Training, Research, and Development Center to Support Instream Flow and Water Level Conservation

Feasibility Assessment
Project Number F21AP01124

Prepared by the **Instream Flow and Water Level Conservation Steering Committee**

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INSTREAM FLOW COUNCIL

AFS
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PREFACE

This document represents the Final Feasibility Assessment for the establishment of an Instream Flow and Water Level Conservation training, research, and development center. The final assessment benefited greatly from comments and suggestions provided by reviewers of an earlier draft that was circulated in January 2023; the authors are grateful to all respondents.

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The Committee also appreciates the support provided by Kleinschmidt Associates in the preparation of draft and final versions of this assessment. Many other versions preceded those provided to the public, and Sabrina Panos of Kleinschmidt Associates was instrumental in bringing those together into a single cohesive document.

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EXECUTIVE SUMMARY

The state-of-the-art for instream flow and water level conservation (IFWLC) has advanced since the mid-1970s. However, since closure of the Cooperative Instream Flow Service Group (CIFSG) in the early 2000s, formalized IFWLC training has been lacking in the interdisciplinary and scientifically robust application across all eight key elements as defined by the Instream Flow Council (IFC). These elements are comprised of important hydrology, geomorphology, biology, connectivity, and water quality components, and overarching legal, institutional, and public involvement considerations. Although some level of training within specific elements has occurred, opportunities for interdisciplinary training and methods development are not broadly available to all water stakeholders. Recognizing this void, the IFC and American Fisheries Society (AFS) partnered to obtain a multi-state conservation grant (co-administered by the U.S. Fish and Wildlife Service [USFWS] and Association of Fish and Wildlife Agencies [AFWA] and funded from the Wildlife and Sport Fish Restoration [WSFR] program) to evaluate the need and feasibility of establishing a national training and development center (Center). This training is critically important to regulatory staff and management, and other engaged stakeholders so that the ecological implications of water allocation decisions on freshwater ecosystems are clearly understood.

A ten-member steering committee (Committee) was formed to administer and conduct the feasibility assessment. Using a combination of personal contacts among colleagues, peers, and associates, and results from an internet-based survey of water stakeholder interests, the Committee concluded that no appropriate, comprehensive, and consistent training opportunities currently exist, and there was overwhelming and broad support for the formation of a Center. The Committee then proceeded to evaluate its feasibility by considering what functions such a Center would provide, how it could be organized and managed, and how it could be funded.

The Committee envisions that the Center would provide four primary functions: leadership, interdisciplinary training, collaboration with partners on development and testing of new methods and subsequent integration into the Center curriculum, and support services. To a large extent, this mirrors the successful framework employed by the original CIFSG.

Four concepts were identified and evaluated for organizing and managing the Center – Centralized, Decentralized – Distributed Network, Centralized Distributed Network, and Joint Sponsorship.

Centralized – Brick and Mortar	Decentralized – Distributed Network	Centralized Distributed– Network with Both Virtual and In-person Training	Joint Sponsorship with Other Stakeholder Organizations
Buy, build, or lease a facility to house the Center; location to be determined but favor university setting that would provide flexibility in office space.	Use a distributed network composed of selected personnel from one or more host institutions at one or more locations to cover the required training disciplines.	Use a distributed network that includes a single centralized location that houses core administrative and technical staff that would serve as a hub to regionally based satellite centers (other universities) most knowledgeable of local and regional training needs.	Collaborate with other existing programs in water resource management and development of instream flow/water level models and methods.

The Centralized option would be most similar to the original CIFSG but would also carry the highest costs and face the challenges in Center location and filling on-site staffing needs. Decentralized – Distributed Network concept provides more flexibility in staffing and provides greater out-reach potential provided by having a geographically diverse team of instructors. This concept would have lower start-up costs and would rely primarily on virtual training. The Centralized Distributed Network approach is similar to the Decentralized concept but would include a single centralized location that houses core administrative and technical staff that would serve as a hub to regionally based satellite centers (other universities) most knowledgeable of local and regional training needs. Both distributed network approaches would combine virtual and in-person training and would have the advantage of starting with a small core team of instructors but can expand as needed, reducing start-up costs. The Joint Sponsorship concept builds on the recognition that stakeholders from governmental, non-governmental, academic, and private interests have remained involved in the development of instream flow and water level conservation methods and that further collaboration will continue to update new and innovative approaches to IFWLC and increase integration of relevant topics into the training curricula.

Regardless of the final approach used, the Center will continually leverage networking and collaboration with the active research communities at universities, research laboratories, and private organizations to promote application and integration of best available science across all eight IFC interdisciplinary elements.

Three funding options were evaluated including a Governmental Agency Concept, whereby the Center would be supported much like that provided for the CIFSG; Private/Philanthropic Concept, which would seek funding from non-governmental entities and should allow the structuring of the Center independent of outside political or budgetary forces; and the Cooperative Concept which would offer elements from both concepts.

Based on results of the draft feasibility assessment and subsequent comments on the assessment, the Committee recommends that the Center be housed within a university or research center with shared interdisciplinary objectives for natural resource conservation, management, and law. The Center would function as a Centralized Distributed Network and would include a centralized core staff responsible for administering and directing training options with a decentralized group of regionally distributed technical specialists most knowledgeable of local training needs. The eventual format, function, and funding of the Center will be guided by the IFC and AFS and will evolve over time, with input and feedback provided from the stakeholder community.

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1. INTRODUCTION AND OBJECTIVES

This document assesses the needs, feasibility, and options, and provides an implementation strategy for establishing an instream flow and water level conservation (IFWLC) training, research, and development center (Center). Globally, watersheds, with their linked surface and groundwater ecosystems and estuaries (Figure 1) are at increased risk of maintaining ecological integrity given the competing demands for water allocation and associated uses. A Center is needed to promote and provide instruction in the necessary methods and interdisciplinary analytical tools for determining defensible flows and water levels to conserve (protect, restore, and enhance) and manage aquatic ecological functions. Conserving adequate amounts of clean water within these freshwater ecosystems to sustain and curb declines in biodiversity is a worldwide challenge.

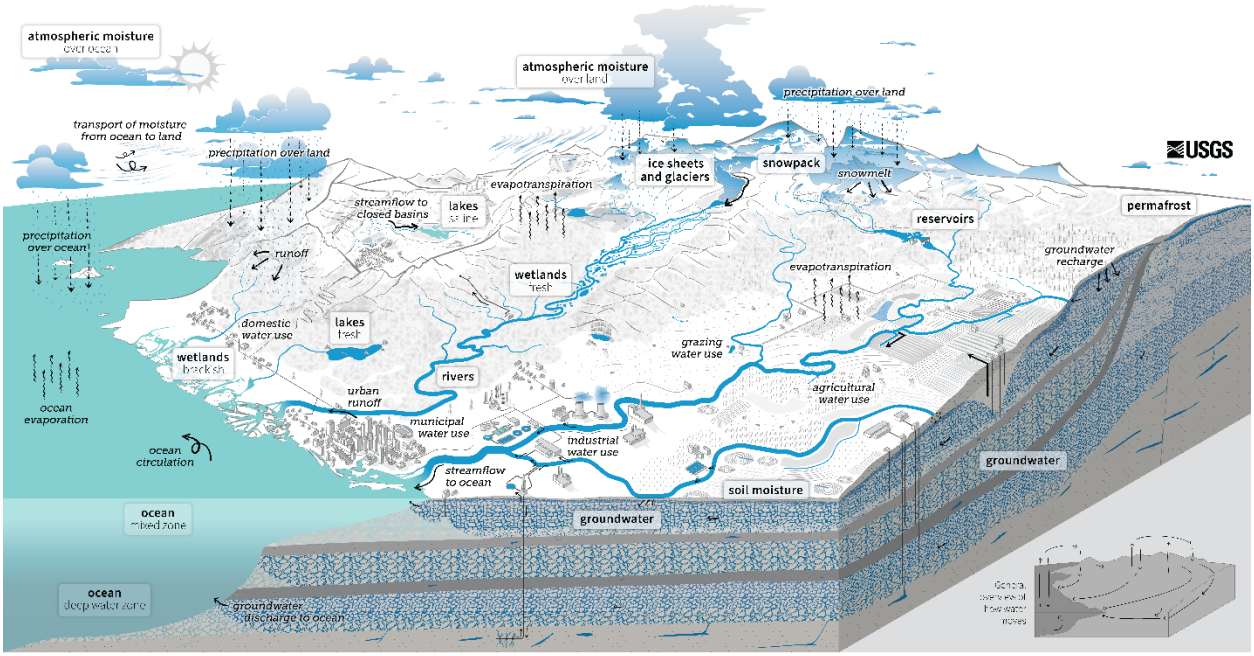

Figure 1 Conceptual watershed illustrating linked surface and groundwater ecosystems and estuaries that displays hydrologic flow paths, interrelationships, and connections between surface (rivers, streams, lakes, wetlands) and groundwater flows as influenced by geomorphic processes within a watershed. Figure adapted from U.S. Geological Survey [USGS][1]).

[1] https://labs.waterdata.usgs.gov/visualizations/water-cycle/index.html#/

Notably, the Living Planet Index for freshwater vertebrate populations showed an 84% decline between 1970 and 2016, a rate twice that of the biodiversity loss in terrestrial and marine realms (World Wildlife Fund 2020). Consequently, it is critically important that the ecological processes and linkages of freshwater ecosystems be considered in any water allocation process. Moreover, the increased uncertainty of seasonal water availability and impacts attributed to short and long-term climate variability is already affecting water allocation strategies where total demands exceed total projected supply in some systems.

The regulatory processes that govern water allocation and use decisions require those participating in or impacted by the decisions and outcomes (hereafter stakeholders), to navigate complex scientific, legal, institutional, and policy settings. Stakeholders are confronted with increasing complexities associated with the evolution and rapid development and application of advanced technologies for data acquisition, analyses, and modeling that are employed across the breadth of the social, economic, physical, chemical, biological, and legal disciplines that must be considered and addressed within regulatory processes. This can impede stakeholder involvement due in large part to a lack of access to credible and consistent training as documented below.

The overall success and application of given regulatory process(es) for water allocation from or within a water body involve(s) balancing societal needs (e.g., municipal, agricultural, industrial, etc.), while protecting, restoring, enhancing, or managing adequate amounts of water to sustain the ecological integrity of the affected freshwater and estuarine ecosystems. Management must also recognize and address the spiritual and cultural connections and values of surface waters for some communities and cultures that exist outside the strict descriptions of science. Sustainable water management and uses also require that end water users and beneficiaries are aware of their water sources and how its delivery can impact the source water body (Table 1). Ultimately, combinations of public involvement, legal, institutional, and policy requirements typically influence allocation options and the decisions for resolving competing water demands and uses.

Currently, aquatic resource managers and many stakeholders acknowledge the guidance provided by the Instream Flow Council, (IFC)[2], the American Fisheries Society (AFS)[3], and The Nature Conservancy (TNC)[4], among others on ways to effectively navigate this regulatory process. This document embraces the IFC definition of IFWLC that the long-

[2] https://www.instreamflowcouncil.org/
[3] https://fisheries.org/
[4] https://www.nature.org/en-us/

term conservation of the ecological integrity of freshwater (lotic and lentic) and estuarine ecosystems requires the integration of credible management concepts drawn from eight interdisciplinary elements comprised of five science elements (hydrology, geomorphology, biology, connectivity, water quality), and three social elements (legal, institutional, and public involvement) (Annear et al. 2004) (Figure 2)[5]. Integration of all eight elements is key to informing the regulatory process of the implications of water allocation decisions on freshwater and estuarine ecosystems.

The state-of-the-art for IFWLC has advanced since the mid-1970s including more recent emphasis on the recognition and need for integration of these eight elements into both freshwater lentic and lotic waterbodies including estuaries. Unfortunately, formalized training in the interdisciplinary integration of the eight elements, ongoing research into development and application of new approaches, and support services for conserving adequate amounts of water in both lotic and lentic habitats are critically lacking.

Table 1 Examples of water allocation uses and demands (includes frozen state).

Instream Flow/Water Level Conservation Uses	Withdrawal/Diversion/ Impoundment Uses
Water amounts retained within waterbodies to carry out and sustain vital watershed ecological related functions/uses such as: • Fish and Wildlife • Recreation/Aesthetics • Navigation/Transportation • Water Quality	Water amounts removed from or modified within waterbodies that alter flow regime/water levels in watersheds to support uses such as: • Power Generation • Domestic/Industrial • Irrigation • Mining • Recreational • Water Export • Ice Roads

[5] The IFC eight interdisciplinary elements are referred to as the "eight (or 8) elements" from here on in this document.

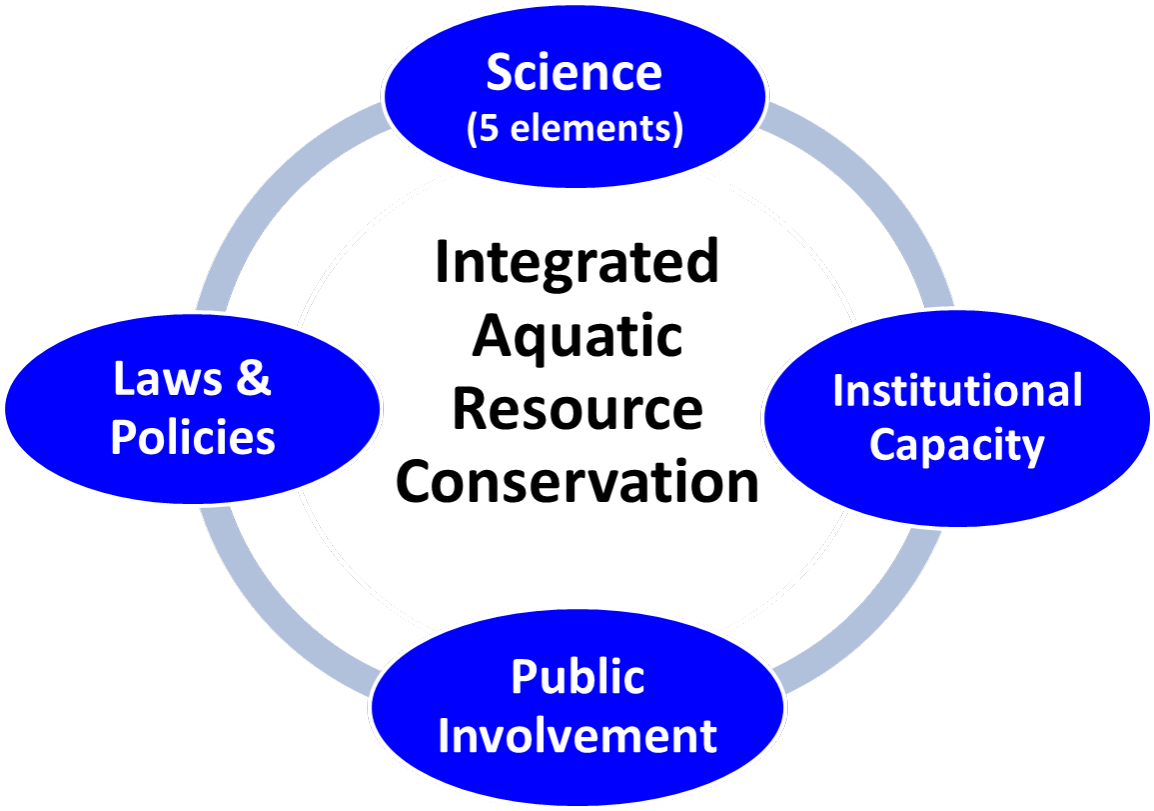

Figure 2 **Effective aquatic resource conservation and management is achieved by the integration of eight interdisciplinary elements that include three social elements – laws and policies, institutional capacity, and public involvement, and five science elements (hydrology, geomorphology, biology, connectivity, and water quality).**

Beginning in the mid-1970s, the Cooperative Instream Flow Service Group (CIFSG) was charged: to develop and improve methods for assessing and recommending instream flow regimes for habitats of fish, wildlife, and other aquatic organisms, and for recreation; to establish an effective communication network for disseminating instream flow information and training for the purpose of promoting skills needed by water resource managers and stewards in a consistent and credible manner; and to identify research needs and support applied research projects designed to evaluate new approaches. The CIFSG was the major source of this synthesis, development, and training from the mid-1970s to 2000 when the original training center ceased to exist. Many of those trained through the CIFSG program have either retired or moved on to other positions. Although some continuance of these skills has occurred via personnel mentorship and on-the-job training from experienced practitioners, such opportunities are not broadly available to stakeholders. This has created a void in the continuum of methods development and application in instream flow and water level conservation science.

Recognizing this void, the IFC and AFS partnered to apply for and obtain a multi-state conservation grant (co-administered by the U.S. Fish and Wildlife Service [USFWS] and Association of Fish and Wildlife Agencies [AFWA] and funded from the Wildlife and Sport Fish Restoration [WSFR] program) to evaluate the need and feasibility of establishing a Center, more broadly named the Center for Integrated Aquatic Resource Conservation, hereafter the Center. The grant application was approved in September 2020 and a ten-member steering committee[6] (Committee) formed to complete the feasibility assessment (see Appendix A).

As an initial step, Committee members solicited the opinions of colleagues, peers, and associates regarding the general need for a training center. The feedback received was positive and prompted the Committee to seek opinions and recommendations from a broader range of water stakeholder interest groups via a formalized internet-based survey in July 2021. This provided further confirmation of need, and the Committee subsequently proceeded with the draft feasibility assessment to explore various alternatives more fully for organizing, managing, and funding such a Center. The Committee received positive feedback on the draft report and included excellent suggestions on implementation and Center curriculum among other areas. This final report reflects both the survey and draft report respondent comments. The assessment led to the formulation of an implementation strategy and identification of "next steps" directed toward the future establishment of the Center.

The document is organized into the following sections:

- **Introduction and Objectives** (this section);
- **Review of Historical and Current Training Opportunities**, that describes the beginnings of instream flow science in the 1970s and the genesis of formalized training and research programs that culminated in the formation of the CIFSG and then contrasts that with present day training needs and available training opportunities;
- **Current Interest and Need for a Center**, that summarizes results from respondents to the August 2021 Instream Flow and Water Level Training Center survey;

[6] The steering committee was comprised of experts representing governmental, non-governmental, academic, and private sectors with extensive experience in integration of the interdisciplinary development, training and application of instream flow and water level conservation methods and who have remained actively involved in water resource allocation issues (see Appendix A for members' names, affiliations, and experience).

- **Alternatives Considered for Establishment of a Center**, that includes its organization, management, and funding;
- **Implementation Strategy**, that describes the Center functions and the Committee's proposed approach for advancing the development of a Center; and
- **Next Steps,** that briefly lists and describes follow-on activities to this feasibility assessment.
- **References**

1.1 Goals and Objectives

The overarching goal of the Committee is to promote the establishment of an interdisciplinary Center that develops methods, provides instruction and other services that lead to full and routine incorporation of ecological principals within freshwater planning and management practices at all levels of government.

Objectives were first to determine the needs and second to demonstrate that feasible pathways exist to establish such a Center. The first objective has been reached and several pathways for possible establishment have been identified as well. The committee envisions that the Center will provide four key functions in supporting the stakeholder community: Leadership, Training, Research Development, Networking, and Support Services.

2. REVIEW OF HISTORICAL AND CURRENT TRAINING OPPORTUNITIES

As part of determining the "need" for an IFWLC Center, the Committee reviewed both historical and current resource issues and needs, and the opportunities for receiving formalized training in the integration of credible science across all eight elements.

2.1 Historical Resource Needs and Training Opportunities

In the mid-1970s, the Fish and Wildlife Coordination Act required agencies such as the U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and U.S. Federal Energy Regulatory Commission to consult with the USFWS on projects pertaining to water management on federal facilities and resources. USFWS field office staff in the Division of River Basin Studies were frustrated with the lack of widely accepted, credible methods to quantify flow needs below large reservoirs. Flow release recommendations were offered but the general lack of standardized approaches often created more controversy than they resolved.

To address this concern, the USFWS obtained funding from the U.S. Environmental Protection Agency (EPA) Office of Water Research and Technology to host workshops to document the state-of-the-art and identify instream flow and related training needs. In 1974 the CIFSG in Fort Collins, Colorado was established. It was fully staffed by July 1976. These efforts led to a symposium and specialty conference in Boise, Idaho, in May 1976 that was jointly sponsored by the Western Division of the AFS and the Power Division of the American Society of Civil Engineers (ASCE) (Orsborn and Allman [eds] 1976). The symposium provided a forum for discussing needs and solutions to scientific, technical, legal, and social problems caused by increasing competition for limited stream flow. One of the more seminal and forward-thinking papers presented was by Waters (1976) who described a computer based incremental approach for evaluating fish habitat and flows in California, with many of its underpinnings reflected in the later development of the Physical Habitat Simulation (PHABSIM) model (Milhous et al. 1984) and the overarching Instream Flow Incremental Methodology (IFIM) by the CIFSG.

The CIFSG was an interdisciplinary entity intended to be a national center of activity and focal point relating to instream flow method development, training, research oversight, and support services. The current project's Committee member Dr. Clair Stalnaker was a member of the 1976 symposium organizing committee and Leader of the CIFSG throughout its existence.

The CIFSG initially researched the state-of-the-art in hydrologic, hydraulic, earth resources, sediment transport, water quality, aquatic biology, and the inter-relatedness of these elements to riverine ecology. Through many brain-storming events involving different discipline-trained staff and invited experts on temporary assignment, new methods and analyses were developed and documented. Curricula were prepared and training initially offered for federal, state, and provincial agency employees charged with protecting instream flow regimes through interdisciplinary technical, legal, institutional (policy), and public involvement mechanisms. Training was expanded and provided to a mix of water resource engineers, hydrologists, lawyers, water policy analysts, consultants, tribal entities, and other stakeholders. The grounding in hydrology, hydraulics, water quality, fluvial and lacustrine geomorphology (hereafter referred to as geomorphology), and biology made the concept of instream flow issues more acceptable to resource managers and stakeholders. The CIFSG expanded the scope of traditional instream flow and water level objectives beyond single-flow minimum instream flow prescriptions to the integration of the interdisciplinary sciences that drive ecological processes. This integration of riverine sciences and the need for mitigation planning by the USFWS along with promotion of intra- and inter-annual flow variability for protection of aquatic organisms dictated that research and training requirements grow considerably.

A summary of training courses provided by the CIFSG is provided in Appendix B and serves as a foundation to inform Center curriculum development. The Committee notes that training suggestions from the initial survey responses in 2021 and comments received on the draft feasibility assessment in 2023 will be considered during Center implementation.

This organizational structure led to the widely recognized success of the CIFSG. In 1987 Dr. Robert White, then leader of the Montana Cooperative Fisheries Unit and later President of the AFS, wrote "*... the group has far exceeded the intent of its original objectives and, in my opinion, has made the largest contribution to fisheries of any specialty group within the USFWS or any other federal agency. Through their efforts, the Instream Flow Incremental Methodology that was developed ... provides a framework presenting decision-makers with a series of management options, and their consequences. The positive outcome of these efforts toward the protection of inland stream fisheries is immeasurable.*"

Between 1990 and 1991, the U.S. Department of Interior sought to enhance the science function within Interior agencies by creating a new biological research agency called the United States Biological Survey. In the process of multiple reorganization efforts and

retirements of long-term staff, the CIFSG ceased to exist in the early 2000s. A comparable national organization has not existed since that time.

Since its formation, the CIFSG worked to counter the misconceptions that a single year-round minimum flow within a fluvial water body was adequate to protect ecological processes and related uses. In its place, they promoted instream flow regimes that mimicked natural intra- and inter-annual flow and habitat variability. Further, the CIFSG promoted the importance of basing flow regime needs on all ecological elements (like the eight elements) of the aquatic community and life stages. The IFIM was developed to provide a framework to address and quantify potential impacts of water development projects necessary for mitigation planning as required by the National Environmental Policy Act (NEPA).

During its tenure, the CIFSG provided standardized instream flow training to thousands of stakeholders involved with instream flow and water level conservation on a global basis. Recipients of that training are now retiring, which is creating a void in skilled IFWLC practitioners. This is leading to a situation like in the mid-1970s, when there was fragmentation in uniform, credible scientific approaches to quantifying instream flow regimes and water level conservation needs.

2.2 Current Resource Needs and Training Opportunities

The basic premise of the proposed Center is that effective conservation of instream flow and water levels depends upon integrating all eight elements specified by the IFC (Annear et al. 2004). Most of these elements were first individually identified at the AFS and ASCE specialty conference (Orsborn and Allman [eds] 1976) and later more formally described by the CIFSG as presented in their IFIM approach (Bovee et al. 1998). Advancements in methods and their integrated applications have proliferated from efforts by researchers and instream flow practitioners across governmental, and public and private sectors.

However, while many of the scientific disciplines and some legal and institutional parameters have advanced considerably, what is lacking for stakeholders today is access to an integrated training and development program. The proposed Center is intended to address this deficiency by offering focused training and collaborating with other entities that can supplement individual elements. The Committee acknowledges that many IFWLC elements exist within various graduate and undergraduate university programs, but no integrated systematic program exists covering all elements, and that these academic programs are ill suited for access by existing practitioners and stakeholders. Likewise, the

Committee is not aware these programs exist or are available to stakeholders through private, governmental, and non-governmental entities.

Based on information received to date by Committee members and their networking efforts, there are several sources of governmental, non-governmental, professional, academic, and private organizations offering individualized, continuing training courses in one or more of the eight elements. Some examples of these include the USFWS National Conservation Training Center[7], the U.S. Army Corps of Engineers' Hydraulic Engineering Center/River Assessment System (HEC-RAS)[8], in particular, the Hydraulic Engineering Center Ecosystems Functions Models (HEC-EFM)[9] that define relationships between hydrology and ecology and can display results spatially. The EPA also offers training on various elements related to water quality (e.g., BASINS[10]) and has developed tailored training to increase the adaptive capacity to deal with climate change developments[11]. The National Oceanic and Atmospheric Administration's (NOAA) National Climate Centers for Environmental Information[12] is another important source that details the effects of climate change on hydrology, adaptation, and resilience.

The Nature Conservancy has specifically focused on environmental flows and has developed a set of tools/models that can be applied in addressing water management issues. These include the Indicators of Hydrologic Alteration (IHA) (Richter et al. 1996), the Environmental Flow Components (EFC), and the Ecological Limits of Hydrologic Alteration (ELOHA). TNC provides access to these methods and models and references to other sources of useful information via its Conservation Gateway[13].

Likewise, Trout Unlimited (TU)[14] has championed watershed and riverine ecosystem conservation for over 50 years and has partnered with agencies, landowners and other stakeholders on numerous instream flow related projects[15]. The Committee sees much potential to collaborate with these entities and others to supplement training offered by the Center, especially when more focused instruction is required by trainees.

[7] https://www.fws.gov/program/national-conservation-training-center
[8] https://www.hec.usace.army.mil/factsheets/default.aspx
[9] https://www.hec.usace.army.mil/software/hec-efm/
[10] https://www.epa.gov/ceam/better-assessment-science-integrating-point-and-non-point-sources-basins
[11] https://www.epa.gov/ceam/basins-tutorials-and-training
[12] https://www.ncei.noaa.gov/regional/regional-climate-centers
[13] https://www.conservationgateway.org/ConservationPractices/Freshwater/EnvironmentalFlows
[14] https://www.tu.org/
[15] https://www.tu.org/?s=instream+flow+protection

Some of the same governmental and non-governmental organizations, as well as professional organizations, private entities, and the academic sector have also developed applied training specific to legal, institutional, public involvement curricula relating to IFWLC. Collaboration and networking with these entities will be pursued to ensure training that reflects present-day laws, policies, and public demands on geographically and jurisdictionally appropriate bases.

The Committee also recognizes that several instream flow-related analysis techniques have been developed by the private sector over the past two decades with five of the more recent methods provided as examples in Appendix C. Formalized techniques for assessing ecologically based water level requirements for lentic habitats are generally lacking, but examples of project specific approaches for doing such have been applied in Alaska, Alberta, Colorado, Florida, Nevada, Oregon, and other locations. New methods, including those focused on water level conservation will continue to be developed to address novel and ongoing concerns such as the effects of groundwater withdrawals (Arthington 2022), hydropeaking (Smokorowski 2022), ice formation and breakup (Thellman et al. 2021), and climate change variability (Peterson et al. 2013) on aquatic ecosystems. Furthermore, the numerous models and sources of information regarding environmental flows can create confusion among stakeholders and resource managers as to which method/models are "best" for their application (Williams et al. 2019), and beyond that, how do you use and then interpret data once the method/model has been selected. Indeed, one of the functions of the Center would be to provide a platform for the review of new methods, as part of its overall holistic training approach to addressing and solving IFWLC issues.

3. CURRENT INTEREST AND NEED FOR A CENTER

A significant step in the assessment, was for the Committee to develop and conduct an independent survey to determine the interest in and support for a proposed Center. This survey was conducted in the summer of 2021 and was distributed widely via the internet to numerous organizations with water management interests (Appendix D). The recipients were also encouraged to forward the survey link to others who might have qualifications and desire to provide input. The committee also made a draft final version of this report available for broad review and comments in January 2023; Appendix E summarizes the stakeholder categories and entities contacted. Comments received were unstructured so not quantifiable like the 2021 survey. Responses to both reviews were accepted for 30 days after launching them and reminders were sent during the open period.

The 2021 survey consisted of ten questions with key findings and preliminary conclusions for each question summarized in Appendix F. Some of the key findings from the survey include:

- Four hundred eighty-six (486) people participated in the survey. Nearly 95% of participants indicated support for establishing a training, research, and support Center that would promote integration of multiple disciplines in flow and water level prescriptions (Figure 3).

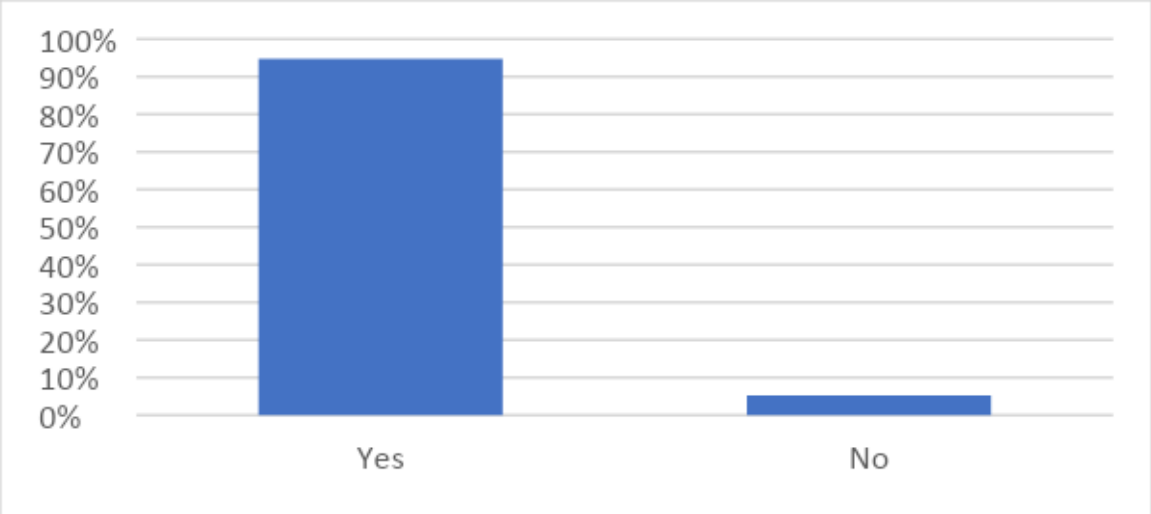

Figure 3 Percentages of survey respondents favoring establishment of a training, research, and support Center.

- Most of the responses (75%) indicated affiliation with either a state/provincial or federal (Canadian or U.S.) governmental agency.

- Most respondents were involved in natural resource management either as a biologist, scientist, or the broader category of natural resource manager.
- Three hundred forty-six (346) of the 475 (73%) people who responded to this question have been doing this work for 20 years or less. This indicates that most respondents did not get training directly from the CIFSG.
- Most survey participants said they already possessed some skill in the eight elements noted above. They also expressed strong interest in additional training in all of those elements.
- Four hundred and thirty-nine (439) of the 448 (98%) people who responded to this question indicated a desire to attend a future workshop on this topic if one is held. Of these, one hundred and eighteen (118) (27%) indicated a desire to give a professional presentation at a workshop if one is held.
- Several participants indicated a willingness to work with the Committee to find a setting where training and support services could be provided.

The 2023 draft final report was sent out for review to all participants in the initial survey as well as circulation to a broader audience in the water resources stakeholder community. Over 100 sets of comments were received, many of which have been incorporated into this final version of the document. As with the 2021 survey, support for the creation of the Center was unequivocally positive. There were no negative responses submitted.

3.1 Committee Conclusion

After deliberation of responses from the initial survey, review of stakeholder comments received on the draft version of this assessment, and feedback by Committee members and their network of contacts in federal and state agencies, tribal entities, non-governmental entities, and the academic and private sectors, the Committee concluded that no appropriate, comprehensive, and consistent interdisciplinary training opportunities currently exist in North America that is available to all stakeholders to address the needs identified in this document.

By making the proposed Center available to all stakeholders, and emphasizing the interdisciplinary nature of IFWLC studies, the Center would differentiate itself from other training programs by its framework to promote the integration of credible science from all eight elements to inform the regulatory process of the implications on the ecological integrity of the affected freshwater ecosystems. It further distinguishes itself by the multidisciplinary guidance to the stakeholder community for proper application and interpretation of technical approaches across all eight elements. The Center's leadership

role derives from the direct involvement of AFS and IFC members who deal with these complex issues on a regular basis beyond the theoretical application of individual elements. The Center's collaborative networking with universities, national research centers, and private industry engaged in research and development and application of new methods will further improve the ability of all stakeholders to assess the implications of these water resource decisions on affected freshwater ecosystems. We stress again that these systems are comprised of linked surface water and groundwater systems as expressed by rivers, streams, lakes, reservoirs, wetlands, springs, and estuaries.

4. ALTERNATIVES CONSIDERED FOR ESTABLISHMENT OF A CENTER

There is broad and diverse support for the establishment of the Center across the spectrum of stakeholders who participated in this feasibility assessment. As noted in the next section, there will always be an ongoing need by stakeholders for Center services, considering the growing competing global demands for water and the regulatory processes compounded by hydrologic alterations attributed to climate changes and anthropogenic actions. This was a key question to answer before the feasibility assessment could progress. The Committee received input from the 2021 Survey and reviews of the draft report, input from several independent experts as well as comparisons to similar program structures to guide implementation strategies for the Center in the feasibility assessment. Three key considerations factored into the feasibility assessment of the Center: 1) identification of potential Users/Customers of the Center; 2) Organization and Management of the Center including where and how it would generally function; and 3) approaches for securing potential funding to operate and maintain the Center. These are described below.

4.1 Users and Customers of the Center

The overarching regulatory environment is a process that requires the engagement of regulatory management and enforcement staff at the local, state, regional, provincial, national, tribal and at times international jurisdictions. Regulatory staff often review highly technical reports covering some or all eight elements and their synthesis in the process. The regulatory process may further require engagement with local, state, regional, national, or tribal jurisdictions which may constrain or facilitate consideration of alternative allocation strategies. In addition to technical staff at resource agencies there is stakeholder participation from legal counsel representing the respective local, state, federal and tribal jurisdictions. Additional stakeholders represent the interests of specific private sector businesses, Non-Governmental Organizations (NGOs), foundations, academic institutions, and citizen groups. This underscores the importance of the Center to provide regional specific guidance and training for stakeholders on how to effectively navigate the legal and institutional environments as part of facilitating informed stakeholder engagement.

Support for the Center was affirmed across the broadest possible spectrum of stakeholders who provided input and included several private businesses, universities,

research laboratories and private individuals. Stakeholders included international entities supporting the establishment of the Center and access to its support services including training in the near term.

The strategic need for the Center is imperative given turnover of staff at all levels of government and extends across the spectrum of all stakeholders. The Committee stresses the critical importance of training regulatory staff and management and engaged stakeholders who are influencing water allocation decisions to understand the implication of those decisions on the ecological integrity of affected freshwater ecosystems. These decisions will ultimately affect the linkage of groundwater and surface waters expressed as springs, streams, rivers, ponds lakes, wetlands, and estuaries far into the future.

4.2 Organization and Management Approaches

For planning purposes, the feasibility of four administrative concepts were considered with the pros and cons of each summarized in Table 2. The approaches range from a centralized and traditional "brick and mortar" concept in which the Center would be housed in a fixed location where in-person training would occur, to a more dynamic de-centralized concept in which virtual training offerings would be provided via a network of personnel from multiple host institutions. A hybrid approach was also considered that encompassed elements of both in-person and virtual training. The fourth approach considered joint sponsorship with an existing entity such as TNC that has pioneered and provides training in several environmental flow models and methods.

Each of the four concepts was evaluated in terms of Pros (+) and Cons (-) with evaluation factors primarily associated with implementation costs (start-up and operations and maintenance), staffing requirements (both technical and administrative), management structure, and ease of implementation (Table 2). The **Centralized** concept would be most similar to the original CIFSG that was located in Fort Collins, Colorado, but would also carry the highest costs and face the greatest challenges in terms of selecting a location and filling on-site staffing needs. Its resemblance to the CIFSG would provide a pre-existing "Identity" to the Center and promote broad interest and support in its operation. The Center would be developed to provide both in-person and virtual training. The **Decentralized – Distributed Network** concept provides greater flexibility in meeting staffing requirements and also provides greater out-reach potential provided by having a geographically diverse team of instructors. This concept would rely primarily on virtual training, although some strategically held in-person training sessions could be scheduled either by design or group sponsorship. A **Centralized – Distributed Network** approach

would operate similarly but would include a single centralized location that houses core administrative and technical staff that would serve as a hub to regionally based satellite centers (other universities) most knowledgeable of local and regional training needs. These concepts have lower start-up costs and have the advantage of allowing for a "phased" implementation process. Thus, training could start small with a core team of instructors that fulfill the primary tenets of instream flow and water level science and can expand as needed to increase instruction and/or diversify training modules. The fourth concept, **Joint Sponsorship**, builds on the recognition that other stakeholder organizations have remained involved in the development of environmental flow and water level models. This would rely on negotiations with them and defining roles and responsibilities mutually beneficial and agreeable to both entities. **Other Concepts** may be identified and explored following review of this feasibility assessment.

4.3 Potential Funding Options

The specifics of funding needs, sources, and financial mechanisms will be developed as part of forthcoming Business Plan(s) based on the actual implementation strategy(s) of the Center (Table 2). Previous sections of this document addressed the history, status, and possible future format and functions of IFWLC training. Though the Committee presently envisions a single approach to initiate the program, there are several strategies and formats that may prove feasible depending on a number of factors. These include, but are not limited to, requirements of a host or partner institution, requirements of potential funding sources, demand for services, and the rate at which full-scale training and related services are developed over the first several years. In consideration of those factors, it is difficult to project the annual cost to initiate the program or approximate the cost over time. Dedicated short and long-term funding is needed as it is questionable whether the Center will be sustaining on training fees alone.

The Committee will continue to explore implementation opportunities which will include preparation of proposals and business plans as part of the application process for a given program or organizational submission. The Committee is committed to a flexible yet focused approach to the implementation process. Securing adequate start-up funding is a first priority, but stable long-term funding remains a priority. As opportunities arise that are not initially recognized, the Committee will shift efforts as needed.

Table 2 Options considered[16] and benefits and risks of each for the organization and management of an Instream Flow and Water Level Conservation Center.

Option and Description	Pros (+)	Cons (-)
Centralized – Brick and Mortar: buy, build, or lease a facility to house the Center; location to be determined but favor university setting that would provide flexibility in office space. This option most closely resembles the operation of the former CIFSG in Fort Collins, Colorado.	• Establishes physical presence and Identity/Brand of the Center although would need decision on whether to own or lease facility; • Majority of Center technical staff in close proximity to the facility and would facilitate intra-staff collaboration, curricula development, and planning; • Center includes dedicated in-house training facilities (no competing interests to work around); • Could ultimately serve as a central clearing house for disseminating IFWLC related information, and promoting and implementing new and innovative approaches for addressing IFWLC issues.	• **Mostly cost-related**, as startup and operations costs would be high including: - Large initial capital costs for infrastructure, although university setting would obviate the need for major construction; - Unless already present at selected facility, identifying, hiring, and sustaining full-time requisite technical and administrative staff would be lengthy and costly; - Ongoing Operation and Maintenance costs (utilities, supplies, administration, insurance, etc.); - Disbandment and closure of the Center could be complicated and costly. • Centralized presence in one location may geographically bias the focus of the training; however, this could be avoided/reduced by conducting regional workshops and video-training; • Would likely require lengthy start-up time before Center becomes fully operational.

[16] Note – the options listed, and associated pros and cons are those identified by the Committee as most conducive for meeting the overall objectives of an IFWLC Center. Other options may exist, and the Committee is open to evaluating other concepts as they are identified.

Option and Description	Pros (+)	Cons (-)
Decentralized – Distributed Network: use a distributed network composed of selected personnel from one or more host institutions at one or more locations to cover the required training disciplines. These could be federal, state, provincial, private, or university locations and personnel.	• Provides a geographically diverse portfolio of multidisciplinary expertise; • Provides flexibility in staffing to meet evolving water resource issues; • Softens the need (and cost) for full time staffing; • Infrastructure already exists and averts the need for one physical location of the Center; • Reduces singular financial risk as operational costs shared among participating organizations; • Shortens timeframe for implementation of training modules; e.g., some initial courses could be offered in the near-term; • Allows for "phased" implementation – start small and build network as demands increase.	• Center "identity" less defined and may need different brand – e.g., IFWLC as in Consortium instead of Center; • Limited opportunities for in-person brainstorming and collaboration, which may hamper future planning and curricula development. However, establishing a network of personnel with a shared vision of objectives should reduce such limitations; • Management is potentially more difficult (as a function of who is involved); • Imposes structural challenges to sustained or focused collaborations; • Personnel turnover could be problematic, especially if specialty topics are reliant on single instructors; i.e., no backup. This indicates all courses should have at least two instructors available (and substitutes if possible) who could each singly instruct the course; • Everyone potentially has their own day job.

Option and Description	Pros (+)	Cons (-)
Centralized – Distributed Network: establish a central base of operations (hub) for administrative and planning purposes that is linked to a distributed network composed of selected personnel from one or more host institutions at one or more locations to cover the required training disciplines. This option would fit best within a university framework whereby one university would serve as the hub, with others strategically located at regionally based institutions.	• Provides a central hub with administrative and technical staff to develop training modules and coordinate between other satellite institutions; • Center "identity" better defined via existence of central hub; • Provides a geographically diverse portfolio of multidisciplinary expertise; • Provides flexibility in staffing to meet evolving water resource issues; • Infrastructure already exists and averts the need for one physical location of the Center; • Reduces singular financial risk as operational costs shared among participating institutions; • Shortens timeframe for implementation of training modules; e.g., some initial courses could be offered in the near-term; • Allows for "phased" implementation – start small and build network as demands increase.	• Some upfront increased costs due to full-time staffing of central hub; • Imposes structural challenges to sustained or focused collaborations; • Personnel turnover could be problematic, especially if specialty topics are reliant on single instructors; i.e., no backup. This indicates all courses should have at least two instructors available (and substitutes if possible) who could each singly instruct the course; • Strict administrative oversight needed to ensure collaboration and consistency among trainers.

Option and Description	Pros (+)	Cons (-)
Joint Sponsorship with Other Stakeholder Organizations: others already may have a prominent role in water resource management and development of instream flow/water level models and methods.	• Builds on and enhances existing platforms of environmental flow/level training and strategies; • Consolidates separate training modules so that training opportunities can be more comprehensive.	• Requires strong relationship and shared vision between parties; unless this already exists, this would take time to develop; • Increased complexity in defining roles and responsibilities and curricula development.

4.3.1 Governmental Agency Concept

Under this concept, the Center would be supported entirely by one or more governmental agencies much like the original support provided by the USFWS (and later the USGS) for the CIFSG. Funding would ideally be from a congressionally dedicated agency budget that is protected from defunding or redirection for other purposes. The training site could be located at an existing facility, such as the USFWS National Conservation Training Center, U.S. Forest Service Science Center, the Bureau of Reclamation Science Center, and the U.S. Army Corps of Engineers Learning Center. These facilities offer advantages in that they are already established, likely have adequate support staff (accounting, information technology, maintenance, etc. – but not necessarily trainers), are in a location that is recognized by many potential stakeholders and might absorb the proposed facility with relative ease.

Center staff will collaborate with these entities and leverage where possible training opportunities. However, none of these entities are currently engaged in providing consistent training in the integration of all eight elements to inform IFWLC recommendations, assessments, and mitigation strategies. Considering that existing centers already have budgets and staff, it may be difficult to generate additional funding for the interdisciplinary staff functions proposed here, unless an agency sees the need and opportunity in the way that the USFWS did in the 1970s, 1980s, and early 1990s. It may likewise prove difficult to insulate funding and administration of the proposed Center from redirection to other purposes of those existing centers. Considering changing governmental priorities, it may prove difficult to guarantee that the proposed Center can persist long-term as envisioned by the Committee.

4.3.2 Private/Philanthropic Concept

This concept offers the potential to secure the desired long-term revenue stream (depending on the funding source) and the ability to structure a Center that is more independent of outside socio-economic and political forces. The flexibility afforded by such an approach is both a challenge and a potentially significant benefit. This approach could be sufficient to hire a few permanent staff and engage experts (trainers) on long-term retainers. Compensation would be based on the effort provided by each one but needs to be adequate to ensure trainers were qualified and would remain engaged for at least 2-3 years to ensure full development of the curriculum and training materials and support continuity in training concepts. This approach might appeal to experts who wish to retain their existing jobs but provide services to the Center on a part-time basis or work

on a loan basis from a federal agency, research center, or university. Contracting with trainers may relieve the proposed Center of needing to pay benefits, insurance, etc. and be a cost savings compared to the governmental concept.

This approach could be supplemented with government grants or contracts with states, tribes, and federal agencies and fees from participants. The private/philanthropic concept seems most likely to allow the Center to focus on a strictly scientific agenda with less concern about appeasing political pressures.

One of the main challenges of this concept may be the high cost of leasing space for the Center. However, there are several options for securing training space that could be either semi-permanent, transitional, or cloud based. Combining the private/philanthropic concept with governmental agency and/or university support, i.e., a cooperative approach (see below) would be one way to reduce such costs and provide flexibility in securing training space. This funding approach could allow the Center to start relatively small in scale, grow as demand increases and show proof of concept over a 3 to 5-year start-up period to provide a basis for longer-term funding.

4.3.3 Cooperative Concept

The cooperative approach offers favorable elements from each of the above strategies. An interdisciplinary and cooperative facility comprising, for example, a university, private foundations, government agencies and rotating expert staff offers several advantages. The USGS Cooperative Fish and Wildlife Research Units (of which there are 40 located in 38 states) and the National Conservation Training Center are examples, as was the CIFSG. A cooperative approach where the Center is hosted at a university with a cooperative fish and wildlife research unit or water center has potentially significant advantages. An effective cooperative agreement would provide for a semi-permanent organization perceived as adding scientific expertise and national recognition to the agreement partners.

University space and staff appointments have the advantage of being able to partner with other university staff to help obtain and process grants in addition to providing other functions of the Center. Under such a cooperative arrangement, if for example a federal agency was to withhold funding, the Center could continue to function if private funding was also a major component of the program. A 2021 survey conducted by the Association of American Colleges and Universities, revealed that 74% of universities were financially challenged (Hess 2021). Therefore, they will be open to creating centers that generate

revenues. Since the Center establishes an interdisciplinary program, those institutions having Water Laboratory/Water Resources Research programs, Cooperative Fisheries Research Units or other similar units might offer desirable settings for the proposed Center. The proposed Center that embraces biology, hydrology, earth sciences, water quality, and engineering sciences, supplemented by legal, institutional, and public involvement curricula would likely bring strong private support.

5. IMPLEMENTATION STRATEGY

Regardless of how the proposed Center is housed, sited and funded, it is needed to provide national (and international) leadership, training, integration of emerging research and development, and stakeholder support. The Committee developed an implementation strategy that first defines the primary functions of the Center and then a path forward.

5.1 Center Functions

The Committee envisions that the Center would provide several key roles including leadership, integrated interdisciplinary training, collaborative research on emerging methods and the integration of such methods into the training program, and stakeholder support services.

5.1.1 Leadership

The Center will continue the IFC/AFS collaborative leadership role established over the past two decades representing and serving the IFWLC stakeholder community and to ensure that the Center adheres to its stated goals and objectives. This Center oversight leadership also includes providing Center and stakeholder guidance on the application and integration of appropriate tools and strategies for applying all eight elements to understand the implications of water allocation decisions and options to achieve IFWLC conservation outcomes. This includes maintaining a strong collaborative network with the research communities on emerging methods and their integration across all eight elements.

5.1.2 Integrated Interdisciplinary Training

The Center will engage instructors, prepare state-of-the-art curricula, guidance manuals, analytical techniques and interdisciplinary courses covering the ecological components necessary for addressing flow and water level needs for protection and/or documenting consequences of water management schemes. The Center curriculum will provide a systematic and consistent presentation of the interdisciplinary nature required for the integration of the eight elements. Training must provide stakeholders with an understanding of basic concepts within each IFC element and their linkages to all other elements. This foundation allows the introduction of more detailed IFC element-specific technical approaches and integration with other IFC elements to assess the ecological implications of proposed water allocation strategies.

Comments received as part of the initial survey and review of the draft final report provided several excellent suggestions for structure and content of the Center curriculum. It is important to bear in mind that IFWLC science is inherently data and model based, so this function addresses relevant ecological modeling expertise and techniques. Its purpose is to make modeling approaches and methods developed in other engineering and ecological fields available to IFWLC practitioners, and to develop needed new methods. These suggestions will be considered during development of the Center curriculum which is a priority task as part of implementation.

An example of how to scope an instream flow study can be found in Appendix G of this document as well as Annear et al. (2004).

5.1.3 Research and Development

The Center would continue support for existing methodologies and engage in collaborative development, testing, application and interpretation of new methods and strategies for achieving IFWLC conservation outcomes. The Center's collaborative network will continually evaluate emerging techniques and applications within all eight elements, their applications, and methods for integration to effectively update training materials and communicate the state-of-the-art and practice. Evaluation and collaboration will include national, regional, tribal and international governments, non-governmental organizations, and university and private research facilities. This research will focus evolving interdisciplinary science, developments and practice in integration published in scientific and grey literature, project reports, and interviews with experienced practitioners. This allows the Center to identify and synthesize emerging science and state-of-the-art methods related to integrating the eight elements including the development of procedures and analytical systems necessary for their integration.

5.1.4 Support and Networking Services

The Center will promote networking, provide a clearinghouse function, document up-to-date information and evolving techniques, track ongoing water project studies, give advice, review project plans of study on request, and circulate periodic reports on the state-of-the-art and practice. The Center will also provide a range of fee-based services including but not limited to training courses, specialized workshops, reviewing scientific, legal, institutional, public involvement, and technical reports, evaluating study and research proposals, and monitoring designs. Center support will include providing updated guidance for emergent approaches within each IFC element. The proposed

Center would not likely conduct independent detailed field studies to quantify flow and water level regime needs as part of specific development activities, and it will not compete with private sector firms, institutions, or entities. This does not preclude the Center from engaging in collaborative research with private sector firms, institutions, or entities through other mechanisms.

5.1.5 Staffing

Full time Center staff envisioned are a Leader and Assistant Leader, providing a balance in aquatic ecology and complementary expertise in hydrology, engineering, geomorphology and/or social sciences. An Administrative/Training Coordinator may be needed for assisting in budgeting, arranging travel, coordinating classes, and other routine details.

A Science Advisory Board of up to five interdisciplinary experts will be established to ensure all eight elements are represented in training. The Board would provide annual reviews, advice on evolving research and development within their respective disciplines, and assist in recruiting experienced instructors.

5.2 Recommended Path for Implementation

The Committee spent considerable time evaluating various implementation alternatives (Table 2) and recommends that the Center be housed within a university or research center with shared interdisciplinary objectives for natural resource conservation, management, research, and law. Several universities and research centers have expressed interest in exploring such a relationship.

The Center will function as a Centralized Distributed Network featuring both virtual and face-to-face training, service, and integration of emerging research and development into advancing the state-of-practice for instream flow and water level conservation. The core Center personnel and operations will be supported through the establishment of an endowment and supplemented through grants and contracts from private, state, federal, provincial, and tribal programs. Training and service must reflect the local and regional differences driven by the legal, institutional, and policy settings and this format will promote a regional approach that may ultimately extend internationally.

Given the pressing needs for training, initial efforts will target the development of training modules for basic, introductory aspects of the eight elements associated with the integration of the state-of-the-science and relevance to the socio, political, cultural,

environmental, and economic interests to address needs of stakeholders affected by water resource decision processes and outcomes. This mandates a clear understanding of the potential constraints or opportunities afforded by the legal, institutional, and policy settings at the local, county, state, federal, provincial, tribal, and private jurisdictions within any given regulatory process. These differences were a key element in the development of the implementation strategy for the Center.

To address the immediate need for the functions of the Center and provide a description of its possible evolution, a four-phase process is proposed and described below. The Committee recognizes that the size of the core staff at any of these phases is contingent on access to secure funding levels and the mix of expertise within the staff.

- **Phase 1 – Non-Profit Designation and Funding Acquisition:** Immediately begin the process of securing status for the Center as a non-profit 501(c)(3) entity. Regardless of available funding at the outset, this designation is needed to afford tax exempt status and facilitate receipt of donations and other financial assistance.
- **Phase 2 – Near Term Training and Initial Center Launch:** Establishing a formal entity would allow IFC and AFS managers to endorse training activities that are conducted on an intermittent basis by Committee members at present and build proof of concept. Providing training by select individuals would afford a measure of training credibility to customers and be a bridge to more long-term trainers and administrators. This temporary format would allow IFC and AFS to provide some leadership by conducting workshops on tools and techniques. The format could also provide some basic support to review requests for assistance of study proposals and results on a very limited basis as Committee members and selected IFC and AFS members and others could provide. This phase would likely not address research development needs.
- **Phase 3 – Identification of and Hiring Core Staff and Administrators:** This would evolve when the Center secures short-term funding to support three full-time centrally located staff consisting of a Leader and Assistant Leader and an administrative coordinator, along with three strategically located contract trainers to represent regional IFWLC issues. This core group of people would develop formal curricula and related training materials and conduct training according to the Centralized Networking format described above. They would also provide leadership, support, and research development as those opportunities arise. This phase would be most important during the first 2-3 years of Center operation but could continue longer if needed.

- **Phase 4 – Full Scale Center Operations:** This would be the desired, long-term structure of the Center. Having firmly established proof of concept, long-term, stable funding would be secured to support all the administrators and trainers identified in Phase 2 as permanent employees. The remote trainers would transition from working as a single collective group to establishing training hubs in their respective regions and enlist the involvement of other contract trainers to provide more focused, regionally appropriate training. An Advisory Board of up to five experts skilled in one or more of the eight elements would also be established to provide annual reviews of operations, advice on evolving research and development trends within their respective disciplines and assistance in recruiting experienced trainers.

While the eventual format, function, and funding of the Center will evolve as needed over time, the implementation of the project will be administered by the IFC, with close collaboration with the AFS. Center personnel and operations could be supported through the establishment of an endowment and supplemented with grants and contracts from federal, state, private, and tribal programs. The endowment could be managed by AFS or IFC as a separate stand-alone fund but could also be combined with a larger fund managed by a project partner (such as a university). Regardless of how information and training are provided, the Committee recognizes that training, research, and support services are likely to occur at different venues as a function of IFWLC stakeholder needs.

No matter which approach is implemented, certain strategic considerations are essential to its implementation and prospects for long-term function. These include the following:

- Develop business plan to market Center implementation.
- Seek formal endorsement by the Association of Fish and Wildlife Agencies.
- Secure short-term funding for start-up covering at least the initial 5-years.
- Secure long-term funding or commitments through endowments or other means.
- Be insulated from social, political, and legal economic forces that might limit or compromise the prospects for the effectiveness and existence of the Center.
- Review research, state-of-the-art techniques, and science within and relevant to all eight elements and development of procedures and computer-based methods (including documentation) that significantly improve state-of-the-art conservation applications and outcomes.
- Deliver a high-quality curriculum that provides students with skills to assess the consequences of flow and water level-related alterations that may affect conservation of the eight elements of streams, lakes, wetlands, and estuaries.

- Adapt and incorporate new scientific knowledge and state-of-the-art flow and water level-regime conservation techniques, assessments, and prescriptions.
- Include a recognition of regional differences in the eight elements and how to calibrate accordingly.
- Provide flexible training to individuals or groups. This might entail an ability to conduct training in various locations upon request as well as at a centralized training location.
- Provide training at a reasonable cost to students that is not a significant burden to them or their employers.

6. NEXT STEPS

The Committee recommends that next steps include the following four emphasis areas.

Potential Center Location – Feedback from the document review generated seven entities or institutions that might host or collaborate with some aspect of the Center. Over the coming year, each of these entities will be contacted to explore the potential they offer either a stand-alone location or facility that might function with other locations.

Potential Funding Sources – Respondents to the recent review identified several possible sources of funding for the Center. In addition, we have separately been in contact with several other potential sources of funding. Over the next year we will work with the individuals who identified potential sources of funding and explore those sources that appear most promising.

Potential Curriculum – Suggested training components will be added to the preliminary list already discussed by the Committee. It is unlikely that a specific curriculum will be developed before trainers are identified. It is most likely that each trainer will refine curriculum components and training manuals under the guidance of IFC and AFS.

Potential Trainers and Administrators – The Committee is encouraged by the relatively large number of review respondents who indicated an interest in serving as either trainers or administrators for the proposed Center. It is unlikely that we will make concrete progress with this information until funding and a training location have been identified.

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APPENDIX A

STEERING COMMITTEE MEMBERS

David Weedman, co-chair, is the retired Aquatic Habitat Program Manager for the Arizona Game and Fish Department and a Past President of the Instream Flow Council. He has over 28 years of experience designing, conducting fish and aquatic habitat inventory, monitoring, and restoration projects in his state. He has participated in and helped plan numerous IFC Flow workshops since 2010 as an IFC Regional Director, President-Elect, President, and now Past President. He holds a bachelor's degree in Interdisciplinary Studies from the University of Arizona and is a Certified Public Manager of Arizona State University's Bob Ramsey Executive Education program.

Doug Austen, co-chair, is Executive Director of the American Fisheries Society and has been working in fisheries science and conservation for over 35 years. Doug has served with the U.S. Fish and Wildlife Service as the first national coordinator for the Landscape Conservation Cooperatives, as Executive Director of the Pennsylvania Fish and Boat Commission and with the Illinois Department of Natural Resources and the Illinois Natural History Survey. Doug received his Ph.D. from Iowa State University, M.S. from Virginia Tech, and B.S. degree from South Dakota State University. Doug is an AFS Certified Fisheries Professional, alumni of the National Conservation Leadership Institute and a Fellow in the American Institute of Fisheries Research Biologists.

Tom Annear is the retired water management supervisor for the Wyoming Game and Fish Department where he worked for over 37 years. He helped develop and implement their instream flow program, formed and chaired the department's water rights management team, and studied potential aquatic benefits and impacts for every major water development project in the state from 1983 to 2017. Mr. Annear is a co-founder of the Instream Flow Council (IFC), served as that organization's first president, and is a member of the Executive Committee. He secured funding for and is senior author of two books published by the IFC, co-authored another IFC book, and was project leader for an IFC project that assessed the status and effectiveness of state and provincial instream flow programs in the U.S. and Canada. He is currently adjunct professor at the University of Wyoming where he teaches a class that explores the theoretical and practical integration of stream ecology, water law, institutional capacity, and public involvement. Mr. Annear has a bachelor's degree in fisheries and wildlife management from Iowa State University and a master's degree in aquatic ecology from Utah State University.

Daren Carlisle was brought up in the arid west and took full advantage of every opportunity to escape to mountain waters. That interest propelled him to earn a B.S. in Fishery Management (statistics minor) from Utah State University. He continued at Utah

State University for an M.S. degree in Aquatic Ecology, where he studied the dynamics of fish populations and their invertebrate prey in remote wilderness lakes. He then worked for about a year with the Idaho Department of Environmental Quality, focused on developing a water-quality management plan for the middle Snake River. His interests evolved once again, and he returned to school at Colorado State University to study how pollution affects mountain stream ecosystems. Upon graduation, he worked for two years with the National Park Service as a regional technical advisor on all things related to aquatic science, including fishery management, pollution assessments, and the design of monitoring programs. Daren has worked at the USGS for 20 years. His research has included developing regional and national tools for ecological assessments of streams and rivers, and most recently on relationships between streamflow modification and biological integrity of aquatic organisms. Daren currently manages the Ecological Flows Program within the USGS Water Mission Area, which aims to improve understanding and predictive capabilities of the water quality and quantity required to sustain aquatic ecosystems.

Christopher Estes has contributed to interdisciplinary instream flow and water level conservation (IFWLC) outcomes since the early 1970s. After his 2010 retirement from the Alaska Department of Fish and Game as a Fisheries Scientist and Chief of its Statewide Aquatic Resources Coordination Unit, he entered into private IFWLC consultation as an Aquatic Resources and Habitat Scientist and principal of Chalk Board Enterprises, LLC. He is a co-founder of the *Instream Flow Council* and has served as one of its Directors-at-Large since its formation in 1998. He has authored numerous IFWLC and related publications and held several national leadership positions including the development and implementation of the 2006 *National Fish Habitat Action Plan* (NFHAP) which was codified by *Title II of PL 116-188* as the *National Fish Habitat Partnership* (NFHP) in 2020. Estes serves on several science and technical committees for professional societies and organizations. Estes has received several awards for his professional contributions throughout his career and received the 2021 *Stanley A. Moberly Award* for his Outstanding Lifetime Achievements and Contributions to Fish Habitat Conservation. He obtained his bachelor's degree in biology and environmental science from Prescott College, Prescott, Arizona and his master's degree in environmental science from Washington State University, Pullman, Washington.

Dr. Thom Hardy retired as the Meadows Center Water and the Environment Endowed Professor for Environmental Flows at Texas State University Department of Biology. He holds B.S.s in Education and Biology, and an M.S. in Aquatic Ecology at University of

Nevada at Las Vegas. He obtained his Ph.D. in Civil and Environmental Engineering at Utah State University. Thom's interests have focused on the development and testing of integrated instream flow assessment frameworks including development of supporting software systems and training materials. He was the Associate Director of the Utah Water Research Laboratory (10 years) and Director of the institute for Natural Systems Engineering (21 years) at Utah State University College of Engineering. He holds the IFC Life Time Achievement Award, and is a founding member and Honorary Fellow of the Ecohydraulics Committee of the International Association for Hydro-Environment Engineering and Research.

Allan Locke is an aquatic habitat scientist who has been working in the field of aquatic habitat protection, management, and restoration; conservation biology; and environmental flows for more than four decades. From 1975 to 1981, Mr. Locke worked at several Conservation Authorities in Ontario as both a wildlife and fisheries biologist, and as a fisheries biologist for the Ontario Ministry of Natural Resources. In 1981, he joined the Alberta Fish and Wildlife Division where his duties were to develop fisheries habitat protection guidelines and environmental flow science and policy. As the provincial environmental flow specialist, Mr. Locke developed a province-wide program to protect Alberta's flowing waters. From 1998 to 2000, Mr. Locke served on the Instream Flow Council Executive Committee as the first director of Region 5 (Canadian Provinces). From 2004 to 2006, he was honoured to serve as the President of the Instream Flow Council. Along with several colleagues, Mr. Locke co-authored three books published by the Instream Flow Council. In 2013, he formed his own consulting company and provides environmental flow scientific and policy expertise to governments, industry, and NGOs. Mr. Locke received his Hon. B. Sc. degree in Zoology from the University of Guelph. Mr. Locke is a registered professional biologist with the Alberta Society of Professional Biologists and with the British Columbia College of Applied Biology.

Dr. Donald Orth is the Thomas H. Jones Professor in the Department of Fish and Wildlife Conservation at Virginia Polytechnic Institute and State University. Don's expertise focuses on instream flow assessment, population dynamics, habitat use by stream fishes, and restoration ecology. Don attended Eastern Illinois University (B.S.) and Oklahoma State University (M.S. and Ph.D.). He is a Life Member of the American Fisheries Society and a Certified Fisheries Professional. He is also a Fellow of the American Fisheries Society, the American Institute of Fisheries Research Biologists, and the Virginia Natural Resources Leadership Institute. In 2008, he received the Instream Flow Council's Making a Difference Award for contributions to the science, practice, and practitioners of instream

flow. In addition to over 180 popular writings, Don has published over 200 scientific publications on fishes, fisheries, and riverine management and has received numerous awards for his teaching and contributions to conservations and public outreach.

Dr. Dudley Reiser is a fish scientist with more than 42 years of experience designing, implementing, and managing fisheries and aquatic ecology projects, and instream flow studies. He was the co-founder and President of R2 Resource Consultants in Redmond, Washington which specialized in instream flow analysis and detailed hydraulic and hydrologic modeling. He is now a Senior Science Advisor for Kleinschmidt Associates where he is leading several multidisciplinary instream flow and lake level assessments. Dr. Reiser has prepared numerous peer reviewed publications and provided both written and oral testimony at state and federal proceedings related to water rights. He is a member of the American Fisheries Society and past member of Washington State's Independent Science Panel focused on salmon recovery. Dudley obtained his Ph.D. in Forestry, Wildlife, and Range Sciences from the University of Idaho, an M.S. in Water Resources from the University of Wyoming and a B.A. in Zoology from Miami University, Ohio.

Dr. Clair Stalnaker has been a key player in the instream flow arena for over forty years. He organized and served as Leader of the Cooperative Instream Flow Service Group, U.S. Fish and Wildlife Service. This program solicited interdisciplinary scientists for the purpose of advancing the state-of-the-art and elevating instream flow science and management to national and international prominence. His primary focus was toward a more holistic view of river science and policy, addressing the scientific components and promoting instream flow regimes and mitigation planning rather than "minimum flows." He received his B.S. degree from West Virginia University and Ph.D. from North Carolina State University. He is a life member of the American Fisheries Society and was Assistant Fisheries Unit Leader at Utah State University. He served on national and international task forces and advisory committees and authored numerous publications on instream flow, water allocation, and river management. He served on two committees of the National Research Council (Water Transfers in the West and Fishes of the Klamath River). He is an honorary member and recipient of the Lifetime Achievement Award from the Instream Flow Council.

APPENDIX B

TRAINING COURSES OFFERED BY THE ORIGINAL COOPERATIVE INSTREAM FLOW SERVICE GROUP (CIFSG)

This appendix contains a listing and brief descriptions of instream flow and water level conservation related courses that were offered via the U.S. Fish and Wildlife Service's Cooperative Instream Flow Service Group in Fort Collins, Colorado from 1976 to the late 1990s. These are provided for historical context and in conjunction with our survey results and review comments on this draft document will serve as the foundation for developing Center curriculum and training modules.

Introductory Courses

IF 100 – Offered for one to two days for administrators and others, including the lay public, wanting a basic understanding of IFIM.

IF 200a – Designing and Conducting Studies Using IFIM. Prerequisite to all software and advanced courses. Five days covering concepts of IFIM, project scoping, river segmentation, study reach and site selection, and the uses of IFIM. IFIM philosophy and approach to scoping, developing a plan of study, implementing, documenting, conducting alternative analyses, problem solving, and negotiation.

IF 200b – Instream Flow Incremental Methodology-A Method for Evaluating Conservation Flows. Overview specifically tailored toward those charged with evaluating applications of IFIM to hydropower projects ongoing in the Northeastern U.S. Understanding of different flow decision environments. How basic components of the IFIM are integrated for specific studies. How IFIM products are used in problem solving,

IF 201 – Problem Analysis and Negotiating Solutions Using IFIM. How to formulate, generate, and evaluate alternatives in management of water with special emphasis on hydropeaking applications. Conducting quality assurance reviews of data and simulations used in IFIM applications. Preparing your data and yourself for negotiation or other decision-making processes.

IF 205 – Field Techniques for Stream Habitat Analysis. River segmentation, study reach and site selection, choosing aquatic species/guilds, habitat suitability criteria for habitat description.

IF 251 – Practical Applications in IFIM. An advanced course organizing student teams to conduct and negotiate solutions to using case studies, actual data and hands-on analyses. Integrating hydrology analyses, temperature screening, transferability of suitability criteria, integration of micro and macro habitat, habitat time series, habitat bottlenecks, negotiations, feasibility, risk analysis and contingencies.

Advanced Courses

IF 305 – Field Techniques for Stream Habitat Analysis. Covered everything as in the earlier 205 course. Added emphasis on stream representation, sampling strategies, selection of segments having morphologically differing stream reaches throughout study area, selection and replication of representative (sample) reaches within segments, description of meso-habitats within representative reaches, hydrologic and hydraulic data, calibration to water surface elevation, data for velocity calibration, preparation for entry into PHABSIM, and input to hydrology time series and habitat time series software.

IF 310 – Using the computer based Physical Habitat Simulation System. In addition to learning how to operate the software, additional practice in calibration to water surface elevation and measured velocities, combining micro- and macro-habitat creating total habitat values throughout the study area, applying habitat simulations for comparing management alternatives.

IF 312 – The Stream Segment and Stream Network Temperature Models. Describing the macro habitat throughout the entire study area, combining with output microhabitat as input to habitat time series simulations.

IF 402 – Reviewing and Evaluating Instream Flow Studies for Hydropower Relicensing. Designed specifically for those charged with reviewing the study plans and work of others as part of an agency or other entity's input to decision making related to licensing of hydropower units. How to know what constitutes a good hydropower relicensing study plan, with particular attention to a) problem identification, b) addressing study objectives to those problems, and c) determining whether the study has been implemented to meet those objectives. When and how to make enlightened assumptions about missing data, and how and why to ask for additional information. Sharpen skills for making sound, defensible instream flow recommendations to support your resource goals, with emphasis on understanding feasible alternatives and evaluating their effectiveness.

Documentation for These Courses

- Data Collection Procedures for the Physical Habitat Simulation System.
    - Trihey, E. Woody and David L. Wegner. 1981. *Field data collection procedures for use with the physical habitat simulation system of the Instream Flow Group*. Cooperative Instream Flow Service Group, 1981.

- Description and Application of the Stream Simulation and Assessment Model.
    - Grenney, William J. and Andrezej K. Kraszewski. 1981. *Description and application of the Stream Simulation and Assessment Model Version IV (SSAM IV)*. No. 17. Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior.
- A Guide to Stream Habitat Analysis using the Instream Flow Incremental Flow Methodology.
    - Bovee, Ken D. 1982. *A guide to stream habitat analysis using the instream flow incremental methodology*. Vol. 1. Western Energy and Land Use Team, Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior.
- Introduction to Stream Network Habitat Analysis.
    - Bartholow, J.M. and T. Waddle. 1986. *Introduction to stream network habitat analysis* (Vol. 86). National Ecology Center, Division of Wildlife and Contaminant Research, Fish and Wildlife Service, U.S. Department of the Interior.
- A New Perspective in Institutional Analysis: The Legal-Institutional Analysis Model.
    - Wilds, L.J. 1986. *A new perspective in institutional analysis: the Legal-Institutional Analysis Model (LIAM)* (Vol. 86). National Ecology Center, Division of Wildlife and Contaminant Research, Fish and Wildlife Service, U.S. Department of the Interior.
- Stream Temperature Investigations: Field and Analytic Methods.

  Bartholow, J.M. 1989. *Stream temperature investigations: field and analytical methods* (Vol. 89). U.S. Fish and Wildlife Service.
- Reference Manual for Generation and Analysis of Habitat Time Series.
    - Milhous, R.T. 1990. *Reference manual for generation and analysis of habitat time series: Version II* (Vol. 90). U.S. Department of the Interior, Fish and Wildlife Service.
- Instream Flow Incremental Methodology-A Method for Evaluating Conservation Flows.
    - Bovee, K.D., B.L. Lamb, J.M. Bartholow, C.B. Stalnaker, and J. Taylor. 1998. *Stream habitat analysis using the instream flow incremental methodology*. Geological Survey Reston, VA, Biological Resources Div.

APPENDIX C

EXAMPLES OF CURRENT INSTREAM FLOW ASSESSMENT METHODS FOR LOTIC WATERBODIES

This appendix contains brief descriptions of five contemporary methods/models that have been applied in addressing instream flow related issues in lotic water bodies. These methods are provided as examples only and do not reflect Committee preference for any one method. Other methods do exist and should be considered when addressing instream flow issues (see Annear et al. 2004 for descriptions of other methodologies). The Committee is not aware of any methods specifically focused on addressing aquatic resource needs of lacustrine and palustrine systems.

The System for Environmental Flow Analysis (SEFA) suite of programs was tailored around the same overarching guidance of the IFIM and includes an integrated set of tools useful in environmental flow assessments. Many of its components mirror those available in the IFIM, with separate modules for defining habitat-flow relationships, sediment deposition and flushing flow analysis, and water quality modeling (water temperature and dissolved oxygen) (Payne et al. 2011). Developed collaboratively by Thomas Payne, Robert Milhous, Ian Jowett, and Juan Manuel Diez Hernandez, SEFA has gained some recognition for its multidisciplinary focus and is available at http://sefa.co.nz/. However, its administration, training, and support services are not readily available, and the cost of the software hamper its widespread application.

Meso-HABSIM, as its name suggests, was likewise patterned after the IFIM software program PHABSIM but is intended to upscale results to the river and watershed level. Developed by Piotr Parasiewicz (Parasiewicz 2001, 2007), this software is available for a fee at https://mesohabsim.org/index.html.

The inSTREAM – Individual-based Stream TROut Environmental Assessment Model, and inSALMO (for salmon) models take a different approach to environmental flow assessment focusing more on how fish populations may respond to flow modifications, rather than on habitat. Collaboratively developed by Steve Railsback, B.C. Harvey, S.K. Jackson, and R.H. Lamberson (Railsback et al. 2009, 2021) these models are available for free at https://ecomodel.humboldt.edu/instream-and-insalmo-overview. The models represent a promising approach for taking environmental flow analysis a step beyond habitat and into population level effects. Their field data and analysis requirements are comparable to those of thorough PHABSIM studies. They have been used at over 50 sites for habitat restoration design as well as instream flow and temperature assessment. However, these models are specific to salmonids. Comprehensive user manuals are available, but training materials and classes have been limited.

The CASiMiR (Computer Aided Simulation Model for Instream Flow and Riparia) is a free set of models developed in Germany for evaluating conditions of aquatic ecosystems under different flows (http://www.casimir-software.de/ENG/publications_eng.html). In addition to fish habitats, the models consider aquatic benthic organisms as well as floodplain vegetation. The CASiMiR model has had limited application in the United States.

Ecological limit functions (ELF) describe relations between flow and species richness predicted by the River Continuum concept. The ELF framework, employing a fish monitoring database, provides an alternative method for assessing flow depletion impacts without the need for extensive habitat characterization or in-depth flow modeling (Kleiner et al. 2020; Rapp et al. 2020). The ELF framework (https://github.com/HARPgroup/elfgen) can prioritize water withdrawal permits at regional scales from estimates of withdrawal amounts which could be potentially protective of species richness.

Each of these systems incorporate many but not all of the IFWLC elements and are primarily focused on quantifying instream flows in lotic habitats without integrating lake, wetland, and estuary systems, and remain primarily fish centric. Nor do they integrate legal, institutional public involvement elements. However, there are many lacustrine, palustrine, and estuarine systems that can be jeopardized by water developments and yet few examples exist of methods developed specifically to assess the needs of those types of systems. As noted in the main document, the Center would focus on instream flow and water level conservation, and its training and research functions would encompass both riverine (freshwater and estuarine) and lacustrine/palustrine systems and address open water and ice-covered seasonal variations, in addition to integrating legal, institutional, and public involvement curriculums that currently exist.

APPENDIX D

IFWLC TRAINING CENTER 2022 STAKEHOLDER SURVEY OUTREACH CATEGORIES

The Instream Flow and Water Level Conservation Committee solicited, via a web-based survey, input from a wide range of stakeholders and interest groups (listed below) regarding the support for establishing an IFWLC Training Center.

- American Bar Association (ABA) (https://www.americanbar.org/)
- American Fisheries Society (AFS) and AFS Stakeholder Mailing Lists (https://fisheries.org/)
- American Water Resources Association (https://awra.org/)
- Association of Dam Safety (https://damsafety.org/)
- Association of Fish and Wildlife Agencies (https://fishwildlife.org/)
- Bureau of Land Management (https://www.blm.gov/)
- Canadian Water Resources Association (https://cwra.org/en/)
- Dividing the Waters at The National Judicial College (https://www.judges.org/dividing_the_waters/about-dtw/)
- Fisheries and Oceans Canada (https://www.dfo-mpo.gc.ca/index-eng.html)
- Hydro Review (https://www.hydroreview.com/)
- Instream Flow Council (IFC) (https://www.instreamflowcouncil.org/) and IFC Stakeholder Mailing Lists
- Interagency Hydrology Committee for Alaska (https://sites.google.com/site/ihcalaska/home/)
- International Association for Hydro-Environment Engineering and Research (IAHR) (https://www.iahr.org/)
- Interstate Council on Water Policy (https://icwp.org/)
- National Fish Habitat Board and National Fish Habitat Partnerships and Partners (https://www.fishhabitat.org/)
- National Hydropower Association (https://www.hydro.org/)
- National Park Service (https://www.nps.gov/index.htm)
- North American Wetlands Conservation Act Migratory Bird Joint Ventures and Partners (https://mbjv.org/ and https://www.fws.gov/law/north-american-wetlands-conservation-act)
- Northwest Hydropower Association (https://www.nwhydro.org/)
- The Nature Conservancy (https://www.nature.org/en-us/)
- Trout Unlimited (https://www.tu.org/)
- United States Society of Dams (https://www.ussdams.org/)
- U.S. Fish and Wildlife Service Retirees Organization (https://www.fwsretirees.org/)
- U.S. Forest Service Regional Offices (https://www.fs.usda.gov/)

- Western States Federal Agency Support Team (https://westernstateswater.org/westfast/)
- Western States Water Council (https://westernstateswater.org/)
- Several universities in the U.S. and Canada
- Legislators
- Private individual and other stakeholders (unaffiliated with the above)

APPENDIX E

IFWLC TRAINING CENTER 2023 DRAFT ASSESSMENT STAKEHOLDER REVIEW OUTREACH CATEGORIES (BASIS FOR THIS FINAL REPORT)

This final assessment report is based on the feedback received from a review of the January 2023 draft version of the Instream Flow and Water level Conservation Center feasibility assessment in addition to online and direct input from a wide range of stakeholders and interest groups regarding the support for establishing an IFWLC Center.

Following is a general summary of the stakeholder categories and entities contacted[17].

- Alaska Department of Environmental Conservation (ADEC) Watershed Groups Mailing List (https://dec.alaska.gov/)
- American Bar Association (ABA) (https://www.americanbar.org/)
- American Fisheries Society (AFS) (https://fisheries.org/) website and AFS Global Stakeholder Mailing Lists
- American Geophysical Union (AGU) (https://www.agu.org/)
- American Geosciences Institute (AGI) (https://www.americangeosciences.org/)
- American Water Resources Association (AWRA) and AWRA Stakeholder Mailing Lists (https://awra.org/)
- American Society of Civil Engineers (ASCE) (https://www.asce.org/)
- American Sport Fishing Association (ASA) (https://asafishing.org/)
- Arctic Research Consortium of the United States (ARCUS) (https://www.arcus.org/)
- Association of Dam Safety (https://damsafety.org/)
- Association of Fish and Wildlife Agencies (https://fishwildlife.org/)
- Canadian Water Resources Association (https://cwra.org/en/)
- Congressional Sportsman Foundation (https://congressionalsportsmen.org/)
- Cryospheric Community (https://lists.cryolist.org/mailman/listinfo/cryolist)
- Dividing the Waters at The National Judicial College (https://www.judges.org/dividing_the_waters/about-dtw/)
- Fisheries and Oceans Canada (https://www.dfo-mpo.gc.ca/index-eng.html)
- Hydro Review (https://www.hydroreview.com/)
- Instream Flow Council (IFC) (https://www.instreamflowcouncil.org/) website and IFC Global Stakeholder Mailing Lists: includes past attendees/participants of *FLOW Workshops*
- Interagency Arctic Research Policy Committee (IARPC) (https://www.iarpccollaborations.org)

[17] Apologies to individuals and other stakeholder entities included in larger global distributions not listed.

- Interagency Hydrology Committee for Alaska (https://sites.google.com/site/ihcalaska/home/)
- International Association for Hydro-Environment Engineering and Research (IAHR) (https://www.iahr.org/)
- Internet of Water (IOW) (https://internetofwater.org/)
- Interstate Council on Water Policy (https://icwp.org/) Stakeholder Mailing Lists
- Kleinschmidt Group Mailing Lists (https://www.kleinschmidtgroup.com/)
- National Fish Habitat Partnership (NFHP) National Fish Habitat Board, Fish Habitat Partnerships, and Stakeholder Lists (https://www.fishhabitat.org/)
- National Hydropower Reform Coalition (https://hydroreform.org/)
- National Hydropower Association (https://www.hydro.org/)
- Native American Fish and Wildlife Society (NAFWS) (https://www.nafws.org/)
- Native American Rights Fund (NARF) (https://narf.org/)
- North American Wetlands Conservation Act Migratory Bird Joint Ventures and Partners (https://mbjv.org/ and https://www.fws.gov/law/north-american-wetlands-conservation-act)
- Northwest Hydropower Association (https://www.nwhydro.org/)
- The Nature Conservancy (https://www.nature.org/en-us/)
- Other individuals and entities, including social media platform postings
- Permafrost Young Researchers Network (PYRN) (https://pyrn.arcticportal.org/)
- Several universities in the U.S. and Canada
- Springs Stewardship Institute (https://springstewardshipinstitute.org/)
- Theodore Roosevelt Conservation Partnership (TRCP) (https://www.trcp.org/)
- Trout Unlimited (https://www.tu.org/)
- Uncommon Dialogue (https://woods.stanford.edu/research/hydropower-home)
- United States Society of Dams (https://www.ussdams.org/)
- U.S. Bureau of Land Management (BLM) (https://www.blm.gov/)
- U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) (https://www.noaa.gov/)
- U.S. Fish and Wildlife Service (USFWS) (https://fws.gov/)
- U.S. Fish and Wildlife Service Retirees Organization (https://www.fwsretirees.org/)
- U.S. Forest Service (USFS) Regional Offices (https://www.fs.usda.gov/)
- U.S. Geological Survey (USGS) (https://www.usgs.gov/)

- USGS National Climate Adaptation Science Centers (https://www.usgs.gov/programs/climate-adaptation-science-centers)
- USGS Cooperative Research Units (https://www1.usgs.gov/coopunits/)
- U.S. National Park Service (https://www.nps.gov/index.htm)
- U.S. Permafrost Association (USPA) (https://www.uspermafrost.org/)
- Western States Federal Agency Support Team (WestFAST) (https://westernstateswater.org/westfast/)
- Western States Water Council (WSWC) Stakeholder Mailing Lists (https://westernstateswater.org/)
- Wildlife Management Institute (WMI) (https://wildlifemanagement.institute/)

APPENDIX F

SURVEY RESULTS, FINDINGS, AND KEY CONCLUSIONS

The following summarizes the questions and responses received from the Instream Flow and Water Level Conservation web-based survey regarding the needs and support for a IFWLC Training Center. Note that the Preliminary Conclusions are based on the Steering Committee's subjective interpretation and are not necessarily based on data analysis.

Question 1 – I am completing this survey on behalf of ...

Instream flow and water level issues are commonly dealt with by a wide range of professions. To help identify the kinds of training and support that is needed, we asked which sectors may find value in the proposed Center. Figure F-1 summarizes the responses received to this question.

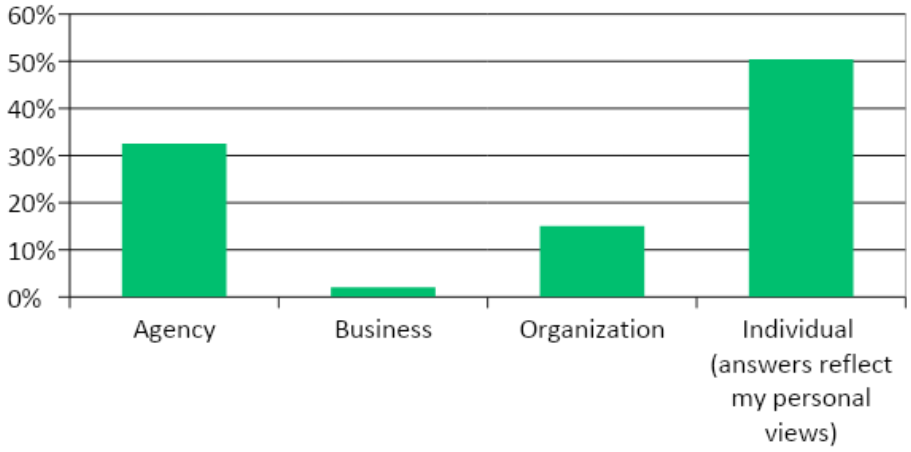

Figure F-1 Percent of total respondents who were responding on behalf of the entity they were representing.

Key Findings

- Half of all respondents were speaking on their own behalf.
- About one-third were speaking on behalf of their agency.
- Less than 20% were speaking on behalf of their company or organization.

Preliminary Conclusions

- Responses were received from forty-nine U.S. states, seven Canadian provinces, and seven other countries demonstrating a wide geographical distribution. The responses reflect a wide range of needs and views.
- The response to the survey may have been limited by the fact that it was only active for 30 days during the traditional field season for many of the people who are likely to need this kind of training. We do not necessarily suspect a bias since the trends observed in the final data set were nearly identical to each download through the survey period.

Question 2 –What best describes your affiliation/water interest? (Select all that apply).

Instream flow and water level conservation principles are commonly dealt with by a wide range of stakeholders. To help us understand the kinds of training and support that is needed, we wanted to identify which stakeholders may find value in the proposed Center. Figure F-2 shows the range of affiliations for which respondents were associated.

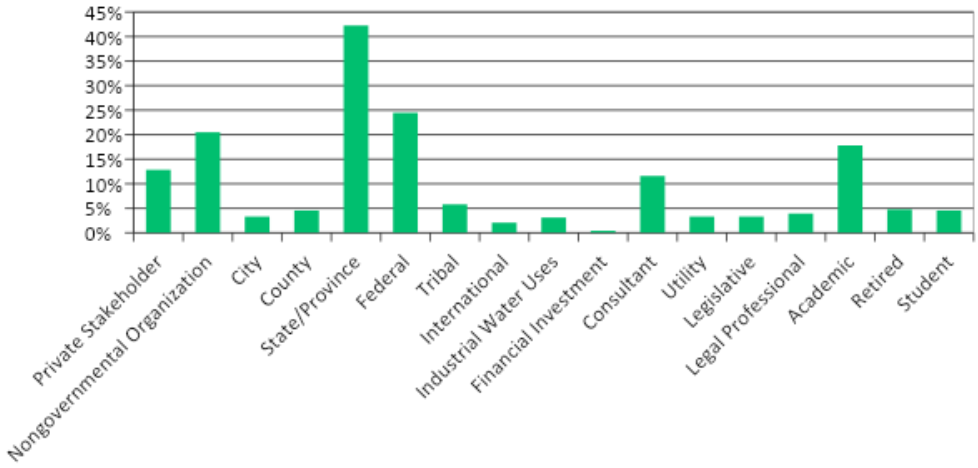

Figure F-2 Percent of total respondents who were affiliated with various professions or entities. Note, respondents were free to select more than one affiliation.

Key Findings

- Most of the responses indicated affiliation with either a state or federal (Canadian or U.S.) agency. Almost twice as many respondents (42%) were associated with state or provincial agencies as for federal agencies (24%).
- The next highest groups of respondents were people associated with nongovernmental organizations (20%), academia (18%), private stakeholders (13%), and consultants (12%).

Preliminary Conclusions

- These groups comprised 75% of all responses, which is not unexpected. These disciplines typically are on the front lines of instream flow and water level quantification efforts.
- It is likely that most people who would seek training at the proposed Center will come from these disciplines.
- Though the proposed Center should market to all the disciplines who responded, we should anticipate that support and funding (student fees) will come from these four main areas. As such, fee structure must be sensitive to the fiscal limits of these groups.

Question 3 – What 3 categories best describe your instream flow and water level conservation related responsibilities?

Instream flow and water level conservation issues are dealt with by stakeholders with a wide range of professional responsibilities and interests (Figure F-3). Understanding the responsibilities of those responding to the survey was intended to give us a general sense of who might find value in the proposed Center and further refine the range of people who might eventually seek training, research assistance, and general support services.

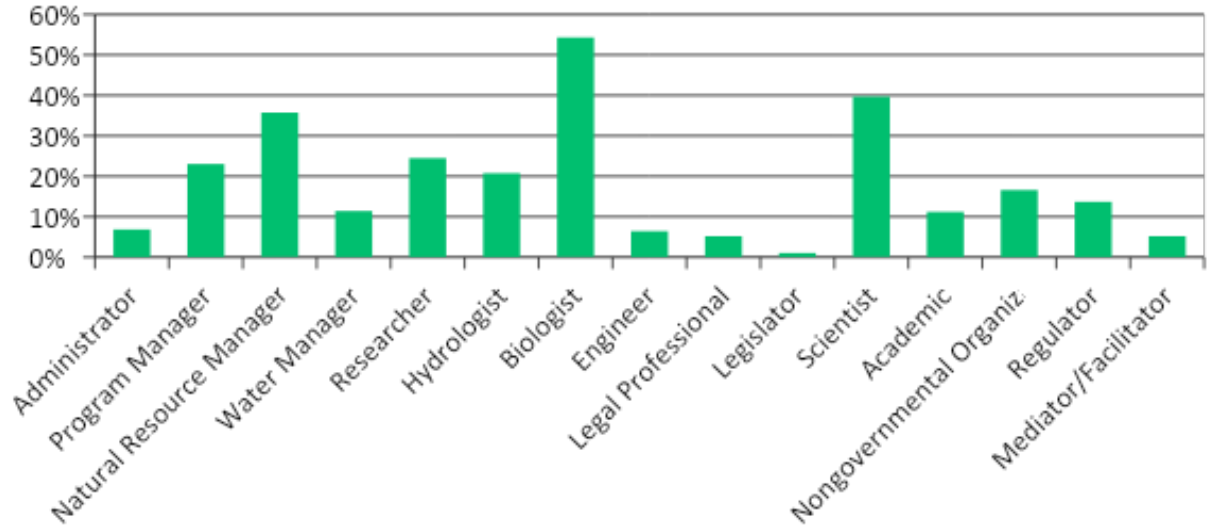

Figure F-3 Percent of people who responded who defined their professional responsibilities in one (or more) of fifteen water management-related professions.

Key Findings

- Most respondents were involved in natural resource management either as a biologist, scientist, or the broader category of natural resource manager.
- Few administrators completed the survey (7%).

Preliminary Conclusions

- Numerically, there are generally fewer administrators related to this discipline compared to the field staff who also took the survey, so we do not read this as a lack of interest by administrators. Administrative support will be critical to getting the Center established and then attracting people for training.
- These results suggest that the need for training in this field is widely recognized among a broad range of people in the scientific community.

Question 4 – How many years have you engaged in instream flow or water level conservation activities?

Considering that the CIFSG ceased providing training in 2001, we wanted to know how many people are conducting instream flow studies today that did not have the benefit of receiving training from that institution (Figure F-4). This information can provide a general sense of how people today may be doing studies and making recommendations.

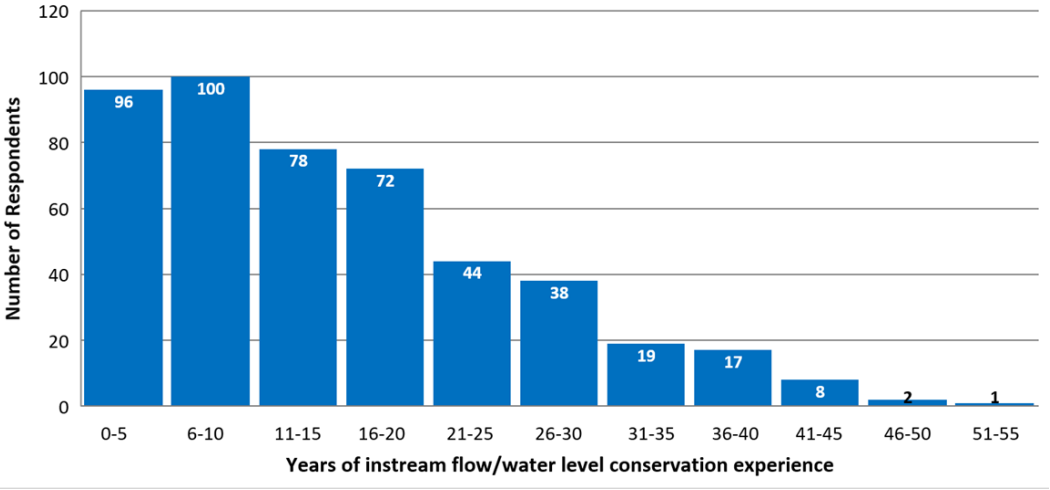

Figure F-4 Number of years people have been doing instream flow and water level conservation studies. Bars represent the sum of responses by five-year increments.

Key Findings

- The mean number of years that people have been involved in this area is 16 years.
- 346 of the 475 respondents who answered this question (73%) have been doing this work for 20 years or less (Figure F-4).

Preliminary Conclusions

- Most respondents have been doing instream flow and water level conservation studies for a relatively long time.
- Since the CIFSG ceased training 20 years ago, results for this question mean that almost three-fourths of all the people doing instream flow and water level studies today did not receive training directly from the former center.
- In the absence of standardized training, most of the people doing instream flow and water level conservation studies today were not trained by the CIFSG.
- The absence of standardized training ultimately leads to variability in the way studies are done today. This trend of high variability among flow and water level studies has been observed by many Committee members.

Question 5 – How often do you analyze or integrate the following disciplines when assessing environmental flows or water levels?

The form and function of rivers and lakes and the ecological systems they support are largely determined by the unique interaction of five elements – hydrology, biology, geomorphology, water quality, and connectivity. These elements must also be integrated with legal constraints and public needs and involvement. As a consequence, it is typically necessary that instream flow and water level conservation studies address all of these elements and integrate the output to assess the effect of flow regimes and water levels on ecosystem characteristics. Figure F-5 shows the range of responses to this question.

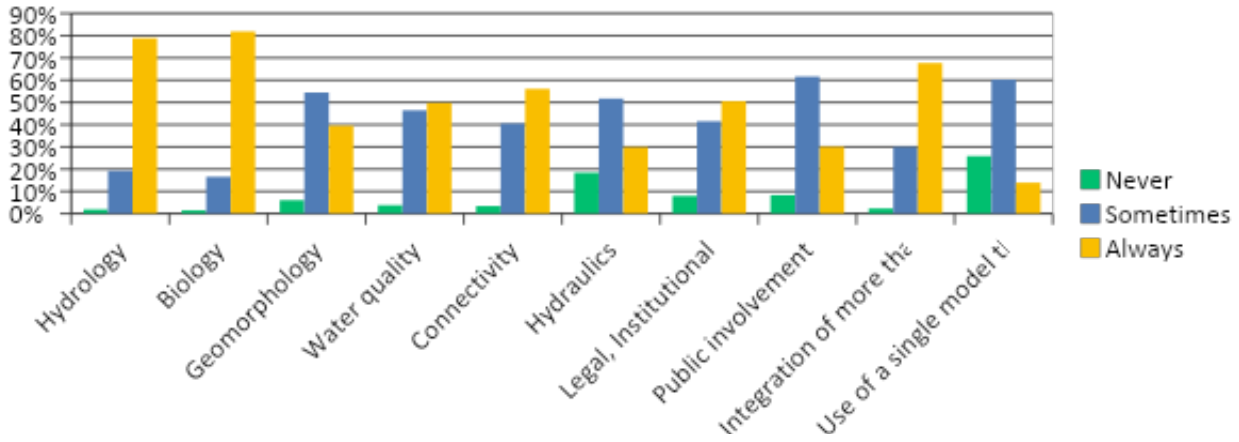

Figure F-5 Frequency that respondents use various disciplines to quantify and recommend instream flow and water level conservation prescriptions.

Key Findings

- The majority (~80%) of respondents indicated that they always address hydrology and biology in their assessments. This is expected since this has been the focus of instream flow work since its origins.
- ~ 40% to 55% of respondents said they also address each of the other elements with connectivity getting mentioned slightly more than the other elements.
- A number of respondents said they sometimes or always address legal and institutional issues though it is impossible to know at what level based on this survey.

Preliminary Conclusions

- This question should have been posed a bit differently. By only asking if people used more than one element, we were unable to know how many they actually used in individual studies or if they integrate all five elements in their assessments, which was an important goal of this question. As a consequence, it was easy for

people to answer affirmatively if they integrate hydrology and biology (or any two elements) but nothing else.

- Likewise, the Committee did not ask if people used a model that integrates and analyzes all five elements. None of the members of the Committee is familiar with such a model (i.e., none of us have encountered a study that is based on such a holistic model). For reference, see Locke et al. (2008), Chapter 9.
- Notably, water quality was addressed less than expected. However, most governmental agencies split water quality and water quantity responsibilities between different agencies.

Question 6 – Please indicate what level of training or proficiency best describes your current status in each category below.

As part of our evaluation of the need for a national-level training Center it is important to understand the current level of training or proficiency in the application or evaluation of the disciplines relied on for instream flow and water level conservation efforts. Figure F-6 provides a summary of this information.

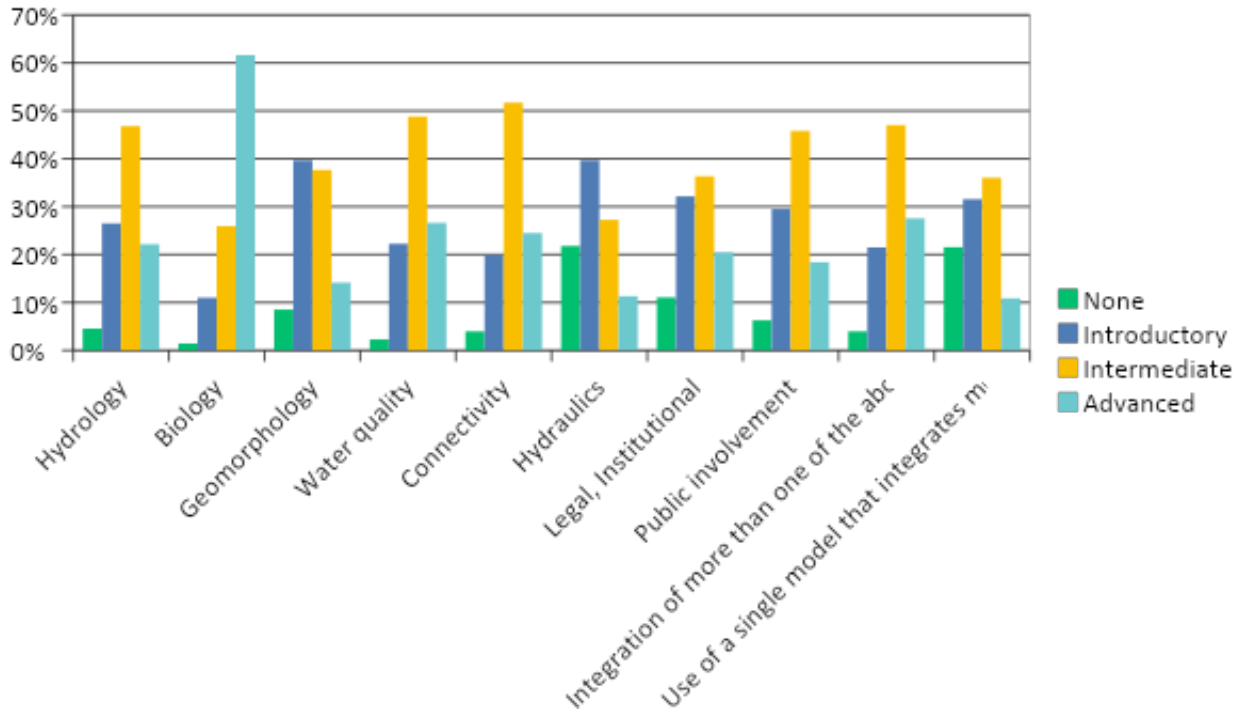

Figure F-6 Summary of responses indicating the level of skill or training respondents thought they possess for doing instream flow and water level conservation studies.

Key Findings

- Most respondents felt they were competent at intermediate or advanced levels (combined) of biological studies.
- ~ 40%-50% of respondents indicated that they had at least an intermediate level of skill or training in the other 4 scientific disciplines.
- Hydraulics was the scientific discipline that respondents had the least skill with. This response may reflect the lack of appreciation that existing instream flow models such as PHABSIM and two-dimensional models are based on hydraulics, as reflected by reference to the output of these models as "hydraulic habitat."
- Most respondents felt they had intermediate levels of training and skill with public involvement.

Preliminary Conclusions

- People generally had a relatively high regard for their ability to use the various scientific disciplines.
- Although many respondents felt they had a reasonable aptitude for dealing with the public, this does not mean they would not benefit from training to better implement their skills and knowledge.
- Both of these facts came across in the general comments at the end of the survey as well as in Question 8 (i.e., for as much as people know, most people expressed a need for more training).

Question 7 – Select the type(s) of training that best describe(s) how you acquired your current knowledge and proficiency within each of the applicable categories (can choose more than one).

The CIFSG was the primary source of training for instream flow work for over 20 years. Since its termination there has been no central, standardized source of integrated training for instream flow and water level conservation studies. Given that 72% of all people doing such studies today did not have the opportunity to receive training from the CIFSG, we wanted to know where people have received training. To better understand the potential role and function of a national-level training Center, the identification of the existing sources of training given the previously identified levels of proficiency is necessary. Figure F-7 shows where respondents have received training.

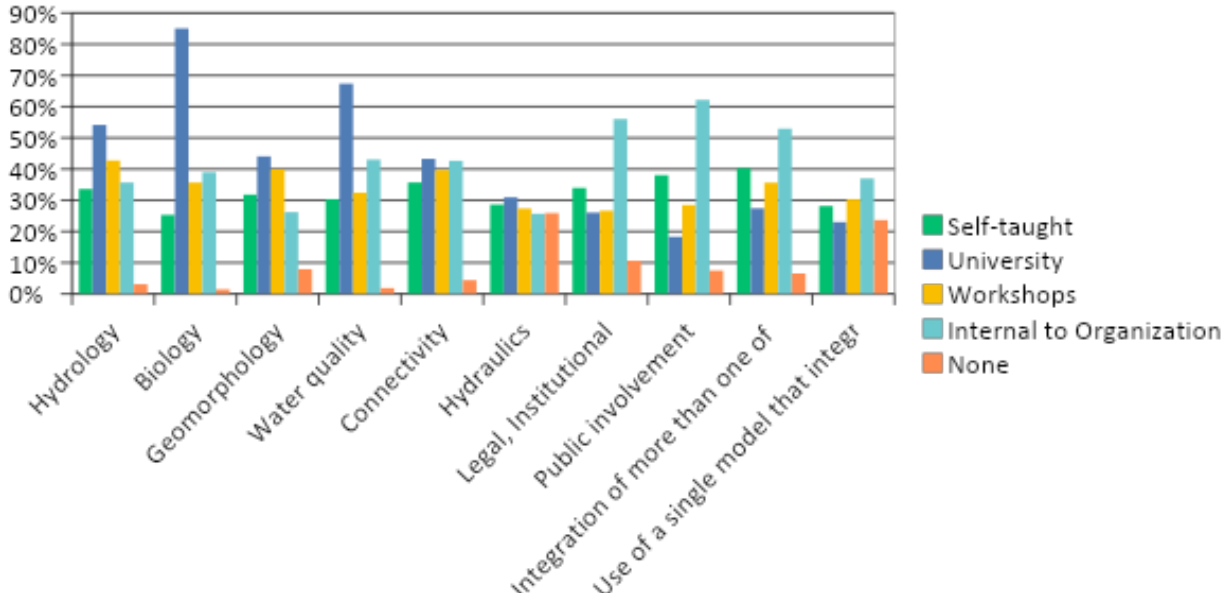

Figure F-7 Sources of training where respondents have obtained skills for doing instream flow and water level conservation studies and recommendations.

Key Findings

- Most respondents indicated that their training in hydrology, biology, and water quality training originated in universities.
- Most training in legal, public involvement, and integration of multiple disciplines originates within agencies and organizations.
- Training in the other scientific disciplines comes from a combination of sources.

Preliminary Conclusions

- The diverse source of training suggests that such training is not standardized across agencies or organizations but is focused on specific needs and projects that may not be applicable to other situations. The fact that training for integration of multiple disciplines comes largely from within a person's agency suggests a relatively high degree of variability in the way this information is collected, interpreted, and applied.
- These findings suggest that such training may be relatively unstructured and variable for each technical discipline.
- Because most training in the instream flow and water level conservation field comes from a broad spectrum of sources suggests a trend where each practitioner may do studies differently from the next. This may well lead to conditions of the early years of instream flow work (1970s and 1980s) where each management agency did studies differently than was done in other agencies and organizations.

Such variability exposed practitioners to challenges by flow opponents because their work "was different than another state or province."

- This finding does not minimize the knowledge that people have acquired but does reflect a need to standardize the way data are collected, interpreted, and applied. Consistent, standardized training is known to increase the credibility of studies and recommendations in most other disciplines as evidenced by the need for training to support certifications in other disciplines.

Question 8 – If a Center were established to provide training, synthesis of emerging scientific research, and technical support for instream flow and water level conservation assessments, which of the following training levels by discipline would you consider important? (Can choose more than one).

If this project goes forward to develop a Center that provides training, research oversight, and support services, it is important to know if the people who took the time to complete this survey would find value in the disciplines that the Committee feels are important to recognize in all credible flow and water level studies. Such information will help shape curriculum development and provide insights into how confident most practitioners feel about their current skills and training. Figure F-8 summarizes the input we received for this information.

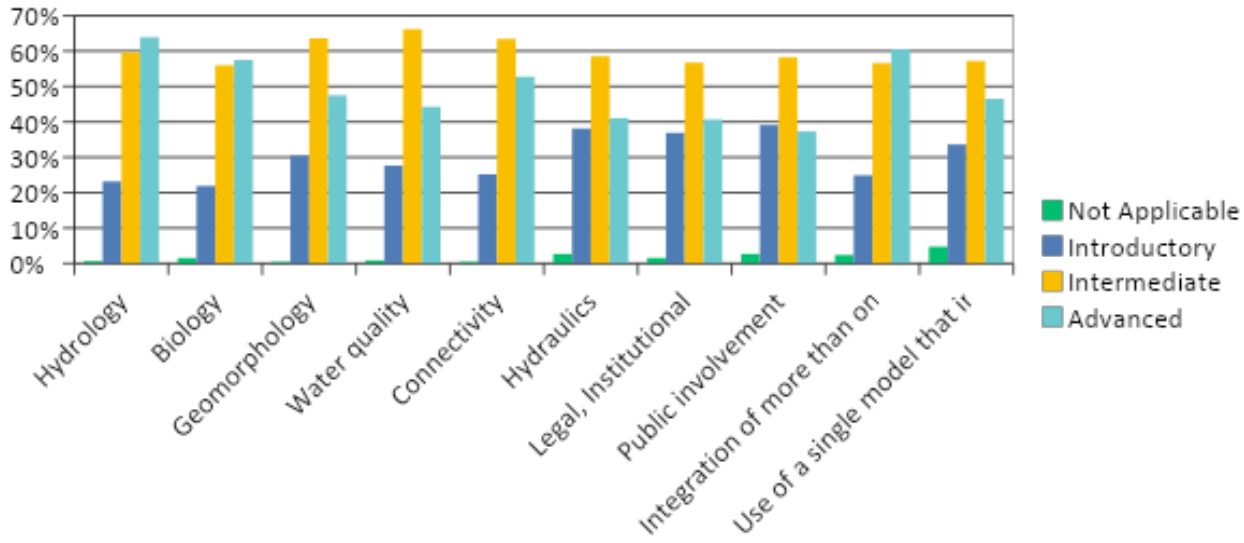

Figure F-8 Summary of how important respondents felt different levels of training were needed for a range of flow and water level disciplines. Percent is based on total responses for each discipline.

Key Findings

- Respondents indicated that intermediate training was needed almost equally in all of the disciplines listed.
- The exceptions to this trend were hydrology and integration of multiple elements, which each received the highest support for advanced training (~ 60% of people supported such training).

Preliminary Conclusions

- Because so many respondents indicated that they felt skilled in these disciplines (Question 6) but still supported such high levels of training for all listed elements speaks to the importance of developing the proposed Training Center.
- Because so many respondents supported the need for training to integrate multiple disciplines in studies further endorses the stated purpose of the proposed Center.
- Because so many respondents supported the need to develop a standardized approach to integrating results across multiple disciplines suggests a broad awareness that this is a pressing need that is not currently being met.

Question 9 – Is there a need for a permanent national-level center that provides standardized, consistent training to guide research, and offer basic and customized support services to train stakeholders in the skills necessary to assess instream flow and water level conservation requirements and participate in water use management, research, processes, and decision making to achieve effective state-of-the-art instream flow and water level conservation outcomes?

The most important question for which an answer was needed by the Committee was whether other water management professionals perceived the same need as the Committee. This information is not an absolute requirement but was important for affirming the strongly held views of the Committee. Results to this question are shown in Figure F-9.

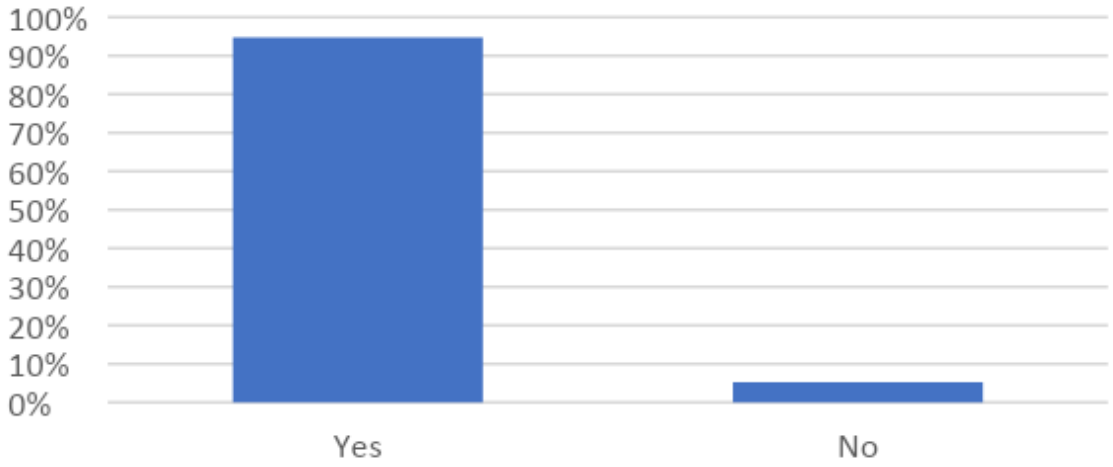

Figure F-9 Responses to whether respondents thought a Center to provide training, research oversight, and support services was needed.

Key Findings

- ~ 95% (451) of all respondents answered affirmatively that there is a need for a national-level center.
- All of the seven people who responded from countries other than the U.S. supported development of the proposed Center.
- Only 5% (30) of respondents answered that the proposed Center is not needed.
- The Committee's review of those who said a Center is not needed did not reveal any trends in terms of the agency or organization they worked for, their level of responsibility, or geographic location. In fact, in their general comments at the end of the survey, three of those said they were glad to see the IFC taking charge of this effort or were otherwise in agreement that the Center was a good idea.

Preliminary Conclusions

- Given this level of support by people who are already doing instream flow work and feel relatively skilled, we conclude that there is merit to proceed toward implementation of a new training and research Center.
- Reasons given for not supporting the Center reflected a range of opinions about the proposed project, not all of which were in line with the Committee vision for the Center. Some of these we suspect were based on preconceived notions, but the survey was not designed to dig very deep into the reasons. This finding encouraged the Committee to be more specific about the proposed purpose and function of the Center, and we hope we have addressed some of those reservations in this Plan.

Question 10 – If a state-of-the-art workshop were to be scheduled, would you be interested in either of the following (attending or presenting)?

The Committee considers this feasibility assessment to be a work in progress. We have gained a great amount of information and guidance from the survey but know that there are many people who would like to provide additional, more specific assistance. We believe that an international workshop could provide additional insights that would help ensure the success of the proposed Center if this effort ultimately leads to that point. As such, we wanted to know if people who completed the survey would have interest in either attending such a workshop or presenting a professional paper addressing ways to integrate the various disciplines we present.

Key Findings

- 98% (439) of respondents indicated a desire to attend a workshop if one is scheduled.
- 26% (118) respondents expressed an interest in presenting a paper at a workshop if one is scheduled.
- 73% (22 of 30) of people who did not support development of a Center said they would attend a workshop if one were held, and seven said they would consider presenting a paper.

Preliminary Conclusions

- There is strong evidence of enthusiasm for networking and willingness to help advance this idea.
- Scheduling and hosting a workshop should be considered after completion of this initial phase of the feasibility assessment.

Other Key Messages from the Survey

- There were several comments that this Center is urgently needed.
- Several people indicated a willingness to help teach some of the classes if a Center is established.
- There was a recurring concern that this effort will have a regional focus (Western U.S.) and overlook needs in other parts of the country. The Committee envisions a Center that has a national/international focus and not a regional focus.
- There is concern by some that the Center will promote a one-size-fits-all methodology, and that studies need to reflect the unique needs of each situation. The Committee envisions a Center that will provide a wide variety of tools for people to use as they deem appropriate for each situation.

- There is concern that training cost will be too high, and classes need to be within the range of what (state and provincial) agencies can afford to pay. As part of the planning and implementation process, the Committee will complete an economic analysis of training costs that strives to accommodate all interested users.
- There were comments that efforts need to be made to prevent the Center from falling victim to political maneuvers that could lead to its demise as happened with the CIFSG. A permanent, politically insulated institution is needed.

Several people who participated in the survey offered suggestions for facilities where the Center could possibly be placed and funded. More consideration is needed before decisions of this nature can be made, but it is clear that people want to see the Center become established and be a success.

APPENDIX G

EXAMPLES OF TRAINING NEEDS RELATED TO THE EIGHT KEY ELEMENTS (HYDROLOGY, GEOMORPHOLOGY, BIOLOGY, WATER QUALITY, CONNECTIVITY, LEGAL, INSTITUTIONAL, AND PUBLIC INVOLVEMENT)

- Hydrology – this element broadly embraces aspects of natural hydrologic regimes. Regimes that reflect natural patterns of temporal variability such as intra- and interannual variability (includes open-water and ice-covered seasons) are essential for supporting the ecological condition of surface waters. Such patterns are driven by the hydrologic cycle and are critically linked to all other elements listed here and embrace elements such as, but not limited to the following:
    - The historic, present, and projected future hydrologic patterns of a specific water body that are tied to critical geomorphic, water quality, and life history requirements of target organisms, populations, or ecological communities,
    - Flow regimes and water levels affected by groundwater interactions,
    - Proposed water management changes (new flow and water level regimes that may be proposed).
- Geomorphology – this element broadly embraces the linkages between flow/water level, hydraulics, sediment transport, and channel form driven by elements of the flow and water level regimes such as, but not limited to the following:
    - Historic sediment transport load and channel change patterns at relevant temporal and spatial scales,
    - Changes to sediment transport load and deposition are anticipated,
    - Changes in sediment transport load affect channel form and function, and over what spatial and temporal timeframes, will these changes occur.
- Biology – this element broadly embraces the direct and indirect responses at the individual, population, and community levels of aquatic, riparian, and related ecological components of watersheds in response to the flow and water level regimes such as, but not limited to the following:
    - Predicted changes in habitat quantity and quality for species, life stages and or guilds assuming proposed changes in flow/water level regimes, and how might these habitat changes influence organisms,
    - The predicted changes in the distribution, relative abundance, and diversity of communities and populations (fish, macroinvertebrates, mussels, vegetation),
    - Natural patterns in species population and community dynamics are expected over annual, decadal, and longer-term temporal scales and how these patterns change given proposed water management practices.
- Water Quality – this element incorporates several key elements critical to the ecological functions of aquatic systems driven by the complex interaction of flow/water level regimes with physical, chemical, and biological responses that may include, but is not limited to the following:

    - Temperature – any significant changes of flow and water level regimes are likely to result in important changes in water temperature regimes and ice dynamics,
    - Dissolved oxygen-low flows,
    - Turbidity,
    - Salinity,
    - Pollutants/nutrients originating from point and non-point sources.
- Connectivity – refers to the flow/water level exchanges and pathways within localized areas of a watershed that provides for movement of organisms, energy, and matter to, through and within lotic and lentic systems. This element relates to:
    - Physical, chemical, and biological properties and patterns,
    - Processes that include longitudinal, lateral, vertical, and temporal scales that maintain and restore connections between rivers and their floodplains and tributaries or lakes for all life stages of species,
    - These considerations may be critical for species' survival in rivers, lakes and estuaries having extensive hyporheic zones.
- Legal – the basic statutory opportunities (state, provincial, territorial, tribal/First Nation) and how they relate to IFWLC.
    - The basic federal framework and how it relates to the role of states, provinces, tribes/First Nations, and other water stakeholders' ability to protect or restore flow or water level regimes,
    - The role of the Public Trust Doctrine and how it relates to IFWLC regime assessments and water stakeholders' ability to protect or restore flow or water level regimes,
    - The role of interstate and international compacts related to water management between water stakeholders.
- Institutional Capacity – the basic regulations and policies (state, provincial, territorial, tribal/First Nation) and how they relate to IFWLC.
    - Regulations and policies that may differ by jurisdiction from legislation for environmental purposes in rivers, lakes, and wetlands,
    - Specifically include reference to water management in strategic plans instead of speaking more broadly about "habitat,"
    - Staff of agencies and organizations, training, and dedicated budgets.
- Public Involvement – identify effective strategies to include, inform, empower, and motivate stakeholders to participate in IFWLC actions.

- Identify the importance of public involvement, including recreation, social, and economic considerations,
- Recognize the difference between public support and public involvement,
- Identify effective messaging strategies and mechanisms for enhancing public involvement and related effectiveness, and encourage communication between agencies making decisions and the public,
- Identify the role of non-agency partners and the importance of champions.