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GROUNDWATER RESOURCES ASSOCIATION OF CALIFORNIA

Fall 2002

Nitrate: California's Oldest 'New' Contaminant

BY JUDY BLOOM

The schedule for the Nitrate in Groundwater Symposium: Sources, Impacts, Solutions, November 12 -13, 2002 is on page 3. For a complete schedule of speakers, topics, hotel and registration information, please go to www.grac.org.

With interest in the contaminant du jour - MTBE one week, pharmaceuticals another - we report with mixed emotions that nitrate in California's groundwater is making a comeback. Actually, every ground water professional knows that nitrate never really went away. Nitrogen (N), nitrate (NO_3), and nitrite (NO_2) have just been hanging around out there, waiting for their next notorious claim to fame.

The United States Geological Survey looked at domestic wells in the eastern San Joaquin Valley sampled between 1993-1995 and found that 24 percent exceeded the maximum contaminant level (MCL) of 10 milligrams/liter (mg/l) nitrate-as N (NO_3-N), established by the U.S. Environmental Protection Agency (EPA).[1] Whether this study is an indication of what could be found in other areas of California is not clear. Considering the volume of nitrogen that is applied to croplands, golf courses, and suburban yards, and percolates from on-site septic systems, wastewater treatment recharge, and animal feeding operations, perhaps we need to be prepared.

Sources

In California, the EPA estimates that there are more than 1.3 million septic systems currently in use.[2] The U.S Department of Agriculture reported that in 1997, dairy operations in California produced over 4 million tons of dry manure, a 48% increase (148% but only a 48% increase) from the 2.8 million tons produced in 1982.[3] In 2001, more than 600,000 tons of nitrogen fertilizers were sold in California for application to croplands, golf courses, parks, and suburban lawns.[4] While these are statewide estimates, most of the sources are concentrated in the more rural parts of the state. Additional sources of nitrogen include recharge of treated wastewater from treatment plants and atmospheric deposition.

Reliance on Groundwater

In 2001, more than 34 million people called California their home. While the population of California is expected to double in the next 40 years, the population in the Central Valley is expected to triple. Californians will need more food to eat, more water to drink, and more places (or other alternatives) to put wastes. Between 40 to 60% of the total population (depending on whether it's a wet or dry year) rely on municipal water that is comprised of groundwater or a blend of surface and ground waters. Currently about 1/2 million Californians utilize water from their own private drinking water well. When a private well goes 'bad' and nitrate levels are above the MCL, the private well owner has few alternatives - bottled water or deepen/replace the existing well. Surprisingly, the alternatives for the municipal drinking water utility are much the same. Due to the complexities and cost of treatment, municipal operators will generally either deepen the well, abandon the well, or blend the contaminated water with another source to reduce the level of the nitrate below the MCL before serving it to the public.

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

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President's Message

BY JIM CARTER

I am pleased to report that the GRA membership has continued to grow and we are expecting to have more than 800 members by the end of this year! As GRA continues to grow, we are blessed with new challenges for resources and a need more than ever for volunteers. I have asked the Committee Chairs to add volunteers, so if you would like to be part of a committee please contact our Executive Director, Kathy Snelson. The Committees that we are looking to expand include the Annual Meeting; Awards; Education; Electronic Communications; Finance; Hydrovisions; Legislative; Membership; Seminar and Technical Advisory Committee. If you already volunteered as part of your Membership Application and if you don't hear from us by November, please give Kathy a call.

GRA is close to rolling out an enhancement of the web site—the Membership Management System. This system will allow members to access the database of current GRA members, sign up for symposia and workshops and even update your information all online. You will be able to view the name, organization, phone, etc. of all current members, and even sort the database by last name, organization, or branch. Look for this value-added service soon!

We still have several activities planned including Principles of Groundwater Flow and Transport Modeling (September 25-27, Redwood City), Bioremediation of MtBE (October 17th, San Jose), Drinking Water Source Assessment (October 3-4, Livermore) and Nitrate in Groundwater (November 12-13th, Fresno). Please try to attend and let your colleagues know of these great events.

This has been a very busy and productive year for GRA, and I want to make sure that we maintain and grow the value of membership. I encourage you to become active in your Branch or on a Committee, and I ask for your ideas on how GRA can improve. Thanks!

Jim Carter
GRA President

California Colloquium on Water Lecture Series

BY LINDA VIDA, WATER RESOURCES CENTER ARCHIVES

Water is the lifeblood of California. Without it, the landscape that we know today would not exist. The popular California Colloquium on Water lecture series continues in fall 2002 on the UC Berkeley campus, where scholars of distinction in the fields of natural science, engineering, social sciences, humanities, law and environmental design give monthly lectures to increase the understanding and appreciation of water resources in California. The lecture series is financially co-sponsored by the UCB Center for California Studies, and the Deans of the College of Engineering, College of Environmental Design, College of Letters and Science, College of Natural Resources, the Boalt Hall School of Law, the UCB Provost, the Metropolitan Water District of Southern California and the Water Resources Center Archives.

Before each lecture, a reception is held from 4:45 - 5:30 pm at the Water Resources Center Archives, 410 O'Brien Hall, UCB campus. All lectures will be held in 3 Le Conte Hall from 5:30 - 7:00

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Upcoming Events

Nitrate in Groundwater: Sources, Impacts and Solutions

November 12 & 13, 2002
Radisson Hotel & Convention Center, Fresno, CA

Tuesday, November 12

12:00-12:50 p.m.
Registration

12:50-1:00 p.m.
Welcome and Opening Remarks
Jim Carter, GRA President

1:00-2:00 p.m.
Overview of Legal/Regulatory Framework
Moderator: *Tim Parker, CA Department of Water Resources*
"The Use of Federal Authorities"
Speaker TBA
"Porter Cologne, Basin Planning, and Beneficial Uses"
Jo Anne Kipps, Central Valley Regional Water Quality Control Board, Fresno Office
"Evaluation and Mitigation of Nitrate Impacts under the California Environmental Quality Act (CEQA)"
Kevin O'Dea, C.E.G., Baseline Environmental Consulting

2:00-3:00 p.m.
Impacts on Beneficial Use and Public Health
Moderators: *Tracy Hemmeter, Santa Clara Valley Water District*
Cindy Forbes, CA Department Of Health Services
"A Comparison of Nitrates With Other Constituents of Concern"
James Giannopoulos, P.E., State Water Resources Control Board
"Nitrate Issues in Rural Water Systems"
Bill Luikart, California Rural Water Association
"Nitrates: Health Effects and U.S. EPA's Review of the Nitrate Standard"
Bruce Macler, Ph.D., U.S. Environmental Protection Agency

3:00-3:20 p.m.
Break in Exhibit Hall

3:20-4:45 p.m.
Nitrogen Cycling and Chemistry
Moderator: *Thomas Harter, University of California, Davis*
"Nitrogen Sources, Cycling and Vadose Zone Monitoring"
Jeff Bold, Ph.D., Montgomery Watson Harza
"Use of Isotope Analysis in Nitrate Source Characterization"
John Suen, Sc.D., California State University Fresno
"Denitrification in Aquifers"
Roy Spaulding, Ph.D., University of Nebraska

5:00-6:30 p.m.
Reception in Exhibit Hall

Wednesday, November 13

7:30-8:30 a.m.
Registration/Continental Breakfast

8:30-9:00 a.m.
Keynote Presentations:
C. Brian Haddix
Undersecretary, California Environmental Protection Agency
Ann M. Veneman (invited)
Secretary of the US Department of Agriculture
Jean-Mari Peltier (invited)
Agricultural Counselor to the EPA Administrator

9:00-10:20 a.m.
Occurrence, Transport and Monitoring
Moderators: *William Pipes, Geomatrix Consultants, Inc.*
Sarah Raker, San Francisco Bay RWQCB
"Nitrate Trends in Shallow Groundwater of the San Joaquin Valley"
Karen Burow, USGS
"Nitrate in Domestic Wells in Santa Clara"
Tracy Hemmeter, Santa Clara Valley Water District
"Dairy Monitoring and Monitoring Options"
Thomas Harter, Ph.D., UC Cooperative Extension
"Sources of Nitrate to Groundwater and Supply Well Construction"
Kenneth D. Schmidt, Ph.D., Kenneth D. Schmidt & Associates

10:20-10:40 a.m.
Break in Exhibit Hall

10:40 a.m.-12:00 p.m.
Source Controls and Treatment Strategies
Moderators: *Jeffrey Bold, Montgomery Watson Harza*
Denise Mullinax, Hilmar Cheese
"Tales From the Shallow Zone: Case Studies and Experience with Nitrate in Shallow Groundwater"
Carolyn Kneiblher, C.HG., GeoSyntec Consultants
"Remediation of a Nitrate Impacted Shallow Low Permeability Aquifer Using Phreatophyatic Tree Species"
Paul Deutsch, CPSS, Geomatrix Consultants, Inc.
"Managing Dairy Manure Applications to Minimize Groundwater Contamination"
Marsha Campbell Matthews, Ph.D., UC Cooperative Extension
"Land Application of Food Processing Wastewater"
Ron Crites, Brown and Caldwell

12:00-1:30 p.m.
Lunch
Keynote Presentation: *Senator Jim Costa, California Legislature*

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The Colorado Supreme Court Weighs in on Rights to Use Subterranean Storage Space

BY RUSSELL MCGLOTHLIN, ESQ.

With growing water demand and limited surface storage resources, use of surplus subterranean storage space has become a valuable and coveted resource. However, the legal framework for its use has not yet fully developed. One persistent issue is whether overlying landowners can control the use of storage space beneath their land. A convincing argument can be made that California precedent has already decided against landowners on this issue. *See City of Los Angeles v. City of San Fernando, 14 Cal.3d 199, 264 (1975); City of Los Angeles v. City of Glendale, 23 Cal.2d 68, 76-77(1943); and Niles Sand and Gravel v. Alameda County Water Dist*., 37 Cal.App.3d 924. If the California courts follow the lead of a recent Colorado Supreme Court Case, such claims will be conclusively put to rest.

In an opinion earlier this spring, the Colorado Supreme Court held that landowners can not enjoin, and have no right to compensation for, non-injurious use of the storage space beneath their property. *County of Park v. Park County Sportsmen's Ranch, LLP*, 45 P.3d 693 (2002). The case arose from an application for state permits by a private sportsmen's ranch to initiate a conjunctive use storage project on their land. Neighboring landowners filed a declaratory rights action against the ranch alleging: (1) that water from the proposed storage project would enter into subterranean storage space beneath their land; (2) that the ranch had no right to store water beneath the neighboring property without permission of the neighbors; and (3) that such unauthorized use constituted a trespass. The neighboring landowners based their complaint on the common-law property doctrine that holds that property ownership extends to the sky and to the depths of the earth, and on certain Colorado constitutional and statutory provisions.

> *"…the Colorado Supreme Court held that landowners can not enjoin, and have no right to compensation for, non-injurious use of the storage space beneath their property."*

Dismissing the neighboring landowners' claims, the Court held that the law does not recognize control of aquifers as a property right. In the Court's view, the nature of water as a public resource allows water generated or flowing from one property to another to be used by a lawful appropriator. Water resources are not like mineral resources which are relatively immobile and owned as part of land ownership. Accordingly, landowners simply cannot claim absolute ownership of water below their land. On this reasoning, the Court held that the common law doctrine of property ownership extending to the sky and to the depths of the earth is inapplicable to groundwater resources.

While California does recognize an association between groundwater rights and land ownership in the form of overlying rights, the Colorado Supreme Court's reasoning is nonetheless applicable to California where water in its natural state is also considered a common public resource (Water Code § 102) while flowing from one parcel to another.

The Court further noted that Colorado law specifically authorizes use of aquifers for storage of artificially recharged water. Such activity is also similar to the use of a surface stream for transport of foreign or developed water, which Colorado law allows. Accordingly, the Court held that possessors of appropriative rights are entitled to artificially recharge an aquifer as part of their decreed water right if the aquifer can accommodate the recharged water without injury to senior rights and overlying land uses. The California Supreme Court relied on a similar analogy in *Glendale and San Fernando. Glendale, supra, 23* Cal.2d 68 at 76-77 [affirmed by *San Fernando, supra*, 14 Cal.3d at 263-64]. There, the Court reasoned that California Water Code section 7075, which expressly authorizes use of surface stream for transport of developed water, also authorizes use of subterranean storage space to store developed water. *Id*.

Because the reasoning in *County of Park* was largely based on the generically applicable nature of groundwater resources and common legal doctrines, Colorado's approach will likely be followed by other states. Indeed, the Court relied on similar holdings in Ohio (*Chance v. BP Chemicals, Inc*, 77 Ohio St.3d 17 (1996)), Arizona (*W. Maricopa Combine, Inc. v. Ariz. Dep't of Water Resources*, 200 Ariz. 400 (2001)), and California (*San Fernando, supra*,14 Cal.3d 199)). The Colorado Supreme Court quoted *San Fernando*'s explanation that the "fact that spread [artificially recharged] water is commingled with other ground water is no obstacle to the right to recapture the amount by which the available conglomerated ground supply has been augmented by the spreading." *County of Park*, 45 P.3d at 701 quoting *San Fernando, supra*, 14 Cal.3d at 263-64.

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The Colorado Supreme Court Weighs in on Rights to Use Subterranean Storage Space

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The California Supreme Court has twice recognized the right to use surplus subterranean storage space to store developed water on multiple occasions. *San Fernando, supra*,14 Cal.3d at 263-64 and *Glendale, supra*, 23 Cal.2d 68 at 76-77. In neither case did it mention overlying landowners in relation to this storage right. Additionally, *Niles Sand and Gravel* held that a landowner was not entitled to compensation for storage of water beneath its property that interfered with its sand and gravel operation. *Niles Sand and Gravel, supra*, 37 Cal.App.3d 924. These cases suggest that landowners in California are not entitled to compensation for storage of water beneath their property where there is no infrastructure placed upon their land, their overlying groundwater rights are not impaired, and there is no inundation or interference with their lawful use of their surface property. The recent ruling from Colorado provides evidence that sister states are reaching the same result.

Russell McGlothlin is an attorney specializing in water law with the law firm of Hatch and Parent in Santa Barbara, California.

Technical Corner

Potential Effects of Levee Cut-Off Walls on Groundwater Recharge

BY TIMOTHY K. PARKER, CALIFORNIA DEPARTMENT OF WATER RESOURCES, AND MARTIN STEINPRESS, BROWN AND CALDWELL ENVIRONMENTAL ENGINEERS AND CONSULTANTS

Increasing numbers of water purveyors are developing conjunctive use projects that involve heavy groundwater extraction during dry years to increase water supply reliability. Many of these projects involve artificial recharge to maximize the amount of water stored in the aquifer during wet years. A recent trend in stormwater management also includes maximizing infiltration. Concurrently, the interaction between streams and aquifers is becoming the focus of intense political, legal, and scientific interest, as evidenced by the California State Water Resources Control Board's recent report on the legal classification of groundwater [http://www.waterrights.ca.gov/hearings/Special%20Projects/SubStreamRpt(2002-01-20).pdf], as well as several court cases. All of these water resources and water rights related issues are going to continue to escalate with the ever-increasing population and resultant growing demand on water supply.

Ironically, there is the possibility that natural groundwater recharge and discharge from significant stretches of major rivers is being reduced by the construction of cut-off walls associated with river levees. One example is the Lower American River through Sacramento County. In the vicinity of the California State University-Sacramento (CSUS) campus, a slurry wall is keyed to a clay layer at a depth of 60 feet. Much infiltration would normally occur through the riverbanks at high flows and migrate to deeper water supply aquifers through the heterogeneous fluvial deposits. This stretch of the Lower American River is probably similar to many other rivers that would normally provide important recharge to or receive discharge from groundwater basins in the Western U.S.

An evaluation of the stream-aquifer interaction has begun on the Lower American River at the CSUS campus, including the effect of the levee cut-off wall on recharge of the aquifer. Several groundwater monitoring wells have been installed perpendicular to the river. The study will include long-term water level surveys, geochemical evaluation, and aquifer testing adjacent to the levee. The results will provide an initial indication of whether such levee projects may be inadvertently contributing to groundwater basin overdraft.

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Legislative Corner, September 2002

BY TIM PARKER, CHAIRMAN, LEGISLATIVE COMMITTEE AND CHRIS FRAHM, LEGISLATIVE ADVOCATE, HATCH AND PARENT

In spite of the preoccupation with the budget, it was an active year for water issues with more and more attention being paid to groundwater. The action included proposals to regulate groundwater, publication of the Sax report, Statewide Groundwater Monitoring Taskforce activities, and more proposed legislation to regulate contaminant levels. It is clear that more and more top elected officials are beginning to realize the important role groundwater plays in our State's water supply and delivery and trying to protect it. GRA has been an active player helping to shape and resolve these key issues.

AB 599 (Liu) – The Groundwater Quality Monitoring Act of 2001

AB 599 (Liu) requires the State Water Resources Control Board to 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 through direct and other statistically reliable sampling approaches. Further, to create an interagency task force to identify measures to increase coordination among state and federal agencies that collect groundwater contamination information.

The interagency task force and advisory committee have been meeting since February 2002 to meet the requirements of the Act. The US Geological Survey (USGS) has been contracted by the State Board to assist in development of the comprehensive monitoring plan. The USGS is conducting evaluations on two pilot areas: (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 pilot studies include the use and screening of all available well logs from the Department of Water Resources, incorporation and evaluation of the Department of Health Services water supply well water quality database, and development of detailed conceptual models of the subsurface hydrogeology. The results of the pilot studies will be used to develop alternative approaches and prioritization, options, and associated resource requirements for implementation of different levels of comprehensive groundwater monitoring in California

The 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 fate of Prop 50 is uncertain. For more information on AB599, visit the SWRCB website at http://www.swrcb.ca.gov/cwphome/land/gama/webpages/ab599hom.htm

Bills Pending Before the Governor

California's Legislative Session ended September 1 with nearly 3,000 bills presented to the Governor for signature or veto. Among them are a number of critical water measures including California's 4.4 Plan, Cal-Fed, groundwater contamination and desalination studies. The following is a brief recap of some of the activity; the Governor has until October 1, 2002 to sign or veto legislation:

- SB 1822 (Sher) - Public water systems: public health goals: perchlorate. Calls for the State to set a limit on perchlorate allowable in groundwater supplies and begin enforcement by 2004. The Governor has signed SB 1822 into law.
- SB 1348 (Brulte) - Requires DWR to consider whether an urban water supplier is implementing water demand reduction measures in its urban water management plan in order to qualify for consideration for Prop 13 funding. The Governor has signed SB 1348 into law.
- AB 2606 (Harman) - Requires the State to evaluate public health risks and establish an evaluation process for groundwater recharge injection projects. The Governor has signed AB 2606 into law.
- SB 1938 (Machado) — Groundwater management: state funding. Provides that a groundwater management plan must contain certain specified elements in order to qualify for State funding.
- SB 1384 (Costa) — Water supply planning. Adds new requirements for urban water management plans.
- SB 482 (Kuehl) - Provides for a narrow amendment of Fully Protected Species requirements for areas impacted by the San Diego-Imperial and other QSA-related water transfers.
- SB 1653 (Costa) — California Bay-Delta Act - Creates, until January 1, 2006, a 20-member California Bay-Delta Authority (CBDA) in the Resources Agency as the governance organization overseeing implementation of the California Bay-Delta Program.
- SB 1672 (Costa) — Integrated Regional Water Management Planning Act of 2002. Establishes a process by which regional water management groups may develop integrated regional water management plans.
- AB 2717 (Hertzberg) — Desalination. This bill requires the State prior to July 1, 2003, to report

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Federal Legislative/Regulatory Corner

An Interview with Jean-Mari Peltier, Ag Counselor to the EPA Administrator

BY JUDY BLOOM,
U.S. EPA & GRA DIRECTOR

The following is an interview conducted by Judy Bloom, GRA Director, with Jean-Mari Peltier, Counselor to the U.S. Environmental Protection Agency (U.S. EPA) Administrator on Agriculture Policy. Ms. Peltier is an invited Keynote Speaker at the GRA symposium, "Nitrate in Groundwater: Sources, Impacts and Solutions."

Q: I appreciate the time you are taking out of your very busy schedule to answer a few questions for GRA's membership about how you view California's ground water, agriculture, nitrates, and the role of the U.S. EPA.

California is highly dependent on its groundwater resources. It is used as a source of drinking water for humans and livestock, for irrigation, for geothermal energy, and ultimately sometimes as a place of disposal for septic systems, wastewater utilities, industry, and agriculture in lieu of surface water discharge. With these seemingly contradictory needs, the struggle to maintain the quality of ground water has never been as acute as it is today. However, with California's anticipated growth (34 million to 54 million by 2025) our current struggles may pale in comparison. I know that you are very familiar with the issues facing Californians, ground water, nitrates, and the Central Valley. What is your perspective of this? Is this scenario as grim as it seems?

A: I don't see any silver bullets at this stage in the evolution of those issues. I think the solution will have to be multi-faceted, encompassing everything from improved on-site wastewater treatment technology through water conservation and sequestration to local water resources management, using smart growth and more incentives for water conservation. These challenges are all the more compelling because ground water quality is more difficult to restore than surface water quality.

Q: Drinking water purveyors will usually drill a new well before trying to treat groundwater contaminated with nitrates. The only other alternative is to blend with another source to reduce the nitrate level that is being served. On the disposal side, homeowners and livestock producers have few choices that are cost-effective in treating wastewater before disposal. What is the role of the EPA in preserving the quality of ground water in light of the competing needs and cost-inhibiting treatment techniques?

A: EPA's role in prevention is primarily to work with the states to prevent ground water contamination using the tools in the Clean Water Act and the Safe Drinking Water Act. The agency also has a significant role in ground water clean up through the Superfund, the Resource Conservation and Recovery Act, and the Underground Storage Tank program. We also work to protect ground water by putting restrictions on pesticide use through the registration process under the Federal Insecticide, Fungicide and Rodenticide Act. Ground water protection will require national, state and local efforts using all the available tools, and inventing new ones if the current tools are insufficient.

One example of a joint Federal/State effort to protect California's ground water is an ongoing California effort that is now using federal funds under the Drinking Water State Revolving Fund to assess the relative threats of all sources of contamination for all of the state's ground water sources of drinking water. This information will likely be available to the public next year. This assessment effort will inventory potential sources of contamination, including sources of nitrates such as septic systems, agricultural activities, and storm water runoff. We expect communities to act on these assessment results and deal with potential sources of contamination, including sources of nitrate, where they are shown to threaten community water supplies.

In addition, we have developed training materials available to all States on best management practices and other measures for protecting drinking water supplies. These materials cover protection measures for several potential sources of nitrate, including septic systems, storm water runoff, animal wastes, agricultural fertilizer application, turfgrass and garden fertilizer application, sanitary sewer overflows and combined sewer overflows. We have funded training courses using these materials for EPA Regions, tribes, states, and non-governmental organizations. They are also available on the Internet at http://www.epa.gov/OGWDW/dwa/electronic/ematerials.html#SWP .

Q: Aside from the Underground Injection Control Program, EPA has very little authority to regulate sources of nitrate pollutants that may impact ground water quality. I understand that there was some effort to 'expand' authorities in the proposed Clean Water Act NPDES regulation for Confined Animal Feeding Operations and require stricter controls for facilities overlying ground water that recharges surface water. While this language was only proposed and may not make it into the final regulations, do you see the Agency continuing in this vein and taking more of a direct role through regulation? If so, how?

A: When EPA issued the proposed Confined Animal Feeding Operation (CAFO) rule in January 2001, EPA restated "that the Agency interprets the Clean Water Act to apply to discharges of pollutants from a point source via ground water that has a direct hydrologic connection to surface water." For example, if a feeding operation's

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Study of Nitrate and Pesticide Transport Modeling

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The use of agricultural chemicals such as pesticides and nutrients has increased dramatically during the past 50 years to improve agricultural efficiency and productivity. These chemicals can be washed to surface waters by runoff and/or leached through the unsaturated zone to groundwater, thereby polluting the nation's waters and threatening human health, as well as aquatic and terrestrial ecosystems.

Cost-effective assessment tools are needed to regulate the use of agricultural chemicals, identify areas which are potentially vulnerable to nonpoint-source pollution, and support ecosystem restoration goals by improving the water quality of a region or nation. Physically based environmental simulation models can be cost-effective tools for resource managers as an alternative to costly and prolonged field monitoring strategies.

Physically-based models have been developed as part of this collaborative research effort to simulate (1) nitrogen cycling in soils, and nitrate transport and fate in soils and groundwater and (2) pesticide transport in soils, groundwater, and surface water. The initial nitrate transport model (RISK-N) includes both unsaturated and saturated zones, with fewer input parameters than any currently available models simulating the complete system. The model requires a small data set, is easy to use, and is able to quickly run long-term simulations. These attributes make the model a useful tool for those interested in estimating the long-term risk of nitrate contamination, including regulatory agencies, farm managers, and city planners. RISK-N is suitable for use with currently available meteorological, soil, and hydrogeological databases, and could be used in conjunction with geographic information systems. It has been used to simulate groundwater nitrate concentrations in Colorado and in Chile.

Because denitrification is a significant process for the removal of nitrate transported in groundwater drainage from agricultural croplands to streams and has important ecological consequences, a second nitrate transport model suitable for advective-reactive transport due to nonpoint sources was developed. The methodology has been applied to assess the potential impact of denitrification in reduced iron sediments at the base of a surficial aquifer on NO_3- base flow loading to two adjacent agricultural watersheds on the mid-Atlantic coastal plain. Indices were developed that estimate the removal efficiency of NO_3- in groundwater drainage from agricultural watersheds and riparian zones. The indices relate NO_3- removal to denitrification rates and/or other loss pathways and aquifer geometric and hydraulic properties.

We have also developed mass fraction models that simulate three-phase (vapor, dissolved, and adsorbed) pesticide transport and transformation in the subsurface environment that can be used to investigate the impact of crop uptake and volatilization on the vulnerability of groundwater to contamination by pesticides under different soil environments and different agricultural practices. These models, which have been applied to simulate soil and aquifer pesticide concentrations in Australia, Mexico and Spain, are handy tools for providing planners with a quick decision at a low cost for long-term planning when data are scarce.

An integrated (soil-aquifer-river) pesticide transport model (IPTM) has been also developed that possesses enhanced capabilities of characterizing the environmental fate of pesticides, quantifying their spatial and temporal variability in more detail, and identifying their pathways throughout the entire hydrosystem to a considerable extent. It essentially consists of integrated water-flow simulation and pesticide transport modeling in the plant canopy zone, overland, soil surface, crop root zone, intermediate unsaturated zone, aquifer, and river column and active bed. Heterogeneity and transient properties represented by space- and time-variant parameters are taken into account. Internal linkage and joint integration enable the IPTM to characterize the mechanisms and interactions between the subsystems.

Although the IPTM is able to deal with pesticide transport modeling in a conjunctive subsurface and surface hydrosystem, only a portion of the model has been tested due to lack of necessary data. The IPTM has been applied in the Orestimba Creek basin, California, for diazinon environmental fate assessment. Good agreement between the observed and simulated values was observed for both water flow and diazinon concentrations at the outlet of the basin. The application indicated that the magnitude and combined timing of pesticide application and rainfall dominate exposure levels of diazinon residues in both subsurface and surface environments during the rainy (winter) season.

Research Support:

USEPA (R819658) Center for Ecological Health Research, UC Davis (6 years), UC Toxic Substances Research & Teaching Program (2 years), and UC Center for Pest Management Research and Extension (2 years).

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Nitrate – Old Pollutant, New Concern

BY BART SIMMONS

Nitrate is highly water soluble, and migrates to shallow groundwater and surface water. According to one U.S. Geological Survey, at least 6% of the nation's rural wells exceed the current drinking water standard. By far the greatest use of nitrate is in fertilizers; explosives account for about 15% of total use. According to the U.S. EPA Toxics Release Inventory (TRI)[1], 5.9 million pounds of nitrate compounds were reported for on-site and off-site releases in California in the year 2000. In addition to nitrate runoff, other nitrogen-containing compounds can transform into nitrate. Other human exposures to nitrate include foods, medications, and cigarette smoke.

Health Effects

According to the U.S. EPA IRIS information,[2] the current risk assessments are based on methemoglobinemia ("blue baby disease"). This nitrate toxicity is due primarily to its conversion to nitrite, which oxidizes the Fe(+2) form of iron in hemoglobin to the Fe(+3) state. The reduced compound, (methemoglobin) does not bind oxygen, resulting in reduced oxygen transport from the lungs to tissues. According to IRIS,

"Low levels of methemoglobin occur in normal individuals, with typical values usually ranging from 0.5 to 2.0%. However, due to the large excess capacity of blood to carry oxygen, levels of methemoglobin up to around 10% are not associated with any significant clinical signs. Concentrations above 10% may cause a bluish color to skin and lips (cyanosis), while values above 25% lead to weakness, rapid pulse and tachypnea. Death may occur if methemoglobin values exceed 50-60%."

Although methemoglobinemia can affect any age, nitrate-contaminated water principally causes this illness in children under six months. Babies less than six months old have a lower stomach acidity, which allows bacteria to grow in the stomach and intestines that are capable of converting nitrate to nitrite. Poisonings may occur when contaminated water is used to prepare infant formula and foods. Boiling water for infant formula is a good practice for killing bacteria, but it will of course not destroy nitrate.

A newer health concern for nitrate is a possible link with birth deformities. Recent studies, including one by the California Department of Health Services Birth Defects Monitoring Program[3] have found an association between consumption of high nitrate groundwater with birth defects. The DHS study included interviews with over 1000 mothers of babies with and without birth defects, looking for associations with a variety of factors, including illnesses, medication, drugs, alcohol, tobacco, occupation and hobbies. The public water supply companies provided data on drinking water sources and nitrate concentration for each woman's residence.

The findings were that only groundwater contained nitrate exceeding the current allowable standard of 45 milligrams nitrate/liter. Exposure to nitrate above this maximum contaminant level (MCL) was associated with a 4 times higher risk for anencephaly (absence of the brain). There was no increased risk for spina bifida (open spine defects), another type of neural tube defect. Women whose drinking water contained nitrate at levels below the MCL had a higher risk for anencephaly, but only when the water source was groundwater. No increased risk was seen at comparable nitrate levels when drinking water was a mixture of surface and groundwater.

Measurement and Treatment

Reliable test methods are available for nitrate at typical ambient concentrations. They include colorimetric (e.g., EPA 353.2 and 353.6), selective ion electrode potentiometric (e.g., EPA 9210), and ion chromatography (e.g., EPA 300) methods.

Nitrate treatment methods include reverse osmosis, evaporation, and thermal or biological destruction. Los Alamos National Laboratory has demonstrated a non-thermal and non-energy intensive method for reducing nitrates to nitrogen gas.

Conclusion

Nitrate has long been a problem for rural drinking water supplies using shallow groundwater. The question of birth defects caused by nitrate will require additional research and more exposure data.

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Bart Simmons, Ph.D., is Chief of the Hazardous Materials Laboratory in the Department of Toxic Substances Control. He can be reached at bsimmons@dtsc.ca.gov.

IAH and Worldwide Events on Groundwater and Water Resources

BY RAMON LLAMAS AND VICKI KRETSINGER

International Association of Hydrogeologists (IAH) as a global organization, the IAH/US National Chapter, and IAH members are actively involved in worldwide groundwater/water conferences planned later this year and next year. A few key events are summarized below. These events illustrate the increased attention being placed on the role of groundwater in sustaining earth systems and the role that we have as groundwater professionals in advancing hydrogeologic research, furthering the understanding of fundamental water science, applying interdisciplinary approaches to problem solving, and educating others about the importance of science for addressing global water issues.

IAH Special Sessions at GSA Annual Conference

Beginning with a US-based program, and as an update to the Summer 2002 HydroVisions, the IAH US National Chapter is organizing two special sessions at the next Geological Society of America Annual Meeting in Denver during Oct. 27-30, 2002, including *Groundwater Depletion and Overexploitation: A Global Problem (Session T56) and Groundwater and Hardrock Mining (Session T19)*. The Groundwater Depletion and Overexploitation session final program is now assembled and includes presentations on the magnitude and effects of groundwater mining, methods to quantify depletion, U.S. and international case studies, status and future trends, and management solutions. Abstracts for the presentations included in this special session are posted at http://gsa.confex.com/gsa/2002AM/finalprogram/session_2826.htm

In addition to the above noted IAH sessions, the overall Hydrogeology Program at the 2002 Annual GSA Meeting will also include many other sessions of interest to groundwater specialists. More information on the overall meeting is available at http://www.geosociety.org/meetings/2002/

SINEX – Symposium on Intensive Use of Groundwater

Eleven years ago, IAH conducted a *Symposium on Groundwater Overexploitation* held at Puerto de la Cruz, Tenerife, Spain. More recently, in December 2001, a *Workshop on Intensive Use of Groundwater: Challenges and Opportunities (WINEX)* took place in Madrid. As a result of that workshop, a book is being printed which will provide the background for the upcoming *Symposium on Groundwater Intensive Use: Challenges and Opportunities (SINEX)* that will be held December 10-14, 2002 in Valencia, Spain. IAH, and also NGWA and others, are co-organizers of the SINEX symposium. The SINEX symposium is expected to bring together hydrogeologists, engineers, water managers, ecologists, economists, and social scientists to discuss the role of groundwater for supplying human needs, providing sustainable development, and alleviating poverty.

Among the symposium topics to be discussed are:

- Circumstances leading to intensive groundwater use;
- Environmental implications of intensive groundwater use;
- Water management, technical, political, economic, and social issues related to intensive groundwater use;
- Global case studies on intensive groundwater use;
- Regional and continental issues for intensive groundwater use, including transboundary problems and shared aquifer issues and significance for mankind; and
- Ethical issues of intensive groundwater use, including present versus future generations, use of non-renewable reserves, sustainable use, water quality degradation, desertification, alleviation of poverty, and social stress.

Outcomes of the 2002 SINEX symposium are anticipated to include: 1) conveying management strategies to local water authorities that address the challenges and opportunities of intensive groundwater use; 2) generating discussion among participants on the real costs and benefits of groundwater exploitation; 3) producing a position paper containing a declaration (including recommendations) for later worldwide distribution; and 4) preparing a special publication with selected contributions. For more information, visit the web site at http://www.fcihs.org/sinex.htm#_top

Hydrogeology and the Third World Water Forum

The Third World Water Forum (3WWF) will be held in Kyoto, Japan (March 17-23, 2003). The first WWF was in Rabat (Morocco) in 1997; the second WWF was held in The Hague (The Netherlands) in March 2000. The 3WWF will be the most relevant conference on water within the next three years, particularly since the 3WWF will encompass more groundwater issues than prior Forums. Attendance is anticipated to be about 10,000. The World Water Council (http://www.worldwatercouncil.org) together with the host country (Japan) is organizing

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Alliance Corner

MTBE and Protecting the Leaking Underground Storage Tank Fund

BY JULIE SHAW, NGWA

As ground water professionals, you are aware of the importance of addressing MTBE contamination, inspection and compliance of underground storage tanks, and protecting the Leaking Underground Storage Tank (LUST) fund. Recent debates in Congress regarding the LUST fund and the amount to be appropriated to MTBE issues have made it clear to the National Ground Water Association that we must tell those in Washington, DC to retain current and future contamination cleanup funding.

Several states are experiencing problems with MTBE contamination of their ground water resources due to leaking USTs. These problems are reflected in U.S. EPA's biannual report to Congress, which consistently identifies, based on state reports, underground storage tanks as a major source of ground water contamination. Remediation, monitoring, and education are critical to dealing with MTBE in our ground water, and we need to support measures that will address current contamination and prevent it in the future. The LUST fund is a critical part of ensuring that these goals can be met in a timely and efficient manner.

Currently, on Capitol Hill, Congress is debating the amount of funds that should be appropriated to the LUST fund and how much of the money should be released to deal with MTBE clean up. The Senate version of the Energy Bill, which is now in conference, has language submitted by Senator Smith (R-NH) that would authorize appropriations of $200 million from the LUST fund to aid in addressing MTBE nationwide. As negotiations on the Energy bill continue, it is imperative that Members of Congress be made aware that money is needed to address MTBE as well as for inspection, compliance, and prevention of other UST issues.

Other MTBE initiatives include S. 1850, the *Underground Storage Tank Compliance Act of 2001*, introduced by Senator Chafee (R-RI). This legislation addresses inspection and compliance of USTs and authorizes $200 million for the clean up of sites contaminated by MTBE. On the House side, Congressman Gillmor (R-OH), chairman of the Environment and Hazardous Materials Subcommittee of Energy and Commerce, held a hearing on May 21, 2002 entitled "*MTBE Contamination in Groundwater: Identifying and Addressing the Problem.*" NGWA member, Dr. Patricia Ellis, a hydrologist with the Delaware Underground Storage Tank Department, testified about the current status of MTBE contamination and the problems facing ground water professionals. The Senate Finance Committee held a hearing in May concerning protecting the highway portion of the Highway Trust Fund where Senator Grassley (R-IA) raised the issue of whether fuel excise taxes should continue to pay for the LUST fund.

It is clear that several Members of Congress are aware of the importance of cleaning up MTBE and other problems caused by leaking underground storage tanks. However, it is paramount that as ground water experts you make your voice heard in Washington, D.C., explaining the need for funds to cleanup MTBE as well as the need to protect and increase the LUST fund to ensure there are funds for prevention and remediation of any future contamination. For a sample letter for use as a framework to send to your Representatives and Senators, go to the NGWA website at http://www.ngwa.org/govaffairs/MTBE.html.

Groundwater — Center Stage!

BY MIKE MORTENSSON, CGA EXECUTIVE DIRECTOR

"Groundwater - Center Stage" was selected as the theme for California Groundwater Association's 54th Annual Convention and Trade Show this year, as groundwater seems to be attracting more and more attention. This year the Legislature recognized June as Groundwater Awareness Month, and Governor Gray Davis has proclaimed November 3-9 as California Groundwater Week.

Come and celebrate CA Groundwater Week by attending the CGA trade show and the various seminars offered November 8 & 9 at John Ascuaga's Nugget in Sparks, NV. CGA will host the NGWA McEllhiney Lecturer, John Schnieders, on Nov. 9th; his topic is "Chemical Rehabilitation of Wells." Seminars of interest include drilling fluids, well sealing materials, contracts and legal rights, practical pump service, CAL-OSHA consultations and employer rights, rig inspections and utility line safety. There will also be numerous displays of groundwater industry equipment and services. GRA members are offered discounted rates.

CGA is continuing to participate in the California Water Awareness Campaign. We are now finalizing our second educational booklet, "Water Sources," for fall distribution. One of the lessons will cover groundwater - be sure to purchase extra booklets to give to your favorite science teachers. In other educational efforts, CGA is continuing to develop course materials for regulatory official training in well construction. The first session is planned for next spring. If you have any questions on these items, give me a call at 707-578-4408 or email: wellguy@groundh2o.org.

Education Corner

Water Resources Center Archives

BY LINDA VIDA

The Water Resources Center Archives (WRCA) has been described as having "Everything but the water." The Archives is one of the only libraries of its kind in the United States and offers the water resources community a truly unique and valuable resource. Located in 410 O'Brien Hall on the UC Berkeley campus, the WRCA collects and catalogs a vast array of water resources material for the benefit of scholars, students, and professionals. In the early 1950's, coastal engineers and University of California professors Morrough P. O'Brien and Joe Johnson recognized the need for a library in California devoted to collecting technical material about water resources. They identified the need for a library devoted to collecting report literature as well as archival material in the areas of water supply, water quality, groundwater, wastewater treatment, estuaries, and coasts. Thanks to their vision, the Archives was established and has been building upon their legacy.

There are three distinct parts of the collection: current material, manuscript material, and out-of-print material. All of the holdings are cataloged and searchable on the Melvyl Catalog, which is freely available to the public. To search the collection, visit the web site at www.lib.berkeley.edu/WRCA/ and click on Melvyl web, then select Melvyl from the pull down menu.

The majority of current material consists of reports published by a wide variety of government agencies, NGO's or consulting firms. One of the foremost strengths of the Archives has been its ability to procure an enormous array of report information that is not duplicated at other libraries. The manuscript material consists of over 112 separate collections. A few years ago, we were able to put the Finding Aids to these collections on the web to provide increased access. We are still accepting donations of manuscripts. The out-of-print reports collection includes material published prior to 1970.

The Archives is open to the public Monday - Friday from 9:00 am - 5:00 pm. Anyone may use the collections onsite and may borrow material from our circulating collection by becoming a registered patron. You do not need a UCB library card to borrow items from

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For the Record- Correction re: Perchlorate

BY SUSAN GARCIA AND TOM MOHR, GRA DIRECTORS

Highlights from "Ask-A-Groundwater Specialist," Hydrovisions, Summer 2002, p. 20 contained a question from Sarah about perchlorate. The response provided to Sarah's question was for the organic solvent perchloroethylene and not for the inorganic anion perchlorate. A revised response is provided below. In addition, a revised response was provided to Sarah and a correction posted at www.grac.org . We apologize for the error and inconvenience this may have caused. Thank you to everyone that has contacted us on this correction, and to Tom Mohr for providing this revised response.

Revised Response to Sarah's Questions

1. When was perchlorate first detected in drinking water?

The laboratory methods available to water supply managers before 1997 were not sufficient to detect perchlorate at low concentrations. It was possible to analyze for perchlorate using a method known as ion chromatography to detect perchlorate at concentrations of 150 to 200 parts per billion and higher, but most labs were not asked to run this test because the threat of perchlorate was not widely understood. Since most water supplies that have been contaminated with perchlorate have much lower concentrations than the ion chromatography detection limit, even those labs that did test drinking water supplies for perchlorate usually did not detect it.

The California Department of Health Services (DHS) detected perchlorate in wells in Ranch Cordova, near the Aerojet Missile Plant, in 1997. The DHS immediately embarked on a large testing program, and also conducted research to develop a significantly improved laboratory method, which lowered detection limits to 4 ug/L (micrograms per liter or parts per billion). The results of the DHS perchlorate testing effort showed that there are several water supplies near solid rocket motor assembly facilities that have been impacted by perchlorate.

More information on DHS's work on perchlorate and the history of its discovery can be found at http://www.dhs.ca.gov/ps/ddwem/chemicals/perchl/earlyfindings.htm .

2. How did it get there?

Solid rocket motors use aluminum powder as a fuel (about 17%), ammonium perchlorate as an oxidizer (about 80%), and a rubber binder called PBAN (polybutadiene acrylonitrile) to hold it all together after baking the mixture. Solid rocket motors are not

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Call For Nominations - GRA Directors

The Association is now soliciting nominations for GRA Board of Director candidates to run for seats that commence service in January 2003.

To declare your desire to be nominated, please submit a statement of interest, a brief biography and your contact information via e-mail to Kathy Snelson at executive_director@grac.org by October 15, 2002. To nominate someone other than yourself, please email the nominees name, title, organization and contact information by the same date.

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

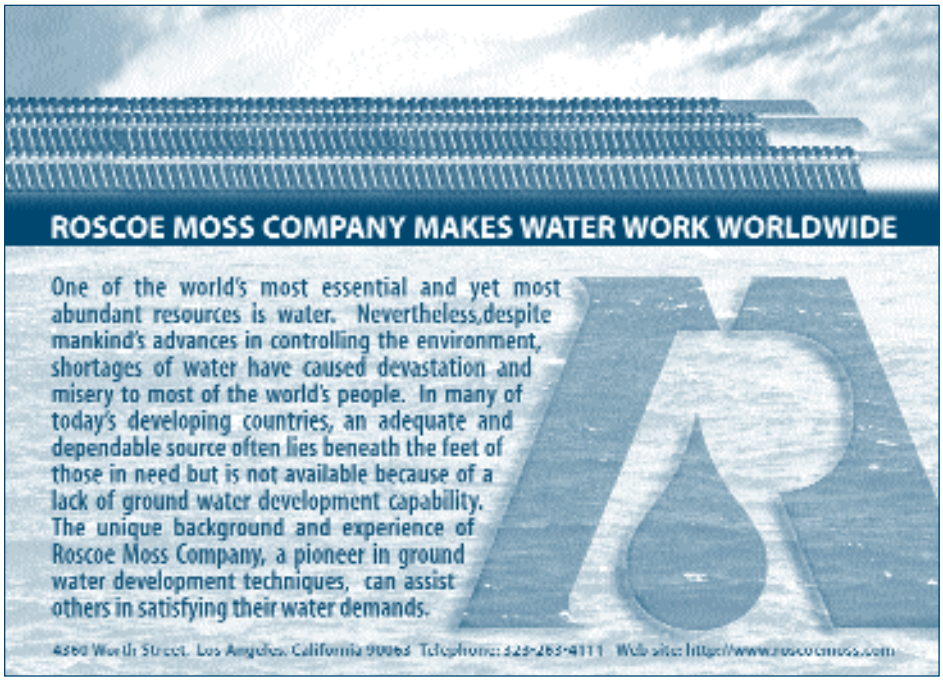
Organizational Corner

Web Site/Database Integration Project Update

BY KEVIN BLATT, GRA WEB & DATABASE MANAGER

The first phase of GRA's web site/database integration project, the online Membership Management System, is nearly complete. Upon completion, you will receive an email notification that provides instructions and a password for you to peruse the system, verify contact information, and submit profile data. Of course, we strongly recommend that you use the system to renew your membership when the time arrives this fall. By using the system to renew, you will expedite the renewal process for yourself while eliminating administrative work for GRA.

Phase two of the project, the online Event Registration Management System, is expected to be completed in November. It will streamline the registration process for attendees to GRA's symposiums, workshops, and annual meetings as well as allow GRA to better focus the mailing of notices of upcoming meetings. Please check www.grac.org for the latest news on the project.



Nitrate: California's Oldest 'New' Contaminant

Continued from Cover Page

It is not clear to what extent California's ground waters are impaired by nitrate. While some believe that our groundwater is in dire shape, others see very localized issues, with the majority of ground water not impacted, nor likely to be affected in the future. Why, after all these years, is the picture still so murky? In some ways, the practice of deepening or abandoning a well to ensure safe drinking water has helped to cloud the picture of nitrate contamination in California. The State Water Resources Control Board (State Board), with the Department of Health Services (DHS), has recently begun examining the water quality sampling data that is supplied to DHS by public water supply systems. While an initial review shows that the supplied water is meeting the current MCL for nitrate, a more extensive review has revealed that a number of wells have been taken off line or abandoned due to nitrate contamination. The review also seems to indicate that nitrate contamination is being found at deeper depths than previously thought. In addition, private well owners are not required to monitor water quality. Some counties may conduct limited sampling of private wells; however, that data is often in paper format and can be difficult to access. Efforts to improve access to existing data has been initiated by the State Board and DHS; however, funding to monitor and study groundwater quality has not been a priority during the budget discussions for federal and state agencies.

Many questions remain that will require long-term study and commitment of funding to accurately reflect the quality of California's groundwater and what that may portend for the future. While shallow contamination is a given in many areas, researchers debate if this shallow contamination may lead to issues at deeper depths. Is nitrate migrating? What role can the soil types and ground water play in predicting where problems may occur? What is, if any, the natural assimilative capacity of the soils? Do natural sources of nitrate play a role? If so, how large? What roles do old wells, improperly sealed wells, or wells screened in multiple aquifers play in providing a conduit to unimpacted water-bearing zones? These are only a few of the outstanding questions that warrant further study.

Health Implications

The current standards for nitrate and nitrite are 10 mg/l (NO3-N) and 1 mg/l (NO2-N), respectively. The standards were originally set at their current levels in order to protect infants, the most vulnerable population. Municipal suppliers are required to deliver water that meets the MCLs; however, private drinking water wells, since they are unregulated, could exceed MCLs. The DHS reported on incidences of methemoglobinemia, or 'blue-baby syndrome,' in a 2001 investigation entitled "Nitrate Contamination and Methemoglobinemia in the State of California."[5] Review of hospitalization data over a 13-year period revealed 97 cases of infant methemoglobinemia of which 10 may have been caused by nitrate-contaminated well water. A recent study in Iowa (reported in the May, 2001 Journal of Epidemiology) indicated that older women may be vulnerable to nitrate contamination even at levels below the MCL.[6] Clearly these studies indicate that further research is warranted, especially as California's population in the Central Valley grows and other rural enclaves where most of the sources of nitrate are concentrated.

Cooperative Approaches

Despite remaining questions, there are many examples of cooperative approaches being used to help solve problems on a local, regional, and sometimes industry-wide basis. For example, the California Dairy Quality Assurance Partnership has been actively working with dairy producers to ensure they meet regulatory obligations. A new tool, Comprehensive Nutrient Management Planning, will soon be added to the CDQAP curriculum that will help dairy producers and growers apply dairy manure to cropland at agronomic rates (nutrients are made available in the amounts that the plant can currently use), reducing the amount of nitrate that may percolate to groundwater. In Chico, the Monterey Peninsula, and the Chino Basin, locals are also seeking collaborative solutions to their local nitrate concerns. Instead of wasting (any more) time pointing at each other to "fix your problem"; regulatory agencies, water purveyors, homeowners, producers, and environmentalists are all working together to identify and solve their water quality issues.

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Judy Bloom is an Environmental Protection Specialist for EPA Region 9, and is currently an Animal Feed Operations Coordinator. Judy is also a GRA Director. This article was edited by Sarah Raker and Mary Rose Cassa, and received technical review by Jeffrey Bold, Ph.D.

An Interview with Jean-Mari Peltier, Ag Counselor to the EPA Administrator

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disposal lagoon was to leach nitrates through the ground into a nearby stream, that would require a permit under the Clean Water Act.

I think the language you're asking about would not be an expansion of Clean Water Act authorities. Under this existing authority, the proposed rule, if implemented, would have preempted such discharges by requiring liners for storage and disposal lagoons - - and monitoring of water quality. If the language remains in the final rule, there would be some collateral benefit to ground water protection but the objective would be to protect surface water from subsurface discharges.

Since EPA is in the midst of a deliberative process for establishing a final CAFO rule, I cannot predict whether the Agency will be including this kind of provision in the final rule.

Q: Are there other measures that the U.S. EPA can take, or has taken, that are more effective than increasing the Agency's regulatory presence?

A: EPA has a court-ordered deadline to issue a new rule by December 15th of this year, and the Agency expects the final rule will strengthen the existing regulation and ensure proper and effective management of manure by CAFOs. However, since we are still deliberating on the components of that final rule, I cannot say what measures will or will not be part of the final rule.

However, in addition to any regulation, there are supplemental approaches that can yield more broad-based results than regulatory programs alone. I can say that EPA is also working in close partnership with the U.S. Department of Agriculture to help ensure that all animal feeding operations voluntarily receive the necessary information or technical assistance to allow them to take appropriate steps to protect water quality through sound management practices.

Also, one of the more promising innovative ideas is for a framework of regulatory requirements combined with economic incentives and implementation flexibility. For example, by allowing dischargers who reduce pollution by more than the amounts required to offset discharges from other sources where reductions are more costly, states could establish a trading program with efficiencies and benefits for all parties, including the environment. Connecticut's trading program to restore Long Island Sound is such an example. We should look for opportunities to design analogues to that program for the protection of ground water resources.

Q: How might EPA increase public awareness of nitrate issues in California through its public policy programs?

A: EPA's regulations under the Safe Drinking Water Act requires certain public water supplies in the State of California (and all other states) to report annually to the public through a Consumer Confidence Report on the condition of each system's water quality. As part of that report, the public is informed as to whether nitrates over the state and national standard of 10 mg/L have been detected in the system's water. The report should also note how a member of the public can get information on the sources of nitrates in their public water supply, if applicable.

We are hoping this increased level of public awareness will translate into increased public involvement at the local and state level in protecting all sources of drinking water, including ground water. Obviously, we need to do more along these lines with respect to private sources of drinking water such as those found in very rural and remote areas, including many farms.

Q: On a more personal note, growing up in California, did you and your family rely on a private well? (If yes) How does this experience change your view of ground water? How does your memory of the quality and taste of that ground water compare to the surface water that Washington, DC residents drink?

A: My folks owned a small resort in the Sierra National Forest at Huntington Lake, and we did have a private well. We had regular concerns with our mountain well, particularly with giardia related to problems with chipmunks and squirrels finding our water tank. But the water in the Sierras was beyond compare! As were the California weather and the views!

Before joining the U.S. EPA, Ms. Peltier most recently represented the California Citrus Quality Council, serving as its President since May of 1999. She served on numerous industry and government advisory committees, including the U.S. delegation to the Codex Alimentarius Committee on Pesticide Residues. Prior to joining the California Citrus Quality Council, Peltier was Chief Deputy Director in the Department of Pesticide Regulation for the California Environmental Protection Agency. Her experience also includes time as the Executive Director of the California Pear Advisory Board,President of the California Pear Growers, Senior Policy Analyst in the Office of Governor George Deukmejian for the California State World Trade Commission, and Legislative Assistant for Congressman Tony Coelho. Peltier graduated summa cum laude from California State University with a Bachelor of Science in Agriculture Communications.

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

Study of Nitrate and Pesticide Transport Modeling

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Key Project Team and Other Contributors:

Miguel A. Mariño is a Professor of Hydrology, Civil & Environmental Engineering, and Biological & Agricultural Engineering, University of California, Davis. The key students were: (1) Mohamed Hantush, who received his Ph.D. in civil engineering, UC Davis, in 1993 and is now a Hydrologist with the USEPA in Cincinnati; (2) Jake Gusman, who received his M.S. in civil engineering, UC Davis, in 1999 and is now a Senior Hydraulic Engineer with West Consultants in San Diego (the study formed the basis of his master's thesis); and (3) Xuefeng Chu, who received his Ph.D. in hydrologic sciences, UC Davis, in 2002 and is now a Research Hydrologist at Grand Valley State University in Muskegon, Michigan (the study formed the basis of his doctoral thesis). Frank Spurlock, Kean Goh and Craig Nordmark (California Department of Pesticide Regulation) and Joseph Domagalski and Peter Dileanis (USGS, Sacramento) provided useful information and valuable field data for model testing. In addition, Bruce Roberts, Daniel Munk and Dougas Munier (UC DANR) provided useful information on cotton planting and aldicarb application in California.

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Water Resources Center Archives

Continued from Page 12

us; however, manuscript and material from our out-of-print collections do not circulate. We can also arrange to send materials by mail from our circulating collection or copies of journal articles on a fee-for-service basis.

For research topics that are more recent or covered more specifically in journal literature, the Archives can access a wide array of commercial databases. GRA members may be interested to browse the Environmental and Pollution Management database, which includes Water Abstracts, Georef, Compendex, and the Web of Science. The items included in the database searches are predominantly articles in journals or conference proceedings. Depending upon the period covered by the database, you can easily find articles from the last 10 years and some include materials back to the early 1970's. However, due to UC licensing agreements, these databases can only be searched from campus computers. GRA members are welcome to use the computers at the Archives and to ask for reference assistance from the librarians when searching these databases. As an illustration of search capabilities, a sample search was done on the topic "land subsidence in the San Joaquin Valley." This resulted in 25 hits in Melvyl, including information published over the last 30 years by the CA Department of Water Resources, the US Geological Survey, the Inter-Agency Committee on Land Subsidence in the San Joaquin Valley and articles from Conference Proceedings. A similar search yielded 46 hits in Water Abstracts, 217 hits in Georef, 8 in Compendex, and 7 in Web of Science.

In addition to managing the collections and making our resources available to students and the public, the WRCA plays an active role in the UC Berkeley campus community by sponsoring the *California Colloquium on Water* lecture series. Each semester, four distinguished speakers lecture on topics concerning California's water. WRCA also publishes a newsletter three times a year, *WRCA News*, and the *Selected Recent Accessions* list bi-monthly. You can receive the newsletter and accessions list in email form, by sending an email to me at lvida@library.berkeley.edu.

Please visit our web site and familiarize yourself with our collections and services and contact me by email or phone at 510-642-2666 if you have any questions. I would appreciate the opportunity to assist you in your research.

Plan To Attend!

for the Fifth Symposium in GRA's Series on Groundwater Contaminants, "*Biological Treatment of MTBE Contamination in Groundwater: Ex situ and In situ Challenges*"

October 17, 2002
San Jose, DoubleTree Hotel

Co-Sponsor: Malcolm Pirnie, Inc.

To view DETAILED PROGRAM AGENDA, please visit www.grac.org

Nitrate in Groundwater: Sources, Impacts and Solutions

Continued from Page 3

1:30-3:00 p.m.

Collaborative Approaches to Achieve Source Management

Moderators: *Paul Martin, Western United Dairymen, Renee Pinel, California Plant Health Association*

"Collaborative Approach in Monterey County"

Matt Zidar, Environmental Science Associates , Katherine Thomasberg, Monterey County Water Resources

"Chico Septic Tank Control Program"

Ron Dykstra, P.E., Central Valley Regional Water Quality Control Board, Redding Office

"CA Dairy Quality Assurance Partnership"

Michael Payne, DVM, Ph.D., CA Dairy Quality Assurance Partnership

"Chino Basin Public/Private Nitrate Management"

Martha Davis, Inland Empire Utilities Agency

"Fertilizer Research and Education Program"

Stephen Beam, Ph.D., CA Department of Food and Agriculture

3:00-3:20 p.m.

Break in Exhibit Hall

3:20-4:45 p.m.

Panel: A Manageable Threat or a Looming Disaster
Where Do We Go From Here?

Moderator: *Robert Feenstra, Milk Producers Council*

Panelists: *Jeff Palsgaard, Director, Merced County Division of Environmental Health*
Martin McIntyre, Director, City of Fresno Public Utilities
Diane Holcomb, Natural Resources Conservation Service
Brent Newell, Staff Attorney, Center on Race, Poverty, and the Environment
Tom Barcellos, T-Bar Dairy

4:30 p.m.

Closing Remarks

Bill Pipes, Symposium

For more registration information, please see www.grac.org.

For the Record- Correction re: Perchlorate

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stable - the rubber binder slowly oxidizes and breaks down, so the motors must be replaced periodically. The solid fuel is removed from the metal casing and replaced with fresh fuel. The waste fuel was often washed into holding ponds, or stored in open burn pits for burning when weather conditions permitted. Because perchlorate is very soluble, rain washed it into soil and groundwater, and it eventually migrated to drinking water wells. Other sources of perchlorate include highway safety flares, fireworks, explosives, electroplating operations, and as a minor component of certain varieties of Chilean nitrate fertilizers.

3. What is being done to remove perchlorate from drinking water?

In most instances, if perchlorate is discovered in a drinking water well or reservoir, that source is no longer used to supply water. State and federal agencies responsible for protecting the environment and our water supply pursue the companies responsible for the contamination and enforce laws requiring that they clean up the contamination. Information on cleanup cases can be found at the agencies' websites. A detailed history of the Rancho Cordova site can be found at http://www.atsdr.cdc.gov/HAC/PHA/aero/agc_p1.html

4. What is the drinking water standard for perchlorate?

In January of 2002, the DHS lowered California's advisory drinking water action level from 18 ug/L to 4 ug/L. Studies are continuing to determine health effects and what levels may be considered safe for human consumption. See: http://www.dhs.cahwnet.gov/ps/ddwem/chemicals/perchl/actionlevel.htm

5. Are there plans to remove perchlorate from drinking water?

There are lots of cleanup projects underway to remove perchlorate from drinking water. Treatment of perchlorate-contaminated water is somewhat more difficult and expensive than many other contaminants. Methods currently in use include oxidation using ultraviolet light, chemical oxidation, manipulation of geochemical conditions in the water using microbiological methods, and specialized resins. Millions of dollars are being spent to remove perchlorate from drinking water in the San Gabriel Valley, Rancho Cordova, and elsewhere.

6. Why isn't the public more readily notified?

Water suppliers are required to notify consumers of the water they distribute when contamination is discovered. The level of notification varies by the severity of contamination and how the contaminant in question is classified. Because perchlorate is not yet regulated using a legally enforceable standard, an Action Level has been developed to advise consumers that a potentially harmful contaminant has been found. Water suppliers are generally very conscientious about notifying their customers when a problem is found, because the success of water supply businesses depends in large part on the trust of the consumer that the supplier is doing everything possible to ensure the consumer is protected. Every year, residents are mailed an annual "Consumer Confidence Report." Most residents don't study this report, but it contains a lot of information about the behind the scenes work that is routinely conducted to ensure the safety of the water supply. To obtain a report, call the local water utility that supplies your water.

There is a wealth of information about perchlorate on the Internet, and the links below have further information. A binder of information from GRA's recent Perchlorate conference can be obtained from GRA - see http://www.grac.org.

http://www.dhs.ca.gov/ps/ddwem/chemicals/perchl/perchlindex.htm

http://www.epa.gov/safewater/ccl/perchlor/perchlo.html

Tom Mohr is the Solvents and Toxics Cleanup Liaison for the Santa Clara Valley Water District and a GRA Director.

EPA Fellowships Available

Fall 2003 EPA Minority Academic Institutions (MAI) Fellowship Program for Graduate Environmental Study (http://es.epa.gov/ncer/rfa/current/2003_mai_grad.html)

Open Date: 08/12/2002 - Close Date: 11/18/2002

The U.S. Environmental Protection Agency (EPA) is offering Minority Academic Institutions Graduate Fellowships for masters and doctoral level students in environmentally related fields of study. The deadline for receipt of pre-applications is November 18, 2002. Subject to availability of funding, the Agency plans to award approximately 25 new fellowships by July 22, 2003. Master's level students may receive support for a maximum of two years. Doctoral students may be supported for a maximum of three years. The fellowship program provides up to $34,000 per year of support. This amount covers a $17,000 annual stipend, $5,000 for authorized expenses, and up to $12,000 for tuition and fees. Actual annual support may vary based on length of fellowship award and tuition and fees. Applicable Category(s): Grant/Fellowship Announcements

Fall 2003 EPA Minority Academic Institutions (MAI) Undergraduate Fellowships (http://es.epa.gov/ncer/rfa/current/2003_mai_under.html)

Open Date: 08/12/2002 - Close Date: 11/18/2002

The U.S. Environmental Protection Agency (EPA) is offering Minority Academic Institutions Undergraduate Fellowships for bachelor level students in environmentally related fields of study. The deadline for receipt of pre-applications is November 18, 2002. Subject to availability of funding, the Agency plans to award approximately 20 new fellowships by July 22, 2003. Undergraduate level students may receive support for their final two years of undergraduate study and a Summer Internship at an EPA facility between their junior and senior years. The fellowship program provides up $17,000 per year of support. This amount covers a $4,500 9-month stipend, $2,500 for authorized expenses, and up to $10,000 for tuition and fees. The Summer Internship stipend provides $7,500 for support for the three-month period. This amount includes a 3-month stipend for $6000, $1000 for travel to and from the summer internship site, and $500 for travel while at the site if needed. Applicable Category(s): Grant/Fellowship Announcements

IAH and Worldwide Events on Groundwater and Water Resources

Continued from Page 10

the 3WWF. Representatives of IAH (and also NGWA) will be participating at the 3WWF.

The World Water Forums are envisioned as a series of stepping stones towards the solution of the world's pressing water problems. The theme of the 3WWF, sustained commitment to action on global water problems, has the goal of implementing the World Water Vision established at the second WWF. Participants of the WWF come from diverse sectors representing water resources interests, including water resources and groundwater professionals, national governmental organizations, trade unions, business, industry, agriculture, and many others. Parallel to the General Conference, a Ministerial Conference will be conducted with the objective of creating a Ministerial Declaration on water issues. This Declaration will represent a consensus of the 3WWF directed at informing world politicians of important technical and scientific issues, establishing public awareness, and creating momentum for solutions to the global water crisis. Most importantly, it will emphasize the necessity of a sustained commitment to action that ensures "Water Security for the 21st Century."

As noted above, the 3WWF will assign much greater relevance to hydrogeology and its role in solving global water problems. The second WWF had only one session out of about 100 sessions that was directly related to groundwater. The number of groundwater sessions in the 3WWF will be substantially larger as a result of the sessions offered as part of the current Virtual Water Forum. The Virtual Water Forum is a kind of "chat" exchange that is logistically organized and controlled by the Secretariat of the 3WWF. Any interested person can apply to the Secretariat to open and chair a session, or participate in any of the already opened sessions. More than one hundred sessions are presently open. Of these, more than ten sessions are directly related to groundwater issues, and about forty sessions are indirectly related to hydrogeological topics.

Detailed information on the 3WWF, participation in the Virtual Water Forum, and information on the second WWF can be obtained at www.worldwaterforum.org

GRA Extends Sincere Appreciation to its 2002 Annual Meeting...

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Central Coast Branch Highlights

BY TERRY FOREMAN, BRANCH PRESIDENT

The Central Coast Branch modified its meeting schedule this year, so that members and meeting participants would have the summer off to enjoy vacations (at least some of us!) and spend time with friends and family. The Branch is gearing up for fall, and we have begun planning for 2003 activities. Please forward your ideas to the Branch officers as soon as possible. The Branch officers include, President Terry Foreman, CH2M HILL; Vice President Stephanie Osler Hastings, Hatch and Parent; Secretary Bill O'Brien, SAIC; and Treasurer Ryan Harding, Tetratech.

Speaking presentations since the Branch's last update have included Dr. Thomas Dune and Andrew Ballantine, and Robert Saperstein. Dr. Thomas Dunne and Andrew Ballantine, professor and graduate student respectively, University of California, Santa Barbara Bren School, spoke on an exploratory study of groundwater response to landscape characteristics and deforestation in the western Amazon basin in Brazil. The Bren School watershed group is conducting an exploratory analysis of the controls on runoff in the Amazon River at scales from the whole basin (~5 million km2) to individual hillslopes. NASA and the National Science Foundation fund the study. At the intermediate scale of river basins with areas of ~ 1000 km2, they are conducting a theoretical and field-based study of how groundwater-dominated streamflow from the unconfined soil-saprolite aquifer of the region responds to physiography and to alterations of the water balance caused by deforestation. Their current efforts include improving a groundwater model and analyzing the role of upstanding bedrock ridges in intensifying the recharge and potentially the streamflow response. These results will be used to analyze flooding, erosion and mobilization of biogeochemical constituents after deforestation.

Robert Saperstein, Partner in the law firm of Hatch and Parent, spoke on the recent attempts to amend the Central Basin Judgment to clarify the parties' rights to storage in the Central Basin. The Central Groundwater Basin, in western Los Angeles County, was adjudicated in the mid-1960's. Imposition of the water rights judgment saved the basin from permanent degradation. The Basin now provides roughly 40% of the potable water needs for almost 2 million people.

Decades of overdraft created significant dewatered, useable storage space in the Basin. Conservatively, the Basin could support 300,000 acre-feet of additional water in storage through conjunctive use operations. In 2001, a consortium of parties to the judgment attempted to gain court approval to make use of this available subsurface storage space. One local special district was successful in opposing this effort in Los Angeles Superior Court. The Court Decision is being appealed by the consortium of parties, which should be heard this year. Stay tuned for the results of this landmark case!

San Francisco Bay Branch Highlights

BY GARY FOOTE, BRANCH PRESIDENT

The San Francisco Bay Branch has continued to be very active in 2002, drawing 40 to 60 attendees at each Branch meeting. Following is a brief summary of past activities and planned activities for the second half of 2002.

On June 19, 2002, the Branch held a joint meeting in Oakland with the American Society of Civil Engineers. Dr. David Sedlak, University of California, spoke about n-nitrosodimeyhylamine (NDMA), a contaminant of concern in recycled waters. Mary Morkin, Branch Secretary, arranged the speaker for this meeting.

The August 14, 2002 meeting in Oakland featured Dr. Jean Moran, Lawrence Livermore National Laboratory (LLNL). Dr. Moran spoke about the Ambient Groundwater Monitoring and Assessment program, which uses ultra low-level measurement of volatile organic compounds and groundwater age dating to assess contaminant vulnerability of public water supply wells.

On October 16, 2002, the Branch will hold its meeting at the Doubletree Hotel in San Jose. Murray Einarson will be speaking about impacts to South Lake Tahoe water supply wells from non-point sources of MTBE. The Branch meeting will be a kick-off event for GRA's October 17, 2002 MTBE Bioremediation Symposium that is being coordinated in conjunction with the Santa Clara Valley Water District. Contact Mark Wheeler, Branch South Bay Coordinator (mark@crawfordconsulting.com), for more details.

In November 2002, the Branch will be conducting a workshop on environmental forensics in Emeryville. The workshop will have nine speakers from the consulting, professional and academic communities who will discuss such diverse topics as inverse plume modeling, gasoline age dating using lead isotopes, underground storage tank corrosion, complex chemical fingerprinting, fuel fingerprinting, Superfund case histories, and the Daubert Rule and expert witnessing. The workshop is planned for an afternoon and evening with a "coffee" break and dinner included. Contact Bill Motzer, workshop coordinator and Branch Membership Chair (bmotzer@toddengineers.com), for more details.

In addition to Branch meetings, the Branch officers are developing an annual scholarship program for students in hydrogeology programs at local universities. J.C. Isham, Branch Vice President, is taking the lead in developing this program.

San Joaquin Valley Branch Highlights

BY BILL PIPES, BRANCH PRESIDENT

Summertime…and the livin' is easy here in the beautiful San Joaquin Valley. As the heat and haze from the season's wildfires blanket our great valley (from the Delta to the Tehachapis and the Coast Range to the Sierra Nevada), the pumps and gateworks are working overtime to supply our families, farms and industry with water.

Like other parts of California, the economic health and vitality of the San Joaquin Valley will increasingly depend on the use of groundwater. This Valley is extremely blessed with abundant, high-quality groundwater and a fairly robust hydrogeologic system. However, only through the protection and proper management of the resource will enough groundwater be available in the future.

Taking its lead from GRA, the San Joaquin Valley Branch was formed to provide a forum for all stakeholders to discuss critical Valley groundwater issues and to be a source of useful and accurate information to the lay community and Valley decision makers. The Branch is off to a great start - we kicked off in January 2002 and have since held meetings on the third Thursday of every month.

The June 2002 meeting featured James Giannopolous, Principal Engineer, State Water Resources Control Board, who spoke on the threat to deeper aquifers from shallow groundwater contamination. In July 2002, attorney Chris Campbell of Baker, Manock & Jensen, treated us to a lively discussion on the art and jurisprudence of water transfers.

The Branch will not hold meetings in August 2002 and September 2002 (to attend GRA's 11th Annual Meeting, of course!). In October 2002, the Branch meeting speaker will be Dr. Neil Dubrovsky of the U. S. Geological Survey. On November 12-13, 2002, the Branch will host the Sixth Symposium in GRA's Series on Groundwater Contaminants, "Nitrate in Groundwater: Sources, Impacts and Solutions".

The Branch sincerely thanks its meeting sponsors, GRA, Welenco, Roscoe Moss Company, Geomatrix Consultants and Hudson*Orth Communications.

I look forward to seeing you in November 2002 in Fresno!



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Legislative Corner, September 2002

Continued from Page 6

to the Legislature on potential opportunities and impediments and need for state involvement in seawater and brackish water desalination and convenes a working group.

- ACA 11 (Richman, Canciamilla) - Infrastructure Funding Constitutional amendment, requiring voter approval, that would dedicate 1-3% of general fund revenue growth to funding infrastructure projects, including water, in positive fiscal years.

Proposition 50: Clean Water and Coastal Protection Bond of 2002.

This $3.44 billion bond will appear on the November 5, 2002 ballot, having been crafted and placed by the Nature Conservancy, Planning and Conservation League, Natural Resources Defense Council, Clean Water Action and the Metropolitan Water District of Southern California. Approximately 44% of the bond 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. As noted earlier, 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. More funding of groundwater programs is possible under one of many competitive grant program funding categories.

California Colloquium on Water Lecture Series

Continued from Page 2

pm, including questions and answers. This lecture series is free and open to all, no RSVP required. To receive an email reminder one week prior to each lecture, please send Linda Vida an email at lvida@library.berkeley.edu. The flyer is also available in a pdf format at www.lib.berkeley.edu/WRCA/ccow.html.

- October 8
  Ron Robie
  Associate Justice, Court of Appeal, Third Appellate District
  California's Water: Perspectives from the Bench
- November 12
  J. David Rogers
  Karl. F. Hasselmann Missouri Chair in Geological Engineering at the University of Missouri-Rolla
  Dams and Disasters: A Brief Overview of Dam Building in California
- December 10
  Tom Graf
  California Regional Director, Environmental Defense
  Environmental Advocacy: A Practitioner's Historical Perspective

Editor's Note: The above summary was prepared before the Governor's October 1 signing deadline. For the final results of the 2002 legislative session, go to www.grac.org.

GRA Welcomes the Following New Members

MAY 16, 2002 - SEPTEMBER 10, 2002

Mark Abbott	Montgomery Watson Harza
Ronaldo Almero	Mission Geoscience, Inc.
Lisa Argento	Air Toxics Limited
Mark Bierei	Montgomery Watson Harza
Steve Brooks	GeoTrans Inc.
Garrett Broughton	England Geosystem, Inc.
Kim Brower	Luhdorff & Scalmanini C.E.
Megan Brzyscz	Tech Law, Inc.
Karen Burden	Air Toxics Limited
Thomas Burton	Montgomery Watson Harza
Dina Calanchini	Tech Law, Inc.
Bryan Campbell	ETIC Engineering, Inc.
Gary Carter	VoV Enterprises, Inc.
Rich Chandler	Komex-H2O Science, Inc.
Les Chau	Kennedy/Jenks Consultants
Harold (Bud) Christiancy	Cucamonga County Water District
Ned Clayton	Saracino-Kirby-Snow, a Schlumberger Company
Shannon Couch	Cambria Environmental Technology, Inc.
Dan Davis	Daniel B. Stephens & Associates, Inc.
Thomas Deane	Tetra Tech, Inc.
Thomas (Ed) Diggs	Cucamonga County Water District
Cynthia Dittmar	Bonkowsi & Associates, Inc.
John Dolegowksi	CH2M Hill
Victoria Ellsworth	ATC Associates
Cal Erdman	Montgomery Watson Harza
Jim Finegan	GeoLogic Associates
Joni Fischer	England Geosystem, Inc.
Craig Fletcher	Fletcher Consultants, Inc.
Arthur Forma	Wallace Kuhl & Associates, Inc.
George Forsythe	SECOR International Incorporated
John Gallinatti	GeoSyntec Consultants
Mary Gaspari	Montgomery Watson Harza
Kathryn Gies	West Yost & Associates
Tim Giles	Sierra-Pacific Group
Peter Gorman	San Francisco State University
Jan Adam Greben	Hatch & Parent
William Greene	Harding ESE
Todd Hall	Montgomery Watson Harza
Dixie Hambrick	Montgomery Watson Harza
Thomas Haslebacher	
Ryan Haughy	ETIC Engineering, Inc.
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Peter Holland	Bonkowsi & Associates, Inc.
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David Irwin	PW Environmental
Mi-ae Jeon	Geomatrix Consultants, Inc.
Lauren Johnson	
Eric Kirkegaard	PW Environmental
Leslie Klinchuch	Chevron Environmental Management Co.
Stephen Koenigsberg	Regenesis
Leonard Konikow	USGS
Peter Leffler	
David Leighton	HydroFocus, Inc.
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Pam Martinson	Geomatrix Consultants, Inc.
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Sandra Maxfield	Montgomery Watson Harza
Wendy McClellan	Montgomery Watson Harza
Carl McGinnis	Shan Environmental & Infrastructure, Inc.
Zachary Miller	CH2M Hill
William Mitchell, II	Wheeldon Geology - Geologic Consultants
Mary Morkin	Malcolm Pirnie, Inc.
Gene Ng	CH2M Hill
Mark Nordberg	EIP Associates
Kevin O'Dea	Baseline Environmental Consulting
David Palais	Arrowhead Mountain Spring Water
Kam Pang	EMAX Laboratories, Inc.
John Pfeiffer	Wallace Kuhl & Associates, Inc.
Kenette Pimentel	EMAX Laboratories, Inc.
Richard Prima, Jr.	City of Lodi
Laura Rainey	DTSC, Southern California Region
Richard Rees	Geomatrix Consultants, Inc.
Kenneth Richardson	Hatch & Parent
John Jay Roberts	Mission Geoscience, Inc.
Scott Romine	Apex Envirotech, Inc.
Julie Rose	McNichols, Randick, O'Dea, & Tooliatos
Tracy Roth	LFR Levine-Fricke
Wally Sandelin	City of Lodi
N. Thomas Sheahan	Geomatrix Consultants, Inc.
Albert Simmons	Cambria Environmental Technology, Inc.
Mark Sorensen	Innovative Technical Solutions, Inc.
Mike Stephenson	Cameron-Cole
Benjamin Stewart	Montgomery Watson Harza
C. John Suen	CSU, Fresno
David Thomas	CH2M Hill
John Vega	Cucamonga County Water District
Brian Van Lienden	Saracino-Kirby-Snow, a Schlumberger Company
Eric Vander Velde	Montgomery Watson Harza
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Kristene Wilder	Cambria Environmental Technology, Inc.
Anna Willett	Regenesis
Martin Wills	Mission Geoscience, Inc.
Brent Wolfe	Saracino-Kirby-Snow, a Schlumberger Company
Brad Wright	Cameron-Cole
Thomas Wright	Mission Geoscience, Inc.
Jim Yost	West Yost & Associates

Dates & Details

GRA Meetings and Key Dates

(Please visit www.grac.org for detailed information unless noted)

"Biological Treatment of MTBE Contamination in Groundwater: Ex-situ and In-situ Challenges"	**October 17, 2002** San Jose, CA
GRA BOARD MEETING	**November 2, 2002** Sacramento, CA
"Nitrate In Groundwater: Sources, Impacts and Solutions"	**November 12 & 13, 2002** Fresno, CA
GRA Strategic Planning and Board Meetings	**January 19 & 20, 2003** Southern California

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

NGWA / AGWSE 2002 Annual Meeting and Conference: "Linking Surface and Subsurface Hydrology - From Science to Technology"	**December 8-11, 2002** Las Vegas, NV
NGWA Southwest Focus Conference: "Water Supply and Emerging Contaminants"	**February 20-21, 2003** Phoenix, AZ

HYDRO VISIONS

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