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Integrated Water Resources Management: Definitions and Conceptual Musings

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Integrated Water Resources Management (IWRM) is widely endorsed over the alternative, yet a deeper look at what the term means and what it implies has merits This paper derives a working definition that emphasizes a unified process directed toward achievement of a common goal. An analysis of U.S. Federal policy, specifically that of the Army Corps of Engineers' Civil Works program, suggests that the common goal for Federal water resources management is sustainable development. We present a framework, using the axes of time, space, institutions, and objectives, for examining the nature and degree of management integration. Finally, we compare this simple derivation to definitions of IWRM from various institutions, and touch upon the relationship of the term "watershed approach" to IWRM as used in U. S. Federal agencies.

Increasing demands on water resources from growing populations, increased concern for environmental quality, and greater recognition of the interrelationships of competing water resource demands prompted the call for a more comprehensive, coordinated, unified and integrated approach to water resource problem-solving. This approach requires consideration of the interactions among different natural resource elements, such as ecology, hydrology, and geomorphology. among different disciplines, such as economics, engineering, and biology, and among different institutions, including federal, state, and non-governmental. In the most recent U.S. Army Corps of Engineers Civil Works Strategic Plan, this approach is called Integrated Water Resources Management (IWRM). It draws on a long history of conceptual development.

Water resources are often public resources in the U.S. where government agencies have long dominated their management. Laws authorizing and regulating water use and management have proliferated due to growing demands on existing supplies. Agency compliance inevitably forces more interaction with other agencies and non-governmental organizations (NGOs), if not more integration of action. Many obstacles impede more effective interaction. Increasing appreciation for the complexity of water resource management systems has been accompanied by increased recognition of inter-organizational collaboration, beyond the minimum required by law, as the key to more effective management, which is increasingly defined by a sustainable development goal. With a broadly acceptable goal held in common, this thesis argues that more integrated, collaborative approaches to water resources management will result in more sustainable water resources development because they more completely reflect societal values and scientific knowledge, and focus them on solving complex management problems in a more comprehensively satisfying way. Because future progress depends in part on common understanding of the concept, we revisit different definitions of IWRM and propose a simple conceptual framework for consideration.

Integrated Water Resources Management: A Basic Definition

Although concepts of integrated water resources management have been promoted for decades, the concept is currently in vogue and connotes

different things to its users and advocates. Closely related concepts have also come into and out of fashion, often under labels that do not fully convey the concept. Examples include river basin management, a watershed approach, a systems perspective, integrated assessment, and integrated watershed management. Therefore, we start our discussion by parsing the term "Integrated Water Resources Management," word by word, to develop a foundational working definition.

Integrated (v. tr.) Defn: To have made whole by bringing all parts together; unified n.: Integrity—completeness, unity

Water (n.; adj.) Defn: A liquid essential for most life and a widely used solvent; a body of water including a sea, lake, river or stream

Resources (n) Defn: Something that can be looked to for support; and accessible supply; means that can be used to advantage or profitably; assets

Management (n.) Defn: The act, manner, or practice of managing, handling, or controlling something. Syn: control, handling v.: To manage. To contrive or arrange; succeed in doing or accomplishing something (objectives/goals implied).

Combining the terms, integrated management implies unification of all essential actions into the handling and control of water resources to accomplish some goal or objective. Here "water resources" means the physical, chemical, biological, economic, cultural, and many other useful "assets" of the nation's wetlands, streams, rivers, lakes, and coastal oceans. Management implies purposeful action taken to achieve development, regulation, facility operation, and maintenance objectives. Management has full integrity when it is complete and unified in purpose from individual to local to national and international scales of activity. This simplistic look implies a basic working definition:

> Integrated Water Resource Management is a coordinated, goal-directed process for controlling the development and use of river, lake, ocean, wetland, and other water assets.

Observation I: IWRM is a process; not a goal. Management is not a goal in itself, but the process used to achieve goals.

Observation II: IWRM is a goal-directed process. Integrated Water Resources Management can be directed by any of various goals, but is not tied to any single goal. For example, management can be integrated to promote agricultural development, to promote economic prosperity, to exercise political control, to maximize ecological productivity, or to improve human welfare. Integrated management can be hierarchical; locally directed, for example, at achieving water resources project objectives that serve national goals.

Observation III: IWRM is a matter of degree. Integration is not all or nothing, and is most often partial - there can be various degrees of coordination, cooperation, and communication completeness in collaborative integration of management activities. For example, some dredging activities administered by Corps Civil Works may be well coordinated with beach nourishment activities, but may not consider changes in upstream land uses; other dredging activities may consider both in a more complete inter-organizational management of the regional sediment system.

Goals for IWRM in the U.S. and within the Corps of Engineers

If IWRM is a desirable process, we need to determine the most relevant goal(s) for focusing integration locally, regionally, and nationally. In the U.S., with a patchwork of laws and policies that guide water resources management, determining a national goal for water management is not clear-cut and conclusive, but one good possibility can be gleaned from the evolution of resource management policy.

As early as 1969, the National Environmental Policy Act (NEPA) established a national policy to "encourage productive and enjoyable harmony between man and his environment; promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man." This landmark law established that human welfare depends upon the maintenance of environmental quality as well as opportunities for human endeavor, and forced federal agencies to take this into consideration in resource development and other activities that might have environmental impact.

Other important statutes followed after the

National Environmental Policy Act. Together with NEPA, they provide the U. S. Federal government with a planning framework and enforceable standards for protecting environment quality and authority for restoring degraded environmental quality. Arguably most important of many that influence water resources management are the Clean Water Act (which required restoration of the physical, biological, and chemical integrity of national waters), the Endangered Species Act (which directs the protection and recovery of species at risk of extinction to a viable, sustainable state), and various water resource development acts that prescribe management actions for the nation's waterways, including restoration of ecosystems in order to recover damaged environmental quality to a more sustainable condition.

At the direction of the 1965 Water Resources Planning Act, a Water Resources Council was created to coordinate overarching federal policy. Before it was disbanded in 1983, it wrote the *Principles and Guidelines for Water and Related Land-Resources Management* (U.S. Water Resources Council 1983), which set forth the federal objective for water resources project planning. The objective incorporated the NEPA principle and the standards set by other environmental laws to assure environmental protection at projects. It directed federal water resources investment projects to "contribute to national economic development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes…" Consideration of environmental quality (EQ), regional economic development (RED), and other social effects is also explicitly allowed through additional "accounts."

Meanwhile, an important concept was evolving primarily in the international arena of the United Nations. With the establishment of the World Commission on Environment and Development, also known as the Brundtland Commission, by the U.N. and the publication of its report entitled "Our Common Future" (World Commission on Environment and Development 1987), the terms sustainable development and sustainability became much more commonly a part of natural resource and environmental management vocabulary and thinking. The Commission defined sustainable development as development *"..to meet the needs of the present generation without compromising the ability of future generations to meet their own needs."* The World Bank incorporated this concept of sustainable development into its policies and defined its relationship to concepts of economic, environmental, and social sustainability (Goodland and Daly 1996). In 1993 the President's Council on Sustainable Development (PCSD) was tasked "to develop bold, new approaches to integrate economic, environmental and equity issues" and highlighted sustainable development as a national goal for resource management in its 1996 report (President's Council on Sustainable Development 1996).

Within this context of national policy development, evolution of policies and goals within the water resource management agencies is illustrated by the policies of the largest water resources management program, the Civil Works Program of the U.S. Army Corps of Engineers (Loucks 2003). The goals of the Civil Works Program are presented in various documents including the Civil Works Strategic Plan, Policy Guidance Letter 61, the Environmental Operating Principles, and its Engineering Regulation 1105-2-100 - the implementing guidance for the Principles and Guidelines and for ecosystem restoration planning (U.S. Army Corps of Engineers 2000). *Policy Guidance Letter 61* (PGL 61, U.S. Army Corps of Engineers 1999) presents policy for applying a watershed perspective to Corps' water resources management, including a goal to guide application. Although PGL 61 does not mention IWRM specifically, the policy for applying a watershed perspective aligns with the concept of IWRM presented above. The goal is to assure sustainable use of water resources, taking into account environmental protection, economic development, and social well-being. This goal was derived from the President's Council on Sustainable Development and is consistent with a sustainable development goal generally accepted by The World Bank and achieved through economic, environmental, and social sustainability (Goodman and Daly 1996).

The *Environmental Operating Principles* (U.S. Army Corps of Engineers 2002) describe how to conduct practices within the Corps with the goal of environmental sustainability, pursued through

"a synergistic process whereby environmental and economic considerations are effectively balanced through the life cycle of project planning, design, construction, operation and maintenance to improve the quality of life for present and future generations." The doctrine behind the Environmental Operating Principles recognized the great influence of the sustainable development concept developed by the Brundtland Commission.

Thirdly, the *Strategic Plan for the Corps' Civil Works Program* (U.S. Army Corps of Engineers 2004) specifically promotes "Integrated Water Resources Management and a watershed focus" as a means to achieve five strategic goals, the first of which is to "provide sustainable development and integrated management of the nation's water resources." The Strategic Plan sets a vision for the Corps "as the premier public service provider of comprehensive, sustainable solutions for water challenges through integrated water resources management."

The goals from the U.S. federal policy documents (Table 1) indicate that the definition of *"sustainable development"* as the national goal for water resources management, is fully consistent, not only with guidance within the Corps, but also with national goals for natural resources management outlined by the National Environmental Policy Act, the President's Council on Sustainable Development and the Principles and Guidelines. However, any law or other clear statement of national policy that explicitly states so has yet to emerge. A sustainable development goal is unevenly acknowledged among agencies and its relationship to IWRM remains unclear. While the goal of IWRM within the Corps' Civil Works Program appears to be sustainable development, IWRM is not clearly stated as such in the Civil Works Strategic Plan. Thus, while the concepts of sustainable development and IWRM have recently become prominent in U.S. water resources policy, they remain fragmented and evolutionary. Clear declaration of the relationship between IWRM and sustainable development could be the next major step in advancing water resources management toward a more coherent integration into national and international visions of a sustainable earth.

Table 1. U.S. policy statements that help define a U.S. national goal for Integrated Water Resources Management (organized chronologically from 1969 to 2004).

Source	Goal
NEPA	Encourage productive and enjoyable harmony between man and his environment; promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; enrich the understanding of ecological systems and natural resources important to the nation
Principles and Guidelines	To contribute to national economic development consistent with protecting the nation's environment, pursuant to national environmental statutes
President's Commission on Sustainable Development Report	A sustainable United States will have a growing economy that provides equitable opportunities for satisfying livelihoods and a safe, healthy, high quality of life for current and future generations. Our nation will protect its environment, its natural resource base, and the functions and viability of natural systems on which all life depends… Sustainability as balancing of three major elements: environmental health, economic prosperity and social well-being
Policy Guidance Letter 61	Use of water resources in a manner that is sustainable, taking into account environmental protection, economic development, and social well being
Environmental Operating Principles	Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.
Army Corps Strategic Plan	Provide sustainable development and integrated management of the nation's water resources.

Conceptual Framework for IWRM

Even with a definition of IWRM as a goal-directed process and understanding of a possible national goal in the U.S., questions remain about what kind of integration is necessary in water resources management. Basic hydrology concepts illustrate the need for integration spatially; most clearly, geographically in the concept of watershed or water catchments. The many demands placed on water resources also imply a need for integration over diverse management objectives, and, considering the fragmented nature of water management in the U.S., a need for integration among institutions. Finally, because values change and knowledge expands, there is a need to integrate management over time. Hence "integrated" water resources management can and must consider integration along at least four axes: space, objectives, institutions and time (Figure 1).

1. *Spatial Integration* – coordination of management for unified achievement of common objectives and goals within a geographic area and among vertical strata from lithosphere to atmosphere.
2. *Objective Integration* – coordination of management for some optimum achievement of multiple objectives, such as for agricultural, forest, soil, flood control, navigation, recreation, hydropower, water supply, and environmental resource improvements.
3. *Institutional Integration* – Coordination across mandates, missions, policies, programs, projects, and management measures of governmental and non-governmental institutions into unified achievement of common objectives and goals.
4. *Temporal Integration* – coordination of activities on different time scales—from daily operations to considerations decades away—into unified achievement of common objectives and goals.

These axes place broad dimensions on the implementation of integrated water resources management. What should the spatial extent of an analysis be to ensure achievement of common goals and objectives? What objectives need to be considered to enhance the success of management decisions? What other institutions, policies, programs, or

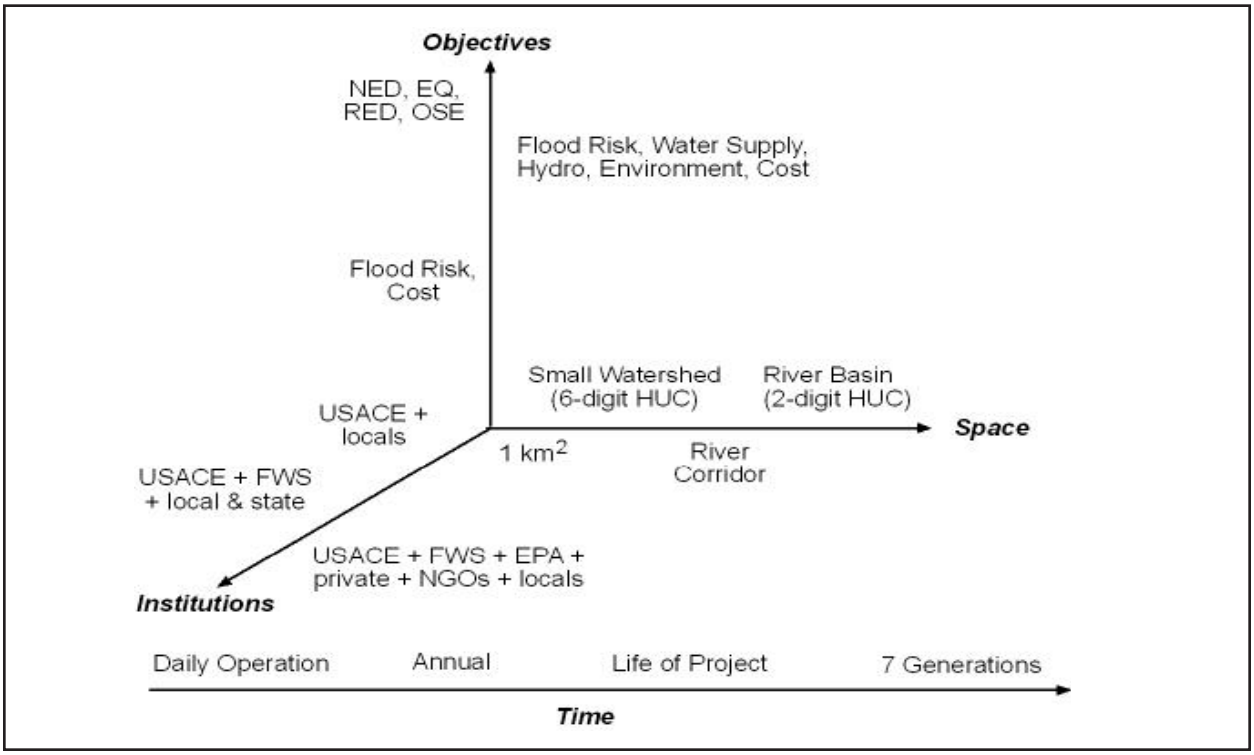

Figure 1. Conceptual framework for IWRM using four axes.

interests might be incorporated into planning and implementation to improve efficiency and effectiveness? What are the cumulative long-term impacts of management in a dynamic environment and how might they be controlled through more integrated long-term planning? Whereas activities will differ in the degree of integration that is appropriate over each of these axes, the axes set a context to consider the appropriate degree of integration.

Spatial Integration – The need to scope a problem in a geographic or spatial manner is as common to project planners as it would be to operators and regulators. Critical connections can be overlooked if a project plan, operating plan, or regulatory decision limits consideration to interactions immediately upstream and downstream. Conversely, it would be folly to analyze interactions 1000 miles upstream if they were known not to affect the activity under consideration. Thus a basic analytical challenge for IWRM is to scope the analysis broadly enough spatially to consider all important consequences of all interactions, but narrowly enough to be efficient in making decisions about planning, operations, regulations, and other considerations. In the realm of water resources management, plan formulation is most often scoped in a geography defined by the reach of watershed or coastal process into the planning environment, but plan evaluation of the economic and environmental consequences considers a spatial context defined by business-system interactions that may not align with the hydrology.

Integration of Objectives – Objectives abound in water resources management, so how do we consider which objectives to integrate? The significance of the effects on resource condition is a good guide. The effect can be positive or negative. A positive effect on resources produces significant benefits, that is, benefits that exceed costs. A negative effect results in unacceptable environmental or other costs. If the environmental effect is expected to be negative and significant, National Environmental Policy Act guidelines require an assessment of environmental impacts and incorporation of the costs of avoiding, minimizing, and compensating for the negative effect in project plans. In this way, environmental and national economic development objectives are integrated for optimal societal result. Environmental assessment under the National Environmental Policy Act details how proposed management activities affect a larger number of objectives. As with scoping spatially, if impacts of the proposed management activity on various objectives are not "significant," then the scope of integration over objectives can be narrower. In addition to national objectives, water management must consider local or regional objectives, which may conflict with national objectives. This tension between local and national interests in water management has a long history and helped spur the development of the Principles and Guidelines to ensure that Federal water expenditures served national as well as local objectives.

Institutional Integration – Many institutions have unique authorities and mandates that affect water resources; hence the commonplace involvement of multiple governmental and non-governmental institutions in water management. Yet what institutions need to be involved? Again the issue is one of scope and degree – of which organizations to involve and how to involve them. A rule of thumb would be if the planned action may significantly affect (or be affected by) other institutions, then activities should be integrated or at least coordinated. Institutions are also hierarchically organized—internationally to locally, for example. Generally, broad public service goals and objectives, established in laws and executive orders originating in the top layer of government, are served via integration of agency, program, and project levels of execution. This inter-organizational vertical integration often shows up most clearly in annual budget allocation decisions. An organizational strategic plan can facilitate this integration or confuse it.

Integration over Time – Time pervades the consideration of the degree of integration over the other three axes. For example, community water-supply planners must consider long-term demographic, economic or land use trends in the immediate service area, but also coordinated operation of basin-wide infrastructure on a daily or finer time scale. Objectives also may be defined on differing time scales—acute water quality conditions versus flow regimes that would depend on rainfall that year, or may change over

time based on changing values, parameters or the knowledge base. Because conditions such as demographic shifts, economic or societal values, and knowledge of ecosystem interactions change over time, water resources management must also change over time, requiring the incorporation of adaptive management concepts. This reinforces the notion that IWRM is a process that requires periodic updates and review.

This conceptual framework for IWRM provides a starting point for organizing thinking about and discussing IWRM, and thus provides the foundation for the discussion that follows. Other useful frameworks are conceivable. For example, the time and institutional axes could be subsumed into the objectives axis. Another example might organize spatial, temporal, and objective integration based on institutional types of integration, such as functional (various agencies with various mandates), vertical (local, state, federal), and horizontal (state to state, local government to local government) (Muckleston 1990). Another approach might emphasize integration of objectives (again considered in degrees) from single objective to watershed planning for economic and environmental objectives, to integration of Corps activities for a limited set of purposes along a river corridor as opposed to the entire watershed, to planning across institutions' activities for multiple objectives within an entire watershed (Stakhiv 1996). Regardless of approach, an IWRM framework should, minimally, provoke thinking about management integration for improved public service performance.

Other Definitions for IWRM

To ground-truth our basic working definition of IWRM as a coordinated, goal-directed *process* for controlling the development and use of river, lake, ocean, wetland, and other water assets, we compare it with definitions of IWRM that have been proposed by different agencies or organizations. We start with the definition that appears to be most widely cited—that used by the Global Water Partnership:

> The integrated water resources management (IWRM) approach is defined as a process that promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Global Water Partnership 2000: 22).

Like our definition above, the Global Water Partnership defines IWRM as a process. Unlike our definition, Global Water Partnership extends the definition to a specific a goal – that of maximizing economic and social welfare to the extent allowed by an "equitable" manner and the sustainability of vital ecosystems. In extending the definition to explicitly set goals and constraints on water management, for better or for worse, the Global Water Partnership implicitly sets the IWRM concept within a value system. Note that the goal is consistent with the sustainable development concept.

In terms of implementation, the Global Water Partnership definition does not specify what aspects of management to coordinate, although the four axes presented above can equally apply within the Global Water Partnership definition. The Global Water Partnership also explicitly includes water development as an aspect of management; our working definition similarly includes water "development" activities as water "management."

A second definition comes from the "water team" of the United States bi-lateral development agency —the U.S. Agency for International Development (USAID):

> IWRM brings together governments, communities, and other stakeholders to choose among alternative uses of freshwater and coastal resources. Using a participatory planning and implementation process, these stakeholders identify ways to meet their diverse water needs without depleting or damaging water resources and their underlying ecosystems (U.S. Agency for International Development 2003: 1).

For the U.S. Agency for International Development, IWRM is about the process through which integration should occur, focusing on institutional integration and objectives integration. Like the Global Water Partnership, the U.S. Agency for International Development definition also prescribes a specific goal of meeting diverse water needs in its definition of IWRM, and constrains the process by forbidding damage to water resources and ecosystems. The U.S. Agency for International Development definition focuses on uses of water

and ways for stakeholders to meet their water needs. Such a focus may limit the integration to management activities that directly impact water use. Like the Global Water Partnership, the U.S. Agency for International Development does not specify the aspects of management that will be integrated. Also like the Global Water Partnership, the goal is consistent with the sustainable development concept.

A third source is the World Bank:

> An integrated water resources perspective ensures that social, economic, environmental and technical dimensions are taken into account in the management and development of water resources (World Bank 2003a:1).

The World Bank's integrated water resources "perspective" requires that multiple dimensions or objectives be considered in water resources management. This "perspective" is supplemented by the Bank's 2003 policy paper that strongly and explicitly endorses integrated water resources management (World Bank 2003b). While the 2003 paper does not define IWRM, it does refer to it as a goal and, through a reference to "good IWRM" implies that there are degrees of such integration. Although generally regarded as a strong endorsement of IWRM concepts (World Bank 2003b), the Bank's 1993 water policy paper (World Bank 1993) does not define or explicitly promote the term "Integrated Water Resources Management." Overall, the Bank assumes the definition of IWRM is implicit and instead concentrates on potential Bank and government actions to improve management. This IWRM concept is primarily procedural and only vaguely implies a sustainable development goal through the economic, environmental. and social dimensions that need to be "taken into account."

The United Nations Development Programme (UNDP):

> Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and social and economic good (United Nations Development Programme 1990: 22).

The use of the term IWRM by the United Nations Development Programme emphasizes a broad perception of water having ecological, natural resources, and social and economic aspects. The emphasis is to enlarge the perception of the role of water; a broader perception of the multiple roles of water resources will thus lead to integration across objectives such as social, economic, and environmental, if not time, institutions and space. This "definition" is more derivative (where the concept comes from) and is less procedural or goal-oriented than others presented here.

The Inter-American Development Bank (IADB) offers one of the more elaborate definitions:

> Integrated Water Resources Management: water resources management where the aim of its actions and projects also includes the allocation of water and decreasing of conflicts between competitive water resource subsectors and uses, both in quantity and in quality. Sometimes it is also referred to as comprehensive water resources management…It is the process of diagnosing, responding to and resolving water use problems [while] acknowledging their interrelationships (Inter-American Development Bank 1998: 3).

The Inter-American Development Bank defines IWRM as a process with the goal of reducing conflict over both water quality and quantity. The definition explicitly refers to various uses or objectives for water management. By defining conflict reduction as the distinctive element of IWRM, the definition implies consideration of multiple objectives, that various institutions are involved, that analysis is spatially integrated, and that conflicts might occur over time. The Inter-American Development Bank sees integrated water resources management as a change in paradigm—"from development to management and from a sectoral to an integrated approach" (Inter-American Development Bank 1998: 16).

The IWRM concepts summarized above go considerably beyond the idea of at least some integration across space, institutions, objectives and time. The concepts refer to diverse water needs, the perception of water as a social and economic good, and maximizing economic and social welfare in an equitable manner. Many mandate specific ways to achieve integration, such as participatory planning and conflict resolution. Others specify goals of the integration. Most of the definitions reflect the new consensus that the process of water resources management needs to consider social,

economic, and environmental aspects of water resource systems. Fewer definitions explicitly indicate that public participation is necessary to determine management actions that serve broad social welfare goals.

The term IWRM is almost exclusively used by international organizations. One explanation is the continued emphasis in developing countries both on potable water supply issues and large-scale water resource development. The international community has been criticized too often for promoting water projects that result in unacceptable levels of social or environmental damage. The IWRM term is used to connote more participation, and a broadly scoped analysis of the impacts of water resources management. The term may be less popular domestically because many of the same precepts have been incorporated under the concepts of watershed approach and ecosystem management, which became established in federal land management and environmental agencies during the 1990s. The next section examines the relationship between the concepts of IWRM and the watershed approach.

IWRM and the Watershed

In 2000, eight U.S. federal agencies adopted the Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management (U.S. Department of Agriculture et al. 2000) which defines the term:

> Watershed approach: A framework to guide watershed management that: (1) uses watershed assessments to determine existing and reference conditions; (2) incorporates assessment results into resource management planning; and (3) fosters collaboration with all landowners in the watershed. The framework considers both ground and surface water flow within a hydrologically defined geographical area (U.S. Army Corps of Engineers 2000, online).

This "watershed approach" of U.S. federal agencies endorses some of the same concepts that the international water community embraces through the concept of IWRM. As interpreted into implementation guidance by the Corps in Policy Guiadance Letter 61, the watershed approach is even more like IWRM. Much of this guidance document reads like a discussion of IWRM. Its definition of the watershed "perspective" touches on integration along all of the four axes deve-loped in the conceptual framework above: space—"other resources in the watershed"; institutions—"…active participation of all interested groups…"; time "…the variability of social interests over time..", and objectives—"balance among multiple, and often competing, watershed goals." And it defines a sustainability goal for watershed resource management.

The Corps guidance also implies that, in some respects, the watershed approach has limits for planning purposes. It defines a watershed in two incongruous ways—as a hydrologic feature: "an area of land within which all surface waters flow to a single point" and as a "problemshed": "the area necessary to adequately scope, analyze and manage related water and land resources." One of two intents can be inferred. It may require analysis across a hydrologic watershed, stopping at the boundary regardless of problem origins, or, more likely, it treats the watershed as an entry to IWRM, extending as needed beyond the hydrologic boundaries to the source of the problems and the effects of their solution. The intent is not entirely clear, but the latter interpretation is more consistent with the more general "systems-approach" to planning, which allows the problem origins and the planned solutions to define the system boundaries. In either interpretation, the limits of the term "watershed approach" become obvious.

It would be much clearer to refer to spatial, institutional, objective, and temporal integration or any other appropriate dimensions in water resources management as IWRM, rather than to force a much larger and more analytically comprehensive concept into a hydrologic concept. It is important to emphasize that IWRM is a systems concept—that the intent is to maintain integrity in the management process defined by the goals to be pursued. The watershed is one logical entry to IWRM, but the watershed concept is neither universally applicable nor comprehensive enough to incorporate all of the necessary considerations for effective water resources management. Definitions may differ, but the fundamental needs in concepts of integrated management appear to be consistent. IWRM is a concept that will continue to evolve, but whose time has come in the U.S., as

it already has in much of the world.

Summary and Conclusions

As the demands placed on water resources in the U.S. and elsewhere have grown, many organizations are promoting more collaborative, integrated approaches to water resources management. Out of that concern, many terms and definitions for more integrated approaches to management have proliferated with apparently small differences in core concepts. Clearly, the need for more integrated management of water resources is now widely stressed, as indicated by the proliferation of related terms and the concepts they represent.

Despite general endorsement of IWRM in the U.S., full implementation of IWRM is hampered by inconsistent concept definition and a basic framework for concept implementation. Confusion has been abetted by using the "watershed approach" in its place, based on a concept that is much more limited than needed to facilitate more effective integration. Our contribution to the debate about how to implement integrated approaches to water management in the U.S. was to develop a basic definition of IWRM as a goal-centered process, and a rudimentary framework for organizing integration in public water resources management. We view this as a starting place only for more elaborate definition of IWRM practices in U.S. water resources management, and especially in the Civil Works Program of the Army Corps of Engineers.

In reviewing IWRM in the public water resources management sector of the U.S., a national goal for focusing IWRM is emerging in the concept of sustainable development. This concept has roots in U.S. environmental law passed over three decades ago, but has been much influenced by concept development and advocacy in the United Nations and The World Bank. In the U.S., the Army Corps of Engineers referred to sustainable development as a basis for its recent pronouncement of Environmental Operating Principles and identified it in one of five goals to be pursued in the Civil Works Program.

To further the discussion of how to integrate, this paper suggested a conceptual framework for looking at what to integrate by proposing four axes of integration: space, institutions, objectives, and time. These organizational concepts are inadequately captured in the concepts of a "watershed approach" to water resources management, which is the most recent emphasis in the U.S. federal perspective. An analysis of other definitions of IWRM, derived almost entirely from international organizations, shows that different organizations go considerably beyond the idea of IWRM as a process operating through spatial, institutional, objective. and temporal integration to touch on goals reflecting organizational values. They reflect the consensus that the process of water resources management needs to consider social and environmental aspects of water resource systems. They endorse a democratic concept that the public must be involved in decision-making.

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Integrated Water Resources Management (IWRM) has been defined by the Technical Committee of the Global Water Partnership (GWP) as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems."Â The right of all users to the benefits gained from the use of water also needs to be considered when making water allocations. Benefits may include enjoyment of resources through recreational use or the financial benefits generated from the use of water for economic purposes. The integrated water resources management approach helps to manage and develop water resources in a sustainable and balanced way, taking account of social, economic and environmental interests. It recognises the many different and competing interest groups, the sectors that use and abuse water, and the needs of the environment. The integrated approach co-ordinates water resources management across sectors and interest groups, and at different scales, from local to international. It emphasises involvement in national policy and law making processes, establishing good governance and creating eff... It is critical to integrate water and environmental management. This principle is widely and strongly supported. IWRM can be strengthened through the integration of Environmental Impact Assessments (EIAâ€™s), water resources modeling and land use planning. It should also be understood that a catchment or watershed approach implies that water should be managed alongside the management of codependent natural resources, namely soil, forests, air and biota. A systems approach. A true systems approach recognizes the individual components as well as the linkages between them, and that a disturbance at one point in the system will be translated to other parts of the system.