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Update on Wetland Buffers: The State of the Science

Responses to Comments on the DRAFT for Review

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Update on Wetland Buffers: The State of the Science

Responses to Comments on the DRAFT for Review

by
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Introduction

This document contains all of the comments received by the Washington State Department of Ecology during the public review of the draft of the Update on Wetland Buffers: The State of the Science (Ecology Publication #13-06-011). Anyone who wanted to review the document was encouraged to do so. We sent an announcement to Ecology's wetlands information email listserv when the draft was available for review. Seven individuals or groups responded by providing comments. A list of the reviewers is provided in Table 1 on the next page.

Ecology requested reviewer's comments on how we interpreted the data and whether we had missed any significant articles. Specifically, we wanted to know:

1. Are there any articles we have missed on wetland buffers and their role in protecting wetland functions?
2. Have we misinterpreted the results of any articles?
3. Are the conclusions we are making consistent with your understanding of current scientific research?

Ecology also wanted reviewer's comments on how the current research might impact Ecology's guidance on buffers.

The comments and responses are organized in the order they were received. It was not possible to organize them by reference to a specific page in the draft because some of the comments spanned several pages and sections. Comments from wetland staff at the Department of Ecology are not included in this document because their review was an ongoing informal process.

Note: We have received a number of comments on the policy aspects of buffers and their regulation. These will be addressed as part of the review Ecology is doing of its policies on buffers. They are not addressed in this set of responses because the comments were not on the document or the science. Two of the reviewers listed in Table 1 provided comments only on the policy aspects and these are not included below.

Table 1. List of reviewers.

Name of Individual or Organization	Affiliation at the Time of Review (if Individual)
Janet Alderton	
Jeff Azzerad	Washington Department of Fish and Wildlife
Brent Davis	Clark County Environmental Services
Cindy Dittbrenner (Flint)	Snohomish Conservation District
Tim Quinn	Washington Department of Fish and Wildlife
Ben Shumaker	Planning Director, City of Stevenson
U.S. Army Corps of Engineers	

Responses to Comments

Reviewer A

Comment A1: Why do I see no sections on wetlands buffers and global warming? Is there no research relevant to the benefits of buffers in light of increased global temperature? Has anything been written about the possible value of buffering wetlands that are near coastal zones where sea level changes will be a factor? How about buffers as a tool to ameliorate rising wetland water temps in the coming years? Seems like an oversight, unless no research has looked into the functions of buffers with respect to climate change. If this is beyond the scope for of the Ecology BAS pub, please explain why in the intro?

Response: We did not address the effects of global warming for two reasons: 1) The update is focused on freshwater wetlands. We decided in the beginning that we were not going to review information on marine coastal wetlands to maintain consistency with our original 2005 synthesis. 2) We did not find any additional information on the role buffers may play in moderating the temperature of wetlands.

Comment A2: We at WDFW need to be doing what you're describing here (i.e., regular updates). The riparian project would be much less intensive if we did what you're doing with the Wetland's BAS publication (update 8 years later as compared to 16 years later). I commend you and ecology for following through with a timely update.

Response: Comment noted. No changes needed.

Comment A3: Since our ability to review lit published prior to the publication of the 1997 riparian publication is limited, this is what likely we'll be doing as well.

Response: Comments noted. No changes needed.

Comment A4: How does this database get fed with new titles weekly? Is it linked to one of the more commonly used biological science search engines like Biosis, Web of Science, etc.? For riparian, I did a search in these databases using a set of targeted keywords (in a Boolean strategy). Then I set the database to give me a monthly email alert with any new papers that came to light from that search strategy. Is the database maintained by ecology set up in a similar fashion using a set of terms and a weekly alert that feeds new papers directly into the agency's database? If so, what database is it linked to? Explain how it decides which papers to feed into Ecology's wetland database (e.g., specific KW search).

Response: The process for maintaining the database has been added to the text.

Comment A5: By the way, WDFW may want to think about maintaining a similar self-updating agency database for our next update to PHS riparian.

Response: Comment noted. No changes needed.

Comment A6: I know the terms buffer and setback have different meanings, but isn't there a chance you may have missed papers by limiting the primary KW to "buffer" Although you've probably caught the majority of relevant papers, you likely missed some papers that did not use the word "buffer", but instead used other words with a similar meaning. For us words like streamside management and setback were used to capture the few papers that did not explicitly use the word buffer.

Response: Yes the two terms have different meanings here in the U.S. It is sometimes used to mean buffer, but mostly by scientists in Europe, South Africa, Australia, and New Zealand. A preliminary search using the term did not provide us with any new information relative to buffers for wetlands in the U.S., so we dropped it as a keyword to combine with the others. The research we found in the preliminary search was all done outside the US, and not of high priority. Using it as a keyword would have more than doubled our search efforts because most of the articles found were related to building setbacks and not buffers.

Comment A7: Why not fish?

Response: Yes, we did use "fish" as keyword. It was omitted from the list by accident. It has been added.

Comment A8: Do you have some more descriptive information on what constituted an A, B, and C article? This is not so much a comment. More of a request to see how you went about doing this to maybe help guide the work I'm doing. If you could send me more detail on this, it would be much appreciated.

Response: A more detailed explanation has been added to the text (third paragraph, page 5 of final).

Comment A9: Maybe you explain later how you handled these. But if you don't, you probably should. Did you typically exclude articles that received no peer-review? Also, how do you define peer-review? For instance, do you consider a paper that was reviewed within the agency where it was published as being peer-reviewed? Or is a publication considered peer-reviewed if it went through a more rigorous process, such as the type of blind review that an article in a reputable journal would go through?

Response: Explanation has been added to text (third paragraph page 5 of final).

Comment A10: So is the review going on now considered the final review? That draft was also reviewed by wetland people in your agency? If so, mention that.

Response: The text now describes the review process in more detail. The draft did not have this description because it was published before the full review process was complete.

Comment A11: General formatting question: It seems like the way these updates to the 2005 pub are being presented is kind of clunky. Are you going to somehow integrate this into the 2005 publication and call it the 2013 update? As I was going through the pages below keep wanting to refer back to the original 2005 document to crosscheck. I'm hoping eventually that this publication will just get woven into the 2005 document as the 2013 update. I assume they are not going to be 2 separate documents. Is that correct?

Response: This update will be published as a separate document. It updates only a small part of the 2005 publication and we did not want to reprint the entire document and only update a small part with the more recent information.

Comment A12: Shouldn't you be using original sources rather than citing the WRS manual?

Response: The WRS (Washington Rating System) manual is an original source because it contains information collected during the calibration of the tool as well as citing other works. It underwent a full peer review process and thus meets the criteria of a Category A reference.

Comment A13: This document was published in 2004 (*Note: actual publication date of the original synthesis was 2005*) and is likely citing mostly pre-2003 studies, since it is a review article. Should you be citing this in the update? Weren't many of the source articles cited in this review paper used to formulate the BAS in the 2005 BAS pub?

Response: We are also including some references we missed in the 2005 synthesis if they provide useful information. This has been clarified in the introduction.

Comment A14: Nit-picky format comment: Maybe they do it this way in Science and Nature. But it's easier if you list these numbers in ascending order. I say this because I wanted to look at each reference, and w/o it being listed in order, it's a little harder for me to make sure I did not miss one of the citations.

Response: The final version will have the references listed in ascending order.

Comment A15: Also, this is another example of a review paper that is based entirely on pre-2005 lit. How can the finding be considered an update from the 2005 BAS pub?

I'm concerned about prevalence of reliance on review papers. Although they are germane, are you also looking at the original sources that are cited in these papers? Review papers tend to receive a lot less scrutiny in their peer review compared to published papers discussing individual research studies.

Response: We disagree with this conclusion. Review papers written in the last decade or so often contain statistically based meta-analyses of the results from many different studies. This allows a better understanding of why different studies may present different results. For example, the meta-analyses provided by Mayer and others (2007) and Zhang and others (2010) help us understand that buffer width is only one of many factors that influence the effectiveness of a buffer at protecting a wetland.

Comment A16: (*page 15 third paragraph from bottom*) You should say in the sentence where the study occurred, esp. if it is from out-of-region like this one. I'd make sure to identify where each study took place to provide context to the reader. It seems that this context is important since a study in the PNW will usually be more applicable than a study in Ontario (like this one).

For instance, I'd change this sentence to say: "Smith and Chow-Fraser (82) found that the presence of a forested buffer surrounding a wetland in Ontario was not an important factor in predicting the distribution of generalist, wetland-dependent, or synanthropic species in wetlands."

The same recognition of place should be used for other studies that you cite. I know as I have been going through your draft, I have been looking papers up to see where the research took place. It saves the reader time if you are explicit about that right in the text.

Response: The locations where studies were done were added to the text. However, as mentioned in the text, some studies done outside the Northwest are very relevant because they were done on species that are found in Washington.

Comment A17: I hope that in your strategy to weight/categorize each paper you reviewed, gives a significantly lower weight to studies from across the Atlantic or Pacific. For our riparian work, we primarily stuck to North American research. Although papers from places like Australia (refs #22 and 92) have some applicability, it seems more limited than papers dealing with species native to our region. Relying too heavily on papers from far flung places also has implications when users see a recommendation being backed up by a study in a place with vastly different ecosystems and species.

Response: See response to comment A16.

Comment A18: I'm a bit confused by the last column in Semlitsch's table (*on page 17 of draft*). Are not all the groups identified in the other columns considered "herpetofauna"? I guess what he is saying is that for all the spp groups above here's the average in the last column.

Response: The text in Semlitsch's article does not define the terms used in his table, and we assume like you do that "herpetofauna" refers to the average of all species.

Comment A19: Just so you know, our search for literature dealing with WAs 2 native turtles also turned up very little. So your search just helps confirm that there is not much out there in terms of research for the pond and painted turtles. I found it surprising that so little has been published on one of WA state endangered species.

Response: Comment noted.

Comment A20: (*first bullet on page 21*) This does not seem like a new revelation? Rather, it seems that this one study just confirms what other previous studies also have concluded (including pre Y2K studies). What does this mean? 4000m is like 2.5 miles. So is the researcher saying that some activity 2 miles away has no impact? Please clarify what point the author is trying to get across here.

Response: The text has been re-written clarify the author's conclusions.

Comment A21: I go back to my earlier comment when you showed a bulleted list of KW that you plugged into Google scholar. The comment I made was "why no fish?" Here it seems like you did look into fish research but found little. Someone may ask "where in the lit search strategy did you say you were targeting fish research?" In the section on this page you seem to say you looked but did not find anything. You need to better articulate in the section describing search strategy exactly what you did to find relevant fish papers. I assume it came from your eval of that database with 5000 papers maintained by Ecology. But I can only assume without you being more explicit.

Response: See response to comment A7.

Reviewer B

Comment B1: During the Critical Areas Ordinance Update for San Juan County, I have closely followed the legislative process with special attention to the Best Available Science adopted by San Juan County.

Because I am a retired biologist from the University of California at Berkeley, I was able to read most of the original research articles that are the basis of the meta-analyses by Mayer et al. 2007 and Zhang et al. 2010.

The data used by Zhang et al 2010 was selective. They cherry picked some of the data from the original research articles and ignored other data in the same article. As a result, the buffer widths that they contend remove "X percentage" pollutants are invalid. They also did not include the criteria that they used to select which articles were included in their meta-analysis. They did not explain why they excluded a large number of research articles that were included in the Mayer et al 2007 meta-analysis.

I have copied below comments on this issue that I sent to Dr. Paul Adamus, San Juan County's wetlands expert for the CAO Update process. Dr. Adamus concluded that Zhang et al. 2010 should not be used to set buffer widths. He presented his reasons why Zhang et al. 2010 should be disregarded to the San Juan County Council and they accepted his judgment.

I strongly think that the Zhang et al. paper is very poor science and should not be included in the "Update on Wetland Buffers: the State of the Science."

Response: We disagree that we should omit the Zhang article from our review. But, we agree with your previous comments that their data should not be used to set buffer widths for nitrogen removal. However, we do not think that was the intent of their meta-analysis, and their results should not be compared to the meta-analysis done by Mayer. We do not believe their intent was to do an exhaustive analysis of nitrogen like Mayer did. If buffer

widths are to be determined based only on the effectiveness of the buffer at removing nitrogen, then yes we should be guided by Mayer not by Zhang.

Our interpretation of their study: Zhang et al. were analyzing the different factors that affect the effectiveness of buffers at removing pollutants, of which width was only one of four variables and nitrogen only one of four pollutants. They did not compile their data study by study as Mayer did, but rather variable by variable (their Table 1 in the article). They looked at 73 studies of which 10 included data on nitrogen. They could have been more specific on the procedure they used to select the articles, but we believe that 73 is a reasonable sample size for this type of meta-analysis since they had to find studies that had data on the other three environmental variables as well (other than width). Many of the articles used by Mayer in his analysis may not have been suitable because they did not contain data on the other environmental factors (other than width). If the meta-analysis were only to address nitrogen and width, then yes, they did not have enough data. We found only 144 articles suitable for our synthesis and actually used only 96.

The important point that we found in the Zhang meta-analysis was stated in their abstract - width accounts for only 35-60% of the variability in the effectiveness of a buffer at removing a range of pollutants.

Reviewer C

Comment C1: *This is a comment on Chapter 4 of the 2005 synthesis* In Table 4.4 of the 2005 document, the authors indicate that the scientific literature reports five (5) of the ten (10) types of human disturbances negatively affect wetlands:

- changing physical structure in a wetland (4.3.2),
- changing the amount of water in a wetland (4.4.2),
- increasing the amount of nutrients (4.7.2),
- introducing toxic contaminants (4.8.2), and
- changing acidity (4.9.2).

In actuality, only the synthesis in 4.7.2, increasing the amount of nutrients, contained adequate documentation to hypothesize negative impacts would result. As for the other types of disturbance, the single paragraph in 4.3.2 doesn't mince words when it says "no information was found" and "it is not possible...to hypothesize how such changes might alter wetland functions". The synthesis in 4.8.2 indicates that introducing toxic contaminants can have a beneficial effect on wetland functions and not a negative impact. The syntheses in 4.4.2 and 4.9.2 are inconclusive in their hypotheses regarding the potential benefits and impacts of changing the amount of water or acidity on wetland water quality functions.

Response: The 2013 draft review of the scientific literature only addresses the role buffers play in protecting wetland functions. We did not review the literature relevant to Chapter 4 on all the stressors that can impact wetland functions due to lack of resources. The 2005 synthesis underwent a thorough review and we compiled all comments received and our response to them in a separate document that can be found at:
<https://fortress.wa.gov/ecy/publications/summarypages/0506007.html>.

This review of the literature does not update the other conclusions we reached in Chapter 4 in the 2005 synthesis. However, we can attempt to clear up potential misinterpretations of what we wrote.

- All of the 10 human disturbances (not five) listed in Table 4.4 have a major negative impact on at least one of the eight wetland functions listed (as noted with the symbol “++” in the columns).
- The single “+” in a column represents a hypothesized impact based on our interpretation and understanding scientific information and principles. We did not have articles that document a specific impact but as scientists we could generate hypotheses. This is one of the major differences between a synthesis of the science and a simple review. A synthesis “involves the integration of disparate data with existing concepts and theories to yield new knowledge, insights, and explanations.” (Pickett, S.T.A. et al. (2007) *Ecological understanding: The nature of theory and the theory of nature* (2d edition) Academic Press. Also, “Synthesis creates emergent knowledge through novel combinations of information.” (Carpenter, S.R. (2009) Accelerate synthesis in ecology and environmental sciences. *BioScience* 59:699-701.)
- The single “+” marks a hypothesized impact, but we intentionally did not state a “negative” impact. Impacts can be both negative and positive.

Comment C2: *This is a comment on Chapter 5 of the 2005 synthesis* The logic really starts to break down though in Chapter 5.5, as the discussion shifts away from the water quality functions of wetlands related to their watersheds and to the water quality functions of buffers related to their wetlands. The divergence begins in section 5.5.2, which contains a list of seven (7) ways in which buffers protect wetland functions, three (3) of which relate to wetland water quality functions. Only one of these factors (removing excess nutrients) is related to the conclusions in Chapter 4. The first factor (removing sediment) is listed despite Chapter 4’s conclusion that information is lacking regarding whether changing the sediment load in a wetland even impacts its water quality functions. For the same reasons why I question that the science supports our interpretation that introducing toxic contaminants can be considered a negative impact, rather than a beneficial effect, on wetland water quality functions, I question listing the third benefit (removing toxics) as unsupportable.

Response: The benefits of buffers in protecting wetland functions are not limited to protecting the ways in which wetlands improve water quality (the “water quality improvement” function). Buffers are also important in protecting the habitat functions a wetland provides. Section 5.5 in the 2005 synthesis is looking at all the different wetland functions that are protected by buffers. The bulleted list in section 5.5.2 identifies the processes (ecological functions) that a buffer provides in protecting many wetland functions, not just one. Your comment highlights toxic contaminants and an apparent disconnect with the reviews in Chapter 4 and Chapter 5. We know little on how toxic contaminants can affect the ways in which wetlands improve water quality, but we do know they have a significant impact on the animals living in a wetland. Many invertebrates and amphibians living in wetlands are highly sensitive to a wide range of toxic contaminants. Buffers can be effective at protecting these species if they function to remove these contaminants before they reach the wetland. That is the point we are trying to make in this section.

Comment C3: *This is a comment on Chapter 5 of the 2005 synthesis.* The source of the logical divergence, I believe, can be found later in section 5.5.2, where it states that wetland buffers perform the same functions as riparian buffers. I don't dispute this, but the simple fact is that we don't value the same functions of riparian areas as we do wetlands. Riparian areas, and the quality of water within them, are valued for their ability to support habitat. Wetlands share that same function and value, but are also valued for the function they provide in producing higher quality water. This second value is ignored in the synthesis and is transferred from the functions of wetlands to the functions of wetland buffers. Instead of relating the benefits of buffers to their ability to reduce or eliminate the human disturbances found to negatively impact water quality functions in Chapter 4, the synthesis in Section 5.5.3 focuses on water quality itself. According to the conclusions the authors reached in Chapter 4, buffers should be discussed only in relation to their ability to prevent the impacts to wetland water quality functions summarized in Table 4.4. Any other discussion of buffers in relation to wetland water quality should be reviewed in the areas where the impact can be supported in the science (i.e. habitat functions).

Response: Yes, riparian areas are valued for their habitat. However, wetland buffers also provide critical habitat for amphibians living in wetlands as we summarized in the update. We disagree that the only valuable function of riparian areas is to provide habitat. Riparian areas also can hold back pollutants that would otherwise degrade water quality in streams and lakes. The National Academy of Sciences published a thorough review in 2002 of the many other functions provided by riparian areas.
<http://www.nap.edu/openbook.php?isbn=0309082951> .

Section 5.5.3 focuses on how buffer improve the water quality in a wetland, not the function the wetland provides in improving water quality. This function of buffer is important for wetlands because it helps maintain the water quality that is important for many species using the wetland.

Comment C4: *Comments on Chapter 3 of the update.* The update to the scientific information in Section 3.2 of the new document largely falls victim to the same logical breakdowns of the original document, but it doesn't have to. By simply updating the key points of the 2005 document, you have constrained your ability to improve the errant synthesis that document provided. The focus thus remains on water quality, and not on the function of producing quality water. The focus can be returned to water quality functions, I believe, by focusing on those sources, such as Vidon and Hill (2006), that place wetlands in relation to their landscape setting.

Response: The purpose of the literature review on buffers was to better understand how upland buffers can protect the functions a wetland provides. It was not the intent of this review to address the actual functions that a wetland provides such as improving water quality. There is little research on how the presence of a buffer can affect the wetland functions of removing pollutants so we were unable to report extensively on this subject. Most of the possible effects are still hypotheses based on correlating a wide range of observations.

We have developed a number of tools that characterize how well a wetland functions to improve water quality (Wetland Rating Systems, Wetland Function Assessment Methods, Credit-Debit Methods for determining mitigation requirements). This however, is a different subject than how well buffers perform to protect these functions.

Comment C5: *Comments on Chapter 4 of the update.* I cannot accept the conclusions in this chapter until specific sources are cited to justify them. The sources are there, I'm sure, but they must be made explicit, lest the Precautionary Principle be used as an adequate substitute for Best Available Science.

Response: The conclusions in this chapter are based on information presented in the previous sections. The specific sources are all cited there. We will identify the appropriate sections of the review that apply to that conclusion. However, some of the conclusions will not have a specific reference because this section is a synthesis. As mentioned above a synthesis “involves the integration of disparate data with existing concepts and theories to yield new knowledge, insights, and explanations.” (Pickett, S.T.A. et al. (2007) *Ecological understanding: The nature of theory and the theory of nature* (2d edition) Academic Press). Conclusions that come out of a synthesis may not have been made previously by others and thus cannot be cited.

Comment C6: In the discussion above, I have made the point that the focus of the synthesis has incorrectly placed a greater value on water quality within a wetland than on wetlands' function in producing quality water. As interpreted through that lens, the necessary width of wetland buffers has been turned on its head.

To explain, I use an analogy of two groups of students and their ability to obtain the knowledge an educator is attempting to bestow. One group of students, gifted, listens to the instructor's lecture, processes the information, internalizes it, and is immediately able to utilize the lesson in their assignment. The second group of students, developmentally disabled, listens to the same lecture, cannot process the information, becomes overwhelmed, and abandons any attempt to complete the assignment. The educator, in her effort to convey knowledge, responds to these different students' different capabilities by creating separate lesson plans. The lesson plan developed for the first group is short, and the knowledge is still transferred. For the second group, the educator must develop a longer lesson plan for the same amount of knowledge to be conveyed.

Applying the analogy to this topic, I would describe two groups of wetlands and their ability to produce quality water. One group, Category IIs, accepts polluted water, processes it, and transfers the higher quality water “downstream”. The second group, Category IVs, accepts polluted water, becomes overwhelmed, and transfers polluted water downstream. As environmental regulators, we have taken the opposite approach from the educator. We have lost sight of our effort to convey knowledge (quality water) downstream and instead have developed lesson plans (buffers) that bear no relation to our pupils (wetlands). We have created longer lectures for our better functioning students and shorter lectures for our underperforming students. In doing so, we have ceased to value the water quality functions of a Category II wetland that help make it a Category II wetland, and we overvalue the water quality functions of a Category IV wetland that simply don't exist.

Note- I use Category II wetlands instead of Category I in this analogy, because of what seems to me as an incongruous relationship between very high performing wetlands, which can handle a greater degree of disturbance, and rare or fragile wetlands, which cannot.

Response: We agree that the improvement of water quality that wetlands provide is an important function for society. However, it is not the purpose of this literature review to address that value. The 2005 synthesis discusses how wetlands improve water quality and their values in Section 2.6. We have incorporated these aspects of wetland functions in our tools that characterize wetlands. Access our website at <http://www.ecy.wa.gov/programs/sea/wetlands/index.html> . Our tools can be found under Wetland Tools and Wetland Mitigation. From a water quality perspective, this synthesis considered only how buffers function to keep pollutants from reaching a wetland and the variables that are involved in this “buffer” function, not the wetland function of improving water quality. We know little of how buffers protect how well wetlands perform to improve water quality. Table 4.4 in the 2005 synthesis has identified many unknowns and a few hypotheses (only “+” rather than “++” in the column for water quality improvement). Unfortunately, the literature review did not identify any new or updated information which could have increased our understanding of this issue.

The Wetland Rating Systems characterize wetlands based on five criteria of which high level of function is only one. So, yes, Category I wetlands can either be high functioning, or sensitive, or rare, or difficult to re-create. That is intentional because one of the main purposes of the rating system is to identify wetlands that need a high level of protection. These aspects are described in Chapter 3 of the rating systems (Ecology publications #04-06-025, #04-06-15).

Reviewer D

Comment D1: *Page 5 first paragraph* - This is a result and the paragraph seems a little out of place here.

Response: Text was changed to better explain what we did.

Comment D2: *Text box at top of page 6* - I would move this up in the document; since I was wondering what the numbers were earlier.

Response: Box was moved to the top of page 1.

Comment D3: *Text box at top page 7* - I would add some introductory paragraph about the contents in this section, like how many conclusions and key points were updated, etc.

Response: This is described in the introduction and the beginning of Chapter 2.

Comment D4: *Page 8, Section 3.2* - The gray box at the beginning states these are unedited from the 2005 document, but this is a different format from the above sections. It should be italicized and only have conclusion.

Response: Formatting was changed so all headings are the same.

Comment D5: *Page 10, paragraph 5, first line* - This phrase does not make sense.

Response: Sentence was re-written.

Comment D6: *Page 11, last bullet* - Does this mean the size of the area?

Response: Yes. Text was edited to better explain this.

Comment D7: *Page 14, second paragraph* - Significant figures?

Response: Number was changed to two significant figures to match the rest of text.

Comments D8, D9: Same comment as above about format change.

Response: Formatting was changed to so all headings are the same.

Comment D10: *Page 16, fourth paragraph* - This reads that only tagged salamanders would do this, not untagged salamanders. The previous sentence also implies this.

Response: Text was edited to better explain this.

Comment D11 , Comment D13, and Comment D16: *Page 16, fifth paragraph; page 19 second paragraph, page 27 first bullet* - Canada or California?

Response: Canada was inserted into text.

Comment D12 and Comment D14: *Page 19, figure; page 26 Figure-* The title should go below the figure.

Response: The position of the legends is a matter of choice, and the location of the legend was not changed.

Comment D13: *Footnote on page 25* - The footnote text seems to be cutoff.

Response: The printed version shows the entire footnote. This may be a result of different formatting in your version of Word.

Comment D15: *Page 27, first paragraph* - The word “however” is used a lot in this document. I recommend substituting a different word at times.

Response: Text was edited to reduce the usage of this word.

Reviewer E

(Comments on preliminary draft sent out for inter-agency review, not the draft sent out for general review).

NOTE: Several comments from this reviewer applied to the original text that was copied from the 2005 synthesis. These comments are not included here because they do not apply to the new material presented in the update. Since we are not editing the 2005 synthesis, we did not edit the quotes in this document that were copied from the original to maintain consistency with the original version.

Comment E1: *page 4 list of topics* - Did hydrology (flood functions) drop out ?

Response: Text was edited to explain why hydrologic functions were not included.

Comment E2: *Section 2.5, first paragraph* - I do not understand this or its relevance here.

Response: Text was edited to better explain how the synthesis was organized.

Comment E3: *Section 2.5, second paragraph* - Not sure what you are saying here. We determined if conclusions and key points from the new literature were consistent with our interpretation of the science in the 2005 review.

Response: Text was edited to better explain this.

Comment E4: *page 6, third paragraph* - Why is this not considered new research on the questions such that you were not able to find “any “new research

Response: Reference 40 is our wetland rating system that was written before the 2005 synthesis. The point is to highlight the wetland functions, not those of the buffer.

Comment E5: *Section 3.2 sixth bullet* - Flow rates are slowed?

Response: Text was edited to provide a better explanation.

Comment E6: *Section 3.2 sixth bullet* - Sediment and phosphorus in other contexts are not necessarily pollutants??

Response: As far as we know, Phosphorus and sediments created by human activities are always considered as pollutants. We have not seen anything that suggests they provide a benefit to aquatic resources.

Comment E7: *Page 9, Keypoint #3, 2d paragraph* - This description of the study design is too brief to be useful. Add another sentence to make it clearer.

Response: A better description was provided.

Comment E8: *Page 9, Keypoint #3, 2d paragraph*- The shape of these functions would be really useful to have here.

Response: Unfortunately, the original reference did not provide this information.

Comment E9: *Page 10, Keypoint #3, 3d paragraph* - This seems contradictory to reference 49 since uptake by vegetation denitrification and immobilization should be a function of distance the ground water travels all else being equal?

Response: The differences between reference 49 and 62 were clarified. We have added density of vegetation as the variable in reference 49. Also, nutrients from decaying plants get released back to groundwater as well surface water, so there might not be a big change in the further transport of the nutrients.

Comment E10: *Page 11, Keypoint #4, first paragraph re: Figure 1* - There is a difference between a strong and variable. I would argue that the open circles represent a strong but very variable response. I would also point out the lines suggests inference in any area of the domain without data.

Response: The discussion of the figure and the data was expanded to clarify the statistical questions.

Comment E11: *Section 3.3 page 14, last bullet* - What is a first stage connection. This paragraph needs more words.

Response: The discussion was expanded to clarify the connections between buffers and the landscape.

Comment E12: *Update on “conclusion page 5-38”; page 14 in text* - I am still struggling with the notion that buffer width is only part of the equations, buffer composition (type of landcover) is equally important here and needs to be connected to all the narrative that includes widths.

Response: The composition of the buffer is a variable factor and depends on the species. The review of the literature indicates that some amphibian species actually prefer open grasslands and pastures, and this is noted later in the text.

Comment E13: see response to comment E10.

Comment E14: *Update on “conclusion page 5-41”; page 15 in text* - Hard to imagine that given the choice the frog would select agricultural areas over other types. I would qualify this statement.

Response: We only have the abstract of the reference but it specifically states agriculture. GOLDBERG, C. S. and WAITS, L. P. (2010), Comparative landscape genetics of two pond-breeding amphibian species in a highly modified agricultural landscape. *Molecular Ecology*, 19: 3650–3663.

Abstract -Evaluating fine-scale population structure of multiple species in the same landscape increases our ability to identify common patterns as well as discern ecological differences among species' landscape genetic relationships. In the Palouse bioregion of northern Idaho, USA, 99% of the native prairie has been converted to nonirrigated agriculture and exotic grasslands. Columbia spotted frogs (*Rana luteiventris*) and long-toed salamanders (*Ambystoma macrodactylum*) in this area breed almost entirely in artificial ponds on private land. We used genetic distances (F_{ST} and D_c) derived from eight microsatellite loci in 783 samples to evaluate the relationships among sympatric breeding populations ($N = 20$ and 26) of these species in a 213-km² landscape. Both species showed a pattern of isolation by distance that was not improved when distance was measured along drainages instead of topographically corrected straight lines ($P < 0.01$). After testing for autocorrelation among genetic distances, we used an information theoretic approach to model landscape resistance based on slope, soil type, solar insolation, and land cover, and multi-model inference to rank the resistance of landscape surfaces to dispersal (represented by genetic distance). For both species, urban and rural

developed land cover provided the highest landscape resistances. Resistance values for long-toed salamanders followed a moisture gradient where forest provided the least resistance, while agriculture and shrub/clearcut provided the least resistance for Columbia spotted frogs. Comparative landscape genetics can be a powerful tool for detecting similarities and differences between codistributed species, and resulting models can be used to predict species-specific responses to landscape change.

Comment E15: *Update on “conclusion page 5-41” third paragraph; page 15 in text* - How is this similar?

Response: Text was re-written to clarify this point.

Comment E16: *Keypoint #3 Page 5-49, update, first paragraph* - What is habitat ranges?

Response: Wording changed to “habitat zones” for more clarity.

Comment E17: *Keypoint #3 Page 5-49, update, second paragraph* - This comment is pertinent to all the data presented here; It seems like you need to describe better the type of buffer (cover type, quality, level of disturbance) before any of these make sense.

Response: The references did not provide this information so we could not include it.

Comment E18: *Keypoint #3 Page 5-49, update, section on birds, 2d paragraph* - Is this not true of amphibians as well?

Response: Yes, and this is discussed in each section where appropriate. Not all amphibians respond to the type of vegetation in the buffer in the same way.

Comment E19: *Keypoint #3 Page 5-49, update, section on birds, 3d paragraph page 21 in text*– restate.

Response: Text was re-written to clarify this point.

Comment E20: *Keypoint #3 Page 5-49, update, section on birds, first bullet, page 22 in text* – This is not complete enough disclaimer. How about the extent of disturbance or marsh habitat. This is too brief a description.

Response: Text was re-written to clarify this point.

Comment E21: *Keypoint #3 Page 5-49, update, section on birds, third bullet, page 22 in text* - Same here, how about the extent of developed land within 2 km that might be correlated with increased flows and nutrients?

Response: The references did not provide this information so we could not include it.

Comment E22: *Section on fish, first paragraph, page 22*- Do you define what is a lake versus a wetland anywhere?

Response: The authors of the article did not provide a definition for lakes so we cannot either.

Comment E23: *Section on fish, first paragraph, page 23* - Interesting stuff.

Response: Comment noted, no response needed.

Comment E24: *Section on buffers and plants, second bullet page 27* - What does integrity of the plant community mean - spp richness?

Response: Text was re-written to clarify this point. Integrity was based on a plant Index of Biological Integrity.

Comment E25: *Section on buffers and plants, third bullet, page 28* - What does quality of vegetation mean??

Response: Text was re-written to clarify this point.

Comment E26: *Section on synthesis 4.1 (now section 5.1) 2d paragraph* - This is pretty basic – not sure it needs to be here.

Response: The audience of this report includes many who are not scientists, so we thought it important to repeat simple conclusions.

Comment E27: *Section on synthesis 4.2 (now section 5.2) 2d bullet* - I got confused here.

Response: Text was re-written to clarify this point.

Comment E28: *Section on update on buffer ranges, keypoint #3, first paragraph* - What do you mean by optimal?

Response: Optimal was not defined in the reference, so we could not as well.

Comment E29: *Section on update on buffer ranges, keypoint #4, first paragraph* - What about other functions?

Response: Text was re-written to clarify that the discussion refers only to wildlife as mentioned in the quote from the original 2005 report.