA's 2003 slate of Officers for one year are: Jim Carter - President, Tom Johnson - Vice President, David Von Aspern - Treasurer and Paul Dorey - Secretary.

Earth and Space Science Education Setbacks

BY SUSAN GARCIA

The California State Board of Education issued a step backward to the Earth and Space Science community when they adopted the “Science Framework for California Public Schools, Kindergarten Through Grade Twelve,” on February 6, 2002. The Science Framework “is the blueprint for reform of science curriculum, instruction, professional preparation and development, and instructional materials in this state. It outlines the implementation of the *Science Content Standards for California Public Schools*, (adopted by the State Board of Education in 1998) and connects the learning of science with the fundamental skills of reading, writing, and mathematics. The Science Content Standards which are a concise description of what to teach at specific grade levels, and this [the] framework extends those guidelines by providing the scientific background and classroom context.”¹

Language in The Science Framework states that all high school students “take, at a minimum, two years of laboratory science providing fundamental knowledge in at least two of the following content strands: biology/life sciences, chemistry, and physics. **Laboratory courses in earth sciences are acceptable if they have as prerequisites (or provide basic knowledge in) biology, chemistry, or physics.**”¹ The Framework further states in a footnote that these laboratory requirements are consistent with “laboratory science subject requirement for admission to the University of California and, beginning in fall 2003, to the California State University.”¹ This action relegates earth science to a second-class lab; thereby, disemboweling earth and space science programs in high schools, colleges, and

Education Corner

ultimately graduate, educational, and professional venues making it more unlikely that a high school student will take an earth science course because he/she cannot readily use it for college entrance nor for college credit as an advanced placement course. One glaring example is that “laboratory courses in earth sciences are acceptable if they have as prerequisites (or provide basic knowledge in) biology, chemistry, or physics.”² Please note that GRA, along with many other professional organizations, sent a letter to the State Board of Education urging them to revise the wording, but that relegated Earth and space science laboratory courses to second-class status. The document was approved without modifications to the language.

Enrollment in Earth and Space Science Courses Drop

Actions, such as this, may be responsible for the drop in enrollment of high school students in earth science classes across the nation. According to the American Geological Institute’s (AGI’s) 2001 National Report on the Status of Earth Science Education, out “of the roughly 13 million high school students in our nation, only 7% (860,000) will take a high school Earth and space science course. Contrast this with roughly 88% of students who take biology. Only two states (North Carolina and Kentucky) require Earth and space science for graduation, and 17 states do not even consider Earth and space science as a standard lab science course.”²

In addition, to the decline in enrollment in high school Earth and space science classes, we are also seeing the decline at the college level. Fewer students are majoring in geology, which makes it a struggle for Geology Departments to preserve their funding while other departments are bursting at the seams with rising college student populations. AGI data reported in *Geotimes*³, indicates that over 7000 Geology degrees were issued in the U.S. in 1983; by 1991 and

2001, this level had dropped to below 3000 and just above 2000, respectively. Masters of Science and Doctorate degrees in geology during this timeframe remained roughly between 1000 and 2000 for the MS and well below 1000 for the Ph.D.³ The reduced interest in higher education in Earth Sciences impact the number of teachers who are being trained to instruct Earth and space science in high school. For example, if we compare the number of high school teachers for the sciences in 2000, we find that there were 51,048 Biology teachers, 25,931 Chemistry teachers, 15,853 Physics teachers and 14,057 Earth Science teachers.³

What is the Impact?

These reduced numbers of geology students and Earth and space science educators does not bode well for the groundwater profession and the well being of our State, or for that matter the nation. Is the next generation of groundwater professionals being trained? Can California afford not to have its residents trained in Earth and space science at a time when the population is soaring, our water resources are being tapped to their limits and natural geologic hazards abound? The State requires educated decision makers to address future water resource and geologic hazard issues.

What is GRA Doing?

What is GRA doing to help curtail this reduced interest in Earth and space science? I am aware of at least two actions by GRA in the last year and a half to help promote education in Earth and space sciences. One action was to support the “Revolution” resolution, which promotes Earth and space science education across the U.S. The other action was participation on the state-based alliance, which specifically promotes Earth and space science education in California.

Continued on page 24

Editorial Page

BY FLOYD FLOOD, EDITOR

GROUNDWATER NO LONGER "OUT OF SIGHT, OUT OF MIND" IN URBAN WATER CONSERVATION

The California Department of Water Resources (DWR) invited local agencies to submit applications for 2003 funding under the Urban Water Conservation Program. It was good to see that Section F-1 of the program (Net Water Savings; www.water.ca.gov) has a new requirement for projects to qualify for this round of funding:

"Under this program, all urban water conservation projects must demonstrate net water savings in order to be eligible to receive funding. Net water savings means savings achieved by reducing water losses that are currently going to an "unusable" destination from an already-developed primary water source or sources. Net water savings can be achieved by reducing losses to the atmosphere through evaporation or transpiration, or by reducing losses to saline or other unusable aquifers or water bodies through percolation or

surface flows. The reduction or elimination of water losses percolating to usable groundwater aquifers or returning to streams where the water is available for reuse is not considered part of net water savings. The reduction or elimination of water losses recovered or potentially recoverable outside the local agency's service area is also not considered to be net water savings."

As water becomes scarcer in California, one man's savings is too often another man's loss. Unless water is flowing directly to the ocean, to an unusable aquifer, or being lost to evapotranspiration, chances are that water saved would have been captured and used by another entity anyway. The "savings" from the lining of the All-American Canal (see the Technical Corner in this issue) is one such example, and only the fact that the groundwater resource being impacted is Mexico's makes it likely that this project will proceed.

In California, we have plenty of worthy water supply and conservation projects that warrant funding. Let's not shell out taxpayer money for one entity to conserve that will negatively impact another. Most of our groundwater basins are already fully developed, and many are

and problems such as subsidence, increased pumping costs, wells requiring deepening, salinity intrusion or other water quality problems will only worsen. DWR is to be applauded for this new requirement that ensures that the state's money is spent wisely, and that groundwater, though out of sight, is not out of mind. ♠

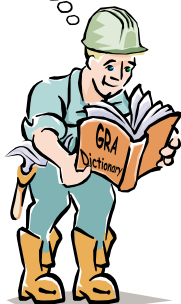
Déjà vu

In July, Southwestern Water Exploration Company announced that a newly discovered deep aquifer in Colorado is of drinking water quality. Engineering reports state that the available water for sale is 129,000 to 300,000 acre-feet dependent on which reservoir development scenario is undertaken, and end-use contracts are being sought. The company is now shifting its exploration focus to other deep prospects of equivalent or greater size (Southwest Hydrology, September/October, 2002).

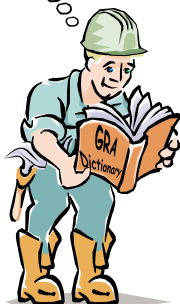
For the many groundwater professionals who migrated over from the minerals or oil and gas industry, this has to sound familiar and perhaps a bit unsettling. One can't be too surprised that droughts and looming water shortages have inspired water exploration by companies, especially given the trend towards privatization of water systems. Previous natural resources booms certainly led to technological innovation and lots of exciting discoveries. But it is worth noting that the attendant hype and speculation were not sustainable and that the frenzy led to some painful busts and created some environmental consequences that may never be fully remediated. ♠

"Deep Waters"

Conjunctivitis (noun):



Affliction of many California groundwater basins requiring expensive treatment funded by the State



art by AHW in GRA-Fix

Highlights from GRA's Fifth Symposium on "Biological Treatment of MTBE Contamination in Groundwater: Ex-Situ and In-Situ Challenges" - Continued from Cover Page

Highlights from each of the four sessions are presented in the following sections. For additional information on the symposium, binders containing speaker contact information, slides, abstracts and other supplemental information can be obtained by contacting GRA (914-446-3626; www.grac.org/publications.pdf).

Session 1 - Advances in Ex-Situ MTBE Biodegradation Research

Understanding the principles of MTBE biodegradation at the molecular level and the application of these principles to above-ground treatment systems were the focus of the symposium's first session which was moderated by Mr. Tom Mohr (SCVWD) and Mr. Jim Strandberg (Malcolm Pirnie, Inc.). Dr. William Stringfellow, a researcher at Lawrence Berkeley National Laboratory, discussed the biodegradation of MTBE by *iso*-pentane degrading bacteria. His research showed that bacteria grown on *iso*-pentane were able to cometabolically degrade MTBE. Dr. Stringfellow suggested that alkane monooxygenase is likely the major enzyme involved in MTBE metabolism and that MTBE biodegradation could be slow due to the enzyme's low affinity for MTBE.

The second speaker of the session was Dr. Makram Suidan, a professor at the University of Cincinnati. Dr. Suidan presented his research on the effectiveness of three bioreactors for the removal of MTBE from water. These included an external membrane bioreactor, a novel biomass concentrator bioreactor and a fluidized-bed granular activated carbon (GAC) reactor. Dr. Suidan showed that MTBE was mineralized (completely degraded to carbon dioxide) in all three types of reactors tested, and that effluent concentrations lower than 5 ug/L were achieved under optimized operational conditions. Dr. Suidan concluded that the key to successful MTBE ex-situ biological

treatment was effective biomass retention in the reactors.

Dr. Marc Deshusses, a professor at the University of California at Riverside, was the third speaker of the session. Dr. Deshusses presented the results of experimental and modeling studies on the



use of trickling bioreactors for the removal of MTBE and tert-butyl alcohol (TBA) from water. Dr. Deshusses suggested that the removal of TBA is easier than that of MTBE using this type of treatment system, and that results from ongoing field studies demonstrating the scale-up of this process are promising.

An update on the cometabolism of MTBE by microorganisms grown on other compounds was presented by Dr. Michael Hyman, a professor in the Department of Microbiology at North Carolina State University. Dr. Hyman discussed the production of a non-specific alkane monooxygenase enzyme facilitating the degradation of MTBE by an alkane-oxidizing bacterium, *Mycobacterium vaccae* JOB5. Dr. Hyman stated that MTBE, TBA and tertiary amyl methyl ether (TAME) were able to induce the production of this enzyme. Dr. Hyman concluded that the cometabolic degradation of MTBE could be potentially supported in environments containing low

concentrations of a number of alternative carbon sources.

The last speaker of this session was Mr. Kent Miller, the director of commercial development at Shell Global Solutions. Mr. Miller talked about the biological destruction of MTBE and TBA by microorganisms isolated or enriched by Shell researchers, and subsequently marketed as BioRemedy®. Mr. Miller discussed efforts to seed GAC reactors with these microorganisms to treat water contaminated by MTBE, TBA and other gasoline components. Mr. Miller then discussed the benefits, operational constraints and applicability of BioRemedy at MTBE-impacted sites by presenting case studies involving a wide range of MTBE mass loadings and groundwater flow rates.

Session 2 - Advances in In-Situ MTBE Biodegradation Research

This session focused on experimental and field studies investigating the intrinsic and enhanced biodegradation of MTBE in-situ, and was moderated by Mr. George Cook (SCVWD) and Dr. Jim Mueller (Malcolm Pirnie, Inc.). The first speaker of this session was Dr. Staci Kane, a researcher in the Environmental Restoration Division at Lawrence

Livermore National Laboratory. Dr. Kane discussed results of her studies which focused on evaluating the potential of aerobic MTBE biodegradation in soil and groundwater samples from eight gasoline-contaminated sites in California. Dr. Kane showed that while MTBE biodegradation was rapid in samples from some of the sites, no biodegradation was observed in the remaining samples. Dr. Kane concluded that in-situ MTBE biodegradation potential can be expected to vary from one site to another, and that the nature and extent of biological activity depends on the presence of oxygen, microorganisms with the necessary degradative capabilities, and

Continued on page 17

"in-situ MTBE biodegradation potential can be expected to vary from one site to another"

Highlights from GRA's Fifth Symposium on "Biological Treatment of MTBE Contamination in Groundwater: Ex-Situ and In-Situ Challenges" - Continued from Page 16

other contaminants which may act as inhibitors.

Ms. Karen Miller from the Naval Facilities Engineering Service Center then presented her work, which involves a large-scale in-situ biobarrier for the mitigation of a highly-publicized MTBE plume at Port Hueneme, California. Ms. Miller discussed in detail the design of the biobarrier as well as results from a two-year field demonstration. Ms. Miller concluded that the biological remediation system at Port Hueneme is expected to lead to a cost savings for the Navy in excess of 30 million dollars relative to a proposed pump-and-treat system.

After lunch was served, Dr. Douglas McKay, a professor at University of California at Davis, discussed practical issues related to the scale-up of in-situ aerobic bioremediation systems at MTBE-impacted sites. Dr. Mackay suggested that key considerations for the in-situ treatment of dissolved MTBE include the presence of native MTBE-degrading microorganisms in sufficient numbers, successful oxygen delivery and adequate approaches for evaluating overall system performance.

Dr. Kirk O'Reilly from ChevronTexaco Energy Research and Technology focused his presentation on the evaluation of oxygen based biobarrier systems for controlling MTBE plume migration. Dr. O'Reilly discussed in detail the concepts of oxygen demand (dissolved and solid) and supply in aquifers, and the applicability of these concepts at MTBE-impacted sites. Dr. O'Reilly also presented the results of two field studies where different oxygen delivery systems were used to decrease MTBE concentrations.

Gretchen Shorr, a graduate student in Dr. Hanadi Rifai's research group at the University of Houston, discussed the results of a multi-site MTBE plume study. The goal of the study was to understand

MTBE behavior relative to that of benzene in subsurface environments, and to evaluate MTBE field attenuation rates. Benzene and MTBE plume lengths, concentrations and point decay rates at a number of sites in Texas were compared and evaluated. Ms. Shorr suggested that MTBE plumes in Texas appear to be stable or decreasing in length based on the data reviewed for the purposes of her study.

The last speaker of this session was Mr. Joseph Haas from the New York State Department of Environmental Conservation.

Mr. Haas presented the results of a study involving the use of hydrogen r e l e a s e compounds, HRC, to enhance MTBE biodegradation at a site in Lindenhurst, New York. HRC was injected in the

dissolved MTBE plume at the site. MTBE concentrations, as well as biological indicator parameters, were then monitored. Mr. Haas concluded that while the presence of HRC resulted in reduced conditions in the biotreatment zone, methanogenic conditions were not achieved and significant anaerobic MTBE biodegradation was thus not observed.

Session 3 - Tools for Evaluating MTBE Biodegradation in the Field

This session focused on the use of molecular, isotopic and other innovative tools for evaluating the success of in-situ bioremediation in the field, and was moderated by Dr. Rula Deeb (Malcolm Pirnie, Inc.). The first speaker of this session was Dr. Kate Scow, a professor at the University of California at Davis. Dr. Scow discussed the use of molecular techniques as diagnostic tools for assessing the performance of in-situ MTBE biological treatment systems. Specifically, Dr. Scow focused on detection and isolation techniques of MTBE-degrading bacterial strains including PCR-based DNA fingerprinting and quantitative PCR.

Dr. Scow then discussed the applicability of molecular tools at several MTBE-impacted sites in California including Vandenberg Air Force Base and Port Hueneme.

Dr. Ravi Kolhatkar, a senior environmental engineer with a BP affiliated company focused his presentation on the use of stable carbon isotope analysis to demonstrate MTBE biodegradation in subsurface environments. First, Dr. Kolhatkar presented results from a site where anaerobic MTBE and TBA biodegradation was demonstrated intrinsically, and where biodegradation was shown to be the dominant natural attenuation mechanism at the site. A second case presented by Dr. Kolhatkar focused on evaluating the success of oxygen delivery to stimulate aerobic MTBE and TBA biodegradation. Dr. Kolhatkar concluded that carbon isotope measurements could be cost effective indicators of MTBE biodegradation when groundwater MTBE data are suggestive of a stable or shrinking plume.

The last speaker of this session was Dr. Patrick McLoughlin from MicroSeeps, Inc. who focused on analytical issues related to the measurement of MTBE and TBA in groundwater. Dr. McLoughlin discussed in detail the formation of TBA from MTBE hydrolysis when groundwater samples are preserved using acid. In addition, Dr. McLoughlin detailed the use and applicability of a range of analytical methods for the analysis of fuel oxygenates in groundwater.

Session 4 - Potential for Success of Monitored Natural Attenuation at MTBE-Impacted Sites: Industry and Regulatory Perspectives

This session involved a panel discussion on the use of monitored natural attenuation at sites contaminated with MTBE. The panel discussion was moderated by Mr. Jim Crowley from SCVWD. The four panelists (Mr. Kevin Graves from the State Water Resources Control Board, Mr. Matt Small from US EPA Region 9, Mr. Curt Stanley of Shell Global Solutions and Dr. Rula Deeb

Continued on page 18

"Although there is significant potential for MNA to be applied at well-defined low risk sites with limited sources, the panelists suggested that caution is necessary"

Highlights from GRA's Fifth Symposium on "Biological Treatment of MTBE Contamination in Groundwater: Ex-Situ and In-Situ Challenges" - Continued from Page 17

of Malcolm Pirnie, Inc.) gave short presentations with their perspectives on this issue. The audience then engaged the panel with tough questions exploring whether natural processes can be relied upon to restore groundwater contaminated with MTBE, and what types of sites could be amenable to Monitored Natural Attenuation (MNA) as a remediation strategy. Although there is significant potential for MNA to be applied at well-defined low risk sites with limited sources, the panelists suggested that caution is necessary in moving the first of these sites through the regulatory process. Additional research to reduce uncertainty, good practical guidance and rapid screening methods could make MNA a successful remedial strategy for many of California's low risk MTBE-impacted sites.

About the Authors . . .

Rula Deeb, Ph.D., is a senior project engineer and bioremediation specialist at Malcolm Pirnie, Inc., in Emeryville, CA. Over the last decade, she developed and implemented research programs focusing on the in-situ bioremediation of sites impacted with contaminant mixtures including gasoline aromatics and fuel oxygenates. Dr. Deeb is a recognized expert on the biodegradation of MTBE and TBA, and has co-authored over a dozen publications on this topic.

James (Jim) Strandberg, C.E.G., is Vice President at Malcolm Pirnie, Inc. in Emeryville, CA where he oversees the environmental restoration practice for the state. He has over 19 years of experience managing investigation and remediation projects involving a range of groundwater

and soil contaminants including petroleum hydrocarbons and chlorinated solvents.

Maryline Laugier is a project engineer at Malcolm Pirnie, Inc., in Emeryville, CA. She is working on a number of projects investigating the environmental fate and transport of MTBE and alternative fuel oxygenates, and the effectiveness of a range of technologies including bioremediation for the removal of MTBE from soil and groundwater.

James (Jim) Crowley is the Engineering Unit Manager of the Water Supply Management Division at the Santa Clara Valley Water District. He oversees both the Leaking Underground Storage Tank Oversight Program (LUSTOP) and the Solvent and Toxics Liaison Program in Santa Clara County. Mr. Crowley is an expert on the investigation and remediation of MTBE-impacted sites. ♪

GRA's 11th Annual Meeting 2002 - Sustaining Groundwater Resources: The Critical Vision - Conference Summary, Upcoming White Paper and Thank You's - Continued from Page 3

in this newsletter, it is not a new term. According to comments from colleagues, it has at least 25 definitions. For purposes of defining the framework for this Conference, our working definition of sustainability was: "Achieving sustainability occurs when a long-term balance between supply and demand is maintained with threshold limits established to mitigate the potential for unacceptable changes to the natural resources infrastructure."

Regardless of the groundwater management programs that have worked for many, many years in some basins and will continue to work in others, it is time to review those programs and also to develop new ones, as needed, to ensure that water resources are being managed to achieve and/or ensure sustainability. Management

begins with gathering the necessary data, but it obviously does not stop there; we need to know what our data are indicating and whether we are achieving the management goals or objectives that we have established. There is an increasing need to define and quantify critical groundwater issues and particularly to expand our knowledge of the interrelated

nature of the components of the hydrologic system in order to develop, implement, and/or maintain successful,

comprehensive groundwater management programs. A review of our groundwater management practices involves scientific analysis of how effective we have been at balancing our demand with our resources in the past and how we will do so in the future. While California is a leader in this arena, there are many instances where our

report cards are not yet singing success. Conference presenters brought forth many questions about quantifying sustainability and addressing the expanding pressures on our water resources including:

- ♪ How are we defining the current status (quantity and quality) of our resources;
- ♪ How are we determining the future availability of our water resources;
- ♪ How are we planning for the future distribution of our surface and groundwater resources;
- ♪ How are we determining the value of our resources for current and future needs;
- ♪ How are we protecting the quality of our resources; and
- ♪ How are we ensuring protection of our directly managed resources and also elements of the ecosystem intrinsically linked to our water resources?

Continued on page 19

GRA's 11th Annual Meeting 2002 - Sustaining Groundwater Resources - Continued from Page 18

Upcoming White Paper

A planned outcome of the Conference, that was set forth in early Conference planning, is preparation of a White Paper that summarizes the information presented in the special Plenary Assembly (Groundwater as a Component of the Natural Resources Infrastructure), the views expressed by the speakers, and the discussions that ensued. Many thanks are extended to Professor T. N. Narasimhan of the University of California at Berkeley for his contributions for the concept of the Conference, particularly the Plenary Assembly. Professor Narasimhan is leading the preparation of the White Paper. The purpose of this paper is to articulate, on behalf of the GRA, the actions that are necessary in California and elsewhere to ensure sustained benefit from groundwater resources for the present generation as well as for future generations. The critical vision expressed in the White Paper is based on the premise that the balance between water use and long-term groundwater sustainability

requires the concerted efforts of the sciences, law, and the humanities. The White Paper (now in preparation) begins with an overview of what we know about the science of groundwater (its nature, occurrence, movement, and influence), as well as its human aspects (history, institutions, and public perceptions). The Paper discusses the term "sustainability" and details the assumptions that underlie the approach that is taken towards a sustainable use of groundwater resources. The paper concludes with a discussion of actions that are recommended to achieve sustained groundwater use.

Other Conference Highlights

GRA President Jim Carter led the presentation of several annual GRA awards. GRA's first Special Recognition Award was presented to Bill Mills, former General Manager of the Orange County Water District, which has been a leader in water reclamation and recharge. The Kevin J. Neese Award for outstanding work during

the past year was presented to the Glenn County Water Advisory Committee for their adoption of a water ordinance this year. The Lifetime Achievement Award, in recognition of an exemplary contribution to the groundwater industry, was presented to Thomas W. Dibblee for his major contributions to field geology, stratigraphy, structural geology, and tectonics of California. During his career, he has mapped more geology in California than the entire size of many states and has walked over 30,000 miles during his mapping efforts. Of 500+ geologic maps that he has prepared, about 125 have been published. In his acceptance remarks, Dibblee simply and humbly stated "that was his job". His "job" has been cited an untold number of times by those in the groundwater profession. (For additional information on the Awards presentations, please see the related articles in this issue). ♠

Progress continues in the legislative arena - in a very active year - Continued from Page 6

Of the 10 percent of the membership that responded, the results were Support 74%, Undecided 16%, and Oppose 10%. GRA provided a letter of support for the proposition, on the basis of the email response of GRA members.

The elections are over and **Proposition 50: Clean Water and Coastal Protection Bond of 2002** has passed. And what does this mean? Approximately 44% of the \$3.44 billion bond crafted by the Nature Conservancy, Planning and Conservation League, Natural Resources Defense Council, Clean Water Action and the Metropolitan Water District of Southern California is dedicated to land acquisition with remaining funds dedicated to water supply (27%), water pollution (14%), drinking water (12.6%) and water security (1%). Of the Clean Water and Water Quality category, roughly \$100 million is allocated for restoration and protection of groundwater quality. An additional \$50

million is set aside for statewide groundwater monitoring funding as part of the AB 599 process from the Integrated Regional Water Management category. We will see over the next several months how implementation occurs, and just how the funding gets rolled out and when.

Legislative Committee and Development of Legislative Guidelines

The Executive Director, Kathy Snelson, recently forwarded the names of individuals interested in either the Legislative or Regulatory Committee, names collected during 2002 membership renewals. The Legislative Chair will be contacting those individuals and finding out who is interested in joining the Legislative Committee and determining how to best improve the current process.

Over the winter, the Legislative Committee will be developing Legislative

Guidelines for GRA. The guidelines will be focused on several groundwater issues to give some direction to the effort, yet broad enough to cover a wide range of elements, and will incorporate GRA's mission. The Legislative Guidelines will lay out the ground rules for GRA's approach to responding to legislative initiatives to promote consistency and coordination in legislative matters. They will assist the GRA in: (1) determining official GRA positions on issues; (2) identifying primary responsibilities for legislative measures; (3) preparing and submitting testimony, information, and reports to the legislature; and (4) enhancing effective communication with the legislature.

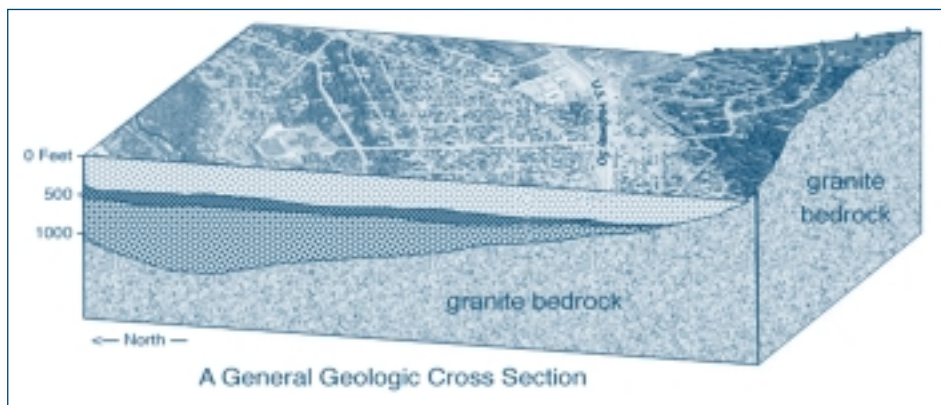
The Legislative Committee will be providing the guidelines to the GRA Board of Directors in January 2003 and to the Membership subsequent to Board approval. For updates on legislation - see the GRA Web Page at www.grac.org. ♠

Operating Agreement, is settled. The Truckee River, the only outlet for the entire Lake Tahoe basin, is the primary water source for thousands of stakeholders in Nevada as well as in California. Until the Truckee River Operating Agreement is settled, South Shore residents must continue to use groundwater as their only water supply.

and #2. The District eventually destroyed Arrowhead Wells #1 and #2 and constructed another well, Arrowhead #3, at the same location but screened in the deeper aquifer below the aquitard. The District analyzes Arrowhead Well #3 water at a detection limit of 0.2 ug/L and has detected MTBE at concentrations between 0.2 and 0.4 ug/L.

containing MTBE. Some defendants settled prior to a trial. In August 2002, the District reached a settlement with the remaining defendants, concluding a jury trial that began in September 2001. The total payments to the District, including settlements before the trial, were just over \$69 million. In April 2002, the jury issued an unprecedented special verdict that MTBE and gasoline containing MTBE were defective products. The jury also found “clear and convincing” evidence that two of the defendants acted with malice. The jury was hearing evidence about the District’s damages when the settlement was reached.

David Harpole, a spokesperson for Lyondell, one of the defendants in the lawsuit, said “MTBE has been unfairly maligned. The problem has been leaking underground storage tanks.” Apparently, the jury did not agree. The South Lake Tahoe case, one among dozens throughout the United States suing over MTBE contamination, set a precedent as “the first time that any jury has ruled that gasoline containing MTBE was a defective product,” said Washington environmental lawyer Steven Leifer. It was the first in the country to go to trial on the theory that the manufacturers of MTBE and the refineries were responsible for damage done to public drinking water supplies by MTBE.



Background

The local water purveyor, the South Tahoe Public Utility District (District), operated 35 supply wells in the South Shore until shutting down 10 wells because of MTBE detections in the well water and shutting down five wells threatened by MTBE plumes. Many of the wells that were shut down were screened in a shallow aquifer overlying a clay aquitard that has been observed in some parts of the South Lake Tahoe area subsurface. Some of the wells are screened in a deeper aquifer underlying the clay aquitard and consequently received a greater degree of protection from MTBE pollution. In 1997, the District discovered MTBE in Arrowhead Well #2 at a concentration of 1.4 micrograms per liter (ug/L) from a UST piping leak located approximately 1,300 feet from the well. Arrowhead Well #2’s well screen extended from above the clay aquitard to below the aquitard. Subsequent sampling and analysis showed MTBE concentrations rising. Continued operation of the well, and adjacent Arrowhead Well #1 (screened in the shallow aquifer), would have drawn the MTBE plume into the wells resulting in MTBE concentrations exceeding drinking water standards. Consequently, the District shut down Arrowhead Wells #1

Under the direction of the Lahontan Regional Water Quality Control Board, environmental contractors removed contaminated soil in the vicinity of the UST that was the source of MTBE in the Arrowhead wells, and groundwater in the source area was treated so that groundwater concentrations of MTBE at the source are typically less than 5 ug/L.

Because of the severe impacts to groundwater quality by MTBE releases (and the apparent skepticism in the effectiveness of UST containment), the El Dorado County Board of Supervisors passed an ordinance in April 2000 banning the sale of gasoline containing MTBE in the El Dorado portion of the Tahoe basin. The El Dorado County portion of the Tahoe basin includes the South Shore.

The Lawsuit

In November 1998, the District filed suit in San Francisco Superior Court against numerous defendants including refiners, manufacturers, and distributors of gasoline

Regional Board Closure Evaluations

What is the regulatory role for MTBE in South Lake Tahoe groundwater, specifically for site closure evaluations?

Cleanup levels are established pursuant to State law, Regional Board basin plans, and State Board policies. Regional Board staff evaluate sites on a case-by-case basis and

determine whether appropriate cleanup level criteria have been met before issuing a “No Further Action Required,” or closure, letter.²

“first trial in the country on the theory that the manufacturers of MTBE and the refineries were responsible for damage done to public drinking water supplies by MTBE”

Continued on page 21

Regional Board Staff promote cleanup to background conditions if reasonable. For a man-made substance like MTBE, “background conditions” mean the substance cannot be detected by standard laboratory analyses. In practice, it has been found that cleanup costs increase significantly as MTBE concentration levels in the aquifer approach detection limits. In some cases, the costs to further reduce MTBE concentrations in the aquifer below the established water quality objective of 5 ug/L are considerable and the treatment methods would probably not reduce the MTBE concentrations significantly further. Regional Board Staff evaluates other criteria such as sensitive receptors, mobility and mass of the plume, the threat to pollute additional groundwater, and the length of time MTBE concentrations are expected to reach non-detect levels. If all of the above criteria (plus other site-specific factors that may pertain) are met, the Regional Board may not require further action. (Although the Regional Board has used the strictest established water quality objective [5 ug/L] to close over 20 sites since 1992, no site in the Lahontan Region or in the state has been closed in which the MTBE continues to be detected in a private or municipal supply well.)

Regional Board staff believe this current process conforms to the 1995 Water Quality Control Plan for the Lahontan Region (Basin Plan), California Water Code provisions, and State Water Resources Control Board Resolutions 68-16 and 92-49.

Current Situation

The Regional Board is not currently requiring the groundwater in the aquifer in the vicinity of Arrowhead Well #3 to be treated to non-detect levels. The District, however, has adopted a “no-MTBE” policy. This non-detect policy means that the District will not serve its customers water with MTBE above their current detection limit of 0.2 ug/L. The current

solution adopted by the District is to treat the groundwater at the wellhead.

The District installed a wellhead treatment system to remove the low levels of MTBE in the groundwater that is pumped to the surface. The wellhead treatment system at Arrowhead Well #3 is a proprietary system designed by Applied Process Technology that mixes hydrogen peroxide and ozone to form an oxidant that reacts chemically with MTBE and other volatile organic compounds, thereby converting them to carbon dioxide and water. The carbon dioxide is vented off and the water is returned to the drinking water distribution system. The system operates at a production rate of 800 gallons per minute. The District paid approximately \$1.4 million to purchase the system, install support facilities, and to initiate operation. The wellhead treatment costs \$3,500 per month to operate under current conditions.

The District anticipates the groundwater quality in the aquifer will return to background conditions in a matter of months or years and is prepared to move the treatment system to another well when it is no longer necessary at Arrowhead Well #3. There are other wells in the South Shore screened in groundwater that is impacted with concentrations of MTBE below 5 ug/L. These wells are candidates for wellhead treatment.

Conclusion

Regional Board staff, based on current law and policy and the significant cleanup costs, believe it does not serve the interests of the people of the State to clean up the MTBE in groundwater near Arrowhead Well #3 to non-detect levels. The Regional Board has used source excavation coupled with onsite groundwater remediation and offsite groundwater hot-spot remediation to reduce and control MTBE contamination to reasonable levels that meet, or will meet, water quality

objectives, and the District has used wellhead treatment to meet the District’s goal of providing MTBE-free water to its customers.

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- ² 2001, California Regional Water Quality Control Board, Lahontan Region, *Staff Report*, presented to the Regional Board on May 10th.

About the Author

Richard Booth worked as a hydrogeologist in a consulting firm for nine years before joining the California Regional Water Quality Control Board, Lahontan Region, in March 2001. He holds undergraduate degrees in mathematics and geology and a Master’s Degree in Hydrology/Hydrogeology from the University of Nevada, Reno and is a state California Registered Geologist and a Certified Hydrogeologist. Mr. Booth lives in South Lake Tahoe and drinks the District’s water, primarily from Arrowhead Well #3. He can be contacted at (530) 542-5574 or Rbooth@rb6s.swrcb.ca.gov.

“This non-detect policy means that the District will not serve its customers water with MTBE above their current detection limit of 0.2 ug/L.”

Problems Abound in Lining the All American Canal - Continued from Page 5

to the seep water from the Canal and that it will be illegally harmed by the lining of the Canal. Mexico has argued that groundwater rights were “grand-fathered” in to the treaty, even though they are not expressly mentioned, because they constituted the background of water rights when the treaty was signed. Mexico also claims that the US has not fulfilled its obligations to consult with Mexico on border water issues, as it is required to do under a supplement to the 1944 treaty. Expanding the capacity of the Canal to allow for transport of Mexican treaty water, in addition to the IID entitlement, has been discussed, but not finalized.

The US position is that the treaty does not cover groundwater and Mexico has no rights to the seep water from the Canal. Moreover, the US claims that the lining issue has already been resolved through consultations with Mexico, completed in 1993, pursuant to the treaty supplement’s directive.

Further complicating matters are the concerns of environmentalists about the effect of reduced Colorado River water flows to the delta in Mexico. Environmentalists are claiming that environmental laws, particularly the Endangered Species Act, apply even to extraterritorial impacts. That is, actions taken within the United States must be considered in light of their effects on the environment outside of the United States, such as in the Colorado Delta in Baja California.

“The best interpretation is that [the ESA] does apply to this case.” Buzz Thompson, of Stanford University School of Law, added: “Looking at the goals of the [Act], there’s no good policy justification for not applying it to extraterritorial impacts.” However, the Bureau of Reclamation, one of many water agencies having a role in management of the Colorado River, has gone on record saying that the ESA does not apply to extraterritorial effects.

If environmentalists win this debate, it will put more pressure on the US to continue groundwater seepage from the Canal because farmers in the Mexicali Valley, and elsewhere in northern Mexico,

may have less Colorado River surface water to rely on.

It is not clear exactly when the canal lining project will be completed, but in all likelihood this project will go forward. This conclusion is made more likely due to the recent deal reached between the San Diego County Water Authority, IID, MWD, and Coachella Valley Water District, to transfer up to 200,000 af per year from the Imperial Valley to San Diego. This transfer is, with the Quantification Settlement Agreement, one of many inter-related agreements designed to help the state of California satisfy the federally imposed Interim Surplus Guidelines. These Guidelines require California to live within its allocated Colorado River water rights – 4.4 million af per year as opposed to the 5.2 million af we have been using – by December 31, 2002. If the Guidelines are not satisfied by this date, California will lose the benefit of any excess water from the Colorado River. Therefore, if the QSA and the SD/IID transfer were not completed, California would lose approximately 800,000 af of water per year – a potentially catastrophic cutback.

In closing, the All American Canal, like all large water projects, has its share of controversy. However, the actual and alleged harms must be weighed against the countervailing considerations, as much as such weighing is possible, and the tough policy choices must be made considering all the relevant consequences. This policy debate is, of course, influenced by the international legal issues outlined above. The lining project is, like the San Diego/IID transfer, part of a much larger effort to ensure California’s long-term water supply. Therefore, the importance of these projects may well outweigh their acknowledged drawbacks.

Tamlyn Hunt is an attorney with the law firm of Hatch & Parent, in Santa Barbara. He attended the UCLA School of Law and practices primarily water rights law. He also has experience in environmental and international law. He may be reached at (805) 963-7000, or THunt@HatchParent.com.

2002 Kevin J. Neese Award Given to the Glenn County - Continued from Page 12

The intent of the ordinance was to allow the WAC to develop management objectives for operating the groundwater basin. The objectives resulted in thresholds that provided a “value system” for defining acceptable versus unacceptable changes in groundwater in the basin. The ordinance required threshold values for groundwater levels, groundwater quality, and land surface subsidence.

In 2002, the WAC adopted basin management objectives for groundwater levels in 17 areas within the County that use groundwater, which were subsequently approved by the Board of Supervisors. This year, the thresholds for groundwater levels were adopted, and the WAC is now working on thresholds for groundwater quality and land subsidence.

GRA congratulates the Glenn County WAC and the Board of Supervisors for providing leadership through the first ordinance to require management objectives and threshold values for basin management.

GRA 2002 Lifetime Achievement Award Presented to Thomas W. Dibblee - Continued from Page 12

Recipient of so many honors and awards, from so many prestigious organizations; and even an award to you from a President of the United States.

In the course of mapping almost 400 quadrangles over seventy years, you have probably walked the equivalent of ten times across the United States or once around the world – and perhaps more.

How pleased we are to present you with the 2002 Lifetime Achievement Award for your contributions to the groundwater industry.

Stay with us, Tom. We still need your help.

Editor’s Note: The above article is a summary of Joe Birman’s comments when he presented the 2002 “Lifetime” award to Thomas Dibblee at GRA’s 11th Annual Meeting and Conference. Joe Birman was GRA’s 2000 Lifetime Achievement Award recipient.

makers not affiliated with the better-equipped meth gangs typically get their red phosphorous by dissolving highway flare striker caps, or the striker pads from match books. There may be more operating labs than labs that have been shut down by enforcement actions. The District is obtaining records on locations of meth lab arrests and the hazardous waste found at the sites of these labs in order to assess potential impacts to watersheds and groundwater basins. It will not be possible to quantify this potential source of perchlorate; however, this possible source may play a role where no better explanation can be found.

5) **Analytical artifacts due to matrix interferences:** Nearly 500 of the more than 4,500 reported UCMR analyses were less than 5 ug/L, whereas the most common laboratory reporting limit for perchlorate is 4 ug/L. There has been a sudden increase in the demand for perchlorate analytical services, and there may be an accompanying learning curve for commercial labs new to the use of ion chromatography for low-level perchlorate quantification. Laboratories routinely maintain rigid internal quality control programs and report results for spiked control samples with every batch of analyses. However, most users of laboratory services do not take the extra verification step of submitting double blind standards to directly understand how performance issues specific to their sample matrix, such as interference from other ions, may affect the validity of reported results.

The ion chromatography (IC) method relies solely on retention time for perchlorate identification, as the electrical conductivity detector used for this method is nonspecific and will respond to any anions passing through it. Identification and quantification of low levels of perchlorate by IC can be problematic when the water matrix contains other anions, such as sulfate, at much higher concentrations than perchlorate. In such cases, the target perchlorate ion may not appear as a distinct peak on the chromatograph, but instead as a small shoulder on the broader peak of another ion. Also, excessive noise in the retention time window of perchlorate may lead to a false positive detection of perchlorate. An

alternative method, electrospray ionization mass spectrometry/mass spectrometry (ESI/MS/MS), has been used primarily by research scientists to quantify perchlorate at lower detection limits and with much higher confidence in perchlorate identification. A study contrasting these two methods for analysis of perchlorate-contaminated groundwater samples found no statistically significant differences in accuracy above the detection limits of both methods. Users of commercial laboratories can seek to assess potential interferences by requesting that their matrix be spiked, and by splitting samples between two laboratories running the same method. An additional measure worth considering is the submission of double blind standards with perchlorate concentrations near the reporting limit, commercially available from firms such as ERA in Arvada, Colorado. The fact that commercial laboratories in general maintain excellent quality control records and are operated in a highly professional manner does not relieve the user of these services from the obligation to play an active role in determining the accuracy of results.

The large number of UCMR results found just above the common commercial laboratory IC reporting limit of 4 ug/L raises the question of whether sample matrices may be resulting in false positive results. The District is weighing the benefits of conducting a round-robin study of laboratory performance for perchlorate analysis by IC, to better understand the results found in Santa Clara County.

Many water utilities have yet to complete the UCMR testing for perchlorate. The deadline is 12/31/03. Recently signed legislation (Senate Bill 1822 by Sen. Byron Sher, D-Stanford) requires that California adopt a Maximum Contaminant Level by January 1st, 2004. Sage water utility operators will complete their UCMR perchlorate testing as soon as possible to allow sufficient time for resampling, source investigations, or other strategic initiatives related to the possible discovery of perchlorate in their water supplies.

Thomas K.G. Mohr, C.E.G., C.H., is the Solvents and Toxics Cleanup Liaison for

the Santa Clara Valley Water District, and a GRA Director. Jim Crowley, P.E., is the Engineering Unit Manager of the District's Underground Storage Tank Program. Thanks to Dr. Harry Beller of LLNL for the expert analytical chemistry advice.

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GRA Events for 2003 - Continued from Page 3

In June, GRA will co-sponsor the Lower American River conference at California State University Sacramento, which will focus on climate, fisheries, and groundwater.

In August, GRA will team with NGWA and the American Petroleum Institute for an MtBE Conference in Costa Mesa.

September is GRA's Annual meeting, which will be held jointly with the University of California Biennial Conference on Groundwater.

If you would like to help plan, organize, and present GRA's seminars, classes, and workshops, volunteers are welcome. To register your interest in participating on GRA's seminar committee, please contact Tom Mohr, Seminar Chair, at 408-265-2607x2626, or e-mail him at tmohr@valleywater.org. ♣

Revolution

GRA's Board of Directors voted during their April 2002 Bboard meeting to support the following a resolution developed by the National Conference on the Revolution in Earth and Space Science Education (Revolution) held in June 2001. This National Science Foundation (NSF) funded conference was held to develop a "vision and 'blueprint' for K-12 Earth and space science education reform for the next decade."²

"As our nation deliberates on education policy and funding, we, as leading science educators and scientists, call for legislators, decision makers and stakeholders to implement all measures that support science education in general and earth and space science in particular.

Fueled by new technologies over the last 40 years, advances in Earth and space science are revolutionizing our understanding of Earth's systems and processes. This growing understanding is increasingly needed to inform political and economic decisions of local, national and global impact.

For this reason, a science-literate citizenry is vital to the nation's well being and security and will insure our nation's continued leadership in science and technology in the 21st century. To empower the public to make sound and reasoned choices, earth and space science must be taught throughout the United States in K-12 classrooms and be accessible to all students." - National Conference on the Revolution in Earth and Space Science Education, Snowmass, CO, June 2001²

Key recommendations from the Revolution are to:

- Establish state-based alliances to promote Earth and space science (ESS).
- Promote student learning experiences that have a stronger emphasis on inquiry-based learning, use of visualization technologies and understanding Earth as a system.
- Promote the approval at the high school level of Earth and space science ESS as a lab science, with depth and rigor akin to biology, chemistry and physics.
- Create national and state professional

development academies in Earth and space science ESS.

- Enhance access to high-quality Earth and space science ESS education for students and professional development for teachers.
- Develop a strong research program in Earth and space science ESS education.

These recommendations are worthy of the support of GRA. The concept of Earth as a system is one that is most appropriate for our multidisciplinary profession. The Revolution indicates that "Understanding Earth as an integrated system of components and processes has become the dominant paradigm in Earth and space science research - and should become the central unifying principal in Earth and space science education as well. Students should not experience Earth and space science as a series of topics, but rather as a whole system - the interconnected geosphere, hydrosphere, atmosphere and biosphere."²

Funding was sought from the NSF for phase II of the Revolution, which was to create state-alliances and implement a portion of the recommendations. Due to reduced funding, the NSF was denied recently, and the phase II Revolution funding in early October 2002. The Revolution is currently pursuing other sources of funding.

California Alliance for Earth and Space Science Education Formed

On a related note, The California Science Teachers Association (CSTA) formed the California Alliance for Earth and Space Science Education (CAESSE) in December 2001. CSTA agreed to fund CAESSE even if NSF funding for phase II was not obtained. As a participant of the June 2001 Revolution, science teacher and GRA Board Member, I was asked to join the Steering Committee for CAESSE. On August 20, 2002, the Steering Committee met to develop its goals and to focus its energies on promoting Earth system science education within the State.

CAESSE is currently acquiring templates of Earth and space science laboratory courses that have been accepted by the University of California System as

rigorous enough to serve as a laboratory for college entry. These templates will be promoted to other schools so that their Earth and space science laboratories can also be accepted.

In addition, CAESSE is examining the potential for tying Earth and space science content standards to specific job skills so that high school students have marketable skills that may be used toward Earth science careers. Also, by tying content standards to job skills, we may be able to access funding from the Department of Labor to help improve Earth and space science education by training new and existing teachers. CAESSE is expected to meet within the next quarter to further develop their mission.

What Happens Now?

GRA is in the wait and see mode. We need to determine what CAESSE will be doing in California, and how we can support their efforts. Individuals with suggestions on how CAESSE can proceed can or wanting to assist GRA promote Earth and space science education in other ways should contact GRA's Education Committee at education@grac.org.

References

¹ State Board of Education, 2002. Science Framework for California Public Schools, Kindergarten Through Grade Twelve. Adopted by the on February 6, 2002, Subject to technical editing.

² Barstow, Daniel, 2001, Editor. Blueprint for Change: Report from the National Conference on the Revolution in Earth and Space Science Education. June 21-24, Snowmass, Colorado. <http://www.EarthScienceEdRevolution.org>.

³ Ridky, Robert, 2002. Why We Need a Corps of Earth Science Educators. Geotimes, September, pp. 16-19. <http://www.geotimes.org>

Susan Garcia is a teacher at Colin L. Powell Academy in Long Beach Academy and is Chair of GRA's Education Committee. She may be contacted at ssgarcia55@cs.com.

San Francisco Bay Branch Highlights

BY GARY FOOTE, BRANCH PRESIDENT

The San Francisco Bay Branch is wrapping up 2002 with two major events and is beginning to make plans for 2003.

The October 16, 2002 Branch meeting was a kick-off event for GRA's Fifth Symposium in its *Series on Groundwater Contaminants*, "Biological Treatment of MTBE Contamination in Groundwater." Nearly 50 people attended the Branch meeting, which was held at the Doubletree Hotel in San Jose. Murray Einarson delivered a very thought-provoking talk about impacts to South Lake Tahoe water supply wells from non-point sources of MTBE.

On November 14, 2002, the Branch will be conducting a workshop on environmental forensics at the Holiday Inn located in Emeryville. The workshop will feature nine speakers from the consulting, professional, and academic communities. Topics will include inverse plume modeling, gasoline age dating using lead isotopes, underground storage tank corrosion, complex chemical fingerprinting, fuel fingerprinting, Superfund case histories, the Daubert Rule

and expert witnessing. The workshop will be held from 12 noon to 9:00 p.m. with a coffee break and dinner included. Workshop participants will receive a notebook containing speaker presentation materials. Check out GRA's Web site or contact Bill Motzer, workshop coordinator (bmotzer@toddingengineers.com), for details.

In January 2003, the Branch plans to have its annual update from San Francisco Bay Regional Water Quality Control Board staff. The update typically includes information about important policy and program changes, emerging trends, outlook for the future, and new projects being conducted by Board staff.

Southern California Branch Highlights

BY TONY MAGGIO, PRESIDENT

The Southern California Branch was extremely happy with GRA's 11th Annual Meeting and Conference held in Newport Beach in September 2002. The Branch was involved with Orange County Water District (OCWD) in setting up the field trip on September 17th, the day before the Conference. The attendee's of the field trip were treated to an informative afternoon viewing the groundwater

spreading grounds along the upper Santa Ana River, Water Factory 21 which treats wastewater for recycling, and the seawater intrusion barrier project which is actively maintained by injecting Factory 21 water under pressure to create a barrier to seawater flow towards the basin. Many thanks to Roy Herndon, Tim Sovich and Marina West of the OCWD for their time and effort in coordinating an enjoyable and educational field trip!

The Branch's November meeting will feature a presentation by Mr. Robb Whitaker, P.E. of the Water Replenishment District of Southern California, a regional groundwater agency that manages 40% of the total demand for water to nearly 4 million residents in southern Los Angeles County. The WRD has responsibility for protecting the Central and West Basins of Los Angeles through groundwater replenishment, deterrence of sea water intrusion and groundwater quality monitoring of contamination. Several programs are underway to attain these objectives, including the diversion and spreading of water into ponds along the Rio Hondo and San Gabriel River spreading grounds, injecting replacement water into barrier wells to prevent seawater intrusion into the West Basin, maximizing the use of recycled water and storm water runoff to reduce loss to the ocean, and establishing a series of Clean Water Programs to safeguard water quality.

In addition to the November 2002 meeting, the Branch is in the process of lining up speakers for its 2003 meetings and discussing a seminar of interest to a large number of its members. More to come on these future items of interest!

Sacramento Branch Highlights

Due to space limitations, the Sacramento Branch highlights will be presented in the Spring 2003 edition of *HydroVisions*.

- Editor

Hydrovisions 2003 Advertising Rates

4 Issues Annually

Blue & White cost per issue	1x	4x
1/4 page	\$175.00	\$150.00
1/2 page	350.00	275.00
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The above prices assume advertisements are received camera ready (via film).

For additional information, visit GRA's Web site at www.grac.org or contact Kathy Nelson, GRA Executive Director, at executive_director@grac.org or 916-446-3626.

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GRA Welcomes the Following New Members

SEPTEMBER 11, 2002 - NOVEMBER 8, 2002

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Robert Beggs
Richard Bell
Margaret Bloisa
James Burton
Regina Bussard
Kevin Calcagno
Orlando Carreno
John Copeland
Brad Cross
Todd Del Frate
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Matthew Earnshaw
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William Guarini
Peter Halpin
Jeffrey Hamilton
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Dates & Details

GRA MEETINGS AND KEY DATES

(Please see page 3 or visit www.grac.org for detailed information, updates, and registration unless noted)

- **GRA Strategic Planning and Board Meetings** **January 18 & 19, 2003**
Newport Beach, CA
- **Low Yield Aquifer Testing** **March, 2003**
TBD
- **GRA Board Meeting** **April 5, 2003**
Sacramento, CA
- **Indoor Air Risk From VOC Plumes** **April, 2003**
Oakland, CA
- **GRA Board Meeting** **August 9, 2003**
Point Richmond, CA
- **GRA Board Meeting** **November 8, 2003**
Sacramento, CA

Other Key Dates *(programs in which GRA is a Co-Sponsor or Cooperator)*

- **NGWA/AGWSE 2002 Annual Meeting and Conference:** **December 8-11, 2002**
Las Vegas, NV
“Linking Surface and Subsurface Hydrology - From Science to Technology”
- **NGWA Southwest Focus Conference:** **February 20-21, 2003**
Phoenix, AZ
“Water Supply and Emerging Contaminants”
- **Lower American River Conference** **June 2003**
(coordinated by CSUS) Sacramento, CA
- **API/NGWA Petroleum Hydrocarbon Conference** **August 19-22, 2003**
Costa Mesa, CA



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