Exhibit 35

DECLARATION OF DR. CLAIR B. STALNAKER

1. I, Clair B. Stalnaker, Ph.D., provide this expert report on behalf of The Nature Conservancy in the concurrent relicensings of Exelon Corporation's Muddy Run Pumped Storage and Conowingo Hydroelectric Projects before the Federal Energy Regulatory Commission (FERC). The Nature Conservancy requested that I analyze and provide my opinion regarding the proper application of the Instream Flow Incremental Methodology (IFIM) to the relicensing of the Conowingo Project to quantitatively evaluate the proposed action's and alternatives' flow-based impacts on aquatic habitat.

2. The Nature Conservancy has requested that FERC direct Exelon to complete spatial and temporal analyses of aquatic riverine habitats. This analysis would form the basis for evaluating alternative project operations and determining which alternative(s) are best suited to achieving the dual goals of Project Profitability from hydroelectric generation *and* Environmental Enhancement of degraded aquatic resources. I understand that the study plan was to provide data to be used with the IFIM analytical procedures necessary for comparative aquatic habitat based analyses of proposed alternative Project operations. However, the study is incomplete. As supervisor of the U.S. Fish and Wildlife Service/U.S. Geological Survey research and development group that developed IFIM and conducted training over three decades, I conclude that the information requested by the Conservancy is necessary for comparing alternative project operations on aquatic resources.

I.
QUALIFICATIONS

3. I have played a key role in the development of instream flow science for over 30 years. I organized and served as leader of the Cooperative Instream Flow Service Groups (and various subsequent titles) under the U.S. Fish and Wildlife Service. This program brought together an interagency group of multidisciplinary scientists for the purpose of advancing state-of-the-art science and elevating the field of instream flow to national and international prominence. The primary focus of this group has been to develop a holistic view of river science addressing the major components of instream flow management, namely hydrology, geomorphology, water quality, aquatic biology and connectivity, and promoting instream flow regimes (incorporating intra- and inter-annual variability). I retired as a Senior Scientist with the U.S. Geological Survey where I served as Chief of the River Systems Management Section, Midcontinent Ecological Center, Fort Collins, Colorado. I earlier served as Assistant Professor of Fisheries and Wildlife Science and Adjunct Professor of Civil Engineering, Utah State University, Logan Utah, as well as Adjunct Professor in the Departments of Earth Resources and Fisheries and Wildlife, Colorado State University.

4. I have served on national and international technical committees, task forces and review boards, and have authored numerous publications focusing on the instream flow aspects of water allocation and river management. I served for the National Research Council (NRC) on the Water, Science and Technology Board Committee on Western Water Management and the NRC Board on Environmental Studies and Toxicology on the Klamath River Basin. In October

2008, I was recognized by the international Instream Flow Council with their Lifetime Achievement Award.

5. My curriculum vitae is Attachment 1.1 to this report.

6. In preparing this report I have reviewed the following documents specifically relevant to these proceedings:

- Instream Flow Habitat Study Report, Appendix G (Persistent Habitat Tables), eLibrary no. 20120831-5048 (Aug. 2012);
- The Nature Conservancy, "Motion to Intervene," eLibrary no. 20140131-5199 (Jan. 31, 2014);
- Draft Environmental Impact Statement for the Susquehanna River Hydroelectric Projects: York Haven Hydroelectric Project (P-1888-030), Muddy Run Pumped Storage Project (P-2355-018), and the Conowingo Hydroelectric Project (P-405-106), eLibrary no. 20140730-4001 (July 30, 2014); and
- The Nature Conservancy, "DEIS Comments," eLibrary no. 20140929-5354 (Sept. 29, 2014).

I supplemented the information provided in these documents with other literature as cited below and listed in the References section.

II.

RECOMMENDATIONS

I make the following recommendations for next steps to complete the analysis of flow effects on aquatic habitat in this relicensing:

(1) Complete the comparative analyses, as requested by The Nature Conservancy and other stakeholders and apparently intended by Exelon's Study 3.11, and document this analysis in the FEIS.

(2) Specifically focus on dual flow analyses examining the quantitative differences among suggested alternative project operation flow patterns and reporting those differences over representative wet, normal and dry hydrologic conditions.

(3) Use a decision-support framework to determine which combinations of base flow and generation flows best address the goals of enhanced habitat and survival for recovery involving improved recruitment for aquatic species of concern while still achieving reasonable levels of hydroelectric generation and project profits. A typical negotiated settlement for a peaking hydropower project includes different operating rules for seasons within each type of water year. In the case of critical species life stages, peaking may even be curtailed for a period of days in

particular seasons for a particular water year type. For example, Piney Dam (FERC No. 309) is required to cease hydro-peaking and operate in a strict run-of-river mode during spring fish spawning.

The following sections provide background on the IFIM and explain the basis for these recommendations.

III.

IFIM BASELINES AND OBJECTIVES

7. IFIM studies have a long association with licensing and re-licensing of hydroelectric projects. An IFIM Training manual (IF 402, unpublished) was prepared for State and Federal agency staff responsible for reviewing hydroelectric projects. This training manual was designed to specifically address the FERC Revisions to the Federal Power Act, Hydroelectric Re-licensing Regulations Under the Federal Power Act (18 CFR Parts 4 and 16, May 17, 1989). Several IFIM training courses and numerous IFIM applications to hydro projects have been completed since.

8. I understand that the FERC-approved study plan required Exelon to conduct an Instream Flow Assessment below Conowingo Dam. The goal of the study was to determine the relationship between flow and habitat conditions in the river. Exelon undertook aquatic species habitat studies as part of its Study 3.16. These habitat studies can provide the site-specific data necessary for conducting a comprehensive IFIM-based comparative analysis of alternatives, but, as explained below, those studies alone do not provide the data necessary for a comprehensive IFIM analysis, or comparable analysis.

A. Baselines

9. IFIM analyses provide quantitative data for direct comparison of proposed and alternative water management operations against project baseline flow patterns. The project baseline is initially presented as a hydrologic time series representing existing conditions (actual gage records of hydrology as the project has operated since construction), not pre-project conditions requiring speculation about the status of resources prior to construction.

10. The Nature Conservancy, with the support of other resource agencies, has requested that FERC evaluate a run-of-river of river alternative. The run-of-river hydrologic time series is better considered as a second baseline from which to evaluate the effects of proposed alternative flow schedules.

11. These two sets of baseline hydrology time series are created and then transformed to habitat time series. Because the Conowingo Project is a daily peaking hydropower facility, and in some seasons peaks twice per day, habitat time series should be estimated using a metric for persistence. These baselines then serve as reference time series for comparisons among proposed alternative operation schemes. Comparisons to these baselines simultaneously quantify the degree of deviation of hydroelectric generation potential from present operations along with the degree of movement toward positive environmental

enhancement (if any) for each proposed alternative. All comparisons should address the spatial and temporal patterns of suitable habitats for selected aquatic species and/or species guilds.

B. Representative Years

12. Stratification of water years into wet, normal and dry strata is necessary for understanding the dynamic nature of riverine aquatic species and to maintain intra- and inter-annual stream flow and habitat variability essential for healthy aquatic environments. These analyses require a unique set of hydrologic and habitat time series for each alternative operating scenario that may be proposed by resource agencies and stakeholders.

13. It is useful to incorporate Indicators of Hydrologic Alteration (IHA) analyses to assess the natural range of variability of daily discharge within water year strata. There should be less variation in flow among calendar year weeks and months for all annual hydrographs placed within a water year strata than is seen for the same calendar weeks and months across water year strata. The usable locations for spawning within the river channel may be quite different between wet and dry years, perhaps even different between dry and extremely dry years, and are significantly different between different peaking regimes that are based on different base flows. Because IHA can only analyze daily data, the natural range of sub-daily variability, within water year strata, should be assessed using relevant metrics (Bevelhimer et al. 2013).

14. It is the variation within representative water strata that determines timing of spawning, duration of egg incubation and emergence of fry. The simulation of available suitable habitats by water year strata facilitates comparison of alternatives and preparation of decision support displays (*see* Section V).

C. Fundamental Objectives

15. Where protection, enhancement, or recovery of aquatic species of concern is recognized as a *fundamental resource management objective*, as it is in this proceeding, the in-river life stages and periodicity of each species should be compared to corresponding hydrology and suitable persistent habitat time series representing historical conditions available across all water year conditions. Baseline habitat conditions when compared alongside best available historical fish population data[1] assist in identifying "habitat bottlenecks."[2] Such analyses look for correlations between occurrence of "habitat bottlenecks" during past years and any evidence of significantly low population numbers for species of concern (from creel census, age and growth studies, periodic sampling, year-class strength for given years, etc.). *See* Stalnaker, et al.,1994.

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[1] Simple examination of recent hydrology time series translated to habitat time series representing the life stage periodicity of the species of concern can reveal "good years" and "bad years." Specific years when simulated habitat conditions are extremely low and other years when habitat conditions are above average can often be related to generic observations and professional opinions from fishermen and resource agency representatives as relatively poor or good years for certain species. There nearly always is some information available even if no formal "fish population data" has been collected.

[2] These are characterized by extremely low occurrences of suitable habitat present when spawning, fry or juvenile life stages are present.

16. Subsequently, an IFIM impact study compares simulated baseline habitat conditions with simulated hydrology and habitat for proposed alternative project operations. Comparisons of simulated habitat time series for each alternative project operation scenario against baseline habitat time series assist in identifying which alternative(s) may significantly enhance, or further depress, recognized habitat limitations (habitat bottlenecks).

17. A comprehensive IFIM impact analysis will illustrate (and quantify) the comparison of potential impacts (positive or negative) from proposed project operations having different *fundamental objectives. Fundamental objectives* are the most important objectives that represent the core values of the resource agencies, stakeholders and project decision-makers.

18. Given the negative impacts from past project operations and contemporary societal goals for recovery of species of special concern, the resource agencies involved in this relicensing have stated that their *fundamental objectives* for this relicensing are to significantly reduce the frequency and magnitude of habitat bottlenecks from present project operations for species of concern. In contrast, Exelon's *fundamental objectives* may be to optimize hydroelectric generation and maximize profits. The IFIM analyses, when completed as intended, can be quite useful to FERC in selecting an alternative(s) that best achieves a balance between these opposing *fundamental objectives*.

D. Suitable Habitats as Means Objectives

19. Proposed flow schedules and simulated suitable habitats are *means objectives* not to be confused with the *fundamental objectives*. Once *fundamental objectives* have been defined, the *means objectives*, or approach, are defined in a manner that assures all *fundamental objectives* can be addressed using the same flow and habitat currency. Within IFIM impact analyses the proposed alternatives produce unique flow regimes that are transformed to suitable habitat time series that serve as the *means objectives. Means objectives* are the objectives that, if achieved, will presumably support the quantitative analyses required to assess and predict the project's effect on each stakeholder's *fundamental objectives.*

20. Proposed alternatives flow schedules are *means objectives* and should not to be treated simply as "minimum flows," but must be transformed to flow and habitat time series simulating the flow changes to the baseline hydrology time series.

21. The three flow based alternatives identified in Section 2.0 of the DEIS[3] are still *means objectives* that, as such, have no documented basis in aquatic ecology of the river system. They seem to have some habitat basis, but this has not been demonstrated, therefore *they are simply proposed flows. They should be treated as alternatives and transformed to habitat time series for comparison through the IFIM modeling process.*

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[3] DEIS, pp. 33-34, 44-48, 53-55.

E. IFIM is NOT a "Minimum Flow" Method

22. The IFIM modeling process has always been focused on the timing and extent of limiting habitat events that determine success for riverine life stages of aquatic species. Habitat time series provide the basis for comparative analyses.

23. Initial development emphasis was placed on fish population response to habitat imposed limitations often referred to as "habitat bottlenecks" (Bovee, 1982; Stalnaker, 1994; Stalnaker et al., 1994; Stalnaker et al., 1996; Bovee et al., 1998). "Effective habitat analyses" was initially presented as a *quasi*- population model. "Effective habitat analyses allow the manager to determine if there are associations between weak or strong year-classes and patterns of year-class-strength, calculated growth histories, or any other anecdotal information on population status" (Bovee, et al., 1998).

24. The point being that IFIM is not a "minimum flow" method, rather it is a process for comparing alternative water management project operations and their effects on both the spatial and temporal aspects of aquatic habitats. It is best used as an environmental analysis tool.

IV.
Habitat Time Series Analyses

A. Steps to Developing the Analyses

25. There are a series of important steps required to develop time and space sensitive habitat time series analyses. I describe each step below because, based on my review of the DEIS where some of these steps were abrogated or skipped, there appears to be some confusion. I also provide my opinion on whether the appropriate steps have been completed based on the documents I reviewed in preparation for this declaration and consultation with The Nature Conservancy Staff.

26. Step 1. The first step is to develop species-specific Habitat Suitability Criteria (HSC) for species and life stages of fish and aquatic organisms and conduct time series of usable habitats for biologically relevant time periods. Criteria are based on observed physical phenomena that may be a factor in fish preference (*e.g.*, depth, velocity, substrate, embeddedness, cover, proximity to cover, groundwater influence, turbidity). When study efforts are unable to develop robust site-specific data, HSC can be developed using the best available information and selected in consultation with the stakeholders. This step was completed through Study 3.16.

27. Step 2. Apply a mainstem open-water flow routing model that estimates water surface elevations, discharge and mean water velocities longitudinally along sampled habitat river sites. This step was completed through Study 3.11.

28. Step 3. Produce hydrologic time series for baseline and proposed alternative Project operation flow schedules. *This step is incomplete. Alternative operational flow schedules have not been published.*

29. Step 4. Develop integrated hydraulic/habitat models using species specific life stage periodicity and habitat criteria (HSC). This step was completed through Study 3.16.

30. Step 5. Produce habitat time series for baseline conditions and determine time and duration of habitat bottle necks for species of concern. Determine when habitat bottlenecks may occur and at what life stage and season, with particular attention to specific calendar years exhibiting good and poor year-class strength for species of concern. This step is incomplete. I understand there is limited data on which to determine the link between habitat and year class strength to identify bottlenecks. Regardless of the lack of formal study results, there is often some evidence of "poor years" for certain species. Reconstructed habitat time series for those years as compared to other years in the historical time series may be an adequate basis for a finding that "habitat bottlenecks" have acted on specific life stages during those years. IFIM analyses use professional opinion based on knowledge of specific species and simulated habitat conditions over recent history.

31. Step 6. Stratify baseline hydrology into sets of annual hydrographs representing different types of water year conditions (*e.g.*, extremely wet, wet, normal, dry, extremely dry). Identify the degree (timing, magnitude and duration) that habitat bottlenecks may or may not appear within stratified water year types. This step is incomplete.

32. Step 7. Compare proposed alternative operational flow scenarios against historic baselines as hydrologic time series. Also, compare representative annual hydrographs for extremely wet, normal, dry, and extremely dry hydrologic strata (also consider warm and cool climatic year types if water temperature is a major component of total usable habitat analysis). This step is incomplete. An example of this approach is included in The Nature Conservancy, "Motion to Intervene," Attachment 1, pp. 32-36.

33. Step 8. Transform hydrological time series to habitat time series. This step is incomplete.

34. Step 9. Compare proposed alternative project flow schedules. This step is incomplete.

35. Step 10. Select alternative(s) that best achieves compromise between opposing goals of environmental enhancements and maximizing Project hydroelectric generation and profits. This step is incomplete.

36. Step 11. Determine if conditions other than suitable hydraulic habitat may override suitable habitat analysis conclusions. This step is incomplete.

37. Naturally flow and habitat conditions are quite dynamic across time, and species have evolved to cope with these different magnitudes, frequencies, durations and rates of change. The spatial and temporal occurrence of habitat bottlenecks is quite different for different obligate riverine species. Habitat limitations may only be observed during low flow years for some species, only during high flow years for other species and may seldom occur for other more

generalists species. Therefore stratification of analyses and display of comparative availability of persistent habitat by water year type is important. This step is incomplete.

38. Step 12. Prepare a Decision Support Framework capable of conducting a variety of post-processing comparative analyses that focus on comparison and contrast of fundamental objectives for all parties. This comparison uses the common output of habitat metrics (the means objectives), estimated from habitat time series, effective habitat, persistence of suitable habitat over peaking cycles and other models. It is appropriate to use tabular and visual display by water year strata for all comparisons. This step is incomplete.

39. Step 13. Negotiate unique project operating rules for the different water year types. This often identifies the best compromise for balancing environmental and project management goals. This step is incomplete.

B. Effective Habitat, Persistent Habitat and Binary Criteria

40. An effective habitat time series is a modified version of a habitat time series designed to help address the problem of non-uniform effects of available suitable habitat for different aquatic species life stages. This approach was incorporated into IFIM as "quasi-population analyses" termed effective habitat analyses (*see* Bovee, 1982, pp. 100-120; in Bovee et al., 1998, pp. 98-101).

41. The effective habitat time series is a simplified fish population model based on the concept of habitat ratios. The persistence of suitable spawning, incubation and fry habitats as time series is designed to address the special case of unstable habitat conditions below peaking hydroelectric projects. This analysis quantifies the area of wetted stream bed that is suitable for spawning and subsequently remains suitable during the egg incubation period as determined throughout the generation cycle below peaking hydroelectric projects (Stalnaker, 1992; Bovee et al., 1998). The foundational data for this analysis was included in Appendix G (Persistent Habitat Tables), eLibrary no. 20120831-5048 (Aug. 2012), but was not transferred to habitat time series to compare alternatives for Study 3.11 or in the DEIS.

42. Typical impact analyses involving a hydro-peaking project where there are many aquatic organisms of interest will involve multiple comparisons and numerous time series. In such situations the weighted usable area (WUA) index is difficult to interpret. Consequently, *IFIM analyses involving peaking hydro projects are best evaluated by focusing on usable and unusable habitat as defined by binary habitat criteria*. This simpler and more readily understood habitat index greatly facilitates a common understanding among project managers, agency staff and other stakeholders.

43. Thomas and Bovee (1993) converted HSC based composite suitability indexes to binary format, with the optimum range for a variable defined as having a composite suitability index greater than 0.85 and usable habitat defined as having a composite suitability value between 0.2 and 0.85. Suitable microhabitat is then defined as the full range of conditions in which the species life stage was observed. Unsuitable microhabitat is defined as all microhabitat values outside the suitable range.

44. Another way to visualize these habitat categories is as areas of the wetted stream bed that provide optimal, marginal or unusable microhabitat conditions. *Since habitat time series is the currency of IFIM and serves as the basis for comparing baseline conditions with proposed project operating schedules, the use of binary composite suitability indexes and testing of model output represents the state-of-the-art and should become the state-of-the-practice.*

> "For statistical reasons of model testing and for ease in conducting *habitat time series* and *effective habitat analysis*, resorting to this simpler classification of model output should perhaps become the norm" (Locke et al., 2008).

45. Similarly the Norwegians have adopted the convention of suitable, indifferent, unsuitable, and dry (high points that become islands at low flows) presented as color coded 2 dimensional figures, where suitable habitat is blue and unsuitable habitat is red, while the indifferent habitat is yellow and dry areas are clear (Alfredsen et al., 2004; Heggenes et al. 1994). They have found during their studies of Atlantic salmon and brown trout that the "Niche differences were most pronounced with respect to what types of habitat were *not* used: salmon were much more tolerant for high mean water velocities and deeper stream areas." *This highlights the fact that the area under the wetted surface of a stream that is unusable can be quite large, especially during hydropeaking. From the resource perspective negotiations of project operating rules should strive to keep the proportion of unusable area to highly suitable area (optimum) as low as possible.*

46. When proposed project operating flow schedules are to be evaluated, the change in the amount of optimal habitat present for a species life stage at critical times versus the amount of unusable stream area is the most informative metric. Likewise, it is undesirable to see an increase in the amount of marginal habitat at the expense of optimal habitat as a result of proposed project operations. Preventing the total amount of stream area that is *unusable* for specific life stages from being severely increased over baseline levels due to alternative project operation schedules is a common IFIM strategy for protection and recovery of species of concern.

C. Dual Flow Habitat Analyses

47. The idea of dual flow habitat is best understood by contrasting the large difference between the base and generation flows. These dual flows – the daily minimum and maximum – determine the suitability of habitat for aquatic organisms below peaking hydro projects. Again, the foundational data for the dual flow habitat analysis was included in Study 3.11, Appendix G (Persistent Habitat Tables), but was not transferred to habitat time series to compare alternatives for Study 3.11 or in the DEIS.

48. Rapid, frequent, and large magnitude changes in streamflow are common below peaking hydro projects. The discharge and habitat conditions for each square meter of stream bed may change dramatically throughout the peaking cycle. Mobile organisms, such as adult fishes, can move from one area to another to maintain position over areas of suitable habitat conditions.

49. In contrast organisms with restricted mobility, such as mussels and fish fry and juvenile fishes, may be displaced from suitable habitat areas of low velocity when flows increase. Those fish "species that dig redds, build nests, broadcast eggs to substrate or vegetation can be at risk due to rapid flow fluctuations. Likewise species whose young depend on stationary, reliable rearing habitats can be decimated by rapid changes in flow" (Stalnaker, 1992). Only those areas that remain suitable over the entire peaking cycle are considered as suitable for immobile organisms. Typically, during the peaking cycle, a large proportion of the stream bed that may have suitable habitat conditions for immobile organisms during base flow conditions becomes unsuitable as the flows increase. Consequently, the less mobile organisms are either stranded or swept downstream resulting in high mortalities.

50. The objective of dual flow analyses is to determine the effect of different combinations of generation and base flows on different aquatic organisms. This is referred to as "persistent habitat" by The Nature Conservancy in their comments. The "persistent habitat" is the amount of suitable habitat that persists as flow transitions from base flow conditions through generation releases. This persistent habitat metric is quite different (typically much lower) from minimum WUA, average WUA or other static habitat metrics calculated for the duration of the peaking cycle.

51. Negotiating unique project operating rules for the different water year conditions (*see "*Representative Years," *supra*) often identifies the best compromise for balancing environmental and Project management goals. For peaking hydro operations this often means that the base flow upon which peaking is allowed will vary across water years. In the case of recovery for critical species life stages, peaking may even be curtailed for a period of days in particular seasons for a particular water year type(s). Consequently, a typical negotiated settlement for a peaking hydro project includes different operating rules for seasons within each type of water year. IFIM study based negotiated operating rules for weeks, months or seasons within each water year class can be identified as **conditions to be included** in a project license.

V.

DECISION SUPPORT SYSTEM

52. Every process should include a decision support system for illustrating complex analyses contrasting alternative project operation scenarios. A well-defined support system will include a linked set of quantitative models (hydrologic, water temperature, hydraulic/fish habitat, fish population/production) and a Graphic Information System that provides the connection between project operations and ecological effects.

53. Resource agencies, project managers and stakeholders must understand and buy into the chain of analyses within the analytical system and use it as an integrative tool for comparing alternatives, informing management decisions, and assessing progress toward achieving *fundamental objectives*. HSCs, composite suitability indexes, and habitat time series are only *means objectives* (building blocks) that lead to the *fundamental objectives* and potential fish population response as consequence of river flow management. In this proceeding, a few of the *means objectives* have been completed (HSCs, dual flow habitat analysis), but they have not

been used to develop a chain of analyses to comparatively assess performance of alternatives in achieving *fundamental objectives*. Therefore the decision support system is incomplete.

54. A basic understanding of the modeling system and buy-in by stakeholders is critical. Understanding and accepting the uses and limitations of computer based flow to habitat to fish population response is a difficult task for non-modelers and takes time to develop a thorough understanding of the process. Describing the many technical tasks that feed into the process is important for stakeholder understanding. Stakeholders are naturally wary of computer models: trust is gained over time as stakeholders gain understanding and experience with the support system. Confidence and acceptance among all parties (including technical members) comes from many iterations of the linked models in the support system. Through a series of "scenario exercises" stakeholders become more involved and supportive.

VI.

MINIMUM FLOWS AND PERCENTAGE OF WUA

55. I am concerned that the analyses performed to date for this proceeding do not show a full understanding of the importance of habitat variability across time for obligate species. As described below, PHABSIM is not IFIM.

56. "Many people confuse IFIM with the Physical HABitat SIMulation System (PHABSIM). Where IFIM is a general problem solving approach employing systems analysis techniques, PHABSIM is but one specific model designed to calculate an index to the amount of suitable hydraulic habitat available for different life stages at different flow levels. PHABSIM has two major analytical components: stream hydraulics and life stage-specific habitat requirements (Stalnaker et al., 1994).

57. "Practitioners must remember that the habitat suitability criteria are "input" to the habitat model and are not the output" (Annear et al., 2004). "A common practice has evolved among some practitioners for prescribing an instream flow standard by recommending the maximum habitat value from the weighted usable area or discharge graph for a single life stage of a single species or by some aggregation technique of the maximum values from among several species and life stage plots" (Annear et al., 2004). Another common practice is to prescribe a minimum flow standard as some percentage of the peak (*e.g.*, 90%) value from a flow versus habitat graph. This may be useful where local policy dictates that "minimum flow" is the accepted instream flow standard. This is referred to as Standard Setting. Standard Setting is defined as "a streamflow policy or technique that uses a single, fixed rule to establish minimum flow requirements" (Annear et al., 2004).

58. Standard setting of minimum flow is not appropriate for environmental impact studies where alternative water project operations are compared.

59. IFIM was developed to replace the simple but static minimum flow methods practiced during the mid to late 20th century and to specifically address the more comprehensive environmental impact analyses necessary to evaluate alternative water management flow release

schemes. Unfortunately, some have used output from but one model (PHABSIM) within the suite of IFIM models to perpetuate “minimum flow” prescriptions.

60. IFIM is designed to assist natural resource and water management agencies in comparing the relative merits of prosed instream flow management schemes for operating water projects (such as hydro project licensing). The use of habitat time series, coupled with life-history habitat requirements and periodicity is the proper approach when using IFIM to evaluate peaking hydro facilities. The amount of intra- and inter-annual flow and habitat variability present under baseline conditions and the magnitude of any deviations that may occur under alternative Project operations becomes the focus of these impact studies.

61. “There is an extensive ecological literature on habitat-selection modeling, which indicates that simple selection of flow recommendations from a static set of WUA versus flow curves is not considered a credible approach…” (National Research Council, 2008). The National Research Council (NRC, 2008) has devoted several chapters to modeling and river management (Formulating and Applying Models in Ecosystem Management, Instream Flow Study, and Applying Science to Management).

62. The dynamic effects of varying levels of hydraulic habitat on biological processes, including competition, bioenergetics, predation, disease, and the recruitment of juveniles into the population, must be considered (Bartholow, et al., 1993). “Ecological and biological processes occur over variable scales of time and space, so an instream flow prescription should provide an appropriate level of spatial and temporal variability, to preserve the complexity of these processes” (NRC, 2008).

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USFWS/HVT (U.S. Fish and Wildlife Service and Hoopa Valley Tribe). 1999. Trinity River Flow Evaluation. Final Report. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, CA, and Hoopa Valley Tribe , Hoopa, CA. June 1999

Attachment 1.1

CURRICULUM VITAE

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Professional Experience:

2000-present: Retired Senior Scientist, serving as consultant and expert witness.

1998-1999: Senior Scientist, Midwest Ecological Science Center, U.S. Geological Survey, Fort Collins, CO

1993 - 1998: Leader, River Systems Management Section, Midcontinent Ecological Science Center, U.S. Geological Survey, Fort Collins, Colorado

1990 – 1993: Chief, Riverine and Wetland Ecosystem Branch, National Ecology Research Center, FWS, Fort Collins, Colorado

1985 - 1999: Adjunct Professor of Environmental Engineering, Utah State University, Logan, Utah

1986 - 1990: Chief, Aquatic Systems Branch, National Ecology Research Center, FWS, Fort Collins, Colorado

1977 - 1999: Adjunct Professor, Dept. of Fisheries and Wildlife, Colorado State University, Fort Collins, Colorado

1976 - 1986: Leader, Instream Flow and Aquatic Systems Group, Water Energy and Land Use Team, FWS, Fort Collins, Colorado

1976: Fishery Research Biologist, Western Water Allocation Program, Office of Biological Services, U.S. Fish and Wildlife Service, Logan, Utah

1975 - 1976: Fishery Research Specialist, Division of Federal Assistance and Endangered Species, U.S. Fish and Wildlife Service, Region 6, Denver, Colorado

1966 - 1975: Assistant Unit Leader, Utah Cooperative Fishery Research Unit, FWS, Logan, Utah

1966 - 1975: Assistant Professor, Utah State University, Logan, Utah

Education:

Universities

1960 West Virginia University
BS in Forestry and Wildlife Mgt.

1966 North Carolina State University
PhD in Animal Ecology, Physiology and Genetics

Professional Societies

A.A.A.S., American Fisheries Society, Bonneville Chapter of A.F.S. (1973-74, two years executive committee member and chairman of resolutions committee; 1974-75 President Elect; 1975-76 Chapter President and executive committee member of the Western Division American Fishery Society), The Wildlife Society, and American Society of Naturalists.

Scholarly Societies

Gamma Sigma Delta - National Honor Society of Agriculture
Alpha Zeta - National Honorary Fraternity of Agriculture (Chapter Secretary and President)
Xi Sigma Pi - National Honor Society of Forestry (Chapter Secretary-Treasurer)
Phi Epsilon Phi - Honorary Botanical Fraternity
Tau Alpha Sigma - Honorary Wildlife Fraternity (Chapter President)
Sigma Xi

Appointments

Member five person Science Advisory Board, Trinity River Restoration Program, U.S. Department of Interior. 2002-present.

Member, six person National Review Panel, Department of Energy, Water and Power Program. Review of research projects being conducted by the DOE. National Laboratories. 2010 and 2011.

Adjunct Professor, Department of Civil and Environmental Engineering, Utah State University, Logan, Utah, 1985-1999.

Adjunct Professor, Departments of Fisheries and Wildlife, and Earth Resources Colorado State University, Fort Collins, Colorado, 1977-1999.

Member, Committee on Hydrology, Ecology, and Fishes of the Klamath River. National Research Council, Board on Environmental Studies and Toxicology, Water Science and Technology Board, Division on Earth and Life Sciences. Washington, D.C. 2006–2008.

Member, Science Advisory Board, Trinity River Restoration Program, Trinity Management Council, Weaverville, California, 2004-present.

Honorary Life Member, Instream Flow Council, Elected 2003. Awarded the Instream Flow Council’s Lifetime Achievement Award in 2008.

Member, Science Advisory Committee, Upper Gila River Fluvial Geomorphology Study to Restore Habitat, U. S. Bureau of Reclamation, Graham County, Arizona, San Carlos/Safford/Duncan Watershed Group, Arizona, 1999-2004.

Member, Research Review Committee, CalFed, 2005.

Member, Research Review Committee, CalFed, 2002.

Chair, Research Review Committee, CalFed, 2000.

Member, Scientific Review Panel, New Zealand Foundation for Research, Science & Technology, 1997.

Member, Technical Advisory Committee, Joint Electric Power Research Institute and Pacific Gas and Electric Co. Research study on fish habitat/hydro power interactions, 1985-1998.

Member, Technical Advisory Committee, Joint BIA, Salish and Kootenai Tribes, Fishery/water study on the Flathead Reservation, Montana, 1987-1989

Member, Advisory Steering Committee, National Instream Flow Program Assessment,Joint State - Federal Aid assessment of the status of instream flow programs in all States and the seven regions of the Fish and Wildlife Service, 1994-1997.

Member, Technical Advisory Committee, Joint FWS N.Y. Department Environmental Conservation and Niagara Mohawk Power Co. research study on effects of hydropeaking on downstream fisheries, 1986-1990

Member Committee on Western Water Management Changes, National Research Council, Water Science and Technology Board, 1989-1992

Publications

2014. Science Advisory Board. Review of the Trinity River Restoration Program’s Channel Rehabilitation Strategy, Phase I. Prepared for the Trinity River Restoration Program by the five member Science Advisory Board. 38pp with 8 appends.

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2008. Committee on Hydrology, Ecology and Fishes of the Klamath River. Hydrology, Ecology, and Fishes of the Klamath River. National Research Council. Washington, D.C. 249 pp.(a major contributor)

2004.With 14 others. Instream Flows for Resource Stewardship. Revised Edition. Instream Flow Council, Cheyenne, WY.268 pp

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2000. Stalnaker, C. B. and R. J. Wittler. Implementation Plan for the Preferred Alternative of the Trinity River EIS/R, 39p.

1999. Stalnaker, C. B. Impounded river systems. Status and Trends of the Nation's Biological Resources. USGS.

1999. Stalnaker, C. B. and 10 other primary authors. Trinity River Flow Evaluation Final Report. U. S. Fish and Wildlife Service and Hoopa Valley Tribe, Arcata, Calif. 307 p and appendices.

1999.Stalnaker, C. B. and Rodney Wittler. Adaptive environmental assessment and management recommendation for the Trinity River fishery restoration, *In* U. S. Fish and Wildlife Service and Hoopa Valley Tribe, Trinity River Flow Evaluation Final Report.

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1998.Bovee,K.D.,B.L. Lamb,J.M. Bartholow, C.B. Stalnaker,J. Taylor and J. Henriksen. Stream habitat analysis using the instream flow incremental methodology. U.S. Geological Survey, Biological Resources Division Information a d Technology Report USGS/BRD-1998-0004. vii + 131 pp.

1996.Stalnaker, CB, K.D. Bovee, and T.J. Waddle. Importance of the temporal aspects of habitat hydraulics to fish population studies. Regulated Rivers:Research & Management, Vol. 12, 145-153

1995.Stalnaker, C.B, B.L. Lamb, J. Henriksen, K. Bovee, and J. Bartholow. The instream flow incremental methodology: A primer for IFIM. National Ecology Research Center, National Biological Service. Biological Science Report 29. 44 pps.

1994.Stalnaker, C.B Evaluation of Instream flow habitat modeling. Pp 276-286 in Calow, P., and G.E. Petts, eds. The Rivers Handbook. Vol. 2. Hydrological and Ecological Principles.

1993.Bartholow, J.M., J.L. Laake, C.B Stalnaker and S.C. Williamson. A salmonid population model with emphasis on habitat limitations. Rivers 4:265-279.

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and J.B. Cannon, eds. The Scientific Challenges of NEPA: Future directions based on 20 years of experience. Lewis Publishers, Boca Raton.

1993.Stalnaker,C.B. Water management assessment for a Wild and Scenic River.Review of Rio Chama Instream Flow Assessment. by J.L.Fog, B.L. Hanson, H.T.Mottl, D.P. Muller, R.C. Eaton, and S. Swanson. Denver, CO:Bureau of Land Management, 1992,133 pages.

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1992.Committee on Western Water Management, National Research Council. Water Transfers in the West:Efficiency, Equity and the Environment, National Academy Press, Washington, D.C. 300 pp. (contributor to book and principal author of 3 chapters).

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