Changes and Clarifications For Lowlands of Western WA

February 2001

This document contains changes and clarifications to the "Methods for Assessing Wetland Functions Riverine and Depressional Wetlands in the Lowlands of Western Washington: Parts 1 and 2" that have been identified since the methods were released in August of 1999.

It is divided into the following sections:

- General changes or corrections
- Additions and corrections to specific pages in Part 1 of the methods
- Additions and corrections to specific pages in Part 2 of the methods
- Changes and clarifications to size thresholds
- Corrections or changes to data forms
- Clarifications by data
- Table listing size thresholds for specific data
- Replacement Pages
- New appendix – Appendix P

Changes and clarifications include only those which are substantive and affect how the methods should be used. Editorial changes have not been included.

We are providing replacements for selected pages. Otherwise, use this document to pencil in the changes and clarifications in your copy of the methods.

There are two page numbers listed for additions and corrections to specific pages. The top one applies to Part 1 of the final methods. The bottom one, in parenthesis, corresponds to the version distributed during the five-day training that took place on July 12-16, 1999. The content for the training draft is essentially the same even though the page numbering is different. The page numbers for Part 2 are the same for both iterations.

Changes or Corrections

General Changes or Corrections

Thank You EPA - We failed to acknowledge and thank the US Environmental Protection Agency for providing funding for the project through a number of grants. Without their support, the methods would not have been developed. Please replace the current acknowledgements page with a new one provided in the back of this document.

Acre or Hectare Points – Delete reference to using hectare points. Substitute page 16 in Part 1 of both the training and final methods with the replacement page at the back of the document. We no longer recommend that hectare points be used as a performance score to quantify impacts.

Changes and clarifications should be used immediately!

The August 1999 methods state that you can multiply each index of potential or suitability by the acre of impact, or size of the wetland, and compare the impact of alterations in two different wetlands. At present, however, we do not have enough information to support such comparisons. Based on our initial field tests of the method, we do not think that it is appropriate to say that the level of function of 10 hectares (ha) of a wetland with a low score (e.g. score = 3) is equivalent to three ha of a wetland that scores high (score = 10). [10 ha x (index of 3) = 30 ha points is not the same level of function as 3 ha x (index = 10) = 30 ha points].

Classification of Wetlands – Change the terms coastal and estuarine to tidal wherever they appear in the document. These terms are used interchangeably in the documents. Tidal wetlands are those that experience salt or freshwater tidal surges.

Terms Describing Surface Water – Some users have found the terms used to describe the presence of surface water (inundation) in a wetland confusing. The changes below are an attempt to create new terms that will be clearer.

Surface Water - The term open water was used in several different ways that were not consistent. The concept of surface water in a wetland has been broken down into several different categories as described below. The term "open water," whether permanent or not, has been changed to reflect the presence or absence of floating and/or emergent vegetation. Therefore, "open water" is now characterized as "open inundation," "exposed inundation," or "inundation." For example, what was called "permanent open water" is now either "permanent open inundation" (POI), "permanent exposed inundation" (PEI), or "permanent inundation" (PI). Areas of inundation characterized with the adjective "permanent" must be inundated for the entire year for most years.

"***Open inundation***" is used to describe areas where surface water is present but that do not have vegetation on or above the surface of the water. Areas of open inundation can, however, have submerged vegetation attached to the bottom.

Permanent open inundation is an area with surface water present throughout the year that does not have vegetation on or above the surface.

"***Exposed inundation***" is used to describe areas where surface water is present, but that do not have erect and persistent vegetation above the surface. This descriptor is more inclusive than "open inundation." Areas of exposed inundation can have floating vegetation as well as unvegetated areas and/or submerged vegetation. These areas do not have vegetation that emerges above the surface of the water such as emergent, shrub or forest vegetation. Late in the season, some aquatic plants such as Nuphar may extend above the surface of the water when water levels drop. Such areas would still be considered as exposed inundation. Areas of inundation characterized with the adjective "permanent" must be inundated for the entire year for most years.

Permanent exposed inundation is used to describe areas of permanent surface water that do not have erect and persistent vegetation.

"***Inundation***" is used to describe any areas where surface water is present. It can include areas that have vegetation that emerges above the surface of the water as well as open, submerged, or floating vegetation. This descriptor is, therefore, the more inclusive than open or exposed inundation.

Permanent inundation is used to describe any areas with permanent surface water.

Also note that the abbreviation for permanent open water (POW) should be deleted. Using POW is confusing because it is also used as a convention on National Wetland Inventory maps indicating the presence of open water in the palustrine class.

See the list for "Additions and Correction to Specific Pages" and "Corrections or Changes to Data Forms" for places where these terms should be changed in the methods.

Annual and Seasonal Inundation – The term **"annual inundation"** is used to represent the area of the assessment unit (AU) that is inundated with surface water for <u>at least</u> 1 month in a year. It includes <u>both</u> the areas permanently inundated and those that are only inundated for part of the year. Areas inundated for only part of the year, but more than 1 month, are called **"seasonally inundated**." When estimating areas of inundation make sure that "area of permanent inundation + area of seasonal inundation = area of annual inundation."

Standing water – The term "standing water" is still used in a few places. The term "standing water" can be seasonal or permanent and can be vegetated or non-vegetated.

Flooded – The term "flooded" is being deleted to reduce confusion between overbank flooding,required for riverine wetlands, and flooding from other sources such as runoff or groundwater. It is replaced by the term "inundated" or "surface inundation."

Additions and Corrections to Specific Pages in Part 1

Many of the following changes result from the changes to the terms described above. Most of the changes to the calculation pages are typographical errors in the text. The spreadsheets do not contain these errors.

Page 51 *(Pg. 48)* <u>Model at a Glance</u> – Veffectarea1 - change "seasonally inundated" to "annually inundated."

Page 53 *(Pg. 50)* <u>Indicators</u> at top of page – change "seasonal basis" to "annual basis."

<u>Scaling</u> at top of page – change "seasonally inundated" to annually inundated in the first and second line.

Page 55 *(Pg. 52)* <u>Calculations of Potential Performance</u> – Veffectacrea1

Highest: change "seasonally" to "annually."
Lowest: change "seasonally" to "annually" and delete "ponded."

Page 58 *(Pg. 55)* — Model at a Glance – Veffectarea2 – change "permanent open water" to "permanent exposed inundation."

Page 59 *(Pg. 56)* — Scaling at top of page – change "permanent open water" to permanent exposed inundation."

Page 66 *(Pg. 62)* — First line, change "seasonal basis" to "annual basis."

Page 67 *(Page 63)* — Calculations of Potential Performance – Veffectarea 1

Highest: change "seasonally ponded or inundated" to "annually inundated."
Lowest: change "seasonally ponded" to "annually inundated."

Page 72 *(Pg. 68)* — Vinund/shed – change "seasonally ponded or inundated" to "annually inundated" in the definition, rationale (second paragraph, third line) and scaling (first line.)

Page 73 *(Pg. 69)* — Calculations of Potential – Vinund/shed

Highest: change "seasonally inundated" to annually inundated"
Lowest: change "seasonally inundated" to annually inundated"

Page 78 *(Pg. 74)* — Vinund/shed – change "seasonally ponded or inundated" to "annually inundated" in the definition and rationale (second paragraph.)

Page 79 *(Pg. 75)* — Calculation of Potential Performance – Vinund/shed

Lowest: change "seasonally inundated" to "annually inundated."

Page 82 *(Pg. 78)* — Model at a Glance – Vefectarea2 – Leave "seasonal inundation" and delete "minus permanent open water."

Description – Veffectarea2 – Replace the second sentence with the following: "The variable is measured as the percent of the AU that is seasonally inundated. It is calculated as the percent of annual inundation minus the area that has permanent exposed inundation."

Page 83 *(Pg. 79)* — Indicators - change "seasonally inundated" to "annually inundated."

Page 84 *(Pg. 80)* — Calculations of Potential Performance – Veffectarea2

Highest: change "permanent open water" to "permanent exposed inundation."
Lowest: change "ponded" to "inundated"

Page 90 *(Pg. 86)* — Vlwd – change "permanent open water" to "permanent exposed inundation" in the definition (second line) and under scaling (first line).

Page 91 *(Pg. 87)* — Indicators - Delete the term "flooded" in "permanently flooded or inundated," "seasonally flooded or inundated," and "occasionally flooded or inundated."

Page 92 *(Pg. 88)* Vwintersp - change "permanent open water" to "permanent exposed inundation" in the definition (first line) and scaling (line three.)

Page 101 *(Pg. 97)* Vwintersp - change "permanent open water" to "permanent exposed inundation" in the definition (first line) and scaling (line three.)

Vlwd - change "permanent open water" to "permanent exposed inundation" in the definition (second line) and under scaling (first line).

Page 103 *(Pg. 99)* Vhydrop – in the indicators, change "permanently flooded, seasonally flooded and occasionally flooded" to "permanently inundated, seasonally inundated and occasionally inundated."

Page 108 *(Pg. 104)* Model at a Glance – for Vwater, change "permanent water" to "permanent inundation."

Page 109 *(Pg. 105)* Vwintersp- change "permanent open water" to "permanent exposed inundation" in the definition (first line), in rationale (lines seven and eight) and scaling (line three.)

Pg. 110 & 111 (*Pg. 106 & 107)* Vlwd – change "permanent open water" to to "permanent exposed inundation" in the definition (second line) and under scaling (first line).

Vwater – change description of variable to "The percent of the AU with permanent exposed inundation.

In the scaling of the variable change all descriptors as follows:

Highest – AU has at least 50% permanently exposed inundation
High – Au has 10 – 49% permanently exposed inundation
Moderate – AU has no exposed inundation but has permanent inundation in areas with emergent, shrub, or forest vegetation.
Low – AU has 1 – 9% permanently exposed inundation
Lowest – AU has no permanent inundation

Page 113 *(Pg. 109)* Calculation of Habitat Suitability – under Vwater, copy the scaling descriptors listed above into the table.

Page 114 *(Pg. 110)* Calculation of Habitat Suitability (Replacement page provided at the back of the document.)

Vphow - pH of standing water >5.5 – change "0.8" to "1.0"

Page 116 *(Pg. 112)* Second paragraph on page – in the second line, change "permanent water" to "permanent inundation" and in the fifth line, change "permanent open water" to "permanent inundation."

Page 151 *(Pg. 147)* Third paragraph (fifth line) - change "seasonally inundated" to "annually inundated."

Page 152 *(Pg. 148)* Model at a Glance – Veffectarea1 – change "seasonally inundated" to "annually inundated."

Page 153 *(Pg. 149)* Veffectarea1 - change "seasonally inundated" to "annually inundated" in the definition (first line), indicators (second line), and scaling (first and second line).

Page 155 *(Pg. 151)* Calculation of Potential Performance – (Replacement page provided.)

In: Description of Scaling for Veffectarea1:

Highest: change "seasonally inundated" to "annually inundated."
Lowest: change "seasonally inundated" to "annually inundated."
Calculation: change "AU inundated" to "AU annually inundated."

In: Index for Primary Production and Export – change "*x 2.22*" to "*x 2.06*."

Page 167 *(Pg. 163)* Veffectarea1 – under scaling, change "seasonally inundated" to "annually inundated" (first and second lines). (Replacement page provided.)

Page 168 *(Pg. 164)* Calculations of Potential Performance (Replacement page provided.)

In: Description of Scaling for Veffectarea1:

Highest: change "seasonally inundated" to "annually inundated."
Lowest: change "seasonally inundated" to "annually inundated."

In: Index for Removing Metals and Toxic Organics – change "x 2.23" to "x 3.23"

Page 175 *(Pg. 171)* Model at a Glance – Veffectarea2 – Leave "seasonal inundation" and delete "minus permanent open inundation."

Description – Veffectarea2 – Replace the second sentence with the following: "The variable is measured as the percent of the AU that is seasonally inundated. It is calculated as the percent of annual inundation minus the area that has permanent exposed inundation."

Indicators - change "seasonally inundated" to "annually inundated."

Page 176 *(Pg. 172)* Calculations of Potential Performance –

In: Description of Scaling for Veffectarea2

Highest: delete "ponded" and change "permanent open water " to "permanent exposed inundation"
Lowest: change "ponded" to "inundated."

Page 205 *(Pg. 200)* Calculation of Habitat Suitability – Reducer – Score for Variable (Replacement page provided.)

Vphow – pH of standing water >= 5.5 – change "0.8" to "1."

Page 214 *(Pg. 210)* First paragraph, at the top of the page, forth line, delete the sentence "The index for the fish habitat function is added as a variable to reflect the importance fish have in the diet of otters and, to a lesser degree, mink." There is no fish model for depressional closed. (Replacement page provided.)

Page 219 *(Pg. 215)* Calculation of Habitat Suitability (Replacement page provided.)

Vemergent2

Highest: change "2.5 acres" to "1 acre."

Vwintersp2

Highest: change "2.5 acres" to "1 acre."

Page 265 *(Pg. 261)* Calculation of Habitat Suitability – (Replacement page provided.)

In: Vhydrop - Highest: change "w or 4" to "3 or 4."

Page 282 *(Pg. 278)* Under Description and Scaling of Variables - Vflowmods

Scaling: change "[1]" to "[2]."

Page 290 *(Pg. 286)* Calculation of Habitat Suitability – (Replacement page provided.)

Index for Habitat Suitability for Resident Fish - change "x 2.00" to "x 1.75."

Page 308 *(Pg. 304)* Calculation of Habitat Suitability –(Replacement page provided.)

In: Vassemb - Highest: change "10" to "9."
Calculation: change '10" to "9."

Change "Calculate D20/10 to get result" to "Calculate D20/9 to get result."

Page 316 *(Pg. 312)* Model at a Glance – Veffectarea1 – change "seasonally inundated" to "annually inundated."

Page 318 *(Pg. 314)* Veffectarea1 – change "seasonal" and "seasonally" to "an annual" and "annually" under indicators (forth line) and under scaling (first and second line).

Page 320 *(Pg. 316)* Calculations of Potential Performance (Replacement page provided.)

Vstorage

In: Score for Variable, top box in column, change >=2.1 to >=1.0

Calculation, change "Scaling is set as average depth/1" to "Scaling is set as storage/2.1."

and change "4. Result = storage /1" to "4. Result = storage/2.1."

Veffectarea1

Highest: change "seasonally" to "annually."
Lowest: change "seasonally" to "annually."

Page 323 *(Pg. 319)* Model at a Glance – Veffectarea2 – change measures to "area of seasonal inundation"

Page 324 *(Pg. 320)* Veffectarea2 - indicators 2d line only: change "seasonally" to "annually."

Page 329 *(Pg. 325)* Model at a Glance – Veffectarea1 - change "seasonally inundated" to "annually inundated."

Page 330 *(Pg. 326)* Veffectarea1 – change "seasonal" and "seasonally" to "an annual" and "annually" under Indicators (forth line) and under Scaling (first and second line).

Page 331 *(Pg. 327)* Calculation of Potential Performance – Veffectarea1

Highest: change "seasonally" to "annually."
Lowest: change "seasonally" to "annually."

Page 335 *(Pg. 331)* Second paragraph, line two. Delete the sentence starting with "The relative index…"

Page 336 *(Pg. 332)* Vinund/shed change "seasonally ponded or inundated" to "annually inundated" in the definition (first line) and "seasonal" to "annual" in the Scaling (first line)

Page 337 *(Pg. 333)* Calculations of Potential Performance – Vinund/shed (Replacement page provided.)

Highest: change "seasonally inundated" to "annually inundated."
Lowest: change "seasonally inundated" to "annually inundated."

Index for Reducing Peak Flows – change *"x 5.0"* to *"x 4.7"*

Page 342 *(Pg. 338)* Vinund/shed – change "seasonally ponded or inundated" to "annually inundated" in the definition (first line) and "seasonal" to "annual" in the Scaling (first line)

Page 343 *(Pg. 339)* Calculation of Potential Performance – Vinund/shed (Replacement page provided.)

Lowest: change "seasonally inundated" to "annually inundated."

Index for Decreasing Downstream Erosion – change *"x 3.33"* to ***"x 3.0."***

Page 346 (*Pg. 342*) Model at a Glance – Veffectarea2 – change "Measures" to "area of seasonal."

Veffectarea2 (text) – change "seasonally inundated" to "annually inundated."

Page 347 (*Pg. 343*) Under Indicators, change "seasonally inundated" to "annually inundated."

Page 348 *(Pg. 344)* Calculations of Potential Performance – Veffectarea2 delete "ponded" and change "open water" to "open inundation".

Page 363 *(Pg. 359)* Vsubstrate – under Rationale, delete the last line starting with "Moreover, those with organic matter…"

Page 383 *(Pg. 379)* Calculation of Habitat Suitability – Vcover (Replacement page provided.)

Highest: change "AU scored 1 for overhanging veg. And has 6 or more…" to "AU has overhanging vegetation, undercut banks, and has 6 or more…"

In the last row, change "If D45 <4 calculate D32 + D34 + (D45/6) to get result; if D45 > 6 calculate D32 + D34 + 1 to get result"

to: "If D45 <6 calculate (D32 + D34 + (D45/6)) x 0.66 to get result; if D45 > 6 calculate 0.66 x (D32 + D34 + 1)/3 to get result."

Page 388 *(Pg. 384)* Vsubstrate – under Scaling, line 3, change "4 or more" to "5 or more" and change "of the 5 types of substrate" to "of the 8 types of substrate", and finally on line four, change "(# of types/4)" to "(# of types/5)." (Replacement page provided.)

Page 389 (*Pg. 385*) Calculation of Habitat Suitability (Replacement page provided.)

Vcover

Calculation: change "1 for overhang, and 3 for LWD normalized to 4" to "1 for overhang, 2 for banks, and 3 for LWD normalized to 6."

Vsubstrate

Highest: change "at least 4 types of substrate" to "at least **5** types of substrate."

Calculation: change "and organic substrate types/4" to "and organic substrate types/**5**"

Change "calculate [sum (D46.1 – D46.5)]/4" to ""calculate [sum (D46.1 – D46.5)]/5"

Page 412 *(Page 408)* Third paragraph – fifth line. Change "seasonally inundated" to "annually inundated."

Page 415 (*Pg. 411*) Calculation of Potential Performance – Reducer (Replacement page provided.)

Vbogs – delete the entire section on bogs as a reducer.

Index for Primary Production and Export – delete "x Reducer"

Additions and Corrections to Specific Pages in Part 2

Page 14 — We no longer recommend dividing an AU into subunits. Remove this page and use the replacement page provided. (Replacement page provided.)

Page 15 — In the last paragraph, replace "percent cover" with "percent area." (Replacement page provided.)

Page 16 — Add "Visual estimates, however, should not be used to estimate percent area covered by a feature" to the second paragraph under "Areal Estimate vs. % Cover. (Replacement page provided.)

Page 21 — For the presence of a channel to count in D4, the channel must be at least 10m (30 feet) long within the boundaries of the AU. Add this to the description for channel. (Replacement page provided.)

Page 22 — The text describing D4.3 should include the presence of a vertical siphon as well as a culvert smaller than 60 cm (2 ft). (Replacement page provided.)

Page 23 — Note 3 at the top of the page should say "the channel in D5 and D7 is the same as the one in D4."

Page 23 — The text describing D8.1, percent that is annually inundated is missing a definition of annual inundation. The area that is annually inundated includes both the areas permanently inundated and those that are only inundated for part of the year for at least one month. Areas inundated for only part of the year, but more than 1 month, are called "seasonally inundated." Areas that are only occasionally inundated (for less than one month) are noted in datum D9, but not included in any areal estimates under datum D8, D10, or D12. When estimating areas of inundation make sure that: area of permanent inundation + area of seasonal inundation = area of annual inundation.

Page 24 — Note 2, change the term "seasonal" to "annual."

Page 24 — For D8.2, change percent of AU with "permanent standing water" to "permanent inundation."

Page 24 — For D8.3, change percent of AU with "permanent open water" to "permanent open inundation."

Page 25 — The term "permanent open water" is used in several places on this page. Replace them all with "permanent open inundation."

Page 25 — Delete the box at the top of the page. The size threshold is being deleted to be consistent with lack of threshold for the other inundation regimes. (Replacement page provided.)

Page 25 — In Note 1 and 3, add "non-persistent aquatic species" as a description for "aquatic bed." (Replacement page provided.)

Page 26 For D9, delete the term "flooded" from the inundation/saturation categories "permanently flooded or inundated," "seasonally flooded or inundated," and occasionally flooded or inundated." "Flooded" is being deleted to reduce confusion between over-bank flooding, required for riverine wetlands, and flooding from other sources such as runoff or groundwater. (Replacement page provided.)

Page 26 In the first paragraph under D9, types of inundation/saturation categories, delete the reference to hydroperiods used in the National Wetland Inventory's classification. We have changed the names and definitions of the hydroperiods enough that the reference is no longer appropriate.

Page 26 The description for seasonally inundated at the bottom of the page (D9.2) should say "greater than 1 month" instead of "1 month."

Page 27 Delete the note for D9.6. (Replacement page provided.)

Page 27 Change the term "height" of flooding to "depth" of inundation in the title for D10 and in Note 5. (Replacement page provided.)

Page 28 For D12, Replace first sentence with: "Identify all the categories of surface water depths listed below that are present in the areas annually inundated in the AU." (Replacement page provided.)

Page 32 For D18, text should state that there has to be 75 percent canopy closure of overhanging trees or shrubs. This means the canopy occupies more than 75 percent of the width of the stream at that point. Although 75 percent canopy closure is part of the title, repeat this in the text to clarify. The shrubs should be at least 1 meter (3.3 feet) high to count for canopy closure. (Replacement page provided.)

Page 34 For "number of vegetation strata present," change the title for "herbaceous" stratum to "herbaceous/short woody" stratum. The description for this stratum should read "non-woody vegetation, usually less than 2 m tall (except Typha spp. And Phragmites spp. which may exceed the height limit) and woody vegetation less than 2 m tall (eg. Kalmia ssp.)"

Page 37 For D25, replace "open water" with "permanent exposed inundation."

Page 37 For D26.2, delete the term "open water."

Page 39 The chart on log decomposition classes applies to logs not snags (D31). It belongs on page 46 and relates to the categories of large woody debris on the AU surface (D44) and in permanent inundation (D45). (Replacement page provided.)

For D31.1, a decomposed stump greater than 30 cm (12 inches) can qualify as "snags larger than 30 cm.

Page 40 For D32, overhanging vegetation, replace "permanent open water" with "permanent exposed inundation." (Replacement page provided.)

Page 40 For D33, in the box, change "open water" to "exposed inundation." (Replacement page provided.)

Page 41 "For egg-laying structures for amphibians," delete the box at the top of the page. Use thresholds in the key on the data form. (Replacement page provided.)

Page 41 For D35, egg-laying structures, change "exposed water" to "exposed inundation" and "open water" to "exposed inundation." (Replacement page provided.)

Page 42 For D38, replace title with "Interspersion between persistent vegetation and exposed inundation," and the first line with "If the AU has a "permanent open inundation" water regime or "aquatic bed….." (Replacement page provided.)

Page 43 For D41, change the first sentence of the second paragraph to read: "Observe the different heights of vegetation structure on each side of the AU boundary." Don't use Cowardin vegetation classes when determining the height differences in D41 because it doesn't include a moss and ground cover as a type of structure.

Also add: "**NOTE 3:** Edges of the AU that are bounded by open inundation on one side should be treated as if there is no difference in vegetation structure." (Replacement page provided.)

Page 45 For D44, large woody debris on AU surface, change outside area of "permanent open water" to "permanent inundation." (Replacement page provided.)

Page 46 For D45, large woody debris "in permanent open water," change "permanent open water" to "permanent inundation." (Replacement page provided.)

Page 46 There is a minimum size threshold for categories of surface composition to be counted. Within these areas, for each category, at least 50% of the surface must be covered with that composition type. Add this threshold to the text. (Replacement page provided.)

Page 47 Add a new soils check off table that makes it easier to determine the extent of different soil types in the A horizon. The new form, labeled "Appendix P," is provided at the back of the document.

Page 47 For D47, first line, look at the top 15 cm for soils in the A horizon, not the top 10-15 cm.

Page 48 Change Note 1 to "Always dig the hole to a depth of 60 cm (24 in), examining the top 15 cm for D47 and the soil at 60 cm for D48." (Replacement page provided.)

Page 48 Change text in box at the top of the page to read : "To collect data for both D47 and D48, locate all of your sampling points in the areas that are annually inundated for depressional AUs, or in the interior of a riverine AU where the frequent flooding occurs." (Replacement page provided.)

Page 48 Delete Note 3 at the top of the page and replace with the following. "**NOTE 3:** Record the percentage of each soil type only as a percent of the area inundated annually. For example, the AU has only 20% of its total area inundated annually, but all the soils within this area are

mineral, the correct number to record is a [3] (100% of the area is mineral soil)." (Replacement page provided.)

Page 63 Change the title for Figure 5 to "AU contained within dikes." The figure is an illustration that helps when answering D4.2 on the Riverine Flow-through data form.

Changes and Clarifications to Size Thresholds

A number of changes and clarifications have been made regarding the size thresholds that need to be met for particular data. We have created a chart that lists all including any new/changed thresholds.

We have been asked to clarify when small patches of a particular feature can be added together to meet the minimum size threshold. Guidance regarding this issue is also provided in the chart. In general, however, a maximum of ten small patches can be combined when it is allowable to combine patches to meet the size threshold. The chart clarifying size thresholds is attached to this document.

Corrections or Changes to Data Forms

D0 Change 1/0 to 0/1.

D4.2 On Riverine Flow-through data form, add a 0/1 and a line to enter your response.

D8.2 Change percent of AU with "permanent standing" to "permanent inundation."

D8.3 Change percent of AU with "permanent open water" to "permanent open inundation."

D8.5 Add term "larger contiguous" to beginning of the datum – "Larger contiguours unvegetated bars…."

D9 In D9.1-9.3 replace the term "flooded" with "inundated" for D9.1-9.3.

D12 Delete "flooded" from "inundated/flooded."

D12 Add the clarification " not areas occasionally inundated" to the data form.
Delete "flooded" from "inundatd/flooded."

D21 Change "in any plant assemblage" to "in a particular assemblage."

~~D25 Replace "open water" with "permanent exposed inundation."~~

D25 Replace "aquatic bed" with non-persistent vegetation

D26.2 Delete the term "open." Standing includes all types of water for it can be vegetated or not vegetated.

D29 Change the text "Open field: AU is within 5 km (3 mi) of an open field (agriculture or pasture) >16 ha (40 acres)" to "Large field or pasture: AU is within 5 km (3mi) of a large field or pasture > 16 ha (40 acres)."

D32 Change "open water" to "exposed inundation."

D33 Change “open water” to “exposed inundation.”

D35 Change “open water” to “exposed inundation.”

~~D35 Change “open water” to “exposed water.”~~

D35 In key for rating egg-laying structures, delete the words “no more than a” from step 3 and step 6. Also in steps 3 and 6, replace "open water" with "exposed inundation."

D35 Change the word “emergent” to “erect” in the key for rating egg-laying structures for amphibians.

D38 Change the word “erect” to “persistent.”

D38 Replace “permanent open water” with “permanent exposed inundation” and delete “(POW + AB)."

D44 Change outside of “permanent open water” to “permanent inundation.”

D45 Change “permanent water” to “permanent inundation.”

D46 Delete “broad-leaved.”

D46 Note on the data form that within 10 square meter areas for each category, at least 50% of each area must be covered in that surface composition.

D47 Soil box goes with D48 not D47.

D47 The percents used to answer D47 should be the percent of the area of annual inundation *not* the percent of the entire AU. Change “[1] if 1-49% area of AU, [2] if 50% to 95%, [3] if >95%” to “[1] if 1-49% of area annual inundation, [2] if 50% to 95% or area of annual inundation, [3] if >95% of area of annual inundation.”

A new form for this datum has been developed to assist with recording the datum. It is applicable to D47 on the Depressional Outflow/Riverine Impounding data forms and the Depressional Closed forms. If you use the new form, you will record the correct scores on the data form. The new form, labeled “Appendix P,” is provided at the back of the document.

NOTE: There is no place to record logs “inside permanent water” on the single page provided to quickly record snags and logs as they are observed in the field. You can divide the column for logs outside permanent water into two and label one outside permanent inundation and one inside permanent inundation.

General Clarifications by Data

D3 For land uses within 1 km of the AU, ball fields should be placed in the category “agriculture.”

D12 Do not consider areas that are “occasionally inundated,” as described in D9, when collecting data on water depths.

D16 The understory under forest or scrub/shrub areas has to be rooted in the AU.

D20 Co-dominance in a plant assemblage (20%-50%) can be based on the cover of the plant in any stratum.

D26.2 Standing water can be seasonal or permanent and can be vegetated or non-vegetated.

D35 For egg laying structures for amphibians, "thin-stemmed" vegetation includes the stems of herbaceous plants as well as thin twigs. The herbaceous plants should be those that grow in an erect form, and don't have to be "emergent." The vegetation or twigs must occur in areas that are annually inundated.

D42 When rating the buffer of the AU, you can add patches of the edge together to meet the 50% requirement. The 50% does not have to be continuous. **Follow the rule for adding patches for size threshold; a maximum of 10 patches can be added together to meet the requirement.**

D42 Recent chemical applications of herbicides can be considered a disturbance to the buffer of the AU.

D44/45 Category 1 includes downed logs that have not begun to decay yet. Woody debris consisting of small logs jammed into a mass does not count.

D46 Gravels and cobbles can be rounded, angular or irregular. Gravels ranges from .2 – 7.6 cm diameter and includes fine, medium and coarse gravels. Cobbles ranges from 7.6 – 25 cm in diameter.

Size Thresholds for Data

The following is a list of all the size thresholds required in the methods. It also indicates that small, noncontiguous patches can be combined to meet the size thresholds. Minimum thresholds for percent cover are not included.

NOTE: A maximum of ten small patches can be combined when it is allowable to combine patches to meet the size threshold. An * indicates that the size threshold was not in the previous guidance.

Data by Number	Size Threshold	Can Small, Noncontiguous Patches Be Combined to Meet the Size Threshold?
***D4* Channel within AU**	10 meters (33 feet) in length*	No
***D8.5* Larger Unvegetated Bars or Mudflats**	Unvegetated bars or mudflats must be at least 100m^2 in size	No
***D9* Types of Inundation Categories**	For AUs equal to or greater than 1.0 ha (2.5 ac), you need a minimum of 0.1 ha (0.25 ac) of the total AU for this datum. For AUs less than 1.0 ha, the threshold is 10% of the AU.	Yes
***D12* Water Depths**	AUs equal to or greater than 1.0 ha (2.5 ac), you need a minimum of 0.1 ha of the total AU present for at least 1 month. AUs less than 1.0 ha, the threshold is 10% of the AU.	Yes
***D14* Cowardin Vegetation Classes**	For AUs equal to or greater than 1.0 ha (2.5 ac), you need a minimum of 0.1 ha (0.25 ac) of the total AU for this datum. AUs less than 1.0 ha, the threshold is 10% of the AU.	Yes
***D20* Plant Assemblages**	For AUs equal to or greater than 1.0 ha (2.5 ac), you need a minimum of 0.1 ha (0.25 ac) of the total AU for this datum. AUs less than 1.0 ha, the threshold is 10% of the AU.	Yes

***D22* Mature Trees**	Western Hemlock - greater than 45 cm (18 in) Western Red Cedar - greater than 45 cm (18 in) Douglas Fir - greater than 45 cm (18 in) Sitka Spruce - greater than 45 cm (18 in) Black Cottonwood - greater than 45 cm (18 in) Big-leaf Maple - greater than 45 cm (18 in) Red Alder - greater than 30 cm (12 in) Oregon Ash - greater than 30 cm (12 in) Lodgepole Pine - greater than 30 cm (12 in) Pacific Willow - greater than 30 cm (12 in)	No
***D30* Woody Browse**	For AUs equal to or greater than 1.0 ha (2.5 ac), you need a minimum of 0.1 ha (0.25 ac) of the total AU for this datum. For AUs less than 1.0 ha, the threshold is 10% of the AU.	Yes
***D31* Decomposition Stages**	Snags and stumps can be counted only if their DBH is at least 10 cm (4in.) or 10 cm at the base for decayed stumps. There is no height threshold.	NA
***D32* Overhanging Vegetation**	Overhang has to extend 1 m (3.3 ft) from the edge and 10m (33 ft) along the edge of the area with permanent exposed inundation or the stream.	No
***D33* Upland Islands**	Upland islands must be larger than 10 m^2 (1000 ft2) and they need to be surrounded by at least 30 m (100 ft) of exposed inundation deeper than 1 m (3.3 ft)**.**	No
***D33.1* Snags Greater than 30 cm DBH**	Snags must have a DBH greater than 30 cm (12 in).	No
***D34* Undercut Banks**	Area of undercutting must extend at least 2 m (6.6 ft).	No
***D35* Egg Laying Structures**	Refer to the key on the data form. For AUs equal to or greater than 1.0 ha (2.5 ac), you need a minimum of 0.1 ha (0.25 ac) of the total AU of thin-stemmed vegetation or thin branches (less than 8 mm [5/16 inch) in permanently or seasonally exposed,	No

	inundated areas. For AUs less than 1.0 ha, the threshold is 10% of the AU with thin stems.	
D36 Tannins	Waters with high tannin content must extend over at least 10% of the areas of standing water.	Yes
D37 **Steep Banks**	A bank must be greater than 30 degrees steep, greater than 10 m (33 ft) long, more than 0.6 m (2 ft) high, and consist of fine material.	No
D43 **Corridors From AU**	Refer to key on data form. Any vegetated corridor must be a minimum of 5 m in width.	No
D44 **Large Woody Debris on Surface**	Logs must be at least 2 m (6.6 ft) long with a minimum of 10 cm (4 in) diameter at the widest part.	N/A
D45 **Large Woody Debris in Permanent Inundation**	Logs must be at least 2 m (6.6 ft) long with a minimum of 10 cm (4 in) diameter at the widest part.	N/A
D46 **Composition of the Surface**	Patches of any category must be at least 10 square meters to be counted.	No
D49.1 and 49.2 **Substrate of Permanently Flowing Stream**	There must be at least 1 m (3.3 ft) of the streambed, in the direction of flow, with these substrates.	No

Part 1 Replacement Pages

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independent conditions (on the scale of most environmental processes), and thus cannot reflect actual rates of performance. Rather, they reflect the potential or probability that functions are performed at a certain level. Model scores based on indicators, therefore, do not reflect the levels at which a function may actually be performed. Instead, they estimate the potential or probability that a function is being performed.

The potential of a wetland to reduce water velocities might be established by using the size and shape of its outlets and the depth of water stored in the wetland as indicators. An indicator of the potential for filtration of sediment might be based on the percent cover of dense erect vegetation near the ground surface. The equation for removing sediments could then be rewritten as:

> *Potential performance = type of outlets + depth of water storage + %cover of different types of vegetation*

In a logic model, the level of performance would be described using conditional phrases such as "the wetland rates high for removing sediments if it has a constricted outlet and an average depth of storage that is greater than 1 m and erect vegetation over more than 80% of its area."

With mechanistic models, the authors choose the variables and scale them based on their judgement. They assign scores to different "states" of a variable (e.g., > 80% cover of emergent vegetation might be given an index of [1]; 40 - 79% cover of emergent vegetation receives an index of [0.5], etc.). Different types of outlets, and different depths of water storage, would also be assigned scaled scores in this manner.

In developing models, the sum of the scores for the variables in an equation are adjusted (normalized) to [1] or [10] for each function. Normalizing is important because each function may have a different number of variables with correspondingly different total sums. The indices of different functions are more easily interpreted if the highest levels are all recorded as a [10].

2.1.4 Scoring Wetlands

Application of a method results in a set of indices, one for each function in each wetland unit being assessed. The indices are presented as a number, for example between 0 and 10, with a 10 representing the highest level of performance.

The index represents an index per hectare or acre of wetland. For example, a small, 1 hectare wetland, and a large 100 hectare wetland may both have an index of [10] for a specific function.An index itself is without any numeric "dimensions".

woody debris in permanent water. **This variable is considered to be a critical habitat component and is weighted by a factor of 2 relative to the other variables.**

Rationale: Overhanging vegetation provides both temperature control and protection from predation. McMahon (1983) reported the need for streamside vegetation for shading. Small coho juveniles tend to be harassed, chased and nipped by larger juveniles unless they stay near the bottom, obscured by rocks or logs (Groot and Margolis, 1994). Cover for salmonids can be provided by overhanging vegetation, submerged vegetation, submerged objects such s logs and rocks, floating debris, deep water, turbulence and turbidity (Giger 1973). Large woody debris plays an important role in Pacific Northwest streams, creating and enhancing fish habitat in streams of all sizes (Bisson et al. 1987).

When juvenile salmonids move into depressional wetlands they will need the same type of cover as found in streams. The Assessment Teams judged that the types of cover found in streams also are necessary in wetlands if the habitat is to be judged as suitable.

Indicators: The presence of overhanging vegetation is characterized during the field visit based on presence/absence of certain characteristics as described in Part 2. Direct measures of the quantity and quality of decaying woody debris is not feasible for a rapid assessment method. A descriptive matrix of different sizes and decay levels of woody debris was developed as an indicator for the variable. The matrix is based on the assessment procedure developed for the TFW watershed assessment methods.

Scaling: AUs with overhanging vegetation and at least 4 categories of large woody debris in permanent exposed water are scored a [1]. AUs with fewer characteristics are scored proportionally, with each type of cover having equal weight (see Calculation Table 6.10.5). AUs with no types of cover are scored a [0].

V_{pow} – The percent of the AU that is covered by permanent open water.

Rationale: AUs that have permanent surface water present provide habitat the entire year rather than just during the wet season. As mentioned in the introduction, the model for depressional outflow wetlands does not have a variable to reflect an absolute requirement for permanent water that would at first seem to be a necessary pre-requisite for fish habitat. AUs with permanent open water, however, provide better habitat than those flooded only seasonally.

Indicators: The variable is assessed by estimating the relative % of the AU that has permanent open water (described in Part 2).

7.1 Potential for Removing Sediment — Depressional Closed Wetlands

Note: Please read the introduction to the assessment models (Chapter 2) before using these models. It describes several basic assumptions used in modeling that will help you better understand how to use and apply the methods.

7.1.1 Definition and Description of Function

Removing sediment is defined as the wetland processes that retain sediment in a wetland, and keep them from going to downgradient surface waters in the watershed.

All depressional closed wetlands have the potential to remove sediment at the highest levels because they have no outlet. All sediments coming into the wetland are retained and not released to surface waters.

7.1.2 Qualitative Rating of Opportunity

The opportunity of AUs in this subclass to remove sediment is a function of the level of disturbance in the landscape. Relatively undisturbed watersheds in the lowlands in western Washington will carry much lower sediment loads than those that have been impacted by development, agriculture, or logging practices (Hartmann et al. 1996, and Reinelt and Horner 1995). The opportunity that an AU has to remove sediment is, therefore, linked to the amount of development, agriculture, or logging present in the upgradient part of its contributing basin.

Users must make a qualitative judgement on the opportunity of the AU to actually trap sediment by considering the land uses in the contributing watershed and the condition of its buffer. The opportunity for an AU in the depressional closed subclass to remove sediments is **"Low"** if most of its contributing watershed is undeveloped, not farmed, or not recently logged. Densely vegetated watersheds (e.g., undisturbed forest) stabilize soils, reduce runoff velocity, and thus export less sediment (Bormann et al. 1974, Chang et al. 1983).

The opportunity is **"Low"** if the AU receives most of its water from sheetflow rather than from an incoming stream, and it has a good vegetated buffer. Vegetated buffers will trap sediments coming from the surrounding landscape before they reach the AU. A buffer that is only 5 m wide will trap up to 50% of the sediment while one that is 100 m wide will trap approximately 80% of the sediments (Desbonnet et al. 1994). The opportunity is also **"Low"** if the AU receives most of its water from groundwater since this source of water does not carry any sediments.

The opportunity for the AU to remove sediments is **"High"** is the contributing watershed is mostly agricultural or there is recent construction or clear-cut logging in it. In contrast to undisturbed watersheds, urban, agricultural, or logged watersheds have more exposed soils

7.5 Potential for Decreasing Downstream Erosion — Depressional Closed Wetlands

Note: Please read the introduction to the assessment models (Chapter 2) before using these models. It describes several basic assumptions used in modeling that will help you better understand how to use and apply the methods.

7.5.1 Definition and Description of Function

Decreasing Downstream Erosion is defined as the wetland processes that decrease erosion of stream channels further downstream in the watershed by reducing the duration of erosive flows.

An AU performs this function if it stores excess runoff during and after storm events, before slowly releasing it to downgradient waters. This is similar to the function provided by stormwater retention/detention (R/D) ponds that are designed to prevent downstream erosion in developed areas. The AU decreases downstream erosion by reducing the duration of erosive flows (erosive flows are the high velocity, high volume flows that cause much of the erosion in a watershed).

The major processes by which wetlands reduce the duration of erosive flows is by storing some of the peak flows and thus reducing the time during which erosive flows occur, and by reducing the velocity of water flowing through the AU during a storm event. Erosive flows in a watershed occur above a certain velocity based on geomorphology. By reducing the velocity in general, an AU can reduce the overall time during which the erosive velocities occur.

The function of decreasing downstream erosion is closely related to that of reducing peak flows because a reduction in peak flows will also result in a reduction of velocity. All of the variables used in the "peak flow" model are used for this function as well. One way to consider the function being assessed is to ask "What would happen to erosive flows in the watershed if the AU were filled?".

7.5.2 Assessing this Function for Depressional Closed Wetlands

All depressional closed wetlands have the potential to decrease downstream erosion at the highest levels because they have no outlet. All floodwaters coming into the wetland are retained and not released to surface waters.

7.5.3 Qualitative Rating of Opportunity

The opportunity for an AU to decrease erosion will increase as the water regime in the upgradient watershed is destabilized. Research in western Washington has shown that peak flows and velocities increase as the percentage of impermeable surface increase (Reinelt and

Scaling: If an AU has 2 or more of the 5 habitat features it is scored a [1]. AUs with one habitat feature score a [0.5] for the variable, and those with none score a [0].

V_{pow} – The percent area of the AU that is covered by permanent open water.

Rationale: Permanent open water provides refuge for many species of waterfowl. The presence of open water allows for the establishment of aquatic vegetation beds, which also provides food for different species of waterfowl.

In addition, open water of varying depths provides greater diversity of foraging habitat for a greater variety of water birds (USDI 1978). Shallow water areas (less than 20 cm deep) provide habitat for rails and teal. The permanent open water should be present throughout the breeding season for maximum functional benefit (Eddelman et al. 1988). To simplify the models the Assessment Teams decided that the variable "permanent open water" is more appropriate than trying to determine whether the water is open during the breeding season. It is understood that some AUs may have open water during the breeding season, but then completely dry up in the late summer. It is too difficult however to establish the presence of open water only during the breeding season.

The extent of the permanent open water required for different scaled scores is based on an educated guess by the Assessment Team, reflecting the need to provide a rapid method. Areas of open water that are smaller than .1 hectare (1/4 acre), or less than 10% of an AU (if it is < 1 hectare), are difficult to determine from aerial photos.

Indicators: The extent of permanent open water in a AU can be easily determined during the dry summer months and no indicator is needed. There is a problem, however, in establishing the size during the wet season when the AU is flooded to its seasonal levels. The indicators that have been suggested to establish the extent of permanent inundation are the edge of emergent vegetation in the deeper portions of a AU, or the presence of aquatic bed vegetation such as *Nuphar spp*.

Scaling: AUs with 30%, or more, of their area covered in permanent open water are scored a [1] for this variable. AUs with a smaller area are scaled proportionally (%open water/30).

$S_{inverts}$ – The habitat suitability index from the Invertebrate function.

Rationale: The index is used to represent the availability of invertebrates as prey for birds.

Indicators: No indicators are needed. The variable is an index from another function.

Scaling: The index is already scaled and re-normalized to 0 –1.

S_{amphib} – Habitat suitability index for the Amphibian function.

Rationale: The index is used to represent the availability of amphibians as prey for birds.

7.11.5 Calculation of Habitat Suitability

Depressional Closed – Habitat Suitability for Wetland-associated Mammals

Variable	Description of Scaling		Score for Variable	Result
Vbuffcond	*Highest:*	Buffer category of 5	If D42 = 5, enter "1"	
	High:	Buffer category of 4	If D42 = 4, enter "0.8"	
	Moderate:	Buffer category of 3	If D42 = 3, enter "0.6"	
	Medium Low:	Buffer category of 2	If D42 = 2, enter "0.4"	
	Low:	Buffer category of 1	If D42 = 1, enter "0.2"	
	Lowest:	Buffer category of 0	If D42 = 0, enter "0"	
Vwaterdepth	*Highest:*	Water depths >1 m present	If D12.3 = 1, enter "1"	
	Moderate:	Water depths between 1-100 cm present	If D12.1 = 1 **and** D12.2 = 1, enter "0.5"	
	Low:	Depths between 1-20 cm present	If D12.1 = 1, enter "0.3"	
	Lowest:	No surface water present	If all D10 are 0, enter "0"	
Vcorridor	*Highest:*	Corridor rating is 3	If D43 = 3, enter "1"	
	Moderate:	Corridor rating is 2	If D43 = 2, enter "0.67"	
	Low:	Corridor rating is 1	If D43 = 1, enter "0.33"	
	Lowest:	Corridor rating is 0	If D43= 0, enter "0"	
Vbrowse	*Highest:*	AU has more than 1 ha (2.5 acres) of preferred woody vegetation for beaver in and within 100 m of AU	If D30 =1, enter "1"	
	Lowest:	Above not present	If D30 = 0, enter "0"	
Vemergent2	*Highest:*	AU has cover of emergent vegetation that is > = 0.4 ha (1 acre)	If (D1 x D14.5)/100 > = 0.4, enter "1"	
	Lowest:	AU has no cover of emergents or emergents < 0.4 ha	If (D1 x D14.5)/100 < 0.4, enter "0"	
Vwintersp2	*Highest:*	If AU is > 0.4 ha (1 acre) and interspersion between vegetation and exposed water is high	If D1 > = 0.4 and D38 = 3, enter "1"	
	Moderate:	If AU > 0.4 ha and interspersion is moderate	If D1 > = 0.4 and D38 = 2, enter "0.67"	
	Low:	If AU > 0.4 ha and interspersion is low	If D1 > = 0.4 and D38 = 1, enter "0.33"	
	Lowest:	AU has < 0.4 ha or AU has no interspersion	If D38 = 0 OR D1 < 0.4, enter "0"	
Vow	*Highest:*	If OW > 0.1 ha (0.25 acres) and OW at least 30% of AU	If (D1 x D8.3) / 100 > 0.1 and D8.3 > = 30, enter "1"	
	High:	If OW > 0.1 ha and OW = 10 - 29% of AU	If (D1 x D8.3) / 100 > 0.1 and 10< = D8.3 < 30, enter "0.8"	
	Lowest:	If OW < = 0.1 ha	If (D1 x D8.3)/100 < 0.1, enter "0"	
	Calculation:	If OW > 0.1 ha scaled as % OW x 0.08	Enter result of calculation	
	If (D1xD8.3)/100 > 0.1 and D8.3 < 10 calculate as D8.3x0.08 to get result			

Table continued on next page

The Assessment Teams recognize that site observations made during the summer will usually result in a higher count of plant species than those that are done during the winter will. This issue is currently unresolved as most of our calibration occurred during the summer and fall. A different scaling may be developed for winter and summer if further data necessitates.

Scaling: If the AU has 30 or more native species it is scored a [1]. AUs with a fewer number of native species are scaled proportionally (# of native species/30).

V_{bogs} – The percent area of the AU is covered by a sphagnum bog (defined as areas where sphagnum mosses represent more than 30% cover of the ground).

Rationale: Sphagnum bogs are often the habitat for many unique plant species (Mitch and Gosselink 1993). These plants are often small and hard to identify. Also sphagnum bogs often lack the physical structure of many other mature wetland plant communities. The presence of bogs is used as an indicator of a potentially very rich native species assemblage that may not be captured by the other variables.

Indicators: No indicators are needed for this variable since the % area of an AU covered by Sphagnum bog can be determined directly.

Scaling: This is an "on/off" variable. AUs with 25% or more Sphagnum bog are scored a [1]. Those with a bog cover <25% are scored a [0].

$V_{nonative}$ – The percent of the AU where non-native species are dominant or co-dominant (non-native species are listed in Part 2, Appendix L) **This is a variable of reduced performance.**

Rationale: The Assessment Teams judged that wetlands where one or more of the dominant species is non-native have lost some of their potential for maintaining native regional plant biodiversity. Non-native plants that become dominant tend to exclude many of the less common native plants.

Indicators: No indicator is needed for this variable. The areal extent of non-native species can be determined in the field.

Scaling: AUs where non-native species extend over more than 75% of the AU have their index reduced by a factor of 0.5. Those with an extent of 50 – 75% are reduced by a factor of 0.7, and those with an extent of non-native between 25-49% are reduced by a factor of 0.9. AUs where non-native species are dominant or co-dominant on less than 25% of the AU do not have their index reduced.

8.8.4 Description and Scaling of Variables

$V_{permflow}$ – Channels or streams are present in an AU and contain permanent flowing water.

Rationale: Permanent flowing water is a habitat feature that supports a unique assemblage of invertebrate species (Needham and Needham 1962, and Wiggins et al. 1980). Invertebrates that are found in permanent flowing channels are an important resource for many other aquatic species (Needham and Needham 1962). The presence of a permanent flowing water is a characteristic whose presence adds to the overall invertebrate richness in an AU.

Streams or channels with intermittent seasonal flow also have the potential for providing a special invertebrate habitat. They are not scaled in the model, however, because it was not possible to determine, in the field, if an intermittent stream or channel is maintained by seasonal flows or by high rainfall events. If an intermittent stream is a result of storm flows, the water does not remain long enough to provide a unique invertebrate habitat.

Indicators: No indicators are needed for this variable because the presence of permanent flow in a channel can be established directly in the summer during the dry season. Indicators for the presence of permanent channel flow in the winter, during the wet season, may be more difficult to establish. Users may have to rely on aerial photographs (usually taken in the summer) or other sources of information to determine if the flows in a channel are permanent.

Scaling: This is an "on/off" variable. An AU scores a [1] if permanent channel flow is present, and a [0] if it is not.

$V_{substrate}$ – The composition of surface layers present in the AU (litter, mineral, organic etc).

Rationale: Not much is known about invertebrate distributions in different substrates within a wetland. Data from rivers, streams, and lakes, however, show that the local invertebrate species have preferences for specific substrate (Dougherty and Morgan 1991, and Gorman and Karr 1978). In streams it is well known that Chironomid community composition is strongly affected by sediment characteristics (McGarrigle 1980, and Minshall 1984). The Assessment Teams assumed that a similar relationship between invertebrate populations and substrates is also found in wetlands. Thus, AUs with different substrates present will provide habitat for a broader group of invertebrates than those with only one type. Moreover, those with organic matter will exhibit greater richness and abundance than those found in sand substrates.

Indicators: No indicators are needed to assess this variable. The number of different substrate types can be determined by direct field observations.

Scaling: AUs with six or more types of substrates of the eight identified (deciduous leaf litter, other plant litter, decomposed organic, exposed cobbles, exposed gravel,

8.11.3 Model at a Glance

Riverine Flow-through — Habitat Suitability for Resident Fish

Process	Variables	Measures or Indicators
Refuge and stream habitat for resident native fish (applies to all variables)	**Vpermflow**	Presence/absence of flow in channel
	Vcover	Categories of refuge present in water
	V%closurest	% length of stream with canopy closure >75%
	Vstreamsubs	Gravel or cobbles present in stream
	Vwaterdepth	Depths of water in permanent stream
	Index:	2 x Vpermflow + Vcover + V%closurest + Vstreamsubs + Vwaterdepth / Score from reference standard site

8.11.4 Description and Scaling of Variables

$V_{permflow}$ – There are channels or streams present in the wetland that have permanently flowing water**. This variable was judged to be a critical habitat feature in riverine flow-through wetlands and is weighted by a factor of 2.**

> **Rationale:** This variable is included for the function because flowing water is an important characteristics for cottids and dace in western Washington (Mongillo pers. comm.).
>
> **Indicators:** No indicators are needed for this variable in the summer because the presence of flow in a channel can be established directly during the dry season. Indicators for the presence of permanent channel flow in the winter, during the wet season, may be more difficult to establish. Users may have to rely on aerial photographs (usually taken in the summer) or other sources of information to determine if the flows in a channel are permanent.
>
> **Scaling:** This is an "on/off" variable. An AU scores a [2] if permanent channel flow is present, and a [0] if it is not.

V_{cover} – Structures in the AU that provide cover in and over water. This variable is assessed based on three structural elements: 1) vegetation that overhangs permanent water; 2) undercut banks; and 3) large woody debris in permanent water.

> **Rationale:** Refuge from predators is an important habitat feature for maintaining successful fish populations, and wetlands that provide such refuge have a higher potential of performing than those that do not. Overhanging vegetation and undercut banks provide both temperature control and protection from predation. Large woody

Scaling: AUs with 10%, or more, of their area covered in permanent open water (i.e. stream) are scored a [1] for this variable. AUs with a smaller area are scaled proportionally (%open water/10).

$S_{inverts}$ – The habitat suitability index from the Invertebrate function.

Rationale: The index is used to represent the availability of invertebrates as prey for birds.

Indicators: No indicators are needed. The variable is a index from another function.

Scaling: The index is already scaled between 0 –10, and is re-normalized to a range of 0 - 1.

S_{amphib} – Habitat suitability index for the "amphibian" function.

Rationale: The index is used to represent the availability of amphibians as prey for birds.

Indicators: No indicators are needed. The variable is a index from another function.

Scaling: The index is scaled between 0 –10, and is re-normalized to a range of 0 – 1.

S_{fish} – Habitat suitability index for the Fish function. The assessment methods have two functions to characterize habitat suitability for fish (anadromous and resident). The higher of the two scores is used in this model.

Rationale: The index is used to represent the availability of fish as prey for birds.

Indicators: No indicators are needed. The variable is a index from another function.

Scaling: The index is scaled between 0 –10, and is re-normalized to a range of 0 – 1.

$V_{effectarea2}$ – Areal extent of the AU (as a % of total) that undergoes changes between oxic and anoxic conditions.

Rationale: Nitrogen transformation occurs in areas of the AU that undergo changes between oxic and anoxic regimes. The oxic regime is needed to change ammonium ions (NH_4^+) to nitrate, and the anoxic regime is needed for denitrification by bacteria (changing nitrate to nitrogen gas) (Mitsch and Gosselink 1993).

Indicators: The indicator for the zone where oxygen saturation changes is the annually inundated area minus the area of permanent inundation (area of seasonal inundation). The assumption for using this indicator is that areas that are seasonally inundated are saturated for a long enough period to develop anoxic conditions and thus denitrification. The seasonal drying then re-introduces oxic conditions that promote nitrification. The area that is permanently inundated, however, is not expected to have enough oxygen at the surface to promote nitrification.

Scaling: AUs that are completely inundated seasonally, and have no permanent exposed water, are scored a [1] for this variable. Scaling for the others is proportional, based on the % area that is only seasonally inundated (%area / 100).

V_{out} – The amount of constriction in the surface outflow from the AU.

Rationale: Water will tend to be held longer in an AU if its outlet is constricted regardless of its internal structure (Adamus et al. 1991). The constriction is judged to increase the residence time and permit a longer period for the denitrification to occur in the AU. NOTE: V_{out} is also a variable in the "removing sediments" model. It is used again here because in Ssed is used only to model the removal of phosphorus. Since it is also important in the removal of nitrogen it is used again to model the latter process.

Indicators: No indicators are needed. The relative constriction of the outlet is determined in the field.

Scaling: The scaling of this variable is based on the amount of constriction found in the AU.

Unconstricted or slightly constricted – Unconstricted or slightly constricted outlets are scored a [0].

Moderately constricted – Moderately constricted outlets are scored a [0.5].

Severely constricted –Severely constricted outlets are scored a [1].

No outlet - No outlets are scaled as [1].

Rationale: The variable is a measure of the relative capacity of the outlet to impound water and store it temporarily during a flood event. This reduces the velocity of water downstream of the AU. AUs that have constricted outlets due to undersized road culverts or narrow outlets hold water longer than a flooding event and will therefore reduce the duration of erosive flows. Water velocities and flows out of an AU will be reduced if its outlet is constricted regardless of its internal structure (Adamus et al. 1991).

Indicators: No indicators are needed. The relative constriction of the outlet is determined in the field.

Scaling: The scaling of this variable is based on the amount of constriction found in the AU.

Unconstricted or slightly constricted – Unconstricted or slightly constricted outlets are scored a [0].

Moderately constricted – Moderately constricted outlets are scored a [0.5].

Severely constricted – Severely constricted outlets are scored a [0.8].

No outlet – No outlets are scaled as [1].

$V_{woodyveg}$ – The areal extent (as a % of the AU) of woody vegetation present that will reduce water velocities during a flood.

Rationale: Surface water flowing through areas of woody vegetation will have its velocity reduced because the stiff vegetation provides a structural barrier to flow (Adamus et al. 1991). The extent of the woody vegetation over the entire AU is used because the vegetation can also reduce velocities of water coming in as sheetflow in areas that are not inundated by flooding.

Indicators: The indicator for stiff erect vegetation is the percent area within the AU of two Cowardin vegetation classes – forest and scrub/shrub. The Assessment Team judged that these two classes represent vegetation that will remain erect during a flood event and will provide the structural barrier needed to reduce velocities.

Scaling: AUs that have a 100% cover of forest or scrub/shrub are scored a [1] for this variable. Scaling for the others is proportional, based on the % area that is covered by forest and/or scrub/shrub (% area / 100).

$V_{inund/shed}$ – The ratio of the area that is annually ponded or inundated with the AU to the area of its contributing basin. **This variable was judged to be more important than the others in the equation and was given a weighting factor of 2.**

Rationale: The potential of an AU to reduce velocity is partially a function of the retention time of water in the wetland during a storm event. Retention time is the relative volume coming into a unit during a storm event divided the amount of storage present. The area of the contributing basin is used as a surrogate for the relative amount of water (volume as cubic meters/second) entering the AU, while the area of

to be the area that is seasonally inundated (area that is permanently inundated is excluded from this variable).

Indicators: The indicator for the effective area is the annually inundated area minus the area of permanent inundation.

Scaling: AUs that are completely inundated annually and have no permanent exposed water are scored a [1] for this variable. Scaling for the others is proportional, based on the % area that is only seasonally inundated (%area / 100).

Indicators: The variable is characterized using a condensed form of the depth classes first developed for WET habitat assessments (Adamus et al. 1987). These are 0-20 cm, 20-100 cm, and > 100 cm.

Scaling: AUs with all three depth classes present are scored a [1]. Those with the two shallower ones are scored a [0.5]; those with 0-20 cm of water are scored a [0.1]. AUs with no permanent or seasonal inundation are scored a [0]. In some cases an AU may have steep sides. If the water depth is greater than 100 cm but the AU does not have enough shallow water to meet the size requirements (0.1 ha or 10%, whichever is the smaller) it is scored a [0.7].

V_{cover} – Structures in the AU that provide cover in and over water. This variable is assessed based on three structural elements: 1) vegetation that overhangs permanent water; 2) undercut banks; and 3) large woody debris in permanent water.

Rationale: Refuge from predators is an important habitat feature for maintaining successful fish populations, and wetlands that provide such refuge have a higher potential of performing than those that do not. Overhanging vegetation and undercut banks provide both temperature control and protection from predation. Large woody debris plays an important role in the Pacific Northwest, creating and enhancing fish habitat (Bisson et al. 1987).

Indicators: The presence of overhanging vegetation and undercut banks is characterized during the field visit based on presence/absence of certain characteristics as described in Part 2. Direct measures of the quantity and quality of decaying woody debris is not feasible for a rapid assessment method. A descriptive matrix of different sizes and decay levels of woody debris was developed as an indicator for the variable. The matrix is based on the assessment procedure developed for the TFW watershed assessment methods.

Scaling: AUs with both overhanging vegetation and undercut banks, and at least 6 categories of large woody debris are scored a [1]. AUs with fewer characteristics are scored proportionally, with each type of cover having a different weight (see Calculation Table 9.11.5). Large woody debris is weighted by a factor of 3 and undercut banks by a factor of 2 relative to overhanging vegetation. AUs with no types of cover are scored a [0].

V_{pow} – The percent of the AU that is covered by permanent open water.

Rationale: Ponded surface water is needed for fish. Wetlands that have permanent surface water present provide habitat the entire year rather than just during the wet season, thereby increasing the suitability of the AU as habitat.

Indicators: The variable is assessed by estimating the relative % of the AU that has permanent open water (Part 2).

Scaling: AUs that have 30% or more permanent open water are scored a [1]. Those with less are scored proportionally (%pow/30).

Scaling: If the AU is greater than 6 ha, the variable is scored a [1]. Smaller AUs with buffers that are vegetated with relatively undisturbed vegetation of at least 100 m around 95% of the AU (buffer category #5) are scored a [1]. The categories between 0-5 are scaled proportionally as 0, 0.2,0.4, 0.6, and 0.8 respectively. **The size threshold is included so large wetlands are not penalized for having poor buffers**.

V_{snags} – The number of different categories of snags, based on decomposition states, found in the AU.

Rationale: Snags are a source of cavities and perches for wetland-associated birds. Several species of birds utilize already existing cavities for nesting and/or refuge locations. The presence of cavities in standing trees can indicate the relative age or maturity of the trees within the AU, and therefore the structural complexity present. Dead wood attracts invertebrates and other organisms of decay, which in turn provide a food source for many species of birds (Davis et al. 1983).

Indicators: The number and size of cavities in an AU cannot be measured directly because they may be difficult to count and measure. Eight different categories of snags representing different levels of decay are used as the indicator for the different potential sizes of cavities. It is assumed that cavities will form or be excavated if dead branches or trunks are present.

Scaling: If a riverine impounding AU has 6 or more of the 8 categories of snags present it scored a [1]. Fewer categories are scaled as proportional to 6 (i.e. # of categories/6).

$V_{vegintersp}$ – The relative interspersion between Cowardin vegetation classes (Cowardin et al. 1979).

Rationale: Vegetation interspersion is the relative position of plant types to one another. As an example, an AU may have an emergent marsh of cattails; a nearby shrub/swamp of willows; and an adjacent area of alder swamp. This AU contains three Cowardin classes - emergent, shrub, and forest. For some bird species, this is irrelevant, as many species are single habitat type users. Other species, though, may require several habitat types to being close proximity to aid their movements from one type to another (Gibbs 1991, Hunter 1996).

Indicators: The amount of interspersion between vegetation classes is assessed using diagrams developed from those found in the Washington State Rating System (WDOE 1993).

Scaling: AUs with more interspersion between vegetation classes score higher than those with fewer. The method has four categories of interspersion (none, low, moderate, high) and these are used as the basis for developing a scaled score. A high level of interspersion is scored a 1, a moderate a 0.67, a low = 0.33, and none = 0.

$V_{edgestruc}$ – The vertical structure and linear characteristics of the AU edge.

Rationale: The configuration (e.g., length of shoreline in relation to area) and differences in vegetation strata along the edge of the AU are important habitat characteristics for many species of wetland-associated birds. Additional habitat exists within vegetated lobes and scalloped edges of AUs with differences in edge strata and the shape of the AU edge.

For example, a simple AU may be a nearly circular pond with a fringing emergent marsh composed of cattails, which adjoin immediately to an upland of grazed pasture. The edge of the AU in this case is characterized as having low structural complexity (lack of shrubs and trees), and low linear complexity (as the edge is nearly circular, with no embayments or peninsulas). In contrast, a more complex AU may adjoin with an upland composed of trees and shrubs, adding to the structural complexity, and may be irregular along the edge, with many twists and turns, resulting in enclosed bays and jutting peninsulas. Further, embayments and peninsulas provide "micro-habitats" for certain species that require hiding cover, or "feel" more secure within a more enclosed system (USDI 1978, Verner et al. 1986, and WDOE 1993).

Indicators: The structure of the AU/upland edge is assessed by using a descriptive key that groups the edges and vertical structure along the edge into "high" structural complexity, medium, low, and none.

Scaling: AUs with a high structural complexity at the edge are scored a [1]; moderate = 0.67, low = 0.33, and none = 0.

$V_{spechab}$ – Special habitat features that are needed or used by aquatic birds. Five different habitat characteristics are combined in one variable. These are:

1) the AU is within 8 km (5 mi) of a brackish or salt water estuary;
2) the AU is within 1.6 km (1 mi) of a lake larger than 8 ha (20 acres);
3) the AU is within 5 km (3 mi) or an open field greater than 16 ha (40 acres);
4) the AU has upland islands of at leas 10 square meters (108 square feet) surrounded by open water (the island should have enough vegetation to provide cover for nesting aquatic birds); and
5) the AU has unvegetated mudflats.

Rationale: The suitability of an AU as habitat for aquatic birds is increased by a number of special conditions. Specifically, the proximity of an AU to open water or large fields increases its utility to migrant and wintering waterfowl. If there is strong connectivity between relatively undisturbed aquatic areas the suitability as habitat is higher (Gibbs et al. 1991, Verner et al. 1986). In addition, islands surrounded by open water provide a protected nesting area for ducks if they have adequate cover. Mudflats are an important feeding area for migrating birds.

Indicators: No indicators are needed for this variable because the presence of the special habitat features can be determined on site, from maps, or aerial photos.

Scaling: If an AU has 2 or more of the 5 habitat features it is scored a [1]. AUs with one habitat feature score a [0.5] for the variable, and those with none score a [0].

Chapman, D.W. 1966. The relative contributions of aquatic and terrestrial primary producers to the trophic relations of stream organisms. Pp. 116-130 in: Organism-substrate relationships in streams. PymantuningLab. Ecological Special Publication No. 4. University of Pittsburgh, Pittsburgh, PA.

Cooke, S. Cooke Scientific Services, Inc. Seattle, WA. Personal communication. 1997.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. US Fish and Wildlife Service, Washington, DC.

Cyr, H., and J. A. Downing. 1988. The abundance of phytophilous invertebrates on different species of submerged macrophytes. Freshwater Biology 20:365-374.

Davis, J. W., G. A. Goodwin, and R. A. Ockenfels, Coordinators. 1983. Snag Habitat Management: Proceedings of the Symposium, USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM – 99.

Davis, M. M., E. J. Clairain, Jr., W. Ainslie, M. Gilbert, M.A. Schwinn, M.Sheehan, G. Sparks, K. Trott, and M. Whited. 1995. Development of Regional Wetland Subclass HGM Functional Assessment Model Guidebooks. US Army Engineers Waterways Experiment Station. November Draft.

Denney, R.N. 1952. A summary of North American beaver management. 946-1948. Colorado Fish Game Department Report Number 28, Colorado Division of Wildlife.

Desbonnet, A., P. Pogue, V. Lee, and N. Wolff. 1994. Vegetated buffers in the coastal zone – A summary review and bibliography. Coastal Resources Center Technical Report No. 2064. University of Rhode Island Graduate School of Oceanography. Narragansett RI.

Dougherty, J. E., and M. D. Morgan. 1991. Benthic community response (primarily *Chironomidae*) to nutrient enrichment and alkalinization in shallow, soft water humic lakes. Hydrobiologia 215:73-82.

Dozier, H.L. 1953. Muskrat production and management. US Fish and Wildlife Service Circular No. 18.

Dunstone, N. 1978. The fishing strategy of the mink (*Mustela vison*); time-budgeting of hunting effort? Behaviour 67(3-4): 157-177.

Dupuis, L. A., J.N.M. Smith and F. Bunnell. 1995. Relation of terrestrial-breeding amphibian abundance to tree-stand age. Cons. Biol. 9:645-653.

Dvorak, J. and E.P.H. Best. 1982. Macro-invertebrate communities associated with the macrophytes of Lake Vechten: structural functional relationships. Hydrobiologia 95:115-126.