ESTES 4:

Slide 1 (Title Slide): First, thanks to the Instream Flow Council (IFC), committees, presenters, the audience, sponsors, exhibitors, and all others that contributed to make the Flow 2015 workshop and training sessions possible. It's both a challenge and honor to be the caboose of this freight train. Accordingly, I'll try to provide a succinct and hopefully useful summary of the past 3 days of invaluable information presented.

I will attempt to cover elements discussed for addressing uncertainty that one has to accommodate to be able to conserve—that is, to protect, restore and enhance—sufficient amounts of clean water in our river and lake water body sources and at the same time allow for other types of water uses.

I will also attempt to highlight and summarize some of the key concepts in the short time I have that I think need to be captured. And since we've been able to use electronic technology to capture all the presentations, please don't judge me too critically if I am unable to summarize everything.

Slide 2: So what? What next?

We heard presentations that explain how uncertainty can be your friend, and others refer to it as their worst nightmare and challenge. I think we should try to always make uncertainty our friend.

Slide 3: One thing I'm 100% certain about is that humans and all life depend on adequate amounts of clean water. Water is one of the two most important natural resources absolutely critical to all life on this planet; and, the other, of course, is adequate amounts of clean air.

Despite certainty regarding our dependence on water, more often than not, the significance of proactively inventorying and managing surface and subsurface water sources (especially for water uses associated with retention of portions of water within a source waterbody) do not typically get the same attention and public support given other natural resources such as petroleum products, various minerals, forestry products, etc.

As such, the value of water does not seem to be recognized by the general public and politicians until after we are confronted with a critical water shortage and challenged to meet the most essential water uses and demands. This reactive approach results in a variety of uncertainties associated with long-term water management uses, needs, and actions associated with meeting competing water demands.

The past 3 days of training and workshops summarized these and other types of uncertainty and associated challenges and recommendations for addressing such.

Slide 4: Over the past few days we learned about the importance of the hydrologic cycle, or water budget, and associated uncertainty related to spatial and temporal elements and processes.

We talked about the importance of making sure we include all elements of this cycle, especially to remember to also integrate consideration of seasonal water levels in lakes and lentic habitats in addition to the flowing or lotic elements of the environment. We discussed the need to review short- and long-term multi-year seasonal hydrologic variability and trends. Presenters emphasized the need to assess both surface and subsurface (aka groundwater depending upon terminology that folks use) water sources and whether they are

interconnected. Riparian zones and processes that link aquatic and upland portions of watersheds were covered.

Most presenters referred to or discussed the importance of these multi-directional hydrologic connectivity concepts and processes (vertical, longitudinal, horizontal, and lateral).

Speakers also identified the need to link water quantity to water quality.

Slide 5: We learned about these and other important hydrologic driven and interrelated elements that are described and illustrated in the 2004 IFC book[1].

Slide 6: And, we talked about uncertainties that relate to different types of competing seasonal year-round water uses for water derived from or retained within lotic/flowing type and lentic/lake like water sources.

And, I suspect that's the primary reason why many of us are here, to learn how to better address uncertainty in order to more effectively balance water uses represented in the left and right columns. That is, the goal is to balance water withdrawal, diversion, and impoundment uses illustrated in the right column while conserving flows and water levels within the source water body for the variety of uses that are in the left column. This summary information applies to both lentic and lotic systems on a year-round basis during frozen (ice-covered) and open-water seasons

[1] (note: final slide 14 has IFC 2004 book cover illustration if physical copy not available for display during slide 5 discussion).

Slide 7: As emphasized by IFC literature and in many of the presentations at this workshop, speakers and attendees talked about a variety of flow and water level uncertainty related conservation challenges including: legal, institutional policy level, various components of science, public involvement, and to a lesser degree socioeconomic, and other relevant topics.

Our prior panelists and the audience were just beginning to sharpen their focus on how much value should be placed on a particular use and amount of water that is retained within a system versus another potentially competing water use and how does one quantify and assign a value to each? As such, I think uncertainties related to assigning socioeconomic values to water sources and different water uses will merit more emphasis and should be should be fully integrated into future workshops.

Throughout the workshop presenters pointed out the different types of uncertainties that are related to each of these various categories. As an example, we were provided a combination of a legal/institutional policy and public involvement example by one of our speakers, Dennis Riecke. He explained how there had been little or no progress achieved related to opportunities to legally conserve water in Mississippi during the past 30-years until approximately two weeks prior to this workshop. He gave credit for this improvement to long-term persistence and increased public education, awareness and involvement that ultimately resulted in higher public value being placed on the management of groundwater usage in addition to consideration of surface water uses. That example represents a dynamic change in the legal and institutional background under which Mississippi can operate in order to manage and conserve the state's water resources.

The prior and other sessions included presentations on legal, institutional and other uncertainty considerations related to flow/water level components of science regarding choices and requirements ranging from use of desktop lower cost and hence limited data dependent related methods to the very, very costly data and time intensive types associated with sophisticated analyses. The presenters made it clear there are typically many elements of uncertainty for choosing and determining which flow and water level quantification method to use and how and when to apply it, including legal, institutional, and stakeholder considerations, and whether one has sufficient expertise, and adequate time and resources to collect and analyze essential information, etc.

Speakers emphasized the importance for all stakeholders to reach agreement on science based objectives and linking them to final water use decisions. Recommendations were provided for defining and tracking objectives from beginning to the end of water use studies and decision outcomes to define how to successfully address all uncertainties. Presenters also emphasized the need for all stakeholders to reach agreement on the choices of metrics to be used for measuring and tracking success or failure to meet objectives including establishing realistic mechanisms and deadlines for execution.

Another important uncertainty factor covered related to the amounts, capacity, and types of stakeholder involvement, including which stakeholders will be represented and their knowledge base.

We heard how important it is to involve all stakeholder interests from the very beginning to the very end. Achieving successful water management decisions will depend on knowing what each stakeholder

interest values and what each hopes to obtain, because that's what's going to help guide the process for reaching a successful end point.

I previously identified socioeconomic uncertainties weren't always emphasized in this workshop and training sessions, unlike Flow 2011, and recommended the topic should be revisited in future workshops. This element is especially important as it relates to public stakeholder involvement. Socioeconomic values should represent all water use stakeholders' values and interests, including values of stakeholders who have not identified or decided which values are most important.

It is important to emphasize all of these uncertainty factors mentioned are dynamic. Many of these factors may be subject to politically driven time-sensitive legal and institutional variations triggered by two-, four-, six-, and eight-year election cycles.

These temporal cycles can periodically result in changes to existing laws and regulations and passage of new laws and regulations.

Political will and changes to leadership can also impact how an existing statute or a regulation will be interpreted and whether and how it will be implemented in the respective jurisdictions where you live and work. What you may or may not be able to pursue or achieve in any given situation and time can also be influenced by the budgets that political leaders approve.

In most jurisdictions, water use laws and regulations (especially those pertaining to instream flow and water level conservation) were promulgated during the past 40+ years. Elements of these laws may not yet have been legally tested and fully interpreted.

Litigation challenging interpretation of these laws and regulations can also impact legal and institutional frameworks that inform the basis for water management decisions, including which science methods are acceptable. Administrative challenges can also impact how a law is implemented.

Shifts in one or a combination of these dynamic factors may vary from year to year and within the same year. A suggested approach to help deal with these changes is to routinely take and report snap shots in time regarding the status of laws and policies, application of science options, levels of and types of public involvement, socioeconomic and other factors that have influenced or may have an influence and water management options including how outcomes compare to objectives under varying scenarios. Litigation outcomes should also be tracked and reported. Ideally, experiences gained and the combination of lessons learned over time will hopefully improve everyone's ability and effectiveness to achieve desired outcomes regardless of the scenarios and associated challenges related to uncertainties.

Slide 8: The hydro-illogic cycle represents another uncertainty concept associated with the hydrologic cycle that can add challenges to achieving water management objectives. It too is dynamic. Some of you may have already seen or used this illustration or a variation, especially in locations subject to drought in our country. Other versions of this illustration display a few more steps; but I prefer this simplistic version.

The hydro-illogic cycle reflects that many of us live in a reactive society when it applies to water management. The cycle begins when there are periods of rain and it appears there will be an adequate amount of water available to meet various water use stakeholders'

needs. During this rain cycle there is typically limited consideration and focus on who does or doesn't have access to water (apathy). During this portion of the cycle there are also usually limited water conflicts and little or no effort placed on planning for future water needs and demands. However, as soon as there is a noticeable reduction in rain equated to be a drought condition, this triggers concern regarding who will have access to water and for what purposes. Unfortunately, by the time various competing water dependent stakeholders react and agree to take proactive actions and commit resources to address the drought, it's typically too late to break the cycle. That's because the cycle of apathy reappears as soon as there's more rain. This repetitive cycle illustrates another reason why it can be difficult to implement long-term water management planning and actions.

Choosing options and implementing actions to counteract the hydro-illogic cycle will depend upon addressing one or more of the other uncertainties previously summarized such as where one is located or works geographically and the various associated legal, institutional, socioeconomic, hydrologic, climatic, political, and other dynamic conditions that one has to take into consideration.

This illustration provides another example of why it is important to document and report snap shots in time.

Slide 9: There's another form of uncertainty that I call *generational uncertainty*. Some of the presenters spoke about this type of uncertainty in earlier workshop presentations. I summarize this uncertainty in two basic categories as: *institutional lobotomies*, and *institutional Alzheimer's* (or senility).

Generational uncertainty represents another type of example and reason it is important for seasoned and experienced longer term instream flow and water level conservation stakeholder veterans to routinely take snapshots in time to document, share and bridge historical knowledge with newer generations of apprentice water use stakeholders and practitioners, and vice versa

Understanding the history and continuing evolution of how and why we address all of the various elements displayed in the earlier slides and presented in this and prior IFC workshops, and in IFC's and others' instream flow and water level conservation publications will be critical to improve everyone's effectiveness to address all elements of uncertainty that were presented in this workshop.

If we don't look back in time to research how we got to where we are today and continue to track progress, we're not going to have a good roadmap and context for going forward tomorrow. Instead, we will more likely be limited to reinventing versus improving a wheel and hampered by repetitive cycles similar to the hydro-illogic cycle. And, I think we need to remember to also look back and refer to literature going back to the 1970s and1960s or prior.

Slide 10: So, what we can do? Well, I think we can and must address uncertainty proactively. These are some suggestions:

In addition to all the workshop information presented and discussed, I urge everyone to refer to the 10 IFC stewardship principles for conserving flow and water levels highlighted in the IFC 2004 publication. Also research and review other relevant publications authored by presenters, participants and others.

All of us should also make sure that we update our focus on hydrology to always include and integrate water level considerations for lakes (lentic habitats) in addition to riverine (lotic habitats) when relevant.

We should work with all water use stakeholder interests and experts to develop and implement water use basin plans that help guide and track short and long-term water management decisions. We should report progress and update plans routinely.

Whenever possible, we should execute proactive planning and water management actions to prevent negative water use outcomes (that can be avoided and minimized) versus waiting until negative (and perhaps irreversible) outcomes are experienced. Preventing versus restoring is more cost effective and results in better long-term socioeconomic benefits especially if costs for infrastructure can be amortized over several years.

Monitor water use project outcomes over time to determine whether mutually agreed upon measurable objectives are being achieved. Include the mechanisms and capacity to adapt a project to meet objectives when objectives are not being accomplished. These suggestions were mentioned by several presenters.

We all benefit by sharing our knowledge and experiences with one another. There are a variety of ways to network with one another including participation at workshops such as this. For example one of the attendees, Cathy Flanagan, Region 7 Hydrologist for the U.S. Fish and Wildlife Service, produces and circulates a complimentary email weekly water use newsletter to 100+ individuals each week. Cathy's contact information is listed in the attendee list if you want to send her an email request to be added to the distribution list.

Sharing information also includes bridging the past, present, and future. And, that includes familiarizing ourselves with historical original literature. Many of the legal, institutional and science based water management concepts and practices today were developed in the 1960s, 1970s and 1980s.

As examples, Thom Hardy and Tom Payne previously shared different examples of historical literature related to evolving instream flow and water level concepts and methods.

Slide 11: Those and other references to historical literature prompted me to add this slide as another example for adding more emphasis on the recommendation to bridge time. The 1979 publication displayed represents another example of information that can be extracted from earlier literature. The publication summarizes approaches for application of the Instream Flow Incremental Methodology (IFIM) and includes one of the earlier decision making guideline roadmaps and processes for dealing with different amounts of uncertainty to address flow and water level conservation methods and outcomes. Although out of print, an electronic version can be downloaded from the University of Alaska, Anchorage, Alaska Resources Library and Information Services (ARLIS). The web address is displayed on this slide.

The two volume 1976 *Instream Flow Needs* e-reprint of the American Fisheries Society/American Society of Civil Engineers publication displayed during the banquet awards ceremony last night represents another historical literature example. As also noted, this publication is available for complimentary download on the IFC web site.

Reviewing these and other historical publications, in addition to literature cited in their reference sections, will improve our ability to comprehend how and why we got to where we are today. Historical literature can also help us to communicate with one another by understanding the evolution of terminology used. I mentioned current publications may only reference historical literature dating back 15-years or less. In those instances, current literature references may have re-referenced earlier literature without also verifying the content and purposes of the original source literature. That is, unless we are already familiar with original source literature, we may not know what the original literature actually said about a topic that's been re-referenced multiple times over the past 40 years +. This may result in not knowing and understanding the original assumptions, original limitations, and intended original applications, and whether more current authors might have also inadvertently misinterpreted an original publication's results, etc. by only reviewing a referenced summary of the original publication.

Not periodically sampling earlier historical original source literature also has the potential to be analogous to orally passing along the content of a written message (from one person to the next while sitting in a group circle) without the ability to periodically refer back to the original written message to check for accuracy.

Slide 12: So, what are my concluding summary recommendations to deal with uncertainty? Clearly, I want to first emphasize these suggestions will only represent a subset of the many, many types of topics and ideas that were presented and shared with all of us during the past 3 days.

The first recommendation is to network with IFC representatives. The IFC members are appointed by their parent fish and wildlife agencies to represent their individual jurisdictions (state, territories and provinces). The IFC representatives are essentially a portal to any type of instream flow and water level information relevant to their jurisdictional area. They will be able to help you tackle all these different elements of uncertainty.

IFC representatives may not always have all the answers, but they will be able to serve as the gateway to assist you to identify other experts and individuals that should be able to help you understand what is going on in a given geographic jurisdiction at any given point in time.

And as noted earlier, dealing with water use related uncertainty topics in any jurisdiction is a dynamic situation. What somebody reported as the status quo last month, last year, five years ago, etc. is probably out of date today. So, if one has a need to compare how and whether different jurisdictions are currently dealing with similar legal, science, etc. uncertainties, my recommendation is to network with the most knowledgeable local resource or resources who will likely have the most timely and accurate information.

Hence, take advantage of the IFC members which you've all been exposed, other water stakeholder in attendance, and also communicate with others who couldn't participate in this workshop.

If we make it a common practice to periodically network among one another, we can do a much better job of communicating exactly where we are and help one another to get where we want to go.

Remember to also make it a common practice to integrate consideration of water levels for lakes and other lentic related habitats in addition to consideration of flow regimes to conserve riverine (lotic) habitat conditions as part of an instream flow assessment

The next two recommendations for improving effectiveness to conserve flows and water levels date back to when Clair Stalnaker was leading the Ft. Collins Instream Flow Group and even earlier. The first is to establish the legal ability to link water quantity and water quality management in jurisdictions where this linkage isn't recognized. The second element is to establish the legal ability to recognize and manage surface water and subsurface groundwater as one waterbody source when a hydrologic connection can be scientifically demonstrated.

Only a handful of jurisdictions legally acknowledge and allow consideration of these linkages.

Lack of universal recognition of these two types of linkages represents two of the most critical limitations associated with water management uncertainty. Better water management is dependent on legal and institutional recognition of both types of hydrologic interrelationships. We can and should all help provide scientific information to empower the legal and institutional folks to successfully accomplish such.

Address public involvement related uncertainties by encouraging, engaging and empowering all stakeholders to participate in all legal, institutional, science, and other decision making elements that inform water management actions related to instream flow and water level conservation. Provide training to stakeholders if needed.

Finally, I can't overemphasize the significance of addressing hydrology related uncertainties resulting from inadequate flow and water level information. The solution is: gaging, gaging, gaging, gaging and gaging. Reflecting back on the past 3 days made me realize that perhaps we didn't always place enough emphasis on the importance of having adequate amounts of historical gaging and/or water level data, including the various limitations and uncertainties associated with inadequate hydrologic data.

Desktop and complex science based approaches used for water management all depend on adequate gaging data and/or valid hydrologic estimate models and surrogates. Most flow and lake level quantification methods require reach or site specific long-term mean daily flow and mean daily water level or equivalent synthetic data. If one doesn't have sufficient gaging data or confidence in the gaging and water level data, one will be unable to apply the various flow/water level assessment approaches summarized, let alone manage water effectively.

Uncertainty how much water is likely to be or will be available at any given location and at any given time from surface and subsurface waterbody sources (with and without human uses) represents a global problem and challenge. Long-term mean daily flow and water levels or valid estimates should be the goal.

This limitation represents an Achilles heel for achieving cost effective and meaningful water use management. I hope we all agree adequate hydrologic data (flow and water level) are essential to reduce uncertainty and equitably manage surface and subsurface/groundwater water sources at any given time and location for all competing water

uses and need decisions. Hence, the need for gaging is not limited to flow and water level conservation.

Slide 13: And with that, I'll close. And if there are any questions, I'll try to answer them. Thanks to all of you!

Slide 14: This last slide is for display reference especially if a hard copy of the IFC 2004 book wasn't available for physical display during my presentation.