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Overview Of The Environmental And Water Resources Institute's "Guidelines For Integrated Water Resources Management" Project

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OVERVIEW OF THE ENVIRONMENTAL AND WATER RESOURCES INSTITUTE'S "GUIDELINES FOR INTEGRATED WATER RESOURCES MANAGEMENT" PROJECT

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It has been said that those who fail to learn from the past are doomed to fail in the future. Unfortunately, most people are no longer directly associated with or educated in the management of the water supply that fulfills their basic needs. Therefore, many people believe that water resources management is simply finding a source of flowing or standing water, building a bit of infrastructure to divert, harness or store it and then putting it to use. While this may be true for water users who first develop a given source, successful water management is often a more complicated, robust and iterative process. With the addition of each new user and with each incremental increase in the amount of water being used from a given source, water resources management becomes incrementally more complicated. In the end, successful water resources management programs must incorporate historical and hydrological knowledge, law, socioeconomics, engineering and many other disciplines in order to reduce conflicts and to maximize utilization of the available resource.

Integrated Water Resources Management is a systematic approach to optimizing our understanding, control and management of water resources within a basin to meet multiple objectives. Recognition of the need for integrating water resources within basins is not unique to the Environmental and Water Resources Institute's Integrated Water Resources Management Task Committee. Many individuals, governments and other organizations have attempted to develop holistic water resources management programs. In some cases, the results have been very effective and in other cases, valiant attempts have fallen far short of their initial goals. The intent of this Task Committee is to provide a set of guidelines that discusses the concepts, methods and tools necessary for integrating and optimizing the management of the physical resources and to optimize and integrate programs, organizations, infrastructure, and socioeconomic institutions into comprehensive water resources management programs.

Historical Basin Development

Historically, water resources management has focused on the hydrologic and engineering aspects of water development. It has been seen as a simply using Man's ingenuity to "harness nature". Within most basins, development began with an individual or a group of individuals finding a good piece of land adjacent to a small body of water that was easily accessible and/or where water could be cheaply and easily harnessed or diverted. If the hydrology met local needs, it was simply used "as is". If it did not, engineering solutions were devised to "tame" or "harness" the resource to meet local needs. Since these projects tended to be small and isolated and they typically impacted a relatively small portion of the resource, there were few conflicts and there was little need for collecting hydrologic information or developing a legal or administrative infrastructure.

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Later, as demands continued to grow, larger private companies, local cooperatives, quasi-governmental entities or local/state governments began engineering larger scale projects to harness or divert larger bodies of water in order to serve a larger number of constituents. However, with the addition of new water users, the cost to develop the source and the potential increased as they begin to tap more difficult portions of the source and had to covey the water further from source, and more conflicts typically arose as more users begin to compete for seasonally finite supplies. During this phase of basin development a limited amount of characterization, monitoring, measurement and regulation of the resource became necessary to ensure the reliability and economic viability of these projects. Typically these efforts were confined to the area immediate impacting the project.

Finally, in many basins government agencies became the primary developer of large, complex projects to address very large or very difficult resources issues or to meet other large social economic goals and needs (e.g., depression era "make-work" projects). These projects typically impacted large areas and, therefore, required extensive *a priori* planning and management and, at least within the project boundaries, required relatively extensive characterization, monitoring, measurement and regulation of the resource. However, even large government projects did not necessarily require that the management, utilization or regulation of the resource be compatible or integrated with other unaffiliated projects within the basin or consider the ecological impacts of development.

Each historical development phase contributed a piece of the overall water resources management and infrastructure puzzle that we observe in our developed river basins today. And the cumulative results of development within a given basin introduced a historical puzzle that we must try to understand and balance with present and future needs in those basins today. In some river basins, the water resources projects, management systems and infrastructure evolved into effective, comprehensive, well-integrated systems. In other cases the myriad of projects, infrastructure and programs that developed over time remained independent or become only partially integrated, often to meet specific local needs or goals. In many basins, explosive population growth, climate change, extreme climatic events, continually increasing demands and changing water need are beginning to expose the frailties of poorly integrated basin management programs and infrastructure.

In undeveloped basins, or in relatively undeveloped basins, Integrated Water Resources Management can be a useful tool for conducting *a priori* assessments and planning in order to conduct orderly, integrated basin development and management in the present and in the future. In developed basins, Integrated Water Resources Management can be a useful tool for evaluating the existing water resources management and infrastructure and to optimize existing infrastructure and management practices in order to reduce conflicts between water users, to improve ecological sustainability and to meet other established basin goals.

Attempts to Integrate Basin Management in the US

Many water resources professionals will argue that integrated water resources management is already practiced in the in the United States. This is based on the fact that many Federal and

state laws and policies have been passed which require or recommend comprehensive assessments, the coordination or integration of the management practices and infrastructure, and consideration of the social, economic and environmental impacts of water resources projects. However, the degree to which these laws and policies actually addressed the comprehensive integration of water resources management and the degree to which they have been implemented vary greatly. Muckleston (1990) states:

> *If the term "integrated management" denotes '... the simultaneous consideration of formerly separate resource development problems'...then this management technique has indeed a long and extensive history in the United States; but if the definition describes 'the management of a system of complementary facilities under single control...in a manner which maximizes the combined net benefits from the operations of individual reservoirs and other facilities'...examples are less frequent and of more recent origin.*

Muckleston (1990) and Adler (1995) provide excellent overviews of the numerous commissions and Acts that attempted to institute integrated water resources planning on the national scale. Some of the various Progressive Era commissions included; the 1908 Inland Waterways Commission, the 1909 National Conservation Commission, and the 1912 National Waterways Commission. Each of these commissions proposed coordinating the goals and functions of Federal water agencies, comprehensive water quality and quantity planning, linking cost-sharing with the benefits received from the project, and comprehensive basin planning. However, the primary driver of each of these proposals was social (e.g., populating the western United States) and economic development, therefore, they did not require environmental protection. None of these proposals were ever fully implemented.

The 1920 Federal Power Act required comprehensive basin plans; however, none were actually produced by the responsible agencies. However, many of the goals of the Act have been implemented in the non-federal hydropower sector via the licensing process (Muckleston, 1990). The 1917 Newlands Act authorized the Corp of Engineers to conduct comprehensive watershed planning for the purpose of flood control. The Corps used this authority to evaluate virtually every basin in the United States that wasn't under development by the Bureau of Reclamation. However, focus of these evaluations was the potential for developing flood control, hydropower, navigation, and irrigation projects and once again ignored ecosystem needs (Adler, 1995).

River basin planning during the early part of the New Deal era included comprehensive plans by the National Planning Board, the Water Resources Committee and the National Resources Planning Board. These plans also called for comprehensive planning that balanced the various economic needs within a given basin (e.g., flood control, hydropower, navigation and irrigation). In addition, these plans recognized the link between land use and water quality and quantity and pushed for the creation of jobs in order to help overcome depression-era unemployment. In the late 1940's through the 1950's a number of presidential river basin commissions were appointed. These included the 1949 Hoover Commission, the 1950 Water Resources Policy Commission, and the Presidential Advisory Commission on Water Resources Policy. These primary recommendations of these commissions included the consolidation of most federal water programs into a single cabinet-level department, joint federal-state commissions to conduct water

quality and water quantity planning and management, and independent project reviews by basin-level commissions, respectively.

The 1961 report by the Senate Select Committee on National Water Resources proposed the development of comprehensive basin management plans for all major river basins, the coordination of federal water programs, and increased federal and state cooperation. In addition, it advocated the consideration of both water quality and water quantity in planning and management of river basins. This report eventually led to the development and passage of the Water Resources Planning Act of 1965. The Act created the Water Resources Council, comprised of the heads of federal departments and agencies and authorized the President to establish river basin and related lands resources commissions, as recommended by the Council and with concurrence of at least half the states within the basin. Seven basin commissions were eventually established, including; the Pacific Northwest, Great Lakes, Souris-Red-Rainy, New England, Ohio, Missouri, and the Upper Mississippi commissions. While the Act called for comprehensive basin planning, like its predecessors it focused on economic development within the basins with little concern over environmental issues. In addition, although the Act required federal and state cooperation, most states believed that it gave too much control over basin planning and management to the federal government. In the end, most states were unwilling to cede those authorities to the Federal Government and in 1981 the Water Resources Council and the basin commissions were disbanded.

The most recent attempt to develop a national water resources commission was introduced in 2005. Congressman Linder (R-Georgia) introduced H.R. 135, "Twenty-First Century Water Commission" to study and develop recommendations for a comprehensive national water strategy to address future water needs. Under this bill, the President and Congress would jointly appoint the commission. The purpose of the commission would be to evaluate existing water assessments and conduct additional assessments, as necessary, to project future water supply and demand. In addition, the commission would to evaluate existing Federal, Interstate, State, and local agencies, and private sector entities and water management programs associated with increasing water supplies and improving the availability, reliability, and quality of freshwater resources. Finally, the commission would consult with those agencies and private entities to develop recommendations for a comprehensive water strategy which:

- respects the primary role of States in adjudicating, administering, and regulating water rights and water uses;
- identifies incentives intended to ensure an adequate and dependable supply of water to meet the needs of the United States for the next 50 years;
- suggests strategies that avoid increased mandates on State and local governments;
- eliminates duplication and conflict among Federal governmental programs;
- considers all available technologies and other methods to optimize water supply reliability, availability, and quality, while safeguarding the environment;
- recommends means of capturing excess water and flood water for conservation and use in the event of a drought;
- suggests financing options for comprehensive water management projects and for appropriate public works projects;
- suggests strategies to conserve existing water supplies, including recommendations for repairing aging infrastructure; and

- includes other objectives related to the effective management of the water supply to ensure reliability, availability, and quality, which the Commission shall consider appropriate.

This legislation is a limited purpose proposal that is reflective of the current on-going droughts thorough out much the United States and the increasing demands being placed on water resources in areas which are experiencing high population growth. The bill's primary objective is to increase water availability. In addition, it emphasizes state authority over water allocation, avoiding Federal mandates, and the elimination of duplication and conflict among Federal water programs.

Attempts to Integrate Basin Management Internationally

Within given basins, there are many examples of coupled or integrated water projects that have been planned and constructed internationally. However, their level of integration and the degree to which they meet the goals of integrated water resources management vary greatly. The attempt to formalize the concept of integrated water resources management internationally began with four basic principles agree upon in 1992 Dublin Principles that became the basis for the United Nation's Agenda 21 and for its millennium development goals:

- Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment. This principle recognizes the fact that water sustains all life on earth. Therefore, the effective management of water resources must utilize a holistic approach which links land and water uses throughout each basin including both surface water and ground water resources in order to met social and economic development goals while protecting the natural ecosystem.
- Water development and management should be based on a participatory approach, involving users, planners, and policy-makers at all levels. This principle recognizes the fact that in order to develop and operate an integrated program, it is important to educate, and include the broadest range of participation among users, managers, policy-makers regulators and the general public participation in the planning and implementation of water projects. It also recommends that decisions should be made and implemented at the lowest appropriate level of government.
- Women should play a central role in the provision, management and safeguarding of water. Such a principle may seem unnecessary to many people in developed countries. However, it is reflective of the fact that in many parts of the world women are the primary providers and users of water and the primary protectors of the environment, yet they often cannot own water rights and they often no say in the management or development of water resources.
- Water has an economic value in all its competing uses and should be recognized as an economic good. This principle is probably one of the most controversial principles put forth in Dublin. On the one hand, because water is vital to the survival of all life access to water is recognized in many parts of the world as a human right. On the other hand, because there are inherent costs associated with the development and delivery of water resources, someone must pay those costs. This principle tries to strike a balance that recognizes the basic right of all human beings to have access to clean water and sanitation at an affordable price, yet it recognizes that the failure to value water as an

economic commodity has led to wasteful and environmentally damaging practices. By managing water as an economic commodity, it is believed by some, that we can manage the resource more efficiently and equitably, and increase the level of conservation and protection of water resources.

Agenda 21 was developed at the United Nations Conference on Environment and Development (the "Earth Summit) held in Rio de Janeiro, Brazil in 1992. It was developed as an action plan for sustainable development throughout the world in the 21st century. Chapter 18 of the agenda, "Protection of the Quality and Supply of Freshwater Resources: Application of Integrated Approaches to the Development, Management and Use of Water Resources" establishes seven major program areas for the freshwater sector:

- Integrated water resources development and management;
- Water resources assessment;
- Protection of water resources, water quality and aquatic ecosystems;
- Drinking-water supply and sanitation;
- Water and sustainable urban development; Water for sustainable food production and rural development;
- Impacts of climate change on water resources.

The overall objective of the integrated water resources development and management program is to satisfy the freshwater needs of all countries for sustainable development. While this goal and its associated objectives are rather lofty and may not be obtained by every country, Agenda 21 was ratified by 178 heads of state and government who committed to do so within the limitations of their abilities. Many countries around the world are now developing freshwater sustainability plans and programs, including integrated water resources management plans, for national and/or regional implementation.

What is Integrated Water Resources Management?

Integrated Water Resources Management can mean many things to many different people. To some Integrated Water Resources Management is simply thought to be developing an understanding of and co-managing surface water and ground water sources within a hydrologically competent basin for water allocation purposes or maybe include the integration of water quality and water allocation management. To others, integrated water resources management also includes understanding and/or managing land uses that directly affect water quality and quantity, the impacts of freshwater flows on coastal waters, and ensuring the long-term sustainability and viability of associated natural ecosystems. Yet others add institutional, social, political and/or economic aspects of water management to the growing list of things that could or should be managed in an integrated manner. For some, this would include using integrated water resources management as a tool for achieving human rights and gender equality. At its loftiest, integrated water resources management could be considered some unitary tool or process that allows us to understand and optimize all water-related physical, sociopolitical and economic aspects associated with water within a given river basin. Integrated water resources management can be any and all of the above concepts - the issue is really what aspects of water resources management are of interest within a given basin, and to what level of detail does one need or have the resources to address these issues.

For the purpose of this document, "integrated water resources management" is presently defined as:

> *The integrated and multidisciplinary evaluation and management of atmospheric water, surface water and ground water and the land that affects water quality and water allocation in order to meet the needs of both society and the ecosystem on a sustainable basis. This includes incorporating the social, economic and environmental values of water and the need for sustainable management of the water resources with the full participation of the government, communities and the private sector.*

The primary goal of integrated water resources management is to develop a comprehensive understanding of the available water resources and human and ecological water resource needs within a given basin, and then to manage those resources in an equitable and sustained basis. A number of objectives associated with integrated water resources management are provided in Figure 1.

For the purposes of this effort, integrated water resources management is considered to be a holistic management philosophy intended to integrate the assessment, management, protection and utilization of all water resources within a basin to meet the needs of humans on a sustainable basis, while still protecting the integrity of the resource and its associated ecosystems. Therefore, by necessity, such a program must be very encompassing. It must include an understanding of the physical factors that that affects the timing, location, quality and quantity of the water resources within a given basin. In addition, it must also include an understanding of the human and ecological needs and uses, and the processes, institutions and infrastructure that are use to manage water resources within a given basin.

The EWRI Integrated Water Resources Management Project

Development of the Environmental and Water Resources "Guidelines for Development of Integrated Water Resources Management Programs," is a continuation of previous guidelines developed by the Laws and Institutions and the Water Regulatory Standards Committees of the Environmental and Water Resources Institute. Each of these guidelines (e.g., Draper 2002; Dellapenna 1997; Erheart 2002) focused on specific legal, social or economic areas of water management. However, each document reflects the need for integrating the numerous water-related disciplines, diverse stakeholder needs and desires, and the integration of the characterization, monitoring and management of all hydrologically connected sources of water and of the lands that affect the quantity and quality of water within a basin. These findings are not unique – other authors and organizations have drawn similar conclusions over the years (e.g., the United Nations and World Bank). However, there remains a large gap between our desire to integrate and optimize these resources versus our understanding of the extensive physical, social, legal, political, and economic relationships that affect these resources and our ability to develop new or remold existing programs, organizations, infrastructure, and socioeconomic institutions that manage them.

Figure 1. Examples of Selected Integrated Water Resources Management Objectives.

- Water resources should be evaluated and managed in an integrated manner on a basin-wide basis;
- Water resources should be allocated in accordance with the appropriate laws, customs and needs of the given basin, as agreed upon by the stakeholders within that basin and others who have legitimate interests in those resources;
- Water resources and their associated ecosystems, should be conserved and protected to the extent possible;
- Water has social, economic and cultural value, therefore, its preservation, allocation and use should fully reflect those values within a given basin;
- The allocation and use of water should accurately reflect the full economic costs and benefits of the stakeholders within that basin;
- Management needs to be implemented at the lowest appropriate level and should be coordinated with the appropriate local, regional, national, and international managers and stakeholders;
- All water resources should be managed to meet both human and ecological needs based on the principles of long-term sustainability;
- Land use planning/zoning should be integrated with water management to the extent that land use impacts the availability and quality of water available within the basin.
- delineating and characterizing the hydrogeology of the basin of interest;
- integrating the monitoring, management and use of all hydrologic compartments within a basin;
- harmonizing historical water practices and uses with current and future needs, or possibly ceasing old, non-productive water users to more beneficial contemporary uses;
- establishing an effective planning process to meet existing/future strategic and operational needs;
- establishing interdisciplinary planning and management teams that are able to effectively communicate using common terminology, that have a shared vision for managing water resources, and that understand where/when they need to interact within their team, with stakeholders, and with other affected parties;
- understanding and helping meet human (e.g., sociopolitical and cultural) needs;
- gaining institutional support and cooperation (e.g., how to effectively inform the administrative, regulatory and legislative powers in order to reform water management programs and practices);
- establishing a sound economic basis for managing water (e.g., full life-cycle cost estimating, financing, cost recovery and/or cost sharing);
- ensuring long-term ecological sustainability;
- improving/protecting public health;
- enforcing water rights and operational rules and requirements;
- optimizing operational and capital activities;
- integrating infrastructure, information, and other resources between sectors;
- optimizing information management (e.g., establishing consistent/compatible data standards, and effective data collection, storage and dissemination processes and infrastructure);
- developing constituencies and ensuring full and open stakeholder involvement;
- communication (e.g., being able to communicate between interdisciplinary teams, between cultures; and between professionals and the public); and
- addressing transboundary issues (if applicable);

The purpose for developing the Guidelines is to provide a vehicle for developing integrated water resources management programs and to show how such programs can be instituted in various basins throughout the world. It is also intended to provide a model framework, information and ideas that can be used to develop basin-specific integrated water resources management programs and to provide a summary of the tools and methods available for implementing such programs. It is not possible, nor is it the intent of the committee, to try to fully develop all of the specific information, institutions, programs or tools necessary to institute a fully integrated water resources management program in any specific basin. Rather, this document is intended to provide a comprehensive framework or menu of information, ideas, tools, methods and processes that can provide a basis for developing and implementing an integrated water resources management program in any basin in the world. Governments or other organizations can then choose from those ideas and information, institutions, programs and tools to develop basin-specific plans and/or protocols to help them build their own basin-specific program.

The Guidelines will utilize a tiered approach – it will consist of an overview document which provides a "big picture" or strategic overview of the basic goals, principles, issues and the various "building blocks" that need to be addressed in when developing an Integrated Water Resources Management program. The document will provide an overview of the purpose, scope and objectives of an "ideal" or "model" integrated water resources management program and a brief survey of the full scope of what should be incorporated in such a program. Then it will briefly discuss those issues that typically become barriers that block or retard the development of such programs and provide some suggestions for overcoming those barriers. Beneath this umbrella document will be a series of underlying technical documents that provide more detailed information to address specific issues, processes or methods needed to establish and implement such a program on an "operational" level.

While every basin is unique, the type of information needed to understand and manage a given basin is generally the same – typically, only the amount of information and the level of data quality required to manage a specific basin varies. In order to manage water resources in a basin we must develop an understanding of the geophysical resources and structures that comprise and delineate the hydrologic unit and those processes that affect the timing, location, quality and quantity of the water resources within a given basin. Therefore, this document provides an overview of the "anatomy" of a basin, and provides a summary of the types of information and evaluations necessary to delineate and characterize basins at a reconnaissance-, standard- and detailed-level.

In order to delineate and characterize and later to monitor and manage the water resources within a given basin, one must have an understanding of the suite of tools, techniques and processes that are available or that need to be developed to conduct such tasks. Therefore, this document provides a summary of tools, techniques and processes that can be used to delineate, characterize, monitor and manage a given basin reconnaissance-level, standard-level and detailed-level. These examples are intended to include everything from "rules of thumb" and basic tools to advanced cutting-edge tools, techniques and processes that are either becoming available or that could be developed in order to improve our ability to manage water resources in an integrated manner.

However, developing a successful integrated water resources-management program requires more than just understanding the hydrology and geology of a basin. It must also be based on an understanding of the institutional (e.g., the social, economical, political, legal and informational) issues, processes and infrastructure that dictate how we protect, allocate, and utilize these resources. This document provides an overview of various institutional programs, laws, institutions, tools and methods presently being used successfully to manage water resources in an integrated manner. In addition, it develops model approaches, laws and institutions, that can be selected and customized to meet specific local, regional, national or international (e.g., transboundary) needs.

Conclusions

Environmental and Water Resources Institute's Integrated Water Resources Management Task Committee has embarked on an ambitious effort to develop a holistic approach to manage water in an integrated manner on the basin level. The intent of the Task Committee is not to develop a basin-specific guidance document; it is to develop a generic overview or framework of the process, tools and methods that can be used as a technical reference or the basis for developing basin-specific plans. This process is intended to be a two to three year effort. Task Committee readily welcomes any constructive ideas, advice or contributions for the technical community that can enhance the outcome of this project. It also welcomes the involvement of anyone who would care to help write sections or portions of the Guidelines.

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