

HYDRO VISIONS

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GROUNDWATER RESOURCES ASSOCIATION
OF CALIFORNIA

Spring 2005

GRA's Arsenic in Groundwater Symposium — Tales of Trial, Tribulation, and Treatment

BY WILLIAM PIPES

GRA held the 12th symposium in its very popular and successful Contaminants in Groundwater Series on October 18 and 19, 2004, in Fresno, California. Entitled *Arsenic in Groundwater – Impacts on a Critical Resource*, the symposium drew 135



Steve Hall, ACWA Executive Director, addresses GRA's Arsenic Symposium

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

attendees from throughout California and other states in the Western U. S. to the beautiful San Joaquin Valley to take a hard look at the continuing and escalating problems associated with arsenic in groundwater. Experts, researchers, and stakeholders from academia, consulting, regulatory agencies, water purveyors, and the legal arena presented papers, poster sessions, and engaged in a lively panel discussion on the issue of arsenic in groundwater, the impacts new drinking water standards will have on this critical Western U.S. resource, and possible solutions to mitigate these impacts. Cooperating organizations for the event included the Association of California Water Agencies (ACWA), the International Association of Hydrogeologists, National Ground Water Association, and the Water Education Foundation.

Why Arsenic? Arsenic is a naturally occurring and plentiful element present throughout the earth's biosphere, atmosphere, and hydrosphere. Because of its presence in the earth's crust and its common occurrence in many minerals, arsenic occurs naturally in groundwater, where it is at its highest levels in the alluvial basins of the Western U. S.

Acute exposure to arsenic at high levels poses serious health effects and even death (arsenic poisoning). Research in the last couple of decades indicates that there are also health effects from long term chronic exposure to arsenic, although the critical levels are still somewhat controversial. In

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February 2002, EPA adopted a final standard for arsenic of 10 ppb, lowered from 50 ppb set by the U.S. government in 1942. Under this ruling, the states must adopt this standard (or lower), and all water systems in the U. S. must be in compliance by January 2006. In April 2004, the State of California determined that the health goal for arsenic should be 4 parts per trillion (ppt). California soon will be setting a drinking water standard using this health goal as guidance. 4 ppt is well below the arsenic lab detection limit (2 ppb) and 1,000 times below the level of arsenic in much of the groundwater throughout the Western U. S. and in other groundwater basins across the U. S.

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President's Message

BY TOM JOHNSON

City Water Not Contaminated

I was reading some news articles the other day, most of which had something to do with MtBE, perchlorate, radon, C8 or various wastewater compounds detected in groundwater from Maryland and Massachusetts to Colorado and California, when I noticed something odd. There it was. In the midst of all these reports and articles about the various chemicals found in the local drinking water supply was a simple newspaper article with the heading: "City Water Not Contaminated."

It seems that the town of Fremont, Nebraska (pop. 25,188) reported in the Fremont Tribune that nitrate concentrations from all five of the town's primary wells were found to be substantially less than the 10 mg/l MCL. In fact, nitrate concentrations in the water from these wells was less than 0.5 mg/l. Now, if you have ever been to Nebraska, where there are feedlots the size of downtown Sacramento and widespread irrigation of sandy soils leads to over-fertilization, you probably know that nitrate likely is a constituent of primary concern. The problem is compounded by the fact that 85% of the population reportedly relies on groundwater, primarily from shallow wells.

I'm not sure what surprised me most; the fact that any wells in Nebraska had nitrate levels that low, or that this front-page story was proudly proclaiming that the city water supply wasn't contaminated. Perhaps, groundwater contamination headlines are more interesting and sell

more newspapers, so groundwater good news is much less often reported. Or, have we gotten so used to the presence of the various contaminants du jour in groundwater, that the lack of contamination of public water supplies really is headline news?

The other article that I noticed that day had a more provocative headline: "Many private foothills wells tainted." This article in the Sacramento Bee described the results of sampling of 513 private domestic wells in rural Eldorado and Yuba Counties. This 2002 study, directed by the State Water Resources Control Board, included analyses for various constituents, including bacteria, nitrate, pesticides and fuel ingredients.

The results of this first large-scale sampling of private wells are troubling. More than half of the wells (62%) contained one or more of the contaminants tested. Most disturbing, fecal matter was detected in 16 wells (3.1%), and coliform bacteria were found in 139 wells (27%); not unexpectedly, nitrate/nitrite was detected in 296 wells (58%). Sources for these contaminants included the usual suspects common to rural areas: septic systems, pesticide and fertilizer use, fuel tanks, and farm animals. Owners of those wells impacted by high levels of bacteria were instructed to stop drinking the water and to disinfect the well before using again.

Currently, more than 10 million Californians (30%) rely on water from public supply wells, and the findings from this study of private wells certainly support the argument that all private wells should

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California Groundwater Management

TUESDAY, MAY 10, 2005
HILTON HOTEL, GLENDALE, CA

California groundwater management is an extremely complex system of water rights and technical issues coupled with a historical backdrop of political resistance. Groundwater management is also constantly evolving and continues to present new challenges over time.

This course covers many of the challenging and changing aspects of groundwater management, including groundwater information crucial to creating groundwater management plans and groundwater law.

The Groundwater Resources Association of California's new book, *California Groundwater Management, Second Edition 2005*, will be provided to all course attendees (included in the registration fee).

This course is intended to provide attendees with:

- ◆ A fundamental understanding of groundwater issues as related to the comprehensive management of water resources
- ◆ General guidelines for the hands-on development and implementation of groundwater management plans
- ◆ Information on the current tools and technology available for groundwater management
- ◆ Knowledge of the current and future challenges and obstacles for groundwater projects

Watch www.grac.org for details and registration information. A similar course will be presented in conjunction with the ACWA Spring Conference May 3-6 in San Jose. ◆

Upcoming Events

Subsurface Vapor Intrusion to Indoor Air: An Update

MAY 25, 2005, HYATT HOTEL, SAN JOSE, CALIFORNIA

There are many factors that influence indoor air quality. One of them, subsurface vapor intrusion, has emerged to the forefront of the environmental management landscape. This is evidenced by the recent emergence of related policy, guidance, regulation, and enforcement.

Demonstrating the special attention devoted to vapor intrusion to indoor air, U.S. EPA issued in 2002 a new guidance for soil vapor intrusion. In 2003, the DTSC and the RWQCB-LA Region issued an advisory for collecting soil-gas samples. The DTSC has recently posted their interim final vapor intrusion guidance document on their web site at http://www.dtsc.ca.gov/ScienceTechnology/HERD_POL_Eval_Subsurface_Vapor_Intrusion_interim_final.pdf. With the rising concern from the vapor intrusion pathway, and with EPA's draft risk assessment study on TCE (which comprises a large portion of contaminated sites), indoor air quality has been tested at several sites in California and across the nation.

As a follow-up to a well-attended conference in late 2003, GRA announces a one-day symposium entitled "Subsurface Vapor Intrusion to Indoor Air: An Update." This gathering will feature regulatory agencies, consultants, vendors, and members of the academic community to focus on advancements and new trends on the subsurface vapor intrusion issue.

A regulatory update will be presented in a general session that will involve speakers from Federal and state

regulatory agencies. Of special interest will be the draft "Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air" recently released by the Cal/EPA DTSC for public comment. (See page 21 for related article.)

Case studies will be presented that focus on indoor air measurements, methane at petroleum-impacted sites, chlorinated solvent groundwater plumes, and the sensitivity of computer simulations. Other presentations will address strategic pathway analyses by focusing on outdoor air, building design and land use, crawl spaces, strategies for vapor intrusion assessments, technical aspects of sampling and analysis of soil gas and groundwater, and strategies for the mitigation of vapor intrusion. Perspectives from various stakeholders will be presented in a general session. The symposium will end with a reception in the exhibit area.

Additional Program, Exhibitors and Sponsors Information

If you are interested in exhibiting your organization's services or products, or being a sponsor for the symposium, breaks, or reception, please contact Mary Megarry at 916-446-3626 or mmegarry@nossaman.com. GRA welcomes co-sponsors, lunch, break and reception sponsors. ◆

Editor's note: For a full listing of upcoming events, go to the GRA calendar on the back page and www.grac.org/Upcomingevents. Also see page 13 of this issue.

EIMS Symposium Portrays Benefits and Obstacles Surrounding Groundwater Data Management

BY TODD MILLER, MALCOLM
PIRNIE, AND ELIE HADDAD,
LOCUS TECHNOLOGIES

On 26 January 2005, GRA held its first conference on Environmental Information Management Systems (EIMS) in San Jose, California. The attendance far exceeded expectations, as more than 140 attendants, including many walk-in registrants, crowded the standing-room-only conference room, confirming the vast interest in this topic. The event was co-sponsored by Daniel B. Stephens & Associates, Inc and Locus Technologies, Inc.

Mr. Tom Mohr, GRA's Vice President, initiated the conference and introduced Mr. Elie Haddad of Locus Technologies, the chairman and organizer of the conference, who described how in most companies, environmental information is stored in disconnected and disjointed systems. The value of the data far exceeds any reasonable amount that companies could afford to spend to re-create it, so that there is an immense need to securely store and efficiently manage the data collected. Due to space limitations, this article presents only a summary of the excellent presentations made. The full article is online at www.grac.org/eims/symposium/article.pdf.

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Technical Corner

Trends in Perc-related Litigation in California

BY THOMAS F. VANDENBURG

Introduction

Litigation involving perchloroethylene groundwater contamination and municipalities is increasing in California. Currently, there are two high profile cases involving the City of Modesto and the City of Lodi. In *City of Modesto Redevelopment Agency v. Superior Court*, the California Court of Appeals issued an important opinion allowing certain municipal entities to sue those manufacturers and distributors of dry cleaning equipment and suppliers who "took affirmative steps directed toward the improper discharge of solvent waste" for clean-up of resulting groundwater contamination. This opinion expands the range of potential defendants in these actions.

Conversely, in *FFIC v. City of Lodi*, the Court limited the City's ability to prosecute claims under its local Comprehensive Municipal Environmental Response Ordinance ("MERLO"). Specifically, the California Court of Appeal ruled that the City's MERLO statute was preempted by the Carpenter-Presley-Tanner Hazardous Substances Account Act ("HSAA"). Thus, where the two statutes conflicted, MERLO was overruled. The impact of this ruling is that the City cannot simply order a cleanup by the "potentially responsible parties" ("PRPs") as was authorized under the MERLO statute.

In addition to traditional CERCLA-based groundwater remediation litigation, private plaintiffs are bringing actions for personal injuries and property damage against municipalities

for perchloroethylene groundwater contamination and their exposure to perchloroethylene-contaminated groundwater. These cases raise new questions concerning the boundaries of municipal liability for contamination allegedly caused by third party discharges to sewer systems.

City of Modesto Action

In *City of Modesto Redevelopment Agency v. Superior Court*, the Court of Appeal expanded, in certain circumstances, the potential defendants in groundwater contamination claims brought by certain public entities. The City alleged in its complaint that PCE and TCE groundwater contamination existed in the City of Modesto sewer system. The City also alleged that dry cleaners habitually dumped or leaked solvents into the City's sewer system. The City further alleged that certain defendants instructed dry cleaner operators that solvents could be discharged into City sewer lines, and that these defendants failed to warn about potential solvent contamination and/or failed to recall this equipment. The City brought these claims against chlorinated solvent manufacturers, equipment manufacturers, and distributors of dry cleaning solvent and equipment.

The issue which the Court of Appeal considered in detail in its opinion was the potential liability of these defendants under the Polanco Act, which allows local redevelopment agencies to sue "responsible parties" for clean-up response costs. Under the Polanco Act, responsible parties are defined as "CERCLA responsible

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DHS Waterworks Standards

BY DAVID ABBOTT AND JIM ULRICK

Since July 2003, GRA has participated actively in a Task Force organized by the California Groundwater Association (CGA) to assist the California State Department of Health Services (DHS) Drinking Water Division in revising the DHS Waterworks Standards Section 64554 (c) (2) (A) & (B). These standards are for public water systems. At that time (July 2003), the draft waterworks standard proposed by DHS stated:

The capacity of a well drilled in hard rock shall be determined from existing pumping and drawdown data covering a period of at least ten years or one of the following tests initiated during August, September, or October.

- ▲ Pump the well continuously for a minimum of 72 hours;
- ▲ Take measurements of water drawdown and pumping rate every four hours;
- ▲ Pump until the water drawdown level is constant for at least four measurements;
- ▲ To calculate the assigned well capacity, the pumping rate at the fourth of the measurements in sub-subparagraph 2, shall be multiplied by 25%.
- ▲ Pump the well continuously for a minimum of 10 days;
- ▲ Take measurements of water drawdown and pumping rate every four hours during the first four days, daily for the next four days, and every four hours for the remaining days;
- ▲ Pump until the water drawdown level is constant for at least four measurements;

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Technical Corner

Santa Maria Groundwater Basin: Moving towards Settlement

BY ROBERT SAPERSTEIN, HATCH & PARENT

After almost eight years of litigation, and on and off settlement discussions, the majority of parties in the Santa Maria Groundwater Basin adjudication have agreed on the terms of a settlement. On December 23, 2004 the major parties to the litigation entered into the court record a comprehensive set of settlement points.

Regional Water Supplies

The Santa Maria Groundwater Basin encompasses approximately 160,000 acres in coastal portions of northern Santa Barbara and southern San Luis Obispo Counties. Basin groundwater is a primary source of supply to the prolific agricultural users and the growing urban communities in the area. Currently, about 70% of the water use is agricultural. The local water users are fortunate in that they have two major, local supplemental surface water supplies — the Lopez and Twitchell Reservoir projects — as well as State Water Project (SWP) water available to augment local groundwater supplies. By most accounts, the multiple water supply sources guarantee adequate water supplies for the region, provided the sources are properly managed.

The Litigation

The lawsuit was initiated in 1997, although tension over control of the groundwater basin predated the litigation for many years. Remarkably, the triggering event for the original suit was the completion of the SWP Coastal Aqueduct, which allowed the local

urban users to reduce their reliance on local groundwater, instead relying on SWP supplies. The farming interests that initiated the litigation were concerned that the local SWP contractors might claim rights to store imported water in the Basin in a manner that would negatively impact the integrity of the local groundwater supplies.

The original lawsuit was aimed solely at controlling the public water suppliers' access to the Basin water resources. Given the large numbers of groundwater users in the Basin, the large geographic region involved, and the complexity of integrating management of the multiple sources of supplies, it was clear that all water right holders in the Basin should be subject to an overall Basin management regime. The litigation now includes more than 1,000 parties, although only a fraction of them are active participants. The intention of the settlement is to create an overarching groundwater management plan for the entire Basin that will control and guarantee the long-term integrity of the local groundwater supplies.

The Settlement

The settlement terms are distilled into a few basic themes, all premised on actively managing the Basin so that it can support all current and anticipated future uses reliably and without negatively impacting any individual user's rights.

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California Legislative Corner

Legislative Committee Update

BY TIM PARKER, COMMITTEE CHAIR, AND CHRIS FRAHM AND JEFFREY VOLBERG OF HATCH & PARENT

SB 820 (Kuehl) – The Mega Water Bill

Senator Sheila Kuehl, Chairperson of the Senate Natural Resources and Water Committee, has introduced SB 820. The bill imposes severe penalties on water users that do not meet certain reporting requirements. It also imposes additional duties on the Division of Water Rights of the State Water Resources Control Board without providing state funding. Finally, it increases planning burdens on urban and agricultural water users.

According to Senator Kuehl, the bill has three purposes: (1) strengthen water conservation policy; (2) reduce uncertainty about the use and abundance of the state's water resources; and, (3) increase the integrity and integration of water resources management and planning. While these are clearly worthy purposes, the bill seeks to accomplish them by imposing serious burdens on water users, water suppliers, and on the state government.

For example, to strengthen water conservation the bill establishes a "rebuttable presumption" of waste if a person does not implement "cost effective" water conservation practices. In other words, a person has to defend his or her water rights whenever another person alleges that he or she is not adequately conserving water. If a court or SWRCB makes a finding that the water user is not using cost-effective water conservation, the law will presume that the water rights holder is wasting water, and the burden is on the water right holder to prove that his or her use does not constitute waste.

Water users that fail to file reports of annual surface water use face the forfeiture of their water rights, as well as civil liability and ineligibility for state grants.

Pumpers of over 25 acre feet per year are required to file annual extraction reports with SWRCB. Among other things, the bill also removes the CEQA exemption for Urban Water Management Plans. It requires Groundwater Management Plans (AB 3030) to be updated every five years. The bill requires the filing of Agricultural Water Management Plans by all suppliers of 2,000 acre feet or more as a condition of receiving state grants. And, it requires the Executive Director of SWRCB to establish a list of stream systems that are candidates for being declared fully appropriated, but it does not provide funding.

Senator Kuehl's office has asked for input from interested parties and will hold a series of working group meetings to refine the language of the bill. Senator Kuehl wants to know any policy concerns with the bill, and also asks for specific proposals for changes to the bill's language and provisions.

Senator Kuehl's SB 820 will make major changes to California water law and will place heavy burdens on water users and state government alike. The bill is a first step toward comprehensive regulation of groundwater in California, and it makes the validity and security of water rights contingent on meeting government report requirements and policy objectives. All water users and water suppliers will be affected by this bill and GRA will be following its progress.

AB 1453 (Daucher) – Venue for Groundwater Adjudications

AB 1453 provides that groundwater adjudication cases shall only be heard in certain superior courts that have expertise in the subject matter. Actions over the right to produce groundwater must be transferred to the superior court that is closest to the parcel of land in one of the following jurisdictions:

- ◆ Alameda County
- ◆ El Dorado County
- ◆ Los Angeles County
- ◆ Orange County
- ◆ Riverside County
- ◆ Sacramento County
- ◆ San Diego County
- ◆ San Luis Obispo County
- ◆ Sonoma County

The presiding judge in the jurisdiction must assign the actions to a judge having extensive experience in groundwater adjudication. The assignment may not be challenged. The bill also requires the Judicial Council to develop special rules of practice and procedure, and to prescribe special forms for groundwater adjudications. AB 1453 was introduced on February 22, 2005. The text of the bill may be viewed at <http://www.leginfo.ca.gov/bilinfo.html>.

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California Regulatory Corner

CCGO Highlights – Spring 2005

BY JANE GILL-SHALER, EXECUTIVE DIRECTOR OF CCGO

Sixth Annual Sacramento Drive-In

CCGO Delegates from all over California drove, flew, and hitchhiked (or at least shared a ride) to our state capitol to attend the 6th Annual CCGO Sacramento Drive-in (Lobby Day) on Wednesday March 2, 2005. Delegates included CCGO President Jason Preece (AEG San Francisco); CCGO Vice President Charles Nestle; Jim Jacobs (AIPG delegate); Rick Blake, AAPG delegate and former CCGO President; Jennifer Davis, AWG Student Delegate; Matthew Hawley, AEG Southern California; and Judy Wolen, AEG Lobbyist and CCGO Legislative Analyst.

The CCGO 6th Annual Sacramento Drive-In started the morning by meeting with Paul Sweeney, Executive Officer of the Board for Geologists and Geophysicists (BGG). George Dunfield, a senior staff geologist with the BGG, also attended the meeting. We discussed upcoming proposed legislation and bills to watch. We are pleased to say that in part because of CCGO's lobbying and letter-writing activities, the BGG is a strong board and is not currently slated for elimination.

Later we met with geologist John Parrish of the State Mining and Geology Board (SMDG) and with the California Geological Survey (CGS). The CGS had several presenters, including Michael Reichle, Acting State Geologist. The CGS discussed the need to continue their programs and funding. Over the past two or three years, the CGS budgets have been cut drastically. Even with significant cut backs, they have retained their high

quality staff by working on projects for other agencies. As a result, the landslide-mapping and other programs have not moved ahead as originally planned. Since Southern California has had an exceptionally wet 2004-2005 water year to date, landslides have become more commonplace.

After lunch in the California State Capitol building, we met with representatives Carol Liu, Joe Nation, and Sam Blakeslee. Selected delegates met with representatives of Senator Tom McClintock and Assemblyman Chuck Devore. Representative Blakeslee has a PhD in geophysics and could easily relate to geologic issues. Joe Nation has seen the CCGO delegation for the last several years. He explained his recent hospital bill, which combines knowledge of seismic risks with cost priorities of hospitals.

The CCGO delegation also met with Senator Liz Figueroa, who has been a great supporter of geologists over the years through her involvement with the Business and Professions Committee. During our brief meeting, CCGO Past President Rick Blake presented the

Senator with a CCGO plaque honoring her contributions to the geologic professional community. CCGO's friend in the California Senate, Senator Figueroa, will be termed out shortly. Consequently, her advice to the delegates was to work with other new leaders who will be able to help the geologic profession in California. The drive-in reminded the delegates that the personal relationships that we develop with legislators is key when issues such as professional registration and geologic practice can rapidly change for better or worse by the desires of others.

SB 228

Senator Liz Figueroa has introduced a bill to extend the BGG, but there are hidden dangers. See CCGO.org for details.

Due to space constraints, other CCGO announcements, reports, and events this quarter that are too numerous to be described here, are posted on our website, <http://ccgo.org>. Click on News and Letters at the top of the page for the Spring 2005 Newsletter. 💧



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Current Happenings at the Federal Government

BY JOHN UNGVARSKY, US EPA

30th Anniversary of the Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) of 1974 has helped Americans enjoy one of the safest and cleanest water supplies in the world. The important advances in water treatment over the last century, and since the SDWA's passage, constitute some of the major achievements in modern American public health. More than 273 million people receive water from 53,000 community water systems. During 2005, EPA will highlight key SDWA programs, including the Underground Injection Control and Source Water Protection Programs during May-June. For more information visit: <http://www.epa.gov/safewater/sdwa/30th/index.html>.

Groundwater Ambient Monitoring and Assessment (GAMA) Program

California's GAMA Program is a comprehensive assessment of the State's groundwater quality. The program is designed to help better understand and identify risks to groundwater resources. Groundwater will be sampled at many locations to characterize constituents and identify trends in groundwater quality. The results of the tests will provide information for water agencies to address a variety of issues ranging in scale from local water supply to statewide resource management. For more information, go to <http://water.usgs.gov/pubs/fs/2004/3088/>.

Long-Term Groundwater Monitoring Optimization Seminar

The EPA and collaborating partners invite you to participate in the first seminar on Long-Term Monitoring Optimization (LTMO) for groundwater to be held March 30-31, 2005 in Sacramento, CA. This seminar will provide state and federal regulators with information about new quantitative methods of LTMO for groundwater. For more information, visit <http://trainex.org/>.

Tap Into Prevention

Doctors, nurses, local health officials and other health professionals play an important role in preventing waterborne illness. This continuing education video explains potential health risks from exposure to microbial and chemical contaminants in drinking water and demonstrates actions health care providers can take in their practices. EPA, the Centers for Disease Control and Prevention and its Agency for Toxic Substances and Diseases Registry jointly cosponsor this continuing education activity. For more info, see <http://www.epa.gov/safewater/healthcare/index.html>.

Arsenic Exposure via Drinking Water and Children's Intellectual Function

In addition to the relationships between arsenic exposure and lung, skin and bladder cancers, recent research has linked arsenic exposure to the development of cardiovascular diseases

such as hypertension. Researchers have also documented adverse impacts of acute and chronic arsenic exposure on a range of cognitive functions in adults, including learning, memory, and concentration, as well as peripheral and central neuropathies. For the full article, see: http://wwwapps.niehs.nih.gov/sbrp/researchbriefs/view.cfm?Brief_ID=120.

John Ungvarsky is an Environmental Scientist at the U.S. Environmental Protection Agency, Region 9. He works in the Water Division's Ground Water Office, and his responsibilities include Animal Feeding Operations Coordinator and Source Water Protection, with an emphasis on groundwater issues. For information on any of the above topics, please contact John at 415-972-3963 or ungvarsky.john@epa.gov.

Arsenic and Old Tests

BY BART SIMMONS

The United Nations and World Bank efforts to provide cheap groundwater as an alternative to unsafe surface water prompted the use of tube wells to tap shallow groundwater in Bangladesh and neighboring areas. Unpredicted was the change in groundwater chemistry which mobilized naturally-occurring arsenic and led to one of the greatest mass poisonings in history. An estimated 100 million villagers in Southern Asia now consume water containing more than 10 µg/L arsenic. In addition, arsenic has accumulated in rice paddies, compounding the problem by adding food contamination as a route of exposure.

Beginning in 1997, the World Health Organization (WHO), UNICEF, the World Bank and other organizations collaborated to conduct arsenic field tests for all tube wells in Bangladesh and West Bengal, India. Three field test kits were used, although they all used the same basic Gutzeit technique. The Bangladesh Arsenic Mitigation Water Supply Project (BAMWSP) analyzed over 600,000 hand tube wells and a UNICEF project tested over 400,000 tube wells. A previous review of the field test results raised a question of the reliability of arsenic field tests, because of a lack of correlation between the field tests and the reference method, Graphite Furnace Atomic Absorption Spectrophotometry (GFAAS).

An ongoing issue in the evaluation of field testing is: how good is good enough? A critical consideration is the intended use of the data. In this case, field testing of tube wells in 2000-2001 was used to classify wells as containing

more or less than 50 µg/L, although the current WHO recommendation is 10 µg/L. The field test kits use the old Gutzeit method, which converts arsenic to arsine gas, which is trapped on a strip of paper impregnated with mercuric bromide. The resulting color is compared with a reference scale, which ranges from 0 to 500 µg/l. Van Geen et al did additional field testing with the Hach field test, compared the results with Inductively-Coupled Plasma Mass Spectroscopy (ICP-MS) data, and re-analyzed the classification of wells done using similar field tests. They found a better agreement in well classification overall (88%) between ICP-MS and the field test than had been previously reported. They also found that the proportion of misclassified wells in a sub-fraction could be reduced from 34% to 6% when the field test was modified by extending the reaction time from 20 to 40 minutes. This optimistic report bodes well for the continued use of field tests for the millions of tube wells in Southern Asia.

There are multiple lessons from Bangladesh: 1) We don't always know enough about soil and groundwater chemistry to make wise decisions on water use, 2) field tests can provide reliable data for the intended use, even if field methods do not strongly quantitatively correlate with reference methods, 3) site-specific conditions may need to be considered for refining field (or laboratory) tests.

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

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Lucerne Valley Groundwater Basin Geologic Insights

BY M. BLAZEVIC, M., W.R. LATON, AND J. FOSTER, CALIFORNIA STATE UNIVERSITY, FULLERTON

The Lucerne Valley groundwater basin is considered a closed watershed basin, in that no external surface water flows from the basin. It is typified by large mountain ranges surrounding the basin with protruding hills of basement rocks exposed throughout the region. Its borders are defined by the Ord, Rodman and Stoddard Mountains to the north, the Granite Mountains and crests of alluvial fans in the west, Fry and Cougar Buttes Mountains to the east, and the large San Bernardino Mountains to the south. Adjacent to the mountain fronts, large alluvial fans slope towards the center of the basin where ephemeral (seasonal) streams deposit alluvial materials. The Lucerne Valley groundwater basin has a topographic low of 2,848 feet (ft)

(amsl) in Lucerne (dry) Lake and rises to 8,248 ft in the San Bernardino Mountains.

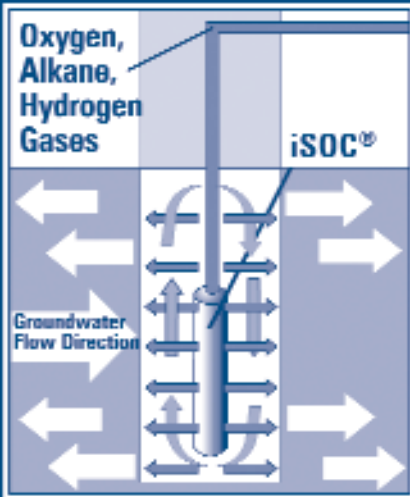
Alluvial materials adjacent to mountain fronts and in the central valley consist of Tertiary formations, Quaternary stream alluvium, alluvial fan deposits, playa deposits, landslide deposits, and dune sand [Gardner, 1941; Hewett, 1954; Dibblee, 1964a and 1964b; DWR, 1967; and Sadler, 1982a]. These deposits are permeable, with varying porosities and high specific yields, and comprise the aquifers in the basin. The total thickness of the water-bearing units is estimated to be approximately 1,000-1,400 ft throughout most of the Lucerne Valley groundwater basin.

The predominant structural features in the Lucerne Valley groundwater basin that affect the subsurface distribution of water-bearing materials include a set of northwest trending, right-lateral, strike-slip faults: the Helendale, Lenwood, Camp Rock, and Old Woman Springs faults. The Helendale, Lenwood, and Camp Rock faults also intersect a zone of thrust faults parallel to the northern front of the San Bernardino Mountains, the North Frontal thrust system of the San Bernardino Mountains, which acts as a boundary to the basin aquifer at the southern edge of Lucerne Valley.

In assessing the subsurface geology of the Lucerne Valley groundwater basin, the following methods were applied: (1) geologic maps of Lucerne

Continued on page 20

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California Groundwater Association Notes

BY MIKE MORTENSSON, CGA
EXECUTIVE DIRECTOR

CGA Office Burns!

The CGA office was destroyed by a fire in the early morning of Monday, November 29th. No one was injured, but substantial fire and water damage resulted from the blaze. The CGA office was promptly relocated to a vacant, smaller office in the same complex. Business is still in the “catch up mode” – the CGA computer network has been restored via an off-site backup tape. Insurance coverage was in place to cover the losses. CGA suggests that all CGA and GRA members check the adequacy of their insurance; be aware that the cleanup/restoration costs can be extensive and are part of property coverage. And don't forget that replacing computers may also require new software and installation services. CGA staff Aimee Jay and Mike Mortenson thank Pentair Water and the Sonoma CGA Branch and the Southern California CGA Branch for their donations to help staff replace supplies and personal items lost in the fire.

Further Study on Proposed DHS Regulations

As you may recall, CGA and GRA have been working together to make recommendations to DHS on their proposed Waterworks Standard. A meeting with DHS Director Sandra Shewry and her key staff, CGA/GRA task force members, and other stakeholders, was held at Assemblyman Tim Leslie's office in October. A proposed section regarding aquifer capacity testing in hard rock well areas for public water systems has been

Continued on page 21

Alliance Corner

EPA Adopts National Academy's Perchlorate Numbers

BY BOB MASTERS, NATIONAL GROUND WATER ASSOCIATION

The breaking story on perchlorate is that on February 18, 2005, U.S. EPA adopted a reference dose of 0.0007 mg/kg for a 70 kilogram adult male human. That's consistent with what the National Academy of Sciences (NAS) found in mid-January, which is 23 times higher than U.S. EPA's original number.

Even though a maximum contaminant level has not yet been established, perchlorate has become a hot issue. The same has been true of MTBE. All the studies, lawsuits, and news articles on MTBE have happened before a national, enforceable MTBE drinking water has been set. This includes the \$900 million dollar lawsuit brought by Methanex against the State of California, and the \$69 million dollar settlement in South Lake Tahoe. Congress is expected to debate Federal Energy Legislation this session. A current discussion draft of the Energy Bill contains language limiting the liability of oil companies regarding MTBE and other oxygenates.

These developments bring forward issues that will be addressed at the upcoming National Ground Water Association (NGWA) conference on Perchlorate and MTBE May 26-27, 2005 in San Francisco:

- ◆ How will US EPA consider the reference dose for a possible MCL?
- ◆ What are the regulatory implications of the NAS report?
- ◆ What are the remediation business implications of the NAS report?
- ◆ What are the implications of the Energy Bill for MTBE remediation?

- ◆ What is the status of current perchlorate and MTBE litigation?
- ◆ What are the current remediation and drinking water technologies?

The conference begins each morning with a keynote session and then provides concurrent sessions on MTBE and perchlorate. The conference will cover a broad list of topics ranging from perchlorate in the nation's milk supply to naturally occurring perchlorate. On Wednesday May 25, NGWA will offer a special 1-day seminar on TBA (tertiary butyl alcohol) and MTBE Remediation which will be taught by Ellen Moyer, Editor of the *Handbook of MTBE Remediation*.

Scientific and policy issues surrounding perchlorate will be the subject of a National Ground Water Association Regulatory Roundtable chaired by US EPA's Kevin Mayer on May 26, 2005 at the San Francisco conference. The conference will be particularly timely with recent EPA and NAS reports and their potential impact to perchlorate regulation. NGWA is excited to come back to California this year, together with its affiliated state society GRA as a co-sponsor. For more information, or to register for this conference, go to <http://ngwa.org>.

A ground water hydrologist, Bob Masters is NGWA's Conference Coordinator. He formerly worked for the U.S. Geological Survey, and has served on the U.S. EPA National Drinking Water Advisory Council Research Working Group and the USGS Advisory Committee on Water Information. ◆

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Organizational Corner



Message From the Executive Director

BY KATHY SNELSON

Weave of Conviction, Strength and Flexibility

In November 1993, National Geographic published a special edition magazine (120 pages) entitled, *Water: The Power, Promise and Turmoil of North America's Fresh Water*. The publication was "devoted exclusively to the subject of fresh water – use and abuse of it, potential supply and prospects for the future." At the time, this special edition was "only the second of its kind in the Society's 105-year history." I believe this demonstrated the Society's conviction that its readers (and others) needed to know and understand the indisputable and increasing need to protect and wisely manage fresh water.

In February 1992, GRA officially formed, developed its plan of action and opened its doors to members. Over the past 13 years, GRA has been at the forefront of California's groundwater resources management evolution. Whether in the form of a conference, comprehensive handbook, quarterly newsletter, white paper or electronic bulletin, GRA's capacity to understand current needs, provide explanations and solutions, and anticipate future conditions is unmistakable. For example, GRA's *Series on Groundwater Contaminants* was developed on the heels of the landmark civil class action lawsuit, *Anderson v. Pacific Gas & Electric*, dealing with exposure to hexavalent chromium. GRA anticipated that groundwater resources professionals and the public would need access to reliable, objective

information about a variety of issues surrounding hexavalent chromium. Accordingly, GRA created the First Symposium in the *Contaminant Series*, entitled "Hexavalent Chromium in Groundwater." The Symposium opened to a sold out audience of 325. Now, GRA is about to offer the 14th Symposium in the *Series*.

GRA's conviction (mission), "dedication to resource management that protects and improves groundwater," has endured the test of time because of the perpetual strength of its membership and their willingness to consider the past, engage the present and contemplate future issues and challenges that might affect California's access to an ample supply of fresh water. This is not so different from National Geographic's conviction to alert the public that fresh water might not always be available, and why.

The National Geographic special edition magazine declared, "We live by the grace of water." If we accept that premise, it is up to each one of us, and up to trusted, vibrant organizations like GRA, to protect and manage our water supply during times of abundance, as well as times of scarcity. I hope that you are and will remain an active participant in GRA for many more years. The ebb and flow of groundwater availability and use will persist, but you have the opportunity through GRA to remain uniformly committed to resource management that protects and improves groundwater. 💧

Save the Date

GRA's Legislative Symposium & Lobby Day

All Day at the Capitol
Wednesday, May 18, 2005

Agenda will include:

- ▲ Briefings on important current legislative issues of interest to groundwater professionals
- ▲ Lunch Keynote to be delivered by a Legislator
- ▲ Dialogue with key legislators on the future of California groundwater
- ▲ Visits with legislators and decision makers, including your local representatives to educate them on the concerns and technical expertise of GRA members
- ▲ Legislative Reception with legislators, key staff, and water agency officials

Contact Jeff Volberg (jvolberg@hatchparent.com) or (916) 441-1232 for further information or to register. ▲

2005 Director Election Results

The election for GRA's 2005 Board of Directors has been officially completed. Board incumbents Susan Garcia, Thomas Johnson, Thomas Mohr and Tim Parker were re-elected. Eric Reichard was elected as a new member of the Board. All Directors elected in 2005 will serve three-year terms ending in 2007.

GRA extends its sincere appreciation and best wishes to Jim Jacobs who retired from the GRA Board of Directors at the end of 2004. ▲

Organizational Corner

Renew Your Membership Online - It's Quick and Easy

If you haven't renewed your membership for 2005, it's time to renew! You can renew online via GRA's Web site, www.grac.org, or you can request a hard copy dues renewal invoice from Kevin Blatt at grac@inreach.com. To save time and effort, GRA recommends that you renew online, as the process is secure and seamless. It will also help GRA to keep related expenses to a minimum.

The goal of having 1,250 members by the end of 2005 is attainable. To

make this happen, please renew your membership and recruit one new member to GRA. Recruiting a new member is a way to introduce your colleagues to a credible, innovative organization that provides many benefits for only \$85.

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

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So the trend is clear – arsenic standards for drinking water are going lower and lower. Water suppliers who rely on groundwater for part or all of their supply are going to be scrambling to be able to meet those standards and remain in compliance. At a drinking water standard of 10 ppb, it is estimated that over 4,000 water systems nationwide are affected; i.e., their water exceeds the standard. 97% of these systems serve less than 10,000 customers.

The two day symposium started at noon on the first day and lasted through the afternoon of the second day. The first session was on the *Regulatory Framework, Occurrence, and Chemistry of Arsenic in*

The trend is clear – arsenic standards for drinking water are going lower and lower. Water suppliers who rely on groundwater are going to be scrambling to meet those standards

Groundwater. Moderated by Dr. Lee Shull, of MWH, the session opened with Cindy Forbes of the California DHS discussing the federal and state health goals for arsenic and the subsequent development of California's drinking water standard for arsenic. Dr. Janet Herring of Cal Tech provided a very informative talk on the speciation of arsenic in groundwater and why an understanding of how arsenic is speciated in groundwater is so important to evaluating its health impact, its fate and transport, and its treatment in groundwater. Just when we thought we were getting the hang of arsenic speciation, Dr. Peggy O'Day, from the brand new UC campus in Merced, showed us just how complicated arsenic speciation can get as processes at microscopic levels in the aquifer linked to the abundance and biogeochemical behavior of iron and sulfur can result in highly variable concentrations and toxicity (within a few feet!). Dr. Karen Burrow, of the USGS, then spoke about the distribution of arsenic, including its speciation in groundwater of the San Joaquin Valley. Finally, closing out the session was another representative from the USGS, John Izbicki, who spoke about water production wells and their construction and hydraulics, and how these factors control arsenic migration into the well bore.

In the second session of the day, *Impacts on Beneficial Use and Public Health*, moderator Cindy Forbes coordinated presentations on some of the practical aspects of having arsenic in groundwater. First, what do you tell your customers if you are a water purveyor with arsenic in your distribution system? Laura Barnhouse of Sonoma County Health Department and Tracy Hemmeter of Santa Clara Valley Water District presented real

life situations of community outreach for customers and private well owners alike. Communication issues include the level of concern versus the actual risk (not usually proportional), the source of the contamination (pollution from an

industrial plant or the natural aquifer), the comfort to consumers of regulatory standards, and the importance of effective communications. Done right, community outreach can result in higher levels of trust, a reduction of health risks, and a more collaborative and effective response for water purveyors.

Then Tom Haslebacher, Geologist for Kern County Water Agency, discussed the impacts to Kern County on lower arsenic drinking water standards. One of the fastest growing counties in the state, Kern County is also home to high levels of naturally occurring arsenic in its groundwater. Given the anticipated future reliance in California on conjunctive use and water banking to manage water supplies, the last two talks focused on the impacts arsenic is having on these programs. Elizabeth Brode, of Schlumberger Water Services, and Jon Parker, of the Kern Water Bank Authority, discussed the impacts arsenic drinking water standards will have on conjunctive use projects in California and on the largest existing water bank in the state (Kern Water Bank).

Day two opened with a keynote presentation by Steve Hall, Executive Director of the Association of California Water Agencies. Steve talked about the

collision of politics and science over the arsenic issue and how his association members are struggling to stay in compliance amid an uncertain future for drinking water standards. The rest of the morning was focused on the *Remediation of Arsenic in Groundwater*. This session was moderated by Sunil Kommineni and Steve Sagstad of Malcolm Pirnie. The session included talks on the more commonplace ex-situ arsenic treatment methods, and the less common in-situ methods and even non-treatment methods. We also heard presentations from water districts and how they are treating arsenic in groundwater in their districts, the practicality of point of use (POU)/point of entry (POE) methods, and what to do about the problematic residuals for arsenic treatment.

With respect to ex-situ arsenic treatment, Sunil Kommineni presented the results of his work on treating arsenic in groundwater in the presence of other contaminants, such as fluoride and uranium. He looked at a range of treatment options (adsorption, ion exchange, coagulation/filtration, and reverse osmosis) and evaluated their feasibility according to residuals management, water chemistry, and site-specific issues. Troy Tranter, of the Idaho National Engineering and Environmental Laboratory (INEEL), described a novel approach to preparing cost-effective granular sorbents, whereby a composite resin of metal hydroxides/oxides is distributed throughout a polymer matrix.

Alan Welch, from the USGS, presented a primer on the in-situ remediation of arsenic in groundwater. His conclusions are that arsenic can be removed from groundwater in-situ depending on the hydraulics and geochemistry of the aquifer, especially in high iron groundwater, although much work still needs to be done before this treatment method becomes commonplace. With respect to “non-treatment” methods, Steve Sagstad and Chris Legg, of Malcolm Pirnie, then looked at non-treatment strategies for bringing existing production wells into compliance with the new arsenic standards. These strategies include varying pumping rates and schedules, modifying well design, and blending the produced water with other water.

Two case studies were presented which showed the trials and tribulations of arsenic treatment for water districts. Randy Hill, of Victor Valley Water District, entertained the crowd with tales of arsenic piracy on the high seas and other adventures as his water district struggles with developing a treatment program for the arsenic in their groundwater. Kristie Witter, of MWH, then presented the results and costs for the design and implementation of arsenic treatment in the Lower Coachella Valley. Ramesh Narasimhan, of Narasimhan Consulting Services, presented the results of a comprehensive feasibility study on POU/POE (“under the sink”) implementation completed for the American Water Works Association. And finally, Dr. Wendell Ela, of University of Arizona, concluded the session with his presentation on the arsenic treatment residuals disposal, which is a significant issue. He showed the importance of proper characterization techniques (TCLP, WET, and alternatives) and disposal and stabilization options for liquid and solid wastes containing high levels of arsenic.

At lunch, we enjoyed a presentation by Dr. Jeffrey Wright, Dean of Engineering at the University of California, Merced. Dr. Wright described the newest UC campus and his plans for the engineering program as he builds the program from scratch. Following lunch, the symposium closed with a panel discussion on the *Consequences of Arsenic Cleanup in Groundwater*. Led by Krista Clark of ACWA, panel members discussed the intended, and unintended, consequences of the new arsenic regulations, including the impact to the groundwater supply, the costs for the water suppliers, the expected benefits to the consumer, and other issues. The panel included Chet Auckley, of Cal Water; Ed James, of the Carson Water Subconservancy District in Nevada; Doug Nelson, of the Arsenic Remediation Coalition; Larry White, from the City of Fallon; and

Fernando Lara and Pedro Soto, of Mexico’s National Commission of Water.

Sponsors of the event were Geomatrix Consultants, Kleinfelder, Chemical Risk Sciences International, and QED Environmental Systems. A binder with copies of all the speakers’ slides and much reference material on arsenic in groundwater was produced for the symposium. For a copy of the binder and information about other GRA programs, please go to www.grac.org or call GRA’s main offices in Sacramento at (916) 446-3626.

William Pipes, Vice President and Principal Geologist of Geomatrix Consultants, Inc. is based in Fresno, California. He serves on the GRA Board of Directors and is the President of the San Joaquin Valley Branch of GRA. ♠

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Electronic Data Management and Delivery

Mr. Cedric Lucas (Locus Technologies) outlined how Locus used its products LocusFocus and EIM™ to provide ChevronTexaco with a centralized electronic data management system capable of storing their environmental information from a variety of sites – from retail gasoline stations, to bulk terminals, to refineries and Superfund sites with more than 5 million analytical records. The system streamlined the process, centralizing the information in an internet-accessible and secure location.

Mr. Bosco Ramirez (Severn Trent Laboratories) presented key aspects about the new realm of electronic data deliverables (EDDs) and how they present distinct challenges to the laboratory and environmental industry. Laboratories have to standardize their processes internally among the different laboratories in different states. Mr. Ramirez urged bringing the laboratory into the planning stage of the project so that they can help identify the best way to document and transmit electronic data.

Electronic Data Collection

Dr. Dave Rich (Geotech Computer Systems) stressed the inherent complexity of environmental projects, the desire to manipulate data in numerous ways, and the need to retrieve and evaluate data quickly due to budgetary constraints. By creating a centralized open database, data storage and retrieval becomes quick and simple.

Mr. Dan Ducasse (Locus Technologies) presented three case studies where a treatment system was upgraded to include automated data collection. The electronic data collection and telemetry systems allowed on-line examination of system operations and remote data collection, as well as automated alarm components. This reduced the number of required trips to the sites, increased the up-time of the systems, and lowered operation and maintenance costs.

Environmental Information Management Systems

Dr. Nicole Sweetland (Daniel B. Stephens & Associates) presented a system that can be used to spatially view environmental information, and review historical information in summary table format for a single point over time or for a single event with numerous sampling points. The system demonstrated capabilities of being linked to other programs that display geologic and/or historic information.

Dr. Arnold Gray (EarthSoft) demonstrated the use of EQUIS, a proprietary product, which combines Oracle's data storage and management capabilities with various vendor software packages (ArcGIS, CARStat, MS Excel, etc.) Dr. Gray stressed the need to push the responsibility for generating and submitting quality electronic data to the laboratories; catching errors early in the data validation process saves time and money.

Dr. Anne Happel (EcoInteractive) presented information about Geotracker, the SWQCB's data management system for UST and SLIC sites in California. The system is utilized by regulators to better and proactively manage release sites. As of January 2005, the State is requiring all site owners to submit information electronically to Geotracker. By July 2005, the state will rely upon the electronic report as the legally binding document.

Mr. Peter Biffar (Terradex) presented information about the Terradex system, which is used to assess institutional and land use controls to ensure that regional impacts are controlled. The system can be used to monitor changes in site conditions, such as ownership change, zoning changes, etc., and can alert the land owner, client and/or regulatory agency of any pending enforcement actions.

Ms. Cris Tulloch (SCVWD) discussed the use of the SCVWD's information management system to manage the enormous volume of environmental data

related to the more than 3,000 active contaminant release sites in the Santa Clara Valley. The system uses Oracle to store the electronic data, ArcGIS to spatially visualize data, and various database query functions to display summary information.

Staged Electronic Data Deliverables

Mr. Joseph Solsky (US Army Corps of Engineers) presented the need for electronic data transmissions to be in an "open" data standard. By using Staged EDDs (SEDDs) the number of data deliverable formats currently used by laboratories could be reduced from 300 to less than 30. By staging the data, customers who require different levels of quality control with a single data format would be served more easily.

Mr. Richard Amano (Laboratory Data Consultants) provided an example of how SEDDs can be used to transmit, validate, and populate a database with environmental information. The SEDD is prepared by the laboratory in XML format and transmitted to the client. The data are then parsed and sent to an automated electronic validation tool, which validates the data. The validated data are then uploaded to a project-specific database where it can be accessed by numerous desktop applications.

Todd Miller is a senior hydrogeologist with Malcolm Pirnie and Elie Haddad is Vice President of Locus Technologies and EIMS Conference chair. James Strandberg, Vice President of Malcolm Pirnie, also contributed to this article. 💧

Trends in Perc-related Litigation in California – Continued from Page 4

parties” and “any person...who has caused or permitted any waste to be discharged and creates a nuisance.” These defendants could not be considered CERCLA responsible parties, because they did not fit the traditional definitions of “owners, operators, transporters or arrangers.” The Court of Appeal was therefore forced to interpret and apply this language by looking to the Porter Cologne Water Quality Control Act.

The Court could interpret the “caused a release” language essentially one of three ways. The first option was to define “caused a release” - as meaning that the responsible party must be “directly involved in the discharge.” The second option was to define “caused a release” as requiring the responsible party to be a “substantial factor” in the release. The third option was to define “caused a release” as “placed the hazardous substance in the chain of commerce.” The Court of Appeal chose the second option, the “substantial factor” test, with an added requirement as follows, “[D]efendants who manufactured equipment designed to discharge waste in a manner that will create a nuisance, or who specifically instructed a user to dispose of wastes in such a manner, could be found to have caused or permitted a discharge.”

As a result, public entities in current or future PCE groundwater contamination litigation should identify the manufacturer of any relevant dry cleaning equipment and investigate the operator’s dry cleaning practices and the sales activities of solvent manufacturers. Once this evidence is adduced, these same public entities should consider whether or not these potential defendants should be joined to any current or future PCE groundwater contamination litigation.

City of Lodi Action

In 1997, in response to PCE groundwater contamination in the City of Lodi, Lodi enacted the MERLO. Under MERLO, the City gave itself the power to investigate and remediate environmental nuisances, hold responsible parties or their insurers liable for remediation costs, and recover “action abatement costs,” which included all legal, technical and administrative fees, interest and other costs of financing. The

ordinance provided no mechanism under which Lodi could be found liable for environmental cleanup costs.

Shortly after enacting MERLO, the City initiated litigation relating to PCE groundwater contamination. Litigation has continued since 1997, and during this time Lodi litigated extensively in state and federal court, and has filed numerous appeals of various adverse court rulings. However, a series of court rulings have limited Lodi’s claims. In *FFIC v. City of Lodi*, 296 F.Supp.2d 1197 (E.D. Cal. 2003), Judge Damrell found that Lodi was a potentially responsible party (“PRP”) for the contamination at issue. The Court further found that the MERLO ordinance was preempted when it conflicted with CERCLA. 42 U.S.C. section 9601, et seq. The impact of this ruling was (1) that Lodi could be sued for contribution; (2) that Lodi could not sue for joint and several liability, only contribution; (3) that Lodi could not recover its attorney’s fees; and (4) that Lodi could not recover its “action abatement costs” outside of those costs recoverable under CERCLA.

On appeal, Lodi argued to the Court that it had inherent power to abate a public nuisance, such as groundwater contamination. The Court agreed that cities in California can abate a public nuisance, but noted that the HSAA carved out an exception for sites “that pose a substantial threat to public health and the environment” according to the DTSC. The Court ruled that for such sites the State, through the DTSC, has exclusive jurisdiction over all remedial response actions. The Court rejected Lodi’s arguments regarding whether the DTSC Order covered the broadly defined “site” in question.

The impact of this opinion upon Lodi’s efforts to enforce its MERLO statute in this instance is that Lodi no longer can simply

order a “responsible party” to clean up contamination, as allowed under MERLO. Further, Lodi must provide DTSC with a detailed clean up plan and obtain the approval of the DTSC before it pursues cost recovery actions against “responsible parties.” The wider impact of this ruling is that it reinforces the State’s ultimate power to determine the manner and timing of remediation of groundwater contamination for DTSC-listed sites.

In at least one location in California there are plaintiffs pursuing toxic tort claims against public entities for groundwater contamination allegedly caused by third party discharges to sewer lines. Under established case law, to recover in such cases the Plaintiffs must either show that there exists or existed a “dangerous condition of public property” which caused them injury, or else fulfill the requirements of an inverse condemnation claim. While case law in California is well developed regarding the broad outlines of public entity liability for “dangerous condition of public property,” there are far fewer reported cases specifically sewer lines in this context. This area of law is likely to draw the attention of public entities, private parties and the appellate courts in California in the coming years.

Thomas F. Vandenburg is a partner in the law firm of Dongell Lawrence Finney LLP in Los Angeles. His practice focuses on environmental and toxic tort litigation. He can be reached at 213-943-6100 or tvandenburg@dlflawyers.com. ♠

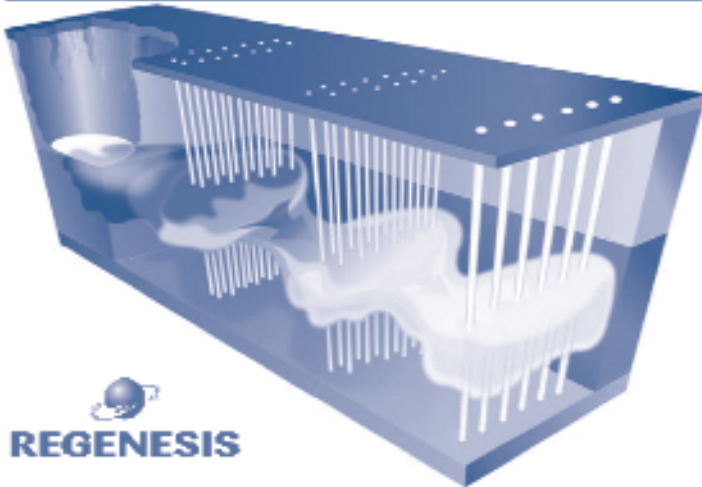
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DHS Waterworks Standards – Continued from Page 5

- To calculate the assigned well capacity, the pumping rate at the fourth measurement collected per sub-subparagraph 2, shall be multiplied by 50%.

An initial meeting was conducted on August 27, 2003. Attendees included 2 representatives from DHS, 5 from CGA, and 2 each from GRA and the California Department of Water Resources (DWR). CGA is leading this effort with significant participation from representatives of GRA (David Abbott and Jim Ulrick). The Task Force has prepared several working documents concerning the issues and has met several times to discuss the proposed and recommended revisions to the Waterworks Standards. The most recent follow-up meeting was on December 7, 2004, attended by 22 representatives from DHS, CGA, GRA, Association of California Water Agencies (ACWA), California Building Industry Association (CBIA), California Business Properties Association (CBPA), Regional Council of Rural Counties (RCRC), and Assemblyman Leslie's office.

The CGA Task Force has identified several technical and logistical problems with the proposed DHS Waterworks Standards including:

What is the definition of hard rock? Does hard rock refer to fractured igneous and metamorphic rocks as well as sedimentary rocks, cavernous limestones, and fractured basalt? Or does hard rock refer to low yield aquifers?

What is the purpose for conducting pumping tests in August, September, and October? Can monthly water levels and hydrographs establish seasonal fluctuations and the impact on hydraulic parameters and the well reliability?

What is the rationale for conducting long-term pumping tests for 72-hours or for 10 days? Can shorter duration pumping tests provide adequate water level responses to predict long-term groundwater sustainability and reliability?

What is meant by “the water drawdown is constant?” Does a constant water drawdown refer to no further water level decline (i.e., recharge boundary), or constant drawdown slope per log cycle?

Why is the pumping rate multiplied by 25% and 50% to obtain the assigned well capacity? If pumping tests are conducted under conservative conditions (i.e., dry season and long-term tests) then why add additional factors for margin of safety?

DHS has prepared the Draft Waterworks Standards (November 12, 2004) and has removed the language quoted above from Section 64554 (c) (2) (A) & (B). The CGA Task Force continues to work with DHS and other stakeholders to develop acceptable language for the Waterworks Standards.

If you would like additional information on these Standards, contact David W. Abbott at dabbott@toddengeers.com or Jim Ulrick at julrick@ulrick.com.

David Abbott is the Treasurer of the San Francisco Branch of GRA and a hydrogeologist at Todd Engineers in Emeryville. Jim Ulrick is a principal at Ulrick & Associates in Berkeley.

Santa Maria Groundwater Basin: Moving towards Settlement – Continued from Page 5

Subarea Management. For a number of geographic, political, economic and hydrologic reasons, the Basin will be managed as three somewhat separate subareas: the Northern Cities, the Nipomo Mesa and the Santa Maria Valley.

The Northern Cities area includes the Pismo Beach and Arroyo Grande areas, generally on the northern end of the Basin. This subarea is dependent on local groundwater and surface water deliveries from the SWP and Lopez Reservoir. Remarkably, for many years predating the litigation, this subarea has had an internal agreement, called the “Gentlemen’s Agreement,” that allocated groundwater rights as between the agricultural and urban water users.

The Nipomo Mesa is located between the Northern Cities and Santa Maria Valley subareas. Essentially, its sole source of recharge is precipitation and local streamflow. It warrants subarea management primarily because it is hydrologically dependent on rainfall, and thus most susceptible to local pumping stresses.

The Santa Maria Valley subarea covers over half the geographic area of the Basin. In addition to native groundwater, users in this area receive the benefit of augmented recharge from Twitchell Reservoir and imported SWP water. Twitchell Reservoir is operated so that winter storm flows that otherwise might flow to the ocean are held in the reservoir until the summer and fall. Controlled releases from the Reservoir then augment the recharge of the Basin. In some years, Twitchell Reservoir has added well over 100,000 acre-feet of supplemental recharge to the Santa Maria Valley subarea.

Water Rights. All parties end up winning with the settlement. In summary, here are the major issues:

1. **Native Groundwater.** Overlying landowners have priority rights to the native yield of the Basin. Each subarea will handle this issue somewhat differently, but the end result is consistent with California law, giving priority water rights to overlying landowners.

2. **Twitchell Reservoir.** The public water purveyors in the Santa Maria Valley subarea (primarily the City of Santa Maria and Southern California Water Company) will assume financial responsibility for the ongoing operation of Twitchell Reservoir. This relieves many landowners from what may be a growing financial obligation to maintain this supplemental water supply. In exchange, the public water suppliers obtain a dedicated right to the yield associated with the Twitchell project.

3. **Imported Water Return Flows.** Those public water purveyors that import SWP water will also be given a guaranteed right to recapture imported water return flows. Although the quantification of the return flow credit will be based on a five-year rolling average use of imported water, the return flows must be pumped within one year, or they are lost to the Basin.

4. **Monitoring and Low Water Level Response.** The public water purveyors will also fund a water level monitoring program that will help the parties anticipate and respond to potential long-term low water level conditions. Several trigger points will be established that impose differing voluntary or mandatory production limits.

5. **Reserved Jurisdiction.** Of course, as with all water rights judgments, the court will retain ongoing jurisdiction for limited purposes.

Further Litigation?

The settling parties hope to enter their stipulated judgment by the summer of 2005. Unfortunately, it appears that some of the litigating landowner parties will not voluntarily opt-in to these settlement terms. Based on the California Supreme Court’s recent ruling in *City of Barstow v. Mojave Water Agency* ((2000) 23 Cal.4th 1224) (Mojave Basin adjudication)), the court cannot impose the settlement on the non-stipulating parties without first litigating their water rights. Thus, until the non-settling parties have had their water rights heard in court, the litigation will continue.

Robert J. Saperstein is a partner with the law firm of Hatch & Parent. He is the firm’s Water Practice Group Leader and is the lead attorney for two public water purveyors in the Santa Maria Basin litigation. 💧

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President's Message – Continued from Page 2

be monitored regularly. In that regard the State reportedly will soon propose rules requiring sampling of private wells by homeowners every five years, and stricter standards for septic system design and construction. Considering that more than 2 million Californians obtain their water from more than 600,000 private wells, you can imagine the possible magnitude of the problem wells and the difficulty implementing any such rules. Not surprisingly, there is reported resistance from local environmental health officials (whose workload would undoubtedly increase), real estate agents, and often the homeowners themselves. Many of the homeowners who volunteered for this study now also find themselves drinking bottled water and wondering what happens next. Stay tuned.

Now, I am not suggesting that we have to travel over 1,600 miles to Fremont, Nebraska to find drinking water, as most of us have the benefit of safe and dependable water supplies. However, we should recognize the important example of the benefits of Fremont's groundwater management planning. And furthermore, we should reflect on the challenges ahead in dealing with the hundreds of thousands of untested private wells in California.

I welcome your feedback and I look forward to seeing you at GRA events. I also welcome you to contact me by email at tom.johnson@lfr.com or by phone at (510) 596-9511. 💧

Lucerne Valley Groundwater Basin Geologic Insights – Continued from Page 10

Valley [Dibblee, 1964; Sadler, 1982a; and Miller and Matti, 2003] were used to construct preliminary cross-sections; (2) all applicable driller's water well logs, oil well logs, and USGS monitoring well data were reviewed with respect to well location, depth of well, and detail of well log; and (3) based on well information and location of wells, 14 wells were gamma logged using a MGX II Portable Logger with the MGX II Console.

The sedimentary units of the basin include the Plio-Miocene Old Woman Sandstone, of Shreve [1968], older fanglomerate and older alluvium unconformable above the Old Woman Sandstone, and unconsolidated surficial sediments that consist of younger fanglomerates, younger alluvium, and playa deposits that are unconformable above older formations.

Depth to pre-Tertiary basement, based on water-well logs and two oil-test holes, suggest bedrock is encountered approximately 1,200 ft below ground surface (bgs) in Lucerne Valley groundwater basin [Division of Oil and Gas, 1964]. Along the Helendale fault, the Division of Oil and Gas [1964] suggest basement rock is reached approximately 1,800 ft bgs.

Richard Laton and J. Foster are Assistant Professors in the Department of Geological Sciences, California State University, Fullerton. M. Blazevic is an undergraduate student in the same Department. Funding was supported by a grant from the Mojave Water Agency. Due to space constraints in this issue, this paper has been shortened considerably. The complete article, including drawings and references, has been posted on the GRA website at www.grac.org/Publications. 💧

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California Groundwater Association Notes – Continued from Page 11

removed from the DHS web site pending further study. A December meeting with additional DHS staff and an expanded group of stakeholders reviewed DHS data and led to an agreement to learn more about this issue. Contact CGA if this issue is of concern to you.

CGA & GRA Members to Attend NGWA Fly-In

Once again both CGA and GRA members will participate in the NGWA Fly-In in Washington DC later this month. Last year we worked together to make presentations to California Congressional members and their staffs on four issues affecting the groundwater industry. Sustainability of groundwater resources will again be a point of focus. Watch the next *HydroVisions* for a report on our joint efforts.

Opportunities for Public Awareness on Water

CGA has long been a co-sponsor of the California Water Awareness Campaign (CWAC). The campaign has developed educational materials featuring groundwater that GRA members might find valuable in your projects. We encourage you to look into the possibility of joining the campaign in 2005. Contact CGA for more info or go to CWAC's website at www.wateraware.org. We are also looking into joint efforts of CGA, GRA and NGWA on special public awareness items during National Groundwater Awareness Week (March 13-19, 2005). ♣

DTSC Guidance Document Available Online

The Department of Toxic Substances Control's (DTSC) "Guidance Document on Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air" outlines the procedures for evaluating this exposure pathway and provides suggestions on elements that should be included in a facility investigation, as well as other information. The guidance document was completed as an interim final, in that DTSC is interested in feedback on the document from its users. Hence, DTSC is soliciting public comments on the document to enhance its usability. It is posted at http://www.dtsc.ca.gov/ScienceTechnology/HERD_POL_Eval_Subsurface_Vapor_Intrusion_interim_final.pdf (104 pages, pdf.) Written comments should be submitted to DTSC by August 15, 2005. If errors or technical deficiencies exist, please provide suggestions for their rectification to Dan Gallagher, DTSC, 8800 Cal Center Drive, Sacramento, CA 95826-3200, or by email to dgallagh@dtsc.ca.gov. ♣

Corrections:

In the Winter 2004 issue of *HydroVisions*, there were several errors noticed by our readers:

- ♣ Chris Frahm was listed as Legislative Committee Chair. She is the GRA Legislative Advocate.
- ♣ The wine tasting dinner was listed as following the GRA annual meeting and conference; it was actually conducted after the field trip.
- ♣ Susan Garcia's email addresses are: home, ssgarcia55@verizon.net and work, sgarcia@lbusd.k12.ca.us.
- ♣ Gary Foote of GeoMatrix Consultants (not Linda Spencer) is the SF Bay Branch Past President. She was listed as past president in our Winter 2004 issue.

HydroVisions regrets any inconvenience these errors may have caused.

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Stephanie Osler Hastings Named Partner at Santa Barbara's Hatch & Parent

SANTA BARBARA, CALIF. — Stephanie Osler Hastings has become a partner at the Santa Barbara-based law firm of Hatch & Parent, according to Steven A. Amerikaner, managing partner. Hastings, who joined Hatch & Parent in 1996, focuses her practice on water law and related environmental issues. Hastings is a director of GRA, and also serves on the water management committee of ACWA. She received a Bachelor of Arts degree in both history and political science from the University of Vermont and a juris doctor degree from the University of California, Hastings College of Law. ♣

Ten New Tom Dibblee Maps Released for San Francisco Bay and San Joaquin Valley Regions

On February 23, 2005, the Dibblee Geology Center of the Santa Barbara Museum of Natural History released ten new geologic maps of the San Francisco Bay area and the San Joaquin Valley region created by legendary Thomas W. Dibblee. These maps will complete a major section of northern California mapped by Dibblee himself. They include: San Joaquin Valley Area, Parkfield, Cholame Hills, Cholame Valley, Orchard Peak, Cholame, San Francisco Bay Area, Mare Island, Benicia, Richmond, Briones Valley, and Walnut Creek. To purchase Dibblee maps, go to the Museum's online store at www.sbnature.org/estore. ♣

California Colloquium on Water Lectures Now Available Online

You can catch that California Colloquium on Water lecture you missed online! WRCA is pleased to announce streaming video of past lectures on our Colloquium web site. The streaming video will typically be available a couple of weeks after the lecture. We also have video tapes and Power Point presentations from many past lectures. Check out the California Colloquium on Water web site for these features: <http://lib.berkeley.edu/WRCA/ccow.html>. ♣

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Legislative Committee Update – Continued from Page 6

SB 773 (Cox) – Urban Water Suppliers: Groundwater Recharge

As introduced, this bill provides that the discharge by an urban water supplier of treated water that meets state and federal drinking water standards into a groundwater basin by means of a groundwater recharge facility, is not a discharge of waste under the Porter-Cologne Water Quality Control Act.

The bill is sponsored by the City of Roseville, in conjunction with its Aquifer Storage and Recovery project. The Central Valley Regional Water Quality Control Board has been taking a very conservative approach to artificial recharge of groundwater, and has required permits for the introduction of treated water, even though it is of drinking water quality.

The bill is a spot bill, as introduced, but the author will take amendments to provide it with greater substance. The amendments provide that the discharge of treated groundwater is not a waste, and spells out a reporting process to satisfy the regional board that the water being injected is, in fact, of drinking water quality.

The bill may be heard in Senate Environmental Quality Committee on April 5.

Chris Frahm and Jeffrey Volberg of the firm of Hatch & Parent are GRA's legislative advocates in Sacramento. ♣

Groundwater Ambient Monitoring and Assessment Program Update

The State Water Resources Control Board (SWRCB) Groundwater Ambient Monitoring and Assessment (GAMA) Program has begun implementing its statewide priority groundwater basin assessment (AB 599-Liu, Groundwater Quality Monitoring Act of 2001). The primary objectives of the priority basin assessments are to comprehensively assess groundwater quality statewide and gain an understanding about contamination risk to specific groundwater resources. GAMA has divided the state into 35 priority basin 'study units' (see map and schedule at www.waterboards.ca.gov/gama/). As of February 2005, GAMA has completed sampling in three of the study units: San Diego, North San Francisco Bay and North San Joaquin Valley. The program is set to begin sampling in the South Sacramento Valley Study Unit in March. Assessment reports will be posted on the GAMA website as they are completed. The SWRCB is collaborating with the US Geological Survey (USGS) and Lawrence Livermore National Laboratory (LLNL) to implement the GAMA Program. Additional GAMA Program information is available at www.waterboards.ca.gov/gama/. ♣

Water Boards Change Names

The RWQCB and SWRCB have changed their names and websites to make it easier to recognize and to create a more unified identification for the Water Boards, collectively. Here is a listing of the 9 Water Boards in the state and their new website addresses.

Regional Water Boards:

- (1) North Coast Water Board
<http://www.waterboards.ca.gov/northcoast/>
- (2) San Francisco Bay Water Board
<http://www.waterboards.ca.gov/sanfranciscobay/>
- (3) Central Coast Water Board
<http://www.waterboards.ca.gov/centralcoast/>
- (4) Los Angeles Water Board
<http://www.waterboards.ca.gov/losangeles/>
- (5) Central Valley Water Board
<http://www.waterboards.ca.gov/centralvalley/>
- (6) Lahontan Water Board
<http://www.waterboards.ca.gov/lahontan/>
- (7) Colorado River Basin Water Board
<http://www.waterboards.ca.gov/coloradoriver/>
- (8) Santa Ana Water Board
<http://www.waterboards.ca.gov/santaana/>
- (9) San Diego Water Board
<http://www.waterboards.ca.gov/sandiego/>



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Bondy, Bryan	Kleinfelder, Inc.	McFarland, Forest	ENSR International
Brown, Nathan	CH2M HILL	Menna, Greg	Geomatrix Consultants, Inc.
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Eppler, Bruce	Cambria Environmental Technology, Inc.	Renan, Dani	EnTerra Environmental
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Sacramento Branch Highlights

BY STEVE PHILLIPS
BRANCH SECRETARY
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In November, Ali Taghavi, Ph.D. discussed the update and refinement of the Sacramento County Ground and Surface water Model (IGSM). Ali is a senior partner and Principal Engineer at WRIME, with over 18 years of experience in water resources planning, management and engineering, and is a recognized expert in groundwater modeling. The Sacramento County IGSM simulates land and water use conditions and the interaction between surface flow processes and the aquifer system from 1922 to 1995. The model was originally developed in 1993, but the need to better simulate water conditions associated with the Cosumnes River motivated the stakeholders to support an update and refinement of the model, which is recalibrated and has been applied to simulate the effects of various groundwater management scenarios in the Central groundwater basin.

Our December meeting was the traditional holiday affair with the local chapter of AEG. Jeffrey Keaton presented a wide range of technological advances in tools for engineering geology mapping and other tasks most of us face. Jeffrey Keaton, Ph.D., P.E., P.G., was selected to be the 2004 Richard H. Jahns Distinguished Lecturer in Engineering Geology, and is a past Chairman of EGD and a past President of AEG. Observation remains the foundation of engineering geology mapping, but many aspects of observation are being supplemented and even revolutionized by information technology (IT). Data acquisition is being accomplished with the aid of pen-based computers, digital cameras, and GPS receivers. Quantitative geophysical and geochemical field measurements can be contoured and/or combined with other

forms of observations to construct useful derivative maps. GIS and CADD software are being used to manipulate and display geospatial data, sometimes in the field. Numerical analysis of observational data, including calculated grids derived from vector data, is being used to produce useful derivative products. However, engineering geology maps produced with GIS tools have the potential to mislead even sophisticated users for two reasons: 1) the strikingly professional appearance of GIS maps implies precision even when uncertainties are noted, and 2) field data can be collected as a series of seemingly independent observations and converted by a GIS technician into a professional-looking map without the benefit of geologic principles or the repeated application of multiple working hypotheses. Consequently, professional discipline is needed to effectively apply modern IT to engineering geology mapping.

In January, Ton Vorster, Chief of the Cleanup Section of the RWQCB, and Brian Lewis, Chief of the Geological Services Unit, Northern California, of the DTSC, provided some insight on what's new and upcoming in groundwater from the Central Valley RWQCB's and DTSC's point of view. Ms. Vorster and Mr. Lewis presented some of the emerging issues, guidance documents and trainings (open to consultants). They helped us understand the roles and responsibilities of both the RWQCB and DTSC. The hazardous waste and water board cleanup programs for both private and federal facilities were briefly reviewed. New guidance on vapor intrusion, soil gas sampling, ground water sampling and the evaluation of soil matrix characteristics were presented and references provided. Brief overviews on the Brownfields and Coordinated Cleanup Programs were delivered including new health goals and cleanup response for five specific analytical parameters. 💧



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San Francisco Bay Branch Highlights

BY BILL MOTZER
BRANCH SECRETARY

The best attended meeting of the year featured Dr. John Cherry on November 17, 2004 at the Marriott Oakland City Center, with 160 members, non-members, and students in the audience. Dr. Cherry currently is Professor and holder of the NSERC Industrial Chair in Contaminant Hydrogeology, University Consortium Solvents In-Groundwater Research Program at the University of Waterloo. He was introduced by Dr. David Keith Todd (Todd Engineers), Professor Emeritus of Hydrological Engineering at U.C. Berkeley. Dr. Cherry completed his master's degree program under Dr. Todd in the 1960s. His talk, entitled *Contaminant Migration in Aquitards*, was based on studies that he and his graduate students have done in the last 40 years in disposal of low level radioactive waste in pits, excavations in clayey till, waste disposal in clayey aquitards, and in the subsurface migration of chlorinated volatile organic compounds (CVOCs) in the solvent phase, also known as dense non aqueous phase liquids (DNAPLs).

Dr. Cherry's excavation studies initially showed that deep fractures through clays generally do not have any surface expression and that released CVOCs as DNAPLs could easily flow through vertical fractures. Therefore, although clay aquitards have excellent integrity with respect to solutes they do not have such integrity with respect to DNAPLs. This explains why DNAPLs have reached lower aquifers and may not be sufficiently retarded by clay aquitards. For those of us who have investigated subsurface contamination by PCE and TCE, this finding has been extremely important for proposing remediation.

Subsequent studies in the use of isotopes as tracers were used to determine downward contaminant transport; the tracer studies confirmed the movement of CVOC DNAPLs by fracture flow and transport. Due to space limitations in this issue, the listing of publications summarizing the work by Dr. Cherry and his students may be found at www.gra.org.

The San Francisco Bay Section January 19, 2005 meeting was held at the Marriott Oakland City Center to hear Stephen Hill, Chuck Heedlee and Sarah Raker of the San Francisco Bay Water Board give their annual regulatory update. Sarah Raker (sraker@waterboards.ca.gov) led off with an overview of the 2000 Groundwater Basin Plan and then gave an update on basin plan amendments. An updated electronic basin plan pilot project by Jeff Kapellas will have hyperlinks, cross references, and GIS figures. Sarah then gave us an overview of the GAMA program, in conjunction with Lawrence Livermore National Laboratory, in which ultra low level VOC and groundwater age dating in public supply wells had been completed for the Livermore-Amador Basin, Niles Cone, Santa Clara Valley, and San Mateo Plain.

Chuck Heedlee (cheedlee@waterboards.ca.gov) updated us on the UST program including Geotracker (via the web) where, by July 2005, RPs will be required to upload entire reports. It's possible that, in the future, this program may include production well data. Chuck also gave us an overview of the leak/detection updates, recent improvements in UST leak detection, the cleanup fund (which has a new manager – Ron Duff), SLIC (now the umbrella for Brownfields), emerging contaminants issues (perchlorate and 1-4 dioxane), and Brownfields.

Stephen Hill (shill@waterboards.ca.gov) concluded the program with a presentation on environmental screening levels (ESLs). The current version is available at www.waterboards.ca.gov/sanfranciscobay/esl.htm. Stephen also

updated us on vapor intrusion, including the new DTSC guidance document, and the Governor's regulatory restructuring proposal known as California Performance Review, which suggested creating a new site cleanup agency within Cal/EPA; the Governor has subsequently withdrawn CPR for further study. ♣

Southern California Branch Highlights

BY DARRELL THOMPSON,
BRANCH PRESIDENT

So-Cal GRA proudly presents Dr. Kenneth Ehman, who will present a discussion to our Branch on March 30 in Costa Mesa. Dr. Ehman is the president and chief geologist of Skyline Ridge, Inc. of Los Gatos, California, a firm that specializes in the application of sequence stratigraphy to groundwater resource and environmental problems. The dinner meeting will be at the Mile Square Golf and Banquet Center in Costa Mesa. Dr. Ehman will be discussing the applications of sequence stratigraphy in better understanding the architecture of the LA Basin water-bearing sediment. For more information, or to make reservations for this event, please email Darrell Thompson, Branch President, at Darrell.H.Thompson@shawgrp.com. ♣

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Dates & Details

GRA MEETINGS AND KEY DATES

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

GRA Board of Directors Meeting	April 30, 2005 Emeryville, CA
GRA Course <i>California Groundwater Management</i>	May 10, 2005 Glendale, CA
GRA Annual Legislative Symposium	May 18, 2005 Sacramento, CA
GRA Symposium <i>Subsurface Vapor Intrusion to Indoor Air Update</i>	May 25, 2005 San Jose, CA
GRA Board of Directors Meeting	August 6, 2005 Pt. Richmond, CA
GRA Workshop <i>Basin Yield & Overdraft: State of the Science & Law</i>	September 15-16, 2005 Southern CA
GRA 14th Annual Meeting	October 25-26, 2005 Sacramento, CA
GRA Board of Directors Meeting	November 12, 2005 Sacramento, CA
GRA Symposium <i>DNAPL Source Zone Characterization & Remediation</i>	December 7-8, 2005 San Francisco, CA

GRA Sponsored Programs

CA State University, Sacramento American River Watershed Conference	April 21-23, 2005 Sacramento, CA
GSA Cordilleran Section/ AAPG Annual Meeting <i>Short Course on Groundwater Age-Dating</i>	April 28, 2005 San Jose, CA
GSA Cordilleran Section/ AAPG Annual Meeting <i>Series on Groundwater & Surface Water Interactions</i>	April 29, 2005 San Jose, CA
ACWA Course <i>Groundwater Management in California</i>	May 3, 2005 San Jose, CA
NGWA Perchlorate and MTBE Conference	May 26-27, 2005 San Francisco, CA



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