

HYDROVISIONS

GROUNDWATER RESOURCES ASSOCIATION
OF CALIFORNIA

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The Science of Common Things

— by Gene Luhdorff, Jr. P.E.

On a cold March evening in 1982, I had completed dinner and decided to take a walk down University Avenue in Madison, Wisconsin. I was attending a groundwater quality protection course offered by the University of Wisconsin Extension, Department of Engineering; at the time, Lake Mendota, which borders the campus, was still frozen. Lights from an occasional ice fisherman's lamp could be seen luminous on the lake. It was a peaceful and quiet evening and a great night for walking. My walk took me past an old bookstore on State Street, which beckoned me to enter. It was a typical college town bookstore, filled with used books from numerous undergraduate classes taught at a major university and turned in by students as they pursued their education on campus.

I began to talk at length to the shop owner, a young man who enjoyed collecting books of all types. I told him about my work, why I was in Madison, and I asked him about "older" books he might have in the store that might pertain to my interest in groundwater science. He asked me to wait until he closed the shop, then we went upstairs to an area of book storage not normally accessible to the public and we began to look at his favorite older editions. There I was shown a book entitled *The Science of Common Things: Familiar Explanation of the First Principles of Physical Science for Schools, Families and Young Students* by David A. Wells, A.M. It was written in 1857 and published in New York by Ivison, Phinney, Blakeman & Co. in 1865. I opened the 117 year old book and looked for comments on wells, pumps or groundwater. To my delight, there were numerous references to all three subjects and much, much, more. I purchased the book, along with nine other

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DWR Well Standards: Highlights of the Monitoring Well Standards

— by Carl Hauge and Sue Erikson



California Water Code Section 231 requires the California Department of Water Resources to develop well standards to protect California's groundwater quality. DWR Bulletin 74-90, "California Well Standards, Water Wells, Monitoring Wells, Cathodic Protection Wells," contains the minimum requirements for constructing, altering, maintaining, and destroying wells. DWR has issued Bulletin 74-90, dated June 1991, as a supplement to Bulletin 74-81. While Bulletin 74-90 is "temporarily considered to be a draft," DWR plans to adopt it as final after several outstanding issues are resolved.

DWR's well standards are needed because improperly constructed, altered, maintained, or destroyed wells can pollute groundwater. Pollution occurs when poor-quality water or chemicals enter a well from the surface, or when poor-quality water or chemicals already in a water-bearing unit enter a well and then move through the well to another water-bearing unit containing good-quality water.

The supplement significantly expands the standards for the construction of monitoring and observation wells and includes revision of the water well construction standards. It also revises and updates the standards for cathodic protection wells (Bulletin 74-1, 1973).

While the DWR standards are the minimum standards to protect groundwater quality, the Department of Toxic Substances Control and the State Water Resources Control Board of the California Environmental Protection Agency, the California Department of Health Services, and the U.S. Environmental Protection Agency promulgate performance standards or guidelines to ensure the proper operation of wells. DWR's standards neither address the proper operation of the well nor the quantity or quality of the water obtained from the well.

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Annual Meeting

November 6th & 7th
See page 11 for details.

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PRESIDENT'S MESSAGE

The Groundwater Resources Association of California has had outstanding success in the first half of its charter year. GRA now has about 400 members and has gained wide recognition in this state and also nationally. As directors, officers and members, we can be proud of many accomplishments in the infancy of GRA. We have developed an incredible enthusiasm and momentum at the state and branch levels and we look forward during the second half of this charter year to building on the foundation that we have established.

Premier Organizing Meeting

GRA was honored to have Douglas Wheeler, Secretary of the Resources Agency, speak on the new California Water Policy and its effect on groundwater-related issues. The premier dinner meeting in Sacramento on March 11 was a grand kickoff for GRA with 94 people in attendance.

Directors/Officers

Brian Lewis of Cal EPA, Department of Toxic Substances Control, was elected by the Board of Directors during the first quarter of 1992 to the position of Secretary/Treasurer. Three of the five active branches have elected officers. Please see Branch News in this issue for more details.

Branch Highlights

GRA has established nine branch areas throughout the state, five of which are active, or in the process of organizing, in the Sacramento, San Francisco Bay, Central Coast, Southern California and South San Joaquin Valley areas. The Sacramento Branch held its first meeting on April 30; Jeffery Scharff of Scharff and Greben spoke on techniques for litigation avoidance and public agency compliance

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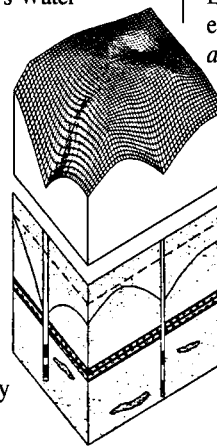
considerations for members of the environmental industry. In June, the San Francisco Bay Area Branch conducted a kickoff meeting on June 17; Carl Hauge of the Department of Water Resources spoke on "Groundwater Management in California: Present and Future Issues."

Also in June, the Sacramento Branch held its second meeting on the 25th; the topic presented by Gary Hall was "Discharge of Treated Groundwater to Publicly-Owned Treatment Works (POTWs), *Let's Be Reasonable*." The Southern Branch held its kickoff meeting on May 13; Fletcher Driscoll, author of *Groundwater and Wells*, was the keynote speaker. The Central Coast Branch had its first meeting on May 28; Richard Volpe gave a presentation on "Land Subsidence and Groundwater: New Methodologies to Forecast and Remediate Subsidence."

At the Southern Branch meeting on July 15, Joe Birman spoke on how America is "Becoming the Cleanest Third World Country on the Planet." On July 16 at the Central Coast Branch program/meeting, Brian Baca, the Resource Management Department Geologist for the County of Santa Barbara, spoke on several new methodologies being developed relative to groundwater use in the County. On August 13, 1992 Dr. Jon Marshak of the Central Valley Regional Water Quality Control Board will present "California's Water Quality Standards and Their Applicability to Waste Management and Site Cleanup" at the Sacramento Branch regular dinner meeting.

First Seminar

Our first seminar, *Testing and Modeling of Low Yield Aquifers*, was conducted on June 2 and June 4 in the Los Angeles and San Francisco Bay areas. The seminar was well



received by attendees; approximately 140 members and non-members attended the sessions. The June 4 seminar sold out approximately two weeks before the class date.

Board of Director's Meeting

On June 26, the Board of Directors and representatives from the five active branches met in Berkeley to discuss activities of the Association. At this meeting, the Board voted to obtain business services to assist the Association in easing the workload that has been performed to date by volunteers. A new State Level Committee was formed: the Technical Standards/Guidance Committee. The first order of business of the committee will be to review the draft Department of Water Resources Well Completion Report. Plans for GRA's annual meeting were discussed (see article this issue). Branch representatives discussed their respective branch operations to date and exchanged ideas on how to improve communication within and between branches.

Groundwater Protection Conference

GRA will be participating at the California Environmental Health Association, Superior Chapter conference being sponsored by San Joaquin County Public Health Services, Environmental Health Division. The conference, *Groundwater Protection, Investigation and Remediation*, will be held on August 25 at Micke Grove Park in Lodi, CA. For additional information, call Linda Begley at (209) 468-3450.

Meeting Notices

If you received this newsletter, but you haven't been receiving meeting notices for the active branch near you, please accept our apology. GRA is addressing the problem of getting new membership information from the State level to each of the branches so that each branch has a

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current member list. If you have not been receiving meeting notices, you may wish to contact an officer or organizing committee member of your local branch to ensure that they now have you on their mailing list.

National Groundwater Consortium

GRA plans to participate in the National Groundwater Education Consortium (NGEC) along with the Water Education Foundation in September in Minnesota. The NGEC is an

informal decentralized network of state, regional, and national organizations currently involved with the delivery of groundwater education programs to diverse audiences. The purpose of the consortium is to provide an informal forum for state, regional, and national groundwater education groups to address issues and common concerns; exchange ideas, strategies and lessons learned; capitalize on one another's strengths; and encourage networking. ●

COMMITTEE REPORTS

Membership

The Membership Committee has well surpassed its initial goal of 200 members! The committee is happy to report that the GRA currently has over 390 members, and they are directing their efforts to reach a new goal of 500 members. The committee is very grateful to all the members who have told their friends/coworkers about the GRA and urge everyone to continue "passing the word" about our organization.

The Membership Committee is having a contest to see who can recruit the most new members. The prize will be \$50.00. In order to qualify, you must have the potential member write "referred by" and your name at the bottom of the membership application. The application and membership dues must be received no later than August 31, 1992. Only members can participate in this contest.

A REMINDER: The Membership Committee is designed to represent the wishes of all the members. Involvement and interaction is welcomed and appreciated. If there are benefits of membership you perceive are lacking or activities that you would like us to promote, please do not hesitate to let the committee members know. Call Margie Namba (916) 393-0936, David Bardsley (916) 485-0792 or Keoni Almeida (916) 638-2085.

Legislative

The Legislative Committee is currently reviewing bills on groundwater and drinking water that are before the Senate and Assembly this term. In the process of reviewing the legislation, we are identifying key members of the legislature to whom we can introduce the GRA. Once the members are contacted, we are aiming to establish a pro-active role in which they contact available members with the appropriate expertise prior to writing a bill. This will enable us to reach our goal of providing legislative members access to a wide variety of professionals with varying opinions so that they may make informed decisions in writing legislation.

Newsletter

The Newsletter Committee appreciates the effort everyone is making to ensure that GRA's
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REGULATORY NEWS

DWR Well Completion Report

The California Department of Water Resources has drafted the "Preparation of Well Completion Report" procedures. Copies of the document have been distributed to GRA and other interested groups for review. GRA's new Technical Standards and Guidance Committee will be reviewing the document; others who wish to review and comment on the procedures may obtain copies from Vicki Kretsinger. The review period ends September 1, 1992. DWR and GRA would appreciate your input.

Sacramento County to Issue LUFT Cleanup Orders

In response to an ever-growing number of recalcitrant responsible parties, the Sacramento County Environmental Management Department, Hazardous Materials Division (HMD) has developed procedures for the issuance of HMD Cleanup Orders. The California Health & Safety Code (Section 25299.37) authorizes the Orders, which will be similar to Cleanup & Abatement Orders (issued by Regional Water Quality Control Boards) in content and impact. The Orders are intended to support timely cleanup of LUFT sites while assuring due process of law during cleanup.

Groundwater Protection

The General Accounting Office (GAO) recently recommended that the EPA Administrator work with states to develop ways to reorient some of EPA's groundwater-related grant programs to provide greater emphasis on pollution prevention (GAO/RCED-92-47, "Water Pollution: More Emphasis Needed on Prevention in EPA's Efforts to Protect Groundwater," Dec. 1991). The report notes that EPA's new groundwater strategy includes initiatives to help states establish comprehensive programs and emphasizes preventing groundwater contamination. "Nevertheless," it continues, "the potential for success in implementing the new approach is limited.... According to the large majority of EPA and state groundwater officials..., a primary problem ... [is] the current balance of limited resources between remediation .. and prevention-oriented activities." To order the report contact GAO, P.O. Box 6015, Gaithersburg, MD 20877, (202) 275-6241.

SRCS D Policy on the Discharge of Hydrocarbon-Impacted Groundwater to Sewer

- by Sam Harader

The Sacramento Regional County Sanitation District (SRCS D or District) is operated and administered by the County of Sacramento Water Quality Division. The District operates the Regional Wastewater Treatment Plant, located near Elk Grove, California; the plant treats

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Committee Reports *Continued from page 3*

newsletter is informative as well as interesting - a "thank you" to this issue's contributors. We request that when possible contributors strive to "synopsise" lengthy articles prior to submitting them; potential contributors may submit articles via floppy discs.

We are also interested to know if you would appreciate a journal published once-a-year that contains the long articles or if you'd prefer the synopses in each newsletter.

Liaison

GRA's officers met with officers of the Sacramento Chapter of the Association of Engineering Geologists (AEG) to explore ways that the two associations might mutually benefit one another. Many ideas for collaborative efforts were discussed, one of which was a joint fall social event/meeting to apprise attendees of the goals and objectives of each association and to encourage dialogue between colleagues. The meeting is discussed further in the Sacramento Branch summary of this issue.

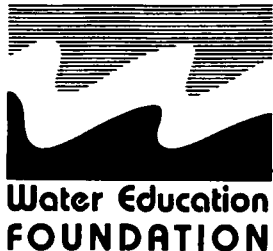
GRA is also exploring liaison activities with the American Institute of Hydrology (AIH). In April, the AIH Executive Board "brainstormed" about possible mutually beneficial relationships between GRA and AIH. AIH has suggested that the two associations consider: joint sponsorship and planning of meetings; working together on short courses and seminars; working together on issues related to legislation; joint sponsorship of student chapters and guest lecturers; and, helping identify qualified groundwater professionals.

AIH's 1992 Annual Meeting will be held in Portland, Oregon at the Red Lion/Columbia River Hotel from October 11-16. The conference program is entitled, "Interdisciplinary Approaches in Hydrology and Hydrogeology." Scheduled for the conference are discussions on water policy, competing water needs, surface/groundwater relations, geochemistry, water management, climate, hazardous and toxic waste, river mechanics, hydrological effect and geographic information systems. For more information call AIH at (612) 379-1030. ●

Water Education Foundation

Answers to your Water Questions

— by Wendy Ernst



We've all had an experience something like this: You need a graphic of the local water levels, or a statewide rundown on the hierarchy of water districts, or a map of U.S. groundwater use, or even an article on recent subsidence levels in the delta region. You go to your files (the ones you meant to organize months ago) and search for the article you saw detailed in one of the groundwater journals (the ones you meant to index by subject). After hours of sweat and searching, you come up

empty. Everyone else has left for lunch, and all their files are organized in some strange coded system. You need help, and you need it now! Don't panic.

An answer may be as simple as a telephone conversation or facsimile transmittal.

The Water Education Foundation, established in 1977, is a nonprofit, nonpartisan, tax-exempt organization. Its mission is to develop and implement educational programs leading to a broader understanding of water problems.

The Foundation offers a diverse range of water information, both technical and broad-based for all people wishing to become better informed on California's water issues. Posters, graphics, layperson's guides, slide shows, videos, classroom materials and their bimonthly magazine, *Western Water*, are just some of the ways the Water Education Foundation can assist us in our search for current information on water issues. Its staff of five, headed by Executive Director Rita Schmidt Sudman, are knowledgeable professionals, able to assist in helping you find the answers to California's water questions.

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CHEMISTS'

Attention to Details Will Maintain Data Viability

— by Joel Kiff

Congratulations! The court found in favor of your client, who was suing her rich, sleazy ex-tenant to recover cleanup costs. The tenant's money laundering operation was responsible for the PCE spill and you proved it. Your client won because your workplan was technically sound. Your data was conclusive and legally defensible. As your client gave you a pat on the back and handed you a bonus check, in your mind you chalked it up to experience. You thought back to lessons learned from past projects, cases that you didn't win.

There was the time when the defense lawyers got you for not performing the proper preservation of a water sample. Then there was the time when you kept samples in the refrigerator at the office over the weekend. The refrigerator had no lock or temperature monitor. Your opponent's lawyers loved you for that one.

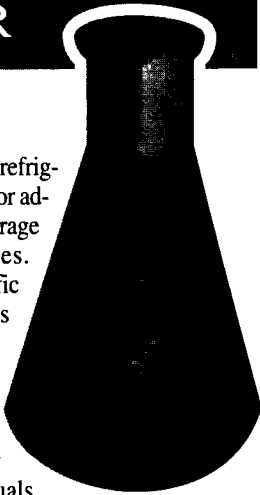
The business of environmental assessments is an unusual blend of earth science and legal science. Most of us are more at home with the former than with the latter, which makes problems like the ones described above fairly commonplace. The goal of this article is to enhance awareness of the legal side of our business, with an emphasis on the responsibilities of the environmental consultant.

As I mentioned before, the science part of our job is to make measurements, to objectively assess a given environmental situation. In order for our measurements to be considered evidence, however, there must be an unbroken chain of properly followed procedures from the time of sampling through the statute of limitations for any potential civil lawsuit. Fortunately for most of you, your responsibilities are primarily confined to the first day of this saga. They are nonetheless critically important.

First, you are responsible for proving that the samples you collected arrived at the laboratory without being tampered with. To do this, keep track of who has had possession of the samples from field to lab. Account for times when the samples leave your view. If this happens, samples (or the cooler that contains them) should be sealed with evidence tape and this should be duly noted on the chain of custody. Avoid storing samples



CORNER



overnight in the company refrigerator, unless the refrigerator adheres to normal lab cold storage documentation practices. These include sample traffic documentation (which tells which samples were in there together) and temperature documentation. The refrigerator must have restricted access whereby only designated individuals have a key to the door.

Give some thought to how tamper-proof your labels are. Avoid writing labels on the container caps or on sealing tape, because in the process of opening the samples, these items are separated from the sample. Also, the tape often cannot be re-attached to the sample once it has been removed. It is best to use a paper or fabric label that sticks securely to the container. Write with indelible ink. You may also find it helpful on occasion to photograph samples prior to sending them off to the lab.

Second, you are responsible for using the proper containers and preservation methods. Refer to EPA SW-846 for container and preservation guidelines. Document the preservation whenever possible. If you have preserved water samples with acid, ask the laboratory to verify this using pH test strips. If you are transporting samples in an ice chest, check the temperature with an appropriate thermometer and record the information on the chain of custody or in your field notebook. Keep in mind that if samples are required to be stored at 4 degrees C and the cooler temperature goes above 10 degrees C, the data generated will not be considered valid.

Third, keep thorough field notes. Sign and date each page. Use pen. Strike out mistakes with a single line and initial and date any struck print. Never use "white-out."

There are many more steps that you can take to support the validity of the measurements that we collectively produce. Just keep in mind that we must not only have the right answers, we must get to the right answers the right way.

Joel Kiff is Laboratory Director for Western Environmental Science and Technology (WEST) of Davis, California. ●

Litigation Avoidance

— by Jeffery Scharff

[Editor's note: The following is the first in a series of three articles by Mr. Scharff that discusses potential liabilities that businesses may face. The article is a follow-up to his presentation at the April 1992 Sacramento Branch GRA meeting].

In today's litigious society, there are any number of potential pitfalls facing businesses. This holds especially true for those that are operating in the environmental arena. This article is intended to discuss some of the more common issues which may affect your business operations and provide some things which you may want to consider.

First, are you at risk of getting sued? There are roughly 30 million people in California of which 150,000 are attorneys. That works out to one lawyer for every 200 people. Odds are a disgruntled client will be able to find a lawyer on virtually every street corner to seek advice on any perceived wrongs.

The following is a hypothetical example of an environmental consulting firm's operations. It will provide the basis for some of the comments to follow:

Generic Environmental Firm (GEF) has recently opened its doors for business. The principals have left the security of working for someone else and have set up shop. In their haste to open their doors, some of those "legal things" such as leases, contracts, employment agreements and the like have been assembled in haste, if at all.

Unfortunately, the days of "business on a handshake" are long gone. As a matter of business necessity, agreements in the business world today must be put in writing. That is not to say they need to be lengthy, complicated, legal "mumbo-jumbo." It can be a simple agreement between the parties reflecting the terms and conditions of any agreement, but it must be in writing.

Based on our firm's experience, one of the areas of concern is an adequate description of the intended job to be performed on the client's behalf. Often times in proposals for work to be done, the scope of work description is too abbreviated and fails to fully discuss and apprise the client of the work to be completed. This takes the form of potentially unrealistic expectations as to the amount of work that will be accomplished in any given phase. Taking the time to describe the task items to be accomplished and the costs associated with them is the first step to avoiding misunderstandings later.

Professional service agreements should also include items such as attorney's fees clauses for the prevailing party and alternate dispute resolution, such as arbitration, which may be a cost effective alternative to litigation. Make sure that any subsequent changes in the scope of work are set forth in writing and approved by the client before the work commences. These are but a few examples of subjects which have tripped up many within the environmental consulting business profession.

Prior to work being commenced at a site, have the necessary permits and approvals been obtained? The common ones such as encroachment permits, well drilling permits and the like are routinely thought of. However, there may be situations where less routine permits, such as a conditional use permit, may be required if excavation spoils will be stored at the site.

Once work has commenced on the job, are proper procedures being followed? Do the techniques employed reflect those generally utilized by other members of the profession? If they do, document it! Documentation in this regard is critically important due to the rapidly changing state-of-the-art for environmental assessment and remediation work.

What happens if, subsequent to the work being performed, additional contamination is discovered? There is the possibility that you may be forced to describe, perhaps ten years later, the work that was conducted at a particular site. Without sufficient documentation to reflect that it was performed in a manner consistent with generally acceptable practices in the industry, you face the possibility of being second guessed. That old saying that hindsight has 20/20 vision applies. Memories are fairly short; the best way to protect yourself is maintaining adequate records that were prepared at or close in time to the work being performed.

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Well Standard Excerpts

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Borings that are not covered by DWR's standards include:

- Mineral exploration holes
- Dry wells or shallow drainage wells
- Elevator shafts
- Geotechnical borings
- Shallow agricultural piezometers
- Extensometers.

Circumstances such as complicated geology or hydrology may require well construction that deviates from the standards. Variances to the well standards can be granted if alternate measures or standards provide the same protection to groundwater as do the DWR-promulgated well standards. DWR's standards are enforced by local governments and by some water districts, which may have more stringent standards than those of DWR.

Bulletin 74-90 was intended to provide not only new technical standards, but also to provide consistency, clarification, and amplification of Bulletin 74-81. The following excerpts from Bulletin 74-90 highlight some of the major technical additions affecting the construction of monitoring wells:

Separation: Monitoring wells shall be located an adequate distance from known or potential sources of pollution and contamination....., unless regulatory or legitimate data requirements necessitate they be located closer.

Flooding and Drainage: Monitoring wells should be located in areas protected from flooding, if possible.....

Accessibility: All monitoring wells shall be located an adequate distance from buildings and other structures to allow access for maintenance, modification, repair, and destruction.....

Disposal of Wastes When Drilling in Contaminated or Polluted Areas: Drill cuttings and wastewater from monitoring wells or exploration wells in areas of known or suspected contamination or pollution shall be disposed of in accordance with all applicable federal, state, and local requirements.....

Sealing the Upper Annular Space: The space between the monitoring well casing and the wall of the well boring, usually referred to as the 'annular space,' shall be effectively sealed to prevent it from being a preferential pathway for the movement of poor quality water, pollutants, and contaminants.....

Wells Constructed in Areas of Known or Suspected Pollution or Contamination: The annular space shall be sealed from the top of the filter pack or monitoring zone to ground surface unless otherwise approved by the enforcing agency. The top of the filter pack or monitoring zone shall not extend into another water-bearing unit above the single water-bearing unit being monitored.....The filter pack or monitoring zone shall not extend into any confining layers that overlie or underlie the unit to be monitored.....The annular surface seal shall not be less than 20 feet in length. Seal lengths less than 20 feet are permissible only if shallow zones will be monitored and approval has been obtained from the enforcing agency.....

Sealing Off Strata: Additional annular sealing material shall be placed below the minimum depth of the upper annular seal, as needed, to prevent the movement of poor-quality water, pollutants, and contaminants through the well to zones of good-quality water.....

Areas of Freezing: The top of the annular seal may be below ground surface in areas where freezing is likely.....The top of the annular seal shall not be more than four feet below ground surface.....

Temporary Conductor Casing: If temporary conductor casing is to be used during drilling, it shall be removed during the placement of the casing and annular seal materials.....If the temporary conductor casing cannot be removed....., sealing material shall be placed between the conductor casing and borehole wall, and between the well casing and the conductor casing.....

Permanent Conductor Casing: If a permanent conductor casing is to be installed, the monitoring well borehole diameter shall be at least four inches greater than the outside diameter of the conductor casing. The inner diameter of the permanent conductor casing shall in turn be at least four inches greater than the outside of the well casing. Sealing materials shall be placed between the permanent conductor casing and the borehole wall, and the conductor casing and the well casing.....

Radial Thickness of the Seal: A minimum of two inches of sealing material shall be maintained between all casings and the borehole wall, within the interval to be sealed, except where temporary conductor casing cannot be removed.....A minimum of two inches of sealing materials shall also be maintained between each casing, such as permanent

conductor casing, well casing, gravel fill pipes, etc., in a borehole within the interval to be sealed.....

Sealing Material: Sealing material shall consist of neat cement, sand cement, concrete [with approval of the enforcing agency], or bentonite. Cuttings from drilling, or drilling mud, shall not be used for any part of the sealing material.....

Transition Seals: Transition seals should be installed by using a tremie pipe or equivalent.....Bentonite can be placed in the well annulus in dry form or as slurry for transition seals.....Water should be added to bentonite at a ratio of one gallon for two pounds of bentonite to allow for proper hydration.....Sufficient time should be allowed for bentonite transition seals to properly hydrate before cement-based sealing materials are placed. Normally, one-half to one hour is required.....The top of the transition seal shall be sounded to ensure that no bridging occurred during placement.

Placement of Annular Seal Material: All loose cuttings and other obstructions shall be removed from the annular space before sealing materials are placed. Sealing may be accomplished by using pressure grouting techniques, a tremie pipe, or equivalent. Sealing materials shall be installed as soon as possible during well construction operations. Sealing materials shall not be installed by 'free-fall' from the surface unless the interval to be sealed is dry and less than 30 feet deep.

Locking Cover: The top of a monitoring well shall be protected by a locking cover or equivalent level of protection to prevent unauthorized access.

Casing Cap: The top of a monitoring well casing shall be fitted with a cap or "sanitary seal" to prevent surface water, pollutants, or contaminants from entering the well bore. Openings or passages for water level measurement, venting, pump power cables, discharge tubing, and other access shall be protected against entry of surface water, pollutants, and contaminants.

Flooding: The top of the well casing shall terminate above ground surface and known levels of flooding.....

Bases: a concrete pad shall be constructed around the top of a monitoring well casing at ground surface and contact the annular seal, unless the top of the casing is below ground surface.....The base shall be at least four inches

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thick and shall slope to drain away from the well casing. The base shall extend at least two feet laterally in all directions from the outside of the well boring.....

Vaults: At the approval of the enforcement agency, the top of the well casing may be below ground surface because of traffic or other critical considerations. A structurally sound watertight vault, or equivalent feature, shall be installed to house the top of a monitoring well that is below ground surface. The vault shall extend from the top of the annular seal to at least ground surface. In no case shall the top of the annular seal be more than four feet below ground surface.....

Protection from Vehicles: Protective steel posts, or the equivalent, shall be installed around a monitoring well casing where it is terminated above ground surface in areas of vehicular traffic. The posts shall be easily seen and shall protect the well from vehicular impact.

Filter: Monitoring well filter pack material shall consist of non-reactive, smooth, rounded, spherical, granular material of highly uniform size and known composition. Filter pack material shall not degrade or consolidate after placement. The grain-size of the filter pack shall be matched to the slot size of the well screen.....

Special considerations that apply to monitoring well casing are described below:

Chemical Compatibility:.....The selected casing shall resist chemical attack and corrosion.....

Plastic and Steel Casing: Standards for thermoplastic well casing are in Section 12 of the Water Well Standards.....Fluorocarbon casing materials shall meet the following specifications, including the latest revisions thereof:

ASTM D3296, "Standard Specification for FEP-Fluorocarbon Tube."

ASTM D3295, "Standard Specifications for PTFE Tubing."

Stainless steel casing shall meet the provisions of ASTM A312, "Standard Specification for Seamless and Welded Austenitic Stainless Pipe," and shall meet general requirements for tubular steel products in Section 12 of the Water Well Standards.....

Multiple Screens: Monitoring well casing strings shall not have openings in multiple

water-bearing units (multi-level monitoring wells), if poor-quality water, pollutants, or contaminants in units penetrated by the well could pass through the openings and move to other units penetrated by the well and degrade groundwater quality.....

Bottom Plugs: The bottom of a monitoring well casing shall be plugged or capped to prevent sediment or rock from entering the well.

Casing spacers: Casing spacers shall be used within the interval(s) to be sealed to separate individual well casing strings from one another in a borehole of a nested monitoring well. The spacers shall be placed at intervals along the casing to ensure a minimum separation of two inches between individual casing strings. Spacers shall be constructed of corrosion-resistant metal, plastic, or other non-degradable material. Wood shall not be used as spacer material. Any metallic component of a spacer used with metallic casing shall consist of the same material as the casing. Metallic spacer components shall meet the same metallurgical specifications and standards as the casing to reduce the potential for galvanic corrosion of the casing. Spacers shall not be more than 12 inches in length and shall not be placed closer than 10 feet apart along a casing string within the interval to be sealed.....Casing spacers shall be designed to allow the proper passage and distribution of sealing material around casing(s) within the interval(s) to be sealed.

Casing Installation:.....Casing, couplings, centralizers, and other components of well casing shall be clean and free of pollutants and contaminants at the time of installation.....Organic solvent welding cements or glues should not be used for joining plastic casing if glues or cement compounds could interfere with water-quality determinations.....Casing shall not be subjected to significant impact during installation that may damage or weaken the casing.

Well Development: This section includes standards for mechanical surging, overpumping and pump surging, air development, water jetting, and chemical development.

Rehabilitation and Repair of Monitoring Wells: Well rehabilitation methods that may, in certain cases, be acceptable for monitoring wells include mechanical surging, backwashing or surging by alternately starting or stopping a pump, surging with air, water jetting, sonic cleaning, chemical treatment, or combinations of these.

Major changes and additions to the Water Well Standards will be highlighted in the next HYDROVISIONS issue.

Carl Hauge is Chief Hydrogeologist for DWR and Sue Erikson, M.S., Hydrogeology, is with the Sacramento County Hazardous Materials Division. ●





BRANCH ACTIVITIES

San Francisco Bay Branch

The premier dinner meeting of GRA's San Francisco Bay Branch was held on Wednesday evening, June 17, 1992 at the Mandarin Garden Restaurant in Berkeley, California. The meeting was attended by 30 professionals representing private, state and academic interests. The program consisted of a short business meeting lead by organizing committee members Scott Warner and Kent Aue, followed by the invited keynote presentation given by Carl Hauge, the Chief Hydrogeologist of the California Department of Water Resources (DWR). Mr. Hauge currently works with staff in the four district offices of the Division of Local Assistance reviewing and coordinating work with local agencies and disseminating information about groundwater to the public.

During the business meeting, several of the goals and objectives of the San Francisco Bay Branch were discussed. Immediate objectives include: establishing steering committees to address membership; discussing future program and education issues; establishing communication links between private and public interests in the groundwater industry; and, developing a strong and locally respected branch of GRA. A short questionnaire was given to meeting participants for use by the organizing committee in assigning, at least initially, the activities and programs necessary to promote growth and continued interest in the local branch.

Mr. Hauge's presentation, entitled "Groundwater Management in California: Present and Future Issues," covered several topics of interest to groundwater professionals including components of groundwater management, laws governing groundwater use in California, well

standards, and pending legislation for groundwater management districts. The presentation was very well received by the audience who responded by asking a number of both general and technically focused questions.

As part of his presentation, Mr. Hauge provided to the audience a number of short publications produced by DWR. Four of the handouts are from the series *Water Facts* which are short reports on water resources issues of general interest. Those reports made available at the meeting were: "Ground Water in Fractured Hard Rock"; "Adjudicated Ground Water Basins in California"; "Seven Steps for Managing Ground Water Supplies"; and, "Ground Water Management Districts or Agencies in California." Additional copies of these reports and other similarly produced reports may be obtained from DWR Bulletins and Reports, P.O. Box 942836, Sacramento, California 94236-0001, or by phoning DWR at (916) 653-1097.

Also available at the meeting was "California Laws for Water Wells, Monitoring Wells and Cathodic Protection Wells," which presents a summary of California State laws that relate directly to the construction, alteration, maintenance and destruction of such wells. Additional copies of this publication may be obtained by contacting the Well Standards Coordinator, State Department of Local Assistance, P.O. Box 942836, Sacramento, California, or by phoning (916) 327-1637.

The next meeting of the San Francisco Bay Branch of GRA will be held in late August. Those interested in providing input to this program or to any facet of the continuing development of the San Francisco Bay Branch should contact Scott Warner or Kent Aue.

Many thanks to other members of the branch organizing committee, including Cindy Fong of J. M. Montgomery Consulting Engineers; Steve Walker of Harding Lawson Associates; and, David Abbott of Todd Consulting Engineers.

Central Coast Branch

The Central Coast Branch of the GRA held its first dinner/lecture and organizational meeting on May 28, 1992 at the A.J. Spurs Restaurant in Buellton, California. The keynote speaker was Richard L. Volpe, President and Manager of Engineering with Earth Sciences Associates in Palo Alto, California. Mr. Volpe's presentation discussed the history of subsidence issues and problems in California, Mexico and Thailand, with particular attention to case studies in the Santa Clara Valley, the Baldwin Hills Dam failure, and Mexico City. He then discussed the feasibility of assessing historical and potential future subsidence through the use of a recently developed one-dimensional consolidation computer program. His dynamic lecture stimulated the interest of many in the audience, and culminated with a lively question and answer period. All of the members of the new Central Coast Branch enjoyed Mr. Volpe's lecture, and thank him for attending the premier meeting and sharing his enthusiasm and expertise.

The meeting was well attended, with 24 people participating. The group promises to be a diverse and interesting chapter comprised of individuals from private firms (geologists, hydrogeologists and engineers), contractors (drilling and pump contractors), suppliers, attorneys, academic and governmental agencies, and other professionals working in groundwater-related matters. It was decided that future meetings will be held on a bimonthly basis, on the third Thursday of the month beginning July 16, 1992.

Following the dinner and lecture, an organizational meeting was held to elect officers and discuss specific direction and goals for the branch.

Southern California Branch

Dr. Fletcher G. Driscoll was the keynote speaker at the premier meeting of the GRA Southern California Branch. Dr. Driscoll's talk was entitled, "Preserving Your Professional

Litigation Avoidance Continued from page 5

The stakes in this game are constantly increasing. As the state-of-the-art evolves, so does the sophistication of individuals who may seek recompense for their harms, real or perceived. These claims can take the form of loss of property value due to contamination, toxic torts alleging exposure to harmful chemicals and claims for fear of cancer. Additionally, the courts are increasingly willing to impose civil fines and penalties for unfair business practices as well as criminal prosecutions.

Before you throw up your hands and quit, these matters, like most others in life, can be avoided with the application of a little bit of time, thought and good old common sense. If nothing else, take a minute to evaluate your current business practices. In addition to contracts and permits, do you have procedures in place for conducting field investigations? Are procedure manuals or other guidance documents available? These and other subjects will be the topics of future articles.

Jeffory J. Scharff, Esq. is a partner in the lawfirm Scharff & Greben. The firm specializes in business, environmental, real estate law and related litigation. ●

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BRANCH ACTIVITIES

Continued from page 8

Reputation." With the benefit of 20/20 hindsight, he reviewed several case studies of preventable, and extremely costly, catastrophic failures. These horror stories included tunnel failures (and apparently clumsy remedial attempts) at a hydroelectric plant; tunnel dewatering problems caused by inadequate hydrogeologic information (including the surprise one-foot-thick clay layer and the neglect of jointing in till); inappropriate grouting techniques; and, outrageous limitations in a set of iron data which provided only "greater than" information.

The saddest part about these stories was not the cost of the failures, but that they were all preventable through simple communication. That is, all the parties on a project, particularly the geologists and engineers, need to break down the professional and social barriers to discussion and technical interaction. Dr. Driscoll emphatically supported the concept of GRA to facilitate such communication and urged all members to freely call one another to discuss project technical issues, stating that one always will receive much more than one gives in this manner. He suggested that one wouldn't be "giving away the store" by providing a simple double check on technical issues and calculations, while noting that of course one couldn't spend several days on such a discussion.

In his conclusion, Dr. Driscoll offered four recommendations to the audience of 40 persons: 1) Do the right thing, however difficult it may appear in the short run; 2) spend time getting to know regulators on a personal basis long before you "need" them (they're good folks just like us - unfortunately none were in attendance); 3) become very active in professional associations like GRA; and 4) force your firms to allow you to attend at least one course a year.

Sacramento Branch

The Sacramento Branch of GRA was active by the end of March 1992; two dinner meetings have occurred, each of which were held at the Royal Hong King Lum restaurant in downtown Sacramento. The meetings were well attended with over 50 participants at each. The branch meets bimonthly on second Thursdays.

The kickoff dinner meeting of 30 April 1992 was hosted by Environmental Geotechnical Consultants, Inc. and featured Jeffery Scharff of

Scharff & Greben as the speaker. Mr. Scharff's presentation was enlightening and in fact will be shared with HYDROVISIONS readers through a series of newsletter articles discussing potential liabilities that businesses face today. Although Mr. Scharff's comments were catered toward environmental consulting and related fields, (practitioners of which comprised the majority of the audience at the kickoff meeting) his comments generally inspired a healthy "stop and think a little" reality check that would apply to nearly any business. The first of the series of articles by Mr. Scharff appears in this issue.

The second GRA Sacramento Branch meeting was hosted by GHH Engineering, Inc. (GHH) on 25 June 1992. The evening's speaker was GHH President Gary Hall, who spoke on the current issues of cost recovery and treatment requirements for discharge of treated contaminated groundwater to sewer systems. Through an animated discussion of: existing discharge fee rate structures (if any); treated groundwater vs. industrial wastewater discharge standards; the accountability of sanitation districts for groundwater contamination resulting from leaky infrastructure; and, inconsistencies of various regulatory criteria for handling contaminated groundwater, Mr. Hall advocated that increased planning and cooperation among interdisciplinary agencies would result in more cost effective contaminated groundwater remediation. Mr. Hall also discussed alternatives to sewer system discharge, including stormdrain and surface discharge for treated groundwater.

The next regularly-scheduled Sacramento Branch meeting will be held 13 August 1992 and will feature Dr. Jon Marshack of the California Regional Water Quality Control Board, Central Valley Region. The dinner meeting will be hosted by the Sacramento County Environmental Management Department, Hazardous Materials Division. Dr. Marshack's presentation is entitled "California's Water Quality Standards and Their Applicability to Waste Management and Site Cleanup." Dr. Marshack has served on several inter-agency advisory committees dealing with waste management issues and is the author of, among other publications, *The Designated Level Methodology for Waste Classification and Cleanup Level Determination* and *A Compilation of Water Quality Goals*.

In addition to the bimonthly dinner meetings, the Sacramento Branch is in the initial stages of planning a joint "fun-emphasized" social event with the Sacramento Chapter of the Association of Engineering Geologists (AEG). Sacramento Branch Member-at-Large Cris Hamilton is spearheading this proposed event; under consideration for location is a Sacramento River cruise boat. ●

BRANCH CONTACTS

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Common Things

Continued from page 1

older books ranging in publishing dates from 1819 to 1912. The 1819 publication incidentally is titled "Elements of Agricultural Chemistry" and consists of a course of lectures for the Board of Agriculture of Great Britain. It includes an appendix "containing a series of experiments to test the value of the grasses cultivated in Great Britain."

But back to "The Science of Common Things." The book was written "to furnish students an elementary textbook on the first principles of science." It consists of nine chapters covering a wide range of subjects including "Laws and Properties of Matter" and the application of the laws and properties to the "Arts." The book presents a list of numbered questions, then provides an answer to those questions. Let me digress back to my childhood, illustrate a learning experience, then apply an illustration of Wells' teaching.

As a young boy, when I came upon an open well - especially a newly drilled well - I could not resist the temptation of dropping a pebble into the well and then awaiting the sound of its contact with the static water level. Then the object was to guess how far the rock had fallen or, more properly stated, what was the depth to water? I must admit that even in my adult years, when I was confident that no one was looking, I have continued to play this game! In "The Science of Common Things," Wells answers the question as follows:

164. How far will a body fall, through the influence of gravity in one second of time?
Sixteen feet.

165. How far will it fall in two seconds?
Four times 16 feet or 64 feet.

166. Will a mass of iron, weighing one hundred pounds, let fall from an elevation, reach the ground any quicker than a mass weighing only one pound, let fall at the same time and from the same place?

No; the lighter mass will fall with the same velocity and reach the ground as soon as the larger one.

Before the time of Galileo, it was taught and believed that if two bodies of different weights were let fall from any height at the same moment, the heavier body would reach the ground much sooner, as its weight was greater than the smaller. Galileo, on the contrary, maintained that they would both strike the ground at the same time, and, as his doctrine was generally disbelieved, he challenged his

opponents to a practical trial. The experiment was made from the top of the celebrated leaning tower of Pisa, in the presence of a great concourse of people, and resulted in the complete triumph of Galileo.

167. What is the rule by which the height from which a body falls may be found, the time consumed in falling being known?

Multiply the square of the number of seconds of time consumed in falling by the distance which a body will fall in one second.

168. If a stone is five seconds in falling from the top of a precipice, how high is the precipice?

The square of 5 seconds is 25; this multiplied by 16, the number of feet a body will fall in one second, gives 400, the height of the precipice.

So here in a century old book, I find a simple answer to my childhood question, explained in an interesting, logical, understandable manner. Was he right? Of course he was. You and I will perhaps remember our high school or college physics course in mechanics which provided us the equations of linear motion that $v = gt$ or $v^2 = 2gh$ or $h = 1/2gt^2$.

I could not resist the temptation of opening my old Physics 4A textbook (*Principles of Physics* by Sears, 1947) and reading the section on "freely falling bodies." I won't bore you with the explanation other than to say it consisted of three pages with lengthy dissertations on the very minor decreasing value of "g," or acceleration, with increased altitude or the effect of air resistance for great distances of fall.

It is no wonder we tend to become so concerned with minor, and in many cases, insignificant, details in our work today. We are inclined to concentrate on the minor issues and overlook what should be our major concern. Personally, I have always enjoyed focusing on the bigger picture while of course recognizing the minor issues which could effect the results of our objectives. In this regard, I can't wait to find my next new well! Now please understand I know we should not drop rocks in a new well but, maybe just two for Galileo? Like a small one and one larger. Think what that does to our theories regarding uniformity of gravel packs; but that's another story.

I hope to share with you in this column from time to time, other selections from these and other publications, as they relate to our soil structure and groundwater, as understood by the scientists of the day, over a century ago. Like most professionals, I have spent a lifetime


reading the current publications of the day. They nearly always were scientific reports or business journals, financial management reports, etc. My wife Sue brought this vividly to my attention one Christmas a decade ago, when she presented me with a series of leather bound editions of what we know to be the classics. Books by Benjamin Franklin, Victor Hugo, Jules Verne, Pasternak, Chaucer, Whitman, Hawthorne, Steinbeck and so many more. She said to me, "Read something else from time to time!" And she was, and is, so correct.

As scientists, or well drillers, we often get too focused on single issues or disciplines and fail to take time to see and enjoy life's riches and most assuredly, the gifts of so many wonderful authors. In our scientific endeavors, each of us should understand the work of our predecessors and the timeframe when mankind began to understand the elements of nature we work with daily. But we should also try to broaden our visions to a wider sphere of influence while we study the past and plan for the future.


When Vicki Kretsinger asked me if I would provide a continuing column in this newsletter, I told her, "Yes, I would be honored to be a contributor." But I asked her to allow me the freedom to vary the topics from technical writings on well construction and design or computer programs, to "other" topics I might have in mind, like "The Science of Common Things" or maybe Mark Twain's "Some Learned Fables for Good Old Boys and Girls."

I hope you will find this column interesting and on some occasions informative. I will try to vary the subject matter to provide you a cross section of the groundwater industry as it exists today and how it was "yesterday." If you have a specific interest that you feel I might address, please let me know. I would enjoy hearing from you.

P.S. Let me know how close you come to correctly guessing the depth to water in your next well! ●



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REGULATORY NEWS

Treated Water Discharge Continued from page 3

wastewater from the surrounding unincorporated areas of Sacramento County, and the Cities of Folsom and Sacramento. The Industrial Waste Section implements the discharge of non-domestic wastewaters.

Discharges of hydrocarbon-impacted groundwater and other hydrocarbon-contaminated wastewaters are accepted under the conditions of the District's "Policy Regulating Gasoline-Contaminated Groundwater Discharges to the Sewer System." This policy was developed in 1987 in response to a number of requests to discharge contaminated groundwater. This policy has also been applied to discharges of diesel-contaminated wastewater, landfill leachate and hydrocarbon-impacted wastewaters from petroleum distribution facilities.

Three basic pollutant limitations are contained in the District's current groundwater policy:

- A 100 mg/L limit on Total Petroleum Hydrocarbons (TPH). This limit is applied to the concentration of TPH-diesel, TPH-motor oil or Oil and Grease in the discharge.
- A 4.57 mg/L limit on Total Toxic Organics (from 40 CFR 413, "Pretreatment Standards for the Electroplating Industry"). This limitation would apply to any of the listed toxic organic compounds including benzene and toluene. However, most of these compounds are limited to much lower concentrations by other regulations and this limit rarely, if ever, applies.
- A 0.25 mg/L limit on "total hydrocarbons that might produce an explosive atmosphere in the sewer." This limit is applied to the number arrived at by subtracting the summation of BTEX concentrations from TPH-gasoline.

The 0.25 mg/L limit above is clearly the most restrictive and determines the level of treatment needed for gasoline-impacted groundwater. This limit was derived using Henry's constants for the typical constituents in gasoline that could produce an explosive atmosphere. As pointed out in the District's policy, prediction of atmospheric concentrations of explosive vapors under actual sewer conditions is extremely difficult. The District is currently reviewing the volatile hydrocarbons and Total Toxic Organics limitations.

Dischargers of gasoline-impacted groundwater are required to install a Lower Explosive Limit (LEL) monitor/controller on the discharge. LEL monitors are required to be set so that an alarm is triggered at 20% of the LEL and the system is shut down at 40% of the LEL. Other conditions include flow monitoring, periodic sampling, and reporting.

Property owners or their representatives must obtain a Sewer Use Permit from the District's Industrial Waste Section to discharge groundwater to the sewer system. The permit administration/application fee for continuous (pump and treat) discharges is now \$833 per year. The monthly sewer bill for groundwater discharges includes 1/12th of the annual permit fee (if not paid in advance), treatment charges and capacity fees, if applicable. Groundwater discharges frequently exceed the capacity paid for with the original connection fee for the parcel where located and must therefore pay additional Capacity Investment Equalization (CIE) fees in accordance with the District's connection fee ordinance.

Monthly costs for a five gpm groundwater discharge would typically be approximately \$95 in treatment charges; \$70 for the permit administration fee; and, \$178 for CIE fees for a total sewer bill of \$343. One-time or infrequent discharges, such as drilling rig decontamination water and sampling purge water, are allowed under temporary (one-time) discharge permits. The fee for a temporary discharge permit is \$200. Purge water discharges from periodic sampling events are usually issued a temporary permit that covers sampling events for one year.

Additional information and applications may be obtained by contacting:

SRCSD Industrial Waste Section

9660 Ecology Lane
Sacramento CA 95827
(916) 855-8354 or 855-8454

Sam Harader is an Industrial Waste Specialist with the SRCSD Industrial Waste Section.

UPCOMING EVENTS

Notice of Annual Meeting

GRA is very pleased to announce that our first annual meeting will be held at the Mark Hopkins Intercontinental Hotel in San Francisco on November 6 and 7. The agenda includes a full day seminar, lunch at the Top of the Mark,



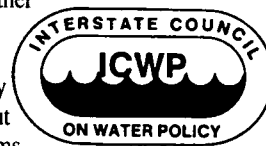
**MARK HOPKINS
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evening reception, and our first annual meeting featuring a keynote speaker and full breakfast. The Mark Hopkins is a world-renowned hotel featuring guest rooms and meeting facilities with spectacular views of San Francisco and the Bay Area. The Mark Hopkins has extended GRA a very gracious discount on room and meeting facility rates that promises to make our first annual meeting an affordable, informative and entertaining event that is sure to be the quintessential groundwater meeting of all time. Details regarding the meeting, seminar and costs will be announced soon. We look forward to your suggestions, participation and attendance.

21st Century Water Management

For the first time since 1988, the Interstate Council on Water Policy (ICWP) is meeting in California; the meeting will be held in Monterey at the Monterey Plaza Hotel from August 29 to September 1, 1992. This national meeting will focus on "21st Century Water Management - The Pieces and How They Fit."

The event will bring together staff from local, state and federal agencies, water associations and advocacy groups who will talk about some of the tough problems regarding the environment and water supply and quality that they see evolving in the 21st Century as well as any solutions that might be on the horizon. They will also explain their roles in: flood control, water quality, environmental protection, and water supply; laws and regulations pertaining to these subjects; and, how the various agencies work together.



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ICWP *Continued from page 11*

Co-sponsors of the event are the California Department of Water Resources, the Association of California Water Agencies, the Metropolitan Water District of Southern California, Kern County Water Agency, Turlock Irrigation District, Coachella Valley County Water District, Boyle Engineering Corporation, James M. Montgomery Consulting Engineers, Inc., and Egret Technologies, Inc.

ICWP represents state, interstate, intrastate, and regional water agencies, academic institutions, professional and business firms, and individuals committed to the conservation, use, development, and wise management of water. Established in 1959, ICWP is the national voice for water-related interests, including both quality and quantity issues.

If you have questions or wish to receive registration information, write to Lynda Dale Herren, DWR Division of Local Assistance, 1020 Ninth Street, First Floor, Sacramento, CA 95814, or call her at (916) 327-1654. ●

Water Education Foundation *Continued from page 4*

The Foundation's programs are largely supported by the development and sale of its materials.

Recently a documentary on California's water premiered on California Public Television stations.

"To Quench a Thirst: the California Water Crisis" made its debut on Friday, May 15th at 9 p.m. Produced by Sacramento Public Television Station KVIE Channel 6, and hosted by veteran journalist Roger Mudd, the program examined critical water resource issues in California, from the state's early history to the present critical juncture.

Funding for the documentary was provided by a grant to the Water Education Foundation from the Hans and Margaret Doe Charitable Trust of San Diego. Rita Schmidt Sudman was technical advisor to the program and chaired the 18-member advisory panel. The panel consisted of experts from California water agencies, agricultural, and environmental interests and other statewide groups.

Also with funding from the grant, the Water Education Foundation has developed a viewer's guide, providing background and resource information, which will be made available free of charge to the public.

If you missed the program, don't panic! Call your local public television stations and request a repeat of the program. For Sacramento area Channel 6 KVIE, the number is (916) 557-4057. If you can't wait, or want the videocassette for donation to local communities or school districts, the videocassettes of the program are available for purchase from the Water Education Foundation for \$25.00.

For more information or to acquire their catalog, please contact:

Rita Schmidt Sudman; Executive Director
Water Education Foundation
717 K Street, Suite 517
Sacramento, CA 95814
(916) 444-6240 FAX (916) 448-7699

Wendy Ernst is proprietor of Gordian Business Solutions. Her business specializes in research, information, and organization management. ●

Sponsor Acknowledgment

GRA operations at this time are solely based on membership dues and contributions by sponsors. Financial support is being sought to establish the new Association in an effective and timely manner to address the many issues related to California's groundwater resources which are facing us today. ●

To date, the following people and firms have contributed financial support to the Groundwater Resources Association:

Supporters (\$10 - \$24)

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