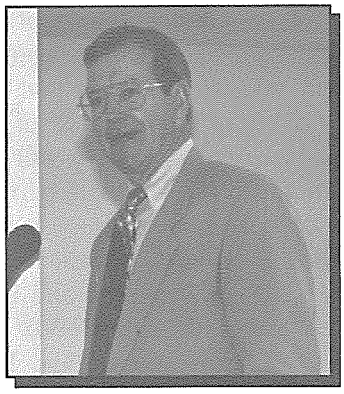

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MANAGING WATER CONFLICTS

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> The law is a tool, not an end in itself. Like any tool, our judicial mechanisms, procedures, or rules can become obsolete. Just as the carpenter's handsaw was replaced by the power saw, and his hammer was replaced by the stapler, we should be alert to the need for better tools to serve the ends of justice.
>
> —Warren E. Burger

INTRODUCTION AND BACKGROUND

In introducing the topic of the engineer in water resources conflict management, I first look at the costs of conflicts. For this background I rely heavily on two issues of *National Forum*-one in 1983 on Conflict Resolution and Peacemaking and another in 1991 on The Litigious Society. Abraham Lincoln more than 125 years ago said: "Discourage litigation. Persuade your neighbors to compromise whenever you can. Point out to them how the nominal winner is often a real loser—in fees, expenses and waste of time."

What is the real cost to the U.S. of our litigious society? What is that cost in terms of the diverted energy of very bright lawyers toward tasks that produce no wealth? Nothing is added to the nation's productivity by conflict and the costly court actions associated with these conflicts. What is the effect of excessive litigation on our nation's competitiveness at this time when the Japanese are still somewhat dominating us in technological progress in consumer goods, including many high-tech consumer goods? Also, China and other Pacific Rim nations are coming rapidly into the global competition scene. What

is the cost in terms of our nation's economic health and international balance of payments?

Lester Thurow, former Dean of the Sloan School of Management at MIT, reported that a Japanese steel official once said that the difference in the number of lawyers and our propensity for civil suits is why his country will eventually beat ours (Thurow 1983). That steel official may be correct because the resources devoted to litigation do not increase productivity. Derek Bok, former Harvard President and former law school dean, seems to agree (Bok 1982). In relation to legal regulations Bok has noted: "Legal regulations seem burdensome to the point that they conflict in dealing with progress, productivity and initiative." He continues: "The total cost of our system of enforcing rules and settling disputes appears more and more excessive." University of Virginia law professor A. E. Dick Howard estimated a decade ago that the total cost of legal services in the U.S. amounts to 2 percent of the nation's GNP. That is more than the entire steel industry (Howard 1982). Is it no wonder that the Japanese steel official dared predict that the Japanese will eventually beat us in economic competition?

We have drifted away from what our founding fathers envisioned more than 200 years ago. They wanted laws to protect individual freedom through common rules with the judicial system functioning in an important but limited sphere. The Founders would likely be surprised at the current attitude of "meet you in court." They wanted to avoid the condition that Yale College President Timothy Dwight mentioned to the 1776 Yale graduating class when he referred to "costly and needless litigations which retard the operations of justice" (Cannon 1983). It appears that, as Chief Justice Warren Burger once suggested, "we are well on our way to a society overrun by hordes of lawyers, hungry as locusts, and brigades of judges never before contemplated" (Burger 1983). The well-documented increasing case load in our courts provides ample evidence of the high cost of litigation.

HOW MIGHT ENGINEERS REDUCE CONFLICTS?

Conflicts in water resources may result from several types of misunderstandings. I mention some of the reasons for conflicts. First, national attitudes toward water resources change. To illustrate, during the first half of this century or more, water was judged to be a key factor in economic development. Our national goal then was economic development and few citizens questioned the water development projects that were proposed by agencies such as the Bureau of Reclamation or the Corps of Engineers. The economic importance of the projects was the overriding justification in those earlier days. Now, there are many other considerations including environmental and social issues that various groups insist be part of the decision matrix. This vastly expands the potential for conflict.

Another reason for conflict is that scientific data may be misunderstood or interpreted differently by different groups. One example relates to the question of environmental quality versus risk. A good question might be termed, "How safe is safe?" which was the title of a paper on this subject (Waterstone and Lord 1989). Waterstone and Lord discuss the risk of five parts per billion of trichloroethylene (TCE) in water. Epidemiological data suggest that drinking two liters of such water per day over a 70-year lifetime would cause up to two additional cancers per million people. The issue of balancing risk is very important when attempting to assess the additional threat due to this drinking water because 200,000 to 250,000 people among those typical one million will develop cancer from other causes. How do you compare risks due to drinking this water with those from other causes? Clearly, economics must be considered. There will always be great potential for conflict when there is no universally accepted way to measure risk or weigh risk against costs.

Another conflict-related issue results because engineers tend to think in discreet, analytical terms. To us, things tend to be "yes" or "no." Engineers find it difficult to cope with the grey areas of human judgement. Perhaps we fall into

the trap of rejecting the notion of compromise, and instead see any compromise as a sign of weakness. Someone once said: "In America, real men don't mediate." In our complex society, this is a frightening thought. Fortunately, that attitude is changing. Still, we subconsciously may be too quick to adopt that narrow view, even if we would not state it openly. The academic disciplines usually viewed as important in streamlining dispute resolution procedures include sociology, social psychology, political science, anthropology, economics and law. Unfortunately, few think of engineering in that role.

I am convinced that engineers should play a much larger role in public affairs work, including conflict resolution. However, to be totally effective in doing so, we engineers must broaden our views. We must learn to look beyond the hard facts of scientific data and recognize the human dimension. This means that engineering educators must begin to include some public policy courses in their course of study. I should hasten to add that it is also very important for those in the social sciences to include more courses in science and technology in their course of study. That way, the bridge of understanding can be better approached from both directions.

THE PROCESS OF CONFLICT RESOLUTION

Everything constructive that is accomplished is the result of a process. If we want to make changes that will improve the way we do things we must focus on the steps involved. Moreover, we must do this in a structured way. David Kearns, former CEO of Xerox Corporation once said, "Insanity is doing the same thing over and over and expecting a different result." We must change some of the things we do if we expect improvement.

Let us look at what might be some key steps in the process. Here are some of my thoughts on some essential steps. First, in every one of these steps, the most critical element is communication among the potential adversaries. So, the first three steps are communicate, communicate, communicate. Seriously, I believe that unless honest and open communication can be established, the chances for avoiding conflicts and quickly and economically resolving those that occur are much reduced. The steps I suggest, all involving communication, are:

1. Do a current situation analysis.
2. Search for areas of agreement, small as they may be.
3. In areas of disagreement, find those where you can agree on the approach to the solution to be used.
4. Establish a regular meeting schedule and the format to be followed before the conflict issues are discussed.
5. Remember that a solution that saves money and leaves *both* parties satisfied is a victory.
6. Progress is made through many little steps (mini-agreements). Keep record of progress being made.
7. Remember that courts are costly in time and in dollars.

Briefly, the current situation analysis is to obtain background information related to the conflict. It brings the historical facts and issues out in the open, including those that relate to culture and tradition. It also provides the opportunity to get the physical data out in the open and starts the process of resolving inconsistent "factual" data before discussions of the central issues begin. If there is confusion regarding definitions or meanings of technical terms, they can be resolved at this first stage. The current situation analysis helps establish the foundation for better communication during the conflict resolution/mediation process.

Find areas or issues in which you have agreement even if they seem insignificant and unrelated to the central issue of conflict. Resolving conflicts requires agreements and it will help to identify even small areas of agreement early. This process will help the potential adversaries to get to know each other.

Regarding the areas of disagreement, discuss the possible approaches to be used. Involving experts in mediation and alternative dispute resolution procedures will be helpful. Remember the cost in time and money of court actions and

the fact that when time and costs are considered, there may be no winners in litigation.

Regular meetings should be held and "ground rules" agreed upon before the meetings begin. These include the schedule, commitment to attendance, meeting format and such factors. The parties should agree that they will discuss issues, not people. Adopt the slogan of "criticize issues, not people."

Keep a record of progress, including agreements reached, even if they are small. If a bottleneck issue emerges, resolve to solve it at the next meeting so the process does not bog down. It is easy to have some critical matter pop up that in the end stifles communication. If meaningful communication stops, progress in conflict resolution stops. Therefore, keep the communication channels open at all costs.

There are many examples where agreements once considered virtually impossible were reached because communication between the parties was established and maintained. The 1980 Ground Water Management Act in Arizona is an example. It appeared that the interests of agriculture, the mining industry, and the cities could not all be met. A virtual impasse was imminent. Rump sessions were held to explore possibilities and the disagreeing parties were directed by the governor to meet until they could agree. Granted, there was a larger issue that hung as a dark cloud over the process. In this case, if agreement was not reached on a means to bring groundwater overdraft under control, the Department of the Interior approval to proceed to complete the Central Arizona Project would be withdrawn.

Another example is the agreement on a management approach to the Potomac River Basin. Here some advanced simulation technology was used to show that the best interests of all were served through cooperation of the many water agencies operating in the basin. Still, the power of the simulation models and computer technology would not have prevailed if the groups had not met and started to communicate meaningfully on the issues. They had to develop trust in each other.

Now, I will present briefly three case studies where better up-front communications and agreements could have prevented problems.

REDUCING CONFLICTS BY EARLY INVOLVEMENT OF ENGINEERS

Twenty-one years of my professional life have been spent in Texas, and I am familiar with its water resources issues. I cite three examples where conflicts have existed or may occur in the future. Parenthetically, I don't even want to think about the New Mexico-El Paso situation and the costly process of resolving that conflict. In the cases I present, I briefly discuss how some of these conflicts might be reduced if engineers were more involved at an early stage.

A few years back in Texas, there were 1,225 water districts and authorities (Smerdon and Gronouski 1986). Some of these are no longer active, but nonetheless exist on the books. At one point each achieved legal status through an appropriate approval process. There are perhaps twenty major river authorities and major municipal water supply districts among this group. In several instances, there is more than one river authority with jurisdiction in a given river basin. In other cases, a separate groundwater management district may be responsible for a groundwater aquifer that underlies a river basin that is managed by a totally separate river authority. Since the groundwater laws in Texas are essentially independent of surface water laws, the potential for conflict is quite evident.

The Stacy Reservoir Conflict on the Colorado River in Texas

There are two principal institutions which share surface water management on the Colorado River in Texas. The Colorado River Municipal Water District (CRMWD) is responsible for the upper reaches of the river. Its boundaries include the cities of Odessa, Big Spring and Snyder, as well as the Colorado River drainage area above the east county line of Coleman County (Smerdon and Gronouski 1986). The CRMWD is governed by a 12-member board of directors representing the three cities. The purpose of this

district is to supply water for the municipalities it serves and it does so through surface reservoirs and groundwater wells.

The Lower Colorado River Authority (LCRA) has a service area of 31,000 square miles, encompassing ten counties in the lower reaches of the Colorado River. The LCRA is governed by a board of 15 directors appointed by the governor with the advice and consent of the Texas Senate. The LCRA is involved in power generation with the lion's share of its revenue coming from that source. Therefore, the LCRA is involved in hydroelectric power as well as water supply. The CRMWD has jurisdiction on the upper reaches of the Colorado River in Texas, and the LCRA is responsible for the lower reaches. Both institutions own reservoirs and are responsible for providing water to customers in their respective regions.

On May 25, 1979, the Texas Water Commission granted a permit to the CRMWD to construct the Stacy Dam and Reservoir Project at the confluence of the Colorado and Concho Rivers (Booth 1985). The location was in the upper reaches of the Colorado. It would provide 113,000 acre-feet of water per annum to meet future municipal and industrial needs of CRMWD customers.

The LCRA objected to this project. An issue of concern was the meaning of "unappropriated water" and how return flow was considered in the unappropriated water determination. Here we had a "communication" problem. This resulted in the Texas Supreme Court reversing the decision of the Texas Water Commission, and remanding the matter back to the commission with instructions to reconsider the Stacy Dam application in view of the Texas Supreme Court's ruling on unappropriated water. This in effect killed Stacy.

Here was a conflict that seemed to be resolved because the Texas Supreme Court had acted. However, there was a larger issue at stake. The political leaders in the state of Texas had been working on a financing package involving state-supported bonds for several water activities including water supply, water quality, flood control, regional systems (sewer, water, and reservoirs), water conservation in irrigation and others. The referendums had been prepared for submission to the Texas voters and broad-based political support was needed for acceptance.

Although the Stacy Dam conflict appeared to have been resolved in the courts with the Texas Supreme Court action, it was not a good solution for the state because it polarized the voters—West Texas versus East Texas. All of the regional problems political leaders had worked hard to resolve with a broadly based bond package to finance water projects, benefiting all citizens of Texas, had been rekindled. The effort of the political leaders appeared to be for naught unless a satisfactory compromise to the Stacy conflict was reached.

Texas politicians do not give up easily on issues such as the Stacy Dam conflict. They decided to play hardball politics with the governing boards of the two water institutions involved. A law was passed placing all river authorities and water districts in the state under a sunset review. Since many districts operated facilities, the law would not permit the districts themselves to be abolished. However, the law provided that the sunset review could result in the current governing board members being removed and a substitute board be appointed by the governor.

The governor, lieutenant governor (who heads the Texas Senate), and the speaker of the house of representatives met individually with the boards of directors of the CRMWD and LCRA regarding the Stacy case. A miracle happened! Within a matter of days the two contending governing boards reached a mutually acceptable agreement. That ended the fight. The Stacy conflict came to an end, but only after the legislature had passed a sunset law providing the potential to reorganize water agencies. The statewide water development and environmental programs provided in the bonding program could proceed if the bonding authority passed.

In the required referendum, bond proposals amounting to over $1 billion were supported by more than seventy percent of the Texas voters. Of 256 counties, ranging from desert western counties to humid southeastern counties, only 24 opposed the proposition. No vote on a water financing referendum since 1897 had received

such widespread support, save the water bond issue of 1957 which followed the most severe drought on record in Texas.

How could this costly conflict in Texas, which was only resolved as a result of hardball politics involving astute political leadership by the lieutenant governor and others, have been avoided? I believe that when two quasi-public water agencies operate on the same river basin and do so essentially independently, conflict is unavoidable as the water resource of the basin is stretched to its limit. If engineers and hydrologists had been more directly involved in framing the water institutions on this river basin, I believe the potential conflicts could have been minimized. The upstream versus downstream development issue involves complex hydrology that should be treated before the issues come to court, as opposed to having hydrologists as expert witnesses supporting the arguments on each side. Laws creating water districts which adhere to political boundaries and ignore hydrologic reality are an open door to conflict.

Edwards Underground Water District/ The Guadalupe-Blanco River Authority/ San Antonio River Authority Case

Here is a case where the Guadalupe-Blanco River Authority (GBRA) and the San Antonio River Authority (SARA) have responsibility for management of surface waters in two adjacent river basins covering a region in the vicinity of San Antonio, Texas, and to the east and southeast of that area. The GBRA serves ten counties, but not the entire basins of the Guadalupe and Blanco Rivers. Its nine-member board of directors is appointed by the governor. The SARA covers four counties including Bexar, where the city of San Antonio is located. SARA is governed by a 12-member board elected with half from Bexar County, and two each from the other three counties. The Edwards Underground Water District (EUWD) is responsible for managing the groundwater in a portion of the Edwards Limestone Formation, and it overlaps GBRA and SARA in several counties. The two river authorities have responsibility for managing the surface water, including water conservation, water supply and environmental quality. The EUWD is responsible for the conservation, protection, and enhancement of recharge of the Edwards Aquifer. The Edwards Aquifer exists in a karst topography subject to rapid recharge of the limestone aquifer in certain areas. Where the formation intersects the surface, there is a direct interplay between the surface water hydrology and the groundwater hydrology. This fact was not recognized in the approval of the three various entities and each governing board manages its operations essentially independent of the other. The potential for conflict is large.

While the conflicts that have existed so far have been relatively minor, it makes little scientific sense to have water management organizations structured as these are. The EUWD would like to build detention structures in the recharge area to detain surface flow for recharge into the aquifer. This purpose would enhance the flood control mission of SARA, but it certainly conflicts with the objective of GBRA, which is more involved in water supply and hydroelectric power production. Therefore, GBRA wishes to maximize flow to its surface water reservoirs for subsequent sale and power production, as well as other uses. San Antonio is currently 100 percent dependent on groundwater and the city has a close tie with EUWD concerning water management.

Again, like the Stacy case, this example is presented to show that water institutions that are organized without adequate attention to hydrologic realities pave the way to conflict. Again, engineers and hydrologists should involve themselves to a greater extent in the political process of formulating such institutions so that potential conflicts are minimized.

Water Supply for the City of Houston

This case comes from a study by Dan Sheer (1985) and illustrates the importance of operating procedures in maximizing the water yield from various combined supply sources. The city of Houston is located in the San Jacinto River Basin. Its water supply comes from Lake Houston and Lake Livingston, which are owned by the city, and potentially from Lake Conroe,

which is owned by the San Jacinto River Authority. The city also uses groundwater which is now managed by the Harris-Galveston Coastal Subsidence District, a district created to control subsidence which has amounted to nearly ten feet since the turn of the century in the most critical areas. Maximum safe groundwater yields have been determined based on the requirement of controlling subsidence. The Brazos River, managed by the Brazos River Authority, is a short distance west of Houston and it flows directly into the Gulf of Mexico. There is no bay or estuary system at the mouth of the Brazos River so the environmental benefits to fish spawning and nursery areas of periodic flood flows does not exist there.

Here we have a case of four institutions having the potential for helping provide water supply to the city of Houston. Sheer has shown that the independent safe yield of the three lakes is 1,533,000 acre-feet per year. Safe annual groundwater yield is 337,000 acre-feet per year, giving a sum of independent yields from the three lakes and groundwater of 1,870,000 acre-feet per year. This assumes uncoordinated, independent operation of the three reservoirs. If the three reservoirs were operated jointly in a coordinated manner, the dependable safe yield would increase from 1,533,000 to 1,660,000 acre-feet per year, an increase of 8.3 percent. If the three reservoirs were operated jointly with groundwater supply, recognizing that temporary overdrafts of groundwater would not create severe subsidence problems, the joint yield increases from 1,870,000 acre-feet to 2,220,000 acre-feet per year, an increase of 18.7 percent. This clearly indicates the scope of water supply increases which are possible by jointly operating water supply systems. If the surplus flows of the Brazos River, which serve no significant beneficial use in the Gulf of Mexico, were captured, an additional 200,000 acre-feet of water could be provided.

This study, one of many of this nature by Sheer, clearly indicates the potential for increased dependable water supply through integrated management of water resource systems. However, such joint management is not easy when so many independent water institutions are involved. Future conflicts may exist which could have been avoided if the hydrologic facts of the water systems were better understood when the water agencies were established. This, again, illustrates the increasingly important role engineers can play in avoiding water conflicts by being more proactive in the political decisions regarding water institutions.

ACTION WE MIGHT TAKE

Certainly, the engineers should look at the factors which are key to the feasibility of water projects. Sometimes the key reason for our work is improvement of a needed service to people and our job is to find a way to solve the problem. We may come up with physical solutions to the problem and in so doing lose sight of the real problem. We must better explain our assumptions and the precise meaning of the terms we use. An example is the expression, "dependable water supply." I could ask you to define "dependable water supply" and I venture to say that many of you would give me a different answer. So, we have communications problems which may lead to misunderstanding and conflict.

I suggest that on every project we should conduct an "analysis of potential conflict" (APC). I am not interested in building bureaucracy, but when a project involving the public is built, I think we should do an APC. It should be part of the project documentation. The engineers and hydrologists should look at the potential conflicts and how these could be resolved. We should think of the potential conflicts which might result from the various uncertainties, the lack of knowledge, the assumptions, etc. Then we might come up with expert systems (artificial intelligence) approaches to resolving conflicts. We could even use simulations to help with the process. Ideally, we might develop a procedure whereby we can look at various types of conflict and establish a framework for solving them before they actually exist. It is difficult to be totally rational in the heat of a contentious battle. The APC process would allow us to play "what if" games before-

hand and, thereby, avoid conflicts or quickly resolve them if they occur. These are like the "war games" of the Department of Defense.

Engineers should reexamine some of our programs with an eye toward conflict resolution. We have many cooperative programs in our engineering colleges. These coop programs are involved with industry. It would be fantastic for engineering students who work with water resources problems to engage in an experimental coop program involving the agencies concerned with conflict resolution. This would give the students experience interacting with the public. It would illustrate how we can play an important role in helping to solve these problems. It could involve an internship type of experience.

I emphasize to students that I don't care how good the engineering solution is, if the public doesn't want it, then it's not a solution. Moreover, if it is likely to result in conflict, it is not a good solution. So, I think having some of our colleagues actually experience internships involving public policy and conflict resolution issues would be extremely important.

At one time water development was driven by physical potential for development. And now the overriding question is whether the activity satisfies the desires of the public. Many have blamed engineers for projects developed in the past. But that's what the political leaders and the public wanted and it's best we not forget that fact. Nonetheless, we need to adjust the way we do things. Perhaps we need to look at some modifications in our curricula. Engineers will always play a role in natural resources development and, therefore, should prepare ourselves to better interact with the decision makers on water projects. We must be up front with our input on resolving conflicts. If not, too often the courts will have the last word.

Note: This paper is a revision and expansion of a paper entitled, "Expanding the Role of the Engineer in Conflict Management," prepared for an Engineering Foundation Conference in Santa Barbara, California. The proceedings of that conference were published in 1989 in *Managing Water Related Conflicts: The Engineer's Role*, edited by W. Viessman and E. Smerdon.

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