Enclosure 1

Revised HSC Curves and Documentation on CD

Enclosure 2

Response to Dr. Margaret Murphy's December 9, 2010 comments.

Response to Margaret Murphy email dated December 9, 2010 (See Enclosure 6)

General Note:

In almost all instances substrate/cover suitability was converted to the NCWRD combined code based on the source substrate and cover. This was necessary because most sources present substrate and cover separately. The process of combining the two codes resulted in changes to the original values. See the attached file: [Substrate and Cover Codes used for Bell Bend (12-21-10).xls] for sources and conversion assumptions and calculations.

We identified the original sources on the graphs and noted adjustments in the source table. In response to your comment, we have changed all citations to the source making the most recent adjustment. In the case of Shorthead (spawning), River chub (adult and juvenile), and Banded darter (all life stages) the original source substrate and cover was converted specifically for the Bell Bend study, with the reference to the original source with a "converted" notation.

American Shad

-depth curves for fry/larvae and juveniles indicate it was based on Gore (2006); this was based on the original HSI doc with a modification based on communication from Odom of USFWS – does anyone have the rationale for this modification? Just trying to be complete – but also to understand the rationale for the change and if that is applicable to the Susquehanna.
-juvenile substrate – reference is to Gore (2006) – any idea where he got them? It is not referenced in that report. Also, there is no reference in that report to aquatic vegetation (Cover Code 18) – where did the SI value come from? Also – Code 17 in Gore is SI of 0.1, not 0.65.

Fry/larvae and juvenile depth - There is no specific documentation available. However, Odom (USFWS) observed that these life stages are found at shallower depths. The modifications are thought to be based on his observations. (Note that Stier and Crance (1985) presented a single depth curve for all life stages.)

Juvenile substrate – Documentation is not available regarding where Gore got his substrate/cover suitability (see [Substrate and Cover Codes used for Bell Bend (12-21-10).xls]), but possibly through discussion with Jim Mead in North Carolina. Code 18 was added by Jim Mead and used for the Smith Mountain Project; suitability was assigned during HSC development with the Virginia resource agencies. Code 17 was 0.65 because this value was recommended as a change by VDGIF. This was changed back to 0.1 to match Gore 2006.

Smallmouth Bass

-both the juvenile velocity and adult velocity curves reference Leonard et al. (1986) although they are actually the modification in Payne and Berger (2007).

Juvenile and Adult velocity – You are correct - we changed it to cite TRPA and Louis Berger 2007.

Walleye

-Fry – substrate code 9 should be SI of 0.52 for consistency with Gore (2006).
-Spawning – substrate code 3 should be 0 and substrate code 4 should be 0.35 for consistency with Gore (2006).

The fry suitability for code 9 – and spawning suitability for code 3 and 4 – were based on comments by VDGIF (see [Substrate and Cover Codes used for Bell Bend (12-21-10).xls]). We have not made changes and the citation is now changed to TRPA and Louis Berger 2007.

Shorthead Redhorse

-Juvenile –cover/substrate SI do not match the reference (TRPA and Berger 2007)
-Adult – depth curve provided is TRPA and Berger (2007) not Aadland and Kuitunen (2006)
-Spawning – depth and velocity do not match what I calculated using the equations in Aadland and Kuitunen (2006) – did you use the equation from Appendix B1? Where did cover/substrate values come from – I did not find them in TRPA and Berger (2007)?

Juvenile substrate/cover –They have been changed to match TRPA and Berger 2007.
Adult depth – Changed to cite TRPA and Louis Berger 2007.
Spawning depth and velocity –They have been changed to match Aadland and Kuitunen (2006).
Spawning substrate/cover – Spawning was not selected for use on the Smith Mountain Project (TRPA and Louis Berger 2007). Source substrate and cover were converted for the Bell Bend Project. See [Substrate and Cover Codes used for Bell Bend (12-21-10).xls]) for SI calculations. Source changed to "Aadland and Kuitunen 2006 – Converted"

River Chub

-Juvenile/Adult – none of the curves match Persinger (2003). I only saw depth and velocity values provided at SI of 0.2, 0.5, and 1.0 in Persinger (2003) – was there something else? Cover/substrate does not match suitability from his Figure 2-9 and 2-14.

Juvenile and adult depth and velocity – We used Persinger (2003) and constructed new curves based on Table 2-13.

Substrate is based on Figure 2-9 of Persinger (2003). Figure 2-14 does not have cover codes and suitability, only number of cover types (individual cover types are not identified in the document). See [Substrate and Cover Codes used for Bell Bend (12-21-10).xls]) for SI calculations.

Greenside Darter

-I do not have USFWS 1978 so cannot confirm this one

Greenside darter HSC curves are being deleted per comment from Mark Hartle.

Banded darter

-need to check the cover/substrate curves for all life stages. The bars in the plots don't match the data provided for each one. In addition, neither the plots nor the data match Aadland and Kuitunen (2006). Not sure what happened there…..

The plots in Aadland and Kuitunen (2006) are of substrate and cover separately. They will not match the plots in the Bell Bend HSC graphs because of the need for combining the codes. See [Substrate and Cover Codes used for Bell Bend (12-21-10).xls]) for substrate/cover SI conversion and calculations.

Enclosure 3

Email from Mark Hartle dated Monday, November 08, 2010 03:01 PM

From: Hartle, Mark [mailto:mhartle@state.pa.us]
Sent: Monday, November 08, 2010 03:01 PM
To: Ballaron, Paula <PBallaron@srbc.net>; Petrewski, Gary; 'pnaugle@srbc.net' <pnaugle@srbc.net>
Cc: 'Lynam, Erin' <elynam@srbc.net>; 'mmurphy@anchorqea.com' <mmurphy@anchorqea.com>; Fischer, Douglas <doufischer@state.pa.us>
Subject: Bell Bend habitat suitability information

Paula, Pat and Gary,

I have given the Bell Bend IFIM meeting information some thought and have discussed some relevant issues with Doug Fischer, our ichthyologist. Here are some points that we would like to have addressed by the bell Bend IFIM study

1. Recently used habitat suitability curves were presented at our 10/21 Bell Bend meeting and were assumed to be most up-to-date. We believe that a more comprehensive look at available information will benefit this study. Old information is should not be considered outdated since an great deal of habitat suitability information was gathered in the 1980s and 1990s. More geographically relevant information should supersede general information. The banded darter/tessellated darter discussion below serves as an example of these points.
2. Eliminate greenside darter and add both tessellated darter (*Etheostoma olmstedi*) and banded darter (*Etheostoma zonale*) as representative species occupying shallow water niches. The rationale is as follows:
    - Greenside darter was not found in Ecology III samples at the Bell Bend site
    - The two darters sampled by Ecology III were tessellated darter (*Etheostoma olmstedi*) and banded darter (*Etheostoma zonale*)
    - The two darters paint a rather complete picture of habitat use with the robust introduced darter occupying preferred habitat and the native darter (tessellated) pushed to fringe habitat to which they are adapting.
    - Applicable information is available for both these species. References are
        - Gray, E. V. S., K. A. Kellogg and J. R. Stauffer, Jr. 2005. Habitat shift of a native darter *Etheostoma olmstedi* in sympatry with a non-native darter *Etheostoma zonale*. American Midland Naturalist 154:166-177.
        - Carlson, R. l. Morphological change in the tessellated darter (*Etheostoma olmstedi*) following introduction of the banded darter (*E. zonale*) to the Susquehanna River drainage. Copeia 661-668
    - We note that darters are not efficiently collected by most sampling methodologies. Even though the percent composition of these species is low in Ecology III samples, we believe these species are important at the site and the two species are sympatrically found throughout the basin and serve as good indicators of potential impact from flow alteration.
    - Therefore, we recommend determination of habitat suitability for each of these two individual species under documented conditions (after banded darter introduction) in the Susquehanna Basin do determine if the Bell Bend withdrawal, particularly at low flows, has an impact on habitat.
3. River chubs make large gravel nests and the spawning and newly hatched fry life stages are susceptible to flow alteration. Ohio reports this species spawns in April and May. New York State reports that the eggs are laid in a trough at the top of the gravel mound that males construct. Suitability curves should be constructed for the spawning and incubation period. I doubt that enough is known about the fry to include in any modeling exercises. I do not have any readily available references to help this effort.

4. Shorthead redhorse spawning movements could potentially be interrupted at low flows if they occurred in the spring. Tom Payne's study for Appalachian Power Co. on the Smith Mountain Project documents curves for juvenile and adult shorthead redhorse. We suggest checking references and addition of a spawning curve. As I indicated on 10/21, PFBC is in agreement to omit a fry curve for this species.
    - A reference for spawning depth and velocity: Curry, K. D. and A. Spacie. 1984. Differential use of stream habitat by spawning catostomids. American Midland Naturalist. Vol. 111, No. 2 (Apr., 1984), pp. 267-279. The reference also pertains to northern hogsucker.

Mark

Mark A. Hartle, Chief
Aquatic Resources Section
Division of Environmental Services
Pennsylvania Fish & Boat Commission
450 Robinson Lane
Bellefonte, PA 16823

Enclosure 4

Email from Pat Naugle dated Wednesday, November 10, 2010 04:39 PM

From: Naugle, Pat [mailto:pnaugle@srbc.net]
Sent: Wednesday, November 10, 2010 04:39 PM
To: Petrewski, Gary; Wise, Bradley A
Cc: Dehoff, Andrew <ADehoff@srbc.net>; Ballaron, Paula <PBallaron@srbc.net>; Hoffman, Jen <JHoffman@srbc.net>; Lynam, Erin <elynam@srbc.net>; Hartle, Mark <mhartle@state.pa.us>; Larry_M_Miller@fws.gov <Larry_M_Miller@fws.gov>; Liaghat, Abdolhossain <aliaghat@state.pa.us>
Subject: FW: Review of PPL revised Habitat Suitability Curves - fish

Gary and Brad,
As a followup from our 10/21/10 meeting, I'm forwarding comments from Margaret Murphy on the BBNPP IFIM HSCs that were presented at the meeting. We offer these comments, along with comments provided by Mark Hartle in an e-mail dated 11/8/10, so that the HSCs can be revised as necessary prior to resubmittal for our approval. Please contact me if you have any questions. Thanks.
Pat

From: Margaret Murphy [mailto:mmurphy@anchorqea.com]
Sent: Thursday, October 28, 2010 11:57 AM
To: Naugle, Pat
Cc: Ballaron, Paula
Subject: Review of PPL revised Habitat Suitability Curves - fish

Pat-
Attached are additional comments on the revised habitat suitability curves received from PPL at our meeting last week. I think we are getting closer on curves for most species, although there are still a few discrepancies that were noted. I was a bit concerned with the lack of attention to detail on some of these (e.g., substrate curves are inconsistent – two go from 1 to 19, and seem to have the bars shifted under the wrong code). I am also including a spreadsheet that creates the curves based on equations found in Aadland and Kuitunen (2006) – Appendix B1. These curves are referenced for northern hogsucker and banded darter in the curves submitted last week; in addition, I have suggested comparison for other species as well (as noted in the comments). I am providing the raw excel sheet – so you can see how the values were calculated. I can make the plots into pdfs if you would like to share with others.

Please feel free to contact me if you have any questions.

Thanks.
Margaret

Margaret H. Murphy, Ph.D.

ANCHOR QEA, LLC

Enclosure 5

Email from Thomas R. Payne dated Tuesday, November 30, 2010 6:09 PM

From: Thomas R. Payne [mailto:t.payne@trpafishbiologists.com]
Sent: Tuesday, November 30, 2010 6:09 PM
To: Mark Hartle; Margaret Murphy
Cc: John Dulude
Subject: Revised Proposed Bell Bend HSC

Hi Margaret and Mark,

Please find attached the revised (new and improved!) proposed HSC for the Bell Bend instream flow study. We did our best to make it easy to identify the sources for both the original curves and for any changes that had been made in applications to previous recent East Coast instream flow studies. If you have any questions or find any discrepancies, please let us know so we can make corrections.

These HSC are provided without any specific endorsement from TRPA, but to provide clarity on what was previously proposed by Normandeau Associates. While we have some experience with several of the species, we don't with others, so our participation in this phase has been advisory. As is normal in these types of instream flow studies, resource agencies and other stakeholders can comment on the curves, suggest modifications (or alternative sources), and add (or remove) additional species or life stages as they consider appropriate so that concensus can acheived.

Mark, we have your comments from November 8 and will follow up with research on tessellated darters, banded darters, and spawning shorthead redhorse to create draft HSC for those species, but wanted to get you a revision of the others as soon as we could.

Thank you,
Tom Payne
Thomas R. Payne & Associates
Fisheries Consultants
890 L Street
P.O. Box 4678
Arcata, CA 95518-4678

Enclosure 6

Email from Margaret Murphy dated Thursday, December 09, 2010 4:47 PM

From: Margaret Murphy [mailto:mmurphy@anchorqea.com]
Sent: Thursday, December 09, 2010 4:47 PM
To: Thomas R. Payne; Mark Hartle; larry_m_miller@fws.gov
Cc: John Dulude; Naugle, Pat
Subject: RE: Revised Proposed Bell Bend HSC

Hi Tom-
Thanks for providing the revised curves. I did find a few discrepancies listed below. We still need to review and discuss if these are all the "right" curves to be using on the Susquehanna River; but I wanted to get you the list of discrepancies at least. Let me know if you have questions or I misinterpreted something.

American Shad
-depth curves for fry/larvae and juveniles indicate it was based on Gore (2006); this was based on the original HSI doc with a modification based on communication from Odom of USFWS – does anyone have the rationale for this modification? Just trying to be complete – but also to understand the rationale for the change and if that is applicable to the Susquehanna.
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Smallmouth Bass
-both the juvenile velocity and adult velocity curves reference Leonard et al. (1986) although they are actually the modification in Payne and Berger (2007).

Walleye
-Fry – substrate code 9 should be SI of 0.52 for consistency with Gore (2006).
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Shorthead Redhorse
-Juvenile –cover/substrate SI do not match the reference (TRPA and Berger 2007)
-Adult – depth curve provided is TRPA and Berger (2007) not Aadland and Kuitunen (2006)
-Spawning – depth and velocity do not match what I calculated using the equations in Aadland and Kuitunen (2006) – did you use the equation from Appendix B1? Where did cover/substrate values come from – I did not find them in TRPA and Berger (2007)?

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Banded darter
-need to check the cover/substrate curves for all life stages. The bars in the plots don't match the data provided for each one. In addition, neither the plots nor the data match Aadland and Kuitunen (2006). Not sure what happened there…..

I am also starting to gather some thoughts on possible modifications to a couple curves. It's probably best to get these discrepancies cleared up first, and then we should try to schedule a time when we can all get together and come to some consensus on the curves so the modeling can move forward. I'll leave the scheduling to SRBC and/or PPL on that one so they can include the necessary parties.

Thanks!
Margaret

Margaret H. Murphy, Ph.D.
ANCHOR QEA, LLC
mmurphy@anchorqea.com