

THE FUTURE FOR WATER RESOURCES PLANNING AND DECISION MAKING MODELS

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ABSTRACT

Despite growing awareness of water and a resurgence of watershed organizations, a quick return to river basin and traditional planning processes is unlikely. National and river basin approaches have been receiving diminishing support and new opportunities to apply a traditional planning process are small in number. The present consensus oriented watershed approach focuses on water quality protection absent a clear planning paradigm. Nevertheless, the watershed approach is likely to create, over the longer term, renewed demand for planning methods and tools and there is current evidence of the kinds of tools likely to be demanded.

INTRODUCTION

Water awareness appears to be growing, fueled by fear of pollution or scarcity. It is often based on misleading aggregate numbers, shallow analysis and little awareness of history, water allocation capability and water's ability to produce economic benefits. At meetings all over the world, there is discussion of the need for Integrated Water Resources Management (IWRM). Although IWRM is well understood as a concept, it lacks very precise definition. At the same time, we hear that water must be valued better; that it is an economic as well as a public good. Because of population growth, development needs, and most important, ecological integrity and service needs, the claims on water are growing and the mix of use patterns is changing. Thus, we hear calls for integrated water resources planning, better coordination, holistic approaches which integrate water quantity and quality, and various sectors of the economy. Many long awaited and predicted watershed activities have begun in the U.S. and are being funded. Is the time now at hand to reapply the vast reservoir (to use an appropriate metaphor) of our experience with water resources planning models for decision making? If so, critical questions are - how to best identify which past models best apply and, which parts of those models have the most relevance to current and near term future water resources settings?

Much of today's debates around IWRM mirror arguments, discussions and the rise and fall of other national and regional water resources organizations, as well as activities

within the Institute for Water Resources (IWR) over the past 25 years. With this metaphor in mind, a brief look at where we have been and where we are today may provide some basis for predicting where we are going in the near future. Several key considerations are relevant to this discussion. There is an unfortunate lack of understanding about past multi-objective water resources development theory, planning and practice in the emerging IWRM paradigm. This includes the unique experience of the U.S. Water Resources Council (WRC) and the various forms of river basin commissions. The failure to learn from and to incorporate key elements from the past paradigm for thinking about water resources could seriously hinder the effectiveness of new approaches. In particular water resources management institutions, multi-objective planning conceptual frameworks and analytical procedures for evaluating and deciding among options are currently missing. While the past has much to offer the emerging IWRM paradigm, times have also changed and the insights and approaches of the past need to be updated and modified to fit the needs of the present. In this context, recent work at the Institute may also help to illustrate, through example, some direction for such efforts. Finally, this discussion will serve to identify areas in which additional work is needed to help apply the lessons of the past to the needs of the future.

WHERE HAVE WE BEEN?

The U.S. has now achieved a preeminence in the world as a regulator of water quality and wetlands with perhaps the world's most comprehensive approach.¹ In addition, the U.S. occupies a significant position as a developer of water resources with about 15% of the world's major dams.² They have provided a stable environment for settlement and economic growth and also provided remarkable resilience to meet flood and drought emergencies and changing needs including the environment, a tribute to past good planning, management and decision making. That capacity for adaptation still exists and can continue to serve the Nation well as more efficient system operations of existing projects emphasize quality and the environment as the predominant activity.

Although some few, smaller dams will likely be built, it is fair to say that dam building activity had already peaked in

the U.S. prior to the landmark Water Resources Planning Act of 1965 which established the Water Resources Council (WRC) and the Title II River Basin Commissions.

The Council completed two national assessments and correctly predicted the leveling off of water withdrawal demands which has occurred over the last twenty-five years. Although Title II of the Act provided the opportunity to establish up to 18 river basin commissions, only seven (Great Lakes, Missouri, New England, Ohio, Pacific NW, Upper Mississippi and Souris-Red-Rainy) were ever established. These were in addition to the three interstate compact commissions (Delaware [DRBC], 1961; Potomac [ICRPB], 1940; and Susquehanna [SRBC], 1970). The Title II commissions were charged with preparing comprehensive coordinated joint plans with Federal agencies and the states. The Interstate Compact Commissions have chartered powers of the implementation beyond the planning and coordination function.

The Council also developed the Federal multi objective, multipurpose planning procedures under the WRC's Principles and Standards (P&S) and later Principles and Guidelines (P&G) for Water Resources Planning which included benefit-cost analysis for water quantity planning.

The procedures also provided for explicit planning objectives, National Economic Development (NED), Environmental Quality (EQ), Regional Development (RD) and Other Social Effects (OSE) and multiple purposes such as navigation, flood control, irrigation, water supply and recreation. They also included public involvement, economic, social and environmental analysis. These more rigorous procedures and comprehensive planning practices were developed and applied after basic development needs had been met, providing tougher tests for additional development. Planning was done in a multi objective framework where the project level outputs (benefits) and alternative plans were compared to costs and a forecast without project condition. The traditional river basin (and subwatershed) and Federal project planning agency approach relied on an iterative planning process which included the following tasks:

- Step 1 - identifying problems and opportunities
- Step 2 - inventorying and forecasting conditions
- Step 3 - formulating alternative plans
- Step 4- evaluating alternative plans
- Step 5 - comparing alternative plans
- Step 6 - selecting a plan

A viable outcome of this process could be to select a no project or action plan as the best investment decision. Past water resources development and adaptive planning and

management had provided the luxury of a relatively stable environment for additional investment decision making. Decision making also became harder in this time frame with conflicting demands and increasing concern over the environment and water quality.

The tough standards for Federal participation in water resources development did not apply to the regulatory water quality programs of the Environmental Protection Agency. These needs at the time were large and support of the need for focused separate action existed. On the other hand, the Nation's water quality programs have now proceeded through a significant development program of their own driven by ever increasing regulation and have satisfied many of the most basic and less costly quality needs. The Nation's overall environmental improvement has now created a new base from which to judge the need for and approach to additional improvements. In recent years, the watershed approach has been receiving significant support from environmental and water quality interests desiring to improve decision making approaches by those concerned with incremental costs and trade-offs for additional improvements. There is a degree of parallelism between the historical development of the Nation's water quantity and water quality programs allowing for the differences between the planning and regulatory approaches and program development time lag.

WHERE ARE WE TODAY?

Today, the water sector is in a transition or readjustment period accompanied by much discussion about IWRM. Although the U.S. has an impressive and well documented history in this regard, it is often not applied to current IWRM discussion. The single purpose regulatory model now appears insufficient, costly, and absent a larger context to many. The need for capital along with increased demand for water has encouraged better pricing and valuation of water, increased local cost sharing and responsibility for water resources development, and more explicit attention to subsidies. But the need for integration between water quantity and quality approaches as a public responsibility is still not well addressed. Paradoxically in this setting, the benefits of all past planning efforts are hard to describe even for those who were intimately involved, as much of the focus tended to be on the need for project development within the specific mission areas of each of the involved Federal agencies. Adding to this difficulty was the diminished need for new projects, often confirmed by planning, and the noninclusion of water quality programs in the P&S and planning efforts.

The issue of the value of planning coordination forums also remains large to some observers. In this regard, Federal funding for the Council and the Title II river basin commissions was terminated in 1981. Several of the commissions, however, have maintained an organizational forum for coordination with voluntary state contributions (Ohio, Missouri and Upper Mississippi). The most active at present is the Upper Mississippi where the governors signed articles of association forming a non-profit organization to promote the Upper Mississippi basin states interests. The Federal agencies are invited to the Association's quarterly meetings, but have no vote. It does no planning, but serves as a state/Federal coordinating forum and as an advocacy group for the state's interests. The Federal funding share for the interstate compact commissions was not a part of the President's budget request in FY 1996 or FY 1997, although funds were received as a result of congressional action in FY 1996. The Federal government is legally a party to the DRBC and the SRBC, but not the ICPRB. The Interstate Council on Water Policy (a state and regional water agency organization) has recently formed a standing committee on river basin committees to coordinate between the weakened remaining entities. The lack of forums to coordinate state/Federal programs is one of the most often and significantly cited voids in U.S. national water policy.³

⁴ One apparent anomaly to the overall river basin organization trend is the effort by three states - Alabama, Florida and Georgia - to form new interstate compacts for the Appalachicola, Chattahoochee, and Flint (ACF) Rivers and for Alabama, Coosa and Tallapoosa (ACT) Rivers. This new effort to establish forums to facilitate allocation of water between the states in very contentious settings appears to be at least partially based on the application of new shared vision planning models. The Federal government, although a party to the compacts, would be subject to a veto by any state of any compact decision.

Curiously, amidst the clear downturn in larger scale public river basin and water planning, the U.S. is also experiencing a watershed revival. The 1996-1997 River and Conservation Directory lists more than 3,000 citizen watershed-related organizations in the U.S. The Environmental Protection Agency (EPA) has established and funded various financial and educational assistance programs to assist this process. In addition, there are now numerous watershed conferences and much watershed rhetoric in the U.S. as well as activities like the American Heritage Rivers program. At the same time, the Natural Resources Conservation Service's PL566 program continues to be minimally funded. This is consistent with the overall downward trend in Federal funding for traditional water programs and increased cost assumption

by local interests. Increasingly, remaining Federal agency funding is also devoted to operation, maintenance and management of the existing systems. Today's emerging watershed protection approach, which is providing the impetus for the funding, formation and proliferation of watershed organizations, hardly refers to planning much less a structured iterative or multi objective planning process characteristic of the past. The EPA Watershed Approach relies on the use of local consensus based processes to restore and protect the Nation's waters, ensure safe drinking water and conserve and enhance aquatic life and habitat. It began in 1991 recognizing that the highly fragmented nature and one-size fits all approaches to the water quality program were insufficient.⁵ The organizations engaged in watersheds today are varied in form but the emphasis is on local decision making to meet specified problems and opportunities in watershed protection and regulatory needs. Lack of broader and more explicit public planning processes to include other water management objectives, however, denies the synergistic opportunities to create greater benefits by focusing too narrowly. Explicit means to consider multiple uses, alternatives, benefits and costs are often lacking. While motivated by important values, this can under-serve the public.

The rapid growth of the watershed approach is a wholesome response to the norm of ecosystem management. However, ecosystem management is ill defined and often confusing in its objectives. Environmental regulations and regulatory agencies such as the EPA have been leading in these initiatives. To a great degree, the regulatory model of local participatory planning has replaced traditional models of public sector planning. Since desired results are often specified in advance, the process is often akin to focusing on site and design processes completely skipping initial problem definition planning steps necessary to establish objectives and compare alternatives. Consequently, many who consider themselves planners today have experienced only this limited coordination for consensus seeking or for siting and design for a selected plan focused on watershed protection and believe it to be a complete planning process. Coordination alone in the traditional multi objective planning model would not constitute watershed planning; it would be necessary to the process, but not sufficient. Current watershed efforts and planning also lack a recognizable planning and evaluation framework designed to address multiple purposes and objectives and to address inter-agency endeavors that go beyond one watershed or to build to the river basin level of management. Yet, the cost to the Nation for floods seems to be rising as documented by the Galloway⁶ report among others. Drought and other water management concerns

remain large as well. Today's approach also seems to focus on single purposes and existing resource use failing to recognize, forecast and compare alternatives, let alone costs and likelihood of success.⁷ This seems to be a long step back to those days before Gilbert White's call to multi purpose water management?⁸ The EPA has, however, established a Watershed Academy for information and training. In fact, EPA's current best-selling document is its *Lessons of Watershed Planning*. The irony of this situation seems to be, if the watershed approach is so good, why aren't we also returning to good comprehensive river basin planning, linking the watersheds and all water management functions at a larger level? Why are we not funding river basin organizations or other such fora as in the past?

Just as ironically, today's students also seem little interested in the tools of traditional iterative and multi purpose planning or in the history of water resources planning methods and study of water institutions. Indeed, the latter topic is invisible in most water-related curricula today. Informal surveys also indicate that planning students now prefer to take jobs with private sector firms as opposed to public agencies in order to focus their talents on well-defined technical work absent community involvement and the vision establishment process inherent to setting objectives, forecasting and alternative consideration.⁹ This reductionist approach, geared toward eliminating unknowns from problems in order to focus on and develop a solvable problem context, further facilitates the siting and design approach to >planning=.

At this point, past national and regional water resources planning organizations are disappearing, a new consent seeking watershed approach to water quality protection is growing in strength, experienced water resources planners in the traditional six-step model are aging and disappearing from the workforce, opportunities for younger planners are scarce and many who consider themselves planners have experience only with a more limited siting and design approach to problem solving. The >planners= who fall into the latter category are now a large part of the active planning community.

WHERE ARE WE GOING?

Faced with the present situation, one might conclude that the future for planning and decision making models is not bright. The bad news for those who espouse a return to the WRC and river basin model, is that at a minimum even with Federal funding and including water quality interests, it is not likely for at least the next decade due to lag time in funding and developing new programs. By that time most remaining experienced planners will be out of the work force. Diminished Federal agency programs for

project development will, on a small scale, continue to use a complete planning approach and wetland's regulatory programs will adapt some area based planning methods since it is becoming more difficult to make decisions on a permit-by-permit basis. New approaches to wetlands regulation using special area management plans and wetlands mitigation banks, presently in use, attest to the latter. In addition, the rigor and cost of planning will also be reduced because of budget concerns. Coordinating forums at the river basin and national level similarly do not appear likely to be reestablished in the near future except where interstate issues and interests appear sufficient to justify continuance or ad hoc establishment by state action.

On the other hand, even though planning as a process, in whole or in part, appears absent from the present quality protection oriented >watershed approach=, the commendable focus on community involvement for consensus will inevitably create a demand for some level of alternative comparison in some watersheds if only through inclusion of different interest groups. As was the case with traditional water project planning processes, an involved public will have different objectives represented by different interests and concern over who pays and for what especially since many easier to obtain water protection benefits have already been obtained. In the future, alternatives might be expected to be compared including cost comparisons for similar outputs as budget constraints continue and improvements seem to be relatively small, more uncertain and more costly. In a lesser number of cases, one might also envision demand for application of a complete planning process, especially where multi functional demands (flood control, wetland preservation, recreation, development, etc.) proliferate. The need to link watersheds to a larger area context including the river basin level might also be foreseen as a longer term outcome of increased involvement of a paying public. In this scenario, a reexamination of past institutional frameworks, analytical tools and processes to develop options, assess impacts, evaluate tradeoffs, assess risks and to build enough agreement to choose water futures can be foreseen. However, analytically, opportunity costs are now coming to be viewed as the basis for economic analysis rather than the more stringent benefit-cost procedures associated with traditional water projects planning. This analytical framework accommodates greater consideration of environmental protection and restoration as well as participatory approaches. The important message, however, is that some analytical framework is necessary for regional and national water management to achieve meaningful watershed management. Meaningful stakeholder participation is necessary, has often been ignored, and

drives capacity to reach agreement and to maintain the programs and projects. But the best efforts will fail in situations which require an effective tie among watersheds. Such ties depend on stakeholder negotiations, often through institutional arrangements such as river basin organizations, but also evaluative frameworks built on some level of critical ecological, economic, engineering and resource criteria. In this scenario, the near future for water resources planning and decision making models is not likely to be a return to the Federally-dominated WRC and P&S-based planning to now include water quality. Instead, movement toward easier-to-apply complete planning models along with special purpose models and methods to cost effectively address parts of the process is more likely.

We are witnessing major data gathering, software and hardware breakthroughs which are helping to improve the dialogue among water professionals and the publics they serve. They are helping to increase the water literacy of all. Real time and interactive simulation and model building is on the verge of revolutionizing the process of water negotiation. In the past, experts listened, then went and built brilliant models that only they could manipulate. Not surprisingly those models reflected, in many cases unconsciously, the values or reductionist context of their creators. Those stakeholders who were so disposed could simply call them a black box producing answers the experts, but not they, wanted. But today, it is possible to jointly and cheaply create sophisticated models with high validity in real time with professional and non-professional stakeholders. It is a little like playing computer games with a river basin or watershed. The point is that the algorithm used is jointly owned by the stakeholders and, using negotiation theory, the screen becomes a single text-negotiating document. This helps parties to create shared visions. It creates a cognitive map of alternatives in situations where parties are primarily disposed to claim value as opposed to creating value.

Such real time modeling, when combined with real time satellite data gathering, could also, in the future, link planners and operators together in ways that minimize the impact of disasters. A past example of the potential power of this information revolution is the Interstate Commission for the Potomac (ICPRB). With little power other than a low flow statute, the commission has brought parties together on a routine basis for joint real time simulation as described. Building a level of trust around the data produced so that the parties will act on the results produced in these simulations. Drought and disaster response has been markedly improved by this process.

Using the IWR program as another current market test and mirror, the demand for recent Institute products of this nature illustrates the discussed trends. The increased use of the Institute as a special planning problem solver—where teams of experts can be assembled to apply either complete P&G or special planning processes to tough problems also illustrates the need to retain special centers of expertise. This is especially true because decreased overall demand results in lower planning experience and staffing levels across any organization including the Corps. The product models currently used at IWR form a conceptual spectrum of capability ranging from the complete six-step planning process to specific portions of the process or to special purpose needs; they are internally consistent and compatible in application.

The illustrative models are :

Planning Manual¹⁰ and Primer¹¹ - used as simple guidance and instructional material for new and relatively inexperienced planners. It is fully compatible with the P&G and helps to inform planners and the public alike of the orderly nature of the complete process and its advantages. Despite the self evident nature of these documents to experienced planners, they have become best sellers in today's environment where many have not had experience in the complete process.

Shared Vision Planning¹² - a way to use computers to help stakeholders participate in rigorous P&G compatible water resources analyses. It need not be driven, however, by NED criteria and does not need to end with plan selection, but can become a tool for continuing adaptive management. It bridges the gap in multi objective planning between specialized computer analysis tools and the way people conceptualize problems and make decisions. Because experts and stakeholders can build these models together, including elements that interest each group, they become a trusted, consensus view of how water systems work as a whole, and how they affect stakeholders and the environment. The flexibility of the models makes it easy to analyze the sensitivity of conclusions to errors in data, changed forecasts, or conflicting assumptions about how water systems respond as well as the benefits and costs of alternative courses of action in a consistent and replicable manner. The demand for this more rigorous approach is especially evident with especially tough, or nearly intractable problems, as evidenced by requests for use in settings such as Devil's Lake and the ACT-ACF.

Simplified Decision Support Software: IWR PLAN¹³ conducts three processing functions: formulation of combinations, cost effectiveness analysis of combinations, and incremental cost analysis of cost effective combinations ; identifying the plans which are the best financial investments and displaying the effects of each on a range of decision variables. The system will formulate alternative combinations of solutions and compare their effects on up to ten user specified decision parameters. The results from different scenarios can be compared through IWR-PLAN's multiple scenario comparison module. A variety of graphing and reporting options are available. All graphs and data in an IWR-PLAN file are directly exportable to a range of other programs to assist with reporting. IWR-PLAN also comes with an on-screen help system which provides instruction for all forms and functions in the program.

The Corps of Engineers and the Natural Resources Conservation Service cosponsored IWR-PLAN development, an indication of its broader applicability. It is available for downloading on the Internet and has proven very popular.

Other Models: The Institute has developed or adapted process and philosophical approaches to public involvement, alternative dispute resolution, wetlands mitigation banking and drought planning among other topics which have constituted a large request area for information.

CONCLUSION

River basin organizations and the traditional six-step planning process will not experience a quick rebirth due to the present popularity of the watershed approach. However, the increased public involvement created by the approach will inevitably recreate some demand for a more structured planning approach to balance the objectives of different interest groups and compare costs. Maintaining a

critical mass of analytical planning expertise until demands increase will be a challenge. The IWR example models are heavily demanded and constitute a current market test of needed expertise and of approaches. Numerous reimbursable training workshops have been requested by other agencies, organizations and levels of government. Numerous downloads of software from the Internet is also indicative of building demand. The development and promulgation of easy-to-use models with training to assist planners in addressing parts of the planning process or special functional needs appears, based on the current market, to be the biggest immediate future need. Based on current work and the projected longer term outcomes of the watershed approach, a beginning list of additional need areas for improved planning and decision making processes and models can be presented for discussion as follows:

- Institutional - Organizational models to retain in-depth, six-step planning expertise and the ability to tech-transfer to future generations.
- Watershed integrating forums and tools encompassing protection and water management decision making.
- A family of six-step planning methods and software adaptable to various budget scenarios.
- Adaptation of planning decision making models to alternative management of existing systems.
- Revisitation of public involvement and ADR processes assisted by development of new interactive software and models which can be more cheaply applied by planners themselves.
- Development and adoption of software and models for ecosystem improvement, restoration and regional wetlands permitting.
- Models to include and compare water quality on an equal basis with other water functions.

ENDNOTES

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