Ecological Flows Science Advisory Board (EFSAB)
Meeting Summary
May 17, 2011

Eno State Park Durham, NC

X APPROVED (For Distribution)

Attendance

Ecological Flows Science Advisory Board

Members

Donnie Brewer, EMC
Mark Cantrell, US Fish and Wildlife Service
Bob Christian, NC Marine Fisheries Commission
John Crutchfield, Progress Energy
Tom Cuffney, U.S. Geological Survey
Linda Diebolt, Local Governments
Chris Goudreau, NC Wildlife Resources Commission
Jeff Hinshaw, NC Cooperative Extension
Jim Mead, NC Division of Water Resources
Sam Pearsall, Environmental Defense
Judy Ratcliffe, NC Natural Heritage Program
Jaime Robinson, NCAWWA-WEA
Fritz Rhode, National Marine Fisheries Service
Jay Sauber, NC Division of Water Quality
Bill Swartley, NC Forestry Association

Alternates

Cat Burns, The Nature Conservancy
Peter Caldwell, USDA Forest Service
Vernon Cox, NCDA&CS
Steven Reed, Division of Water Resources
Vann Stancil, Wildlife Resources Commission
Sarah McRae, US Fish and Wildlife Service

Division of Water Resources Staff

Tom Reeder
Jucilene Hoffman
Don Rayno
Sarah Young

Facilitation Team

Mary Lou Addor, Natural Resources Leadership Institute (NRLI)
Patrick Beggs, Watershed Education for Communities and Officials (WECO)
Christy Perrin, Watershed Education for Communities and Officials (WECO)
Nancy Sharpless, Natural Resources Leadership Institute (NRLI)

The purpose of the Ecological Flows Science Advisory Board:

The Ecological Flows Science Advisory Board will advise NC Department Environment and Natural Resources (NCDENR) on an approach to characterize the aquatic ecology of different river basins and methods to determine the flows needed to maintain ecological integrity.

Presentations, reports, and background information about the E-Flows SAB are available at:
www.ncwater.org/sab

May 17, 2011: Decisions Made/Actions to be Taken

A. The March 15, 2011 Meeting Summary was approved and is posted on the E-Flows SAB website.

May 17, 2011 Meeting Agenda

I. Executive Summary (this executive summary was added by the facilitators in February, 2013)

Purpose of Meeting: To introduce the Eno River Demonstration Project, review Instream Flow Methodology, and demonstate Instream Flow Methodology at the river

Links to Readings:

1. Alteration of streamflow magnitudes and potential ecological consequences: a multiregional assessment. 2010
http://water.usgs.gov/nawqa/pubs/Carlisleetal_FLowAlterationUS.pdf

2. Ecological responses to altered flow regimes: a literature review to inform the science and management of environmental flows. 2010
http://rydberg.biology.colostate.edu/~poff/Public/poffpubs/Poff_Zimmerman_2010_FWB.pdf

3. Evaluating effects of water withdrawals and impoundments on fish assemblages in southern New England streams, USA. 2010
http://southeastaquatics.net/uploads/category/July%2023,%202010%20&Kanno-Vokoun%20on%20flow-ecology%20relationship.pdf

4. Fish Assemblage Responses to Water Withdrawals and Water Supply Reservoirs in Piedmont Streams. 2006
http://www.southeastaquatics.net/uploads/category/Fish%20Assemblage%20Responses%20to%20Withdrawals%20by%20Freeman%20&%20Marcinek.pdf

5. Basic Principles and Ecological Consequences of Altered Flow Regimes for Aquatic Biodiversity. 2002
http://www.deltacouncil.ca.gov/delta_council_meetings/january_2011/Item_8_Attach_2.pdf

For all presentations, go to: presentations on DWR website

QUICK SUMMARY OF DECISIONS/RECOMMENDATIONS MADE AND PROPOSED ACTIONS:

A. Proposed Actions or Identified Decisions to Be Made

- We may need to validate and investigate whether we can extend the preference curves, or whether it is stream specific.
- We need to look more at the biota end—is what the model says is there actually there?
- Don't we want to use guilds then have some endangered species that are not part of a guild?
- How are we going to tie in unregulated streams or smaller streams?
- Most of our discussions have focused on minimum flows to maintain biology, but it is also important to consider high flows to maintain biology.
- Perhaps we should look at WATERFALL (a model) as a way to put land use into the hydrologic models, but this process, as defined by the bill, is not trying to set guidelines for land use.
- Have some meetings outside the beltline of Raleigh.

Review of Instream Flow Incremental Methodology (IFIM) with Jim Mead presenting

Jim Mead, DWR, explained that the EFSAB was meeting at the Eno River State Park because a habitat versus flow study had been completed there approximately 25 years ago. DWR has existing data from that study. At the same time, the model of the Neuse River Basin (of which the Eno is a part) is complete. DWR proposes that they run the Neuse River basin model and the habitat v. flow model as a way to come at eco-flows for the Eno River. If by looking at the results of that modeling the EFSAB felt comfortable with the results, this approach could be used for other areas across the state where habitat versus flow studies and hydrologic modeling have been completed. Jim showed a map of existing habitat v. flow study sites in N.C. (available at http://www.ncwater.org/Data_and_Modeling/eflows/sab/presentations/20110517/)

Demonstration of Instream Flow Incremental Methodology (IFIM)

Jim showed the EFSAB some of the transects used in the IFIM study completed on the Eno1986-1988. Jim provided a handout (available at http://www.ncwater.org/Data_and_Modeling/eflows/sab/presentations/20110517/) showing photos and the bottom profile and the water level at various flows at each of the twelve transects, from that study. Major points covered included:

- DWR used twelve transects at this site to try to cover the variety of habitats included in the stretch of the river in the study.
- The field measurements taken at each transect provide depth and velocity of the water for each measured calibration discharge, you can interpolate or extrapolate for different flows.

- Habitat is determined separately for each cell and then totaled for each transect. The habitat total for each transect is weighted according to the percentage of that habitat type (riffle, pool, etc.) that the transect represents, and then all transects are added together.
- The Physical Habitat Simulation process (PHABSIM) uses a suite of models. Depths and velocities measured in every cell, at each transect at known discharges are used to calibrate hydraulic models. This calibration data is collected under at least three distinctly different flows. Combined with the substrate and cover data collected across each transect, the output of the hydraulic models is a set of physical habitat conditions (depth, velocity, substrate, and cover) at every cell for each of the simulation flows.

Questions, Comments, and Concerns Raised

- Changes in upstream use could significantly change the habitat. R: Upstream changes would change physical conditions if it affected the geometry of the subject stream.
- In some places, substrate changes a lot. How do you model them? R: We still assume that over the stream reach being studied, you have overall equilibrium and, therefore, the model still represents available habitat, even though conditions at a precise transect location might have changed.
- We have to look at the drainage areas of the tributaries between gages. The drainage area for a gage will determine the flow there.

Debrief of the Demonstration of the Eno River IFIM Study

Jim Mead emphasized that they are not trying to determine the ecological flow for the Eno, which is small and flashy, but rather they are asking the EFSAB to look at this to see if this approach works. If it looks like this approach does work, DWR would expand their effort to broaden to other sites, not just small flashy streams like the Eno. DWR is starting in the Neuse because that hydrologic model is completed. The Cape Fear will be completed in 2011. The Neuse and the Cape Fear will be run together because they are interconnected. The Tar and the Broad are in progress. Jim showed a map showing locations of existing IFIM studies. He noted that DWR relies on literature or brings together experts about a particular species to flesh out how different species and guilds react to changes in flow.

Questions, Comments, and Concerns Raised

- We have a paucity of information about the relationship between cover and different species and groups of species. Are there any plans to validate the models relative to the benthic and vertebrate fauna in the streams?
- Do you predict a difference in species composition by stream type?
- It sounds like we are looking at hydraulics (stream geometry and flow) and hydrology, then we need to bring in the biology.

- Do the guilds represent, in another location, the same kinds of species--a different name but the same functional guild.
- Where is water quality fitting into the biology?

Proposed Actions or Identified Decisions to Be Made

- We may need to validate and investigate whether we can extend the preference curves, or whether it is stream specific.
- We need to look more at the biota end—is what the model says is there actually there?
- Don't we want to use guilds then have some endangered species that are not part of a guild?
- How are we going to tie in unregulated streams or smaller streams?
- Most of our discussions have focused on minimum flows to maintain biology, but it is also important to consider high flows to maintain biology.
- Perhaps we should look at WATERFALL (a model) as a way to put land use into the hydrologic models, but this process, as defined by the bill, is not trying to set guidelines for land use.

Revisit "Members' Needs List

Mary Lou Addor, facilitator, solicited additions to the EFSAB's "Member's Needs List". Suggestions included mixing up meeting locations and having a presentation on WaterFALL.

II. Welcome, Agenda Review and introductions

Patrick Beggs, facilitator, welcomed everyone to the fourth meeting of the Ecological Flows Science Advisory Board (EFSAB). He introduced himself and invited all in attendance to introduce themselves, including their affiliation. He then reviewed the agenda.

III. II. Review of Instream Flow Incremental Methodology (IFIM)

Jim Mead, DWR, explained that the EFSAB was meeting at the Eno River State Park because a habitat versus flow study had been completed there approximately 25 years ago. DWR has existing data from that study. At the same time, the model of the Neuse River Basin (of which the Eno is a part) is complete. DWR proposes that they run the Neuse River basin model and the habitat v. flow model as a way to come at eco-flows for the Eno River. If by looking at the results of that modeling the EFSAB felt comfortable with the results, this approach could be used for other areas across the state where habitat versus flow studies and hydrologic modeling have been completed. Jim showed a map of existing habitat v. flow study sites in N.C. (available at http://www.ncwater.org/Data_and_Modeling/eflows/sab/presentations/20110517/)

IV. Demonstration of Instream Flow Incremental Methodology (IFIM)

The group then moved to the river to see some of the transects used in the IFIM study completed on the Eno1986-1988. Jim provided a handout (available at http://www.ncwater.org/Data_and_Modeling/eflows/sab/presentations/20110517/) showing photos and the bottom profile and the water level at various flows at each of the twelve transects, from that study. Jim Mead and others from DWR had measured the flow on the morning of this meeting at 32 cfs (cubic feet per second). Jim pointed out that the 32cfs was pretty close to the 39cfs level in the handout, allowing the group to see how the transects looked today in comparison to how they looked in the 1980s. He noted that the photos in the handout were taken from the other bank.

Why so many transects? DWR used twelve transects to try to cover the variety of habitats included in the stretch of the river in the study. There is a practical limit on how many transects you can do in the limited time before the flow conditions change during a data set. On the Eno, the bottom is fairly rocky, so shifting of the bottom does not occur as readily as it would where there is a sandy bottom. Different hydraulic simulation techniques are available for use in sandy bottom streams. There were no big changes in the two years of working on this study site in the mid 1980's. The model assumes that the profile does not change over the course of collecting data for the study.

The group walked past transects 1 and 2. At transect 3, a riffle, Jim demonstrated how the field flow measurements are accomplished:

1. Install a bench mark (example here was a nail in a tree);
2. Survey a bottom profile relative to the bench mark at multiple points across the river; each point is a "cell";
3. Measure the height of the water at the transect relative to the bench mark;
4. Measure discharge at the transect (velocity x width x depth= discharge for each cell, then total), using a Price AA meter on a wadeable stream like the Eno.

You then know the profile, the depth of the water and the velocity at each cell, relative to the total discharge. Because you know the depth and velocity of the water for each measured calibration discharge, you can interpolate or extrapolate for different flows.

The next step involves habitat suitability indices—what do species like? This gets to habitat quality. Some like it fast, some slow; some like shallow, some like deep; and some prefer coarse substrate and some like fine. For example, if a species likes fast current, the suitability gets weighted as a high value if the velocity is fast and a low value if the velocity is slow. Habitat is determined separately for each cell and then totaled for each transect. The habitat total for each transect is weighted according to the percentage of that habitat type (riffle, pool, etc.) that the transect represents, and then all transects are added together.

With OASIS you can crank out daily flows and convert these to daily habitat. This time series of habitat values can be analyzed to compare different flow scenarios.

Question: How do the habitat suitability indices show organisms responding to flows?
Response: It's reflected in the quality value of a habitat. For example, if a species prefers a fast flow, and the flow is measured as slow, it will result in a low habitat value for the species.

Question: Do the habitat suitability indices include aquatic vegetation?
Response: Yes. In the photos taken at low flows you can see aquatic vegetation, which offers good cover for many organisms.

Question: How often do you update the profile?
Response: Data were collected here in 1986-1988, during which we had no big tropical storms so it was relatively constant. Each time you measure velocity you measure depth. That is a check on whether we have had major shifts. We assume that, although the profile may not be exactly what it was in 1986-1988, there is something nearby, upstream or downstream, that is the same. This is still a riffle. In this case, the model is adequate.

Comment: Changes in upstream use could significantly change the habitat.
Response: Upstream changes would change physical conditions if it affected the geometry of the subject stream. Here, things have not changed that much.

Question: In some places, substrate changes a lot. How do you model them?
Response: There are other approaches that can be used for more unstable situations, but they are data collection intensive. You can collect data once or twice and use that data to represent the stream electronically (for example this was done by consultants working on Swift Creek, southeast of Raleigh). We still assume that over the stream reach being studied, you have overall equilibrium and, therefore, the model still represents available habitat, even though conditions at a precise transect location might have changed.

Question: Is there information for specific species of what flows they like and what they don't like?
Response: Yes. For example, stonerollers (a fish) prefer some flow but not a lot; they prefer cover objects near stream edges.

Jim Mead then demonstrated how to measure velocity using the Price AA meter, going along the measuring tape strung across the river (the transect), measuring at various points. Generally, the current velocity increases as you move from the bank to midstream, but Jim

also pointed out a velocity shelter toward the middle of the river, where a spot downstream of a rock has a slower velocity. The velocity at midstream was 2 feet per second (fps), nearer to the bank it was 0.5 fps, and in the velocity shelter it was 0.1 fps.

As a general rule, water moves faster near the surface than along the bottom. The flow meter is adjusted for depth to measure the average velocity in the water column at the measurement point, or cell. The discharge in each cell is calculated by multiplying the depth (ft), times the average column velocity (fps) at that point, times the width of the cell (ft.) to get the discharge in cubic feet per second for the cell. All of the cells are summed to yield the total discharge measurement at that transect.

The Physical Habitat Simulation process (PHABSIM) uses a suite of models. Depths and velocities measured in every cell, at each transect at known discharges are used to calibrate hydraulic models. This calibration data is collected under at least three distinctly different flows. The hydraulic models can then simulate depths and velocities for any flow specified within a reasonable range (about .4 times the lowest flow and 2.5 times the highest flow at which calibration data was collected). Combined with the substrate and cover data collected across each transect, the output of the hydraulic models is a set of physical habitat conditions (depth, velocity, substrate, and cover) at every cell for each of the simulation flows.

The next step in PHABSIM uses biological information for each of the species or guilds being evaluated. Habitat suitability indices (HSI's) or preference curves are used to determine the weighted habitat value for each cell, at each transect, for each of the specified simulation flows. HSI's for depth, velocity and substrate/cover range from zero (worst) to 1.0 (best) for each of these parameters. At a particular flow, the weighting factor for an individual cell is the product of the HSI values for the depth, velocity, and substrate/cover conditions in that cell at that flow. This weighting factor is then multiplied by the cell width and the length of stream associated with the type of habitat represented by the transect. The result is a value in square feet known as weighted usable area or WUA. The PHABSIM habitat model performs this calculation for every species or guild, at every cell, at each transect, at every simulation flow. When the values are totaled up by flow, the end result is a table or plot of weighted usable area versus flow for each species or guild. The Eno River study conducted in the 1980s looked at a limited number of species and life stages. A big part of this project is to add more species and guilds. [*Facilitators' note: The preceding four paragraphs include clarification by Jim Mead, via e-mail after the meeting, of what was said at the meeting]*

The group moved on to Transect 4, a braided transect when at lower flows than observed on this day, making it different from transect 3, which is not far away. Transects will be far

apart on reaches where the habitat does not change much, but spaced more closely where habitat changes more quickly.

> *Question*: Did you have preset conditions for identifying transects or was it ad hoc?
> *Response*: Typically, we walk all the way up a stream. Returning, we walk the middle of the channel with a tape, measuring the percentage of each habitat; then we walk a third time. Riffles are important habitat. Even though they do not constitute a high percentage of the stream, because they are important habitat and they are difficult to model, we use two riffle transects. Pools, on the other hand, comprise a larger percentage of the stream, but there is little variation among them so using one shallow one and a deeper one will adequately represent.

The group moved to Transect 5, which has shallow bars at either side at low flows. Bars have habitat value, so we want to know what flows cover the bars.

Jim noted that we could use the Wetted Perimeter Model rather than PHABSIM, but it is cruder—wet good; dry bad. The Wetted Perimeter Model does not distinguish enough to assess habitat quality at various flows.

> *Question:* Once you do a study like this at the Eno, then expand and compare and get more done, can you use Wetted Perimeter Models to compare and see if you could use the wetted Perimeter sites to expand the data set? In other words, if you use PHABSIM here, make conclusions, then compare with Wetted Perimeter Models here, could you extend to areas where you just have Wetted Perimeter Models?
> *Response:* Possibly. Wetted Perimeter Models give you a minimum threshold. Also, Wetted Perimeter Models have been used for macroinvertebrate bottom dwellers, who do not move much and need to be wet.

> *Question:* Moving up bank some more, have you identified aspects of the bank (out of channel characteristics) that effect habitat and nutrient processing?
> *Response:* Yes and no. We don't stop at the water's edge. We make notes about undercut bank, root wad, etc. because that is an aspect of habitat. We do not look at nutrient processing or a lot of the riparian zone. That's more relevant to high flows, which are not really what we are looking at.

> *Comment:* Bar areas, for example, are going to be dry at times, so Wetted Perimeter Models are limited there (can't be used as minimum). DWR's recommendations are on at least a seasonal or monthly basis. We don't want to put water there at higher than historic values (July for example). March is very different. March is going to have high flow historically, and we want the flow regime to reflect that.

The group then moved to Transect 6, a pool. It has a flat surface; it is slow and not very deep. Eighteen percent of the habitat here are pools.

The group moved to Transect 7, which did not model right. A tributary, which comes in right downstream from the transect, appeared to create a backwater at Transect 7. Upstream from Transect 7, photos show big changes depending on flow. Transect 7 was not included in the model, as it was determined to be similar enough to Transect 6 to warrant exclusion.

> *Question:* Looking at the flows at the Hillsborough gage, the Lake Orange gage and here, they vary. Why?
> *Response:* We have to look at the drainage areas of the tributaries between gages. The drainage area for a gage will determine the flow there. Also, Hillsborough's wastewater return is downstream from the Hillsborough gage, which increases flow. Some of Lake Orange goes to maintaining levels at the Hillsborough gage, not just to water supply.

Jim described how, as you go upstream, there are some steeper runs, including one short whitewater stretch. The group opted to return to the shelter for discussion, rather than visit more transects.

V. Review of March 15 Meeting Summary

Nancy Sharpless, facilitator, asked if anyone had additional revisions to the March 15, 2011 Meeting Summary, besides the editorial revisions that were received and included. No new revisions were suggested, and the EFSAB approved the March 15, 2011 Meeting Summary. The Final summary is posted on the EFSAB website at http://www.ncwater.org/sab

VI. Debrief of the Demonstration of the Eno River IFIM Study

> *Question:* How much, how long and how does this fit in with what we already have?
> *Response:* Our biggest task is updating this model to include additional guilds and species; that gets the habitat model ready to fit into different flow scenarios. DWR needs input from the EFSAB about what flows we need to look at. DWR has work to do. We can crank out some scenarios for various flows (including 7Q10, minimum average flow, for example) for you to look at, then ask the EFSAB what else to run. We'll build a suite of options to evaluate.
>
> It was suggested that these results be sent out electronically for discussion.
>
> Jim Mead emphasized that they are not trying to determine the ecological flow for the Eno, which is small and flashy, but rather they are asking the EFSAB to look at this to see if this approach works. If it looks like this approach does work, DWR

would expand their effort to broaden to other sites, not just small flashy streams like the Eno. Ultimately they need to identify gaps, and identify places for collecting more field data. For example there is very little data east of I-95.. DWR currently has IFIM studies in 5 or 6 of the 7 classifications.

Question: Are we going to stay in the Neuse, or are we going to other river basins?
Response: We're starting in the Neuse because that hydrologic model is completed. The Cape Fear will be completed in 2011. The Neuse and the Cape Fear will be run together because they are interconnected. The Tar and the Broad are in progress. We have an older version of the Roanoke, which is going to be updated. DWR is doing the river basin models two at a time.

Question: Why do the models [Neuse and Cape Fear] together?
Response: They are connected in management. Some of the municipalities on the Neuse also get water from Jordan Lake (Cape Fear basin). The Jordan Lake Partnership wants to evaluate different ways to allocate water. DWR expects to move next to the mountain basins. This Ecological flow effort might be a driver for which basins DWR goes to next.

Question: What is the Tennessee Valley Authority's (TVA's) favorite model?
Response: I don't know. Ours is just a tiny part of their whole system.

Question: There are not a whole lot of dots [on the map depicting locations of existing IFIM studies] on unregulated streams or on smaller streams. How are we going to tie them in? Aren't they important because they are relatively unimpaired? Shouldn't they be used as a yardstick against regulated streams with withdrawals? Also, we have a paucity of information about the relationship between cover and different species and groups of species.
Response: A lot of the studies that have been done are a result of hydropower relicensing. We could use the Tuckaseegee River (highly regulated) to draw conclusions for the French Broad (not highly regulated). This group will likely talk about what is the baseline. Those spots downstream of big dams represent the existing conditions.

To the point about our limitations about how different species and guilds react, I don't see ourselves doing a lot of research on this (expensive, lots of time). We rely on literature or bring together experts about a particular species to flesh out.

Question: Are there any plans to validate the models relative to the benthic and vertebrate fauna in the streams? How comfortable are you with the information we have, and how confident are you with extending the models to other places?
Response: There are ways to validate, for example using the preference curves. You can go out and see if the critters are where the curves predict they should be. The

trick is how do you measure where they are without changing where they are? You can do it from tree stands for fish. We may have to think about how to do this because it is a key part of the modeling. I don't think we need to do it before we run the Eno demo, where we are testing the process. We should note the concern and decide as a group if it is good enough or whether we need to validate it. We may need to validate and investigate whether we can extend the preference curves, or whether it is stream specific. We think it is not stream specific, though if the finding is that the model is very stream specific, the model is not great for our statewide purposes.

Question: Do you predict a difference in species composition by stream type? For example, are you assuming that other small flashy streams will have the same guilds?
Response: We have a list of thirty guilds or life stages of species. A few are specific to a particular class. What we find is that some guilds have few areas of habitat, or if they exist, they are in a small niche. Our approach is to run them all, and let the simulation guide us. You wouldn't expect to see shallow-preferring guilds in deep streams, for example.

Question: Have you validated that?
Response: Recently most of the work done has been in altered ecosystems for relicensing, so the modeling is not just for what is there but also what should be there. What I am hearing is that we need to look more at the biota end—is what the model says is there actually there? *(many in the group nodded their heads in agreement)*

Comment: It sounds like we are looking at hydraulics (stream geometry and flow) and hydrology, then we need to bring in the biology.
Response: Yes, it's really a three-legged stool. The first two legs are the hydraulic and biological modeling [described above, in discussion at transect 3]. The third leg is hydrologic modeling (in this case the Neuse River Basin model). Hydrologic models are used to produce a series of daily flows for various water management scenarios. The time series of flows for each scenario can be converted to a series of daily habitat values that can then be analyzed and compared to evaluate different water management strategies. [*Facilitators' note: This last paragraph includes clarification provided by Jim Mead, via e-mail, after the meeting]* We are pretty comfortable with the hydraulics and with the hydrology. The biology is harder. At what level does uncertainty about the biology invalidate the process such that we need to work more on the biology?

Question: You said that you have a list of approximately 30 species/guilds; are you planning to add more?

Response: We used four here at the Eno in the 1980s. We want to add the thirty for the Eno. We were not really planning to add more to the list of 30, but we may need to think more about the biology before moving forward.

Question: Do the guilds represent, in another location, the same kinds of species--a different name but the same functional guild?
Response: We might want to consider; are we missing something here in the Eno?

Question: Where is water quality fitting into the biology? Is that data in place for the modeling? It, in addition to flow, has a huge impact.
Response: Yes, largely because we know what species like this quality or don't like that quality.

Question: Yes, but from the biology point of view, is the data in place to look at water quality too? If not, we may be giving too much weight to flow when it is actually water quality that is causing effects.
Response: That would suggest looking at where the Division of Water Quality (DWQ) has sites for water quality here on the Eno and seeing how that affects biological quality. DWQ was sampling here on the Eno during low flows of drought conditions.

Comment: Someone in my office at US Fish and Wildlife is looking at water quality data and biotic indices to develop model/correlations. He is able to predict; we may want to look at that.

Comment: I want to respond to the idea of functional groups. Projects are stopped because of endangered species. Don't we want to use guilds then have some endangered species that are not part of a guild?
Response: Yes, but there are so few of them that it makes determining their habitat preferences very difficult. Remember we are not setting a standard for permitting for specific projects. We are thinking of this as a process. The Neuse has 230 nodes. Ideally we want an ecological flow at each node, so we know whether to flag it for existing/future use. This would be for flagging/screening, not for permitting. Endangered species are very important for a particular reservoir, but not necessarily for the whole system.

Question: Of those 230 nodes, how many are dams and how many are water withdrawal or wastewater returns?
Response: The majority are not dams, but instead are where water is coming in or out. We have been asked to look at how these can affect the whole system.

Comment: US Fish and Wildlife Service (contacts: Tom Augspurger and Ashton Drew) is working on a hierarchical landscape modeling effort that will develop an integrated

landscape, instream habitat, water quality, and mussel-specific model for identifying and prioritizing strategic habitat conservation areas for endangered freshwater mussels inhabiting streams of the south Atlantic slope, with an emphasis on rare and endangered endemic species of North Carolina. Hopefully we will be able to predict where species occur based on landscape and instream habitat characteristics. We might be able to tie this into the EcoFlows efforts. [*Facilitator's note: the preceding paragraph was reworded, via e-mail after the meeting, by the person who made the comment, in order to provide clarity.]*

Comment: In urban areas, some of the withdrawals we already have may be very close to the thresholds. Using thresholds established in other states, can we run our model and see if we are exceeding those?
Response: Yes, you could.

Question: Most of our discussions have focused on minimum flows to maintain biology, but it is also important to consider high flows to maintain biology. High flows change channel morphology. Can we address these upper flow issues? How?
Response: A flow regime is not just the base flow but the range of flows. When we were first tasked with this by the Legislature, they talked about ecological integrity, physical integrity (morphology), and chemical integrity (water quality). The bill eventually focused on ecological integrity, which rolls them all together, essentially. Our sense is that this project will ultimately be used for water use and new reservoirs. Existing reservoirs affect high flow a lot, but we can't influence that much at this point. HIgh flow regimes are affected by big Federal reservoirs or new reservoirs, which have long, involved permitting processes. Likewise land use can have a big effect, but this bill is aimed at water supply planning. Perhaps we could look at WATERFALL (a model) as a way to put land use into the hydrologic models, but this process, as defined by the bill, is not trying to set guidelines for land use.

Jim asked the group about the readings: Do you appreciate our putting papers out? *(many participants raised their thumbs in agreement)* Should we do this some other way? Do you think that we should debrief the papers at meetings, or just use them to expand individual knowledge? EFSAB members and others are also welcome to suggest papers.

Individual responses from EFSAB members:

- I appreciate your providing papers, and I don't feel that that we need to debrief at the meetings.
- As we get to discussing particular aspects of how a paper relates to what you are doing on the Eno, I would like to have pointed out that a particular paper would be useful.
- When something comes up where a paper is relevant, it would be useful to plan to discuss so that everyone can refresh memory of the paper.
- The discussions will happen; we'll have to work through it, process-wise. We need to read the papers and refer to the literature. Otherwise it is decision-making based on opinions.

VII. Suggested Agenda Items for June 21, 2011 Meeting

The following items were proposed for the June 21, 2011 meeting:

- We can talk about potential flow scenarios to run for the Eno demo project. DWR will not be ready to present any results from the demo.
- Based on discussions today, we need to look at literature about validation of the biology and how things transfer; then we could discuss at the June meeting.

VIII. Revisit "Member's Needs" List

*At the November 8, 2010 meeting, the EFSAB was asked to list what they needed in order to move forward and achieve the purpose of the EFSAB. The list was originally published in November 2010 meeting summa*ry.

Mary Lou Addor, facilitator, solicited additions to the EFSAB's "Member's Needs List". Suggestions included:

- Are we going to meet further west at some point?
- Are we going to meet outside the beltline, east or west?
- For the June meeting, could we change location?
    - Discussion ensued with the conclusion that changing location for the June meeting would be challenging at this point, but Members were encouraged to propose alternate locations that have internet connection available, where the EFSAB could meet for 6 hours.
- Is there a plan to have a presentation on WATERFALL and other models this group needs to understand (WATERFALL, a Research Triangle Institute model, as a precursor to OASIS, can handle land use and some aspects of water quality)
    - Yes, we plan to but not for June

Mary Lou Addor shared that an EFSAB Member had previously suggested via e-mail that the EFSAB meet all day on certain occasions. When asked if anyone would oppose meeting all day on occasion, nobody expressed opposition to the idea.