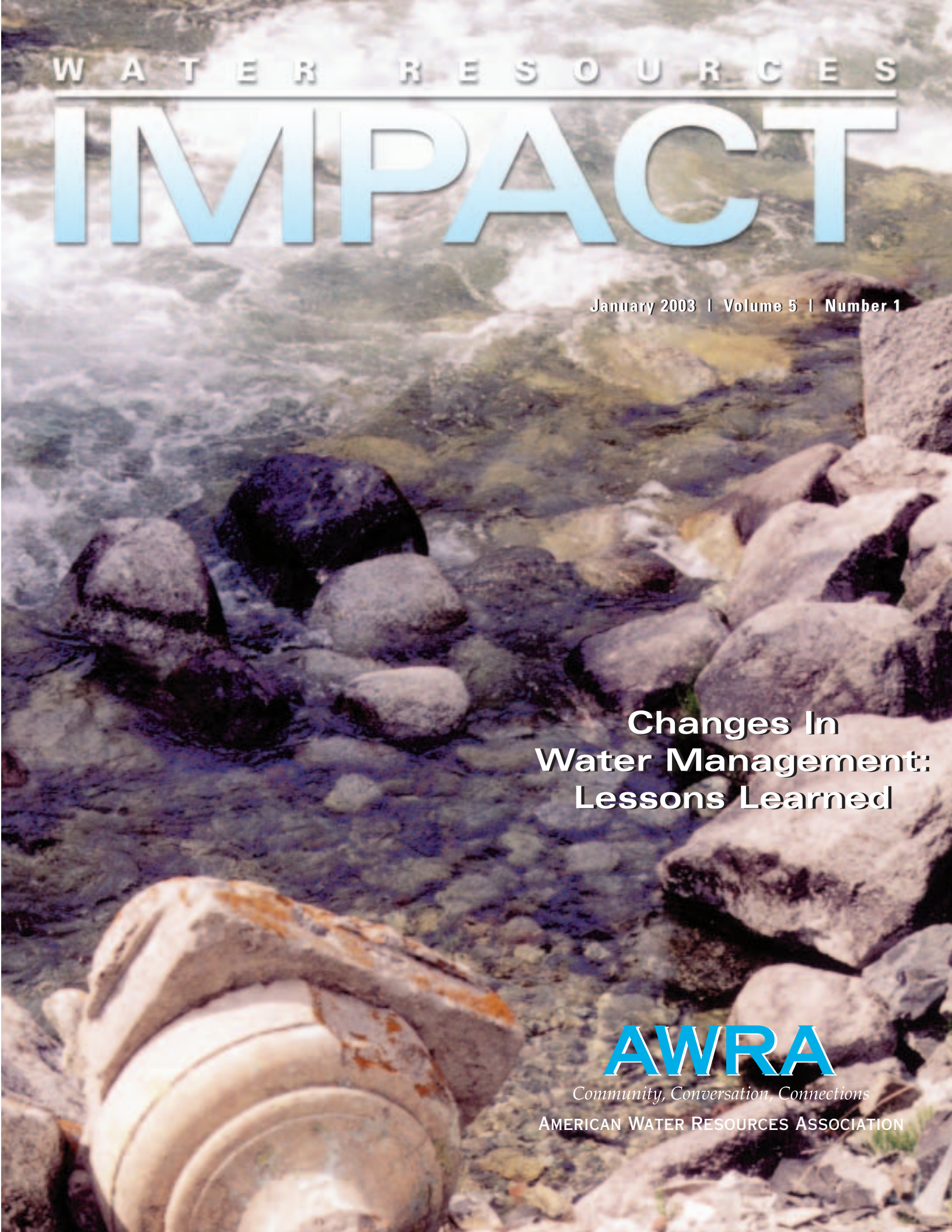

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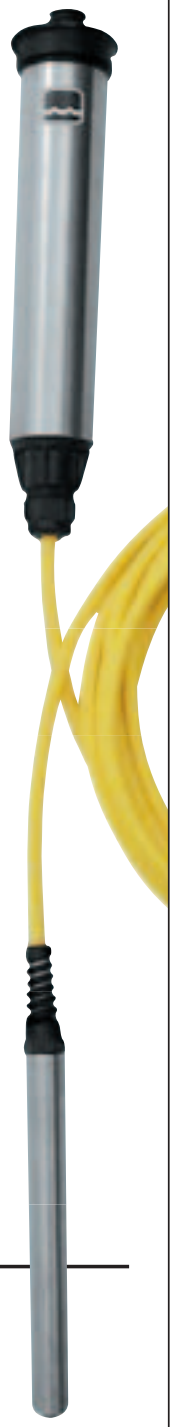

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FAILURES IN WATER MANAGEMENT: LESSONS LEARNED

John Herring, Associate Editor
(JHERRING@dos.state.ny.us)

While a good deal of effort is devoted to publicizing the successes of various water resource management programs, very little attention is focused on examining cases which do not have such happy endings. In this issue of *IMPACT*, the authors point out problems often left out of the water resources conversation, from a mismatch of data needs and data acquisition to internally contradictory programs to innovative public works programs that are obsolete before they are complete. Only if failures are examined can we determine why programs are not as successful as we would like and amend them to lead to improvement. The goal of this issue is not to assign blame ... it is to encourage a clear analysis to support program improvement.

OVERVIEW

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WATER RESOURCES
IMPACT

OVERVIEW
FAILURES IN WATER MANAGEMENT: LESSONS LEARNED

John Herring

When the *Water Resources IMPACT* Editorial Board met last spring, we agreed that it might be instructive to devote an entire issue to looking at programs which have, one way or another, failed. This issue raises several intriguing questions, with each reader likely to answer those questions differently.

As always, the first step is definition . . . just what is a "failure?" As I talked to potential authors, I developed a working definition which notes that almost any large complex program is both a failure and a success. It is difficult indeed to think of a large, complex campaign that made every misstep imaginable, and the best programs are far from perfect. So, to an extent, failure is a matter both of degree and in the eyes of the beholder. The appallingly insensitive dam development that will destroy a wild river and the strenuous effort to conserve precious water resources are sometimes the same project. So, for the purposes of this issue, "failure" evolved to mean either: (a) the major stated objective was not achieved or (b) the side effects of the program largely cancelled out the stated advantages.

The success/failure duality means the authors of the papers in this issue deserve special credit for taking on a thankless task. Critics are routinely derided and dismissed with the observation that if they could do better, they should roll up their sleeves and wade in. These authors have stepped forward to tackle a subject often politely ignored. As you read the articles, note that some are academics, some practicing managers, and one is retired. In no case is the author currently responsible for the program under review.

It was fascinating to seek out topics and authors. I began, simply enough, by bringing up the issue and asking for advice from a wide range of professionals. As the response was so consistent, let me provide a sample conversation.

Professional: "That's a great idea, John. You really should get someone to do something on the [insert name here] program. I've been involved with it for four years, and it is a total waste of time, money, and effort. More work goes into pretty press releases than actually accomplishing anything."

Me: "Terrific idea. And since you know so much about the program, would you be willing to write a short article?"

Professional (suddenly nervous and noticeably pale): "Oh, no, I can't do that. You should get so-and-so to write it."

One topic, relating directly to public drinking water supplies, is not represented in this issue even though every person I spoke to agreed the program is fatally flawed. The first, who supervises a significant portion of the program for a large state, responded when asked to write an article "I can't do that . . . I have three kids in college and have to pay tuition." He suggested I have one of his staff do the deed. The staffer in turn suggested someone in another agency altogether, noting the third person was known for his cogent and blunt critiques of the program. The third individual of course also declined, saying he would like to retain the possibility of working on interesting projects in the future.

Despite the inherent problems, however, the authors have combined to address several topics that can provide insight into the entire issue of failures. **Todd Shallot's** historical survey of some early Army Corps of Engineers works is enlightening, not simply because it provides details on specific projects, but because it highlights a persistent type of problem – by the time the project is completed (usually vastly over budget), conditions have changed and there is no longer a need for it. The St. Lawrence Seaway might be another example of this type of failure.

Another type of failure is the failure to connect pieces to make a coherent whole. **Bethany Neilson** and **Steven Chapra** note that the TMDL program, on its way to becoming a major component of the Nation's water quality strategy, suffers from a disconnect between the data being collected and that needed to support useful modeling efforts. Until this disconnect is addressed, we run the risk of devoting significant resources to a problem with little chance of success.

Doug Nelson's highly personal account of the problems of dealing with onsite wastewater management at the state level highlights the problems arising from what has been referred to as "hardening of the categories."

Marcella Jansen's summary of the coastal nonpoint program is replete with examples of the problems that can arise when an ambitious new federal program meets a combination of inadequate funding, difficulties in partnering, and lack of support from critical groups.

Bernard Schmelz provides an example of problems at the local level in the next article. Again, a disconnect between accepted fact and the adopted program's goals has resulted in a failure, at least by the measure of new costs incurred.

Finally, **Chris Lant's** commentary on the new Farm Bill presents a strong argument that despite its acknowledged successes, its fundamental assumptions fail to allow us to move in the direction we say we wish to go.

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Contact the Associate Editor who is working on an issue that addresses a topic about which you wish to write. Associate Editors and their e-mail addresses are listed on pg. 1.

You may also contact the Editor-In-Chief Earl Spangenberg and let him know your interests and he can connect you with an appropriate Associate Editor. Our target market is the "water resources professional" – primarily water resources managers and such people as planning and management staffers in local, state, and federal government and those in private practice.

We don't pay for articles or departments. Our only recompense is "the rewards of a job well done."

WATER RESOURCES IMPACT

SUCCESS THROUGH FAILURE: ARMY SCIENCE IN HARBOR CONSTRUCTION – 1820 TO 1860

Todd Shallat

In 1836, the Democratic-controlled House Committee on Ways and Means denounced the army's ambitious attempt to rebuild America's ports. "In none of these [harbor] projects has the original estimate of cost, or the probable effects of each expenditure, been verified by experience," said committee chair Francis O. Smith, a Maine Demo-crat. Already, storms had dismantled about 25 army projects. A breakwater failed. A seawall aggravated beach erosion. A pier near Oswego, New York, collapsed. In every case, said Smith, "some unexpected change in the current of surrounding waters has been detected, or some pelting violence of wind or ice or other resistless power has occurred, and just in season to disappoint."[1]

Erratically funded and imperfectly planned, the harbors program was nevertheless a remarkable fusion of executive and Congressional power. From 1820 to 1860, the U.S. Army Corps of Engineers and its sibling organization, the U.S. Topographical Bureau, spent about $46 million on ports, forts, lighthouses, and other coastal improvements – in all, about 200 projects.[2] The expenditure, colossal for its day and roughly equivalent to $939 million in the year 2002, was almost a tenth of all federal spending from George Washington to Abraham Lincoln (1789 to 1861). Sevenfold more than the cost of the Erie Canal, the $46 million developed and maintained a durable fleet of snag and dredge boats, built by Army topographers and engineers. At Minots Ledge near Boston, they shattered construction records with the world's tallest wave-swept lighthouse. At Hampton Roads, Virginia, they defended Chesapeake Bay with the one of the world's largest coastal forts. Engineers – mostly trained at West Point, the nation's first technical school – promoted these monumental efforts with plans imported from Europe. Often, in an America suspicious of big government, the construction seemed grandiose. Eventually, however, the engineers outlasted their critics. By 1860 the Corps had emerged as the bureau of public improvement that bound the far-flung republic into a nationwide network of states.

The prospect of the Army at the helm of public improvement had always been controversial. Although President Thomas Jefferson in 1802 had created the engineer corps to promote science and waterway planning, he remained constitutionally opposed to federal financing for public works. Not until 1824 did President James Monroe allow Congress to fund construction, and then only the truly "national projects" approved by an elite board of Corps engineers. President John Quincy Adams tightly embraced the programs. Schooled engineers would promote, said Adams, "a great, magnificent government."[3] But lofty praise from Adams was a bad omen for army construction. An unpopular President had linked the Corps of Engineers to a magnificent national vision that most voters cared little about.

Adams looked to the Corps at a time when engineers were highly regarded as agents of modernization and governments competed for status with grandiose public works. Britain was the recognized leader, its industry the envy of Europe. Great names in British construction – Thomas Telford, William Jessop, John Rennie, and John Loudon McAdam – were mostly self-made masons and millwrights who thrived in a capitalist culture of pragmatic entrepreneurs. France took another approach. In 1820 the French minister François Becquey launched one of history's most ambitious programs of government – financed construction. Known as the Becquey program, it was administered by an elite and scientific corps of army-trained builders and planners – the Bureau des ponts et chaussées.[4]

The United States – entrepreneurial yet dependent on government money, anti-intellectual yet awe-struck by practical science – had always walked a cultural line between the two dominant powers of Europe, between British-style capitalism and a statist, more militaristic, more regimented and scientific tradition imported chiefly from France. Closely tied to the British economy, Americans, nevertheless, had long ago broken with the British example by allowing private builders to float government bonds. And Americans, although pridefully British in admiration for self-made builder mechanics, had also relied on a more genteel class of builders who looked nothing like the jacks of all trades.

... the prospect of the army at the helm of public improvement had always been controversial . . .

Adam's point-man for national planning was the French antithesis of the Anglo-American builder, Brigadier General Simon Bernard. His largest harbor project, and the only one outside New England, was a thick breakwater of stone near the village of Lewes at the mouth of Delaware Bay. It stood off shore in a treacherous cove exposed to the ocean, where great shears of ice broke off from the frozen Delaware River and gales blowing south and east had forced ships out to sea. The project was "a great national concern," said Philadelphia's Chamber of Commerce. Worthy of a vigorous nation, it would promote the general welfare, reward wholesome industry, and strengthen the ties of mutual interest that assist to bind together this great and happy National Confederacy.[5]

The scope of the project was staggering even for an era of grandiose plans. Bernard proposed a half-mile

breakwater facing the ocean, a detached pier to break up the ice forced down by the river, a floating battery to ward off attackers, a lighthouse and wharves. The project, he predicted, would cost $222,500 – less than half of the value of one shipwrecked freighter from the East China trade. In 1828 an enthusiastic Congress appropriated $250,000. U.S. Quartermaster General Thomas S. Jessup supervised the account but Philadelphians wanted local architect William Strickland to serve as the breakwater's supervising engineer. When Strickland refused to supervise from the breakwater site, Jessup, in 1834, protested to the War Department, but the architect held onto his post until Congress suspended the funding in 1838.[6]

By then the breakwater was already a $1.8 million investment (equivalent to about 36 million 2002 U.S. dollars) and the structure was not yet complete. Each year thousands of ships crowded into the breakwater harbor. Schooners found adequate shelter, but the largest freighters and warships were blocked by shallow deposits near the mouth of the harbor where the breakers washed in gravel and mud. In 1844 a board of inspectors found that the breakwater, by changing the swirl of the current, had aggravated the shoals.

Another problem was the windtunnel between breakwater and ice breaker where ships remained exposed to the frozen river. "It must be conceded," reported the board, "that all that was anticipated from it [the breakwater] has not been obtained."[7] Engineers Richard Delafield and Hartman Bache both recommended extending the project but Congress only funded minor repairs. Again in 1853 Captain John G. Barnard, a jetty expert, requested $300,000 to double the mass of the project with 9,000 tons of additional stone.[8]

Even half complete, the army's harbor of refuge – 862 yards of breakwater and 467 yards of ice-breaker – was already bigger than any in Britain and second only to the world's largest breakwater harbor in Cherbourg, France. Work resumed in earnest during the Civil War. In the 1890s the windtunnel was sealed so that the breakwater/ice breaker became a single angular dike. Engineers also dredged, added facing stones, added height, and built a state-of-the-art iron pier – finishing construction at last in 1896.[9] Seventy-three years had passed since Bernard had first studied the project. Too shallow for ocean freighters and already obsolete, the breakwater harbor, a $3 million investment, had exceeded the original budget by more than 1,000 percent.

Expensive and monumental, the great breakwater harbor was the Corps' future and past: the future of engineering as a paean to national progress; the past of a profession still rooted in the conceptual world of the builder-savant. The project had begun in the mind of its builders as a theoretical construct, an ideal form. Patterned after the great harbor at Cherbourg and designed with a sloping face to minimize the crash of the surf, the massive structure was built on the assumption that nature was predictable and controllable. "There is no place in an ideal engineering system for unpredictable actions," said Eugene Ferguson, a historian of construction.[10] No matter that the problem of the Delaware ice-flows was unlike any known in Europe. No matter that the mouth of the river was an unstable ecosystem swirling with surf and sand. The concept of an ideal form helped builders see the breakwater as a textbook solution with broad applications, even if the study of waves remained highly theoretical, and if science had not foreseen the shoaling in Delaware Bay.

The unpredictable movement of sand and silt caused equal havoc in the hazardous shallows of the northern Great Lakes. Congress invested about $3 million in more than 30 Great Lakes projects from 1820 to 1860. Peaking during Andrew Jackson's presidency and again under Millard Fillmore, the expenditure rose at a time when Toledo and Cleveland became railheads crowded with schooners; when Michigan was growing faster than any state in the union; when Chicago, although still the frontier, was being sold in a Baltimore paper as "the seat of an immense commerce. . . a market for the commodities of all regions."[11] Lake Erie, surging with trade, won the largest appropriation. Next in the favor of Congress were Lakes Ontario, Michigan, and Champlain. No matter that the lakes, with their treacherous straits, sand bars, and Arctic winds, were often more dangerous than the ocean. Boosters remained absolutely convinced that commerce would boom as the center of population shifted into the heartland, that the bounty of the snowy Midwest – its lumber, fish, coal, grain, and abundant grasses for livestock – were a gold mine of national wealth. Even the climate was healthful. "More labor will be performed in a cool, bracing atmosphere," wrote Jesup W. Scott, a De Bow's correspondent who apparently was unfamiliar with the infamous blizzards called "lake effect." Quoting statistics that showed the Midwest growing at five times the pace of New York, Scott, writing in 1859, called the lake cities "the most convenient place of exchange for dealers from all quarters of the country." The lakes, he continued, "were the nation's true heart."[12]

As the star of empire rose on the northern horizon the focus of Congress shifted to Erie, Pennsylvania, where a fragile finger of sand sheltered the harbor called Presque Isle. Five miles long and reputedly "the best natural harbor on the Great Lakes," the port, nevertheless, was obstructed by a six-foot bar.[13] Since 1825 the Corps had labored to flush the sandy deposits with parallel jetties of timber cribbing. Logs about 30-feet long were flattened on two sides, notched and bolted into a box-like crib, floated into position, and anchored underwater with stones. The technology was straightforward and ancient – as old as the Italian Renaissance and older than Marshall Vauban's attempt to scour out Dunkirk Harbor during the time of Louis XIV. But Erie, unlike Dunkirk, was a modest investment that forced the engineers to rely on unskilled workers and spare every expense. Twice the hammering swells dismantled the timber cribbing and in 1829 a storm severed a beach protecting the bay. Still the jetties seemed to be working. Funnel-like, they captured a helpful current and cut 12 feet of sand off the bar.[14]

Simple, expedient, and consistent with the American woodworking tradition, the jetty project was hailed as the prototype for lakeshore improvements,[15] and it was, except that the Corps had neglected a law of engineering

vital to hydraulic construction, the Law of Unintended Effects. What was beneficial in one place proved disastrous in another. Powerful currents funneling through the jetty were altering a delicate balance. Soon the waves washed in from the West, bringing sand, and the harbor superintendent was horrified to report that a shallow deposit was inching toward city dockyards. "The whole of Presque Isle seems to be threatened," wrote Captain Thomas Brown in an 1835 report to Gratiot, the chief engineer. Brown was convinced the jetties had accelerated beach erosion. "In endeavoring to perfect the entrance to this fine harbor, the whole has been put in jeopardy."[16] Boldly the Corps asked for additional funding, but, a builder conceded, "it would be useless now to estimate the ultimate expense."[17]

Engineers deflected the blame by pointing a finger at nature, but lack of candor only salted the wound. In 1836, the House Ways and Means Committee confronted the chief engineer with a list of 25 projects, all over budget. At Cleveland, for example, the cost of harbor construction had swollen 600 percent as the Corps extended its jetties ever farther into Lake Erie. Piers at Oswego were another frustration. Beginning for $33,000, the project was $93,055 over the original budget before Congress finally balked. Meanwhile the jetties on Lake Ontario at the mouth of the Genesee River had cleared a bar but created another. A dredge boat rusted. A wing dam collapsed. Jetties at the mouth of the Huron River were slanted at the wrong angle, leaving the harbor "quite defective" and "too narrow for safety." Government piers at Dunkirk, New York, allegedly "durable" and "substantial," could not survive the ice.[18]

A defeat for army planning, fiascos like Erie and Dunkirk forced John Quincy Adams and the nationalists to concede that America was not France, that Americans, rural and rootless, had reason to remain suspicious of schooled builders with magnificent plans. On May 31, 1830, the new direction was clear in Andrew Jackson's veto of a Kentucky highway called the Maysville Road. It was the first of 12 Jackson vetoes, eight aimed at the engineers.[19] Already Simon Bernard was back in Paris. Destined for high appointment in the government of Louis-Phillipe, he returned to Washington briefly to settle his affairs and resign. Bernard left the Corps with short-term construction failures that buttressed the agency's long-term success. Builders had outspent budgets. Civilians built schools to challenge West Point. The Corps, however, was still a champion of public construction. Its flair for the massive remained.[20]

Adams, by then, had moved from a short retirement to the House of Representatives where he defended federalism and watched the drama play out. "With me fell," he confessed in 1837, "never to rise again in my day, the system of internal improvement by national energies."[21] However, Adams long outlived the era of fiscal retrenchment. Surviving until 1848, Adams was still in Congress to cheer the revival of waterway planning in the post-Jacksonian age.

(Note: This essay has been adapted in part from research commissioned by the U.S. Army Corps of Engineers Office of History.)

ENDNOTES

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WATER RESOURCES IMPACT

INTEGRATION OF WATER QUALITY MONITORING AND MODELING FOR TMDL DEVELOPMENT

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INTRODUCTION AND BACKGROUND

Many governmental agencies, universities, environmental groups, lawyers, and others have identified issues associated with the policy, implementation, and technical approaches in the Clean Water Act's (CWA) Total Maximum Daily Load (TMDL) Program. A study completed by the National Research Council (NRC, 2001) attempted to integrate and address many of the issues associated specifically with the scientific basis of the TMDL program. Water quality modeling for TMDL development was of particular interest and many related issues were addressed. Two key issues associated with modeling were the need to: (a) address uncertainty in models used in TMDL decision making and (b) coordinate modeling with monitoring and data collection programs. Although these issues were addressed independently, they are interrelated and should be addressed collectively.

Uncertainty in water quality modeling is a common topic of concern among those involved in TMDL development. Interestingly, the issue of designing monitoring programs to assist in model development is rarely mentioned in the uncertainty context and, therefore, is often not considered a possible solution to decreasing this uncertainty. Which comes first, the cart or the horse? If uncertainty is a major concern in model development and the resulting decisions, should those involved focus on minimizing model uncertainty by ensuring the most critical information required by models is available? Or should they just focus on quantifying uncertainty once the model is built and calibrated?

MONITORING FOR MODELING

Four global data types needed in modeling efforts are physical data (morphometry, landuse, soils, etc.), forcing data (meteorology, point loads, and withdrawals), rate data (model parameters – settling rates, kinetic coefficients), and state data (flow, temperature, concentrations of constituents, etc.). Typical state water quality monitoring programs, however, focus data collection efforts on determining the health or impairment of a waterbody. Consequently, state monitoring programs are usually limited to state data (constituent concentrations, etc.). Further, due primarily to budget and time constraints, only a fraction of the waterbodies are routinely monitored.

Given the emphasis of long term monitoring programs on health and impairment, modeling data needs are not easily incorporated. The result of this disconnect between monitoring and modeling is the possibility of: (1) variables being measured in monitoring efforts that will not support modeling efforts and (2) data not being collected properly in time and space for modeling needs. This creates a gap between the understanding of a waterbody impairment and determining solutions to this impairment.

In an attempt to begin connecting these two pieces of the puzzle, the following sections discuss the critical data required by most models and the issues associated with these data not being available. These critical data include weather data, hydraulic/geometric data, and representative water quality data. With the recognition of the consequences of not having the proper data available for modeling efforts, this issue may rise in priority in overall watershed management strategies.

MODEL DATA NEEDS

Weather Data

Weather data needed for modeling efforts include precipitation, evaporation, evapotranspiration, air temperature, air water content, solar radiation, cloud cover, and wind speed. These data are necessary to determine the water balance and energy balance, both of which drive all other water quality processes. Weather data is available in most urban areas and at all major airports, but the intervals at which data are collected vary and may only represent the immediate surrounding areas depending on local orographic effects and weather patterns. Hourly precipitation, for example, is required by many of the popular rainfall/runoff models. This data may be collected at an airport in an urban area, but is most likely not applicable to other watersheds in the area.

... optimization of resources is imperative and the process of identifying impaired waters and eventually cleaning these waters up must be connected ...

The applicability of weather data to surrounding areas, of course, varies depending on the location and geography of the area. An example, typical of mountainous regions, may help put this situation into perspective. Assume the impaired waterbody is located approximately 20 miles from the airport. The impaired stream segment, however, is located in the mountains and originates 2,000 feet above the airport. It is highly unlikely that the airport precipitation data would represent conditions in the impaired drainage. This means that any attempt to apply a rainfall/runoff model to this drainage would be inappropriate and inaccurate given the data constraints.

These types of weather data constraints require modelers to manipulate (interpolate, extrapolate, correlate, etc.), and at times, create data that are the critical

forcing functions of the models. These models are in turn used to make extremely important and sometimes expensive decisions.

Hydraulic and Geometric Information

In general, the hydraulic data required by models is some sort of a depth-to-flow relationship. This may be in the form of a stage discharge relationship or it may be width, channel geometry, and slope information. This information is critical in routing flow and correctly estimating flows and water depths which affect the ability to predict travel times and instream temperatures, respectively.

Similar to weather data, hydraulic and geometric information is rarely collected in smaller, less important drainages. In large, high profile watersheds or rivers cross-sectional studies are conducted and stage discharge relationships are established at flow gages. In smaller, less important drainages or streams, flow-to-depth relationships are rarely established, leaving modelers to improvise by using Manning's equation to estimate flows given estimated flow-to-depth relationships, estimated Manning's roughness, and estimated channel geometries. In some cases, this approach may be acceptable, but, in other cases, may introduce large amounts of uncertainty.

State (Calibration) Data

It is well understood that in order to decrease uncertainty in models, significant time series of data are required for model calibration and validation. Generally, a time series of flow and water quality data are required. Flow data are often required on a daily time step while water quality data can range from diurnal to seasonal time scales. In most instances, a short period of flow data and minimal water quality data may be available. In some cases, neither are available. In the atypical "data rich" environments, there is approximately three to five years where meteorological data, flow data, and water quality data overlap in time and space, allowing for calibration of some sort of rainfall/runoff model. Even in these best case scenario situations, flow data will often be collected on a daily interval while water quality measurements are collected much more infrequently. Generally, water quality data are typically collected bi-weekly or monthly on clear days during business hours. As convenient as this approach may be, this provides data that generally do not capture the high-flow events that accounts for the majority of the load to the system.

Looking at a typical situation in dynamic water quality modeling will assist in understanding this inadequacy of water quality data available for calibration in "data rich" environments. Most rainfall/runoff models are run continuously at an hourly time step for three to five years (depending on data availability). There are usually 50 to 100 data points collected over this period that allows for the water quality calibration. Figure 1 shows a six month period of simulated hourly sediment concentrations with a typical number of observed data overlaid.

It can be seen that very few of the data points seem to represent peak concentrations during storm events. Note that since storm monitoring data were not available, it is difficult to ensure that the dynamics of the sediment concentrations are modeled correctly. Modeling the response of a watershed to storm events is almost impossible without having data that represent this phenomenon at a finer scale of resolution. In addition to data quantity, the temporal span of the data that is available (both flow and water quality) in these "data rich" areas may not be fully representative of all flow regimes (e.g., high or low flow years not captured). The combination of the above calibration data constraints result in calibrated models that cannot be used with confidence.

CONCLUSIONS

In an attempt to meet the Clean Water Act's ultimate goal of cleaning up the nation's waters, optimization of resources is imperative and the process of identifying impaired waters and eventually cleaning these waters up must be connected. One of the first steps is that of integrating monitoring programs and modeling needs. It is understood that budget and time limitations within state monitoring programs need to be considered in proposing this type of integration. Policy and science need to come together to determine how to include modeling needs into monitoring programs without distracting from the water quality monitoring program mission and without increasing the budget substantially. More than likely some increase in monitoring funds will be required, but some of the needs can be met through interagency collaboration and/or reprioritization of data needs. Some options include weather data collected through interagency collaboration and hydraulic and geometric information being collected at current water quality monitoring sites.

Another alternative is to institute adaptive water quality monitoring, which provides for monitoring that can adapt to the needs identified by previous monitoring results. In mentioning adaptive monitoring, it is not implied that long term monitoring efforts should cease. It is imperative that these efforts continue, but an adaptive monitoring plan could possibly be implemented where constituents sampled at each location would be dependent on the past monitoring data. For example, if a particular waterbody has not been identified as having fecal coliform impairment in the past, fecal coliform would not be sampled as frequently until possible impairment is identified. This decrease in sampling and laboratory costs would allow for crucial modeling data such as storm sampling in key areas so that the pollutograph of particular constituents can be captured and used in model calibration and/or load estimates.

It is agreed by all that there is a need for more monitoring data. The question that needs to be asked is should we monitor for the sake of monitoring, or should those involved in the TMDL program determine which data need to be collected for both determining waterbody health and providing for future modeling efforts with the emphasis of minimizing uncertainty where possible? If we can integrate the monitoring programs and modeling

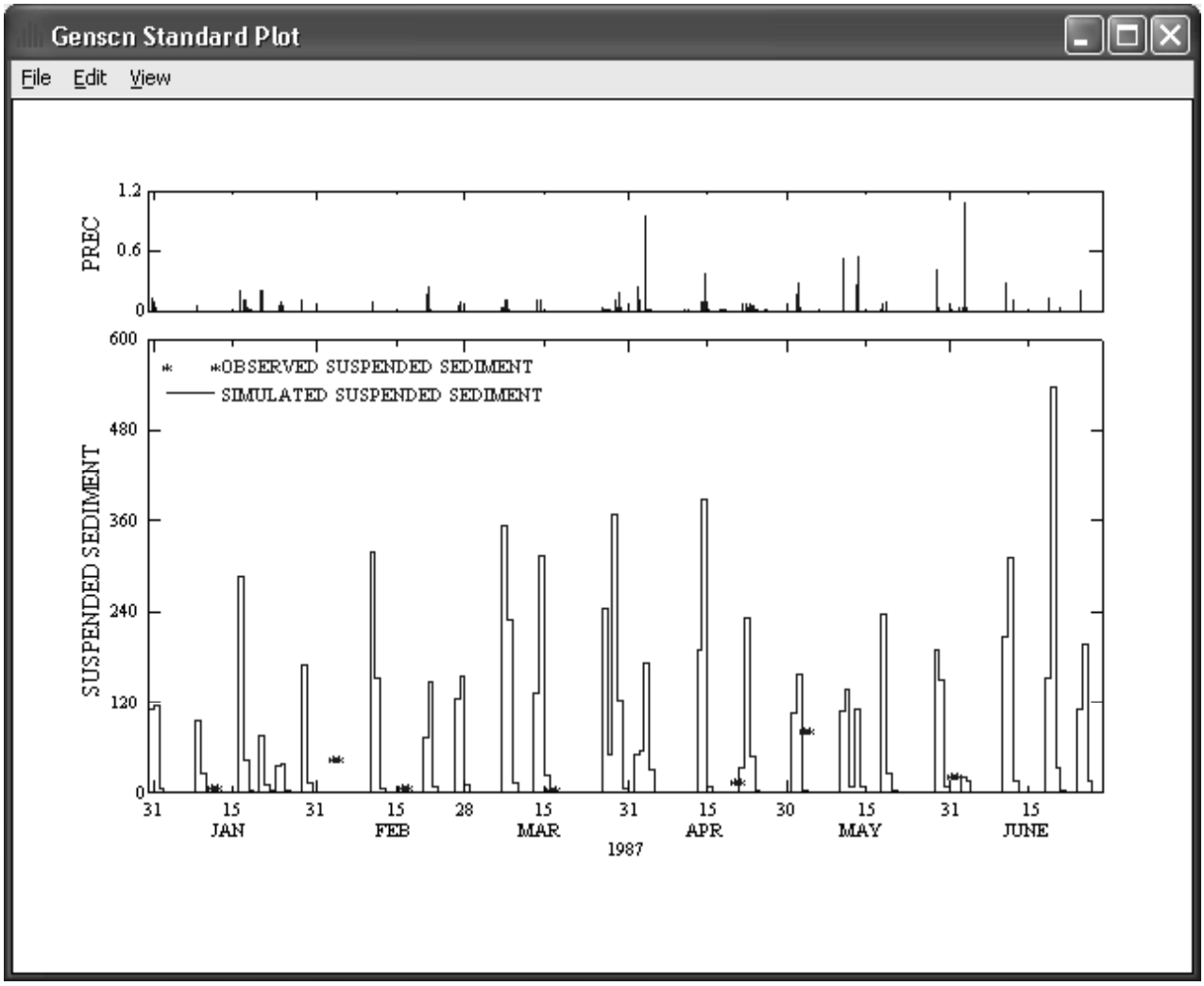

Figure 1. Graph of Simulated Suspended Sediment Concentrations Versus Observed Suspended Sediment Concentrations in the West Branch of the Patuxent River in Maryland.

needs, the end goal of determining how to improve the health of the waterbodies is much more achievable.

REFERENCE

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WATER RESOURCES IMPACT

A FEW LESSONS IN THE SYSTEM

Douglas J. Nelson

I have been a proud resident of upstate New York all of my life; real upstate – within 10 miles of the geographic center of the State, a proud distinction held by the hamlet of Pratts Hollow, New York. I have recently moved away and feel the need to write about some of what I have learned during my 40+ years in central New York. I will have to limit what I write to my current expertise area – onsite wastewater treatment systems (aka septic systems).

I probably need to give a little of my history so that you have some perspective of the opinions expressed herein (what is it a wise man once said . . . "I am the world's greatest expert on my opinion"). I am a teacher by training. I lasted only four years in two different high schools before "graduating" to the two-year technical college level. My expertise area was initially agricultural engineering with a specialty in the mechanical areas. As my career progressed I found that water and wastewater treatment became the center of my life. Initially I was interested in the municipal water and wastewater treatment area, training water and wastewater treatment plant operators. I founded and became director of the Environmental Training Center at my college. As time progressed it became obvious that New York State needed a site for training of professionals in the onsite wastewater treatment field. What better place than a highly respected Environmental Training Center, right? So I enlisted the help of a large group of experienced professionals, and we started the New York State Onsite Wastewater Treatment Training Network. This article is not about the Network, but it is important to understand that most of what I am about to say has been gleaned from countless hours working to build and grow the Network.

ONSITE SYSTEMS – A SIMPLE TECHNOLOGY TO TREAT WASTEWATER CLOSE TO ITS SOURCE

OK, some will say that the technology is getting more complicated every day. After all that is why we need the Network, to increase everyone's technical abilities on the technology. I can assure you today that the technical complexity of any wastewater system never approached the complexity of the political and regulatory quagmire that I have experienced over the past five years since I saw the need for additional training in New York.

The system in New York is very simple, on paper. The New York State Department of Health (DOH) has responsibility for supervising the installation of onsite systems that treat less than 1,000 gallons per day of residential wastewater flow, through the ten-year old regulations contained in 10NYCRR part 75 and appendix 75A. The New York State Department of Environmental Conservation (DEC) has responsibility for installation and operation of systems that treat more than 1,000 gallons/day of residential wastewater or any commercially or industrial generated wastewater. Simple, until you think about the DEC's workload. They have several billion gallons of wastewater per day being produced in just that one most notable city of the state. Such flow rates have to be given priority and lower flow treatment systems are simple, so a memorandum of understanding was developed for the DOH to handle flows under 10,000 gallons per day (the details of this are somewhat complicated, but not important to this article.)

Now, let's review. If a new home is being built in a county with a comprehensive County Health Department, the builder calls the county health department, submits a design, gets it approved, schedules inspections, etc. Fairly simple. But what if that house is being built in a county that does not have a comprehensive health department, or in a county that chooses not to have a county environmental health department, as is the case for about half the counties in the state? Well, then it is the responsibility of the local codes enforcement officer (LCEO) to assure that the new home's on-site system is in compliance with the DOH's regulations. (By the way, that brings in another State department, the Department of State, which has responsibility for the building codes inspectors.) The LCEOs receive guidance from the State's District Health offices, but are generally left on their own, especially with conventional systems.

Still not a difficult system on paper. But who trains the LCEOs? The Department of State (I could ask who has the expertise in on-site systems, but I won't.) How much training? About one-half hour on on-site wastewater systems out of the required 24 hours. It seems that this speaks to the need for training that I have identified. In fact, some of the greatest success I have experienced over the past few years have been in training of LCEOs that did not "have a clue" at the start of their training and today understand what they can do, and more importantly, know their limitations.

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So, now what happens to that homeowner when the on-site system is in failure ten (or five or three) years after it was installed? If the individual lives in the "right" geographic region, he will have a set of locally adopted guidelines that will guide him in his system repair. But in most cases the LCEO has something in his regulatory arsenal to kick the individual out of his home because of a public health hazard, and that is the extent of their guidance. There are areas of the State where the only "fix" available to the property owner is to call the septic pumper every week or so. (Interestingly, if he had called them before the

failure for a pumpout and an inspection he may have avoided precisely this situation.)

This failing system, it is argued, is the perfect opportunity for some of those advanced treatment systems that we all hear about. What a great time to try one of these "new" systems, since there is no statewide guidance and these types of systems are not included in the State regulations. Maybe if they are successful we could get them included in the State's regulations. Sounds like a great plan, except for two problems: (1) there is a single sentence within the State design manual that indicates that repairs and replacements of systems "should" comply with the regulations; and (2) the process to add items to the code requires a change in the regulations, a process which is approaching two years for the most current change, with no end in sight.

So now I need to sit back and look at what I have said – am I a person with 'an ax to grind' or a hidden agenda? I don't think so. I am a person who has been to a lot of national and regional meetings, and I have had the opportunity to see what is happening other places. I have been able to gain an in-depth look at what is happening in New York. Most importantly, I have listened to others as we sat at countless meetings as the New York Nonpoint Source Coordinating Committee (NPSCC)'s Onsite Wastewater Treatment System Workgroup developed what became known as the "White Paper." Such an undertaking by committee is onerous at best, but the finished document attempted to identify the direction that management of the onsite systems in New York State must proceed for the improvement of water quality segments that are impacted by on-site system failures. The group, made up of over 20 interested parties from a variety of backgrounds throughout the State, identified the following issues concerning the management of onsite systems (OWTS) in the State:

1. OWTSs are not being installed properly (while the frequency is thought to be significant, it has not been quantified statewide.)

2. Training in soil profile evaluations for proper OWTS design and installation is difficult to obtain.

3. New system designs may be inadequate or improper. (While the frequency is thought to be significant, it has not been quantified statewide.)

4. The State Education Department requirement that all OWTSs be designed by a design professional is not universally acknowledged or enforced.

5. OWTS responsibility is shared by DOH and DEC (split primacy). As a result, there is no single comprehensive set of regulations governing the design and siting of all (new and replacement) OWTSs.

6. Rehabilitation or replacement of failed systems may be inadequate or improper. (Part 75-A only addresses new construction and does not require any inspection beyond the initial installation and backfilling of the new system.)

7. There is no definition in regulation of what constitutes a failed system. However, all failed systems must be corrected.

8. There are no requirements for OWTS inspections after installation of conventional systems except as required by local legislation or rules.

9. Older systems are not covered by Appendix 75-A or the DEC 1988 Standards, except as dictated by local legislation, and too much "grand fathering" is allowed at the state level. As a result, enforcement of close adherence to 75-A may be inadequate.

10. Self-certification or general permits allowed for the design and installation of OWTS do not guarantee that water quality will not be compromised.

11. There are no maintenance requirements for OWTS unless the system uses an aerobic treatment unit (ATU).

12. There is limited support for centralized management of "decentralized" on-site systems.

13. Cost of repair or replacement can be prohibitive

14. Homeowners are often unaware their system is failing. Also, they tend not to inspect, maintain, operate or upgrade their systems as much as needed, nor in the recommended manner.

15. Updated education and outreach programs are needed at the state level to inform legislators, local officials, regulators and citizens of the consequences of failed, improperly installed or improperly maintained OWTSs, and the potential benefits of centralized management of "decentralized" on-site systems over sewers and wastewater treatment plants.

16. Septage capacity is a problem for septage haulers on Long Island and should be planned in conjunction with increasing use of OWTSs.

17. Waivers and variances allowed under the Public Health Law favor unrestricted development and allow for questionable local design standards.

18. Regulations may not account for cumulative impacts on ground water where new subdivisions are adjacent to older ones. Regulations assume that minimum lot size and separation distance will treat all wastewater produced.

19. Some DEC and DOH designs may be of questionable reliability in terms of protecting ground water.

I offer this list more as an example of the breadth of the problem, not as a comprehensive list of issues. If we were to bring a separate group of individuals together again the list might change slightly, but the breadth of the list would not change much.

I take great pride in always trying to see the other person's view of situations. Several of my closest friends are among those who represent the State Departments which have responsibility for the oversight of the on-site regulations in the State. In fact, I need to commend

James Decker, Ben Pierson, Walt Meyer, James Meachum, Ronald Zimmerman, Gerry Chartier, and Tom Boekelo, all of whom have been in regulatory roles at the Statewide levels in either the DOH or the DEC. (Before getting impressed by the State level employment level in the onsite area, only four of these individuals are working on the topic today.) These folks have served well above their civic duties while being "hog tied" by an outdated system that places very little importance on managing on-site systems within the State.

Let me be very bold and cut to the chase, as only a committee of one can do. The State of New York needs to assess the current status of the on-site industry and formulate a plan to update regulations and management systems within the State for the protection of water quality and the public health. This cannot be done by an agency whose primary responsibility is public health (DOH). A recent tragedy in the State proves the point. The 1999 Washington County Fair had the unfortunate distinction of being the source of waterborne disease that ultimately caused the death of two and the hospitalization of more than 100, with well over 1,000 sickened. The suspected cause of the contamination was traced to an improperly operating on-site system. DOH's reaction was immediate and rather shortsighted. A great deal of effort and resources were put into preventing this type of tragedy from happening again through such activities as: (1) requiring upgrading of disinfection of all water systems at all county fairs, (2) funding additional inspectors for fair type events, and (3) increasing staffing at the District level.

All of these actions were important, but inherent in them is the attitude that 'septic systems are bad.' The real cause of the problem was not addressed. There was no attempt made to review the on-site regulations and determine the holes in the system that allowed the tragedy to happen, only solutions that built walls around the public to protect them, in their own best interest. On-site regulations aimed at protecting water quality (including pathogen contamination) would have most likely prevented the tragedy in Washington County.

LESSONS FOR THE FUTURE

I am one who generally tries to apply lessons learned to help with future situations. As such I would like to leave you with several ideas and concepts that might help improve the on-site wastewater management system in an area. As all of this paper has been, these are my opinions based upon my experience in several different states as well as New York.

1. Regulations governing on-site regulations need to be flexible enough to be adapted to local situations. The degree of risk at specific locations from on-site systems varies tremendously. Advanced/innovative on-site treatment systems are nearly a requirement in some locations and simply a luxury in others. State regulations should help local officials recognize which case they are in and help them set up local guidelines for appropriate use in their area.

2. All siting of on-site systems must be based on high quality site appraisals done by well trained individuals who can assess soil conditions (the receiving environment) well. Just as a community wastewater system is designed based on the river's ecosystem, so too must the on-site system's design be based on the receiving environment.

3. Involve the community. States that have high quality on-site wastewater treatment management programs have involved as many of the players in the process as possible. Successful programs have established guidelines for committees that guide the statewide program.

I talk about the above in terms of statewide programs, but most of us realize that they are simply good consensus building programs that would work at any level and that have worked in many programs for many years.

Postscript: In an amazing act of ironic timing, I am in receipt of a letter written by a DOH official that, eerily, notes many of the points I have made above. In the letter, the author indicates that the proposed advanced treatment system is very appropriate and would improve treatment on the site. It indicates that such a site would be an excellent location to help prove the technology (which is already well proven nationally). It goes on to say that the department will only issue the required specific waiver if the project is not part of a building expansion. If the building is being expanded, a conventional system must be installed. The letter goes on to say that if the building is not being expanded, the DOH does not have to be contacted for approval. Remember, the requirements change from county to county. How is one to know what to do?

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WATER RESOURCES IMPACT

THE COASTAL NONPOINT PROGRAM: EVOLUTION OF AN EFFORT TO ADDRESS POLLUTED RUNOFF

Marcella R. Jansen

In It has been 30 years since the beginning of the national effort to protect and improve water quality. It has been 15 years since those efforts have been directed at the pervasive and difficult issue of polluted runoff.[1] This paper discusses the comprehensive and controversial effort to address polluted runoff through the Coastal Nonpoint Program, also known as Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990. The paper describes the structure of the program, the challenges and impediments to its successful implementation, and the administrative changes made to the program by the Federal agencies to accommodate state concerns and ensure the continuation of the program.

On a national scale, the first effort to directly deal with the control of polluted runoff was the passage of Section 319 of the Clean Water Act. This legislation established the Environmental Protection Agency's (EPA) Nonpoint Source Management Program. This voluntary program provides federal funds to states, territories, and Indian tribes for a variety of nonpoint pollution control activities including training, technical assistance to localities and landowners, pollution control demonstration projects, and water quality monitoring of pollution control techniques.

In 1990,Congress decided a more aggressive and comprehensive approach to nonpoint pollution control was needed. The new approach would first be tried in the Nation's coastal areas, and eventually could be applied to the entire country. The vehicle for this new program was the expansion of the Coastal Zone Management Act (CZMA)[2] to include a new section, "Protecting Coastal Waters." The new legislation required that states and territories with federally-approved coastal management programs develop programs (i.e., coastal nonpoint programs) specifically to address polluted runoff.

The Coastal Nonpoint Program differs from EPA's Nonpoint Source Management Program in two significant ways. First, the legislation prescribes a specific structure to the programs. They are to be patterned on the "technology based" approach that achieved marked success in controlling point sources under the Clean Water Act, and each program must contain specific substantive as well as administrative and procedural elements. Second, the state programs are required to be enforceable under state law.

The Coastal Nonpoint Program is designed to take advantage of already existing resources and experience at both the state and Federal levels by combining the land management expertise developed under the coastal management program with the technical pollution control expertise found in water quality agencies. At the Federal level, administration of the Coastal Nonpoint Program is jointly assigned to the National Oceanic and Atmospheric Administration (NOAA) and the EPA.

The state coastal nonpoint programs are designed as a two-tiered approach to controlling polluted runoff. First, state programs are required to implement specific pollution control techniques for major land-based pollution sources that can affect coastal waters. Once these basic, mandatory control techniques are implemented, water quality is to be monitored and, if water quality standards are still not being met, states must develop and implement additional pollution control measures for both the major sources already identified and/or any additional sources specifically impacting a state's coastal water. This second tier is envisioned as a multi-year iterative process of control – monitoring – new controls until water quality standards are attained and maintained.

EPA, in consultation with other Federal and state experts, was charged with the development of the specific pollution control techniques ("management measures"[3]) to be applied in the first tier of the coastal nonpoint programs. After a mammoth effort, including extensive economic studies, *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* was published in 1993. This document contains 56 management measures to address the major land-based pollution sources affecting coastal waters (i.e., agriculture, forestry, urban sources, marinas, and hydromodification). Management measures were also identified for the protection of wetlands and riparian areas.

... all land uses and individual activities are a potential source of polluted runoff

NOAA and EPA together developed the policy document which further described the legislative requirements for the state coastal nonpoint programs. After numerous meetings with the coastal states and territories and affected interests, *Coastal Nonpoint Pollution Control Program: Development and Approval Guidance* also was published in 1993.

From the beginning, this innovative program presented major challenges to NOAA and EPA, the states and territories, and the affected individuals. For the Federal agencies and the states, the first challenge was the very breadth of the program. The management measures developed by EPA addressed every major land use (exclusive of those already addressed under other Clean Water Act requirements), all aspects of those uses including siting of a facility or activity, and all operational activities that could contribute to polluted runoff. To develop and implement such a broad program required that other Federal and state agencies, local governments, and the corresponding private individuals be involved in the

program development and implementation process. This, in turn, required significant resources that were not readily available. Although it was never envisioned that financial support for states' pollution control efforts would come solely through appropriations under the CZMA, Congressional funding for the states and territories was and continues to be very limited[4], and no additional funding was given to the Federal agencies. From the beginning, limitations on resources and funding slowed the progress of the program and contributed to often strained relationships among Federal and state agencies.

Another challenge presented by the all-encompassing nature of the program, particularly at the state level, was developing productive working relationships with and among the different agencies and programs already involved with the multiple land use activities potentially addressed by the coastal nonpoint program. Where the lead state agencies had previously worked together, the forced wedding of water quality and coastal management agencies went fairly smoothly. In other states, developing a working partnership was difficult and time and resource consuming. In a few states, the coastal nonpoint program was completely subsumed by the water quality agency. In some of these cases, the coastal management agency felt that dealing in depth with polluted runoff and water quality distracted them from more traditional coastal management issues such as coastal hazards and other land use issues. Beyond the two lead agencies, states often faced problems with potentially overlapping jurisdictions between agencies and programs. As is human nature, the issue of turf also raised its head in many state agencies, particularly those long established agencies with close ties to their constituents. The ability to develop effective interagency relationships was critical to developing a successful state coastal nonpoint program. Generally, states with strong coastal management programs were better able to make successful partnerships with water quality and other state agencies.

Of the various procedural and substantive requirements of the legislation, the most challenging is the requirement for state enforceable policies[5] and mechanisms to ensure that the management measures are implemented and the pollution problems successfully addressed. The character of this challenge varied among the land uses subject to the program. For example, most states already had in place many of the management measures to control polluted runoff from agricultural operations. Over the years, the U.S. Department of Agriculture's Natural Resources Conservation Service (formerly the Soil Conservation Service) had developed guidance for farmers on practices to protect against soil erosion, minimize water usage, and efficiently manage their land. Many of these practices were identical to the management measures and practices used to prevent pollution from washing off the farm. However, USDA conservation practices are voluntary, and the concept of state enforcement of practices raised much opposition.

At the other end of the spectrum, state management of marina siting and operations was much more common in that some form of state permit is required for marina siting in all coastal states, and specific criteria for at least some operational aspects are also addressed by coastal states. State management of the other major land uses was variable – both by source and by state. Some states, particularly on the west coast, had comprehensive and enforceable state forestry management programs. Elsewhere, coastal states often had minimal programs for the forestry industry. Most urban uses were addressed to some extent in each state, although in many states, criteria for urban siting and development were at the local level only. Under hydromodification, state focus on dams was usually limited to dam safety. Channelization and other hydrological changes generally had few controls.

Congressional and initial Federal agency time limits for program development and implementation also presented a major challenge to the states and territories. The legislation required that states and territories submit their coastal nonpoint programs to NOAA and EPA for approval within 30 months of the publication of the management measure guidance (i.e., by July 1995). The Federal agencies then had six months to review the state programs. The legislation stated that failure of states to submit an approvable program would result in the loss of funding for both the state coastal management program (under NOAA) and the state nonpoint source management program (under EPA).

From the beginning, NOAA and EPA recognized the severe time limitations. In the 1993 *Program Development and Approval Guidance*, the agencies included a process for giving states early feedback on the development of their programs to enhance their ability to gain full program approval, and provided for a "conditional" approval where states were unable to meet all of the program requirements. The latter was intended to provide states with more time to meet the program requirements without the need to impose financial penalties. The 1993 Guidance required that the first tier management measures be fully implemented within three years of state program approval. The states would then have two years to monitor the effect of management measure implementation on water quality. Thereafter states would have three years to develop and implement the state-specific additional management measures. Early on all parties recognized that this time frame was unrealistic.

The diffuse nature of polluted runoff often makes it difficult to make a direct connection between the generator of a particular pollutant and impacts to water quality. All land uses and individual activities are a potential source of polluted runoff, and in most circumstances, the contributors to a particular water quality problem are many and varied. Congress addressed this difficulty in the legislation by prescribing that all major land users that could contribute to the pollution of coastal waters implement preventive controls that, in sum, would significantly reduce pollution. This approach had been successful in reducing pollution from so-called "point sources," and it was felt that the same approach should work with "nonpoint sources" as well. Nevertheless, the philosophical and practical dispute over applying controls on land use activities (management measures) to all sources versus applying controls only to those sources

that were proven to have an impact on coastal waters was a constant debate during the development of the program. The argument against the preventive approach was and is based both on the perceived economic cost of implementing the measures and the reluctance of businesses and individuals to change behavior until they could be specifically shown to be not only a source of pollution, but one that was significant enough to cause a violation of water quality standards.

A related issue that also presented a challenge to the program was the issue of voluntary versus enforced compliance. The comprehensive review of state authorities to address activities with the potential to generate polluted runoff was very enlightening, particularly to the states themselves. All states identified significant gaps in their ability to deal with polluted runoff, and recognized the political difficulty of developing new authorities to meet program requirements. States and affected interests argued that voluntary programs could be as effective as laws in addressing polluted runoff. In the southeast, states like South Carolina led the way in developing and implementing a voluntary inspection program for forestry operations. They developed a system of "courtesy inspections" and resulting recommendations for operational improvements that seemed to be well received by forestry operators. States and private landowners and operators argued that, particularly in view of the lack of financial support, voluntary and incentive programs should be accepted as meeting the requirements of the law. The Federal agencies strongly resisted this approach, believing that not only would it not comply with the legislation, but that voluntary and incentive programs alone were unlikely to result in the necessary pollution control.

The political, legal, technical, and financial demands of the Coastal Nonpoint Program were a real problem for the coastal states. Many felt that they had voluntarily developed their coastal management program that met Federal standards and now were being required, and could be penalized, if they did not comply with this new mandatory program. One or two states even threatened to leave the coastal management program rather than submit to the new requirements. There were many state-led efforts to weaken or repeal the statute. Nevertheless, all the coastal states and territories submitted coastal nonpoint programs to NOAA and EPA for approval by October 1995. The quality of state program submissions varied widely. Some contained very detailed analysis of existing state authorities and programs, with recommendations for changes to meet the Federal requirements. Others were brief reiterations of the management measures and program guidance requirements with vague discussion of what the state might do in the future. The quality of the submissions generally reflected the interest, ability, and commitment of the states to comply with the Coastal Nonpoint Program. But even as the first programs were submitted, it became clear that none of the states would be able to meet the standards and receive full approval of their first program submissions.

In March 1995, NOAA and EPA responded to the realities of the issues and concerns discussed above by issuing additional guidance[6] for the state programs. The guidance, *Flexibility for State Coastal Nonpoint Programs*, expanded the scope of the conditional approval process, and extended the time frame to complete development (five years after conditional approval) and implementation (an additional six years) of the state programs. More importantly, the guidance expanded the range of enforceable policies and mechanisms that states could use to implement their programs. Rather than requiring that states have a specific authority to ensure implementation of the management measures, NOAA and EPA recognized the use of existing general ("back-up") authorities (e.g. "bad actor" laws, enforceable water quality standards, and general environmental laws and prohibitions, combined with voluntary programs as an approach to meet the program approval requirements). This approach required that states also develop a strategy that would describe how the "back-up" authorities would be used in combination with a voluntary or incentive based program to achieve management measure implementation. The strategy also had to contain measureable goals to determine success of the state's approach. States electing to try this approach would be given conditional approval for three years. If at the end of that period, the goals had not been achieved, the state would need to develop specific authorities.

All the then participating states received conditional approval by June 1998. However, the new flexibility proved insufficient to address the concerns of states and affected interests who felt that the requirements of the program were still too burdensome. In October 1998, NOAA and EPA published *Final Administrative Changes to Coastal Nonpoint Pollution Control Program Guidance*. The most significant change to the program embodied in this Guidance was the expanded approach to the enforceable policy requirements. The 1995 Flexibility Guidance had required states to prove that a voluntary or incentive based approach could work before they would receive full approval of their programs. The 1998 Final Guidance provided that states could receive full approval of program elements with a voluntary approach by providing NOAA and EPA with more information on the details of the approach, and a 15-year strategy describing how the program would be implemented. The information required was: (1) a legal opinion that the "back-up" authority could be used to prevent nonpoint pollution and require management measures implementation, as necessary; (2) a description of the voluntary programs, including methods for tracking and evaluating those programs; and (3) a description of how the agency implementing the "back-up" authority and the agency implementing the voluntary program would work together to ensure that the pollution controls were implemented. The result was an ability to give up front approval to voluntary and incentive based program elements without states having to *prove* that such an approach would work sufficiently to ensure the widespread implementation of the management measures envisioned by the statute.

Ten states and territories have received full approval of their coastal nonpoint programs. All but two have used the expanded approach to enforceable policies to meet at

least some of the program requirements. Most commonly, this approach is used for agriculture and some of the urban development management measures, although it has been used for all source categories.

While most states have and will continue to rely on this "easier" approach to the state enforcement requirement, their efforts to respond to the mandates of the coastal nonpoint program have resulted in significant improvements in their ability to deal with the sources of polluted runoff. Through revisions to regulations and manuals, states are incorporating the comprehensive pollution control procedures embodied in EPA's *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* into the daily operations of local governments, developers, farmers and foresters. Many states have improved the ways in which on-site sewage disposal systems, a major source of water pollution in most coastal states, are designed and maintained. They have also developed improved methods to review existing development to identify opportunities to reduce polluted runoff. Only time will tell if the changes to the original strict program structure will still allow the water quality improvements envisioned in the statute. However, it is clear that the structure and concepts embodied in the coastal nonpoint program have resulted in a major leap forward in dealing with polluted runoff.

ENDNOTES

[1]Polluted runoff or nonpoint source pollution is the pollution caused by rainfall or snowmelt moving over and through the ground, picking up both natural and man-made pollutants and depositing them into coastal, inland, and ground waters.

[2]The CZMA, passed in 1972 and administered by the National Oceanic and Atmospheric Administration (NOAA), is a voluntary national program to encourage state and territorial governments to improve their efforts to manage their coastal zones. The Coastal Management Program (CMP) is a Federal/state partnership wherein the Federal government establishes broad guidelines for effective management of coastal areas, and the states and territories then develop specific coastal management programs within those guidelines to meet the national criteria. The incentives for state participation in the CMP are Federal funding and authority (Federal consistency) to significantly influence Federal activities that may affect a state's coastal zone. Of the 35 states and territories eligible to participate in the CMP, 34 have federally approved management programs. The approved programs cover 99.9 percent of the United States coastline.

[3]Management measures are defined in the statute as economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives.

[4]From FY92 until the authorization expired in FY95, a total of $12.9 million was appropriated for program development. In some years, smaller states and territories received as little as $45,000, while the largest states received less than $100,000. No funds were appropriated in FY96 or FY97. Between FY98 and FY02, $35.5 million was appropriated. A substantial portion of this was for program implementation. All participating states and territories received some of these funds. Those with fully approved coastal nonpoint programs received a bonus amount, which in FY02 was $150,000.

[5]Enforceable policies are defined in section 304(6a) of the Coastal Zone Management Act as State policies which are legally binding through constitutional provisions, laws, regulations, land use plans, ordinances, or judicial or administrative decisions, by which a State exerts control over private and public land and water uses and natural resources in the coastal zone.

[6]In addition to the changes discussed here, the flexibility guidance addressed the geographic area wherein the states would implement their coastal nonpoint programs and described circumstances under which states could exclude nonpoint sources from their programs. These issues are not addressed in this paper.

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U.S. GEOLOGICAL SURVEY HAS A NEW WaterWatch WEBSITE

The USGS has a new WaterWatch website that gives visitors an instantaneous picture of water conditions nationwide in near real time. The site provides information on the entire Nation's streamflow conditions using maps with color-coded dots that show streamflow conditions at about 3,000 stream gages.

Find The Site At

http://water.usgs.gov/waterwatch/

WATER RESOURCES IMPACT

WATER QUALITY STRATEGIES: THE LAND USE REGULATION OPTION

Bernard E. Schmelz

The pursuit of water quality is a continuing aim which affects our daily ability to function. Like Wile E. Coyote and the roadrunner, we just can't seem to reach our primary objective because of our inability to think through to the basics of the problem.

For many states the water quality struggle begins with unbridled and unchecked development. The raw development of property by its very nature results in significant releases of sediment into our waterways. It has been estimated that in the United States nearly 600 million tons of sediment is deposited into our waterways annually. Though there are many sources, a primary source is from construction activities. Other sources of water quality degradation that are closely tied to development include the high and unpredictable use of pesticides and fertilizers used for our lawns, neighborhood parks, and golf courses. As creatures of suburbia, we are awash in "lawn envy" and no longer covet our neighbor's wife, but rather his lawn.

Since the late 1980s, communities across the nation have had to come to grips with a series of requirements imposed by the EPA concerning drinking water standards. The Safe Drinking Water Act (SDWA) interposed a series of standards which communities utilizing surface waters for public water supplies had to meet over a period of years. The Act established strict limits on a number of compounds that were (are) proven or thought to be carcinogenic or otherwise a threat to human life in one manner or another. EPA's directed concern has been and continues to be nonpoint sources of stormwater runoff as a vehicle that ultimately carries sediment, pollutants, and other compounds to the nation's water supplies with harmful consequences.

The initial reaction to the SDWA standards was from and by the purveyors of potable water and the operators of treatment works utilizing surface water for their source of supply. They would be the "first line of defense" as well as the initial point of culpability if their localities' potable water were to fail in meeting the requirements. Though standards were to be phased in over time, there was a perception that if nothing were initially done, the EPA and state regulators would, at a minimum, determine purveyors and owners to be "noncompliant."

The "first line" of defense that was taken by many operators and purveyors was to increase the level of treatment that their water works would achieve, focusing on the primary list of regulated compounds. In the short term this was thought to be a useful strategy, although it failed to address the source of most of those compounds – urban runoff.

As many of us already know, urban runoff is the single largest vehicle by which many pollutants are transported to our nations' water supplies. Nonpoint urban runoff from our homes, businesses, roadways, and construction sites contributes millions of tons of silt, soil, chemicals, and hydrocarbons from a variety of sources to water supplies. How to control all of this is the ultimate question.

Some communities have been proactive in assessing potential impairments to their surface water supplies, and have developed models for protecting their supplies. Evidence points out that where surface water supplies are located in generally undeveloped watersheds, typical loading is low and usually well below thresholds which indicate potential impairment. Where a supply is located within an urbanizing watershed the levels of contaminants increase to levels which qualify the source as impaired.

On a national basis, nonpoint pollution monitoring studies have shown that annual "per acre" discharges of urban stormwater pollution (nutrients, metals, BOD, fecal coliform) are directly related to the amount of imperviousness of land uses. In 1982, Beaulac and Reckhow concluded that nutrient loading rates generally increase with increasing percentages of impervious surface (Beaulac and Reckhow, 1982). In 1986, Driver and Lindstrom found that impervious surface area was one of the most significant variables in predicting storm event loading of nutrients (Driver and Lindstrom, 1986). Their study was based upon a review of data collected from 98 urban test watersheds in 21 metropolitan areas monitored by USGS and 75 urban test watersheds in 15 urban areas monitored by USEPA under the Nationwide Urban Runoff Program (NURP). A review of these studies and the NURP findings have led researchers to conclude that imperviousness is the principal determinant of runoff volume. Thus, annual nonpoint pollution loadings based upon the pooled NURP data positively relate to the percent of imperviousness.

... today we spend millions of dollars annually to treat water that comes from our reservoirs so that we can in fact drink it

Though the analyses presented in the previously cited studies is interesting, its value is more amorphous because it is difficult for the general public and public policy makers to directly link the data to urban runoff pollution. Of greater value is the correlation of density as it relates to development. As people living in urban or urbanizing settings we can relate to density. We can picture traditional development patterns in our mind and once told what a particular density is, we retain that mental image. So do our elected officials.

In 1989 Camp Dresser and McKee Engineers conducted a watershed management study for the Swift Creek Reservoir, located in Chesterfield County, Virginia. Among the various analyses that were conducted is an analysis for differing sources of annual streamflows from a 1,000 acre area with a single land use. This analysis is of interest because it sets out to analyze the potential impact of urbanization upon a 65 square mile watershed that at the time of the study exhibited approximately 15 percent development, the majority of which is located within a single jurisdiction that theoretically can control land uses and urbanization within the watershed.

The results of the analyses are summarized in Table 1. Among the conclusions made by the authors is that "Because of the greater contributions of pavement runoff and runoff from nonnatural sources, land uses with higher imperviousness pose a greater water quality risk (Camp Dresser and McKee, 1989)."

The "greater water quality risk" results from the transportation of nutrients and heavy metals that are a by-product of urbanization, including phosphorous, nitrogen, lead, and zinc. Phosphorous loading increases from 0.4 lb/acre/year to 1.1 lb/acre/year for residential development when density increases from 0.5 units per acre to four units per acre. Nitrogen load increases from 4.1 lb/acre/year to 8.8 lb/acre/year. Heavy metals also increase proportionally.

The evidence is empirical and validated. It comes from many respected sources, including the EPA's own studies. So why is there a continuing debate over how to manage urban runoff and its impact? Unfortunately, the answer may lie in the laps of our decision makers – is there the political will to say that development (if it is to come, and many consider it inevitable) should not exceed certain density standards in particular areas. Some localities choose to do nothing, others have chosen to establish "growth boundaries." Though this movement has been brought about by a rising concern over urban sprawl that rarely includes water quality in its mantra, it is laudable nonetheless because an ultimate benefactor may in fact be water quality.

Some communities have chosen to implement a combination of factors, though there is little evidence that, absent the direct purchase and control of watershed lands such as the Quabbin Reservoir lands in western Massachusetts and much of the lands in New York City's Catskills Watershed, any community has been willing to implement strict land use regulation in water supply watersheds for fear of being sued for "taking" or alienating a special interest or political benefactor. From a general review of recent actions taken by localities that are related to water quality activities, it appears that most choose to "dance" around the issue. Many local plans speak to regulating construction where one factor or another may be a limiting factor. Few dare to state that development shall be limited to a particular density that may result in an "impact neutral" scenario.

In the Virginia case, the very clear opportunity to link development strategies to limits on impervious surface areas was essentially missed. The study concluded that in order to maintain water quality levels so as not to compromise the SWDA standards, development within the watershed should be limited to a density not to exceed 0.5 units per acre. Faced with that level of recommendation the county's planners proceeded to prepare an amendment to the county's land use plan to address the recommendations, including reducing densities to 0.5 units per acre and also establishing a growth boundary that reflected the planned extent of the county's water and sewer system. Outside of the growth boundary, densities were to be further reduced to one unit for each five acres (0.2 units per acre). The recommendations were, to say the least, not well received. In a county that prided itself at having an annual growth rate exceeding 8 percent, any suggestion at curtailing development was answered with cries of economic doom and potential court challenges. The county ultimately adopted a policy of "watchful waiting" and allowed development to continue, though there would be greater attention paid to minimizing potential erosion and sediment contribution to the area's streams and waterways. Now, a decade later, as development pressure has continued within the Swift Creek

TABLE 1. Sources of Annual Streamflows From 1,000-Acre Area With Single Land Use.

	Streamflow (million gallons)				
	Pavement Runoff	**Lawn Runoff**	**Forest/Grass Runoff**	**Subsurface Flow**	**Total Flow**
Forest (.5% impervious)	6	–	144	217	367
Two-Acre Lot SF Res (6% impervious)	68	135	_	205	408
One-Acre Lot SF Res (12% impervious)	137	127	–	192	456
0.25-Acre Lot SF Res (25% impervious)	285	108	–	163	556
Shopping Center	1,025	8	–	25	1,058

Note: Flows are based on average annual rainfall conditions and "C" soils (from Camp Dresser and McKee, 1989).

Basin and the State begins to fully implement the Chesapeake Bay regulations, the county has responded by adopting several landmark measures, including establishing a total phosphorous concentration not to exceed 0.05 mg/l in the reservoir, maximum annual load of phosphorous not to exceed 25,000 lbs and is moving forward with the construction of 59 regional BMP facilities within the basin. The question of density still remains unanswered. So, in essence, the failure clearly to focus on protection of water quality has meant that the development that has occurred in this watershed in the past decade has, at a minimum, a price tag of over one quarter of a billion dollars, which was not included in the calculation of the benefits of development.

In general, land use management often fails by missing several opportunities. Often, of course, there is inadequate knowledge, and officials cannot be blamed for not having crystal balls. However, the Virginia case is an example of a common problem – even though an issue is understood, the implications of taking particular actions are ignored or underevaluated. In the absence of a clear policy linking development restrictions to important public policy goals, the restrictions are readily challenged. For preventive programs this is especially important, in that we can expect a succession of attempts to circumvent restrictions if there is a short term economic advantage in doing so. With no clear justification for the restriction, it is easy for development proponents to assert their adversaries are simply "always against progress," painting them as extremists when in fact they are simply attempting to maintain a consistent policy.

Water quality, or the lack thereof, impacts all of us. It has been said that man can live without food for approximately 30 days, but can survive for only five or six days without water. Today we spend millions of dollars annually to treat water that comes from our reservoirs so that we can in fact drink it. And we spend millions yet again to purchase bottled water that purports to be pure and free from the by-products of treatment. In addition many communities that cannot or are afraid to say NO to development are committing additional hundreds of millions of dollars to build "regional" structural BMPs in order to allow development to proceed while purporting to protect a locality's water supply.

The unfortunate truth is that the concept of regional structural BMPs has not been proven to be effective. Local governments may in fact adopt policies that support limits on nutrient loading, and as some have done, place actual limits on total nutrient loading, but what would be truly effective is directly linking programs to such clearly defined baselines as proportion of impervious area. Absent a direct addressing of land use and density the question remains unanswered. It takes a modicum of will and intestinal fortitude to say NO! to development pressures which will sacrifice long term diffuse benefits for short term political and apparently economic ones. If one must say yes, the decision should be made on a fully educated basis, and both process and result should be clearly disclosed. Such requirements would help assure that development decisions would benefit all and not just a chosen few.

We'll never know the worth of water 'till the well go dry" . . . 18th Century Scottish proverb (1721).

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Solution to Puzzle on pg. 25

WATER RESOURCES IMPACT

THE 2002 FARM BILL AS A WATER RESOURCES MANAGEMENT FAILURE

Christopher L. Lant

A MISSED OPPORTUNITY

On May 13, 2002, President Bush signed the Farm Security and Rural Investment Act of 2002. This Act will serve as the primary U.S. agricultural legislation through 2008. That's too bad. While the Farm Bill contains several features that deserve applause, the overall structure and strategy of the Bill is still based on the New Deal. You remember, from history class, that was FDR's response to the Great Depression in the 1930s. Price supports, sugar subsidies, peanut quotas, even "mohair" payments can be found in this legislation in good old-fashioned log-rolling and pork-barreling style. What was missed in 2002 was an opportunity to start a new century with a break from an unsuccessful past. Instead we got a return to the past, with some "tweaking" on the margin. For this reason, I think the 2002 Farm Bill deserves a place in this issue of *Water Resources IMPACT* focusing on failures.

THE CONDITIONS A FARM BILL NEEDS TO ADDRESS

Since the Great Depression farmers have been going out of business even as the agricultural sector of the economy has continued to grow. "Farming" is now a very small part of a corporately dominated agricultural commodity chain that starts with agricultural input industries (machinery, agrichemicals, genetically engineered seeds, etc.) that farmers purchase as costs of producing crops and livestock and ends with supermarket and restaurant chains (Heffernan, 2000). On most Midwestern farms only a generation ago, the primary products were wheat, vegetables, and especially dairy products and meat that were produced by growing alfalfa, corn, soybeans and other crops. Much of this production was fed to dozens or a few hundred livestock; the livestock was sold on the hoof and the manure produced was returned to the fields. Today, livestock are rare on farms and are instead concentrated in corporate-owned confined animal feedlot operations (CAFOs), many of which are geographically removed from crop-growing areas, while "farmers" specialize only in grain and oilseed production facilitated by chemical fertilizers. Most of the economic output of agriculture lies "downstream" of the farm – in a production system sense – in the food processing, transportation, wholesaling, retailing, and restaurant sectors. Farmers occupy a narrowing niche, and maintain any niche at all only because farming requires large inputs of land and has therefore taken longer to be absorbed by large vertically integrated corporate giants (Heffernan, 2000).

From a water resources management perspective, U.S. agriculture is a huge player and represents an enormous challenge. Agriculture accounts for 87 percent of all water consumption in the U.S. today. It has been calculated that the production of a pound of potatoes requires over 200 gallons of water, and a pound of beef requires over 50,000 gallons (Pimentel *et al.,* 1997). Agriculture is the cause for 59 percent of all impaired stream miles, mainly in the form of siltation, nutrient enrichment, and contamination with bacterial pathogens (www.epa.gov/305b/98report/chap3.pdf). The endangered species crises faced in the summer of 2002 in the Klamath and Rio Grande Rivers are directly related to stream dewatering for irrigation. The Gulf hypoxia issue is directly related to chemical fertilizer runoff from the agricultural Midwest. *Pfisteria* in the Chesapeake Bay is directly related to applications of chicken manure on Delmarva peninsula farms. These newsworthy stories are but the tip of the iceberg of the "downstream" effects of agriculture – this time in the hydrological sense. Thousands of silted in or dewatered streams and eutrophic lakes don't make the news.

How does the 2002 Farm Bill address these issues? The answer is "marginally" rather than "directly."

... as a clearly protectionist bill, it has undermined U.S. efforts to promote free trade abroad ...

WHY THE 2002 FARM BILL FAILS

The 2002 Farm Bill fails because its goals are cheap food and keeping routine crop growing farmers in business and its means are a return to depression era price supports. These goals were laudatory when FDR was President – they no longer are. Using a projected $100 billion or more in taxpayer funds over the six-year life of the bill to augment the price a minority of farmers receive for corn, wheat, rice, cotton, milk, peanuts, and other traditional crops (http://www.fsa.usda.gov/pas/farmbill) is the difference between losing money and making a profit for those farmers today, but it locks them into increasing inputs of water and agrichemicals to continue growing a surplus of the same crops their grandfathers grew. This surplus mainly serves to increase sales of farm inputs and decrease prices feedlot owners and food processors have to pay for their raw materials. It also does little to decrease the price of the food 285 million Americans buy, because prices at the farm represent only a small percentage of the money American households spend on food. Most of the food dollar even the poor

pay is in food processing, transportation, marketing, packaging, restaurants, and so on. Moreover, by artificially decreasing the price that restaurants and food processing and packaging firms pay for meat and other basic foodstuffs, subsidies encourage the tendency of Americans too overconsume these products, with the result that one-third of Americans are overweight, and another third are clinically obese – a problem that costs the U.S. health care industry billions of dollars per year. We have food stamps anyway to make sure every American can afford their nutritional requirements. The Market Transition Payments passed in the 1996 Farm Bill were a little less problematic than price supports to which the 2002 Farm Bill returns because they "decoupled" farm subsidies from the forced overproduction of a few specific bulk commodity program crops.

The 2002 Farm Bill has not won applause overseas either in a time when the U.S. needs all the political capital it can get. In fact, as a clearly protectionist bill, it has undermined U.S. efforts to promote free trade abroad and has been criticized for locking farmers in developing countries out of U.S. markets.

The Conservation Title of the Bill, in contrast, has its bright spots. Under the umbrella of the Comprehensive Conservation Enhancement Program, it maintains a 39.2 million acre Conservation Reserve Program (CRP) and makes water quality and wildlife enhancement co-equal with erosion control in considering enrollments. It expands the Wetlands Reserve Program (WRP) acreage cap to 2.275 millions and initiates other site specific programs. Most importantly, it provides $4.6 billion in additional funding for the Environmental Quality Incentives Program (EQIP). The greatly expanded EQIP adds surface and ground water conservation to the purposes of the program. It provides $600 million for water conservation – $50 million of which is targeted for the Klamath Basin – and provides incentive payments for comprehensive nutrient management plans. From a water resources perspective, these are the best provisions the 2002 Farm Bill has to offer. The new EQIP targets 60 percent of funding to livestock water quality concerns and removes prohibition against cost sharing for waste storage facilities for large CAFOs. U.S. livestock generate 1.8 billion tons of waste annually, several times what humans produce, and CAFOs represent a water quality problem on the scale of urban sewage systems that needs to be addressed. But isn't it corporate welfare to spend billions in taxpayer funds to solve environmental problems caused by giant corporate feedlots? The $450,000 limit per producer represents Uncle Sam at his most generous.

A DIFFERENT APPROACH TO FARM LEGISLATION

Rather than dealing with water resources and other conservation issues such as irrigation efficiency and feedlot runoff as a funded line-item that comes after the major economic approach is set, I would argue that farm legislation needs to be, and should have been, re-thought from the start. We have an ongoing crisis of overproduction of standard crops in U.S. agriculture. The occasional moments of profitable prices delivered directly by the market are becoming so rare that they may simply not happen again in the careers of present-day farmers. Seventy years of price supports have not ameliorated this crisis – on the contrary they have locked it in. Farmers don't need subsidies to continue growing depression-era crops. They need another crop – and that crop could be the environment.

Agricultural landscapes, which constitute about 50 percent of the land in the contiguous U.S., harbor natural capital and therefore produce ecosystem services, such as nutrient cycling, regulation of atmospheric gases, soil formation and binding, sediment trapping, riparian corridors, and expansion of wildlife habitat. Thus the potential to increase the production of ecosystem services in the U.S. lies greatly in private agricultural lands, especially grazing lands and croplands that are marginal due to wetness, dryness, steepness, or erodibility. For example, the vast majority of sites suitable for wetland restoration are now farmland (McCorvie and Lant, 1993). Lal *et al.* (1998) estimate that agricultural lands currently emit 7 percent of the U.S. total for greenhouse gases, but could sequester a net 5 to 14 percent with reasonable changes in farming practices that restore soil organic carbon. Land based carbon sequestration is allowable without a cap under the specifications agreed to in Bonn in 2001 on implementation of the 1997 Kyoto Protocol (http://www.pewclimate.org/bonn/daily.cfm).

Replacing crop based subsidies with ecosystem service based subsidies over time has a number of points in its favor. First, the reduction in output of currently subsidized crops that may occur with a reallocation of farmland from these crops to other crops and ecosystem service production would reduce surpluses and potentially raise prices that farmers receive from the market. In this way the need for price supports would be reduced by ecosystem service payments. Second, ecosystem service payments are legitimate under the Uruguay Round of GATT/WTO negotiations, whereas direct crop subsidies are viewed as protectionist. Third, taxpayers could be obtaining greater public benefits from the subsidies paid to farmers if those subsidies were tied to the production of public benefits in the form of ecosystem services such as carbon sequestration and water quality improvement rather than as private benefits to farm inputs and food processing industries that have no particular claim to corporate welfare. It would focus public support of agriculture on precisely that factor that distinguishes agriculture from other industries – it commands half of our land and consumes or pollutes a similar fraction of our water.

Perhaps in the 2008 Farm Bill, price supports will be slowly phased out in favor of an expanded WRP where all bids received from farmers that are below a reasonable level (e.g., $1000/acre) will be accepted. These wetlands would help meet Total Maximum Daily Load (TMDL) requirements by acting as agricultural wastewater treatment plants. Think about what carbon sequestration credits could accomplish that price supports don't. Each of us, in our role as automobile drivers and/or coal generated electricity consumers, would be paying farmers to take the carbon dioxide we are putting into the

atmosphere and, through photosynthesis occurring on their farms, fix that carbon as soil organic matter, wetlands, and wooded riparian zones and fence rows. These changes would increase wildlife habitat and flood water retention on working lands on farms while decreasing sediment and nutrient inputs to streams. Manure from CAFOs would have a substantial economic value for its contribution to carbon sequestration and would thereby become more economical than chemical fertilizers for many farmers, thus transforming animal waste back into a resource and diminishing overall nutrient flux. Rising energy prices could make manure even more economical compared to chemical fertilizers. Combined with the effect of needed air quality controls on feedlot odor, livestock producers would downsize and relocate toward the farms where their feed crops are grown to take advantage of the local carbon driven manure market. The U.S. would be meeting the terms of the Kyoto Protocol by sequestering carbon on farms and the GATT/WTO guidelines by minimizing direct crop subsidies, gaining much-needed political capital among the nations of the world. TMDLs would be partially met by the reduction in sediment and nutrient runoff from farms. Flooding would be marginally reduced by the improved water holding capacity of wetlands and organic soils and by placing flood-prone croplands into riparian corridors. Farmers, including organic farmers, would be making money again by growing less 19th Century bulk crops and more of what a food surplus 21st Century society really needs from the land – ecosystem services. That would be the rethinking of farm legislation that the 2002 Farm Bill failed to accomplish.

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Christopher L. Lant is Professor and Chair of the Geography Department at Southern Illinois University Carbondale. He is also Executive Director of the Universities' Council on Water Resources and co-Director of the Environmental Resources and Policy Ph.D. program at SIUC. From 1994 to 2001 he served as Editor of the *Journal of the American Water Resources Association*. He has published numerous articles analyzing policies to control polluted runoff, restore wetlands, and manage watersheds.

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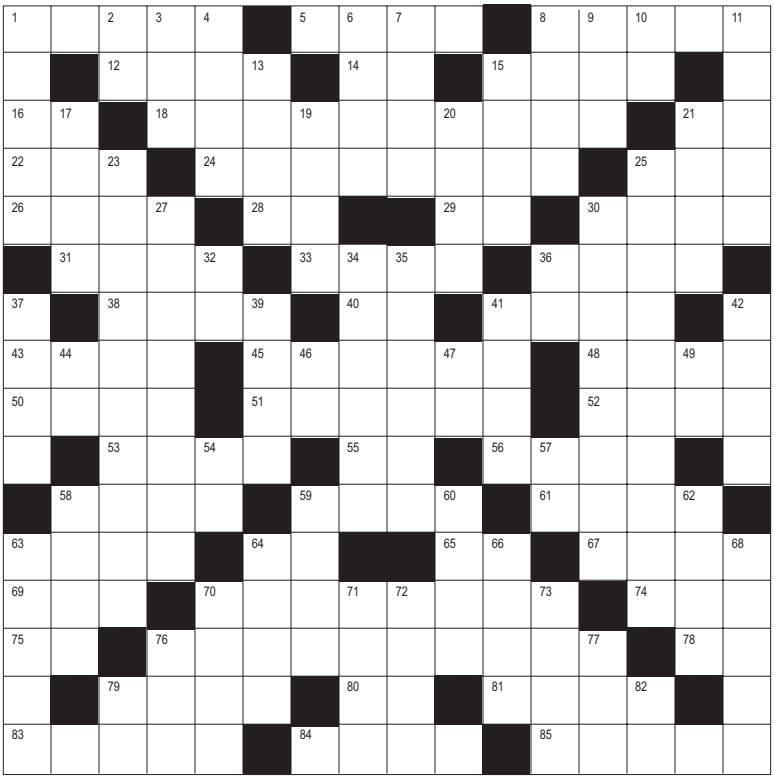
▲ Water Resources Puzzler (answers on pg. 21)



ACROSS

1 spoiled children
5 Malay sailing boat
8 sacred hymn
12 brought to court
14 color of mil. uniforms
15 US naturalist
16 mil. branch
18 meteorological instruments
21 part of a mth.
22 _____ and mouse
24 one of HOMES
25 Wade's opponent?
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31 to tear apart
33 Mets' venue
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38 pulled by dogs
40 dog tag
41 a gull's cousin?
43 a Uto-Aztecan language
45 complete
48 European capital
50 pitchers' stats
51 1900 or 2000, e.g.
52 bridge
53 command to Fido
55 Hirt or Jarreau
56 followed by order or carrier
58 a drug addict
59 once again
61 followed by movie or party
63 Santa's transport
64 loc. of Cape Fear R.
65 in or out in tennis
67 North Sea feeder
69 NFL lineman
70 one of HOMES
74 hospitalization plan
75 shoe size
76 horizontal structure
78 loc. of Edisto R.
79 a Martian plain
80 loc. of Nanticoke R.
81 leap or lunar
83 kills
84 a flat top
85 units of forces

DOWN

1 Manhattan or Miami
2 atomic no. 33
3 bathroom fixture
4 Black and Red
6 city on the Tiber
7 central European river
8 cat sound
9 family mem.
10 atomic no. 18
11 prepares
13 Rango's instrument
15 see 8 Down
17 followed by Deal or play
19 musical composition
20 Ike's ex
21 part of a sentence
23 intruded
25 type of erosion
27 anagram of listened
30 volume of soil interstices
32 loc. of Christine R.
34 a hired killer
35 food
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37 Atkins or Huntley
39 withhold
41 a semester
42 David or ice cream
44 loc. of Rogue R.
46 Greek letter
47 do-_____-mi
49 loc. of Pearl R.
54 loc. of Saline R.
57 cap. is Pago Pago
58 neighbor of radius
59 monetary trans. list
60 pay rate
62 emeralds and sapphires
63 fur or earless
64 _____-to-five
66 the Alamo's Crockett
68 Island and Gibraltar
70 the fourth rock?
71 pelt
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73 a requisite
76 key
77 Milland or sun
79 Parker or Kettle
82 giver of TLC

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WATER RESOURCES IMPACT

WATER ON WALL STREET

Clay Landry and Rachel Cardone

Introduction

Wall Street is not a street unto itself – it operates within the larger network of systems that drive the world, including global, national, state, and local policies. From time to time in this column, we will include some discussion of the broader frameworks of water policy and regulations that are shaping, molding, and driving the water sector's market. Comments and suggestions for further columns are most welcome.

Global Water Policy Frameworks Include Private Sector Participation

The World Summit on Sustainable Development, held in Johannesburg this past August, accomplished two things: it highlighted the need for attention in the sanitation sector, and further strengthened the force of the Millennium Development Goals.

The Millennium Development Goals, or MDGs, were agreed upon by the United Nations in 2000, and were developed out of agreements and resolutions from previous world conferences on sustainable development and poverty. The table below provides a list of the MDGs that relate to the water sector, and the indicators for progress that have been developed:

Goal	Indicator
• To halve, by 2015, the proportion of people lacking access to safe drinking water	• Proportion of population with sustainable access to an improved water source
• To achieve, by 2020, a significant improvement in the lives of 100 million slum dwellers	• Proportion of people with access to improved sanitation • Proportion of people with access to secure tenure

Notably, sanitation was not included in the original goals. It has been suggested that for every dollar spent on improved water systems, two dollars are lost if sanitation is not included. As a result, sanitation was raised to the forefront of the debate at the Summit, and it was agreed to include it in the future as goal.

The push to meet these Millennium Development Goals has gained significant political backing thus far, both from those within the development community, and others. In fact, the goals have largely become a backdrop to other development goals. Initiatives have been announced within the European Union and the United States to promote the water sector in developing countries, citing the goals as the indicator for success.

It is also widely acknowledged that the Millennium Development Goals cannot be met without the private sector's assistance. The private sector provides less than five percent of capital investments for the water industry, largely because of the lack of good projects. Water sector projects in developing countries tend to be small (relative to energy sector), and are associated with high risk, even if they appear somewhat safe. For example, loans based on the dollar carry a high risk if the water bills are paid in a local, and inflationary, currency. Consequently, the initiatives that have emerged from the push to attain the goals have involved looking at how the water sector is financed, and developing mechanisms to attract private capital – whether from international private companies or domestic entrepreneurs.

Industry Consolidation Continues: GE Rolls Up Osmonics

Industry consolidation continued this month as Osmonics agreed to become a wholly owned subsidiary of GE Power Systems, a division of General Electric. GE is paying about $253 million in cash and stock for Osmonics, plus $20 million in assumed debt. Under the deal, Osmonics shareholders will receive $17 of GE common stock or cash for each share of Osmonics. However, the cash option is limited. The merger agreement stipulates that the total cash paid to shareholders cannot exceed 55 percent of the total cost of the merger. The deal is subject to approval by Osmonics shareholder and the transaction is expected to close during the first quarter of 2003.

GE's offer price came in at a 26 percent premium over Osmonics' closing price the day before the deal was announced. Share prices for Osmonics rocketed to $16.79 once news of the buyout hit the street. Osmonics shares ended November up 24.4 percent.

Osmonics will be housed in GE Water, a new unit of GE Power Systems. GE kicked off its water division in 2000 with the acquisition of Glegg Industries, a privately owned water treatment company. In February of this year, GE expanded its presence in the water industry by acquiring BetzDearborn, the world's second largest water treatment business. The acquisition added about $1 billion in annual revenue.

GE has a reputation of being one of the top players in any market it enters. The company, however, has been tight lipped about future water plays. Yet, future purchases are almost certain if GE is to become major player in the water industry. So far the company's acquisitions have been narrow and limited to the water treatment and technology sector. GE Water has shown little interest in other sectors such as water supply and resource development. Yet these are obvious areas for future development.

GE Water provides services to a variety of industries, including power generation, semiconductor manufacturing and petrochemical companies, which are finding it increasingly difficult to secure reliable water supplies. Expanding into the water supply and resource development sectors would allow GE Water to vertically integrate new water services for a large and well developed client base. GE's stock closed on December 10 at $26.17, up slightly over the previous months.

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Water Industry Market Watch

			Share Price						Revenues*		
					52-Week						
Company	Ticker	Dec. 10 close	% Change	Exchange	High	Low	Yield	P/E	Last Reported	Year Ago	Oct. 8 Close
Water *Utility Sector*											
American States Water	AWR	$23.85	-1.4%	NYSE	29.01	20.25	3.71	19.96	258.7	243.0	$24.20
American Water Works	AWK	$45.24	0.8%	NYSE	45.20	41.40	2.17	26.85	1,292	1,075	$44.88
Artesian Resources	ARTNA	$29.03	0.9%	NASDAQ	34.60	24.75	4.00	18.23	25.9	23.9	$28.76
Birmingham Utilities	BIW	$18.02	1.2%	American	20.75	15.65	3.33	5.18	3.4	3.5	$17.80
California Water Services	CWT	$24.55	0.5%	NYSE	26.89	20.45	4.51	19.72	202.2	190.3	$24.42
Connecticut Water	CTWS	$25.84	6.5%	NASDAQ	32.21	20.35	3.13	23.61	34.8	34.7	$24.27
Consolidated Water	CWCO	$13.75	11.2%	NASDAQ	15.45	10.77	3.12	20.12	9.1	8.5	$12.37
Middlesex Water Co.	MSEX	$21.15	-2.3%	NASDAQ	26.72	18.30	4.08	22.17	46.8	34.0	$21.65
Pennichuck Corp.	PNNW	$28.40	4.4%	NASDAQ	32.40	22.15	2.76	27.43	18.5	15.6	$27.21
Philadelphia Suburban	PSC	$20.55	4.1%	NYSE	25.00	16.02	2.71	23.77	240.2	232.2	$19.75
Suez	SZE	$17.45	22.2%	NYSE	31.95	13.18	3.65	19.27	7281.4	7349.1	$14.28
Southwest Water	SWWC	$13.99	-0.5%	NASDAQ	19.10	11.80	1.76	20.06	95.5	83.1	$14.06
York Water Co.	YORW	$16.95	23.7%	NASDAQ	20.17	12.30	3.22	27.52	14.8	14.4	$13.70
Vivendi Environnement	VE	$23.05	13.0%	NYSE	34.80	17.52	8.26	22.15	8372.9	7905.7	$20.40
Water *Filtration and Technology Sector*											
Calgon Carbon Corp	CCC	$4.98	-7.9%	NYSE	9.89	4.00	2.41	41.50	195.5	206.6	$5.41
Ionics Inc.	ION	$23.11	18.3%	NYSE	33.90	17.64	-	10.95	246.5	354.9	$19.53
Millipore Corp.	MIL	$35.32	12.3%	NYSE	61.21	27.25	-	14.94	518.4	488.1	$31.44
Osmonics Inc.	OSM	$16.86	59.5%	NYSE	17.50	10.00	-	29.05	156.9	153.4	$10.57
Pall Corp.	PLL	$16.75	12.4%	NYSE	24.73	14.68	2.12	70.71	654.8	591.1	$14.90
Water *Resource Development Sector*											
Cadiz Inc.	CLCI	$0.57	111.1%	NASDAQ	11.00	0.15	-	-	95.0	84.0	$0.27
Intergrated Water Resources	IWRI	$0.35	133.3%	OTC	-	-	-	-	-	-	$0.15
Layne Christensen Co.	LAYN	$8.40	15.1%	NASDAQ	10.8	5.47	-	142	214.2	236.1	$7.30
Pico Holdings Inc.	PICO	$12.32	44.1%	NASDAQ	17.86	8.05	-	13.41	60.0	52.0	$8.55
Southwestern Water Exploration	SWWE	$0.76	-10.6%	OTC	-	-	-	-	-	-	$0.85
Western Water Co.	WWTR	$0.32	28.0%	OTC	1.26	0.20	-	-	0.9	0.8	$0.25

* Revenues presented are in $ millions and reflect second half revenes ended Sept 30

PLL reports full year end Aug 1, 2002. Suez reflects Ondeo cumulative revenues, VE reflects Vivendi Water cumulative revenues.

▲ President's Message . . . Jane L. Valentine, AWRA President, 2003

As we start off the new year I am reminded of the many accomplishments made by our Association over the last year. We have successfully had several wonderful conferences with themes spanning coastal water resources to issues presented at the National Water Resources Policy Forum in Washington D.C. Summaries of these conferences will be made available on the internet for those of you who were unable to attend.

As we look to the year ahead we are filled with anticipation and excitement for the many meetings planned. In particular there will be the Third World Water Forum in Kyoto, Osaka, and Shiga,Japan, March 16-23, 2003, at which AWRA will have a special "AWRA Water and Information Day" (March 18-19) at the Osaka venue. The AWRA spring specialty conference will feature the theme "Agricultural Hydrology and Water Quality" and will be held in Kansas City, Missouri, May 12–14, 2003. The theme for AWRA's summer 2003 International Congress to be held June 29-July 2 in New York City is "Watershed Management for Water Supply Systems." AWRA's Annual Water Resources Conference will be held in San Diego, California, November 3-6. These meetings should be very stimulating for us.

The Board of Directors of AWRA has been participating in Strategic Planning discussions applicable to the Association. We welcome your input in these efforts and views as to where you would like to see the Association headed in the years to come. We will be communicating with each of you to obtain your input.

I am delighted to serve as your new president. Let's keep the lines of communications open between us. I wish you all a most wonderful and prosperous year filled with joy and wonder and accomplishments in your life and the field of water resources.

Jane L. Valentine

▲ Six Students Acknowledged for "Outstanding" Presentations

Reported by David R. DeWalle
Professor of Forest Hydrology, School of Forest Resources
The Pennsylvania State University • University Park, Pennsylvania

At AWRA's 2002 Annual Water Resources Conference, a record number of student oral and poster presentations (48) were given. Presentations were rated by those attending the meeting, and over 1,500 written evaluations were completed for the student presenters during the four-day meeting. Based upon analysis of evaluations, six student presentations were judged to be "outstanding." Students winning this award were:

THEODORE CAPLOW
High Resolution SF6 Tracer Studies: Hudson River/New York Harbor
Dept. of Earth and Environmental Engineering
Columbia University • New York, New York

CHRISTINA M. CIANFRANI
Developing a Clean Sediment TMDL in Northern Vermont
Dept. of Civil and Environmental Engineering
University of Vermont
Burlington, Vermont

EDWIN J.W. HAMLYN
Water Resource Management Challenges on the U.S.-Mexico Border
Center for Environmental Resources Management
Civil Engineering Department
University of Texas at El Paso • El Paso, Texas

AARON S. ROUTHE
Planners and the Public: The Role of Attitudes in Water Policy
Southeast Water Policy Initiative • Dept. of Sociology
University of Tennessee • Knoxville, Tennessee

CATHERINE SCHMITT
The Effect of Drought on Maine Surface Water Supplies
Senator George J. Mitchell Center for
Environment and Watershed Research
University of Maine • Orono, Maine

DOEHYOK SHIN
Impact of Summer Monsoons on a Reservoir in East Asia
Geography Department
University of North Carolina
Chapel Hill, North Carolina

Abstracts and contact information for these students are available in the "Abstract Proceedings" for this meeting. Please join the members of the Planning Committee for the Philadelphia 2002 AWRA Annual Water Resources Conference and all AWRA members in congratulating and recognizing these student winners.

▲ Recipients of AWRA's Annual Awards for 2002

The following awards were presented at AWRA's Annual Water Resources Conference in Philadelphia, Pennsylvania.

William R. Boggess Award

"Predictability of Surface Water Pollution Loading in Pennsylvania Using Watershed-Based Landscape Measurements"
JAWRA • Vol. 37 • No. 4 • Pgs. 821-835by

GLEN D. JOHNSON
New York State Department of Health • Troy, New York

Glen Johnson is a Research Scientist in the New York State Department of Health and an Assistant Professor at the University of Albany School of Public Health in the Department of Environmental Health and Toxicology. He received a Ph.D. in Quantitative Ecology, an M.A. in Environmental Statistics, and an M.S. in Ecology from Penn State University, along with a B.S. in Biology from the SUNY College of Environmental Science and Forestry. Glen has developed a multidisciplinary career in environmental science, whose focus has ranged from small scale issues of chemical toxicology and microbiology to large scale issues of geography, landscape ecology, and remote sensing. His current research includes disease mapping, small area estimation of health risk factors, and geographic association of human health outcomes with environmental and other risk factors.

WAYNE L. MYERS
Penn State University • University Park, Pennsylvania

Wayne L. Myers earned M.F. and Ph.D. degrees in forest ecology and forest entomology at the University of Michigan. He began his professional career in Canada as a research forest entomologist and biometrician. He then joined the faculty of forestry at Michigan State University specializing in biometrics and remote sensing. The position at Michigan State also encompassed consultancies with the U.S. Forest Service and work in Brazil. After nine years at Michigan State University, he moved to Penn State University in 1978 as Associate Professor in the School of Forest Resources. During 1988 and 1989 he spent two years in India as Forestry Advisor concerned with natural resource sustainability for a USAID/ World Bank project in social forestry. He is Co-Director of the Office for Remote Sensing of Earth Resources in the Environmental Resources Research Institute at Penn State where he conducts and promotes interdisciplinary research in landscape ecology using remote sensing and geographic information systems (GIS).

GANAPATI P. PATIL
Penn State University • University Park, Pennsylvania

Ganapati P. Patil is Distinguished Professor of Mathematical Statistics at The Pennsylvania State University. He is founder and director of the Center for Statistical Ecology and Environmental Statistics – the first of its kind and of national and international renown. He is editor-in-chief of *Environmental and Ecological Statistics*. He is a member of the UNEP Science Advisory Board chaired by Mario Molina, a Nobel Laureate, on the UNEP initiative for Human Environment Index for the Assessment of Human Environment Interface. He initiated the cross disciplines of statistical ecology, environmental statistics, and quantitative risk assessment. He now leads the initiative for multiscale advanced raster map analysis system and geoinformatic surveillance and early warning, also in the context of biochemosurveillance and security. He will be pleased to interact and collaborate with interested members of AWRA.

Pyramid Award

KARL W.J. WILLIARD
Southern Illinois University • Carbondale, Illinois

Karl W. J. Williard is an Assistant Professor of Forest Hydrology and Watershed Management in the Department of Forestry at Southern Illinois University Carbondale (SIUC). He received a B.A. in Biology from Lehigh University, an M.S. in Environmental Pollution Control from Penn State University, and a Ph.D. in Forest Hydrology from Penn State University under the direction of David DeWalle. He was awarded a nationally competitive USDA Water Science fellowship to pursue his Ph.D. degree. Presently Dr. Williard teaches undergraduate courses in Watershed Management, Watershed Management Field Laboratory, Forest Hydrology, Advanced Watershed Hydrology and Management, and Forest Soils at SIUC. His current research interests include nutrient and sediment attenuation in riparian buffer zones, riparian buffer zone restoration and management, bottomland forest hydrology, nitrogen cycling in forested watersheds, and in-stream nitrogen cycling. He has been awarded grants from the USDA Forest Service, USGS, Illinois Department of

Natural Resources, Illinois Council on Food and Agricultural Research, and the Illinois Department of Agriculture to support his research. Dr. Wlliard has been an active participant in all three organizational levels of AWRA. He has been a National member since 1995, a Pennsylvania State Section member from 1995 to 1999, an Illinois State Section member since 2000, a member of the Lehigh University student chapter from 1993 to 1994, a member of the Penn State student chapter from 1995 to 1999, and an advisor for the SIUC student chapter since 2000. He has served as President of the Penn State student chapter and currently serves as President of the Illinois State Section. He also remains active in the Soil and Water Conservation Society and the American Geophysical Union. He is a member of the NC 230 Midwest Riparian Systems Research Group and is a steering committee member of the Illinois Nutrient Management Task Force and the Illinois Buffer Partnership.

Mary H. Marsh Medal for Exemplary Contributions to the Protection and Wise Use of the Nation's Water Resources

IRENE B. BROOKS

Pennsylvania Department of Environmental Protection
Harrisburg, Pennsylvania

Irene B. Brooks currently serves as the Executive Director of the Office for River Basin Cooperation of the Pennsylvania Department of Environmental Protection. Appointed in 1995 by Governor Tom Ridge to represent Pennsylvania on all interstate river basin commissions that include Commonwealth watersheds, Ms. Brooks represents the Governor and the Secretary of the Department of Environmental Protection on a variety of interstate issues, including the development of long-range water basin management plans and adoption of resource protection polices and regulations affecting the water needs of millions of citizens within 15 states and two Canadian Provinces.

In 1989, she was appointed by President George Bush to serve as the U.S. Commissioner to the Delaware River Basin Commission, a five-member regulatory and quasi-judicial agency managing the water resources within the 13,000 square mile Delaware River Basin. She helped formulate federal policy, coordinating a consensus among all federal agencies and working with Congressional committees, individual state and federal senators and representatives and their staffs, and state agencies and nongovernmental organizations.

Prior to service as the U.S. Commissioner, Ms. Brooks was appointed by unanimous vote of the Court of Common Pleas, and was later elected to serve a full term as Chair, as a Chester County Commissioner. In this role she developed and implemented a comprehensive, countywide plan to help protect and preserve the environment, farmland, and open spaces, the first of its kind in Pennsylvania. The Chester County Open Space Program has been adapted by other counties across the country and has won several Presidential Awards.

Ms. Brooks graduated cum laude with a bachelor's degree in political science and public administration from West Chester University. She has received numerus awards for her public service. Among these were recognition for outstanding service from the Great Lakes Commission, including a term as commission chair; the Leadership Award from the Interstate Council on Water Policy; and an Outstanding Service to Conservation Award from The Nature Conservancy. She enjoys fly-fishing, tennis, and exploring the ebbs and flows of notable American rivers and their tributaries.

Fellow Member

JOHN J. WARWICK

Desert Research Institute • Reno, Nevada

John J. Warwick earned BS and MS degrees in Civil Engineering from Lehigh University and a PhD in Environmental Engineering from the Pennsylvania State University. His first faculty position was with the Graduate Department of Environmental Sciences at the University of Texas-Dallas (UTD). Later he became Director of the Institute for Environmental Sciences at UTD prior to moving to join the Department of Environmental Resource Sciences at the University of Nevada-Reno (UNR) in 1991. Shortly after arriving in Reno, his interactions with AWRA accelerated since students within UNR's Graduate Program of Hydrologic Sciences were in need of a professional student chapter and AWRA was a perfect match. He became Director of UNR's Graduate Program in Hydrologic Sciences in 1993. UNR's AWRA Student Chapter won Outstanding Student Chapter honors twice during his tenure as faculty advisor (1994 and 1996). In 1999 he left UNR to become Chair of the Department of Environmental Engineering Sciences at the University of Florida (UF). Upon arriving in Gainesville, he affiliated with the AWRA student chapter advised by Dr. Dan Spangler. This chapter won AWRA Outstanding Student Chapter honors in 2000. During his time at UF he enjoyed the opportunity to interact with another AWRA Past President, Dr. Warren (Bud) Viessman, Jr. (Assoc. Dean, College of Engineering). John recently became Executive Director of the Division of Hydrologic Sciences at the Desert Research Institute (DRI) which brings him back in contact with longtime colleagues in Reno while opening up new opportunities for personal and professional growth with colleagues in Las Vegas.

Formal AWRA service began with involving UNR in performing local hosting functions for the 1992 Annual Conference held in Reno, Nevada. After that experience he was elected to the Board of Directors and became Vice President for Committees (1995-1997), President-Elect (1998), President (1999), and immediate past President (2000). In 2002 he succeeded Dr. Chris Lant as Editor of the *Journal of the*

American Water Resources Association (JAWRA) [this activity being made possible by his wife's (Laura Helsel) willingness to take on the major workload in the position of Managing Editor]. Throughout this period he has learned much from his AWRA colleagues, and perhaps more importantly, he feels that he has made some lifetime friends.

John has authored many peer-reviewed papers, made numerous presentations, and successfully competed for extramual research funding. However, he believes his most valued accomplishment is the relationships with his former, present, and future students. At the end of the day, he takes great pleasure in thinking he has perhaps contributed to the growth of his students who will continue to give back to our profession.

Sandor C. Csallany Institutional Award for Exemplary Contributions to Water Resources Management

GREAT LAKES AND OHIO RIVER DIVISION WATERMANAGEMENT TEAM

U.S. Army Corps of Engineers • Cincinnati, Ohio

The Great Lakes and Ohio River Division Water Management Team, U.S. Army Corps of Engineers, has been selected as the recipient of the 2002 Sandor C. Csallany Institutional Award for Exemplary Contributions to Water Resources Management, for its continued and extraordinary level of service to our nation in performing their unique mission of reducing Ohio and Mississippi Rivers flood damages and preserving and protecting the Mississippi River levee system. During 1984 to 2001, they prevented flood damages of nearly $344,000,000 and reduced flood stages by more than 2-1/2 feet through the complex management of Kentucky Lake on the Tennessee River and Barkley Lake on the Cumberland River. These reservoirs control nearly 30 percent of the Ohio River watershed. The Team manages them during flood events as legislated by Section 7 of the Flood Control Act of December 1944.

In 1997, the Team managed one of the largest floods since the Great Flood of 1937. The Team's management of the Kentucky and Barkley reservoirs prevented the need to utilize the Birds Point-New Madrid Floodway in Missouri and the Morganza Floodway in Louisiana, preventing catastrophic damages within the floodways.

In addition, the following awards were also presented:

AWRA 2002 Outstanding Student Chapter Award

SALT CITY (SUNY-ESF) STUDENT CHAPTER

AWRA 2002 Outstanding State Section Award

FLORIDA STATE SECTION

2002 President's Award For Outstanding Service

RICHARD A. ENGBERG

AWRA • Middleburg, Virginia

2002 Aquarius Club Members

PETER E. BLACK
MICHAEL E. CAMPANA
RICHARD A. ENGBERG
N. EARL SPANGENBERG
CLAIRE WELTY
KARL W.J. WILLIARD

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▲ December 2002 JAWRA Papers (Vol. 38, No. 6)

DIALOGUE ON DAM REMOVAL

- Introduction – Dialogue on Dam Removal
- Bringing Down Our Dams: Trends in American Dam Removal Rationales
- Adjustment of Stream Channel Capacity Following Dam Closure, Yegua Creek, Texas
- Effects of Dam Impoundment on the Flood Regime of Natural Floodplain Communities in the Upper Connecticut River
- Assessment Using GIS and Sediment Routing of the Proposed Removal of Ballville Dam, Sandusky River, Ohio
- Geomorphis Analogies for Assessing Probable Channel Response to Dam Removal
- An Integrative Approach Towards Understanding the Ecological Responses to Dam Removal: The Manatawny Creek Study

DIALOGUE ON WATER ISSUES

- Making Smarter Environmental Management Decisions

TECHNICAL PAPERS

- Potential Phosphorus Load Reductions Under the Lake Okeechobee Regulatory Program
- Fecal Coliform Source Assessment in a Small, Mixed Land Use Watershed
- An Evaluation of Physical Stream Habitat Attributes Used to Monitor Streams
- Priestley-Taylor Alpha Coefficient: Variability and Relationship to NDVI in Arctic Tundra Landscapes
- Cultural Evolution and Water Management in the Salinas River Valley
- Performance Variations of COD and Nitrogen Removal by Vegetated Submerged Bed Wetlands
- Changes in Land Use/Management and Water Quality in the Long Creek Watershed
- Climate Forecasts in Flood Planning: Promise and Ambiguity
- Using Subsurface Drip Irrigation for Alfalfa
- Subwatershed Spatial Analysis Tool: Discretization of a Disturbed Hydrologic Model by Statistical Criteria
- A Reevaluation of the Ground Water Budget for Las Vegas Valley, Nevada, With Emphasis on Ground Water Discharge
- Modeling Streamflow From Artificially Drained Agricultural Watersheds in Illinois

JAWRA

▲ Water Resources Continuing Education Opportunities

MEETINGS, WORKSHOPS, SHORT COURSES

FEBRUARY 2003

17-19/USEPA, SWMM, & PCSWMM 2002 – Stormwater Modeling Workshops. Toronto, Ontario. **Contact** Lyn James at CHI, 36 Stuart St., Guelph, ON, Canada N1E 4S5 (519/767-0197; f: 519/767-2770; e: info@chi.on.ca; w: www.chi.on.ca) (see Feb. 20-21 for Conference)

17-20/Urban Storm Water: Enhancing Programs at the Local Level. Chicago, IL. **Contact** (w: http://www.chicagobotanic.org/research/conference/stormwater)

18-21/Aquaculture America 2003: New Frontiers in Aquaculture. Louisville, KY. **Contact** (760/432-4270; e: woldaqua@aol.com; w: www.was.org)

20-21/Conf. on Stormwater & Urban Water Systems Modeling. Toronto, Ontario. **Contact** Lyn James at CHI, 36 Stuart St., Guelph, ON, Canada N1E 4S5 (519/767-0197; f: 519/767-2770; e: info@chi.on.ca; w: www.chi.on.ca) (see Feb. 17-19 for Workshops)

APRIL 2003

22-25/Developing & Implementing TMDLs for Lakes and Reservoirs – 16th Annual State Lakes Mgmt. Prog. Conf. Chicago, IL. **Contact** Bob Kirschner, Chicago Botanic Garden, 1000 Lake Cook Rd., Glencoe, IL 60022 (e: bkirschn@chicagobotanic.org)

28-30/River Basin Management 2003 - 2nd International Conf. on River Basin Mgmt. Las Palmas, Garn Canaria. **Contact** Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton SO40 7AA, UK. (+44 (0) 238 029 3223; f: +44 (0) 238 029 2853; w: http://www.wessex.ac.uk/conferences/2003/riverbasin2003/4.html)

MAY 2003

12-14/AWRA's Spring Specialty Conf. "Agricultural Hydrology & Water Quality." Kansas City, MO. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org)

13-15/Using Science to Assess Environmental Vulnerabilities. King of Prussia, PA. **Contact** Conf. Coor. Storm Tech. Planning & Mgmt. Corp., Mill Wharf Plaza, Ste. 208, Scituate, MA 02066 (718/544-0423; f: 781-544-3086; e: congerence@tpmc.com)

27-30/8th Annual Workshop on Use of Constructed Wetlands for Water Quality Mgmt. Humboldt State Univ., Arcata, CA. **Contact** B. Smith (707/826-3619; e: smith@humboldt.edu; w: www.olawai.org)

JUNE 2003

18-20/Water Pollution 2003 - 7th Intn'l. Conf. on Modelling, Monitoring & Prediction of Water Pollution. Cadiz, Spain. **Contact** Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton SO40 7AA, UK. (+44 (0) 238 029 3223; f: +44 (0) 238 029 2853; w: http://www.wessex.ac.uk/conferences/2003/water2003/2.html)

23-25/Coastal Engineering 2003 - 6th Intn'l. Conf. on Computer Modeling & Experimental Measurements of Seas and Coastal Regions. Cadiz, Spain. **Contact** Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton SO40 7AA, UK. (+44 (0) 238 029 3223; f: +44 (0) 238 029 2853; w: http://www.wessex.ac.uk/conferences/2003/coastal03/)

29-July 2/AWRA's Summer Specialty Conf. Intn'l. Congress on "Watershed Mgmt. for Water Supply Systems." New York, NY. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org)

JULY 2003

26-30/The Columbia: Conserving a Legacy of Life – SWCS Annual Conf. Spokane, WA. **Contact** Deb Happe, Soil & Water Cons. Soc., 7515 NE Ankeny Rd., Ankeny, IA 50021-9764 (515/289-2331; f: 515/289-1227; e: seb@swcs.org)

28-31/StormCon '03. San Antonio, TX. **Contact** Janice Kaspersen (www.stormcon.com)

30-August 1/Joint UCOWR/NIWR/ASCE-EWRI Conf.- Water Security in the 21st Century. Washington, D.C. **Contact** Margaret Skerly, UCOWR, 4543 Faner Hall, SIU, Carbondale, IL 62901-4529 (e: mskerly@siu.edu; w: ucowr@siu.edu)

AUGUST 2003

10-14/American Fisheries Society 133rd Annual Meeting. Quebec City, Quebec, Canada. **Contact** Betsy Fritz (301/897-8616, x212; e: bfritz@fisheries.org)

SEPTEMBER 2003

16-19/Internat'l. Conf. on GIS & Remote Sensing in Hydrology. Three Gorges Dam Construction Site, China. **Contact** Chairman LOC of ICGRHWE, c/o Prof. Yangbo Chen, Inst. of Water Resources & Environ. Engr., College of Earth & Environ. Sciences, Sun Yat-Sen Univ., 135 Xingangxi, Guangzhou, China 510275 (f: +86-20-3402-2397; e: eescyb@zsu.edu.cn)

OCTOBER 2003

19-22/2003 AIH Annual Meeting & Conf. Atlanta, GA. **Contact** AIH, 2499 Rice St., Ste. 135, St. Paul, MN 55113 (651/484-8169; f: 651/484-8357; e: AIHydro@aol.com)

NOVEMBER 2003

2-5/AWRA's Annual Water Resources Conf. San Diego, CA. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org) (Call for papers will be published in early February - check out AWRA's website for exact due dates)

(Listing of AWRA's 2004 Meetings on pg. 8)

MAY 2004

2-6/4th World Fisheries Congress-Reconciling Fisheries With Conservation: The Challenge of Managing Aquatic Ecosystems. Vancouver, BC, Canada. **Contact** (800/555-1099; e: FISH2004@advance-group.com)

AUGUST 2004

21-26/American Fisheries Society 134th Annual Meeting. Madison, WI. **Contact** Betsy Fritz (301/897-8616 x212; e: bfritz@fisheries.org)

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AMERICAN WATER RESOURCES ASSOCIATION MEMBERSHIP APPLICATION – 2003

MAIL THIS FORM TO . . . AWRA • 4 West Federal St. • P.O. Box 1626 • Middleburg, VA 20118-1626
FOR FASTEST SERVICE . . . FAX this form (credit card or P.O. orders only) to (540) 687-8395
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➤ Complete All Sections (please print)

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PROC. – 1 copy of AWRA's annual symposium proceedings

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❑ Student Member (IMPACT) FULL YEAR ONLY.....$25.00
❑ Institutional Member (JAWRA, IMPACT, & PROC.).....$275.00
❑ Corporate Member (JAWRA, IMPACT, & PROC.).....$375.00
❑ AWRA Membership Certificate.....$6.00

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❑ Conference Discount
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❑ Internet Search
❑ Journal (JAWRA)
❑ IMPACT
❑ Boss/Friend/Colleague
❑ Email Received
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JT13 Other _____

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MA Master of Arts
MS Master of Science
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OT Other _____

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AG Agronomy
BI Biology
CH Chemistry
EY Ecology
EC Economics
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EG Engineering
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GE Geology
GI Geographic Information Systems
HY Hydrology
LA Law
LM Limnology
OE Oceanography
PS Political Science
OT Other _____

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SEND US YOUR FEEDBACK ON THIS ISSUE

(COMMENTS ON PREVIOUS ISSUES ARE ALSO WELCOME)

Water Resources IMPACT is starting its fifth year in publication and we have explored a lot of ideas. We hope we've raised some questions for you to contemplate. "Feedback" is your opportunity to reflect and respond. We want to give you an opportunity to let your colleagues know your opinions . . . we want to moderate a debate . . . we want to know how we're doing. Send your letters by land-mail or e-mail to John Herring (for this issue), or to Earl Spangenberg (Editor-In-Chief). Either way, please share your opinions and ideas. Please limit your comments to approximately 350 to 400 words. Your comments may be edited for length or space requirements.

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