DEPARTMENT OF
ECOLOGY
State of Washington

Characterizing Wetland Buffers in Washington State

September 2017
Publication No. 17-06-008

Publication and Contact Information

This report is available on the Department of Ecology's website at
https://fortress.wa.gov/ecy/publications/SummaryPages/17-06-008.html

For more information contact:

Shorelands and Environmental Assistance Program
P.O. Box 47600
Olympia, WA 98504-7600

Phone: 360-407-6600

Washington State Department of Ecology - www.ecy.wa.gov

o Headquarters, Olympia	360-407-6000
o Northwest Regional Office, Bellevue	425-649-7000
o Southwest Regional Office, Olympia	360-407-6300
o Central Regional Office, Yakima	509-575-2490
o Eastern Regional Office, Spokane	509-329-3400

Accommodation Requests:
To request ADA accommodation including materials in a format for the visually impaired, call Ecology at 360-407-6600 or visit http://www.ecy.wa.gov/accessibility.html. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.

This work was originally produced with funding from the U.S. Environmental Protection Agency Region 10 under Wetland Program Development Grant Assistance Agreement No. CD-00J47401-0.

Characterizing Wetland Buffers in Washington State

by

Thomas Hruby, Donna Bunten, Amy Yahnke and Jerry Franklin

Shorelands and Environmental Assistance Program
Washington State Department of Ecology
Olympia, Washington

September 2017
Publication No. 17-06-008

This page intentionally left blank.

Table of Contents

This page intentionally left blank.

List of Figures and Tables

Page

Figures

Tables

This page intentionally left blank.

1. Introduction

Wetland buffers are a primary tool for protecting wetlands that are used by state and local agencies in Washington State. However, several studies, including three in Washington, suggest that buffers are often not adequately established and maintained after a permit is issued (Cooke, 1992; Dyste, 1995; Morrison and Julius, 2001; Snohomish County, 2014). The benefits that buffers provide in protecting wetland functions and values cannot be realized without effective establishment and maintenance of buffers.

This manual provides procedures to characterize compliance with wetland buffers that are required under regulations both at the state and local levels. It can be used by state agencies and local governments to characterize both the implementation and the effectiveness of their requirements for wetland buffers. The results can also be used to inform management decisions on policies and regulations regarding buffers.

The focus of this analysis is the wetland buffer required on a site as part of a permit issued for a change in land use — not the buffers required on sites used for wetland mitigation. For example, the method characterizes the 100-foot buffer that is required for a commercial building that is built on a parcel containing an existing wetland.

This characterization focuses on two main questions. The first addresses whether permits that are issued are consistent with the requirements of a jurisdiction's wetland regulations. Did a permit require the appropriate buffer width and the conditions specified in the regulations, and was the project built according to the approved site plan illustrating those conditions? The results may indicate whether wetland regulations are being consistently applied.

The second question addresses the ecological condition of the wetland buffer. Has the buffer been maintained according to the permit conditions, and are there stressors currently affecting the buffer's effectiveness? The analysis may reveal that certain key stressors are common in a jurisdiction or that periodic monitoring is required in order to maintain buffers in their natural state.

After conducting a characterization of its wetland buffers, a jurisdiction may want to review its policies and regulation on buffers. To aid in this review, the Department of Ecology summarized the current scientific information on wetland buffers in Update on Wetland Buffers: The State of the Science (Ecology Publication #13-06-011, October 2013).

The main steps in the characterization are:

1. Randomly select permits for review
2. Collect background information on those permits from project files
3. Compare the requirements in the permit with the requirements of the Critical Areas Ordinance (CAO) of the jurisdiction that issued the permit

4. Collect data on four metrics that characterize the condition of the existing buffer using remote sensing methods (e.g., aerial/satellite imagery)
5. Ground-check the accuracy of the data in the field if necessary
6. Compile and analyze data

Forms used in these steps are located in the appendices.

Jurisdictions can use a variety of GIS/GPS-based methods to collect data in Step 4 above. Examples are provided in Section 5, as well as criteria that should be considered when selecting a method.

This work was originally produced with funding from the U.S. Environmental Protection Agency Region 10 under Wetland Program Development Grant Assistance Agreement No. CD-00J47401-0.

2. Selecting permits for review

The first step in characterizing wetland buffers is to select permits to review. If the study involves a local city or county, factors to consider are the total number of permits issued; whether the jurisdiction has a permit tracking system; and, if so, how much information can be obtained from that system.

If a database maintained by a local jurisdiction is to be used as the initial source of permits, at a minimum it should be able to list projects that have required wetland permits or critical area review. The tracking system can then be used to produce an initial list of projects including the project's location, applicant's name and address, and possibly parcel number. If the database does not track the size of the required buffers, the size of the impact project, or whether restoration was required, it may then be necessary to review the permit project files to determine whether a permit meets the criteria for analysis.

Depending on the purpose of the user of this method, all permits may be examined, or a specific number of permits may be selected randomly. To determine a statistically valid sample size, two factors must be considered: the number of classes and the number of permits available for review. For example, if the goal of the study is simply to determine if wetland buffers are being correctly implemented, then one class is under consideration. If an additional goal is to determine whether Category I wetlands are protected more consistently than Category IV wetlands, then there are two classes being considered and the sample size will be larger. Jurisdictions with a large number of permits available for review may use a set of subsamples for analysis. A minimum of 50 samples per class is recommended (Congalton and Green, 2009).

To determine the order of review, use a random number generator (such as http://stattrek.com/statistics/random-number-generator.aspx) to select permits from a

numbered list. It may be necessary to reject some permits that do not meet the desired criteria. In addition, it may be difficult to obtain permission to visit some permit sites, if that becomes necessary. Therefore, we recommend selecting random numbers in excess of the desired number of study permits.

Criteria for selecting a permit to analyze:

- Project file exists
- Project file contains enough information to ascertain or confirm buffer requirements
- Project site actually does contain a wetland or is adjacent to one; i.e., not all on-site wetlands were filled
- Buffer is a wetland buffer, not a stream buffer
- Project was completed

3. Collecting background information on permits

After creating an initial list of permits to review, you will need to review the project files to locate any relevant documents and collect the information about the permit. Use the Screening Sheet in Appendix A to collect information while reviewing the file. This sheet summarizes the information on the project, the wetland, the required buffer in the permit, and the buffer required by the CAO in effect at the time the permit was issued. You may want to scan or flag the source documents so they are easily available if you need additional information at a later time.

NOTE: The Screening Sheet can be altered depending on the needs of a particular study.

4. Comparing the requirements for buffers in the permit to those in the CAO

The objective of this step is to determine whether the requirements for wetland buffers in a permit were issued according to the requirements of the CAO in effect at the time of issuance. A secondary question is to determine if the resulting buffer width is more protective, less protective, or provides the same level of protection as the basic buffer requirements in the CAO. This information is useful in pinpointing where weaknesses might arise in a local government's wetland protection program.

The instructions, forms for recording data, and a table to summarize the results are provided in Appendix B. There are eight questions related to consistency and one related to level of protection. Before answering each question, review the details in the instructions on how to answer the question. In addition to the forms for recording data, two worksheets are provided to help you keep track of relevant information as you review

the permit and the CAO. These worksheets should be filled out for each permit and CAO you are reviewing and kept with the files of your study. This is especially important if you have not scanned copies of the relevant documents for future reference.

It is sometimes difficult to find the pertinent information in a CAO, and the language is often confusing. Exemption language may be in the wetlands section or in the general administration section. Required buffer widths and allowed reductions may be found in an appendix. If the CAO is a searchable document, you should try searching for key words, including *buffers, set-back, vegetation management, signs, exemptions, reasonable use*.

Below are some examples of how to approach specific scenarios, with the response in italics:

1. A jurisdiction's CAO requires a 25-foot buffer for Category III wetlands and allows a 50% buffer reduction with enhancement plantings. The permit for Project XYZ requires a 12.5-foot buffer with enhancement of remaining buffer. Is the permit consistent with the CAO? *Not Possible to Determine (NPD) since no information was given in the permit on wetland rating.* Is the permit the same, more protective, or less protective than the CAO? *You need to make the call on this one since the permit did not document the wetland rating, so we don't know if it is a Category III. If you assume the wetland being protected was a Category III, then answer "the same."*

2. A jurisdiction's CAO requires a 25-foot buffer for Category III wetlands, allows a 50% buffer reduction if adjacent land is densely vegetated, and contains no language regarding increasing buffers or mitigating buffer impacts. The permit for Project XYZ requires a 36-foot buffer for one wetland (a Category III wetland) and planting the impacted areas of the buffers of two other wetlands. Is the permit consistent with the CAO? *No because the buffer is larger than what is required in the CAO.* Is the permit the same, more protective, or less protective than the CAO? *More protective, since the CAO made no provision for increasing width.*

3. A jurisdiction's CAO requires a 25-foot buffer for Category III wetlands, allows a 50% buffer reduction with enhancement plantings, and provides a reasonable use exception (RUE) which requires meeting the usual criteria (minimum alteration to allow reasonable use, etc.). The permit for Project XYZ requires a buffer ranging from 5 feet to 15 feet and describes how the project meets the RUE criteria. Is the permit consistent with the CAO? *Yes, this project met all the RUE criteria.* Is the permit the same, more protective, or less protective than the CAO? *Less protective, because the decision was made to allow a smaller-than-the-standard buffer in order to allow use of the property.*

4. A jurisdiction's CAO requires a 25-foot buffer for Category III wetlands, allows a 50% buffer reduction with enhancement plantings, and provides a reasonable use exception (RUE) which requires meeting the usual criteria (minimum alteration to allow reasonable use, etc.). The permit for Project XYZ requires a buffer ranging from 1 foot to 10 feet; however, the project was constructed without a permit and

did not meet the RUE criteria beforehand. Is the permit consistent with the CAO? *No, this project did not meet all the RUE criteria.* Is the permit the same, more protective, or less protective than the CAO? *Less protective.*

5. Characterizing the buffer*

This method uses four metrics to characterize the condition of a wetland buffer on a project site:

1. The percentage of the wetland edge that is adjacent to an ecologically significant buffer
2. The width of ecologically significant buffer within the permit buffer
3. The area of ecologically significant buffer within the permit buffer
4. Stressors that are present within the permit buffer

A procedure using Geographic Information System/Global Positioning System (GIS/GPS) tools is provided in Appendix E. As an alternative to visiting sites to collect information, jurisdictions may use the highest quality aerial imagery that is available to them. Site visits provide data that are sometimes slightly more accurate but take significantly more staff time. In addition it is often difficult to obtain permission from land owners to access the site, and some sites are difficult to visit because of the terrain. However, there may be circumstances where it is difficult to collect all the information from aerial imagery, and a site visit may be necessary (see box below).

A site visit may be necessary when:

- The wetland and buffer are forested.
- The original site plan is of poor quality, making it difficult to transfer features to aerial imagery
- The available parcel boundary information is difficult to transfer to aerial imagery
- The required features are difficult to interpret on the aerial imagery.

We suggest you obtain the latest aerial imagery available because land uses may change with time. Aerial photos found on Google or Bing are usually no more than one or two years old. Once you have completed the analysis of the aerial imagery, you will need to decide when a site visit is warranted. This will depend on the resources available, the

* *The procedures for collecting data on ecologically significant buffers and on the stressors are adapted from the USA-RAM Manual, Version 11, January 2011. Much of the text is copied directly from the USA-RAM manual. Available from: http://vendornet.state.wi.us/vendornet/wais/docs/17268_3.pdf, accessed 6 July 2017.*

overall purpose of the study, and whether the added accuracy of the field data is important in your decision-making. Some information may be verified by making observations from adjacent properties or roads if permission to access a site is denied.

5.1 Definitions

Ecologically significant buffer*: The land around a wetland only counts as an ecologically significant buffer if it consists of a type of land cover that is capable of protecting the wetland from stressors present in the surrounding landscape. Land covers that might provide limited buffering under special circumstances are not considered ecologically significant buffers for this analysis. An example is pasture land managed for ecological functions, because detailed information about such local conditions cannot be determined from these methods. Tables 1 and 2 provide the criteria for identifying an ecologically significant buffer.

NOTE: These methods are different from assessing habitat in the Washington State wetland rating system because they are based on the USA-RAM.

Table 1. Criteria for Identifying Ecologically Significant Buffers. To qualify as ecologically significant buffer, a land cover must meet all four of the listed criteria.

CRITERIA
1. Is on the list of "ecologically significant buffer land covers" in Table 2
2. Is at least 5 m wide
3. Extends at least 10 m along the wetland boundary as a contiguous cover **patch** *NOTE: This means that land covers that would qualify as ecologically significant buffers that are less than 10 m long along the wetland boundary are to be considered as a "non-ecologically significant buffer land cover".*
4. Is not separated from the wetland by a non-ecologically significant buffer cover that is ≥ 5 m wide *NOTE: This means that a gap of a "non-ecologically significant buffer land cover" that is less than 5m is to be disregarded if a land cover that can count as an ecologically significant buffer continues beyond the gap.*

* *This definition is from the USA-RAM. The USA-RAM manual uses the shortened term "ecological buffer." However, we have found this term confusing for users and have changed it to the more descriptive "ecologically significant buffer."*

Table 2. List of Ecologically Significant Buffer Land Covers Based on the Anderson Land Cover Class System.

Types of Land Covers that Count as Ecologically Significant Buffers	Non-Ecologically Significant Buffer Land Covers
▪ Open water (surfaces of lakes, bays, ponds, rivers, etc. with <5% plant cover) ▪ Wetlands ▪ Permanent ice or snow (year round snow or ice surfaces with <5% plant cover) ▪ Natural, non-vegetated earth surfaces (natural rock outcrops, sand, gravel, etc. with <5% plant cover) ▪ Natural vegetation (areas with ≥ 5% cover of mostly non-impacted vegetation, including herbaceous, forest, or old fields undergoing succession; excludes lawns, playing fields, agricultural crops of any kind, recent clear-cuts or otherwise impacted forest lands, or recently burned lands) ▪ Trails (foot trails, equestrian trails, single-track bicycle trails, etc.)	▪ Built structures (houses, factories, schools, etc.) ▪ Artificial, non-vegetated land surfaces (parking lots, solar farms, feed lots, etc. that support <5% plant cover) ▪ Active mining areas (quarries, strip mines, gravel pits, etc.) ▪ Any active agriculture (orchards, vineyards, row crops, hay or grain fields, sod farms, feedlots, recently clear-cut or otherwise severely impacted forest lands, etc. Includes fallow agricultural fields) ▪ Any recently burned lands ▪ Urban and recreational lawns, sports fields, etc. ▪ Any roadway dangerous to wildlife (railroads, busy streets, highways, etc.) ▪ ATV trails ▪ Stormwater ponds ▪ Utility corridors

It is assumed that the ecologically significant buffer helps protect the wetland by mitigating stress, including the deleterious effects of adjacent human land uses. In this study, we only analyze the ecologically significant buffer within the boundaries of a single property rather than the ecologically significant buffer of the entire wetland or assessment unit as defined in the USA-RAM. The purpose is to characterize the consistency of the buffer with what was permitted and describe its current condition.

Permit Buffer: The area landward of the wetland edge that is specified in the permit as a buffer to protect the functions and values of the wetland. The permit buffer is usually established at a specified width from the wetland edge and appears as a condition in the permit. It is based on requirements in the jurisdiction's wetland regulations, usually adopted in a critical areas ordinance.

Parcel Boundary: The legal boundary of the property for which the permit was issued. Parcel boundaries can be obtained from a surveyed site plan in the project file. It can also be obtained from county assessor's web site for the county in which the permit was issued. The ecologically sensitive buffer is evaluated only on the parcel of interest.

Site Plan: The project file should contain an approved site plan showing the wetland boundary, permit buffer, and other landmarks such as buildings and roads. The approved

site plan is the source of information transferred to the aerial imagery that serves as the base image.

Transect: A perpendicular line extending from the wetland boundary to either the permit buffer or the ecologically significant buffer, whichever is the farthest upland from the wetland. It is generated according to the instructions below for Metric 2.

Wetland Boundary: The wetland boundary shown on the site plan at the time the permit was issued. Ideally, this will be a professionally delineated and surveyed wetland boundary.

5.2 Setting up the permit buffer and ecologically significant buffer for collecting data

For each property in the study, you will need to create a map showing the features necessary for collecting data. Figures 1 and 2 provide visual examples of the steps.

General steps using basic web-based mapping tools or traditional mapping methods (see Appendix E for a specific GIS/GPS method):

1. Create a base image map of the permit site. Select the most recent and highest resolution aerial image of the parcel to use for creating the map. Sources may include NAIP (National Agriculture Imagery Program), Google, Bing, or the County Assessor's office.

2. Overlay the parcel boundaries of the permit site on the base image.

3. Locate the wetland boundary shown on the approved site plan for the permit. Ideally, the site plan will be validated by a survey. Transfer the wetland boundary shown on the site plan onto the base image. The scale on the base image should be used to match the distances on the surveyed map.

4. Locate the permit buffer on the approved site plan and add it to the map. Draw a line that is parallel to the wetland boundary at a distance that is equal to the required buffer width specified in the permit and on the site plan. This can be done by drawing several lines that are perpendicular to the edge of the wetland and equal to the required buffer width. The boundary of the permit buffer can then be plotted by connecting the end points of the lines.

5. Establish the ecologically significant buffer: Draw a line landward of the wetland boundary that indicates the edge of the ecologically significant buffer. You will need to review multiple images in order to decide where to draw the line; for example, different sources may have aerial imagery taken in different seasons, or some sources have oblique views of a parcel. You are trying to determine the boundary between a land cover that functions as an ecologically significant buffer and one that does not (see Table 2).

If the property you are analyzing meets the criteria for a "problem" site (see box on page 5), you will need to verify the ecologically significant buffer boundary and stressors by visiting the site. Fill out a separate data sheet for observations made in the field.

Figure 1 shows an example of a site plan for a project obtained from a permit file. Figure 2 shows the features of this site plan transferred to the base image of the site obtained from the county tax assessor's web site. In this example, the width of the permit buffer is 100 feet or 30.5 meters. Also, the footprints of the built structures shown in Figure 2 are different from those shown on the site plan in Figure 1. The project file does not provide any explanation for this discrepancy. Because the property is heavily forested, it is a good candidate for a site visit.

Figure 1. Example of a site plan for a project to be characterized using this method.

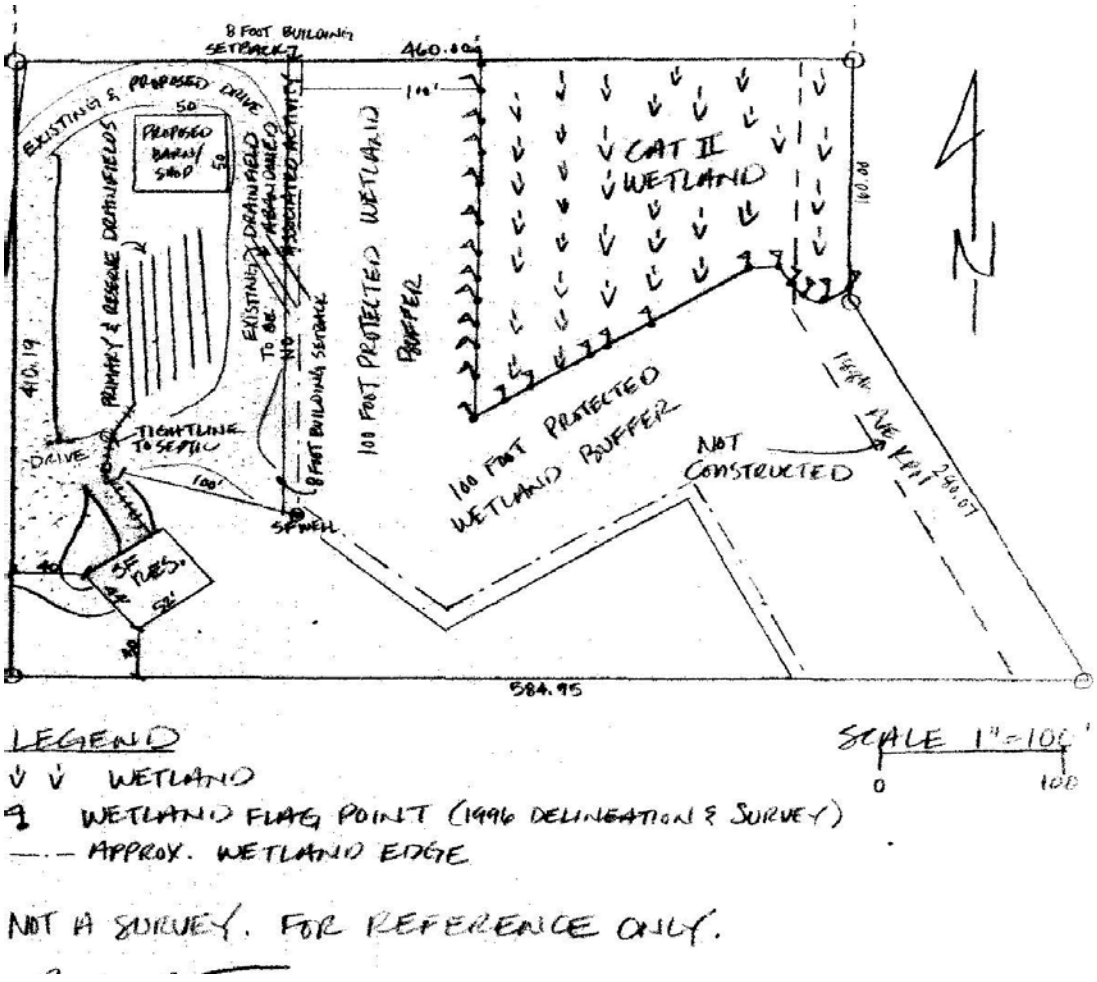
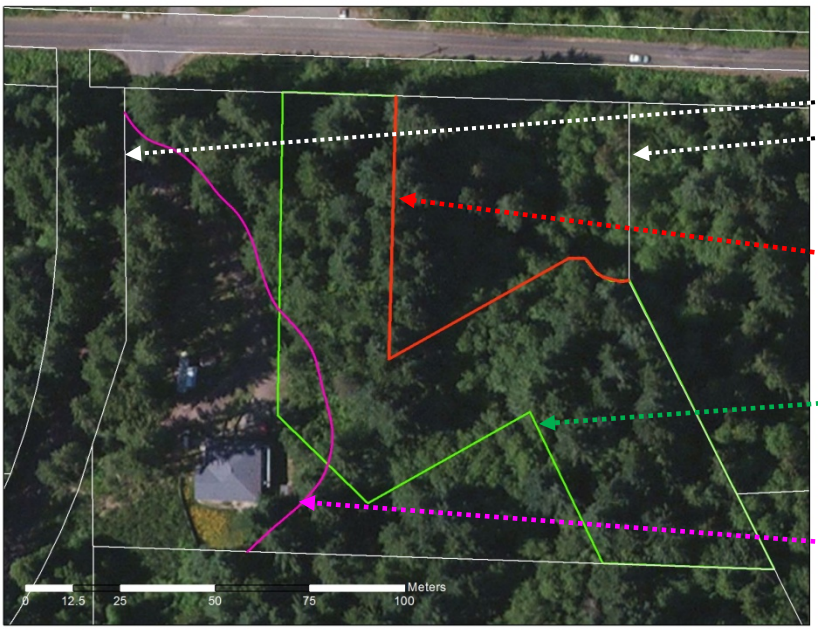


Figure 2. The features necessary for collecting data have been transferred onto an aerial image from the site plan shown in Figure 1.



White parcel lines obtained from county assessor web page

Wetland boundary from site plan

100-ft wide permit buffer as drawn on site plan

Ecologically significant buffer as determined from oblique aerial photos

5.3 Collecting data on four metrics

There are four metrics used to characterize the wetland buffer on a project site. Three characterize how much of the permit buffer is ecologically significant. One metric characterizes the stressors within the permit-required buffer. The field form for collecting data on the four metrics is found in Appendix D.

Metric 1: Percent of wetland edge adjacent to property with an ecologically significant buffer.

What the metric tells us: An ecologically significant buffer needs to be contiguous with the wetland to provide the best protection. Breaks in the buffer allow disturbances to penetrate into the wetland itself. Such breaks may provide a path for pollutants, domesticated animals, or other human disturbances to directly impact the wetland. This metric estimates the relative amount of ecologically significant buffer along the edge of the wetland. The assumption is that properties with a smaller percent of the wetland edge adjacent to an ecologically significant buffer are not protecting wetland functions as well as properties with a higher percent.

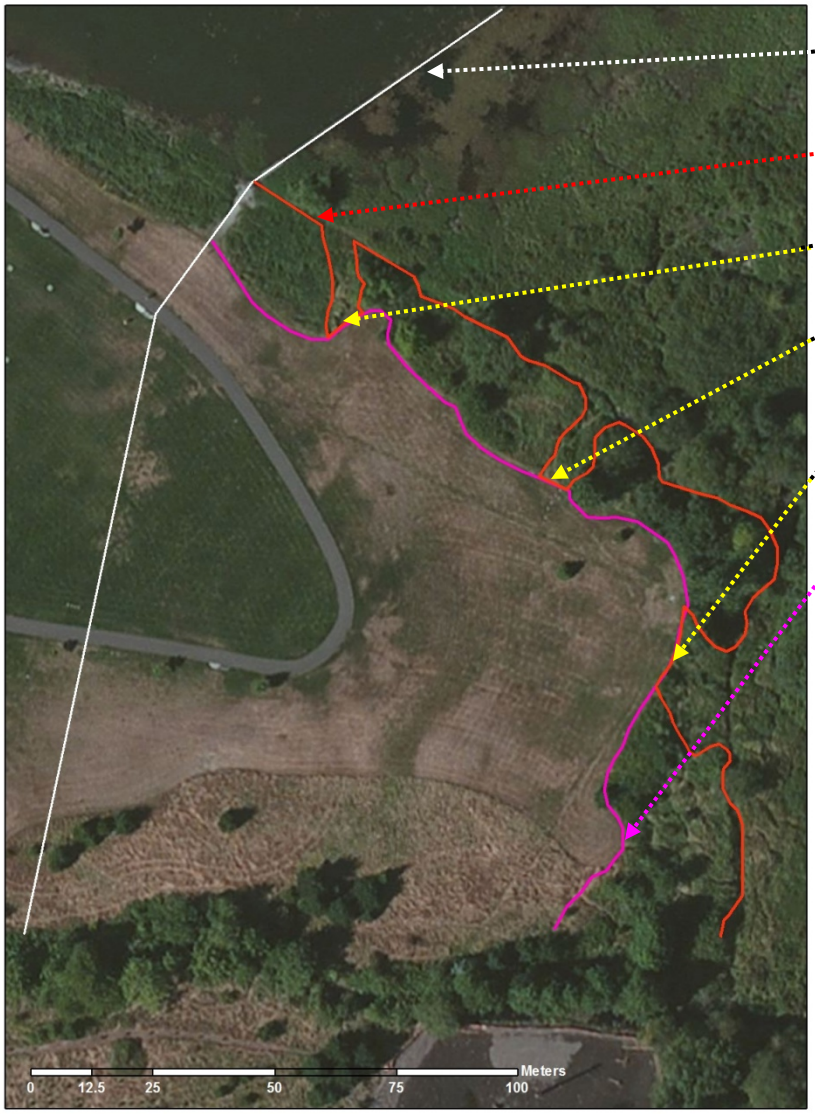
General approach – This metric is based on the percent of the wetland edge that adjoins an ecologically significant buffer (definition on see page 5) that is capable of protecting the

wetland. Only the edges of the wetlands within the property or whose ecologically significant buffer extends into the property are assessed. Use the aerial image to score this metric, followed by ground verification if the site meets the criteria for a "problem" site (see box on page 5). Use the aerial image to examine the entire edge of the wetland that is in or adjacent to the property being analyzed (Figure 2). Determine the percent of the wetland edge that is directly connected to an ecologically significant buffer as defined in Tables 1 and 2. Depending on the method used for this process, measurements can be made directly using online or desktop geospatial analysis programs (e.g., ArcGIS or Google Earth Pro) or by using a map wheel.

Starting with the map of the wetland edge and the property, measure the distance of the wetland edge that is within the property boundary or along its edge. The wetland edge of the property is shown in red on Figure 2. The boundary between a land cover that functions as an ecologically significant buffer and one that does not is shown in pink.

In Figure 2 the entire wetland edge on the parcel is bounded by an ecologically significant buffer, so Metric 1 would be 100%. This distance is 146 meters. Figure 3 on the following page gives an example where Metric 1 is less than 100%.

Figure 3. Example where Metric 1 is less than 100%, showing three areas where the non-ecologically significant buffer (mowed area) comes right to the edge of the wetland. This example was calculated using a map wheel. (Property is different from that shown in Figures 1 and 2.)



White parcel line obtained from county assessor web page

Wetland boundary

Places where wetland boundary has no adjacent ecologically significant buffer

Upland boundary of ecologically significant buffer as determined from oblique aerial photos

Example: Worksheet

Percent of Wetland Perimeter Adjoining Ecologically Significant Buffer (aerial photo) Measured perimeter of wetland edge is 39 mm on aerial photo	
Ecologically significant buffer	34 mm on photo
Non-ecologically significant buffer	5 mm on photo
Total % Wetland Perimeter with Buffer	**34/39 = 87**

Metric 2: Width of ecologically significant buffer within permit buffer

What the metric tells us: The width of the ecologically significant buffer is also an important variable that characterizes how well a buffer protects wetland functions (Sheldon et al., 2005). Many wetland-dependent species need relatively undisturbed vegetated buffers of a specific width if their population is to survive. The average width of the ecologically significant buffer can help us understand what species the wetland may or may not support. The width of buffers prescribed in regulations and permits is often too small to protect all wetland-dependent species (Semlitsch and Bodie 2003; Goates and others 2007). However, when characterizing the compliance of a project with its permit requirements, the focus should be only on the width of the ecologically significant buffer within the buffer area required in the permit.

General Approach - Calculate the average width of the ecologically significant buffer by averaging the width along 10 transects that fall within the required permit buffer, then calculate the average width of the ecologically significant buffer within the permit buffer as a percent of the width required in the permit.

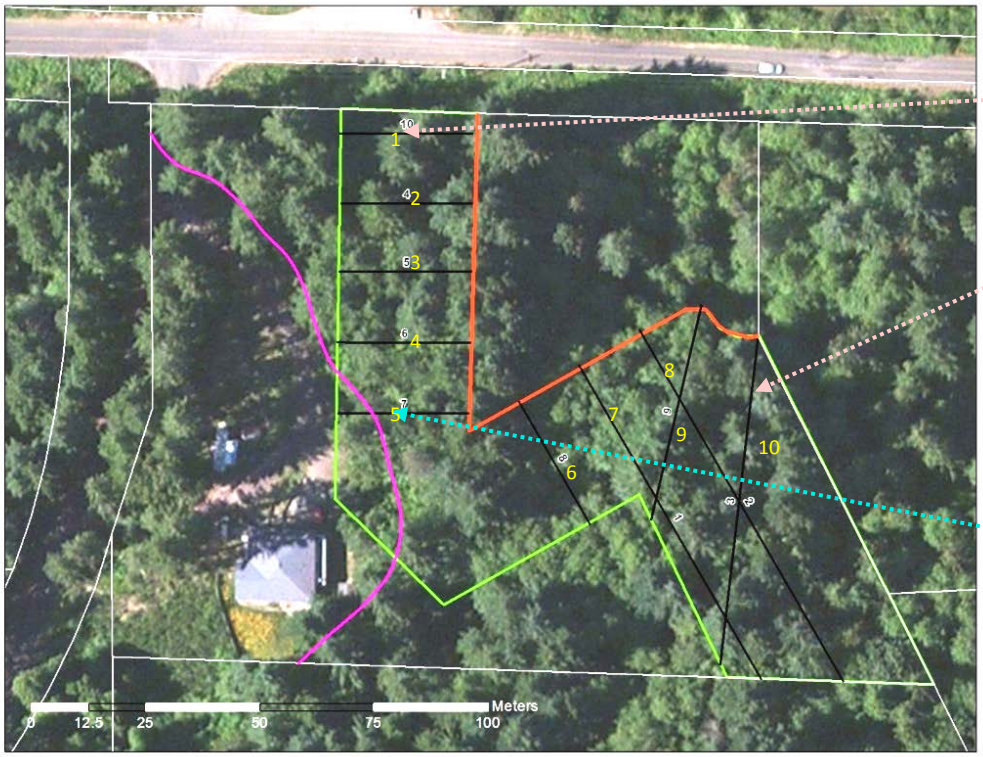
Procedure - Measure the distance of the wetland edge on the aerial image. In some cases, this may be different from the wetland edge that is actually within the property boundary that you measured for Metric 1. The wetland may curve along the property boundary without actually being on the property.

Create 10 equally spaced perpendicular transects along the wetland edge located on the parcel. Each transect will begin at the wetland's edge and end where it intersects the outer (landward) edge of the permit buffer. For each of these transect lines, generate the distance (meters) between the wetland edge and the point at which the transect first intercepts any type of non-ecologically significant buffer land cover (see Tables 1 and 2 above). This distance equals the width of the ecologically significant buffer on each transect line. Next, convert this distance to a percentage. For example, if the permit requires a buffer width of 45.7 m (150 feet) but the actual ecologically significant buffer is only 15.2 m (50 feet), the percent is 33%.

1. Generate the ecologically significant buffer width in increments of 1 meter (3.3 feet).
2. Ignore any non-ecologically significant buffer areas that do not cover at least 2 meters of a line. *NOTE: We deviate here from the distance (5 m) specified in the USA-RAM because many permit buffers are relatively small (15m – 30 m). A 5-meter exclusion would represent 1/3 of the distance*.
3. Record the distance on the worksheet for Metric 2.
4. Calculate the average of the percent value for the 10 transects and record this as the value for Metric 2.
5. If the site meets the criteria for a "problem" site (see box on page 5), check the accuracy of the aerial imagery during the site visit. If the site visit indicates that the aerial image is not accurate, redraw the boundaries of the ecologically significant buffer on the photo and re-calculate Metric 2.

Figure 4 shows how the transects for Metric 2 are created for the property shown in Figure 1.

Figure 4. Ten transects created for Metric 2.



10 equidistant transects from the wetland boundary to the permit buffer, shown as black lines with yellow numbers.

Example of transect where width of ecologically significant buffer is narrower than permit buffer.

Table 3. Example of worksheet for generating average width of ecologically significant buffer from Figure 4. Transect 5, where width of ecologically significant buffer is narrower than permit buffer, is highlighted.

Transect Line	**Metric 2: Ecologically significant buffer width (m) estimated from aerial photo** (in 1 m increments)	**Metric 2: Ecologically significant buffer as a percentage of permit buffer width estimated from aerial photo (%)**
1	30	100
2	30	100
3	30	100
4	30	100
5	20	67
6	30	100
7	110	100
8	120	100
9	70	100
10	90	100
Average Width	**56**	**97**

The ecologically significant buffer in the property shown in Figure 4 extends all the way to the edge of the permit buffer on 9 of the 10 transects. In this case, the ecologically significant buffer is 97% of the permit buffer.

Metric 3: The area of ecologically significant buffer within the permit buffer

What the metric tells us: The area of the ecologically significant buffer is also an important variable that characterizes how well a buffer protects wetland functions (Semlitsch and Bodie 2003). Many wetland-dependent species need relatively undisturbed vegetated habitats next to a wetland (called "core habitats" by some ecologists) if their population is to survive. The area of the ecologically significant buffer can help us understand what species the wetland may or may not support. However, when characterizing the compliance of a project with its permit requirements, the focus should be only on the area of ecologically significant buffer within the buffer width required in the permit. If the area of the ecologically significant buffer is the same as the area of the permit buffer, we can conclude that the project has met its legal requirements.

General Approach - This metric measures the area of the ecologically significant buffer as a percent of the total area within the permit buffer.

Procedure - For this metric, use the boundary of the permit buffer and the boundary of the ecologically significant buffer (as defined in Table 1 and Table 2) that is found within the property. This is the area of the ecologically significant buffer. If there are areas that do not meet the criteria for an ecologically significant buffer within this polygon, mark those areas on the photo. They will not be included in the overall estimate of area.

NOTE: If the boundary of the ecologically significant buffer is landward of the permit buffer along its entire length and there are no patches of non-ecologically significant buffer within the permit buffer, then the answer for Metric 3 is 100%, and you need to go no further.

1. Generate the area of the permit buffer using one of the tools available for measuring area (planimeter, square/dot grid overlay, GIS, online mapping tools etc.). Since Metric 4 is recorded as a percent, there is no need to convert measurements to square meters or square feet.

2. Generate the area of the ecologically significant buffer within the boundary of the permit buffer using the same technique as in #1. Do not include any polygons that are considered as "non-ecologically significant buffers."

3. Calculate the percent of ecologically significant buffer [(area of ecologically significant buffer/area of permit buffer) x 100].

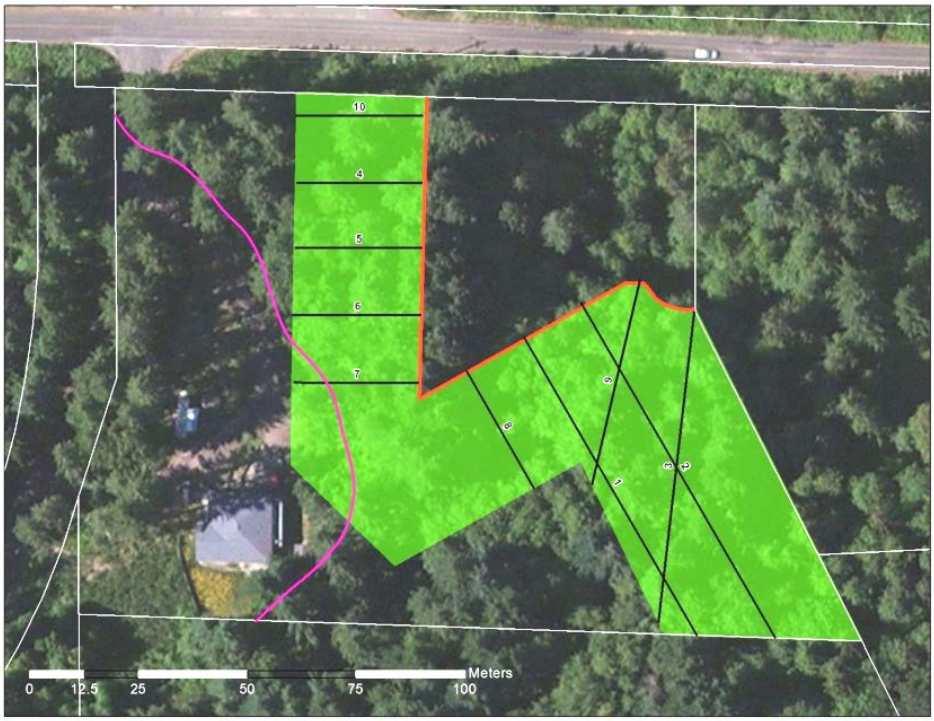
4. If the site meets the criteria for a "problem" site (see box on page 5), check the accuracy of the aerial photographs during the site visit.

Table 4 shows how Metric 3 is calculated for the areas illustrated in Figure 5. The ecologically significant buffer is determined by subtracting the area of the non-ecologically significant buffer from the area of the permit buffer.

Table 4. Example of a worksheet for Figure 5 showing area of ecologically significant buffer as a percentage of the permit buffer area.

Percent of permit buffer that has an ecologically significant buffer Units of measure are grid squares from overlay. Total permit buffer area = 428 squares	
Ecologically significant buffer	400
Non-ecologically significant buffer	28
Ecologically significant buffer as a % of permit buffer	**93%**

Figure 5. Green-shaded area is the area of the permit buffer (428 squares).



Blue-shaded area is the area of non-ecologically significant buffer (28 squares).

Metric 4: Stress within the permit buffer

What the metric tells us - Buffers can provide some protection to wetlands from human activities and the stressors they can generate. However, buffers can become overwhelmed if stressors are too severe. This metric is designed to tabulate and characterize the types and severity of stressors that can reduce the effectiveness of the buffer.

Stressors can occur within the permit buffer, even in the parts that can be considered as relatively undisturbed (the ecologically significant buffer). You will need to record the stressors and characterize their severity in the permit buffer.

General approach - Buffer stress is assessed by examining the permit buffer for evidence of stressors.

Procedure - Observations are made using aerial imagery, maps, and any other useful sources of information. Observations are recorded on the data form (see Appendix D, Metric 4).

This metric is assessed based on the number of stressor categories (Hydrology, Habitat/Vegetation, Residential/Urban/Commercial Land Use, and Agriculture) that are evident within the permit buffer (i.e., their presence or absence), as well as their severity based on the area of the buffer that is "stressed." The indicators of stress for each category are provided in Table 5. Look for the indicators of each stressor category in the permit buffer and check them off on the data sheet. Use this information to characterize the severity of each stressor category according to Table 6. The severity of a stressor category within the permit buffer is characterized based on the relative area affected by all of the individual stressors within each stressor category.

For example, if half of the permit buffer is covered by a lawn from a city park with an access road running through it, you would check off the indicators for "Lawn/park" and "Parking lot/pavement" and circle "2" for the Residential/Urban/Commercial Stressors category. If there is a culvert in the permit buffer, you would check off that indicator and circle "1" for Hydrological Stressors because it influences less than one-third of the area of the permit buffer.

It is important to be consistent when collecting data for this metric. We recommend using the data form on several practice sites and having one person responsible for this metric to eliminate variability. Some indicators will not be evident in aerial photos. Only stressors that are observed at the time of the most recent aerial images or the site visit should be counted. Indicators of past disturbance tend be less reliable and should not be considered.

Table 5. Indicators of stress in the permit buffer. Each category needs to be given a severity ranking using Table 6 below.

Field Indicators by Stressor Category
Hydrological Stressors
Ditches/ drains/ channelization
Dikes/dams/levees/ railroad or road beds
Culverts, pipes (point source discharge except stormwater)
Water level control structure
Obvious spills, discharges or odors; unusual water color or foam
Moderate to heavy formation of filamentous algae
Excavation, dredging
Fill / spoil banks
Wall/riprap
Inlets and outlets
Input from impervious surfaces (road drains, stormwater culvert, bioswales, roof drains)
Lawns or other landscaped features
Habitat/Vegetation Stressors
Soil subsidence, scour or surface erosion (root exposure)
Substrate disturbance (ATVs off-road vehicles, mountain biking)
Sediment input (construction, erosion, agricultural runoff)
Forest - selective cut
Forest - clear cut (this one can affect water regime too)
Removal of large woody debris
Tree plantation present
Heavily grazed grasses, excessive grazing, or mowing
Damage of Tree canopy by pests or herbivory
Shrub layer browsed or weakened by disease or pests
Fire lines (fire breaks)
Lawns, gardens, or other landscaping with non-native vegetation
Recently burned forest canopy
Recently burned grassland
Mowing/shrub cutting (brush hogging)
Other mechanical plant removal
Chemical vegetation control (herbicide application)
Cover of non-native or invasive species (as listed in Table 7)
Presence of power lines or utility corridors (continual maintenance)
Oil/gas wells
Logging roads
Trails, parks, and other recreational uses with dogs
Residential/Urban/Commercial Stressors
Suburban residential land use < 1 house/10 acres
Suburban residential land use 1 house/5 – 10 acres

Suburban residential land use 1 house/1 -5 acres
Urban single or multifamily land use > 1 house/acre
Urban/commercial buildings and other facilities (e.g. electric stations)
Road – gravel
Road – 1 or 2 lane paved
Road- 4 lane
Parking lot/ pavement
Lawn/ park
Golf course
Landfill
Gravel pit/mining
Surface mine
Military land
Trash/ dumping
Agricultural Stressors
Pasture / rangeland
Row crops
Small grains
Nursery and/or greenhouses
Orchard
Dairy
Confined animal feeding operations
Irrigation (irrigated land)
Fallow field – recent
Fallow field – old
Rural residential

Table 6. Guidelines for assessing the severity of a stressor.

Portion of Area of Permit Buffer Influenced by Stressor Category	Severity Code
less than one-third	1
between one-third and two-thirds	2
at least two-thirds	3

Table 7 provides a list of plants that are considered non-native or invasive species for the purposes of this study.

Table 7. List of Non-Native or Invasive Species for Metric 4*.

Eurasian Watermilfoil	*Myriophyllum spicatum*
Waterhyacinth	*Eichhornia crassipes*
Yellow Floating Heart	*Nymphoides peltata*
Giant Salvinia	*Salvinia molista*
Garlic Mustard	*Alliaria petiolata*
Poison Hemlock	*Conium maculatum*
Mile-a-Minute Weed	*Persicaria perfoliata*
Birdsfoot Trefoil	*Lotus corniculatus*
Purple Loosestrife	*Lythrum salicaria*
Knotweed	*Polygonum aviculare*
Japanese Knotweed	*Polygonum cuspidatum*
Perennial Pepperweed	*Lepidium latifolium*
Giant Reed	*Arundo donax*
Cheatgrass	*Bromus tectorum*
Reed Canary Grass	*Phalaris arundinacea*
Common Reed	*Phragmites australis*
Johnsongrass	*Sorghum halepense*
Kudzu	*Pueraria montana var. lobata*
Multiflora Rose	*Rosa multiflora*
Common Buckthorn	*Rhamnus cathartica*
Himalayan Blackberry	*Rubus armeniacus*
Tamarisk	*Tamarix* spp.

At present, EPA has not provided a "key" for interpreting the data for Metric 4 collected as part of the USA-RAM work. However, data on stressors can be used to gain an understanding of the categories of stressors that are more prevalent in a jurisdiction. The numbers can also be used to compare one site to another or for gaining a sense of how one watershed compares to another within a jurisdiction. This information can be used to develop strategies to better protect the functions and values wetlands provide.

The data on stressors (Metric 4) should be summarized for each stressor category in Table 8.

* *U.S. Environmental Protection Agency. 2011. National Wetland Condition Assessment: Field Operations Manual. EPA-843-R-10-001. U.S. Environmental Protection Agency, Washington, DC.*

Table 8. Summary of stressors and their severity by category.

Ranking of Severity	Stressor Category
	Hydrological Stressors
	Habitat/Vegetation Stressors
	Residential/Urban/Commercial Stressors
	Agricultural Stressors

6. Obtaining access to the sites

If it is necessary to visit a site in order to characterize the buffer, you will need to obtain permission. Permission can be difficult to obtain—as few as 20% of' current property owners may be willing to allow access. This should be considered in the design of the study.

If the study is being conducted by the jurisdiction that issued the original permit, access may not be an issue. Many permits include a condition requiring property owners to allow access for monitoring.

If the study is not being conducted by the permitting jurisdiction, you will need to discuss the issue of enforcement with that jurisdiction. For example, to increase participation, it may be necessary to grant immunity from enforcement actions if a site is found to be out of compliance with permit conditions. This will need to be decided before contacting the property owner.

Use the parcel number and local county tax assessor's database to find the current owner, and then use whatever resources are available to obtain the owner's phone number. It is best to make the first contact by phone. Explain the project and ask for permission to access the site. If the owner is willing, send a permission form (see example in Appendix C) and a return envelope so the owner can sign and return it to you. If no phone number is available, send a letter (see Appendix C) explaining the project and asking permission to access the site. Include a return envelope.

7. Summarizing the information collected

After reviewing the wetland permit for consistency with the jurisdiction's wetland regulations and completing the characterization of the resulting wetland buffer, the following questions can be answered:

1. Was the buffer required by the permit consistent with the requirements of the CAO in effect at the time of issuance?
2. Does the full extent of the buffer required in the permit meet the criteria as an ecologically significant buffer?
3. If not, then what portion of the permit buffer is ecologically significant?
4. What are the dominant stressors that can affect the performance of the permit buffer?

Table 9 is an example of a table summarizing the results of characterization. The table is also included in the data collection forms in Appendix D.

Table 9. Summary of wetland buffer characterization.

Question	Result	Other observations
1. Was the buffer in the permit issued according to the requirements of the CAO in effect at the time of issuance?	*(From Section 4 and Appendix B)*	
2. Does the full extent of the buffer required in the permit meet the criteria as an ecologically significant buffer?	*(From Metrics 1, 2, 3 and Appendix D)*	
3. If not, then what portion of the permit buffer is ecologically significant?	*(From Metric 3 and Appendix D)*	
4. What are the dominant stressors that can affect the performance of the permit buffer	*(From Metric 4 and Appendix D)*	

The results for a particular site can then be compared to other sites. After reviewing all the sites in the study, a jurisdiction may want to review its policies, regulations, and procedures to determine where improvements in wetland protection are needed.

For example, you may find that lawns and lawn debris are intruding into the buffer and reducing the buffer's performance. Improved monitoring procedures may help identify and reduce these stressors. Or the study may reveal deficiencies in project file management that make it difficult to determine what wetland buffer conditions (width, signage, vegetation management) were required for the project. This information can be used to assess permit compliance over time.

8. References

Congalton, R. G., & Green, K. (2009). Sample Design Considerations *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices, Second Edition* (pp. 63-83). Boca Raton, FL: CRC Press.

Cooke, Sarah Spear (1992). Wetland Buffers – A Field Evaluation of Buffer Effectiveness in Puget Sound. Appendix A. In: Castelle, A. J. et al. Wetland Buffers: Use and Effectiveness Shorelands and Coastal Zone Management Program, Washington State Department of Ecology Publication No. 92-10. Olympia, WA.

Dyste R. (1995). Wetland Buffers in the Monterey Bay Region: A Field Study of Function and Effectiveness. M.S. thesis. San Jose State University, San Jose, CA.

Goates, M.C., K.A. Hatcha, and D.L. Eggett (2007). The need to ground truth 30.5 m buffers: a case study of the boreal toad (*Bufo boreas*). Biological Conservation 138: 474-483.

Morrison, S. and T. Julius. (2001). Tracking Development on Streams and Wetlands. Thurston Regional Planning Council. Olympia, WA.

Semlitsch, R. and J.R. Bodie (2003). Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles. Conservation Biology 17:1219-1228.

Sheldon, D., T. Hruby, P. Johnson, K. Harper, A. McMillan, T. Granger, S. Stanley, and E. Stockdale. (2005). Wetlands in Washington State – Volume 1: A Synthesis of the Science. Washington State Department of Ecology. Washington State Department of Ecology Publication No. 05-06-006.

Snohomish County (2014). Critical Areas Monitoring Report, Analysis of the Effectiveness and Implementation of Permitting and Enforcement to Protect Critical Areas in Snohomish County. Department of Planning and Development Services & Department of Public Works – Surface Water Management Division. 68 pp.

Appendix A

Form for Screening Permits

This page intentionally left blank.

Form for Screening Permits

Jurisdiction _____

Project Name _____

File Number (need all files: building, engineering, etc.)

_____

Date Reviewed _____ Scanned File Number _____

Date of Project Approval/Permit _____

Date Project Completed_____

Project Type _____

Project Size _____

Project Location _____

Date of Wetland Report _____

Size of Wetland _____

Geomorphic Setting _____

Wetland Rating _____

Permit Required Buffer Width _____

Fixed or Variable Buffer _____

Buffer Averaging_____

Buffer Reduction and Reason_____

Buffer Restoration Type _____

Final Inspection Required _____

Buffer Monitoring Required _____

Date of CAO in Effect _____

Buffer Required by CAO in Effect _____

Other Relevant Information _____

_____

_____

_____

_____

This page intentionally left blank.

Appendix B

Instructions and Worksheets for Comparing Permit To CAO

This page intentionally left blank.

1. Is the initial buffer (before any reductions or increases) specified in the permit the same as the standard buffer in the CAO for that type of wetland?

   NOTE: The "standard" buffer in the CAO means the basic width specified in the CAO for that category or type of wetland. The "standard" buffer includes automatic adjustments for habitat score and land use intensity that are specifically listed in the CAO as part of the initial calculations for widths. It does not, however, include discretionary reductions or increases that might be allowed such as those listed in Question 2.

   Look for any mention of buffers in the permit that are the same as those in the CAO. If no standard buffer is mentioned in the permit to which the reductions or increases are applied, mark the box [NO]. If the CAO buffers are based on wetland category but the permit does not include information on the wetland rating, check the box [NPD] for "not possible to determine." We will address consistency with reductions or increases in the next question.

   Is the initial buffer (before any reductions or increases) specified in the permit the same as the standard buffer in the CAO for that type of wetland?
   _____Yes _____ No _____ NPD
   Comments:
   _____
   _____
   _____
   _____

2. Are any changes in the buffer width in the permit consistent with the discretionary changes allowed in the CAO?

   NOTE: This does not include reductions that are a result of a Reasonable Use Exception or variance (see next question).

   Discretionary changes commonly made to buffer widths include:
   - Buffer averaging
   - Reductions in width with enhancement of the buffer
   - Reductions in width if impact-reducing measures are applied
   - Increases in width under special conditions

   If the CAO includes other options, please note them on the comment line.

   If multiple factors are used in a permit, then all must be consistent with the CAO to get a [YES]. Answer [NO] if the buffer widths in the permit are different from the allowed changes to the buffer in the CAO. If no changes to the standard buffer were proposed in the permit, answer [N/A].

Are any changes in the buffer width in the permit consistent with the discretionary changes allowed in the CAO?

_____Yes _____ No _____ N/A

Comments:

_____
_____
_____
_____

3. Is the justification for the change in buffer width documented in the permit?

   Answer [YES] only if the permit includes a discussion documenting that changes are in accordance with the CAO. The final buffer width may be within the limits specified in the CAO but it is "not consistent" with the CAO because there is no discussion of the rationale for the increases or decreases. In this case, mark boxes [NO] and also [But Within Range Allowed in CAO]. If any other factors must be considered before changes are allowed, note them on the comment line (e.g., buffers can be reduced only if adjacent land is on a 15% slope or less and is well vegetated). If no changes to the standard buffer were proposed in the permit, answer [N/A].

Is the justification for the change in buffer width documented in the permit?

_____Yes _____No _____ But Within Range Allowed in CAO _____N/A

Comments:

_____
_____
_____
_____

4. Are the provisions for a buffer reduction under a Reasonable Use Exception (RUE) or variance in the permit consistent with the requirements in the CAO?

   NOTE: This question applies only to permits that claim a RUE or variance, not to any other exemptions or exceptions in the CAO. It pertains only to buffer reductions allowed under a RUE, not to any other aspects of a RUE.

To answer [YES] for this question, the permit must mention which RUE or variance criterion defined in the CAO is met. If the permit claims an RUE or variance without an explanation, mark [NO]. If no RUE is mentioned in the permit, mark [N/A].

Are the provisions for a buffer reduction under a Reasonable Use Exception (RUE) or variance in the permit consistent with the requirements in the CAO?
_____Yes _____ No _____ N/A
Comments:
_____
_____
_____
_____

5. Are the requirements for active buffer vegetation management in the permit consistent with the requirements in the CAO?

NOTE: In some cases a CAO requires buffer enhancement using native wetland vegetation. This is "active buffer vegetation management."

Answer [YES] if the permit includes the same requirements for vegetation management that are spelled out in the CAO. If the requirements are not part of the permit, or they are incomplete, mark [NO]. Answer [N/A] if the CAO does not contain requirements for actively managing the plants in the buffer. If the CAO states that vegetation management "may" be required, try to ascertain which conditions are mentioned in the CAO that would warrant vegetation management. Note on the comment line what those conditions are, and whether those conditions are 1) present at the site and 2) discussed in the permit.

Are the requirements for active buffer vegetation management in the permit consistent with the requirements in the CAO?
_____Yes _____ No _____ N/A
Comments:
_____
_____
_____
_____

6. Is the fencing of the buffer required in the permit consistent with the requirement in the CAO?

   Answer [YES] if the permit includes the same requirements for buffer fencing that are spelled out in the CAO. If the requirements are not present in the permit but are specified in the CAO, or the requirements are incomplete in the permit, mark [NO]. Answer [N/A] if the CAO does not contain requirements for fencing in the buffer. If the CAO states that buffer fencing "may" be required, try to ascertain which conditions are mentioned in the CAO that would warrant fencing and note on the comment line whether those conditions exist in the permit.

Is the fencing of the buffer required in the permit consistent with the requirement in the CAO?

_____Yes _____ No _____ N/A

Comments:

_____

_____

_____

_____

7. Are the signs for marking the buffer required in the permit consistent with the requirement in the CAO?

   Answer [YES] if the permit includes the same requirements for signs marking the buffer as spelled out in the CAO. If the requirements are not present, or they are incomplete, mark [NO]. Answer [N/A] if the CAO does not contain requirements for signs in the buffer. If the CAO states that buffer signage "may" be required, try to ascertain which conditions are mentioned in the CAO that would warrant fencing and note on the comment line whether those conditions exist in the permit.

Are the signs for marking the buffer required in the permit consistent with the requirement in the CAO?

_____Yes _____ No _____ N/A

Comments:

_____

_____

_____

_____

8. Overall, the buffer width requirement in the permit is the same, more protective or less protective than the basic buffer width requirements in the CAO.

   Consider all the factors that went into determining the final permit requirements and ask yourself this question: Does the permit buffer provide as much, more, or less protection than the buffers required in the CAO? Here is where you can use your judgment. The permit may not be consistent with the CAO but the final buffer in the permit is as protective as the CAO would require with all the modifications to the buffer width that are allowed.

   However, if the buffer is based on an RUE or a variance and is narrower than the "standard" buffer specified in the CAO, we consider that to be "not as protective." We consider it less protective, because the decision was made to allow a smaller-than-required buffer in order to allow use of the property. Land use in this case trumps wetland protection.

Overall, the buffer width requirement in the permit is:
_____ the same _____ more protective _____ less protective
than the basic buffer width requirements in the CAO.
Comments:
_____
_____
_____
_____

Additional Comments

If the CAO is especially vague with regard to reductions, signage and fencing requirements, or vegetation management, note any difficulties this caused on the comment line below.
Comments:
_____
_____
_____
_____
_____
_____
_____
_____
_____

This page intentionally left blank.

Worksheet For Reviewing a CAO

Jurisdiction _____

Date of CAO _____ (check permit to see when it was vested)

Date of Review _____ Reviewed by: _____

Buffer widths (if applicable, consider score for habitat points and land use intensity)

Category I _____

Category II _____

Category III_____

Category IV _____

Other _____

Reductions for implementing impact-reducing measures _____

Allowable discretionary changes to buffer width

Averaging _____ how much _____

Reduction if enhancement _____ how much _____

Increases for special conditions _____ what conditions _____

Other _____

Other requirements for buffer

Enhancement (planting to create an appropriate plant community, removal of non-native invasive plant species) _____

Signs_____

Fencing _____

Other _____

This page intentionally left blank.

Worksheet For Reviewing a Permit

Permit # _____

Date of permit_____ Date of CAO in effect when vested _____

Date of Review _____ Reviewed by: _____

Category of wetland for which permit is required

Category I _____

Category II _____

Category III_____

Category IV _____

Other _____

Basic buffer width specified in the permit_____(including adjustment for habitat points and impact-reducing measures if properly documented) (N/A if not discussed in permit)

Allowable discretionary changes to buffer width

Averaging _____ how much _____

Reduction if enhancement _____ how much _____

Increases for special conditions _____ what conditions _____

Other _____

Other requirements for buffer

Enhancement (planting to create an appropriate plant community, removal of non-native invasive plant species) _____

Signs_____

Fencing _____

Other _____

This page intentionally left blank.

Summary of Comparing the Requirements for Buffers in the Permit to Those in the CAO

Jurisdiction _____ Date of Review _____ Reviewed by: _____

Permit Number	Is buffer same as standard CAO	Buffer changes consistent with CAO	Justification for changes documented	RUE provisions consist with CAO	Buffer vegetation management consistent with CAO	Fencing consistent with CAO	Signs consistent with CAO	Overall width requirement the same, more or less protective than requirements in CAO

Y = Yes
N = No
NPD = Not possible to determine
N/A = Not applicable
< = Less protective than CAO
> = More protective than CAO

This page intentionally left blank.

Appendix C

Sample Letter Requesting Access to a Site

This page intentionally left blank.

Sample

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

November 30, 2012

Mr./Ms. Property Owner
1234 Local Lane
Local Jurisdiction, WA 98000

Subject: Permission to Visit Your Property to Characterize Wetland Buffer

Dear Mr./Ms. Property Owner:

I am writing to ask permission to conduct a site visit on your property.

The Washington State Department of Ecology is developing a method of studying wetland buffers. Buffers are vegetated areas next to a wetland that help protect it from undesirable impacts. Wetland buffers are an important part of local wetland protection programs.

The method we are developing will be used in future studies to determine if the wetland buffers required by local government permits were established, are still present, and what the buffer's current condition is.

Your property was randomly selected from a list of permits issued in *(name of local government)* during the last 10 years that required some type of buffer protection. We would like to visit your property to test our method of buffer characterization. During the site visit, we will take measurements of the buffer width and make observations of the condition of the buffer, such as whether the buffer is vegetated. We estimate that this work would take between 2-4 hours to complete.

If we are allowed to access your property, we will only be making observations of the wetland buffer and not anything else we may see on your property. We will conduct our visit during normal business hours (8 a.m. to 5 p.m.), on a weekday between March 1 and June 28, 2013. I will contact you regarding the exact date and time after I've contacted other property owners in your area.

We hope you will consider helping us complete this part of our wetland buffer study. If you are willing to allow us to visit your property, please sign the enclosed copy of this letter and return it to me in the enclosed envelope by *fill in date*. Please include any instructions regarding fences, animals, or other circumstances that we need to be aware of. We understand that working on your property is a privilege, and we will respect your rights and wishes at all times.

Please call me at (360) 407-7172 if you have any questions about this request or the buffer study. If we are given permission to visit your property, I will contact you regarding the exact date and time after I've contacted other property owners in your area.

Sincerely,

Donna J. Bunten
Project Coordinator
Shorelands and Environmental Assistance Program

Enclosed: Copy of letter and return envelope
cc: Local government contact

Right of Entry Agreement

Property Address:

1234 Main Street, Local Jurisdiction, WA

☐ Yes, I give permission for Department of Ecology and City of XXXX staff to visit the above property for the purpose of performing tasks related to characterizing the wetland buffer, such as taking photographs and measurements of the wetland buffer. I understand that I will be contacted regarding the exact date and time, and I am providing my telephone number below for that purpose.

☐ No, I do not want Department of Ecology and City of XXXXX staff to visit the above property as part of the wetland buffer study, and I deny permission to access this property.

_____
Signature

_____
Address

_____
Phone Number

This page intentionally left blank.

Appendix D

Data Forms for Characterizing the Buffer

This page intentionally left blank.

SITE ID: _____ Date of field work (if applicable) _____
Work done by:_____

Metric 1: Percent of Wetland Adjacent to Property With an Ecologically Significant Buffer

Percent of wetland perimeter adjoining ecologically significant buffer Measured perimeter along property boundary = _____	
Ecologically significant buffer	
Non-ecologically significant buffer	
Total % wetland perimeter with ecologically significant buffer	

Metric 2: Width of Ecologically Significant Buffer Within Permit Buffer

Transect line	**Ecologically significant buffer width (m) estimated from aerial photo** (in 1m increments)	**Ecologically significant buffer as a percentage of permit buffer width estimated from aerial photo (%)**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Average Width Within Permit Buffer		

Metric 3: Area of Ecologically Significant Buffer Within Permit Buffer

Percent of permit buffer that has an ecologically significant buffer Units of measure are _____	
Ecologically significant buffer	
Non-ecologically significant buffer	
Ecologically significant buffer as a % of permit buffer	

Metric 4: Stressors in the Permit Buffer.

If an individual stressor is present, place a checkmark next to it. Circle the appropriate level for *each of the four stressor categories* based on table below. Record initial ratings based on aerial photos and then confirm ratings in the field if necessary. Leave the row blank if stressor is not present. Summarize the stressors in the rows at the end of the form.

Portion of Buffer Zone Influenced by Stressors	**Rating of Severity**
less than one-third	1
between one-third and two-thirds	2
at least two-thirds	3

Circle number for overall severity of stressor category			**Field Indicators by Stressor Category**
1	**2**	**3**	**Hydrological Stressors**
			Check if the indicator is present
			Ditches/ drains/ channelization
			Dikes/dams/levees/ railroad or road beds
			Culverts, pipes (point source discharge except stormwater)
			Water level control structure
			Obvious spills, discharges or odors; unusual water color or foam
			Moderate to heavy formation of filamentous algae
			Excavation, dredging
			Fill / spoil banks
			Wall/riprap
			Inlets and outlets
			Input from impervious surfaces (road drains, stormwater culvert, bioswales, roof drains)
			Lawns or other landscaped features

1	2	3	Habitat/Vegetation Stressors
			Soil subsidence, scour or surface erosion (root exposure)
			Substrate disturbance (ATVs off-road vehicles, mountain biking)
			Sediment input (construction, erosion, agricultural runoff)
			Forest - selective cut
			Forest - clear cut
			Removal of large woody debris
			Tree plantation present
			Heavily grazed grasses, excessive grazing, or mowing
			Damage of Tree canopy by pests or herbivory
			Shrub layer browsed or weakened by disease or pests
			Fire lines (fire breaks)
			Lawns, gardens, or other landscaping with non-native vegetation
			Recently burned forest canopy
			Recently burned grassland
			Mowing/shrub cutting (brush hogging)
			Other mechanical plant removal
			Chemical vegetation control (herbicide application)
			Cover of non-native or invasive species (as listed in Table 7)
			Presence of power lines or utility corridors (continual maintenance)
			Oil/gas wells
			Logging roads
			Trails, parks, and other recreational uses with dogs
1	**2**	**3**	**Residential/Urban/Commercial Stressors**
			Suburban residential land use < 1 house/10 acres
			Suburban residential land use 1 house/5 – 10 acres
			Suburban residential land use 1 house/1 -5 acres
			Urban single or multifamily land use > 1 house/acre
			Urban/commercial buildings and other facilities (e.g. electric stations)
			Road – gravel
			Road – 1 or 2 lane paved
			Road- 4 lane
			Parking lot/ pavement
			Lawn/ park
			Golf course
			Landfill
			Gravel pit/mining
			Surface mine
			Military land
			Trash/ dumping
1	**2**	**3**	**Agricultural Stressors**
			Pasture / rangeland
			Row crops
			Small grains
			Nursery and/or greenhouses
			Orchard
			Dairy
			Confined animal feeding operations
			Irrigation (irrigated land)
			Fallow field – recent

	Fallow field – old
	Rural residential
Total Severity Ranking	**Stressor Category**
	Hydrological Stressor
	Habitat/Vegetation Stressor
	Residential/Urban/Commercial Stressors
	Agricultural Stressors

Summary of wetland buffer characterization.

Question	Result	Other observations
1. Was the buffer in the permit issued according to the requirements of the CAO in effect at the time of issuance?	*(From Section 4 and Appendix B)*	
2. Does the full extent of the buffer required in the permit meet the criteria as an ecologically significant buffer?	*(From Metrics 1, 2, 3 and Appendix D)*	
3. If not, then what portion of the permit buffer is ecologically significant?	*(From Metric 3 and Appendix D)*	
4. What are the dominant stressors that can affect the performance of the permit buffer	*(From Metric 4 and Appendix D)*	

Appendix E

GIS/GPS Method for Characterizing the Condition of a Buffer

This page intentionally left blank.

GIS/GPS Method for Characterizing the Condition of a Buffer

ESRI® ArcGIS v10.0 software was used in this application. As many features as possible should be created using the same source information and the most recent and highest resolution orthophoto imagery. In this application, a site plan map was provided by the local government showing the project parcel boundaries, the wetland boundary, and the permit buffer. The wetland scientist reviewed available aerial imagery to delineate an ecologically significant buffer on a printed copy of the site plan map. The site plan map was then scanned into a GIS compatible digital format (.tif). The scanned site plan map was georeferenced into the GIS environment, and a GIS analyst digitized all features that can be practically extracted with high confidence. In this project, [1] a wetland boundary, [2] a permit buffer*, and [3]an ecologically significant buffer were digitized from the scanned site plan map. In some cases, a permit buffer of a given width was GIS generated.

[4] Ten equidistant transects perpendicular to the wetland boundary, [6] permit buffer area(s) and [7] ecologically significant buffer area(s) were all generated in GIS. All transects that intersect with an ecologically significant buffer or permit buffer were split and given unique identifiers for analysis. Excel spreadsheet tables for all features were exported for the validation process. All GIS features contain unique identifiers and all units are calculated in meters.

GPS field work collected [8]GPS points, lines, or polygon features representing the presence of an ecologically significant buffer on the ground and features representing the presence of non-ecologically significant buffer features using the GIS project site maps as background imagery. The GPS ecologically significant buffer was imported into GIS for final project site analysis (Figure E-1). If the wetland scientist determined the site plan-delineated ecologically significant buffer was inconsistent with the GPS-collected ecologically significant buffer, all transects that intersect the GPS ecologically significant buffer were split and given unique identifiers for analysis. Digital and hard maps were produced for each project site for analysis and GPS applications.

In some projects, GPS digital pictures with cardinal direction were taken and imported into the GIS environment for additional mapping information.

Final GIS analysis will be used to analyze landscape characteristics, validate the existence of the permit buffer, characterize any disturbances within the permit buffer according to this manual, and store the results for documentation.

Some GIS terminology is provided in italics. Standard GIS feature naming convention is provided in [brackets]. A GPS data dictionary was created to standardize GPS data collection.

GIS/GPS Summary

1. Georeference site plan
2. Generate buffers, boundaries, areas, and transects
3. Split transects, calculate lengths and areas, export tables
4. Export maps to GPS
5. Collect GPS features in the field
6. Import GPS data into GIS for final analysis
7. Export final maps and tables

GIS Methods and Support for GPS Field Work

1. Create GIS environment
    a. Open data frame and add background layers or imagery to locate site and zoom to street/neighborhood scale
    b. Set data frame coordinate system properties to WA Stateplane South (WA Ecology standard; see Projection and Coordinate system information below)
    c. Add features to support georeferencing at the parcel scale; e.g., orthophoto imagery, parcel layer, other layers such as transportation, utilities, or hydrography if necessary to see the parcel
2. Georeference locally submitted site plan
    a. Scan locally submitted site plan with the north facing up into a .tif digital format, showing the wetland boundary, permit buffer, and ecologically significant buffer as delineated on the site plan or supplied by the wetland scientist
    b. Scan site plan Use a georeferencing tool; add the unreferenced site plan to the data frame on top of the parcel and aerial imagery (*fit to display*) and *zoom* and/or *pan* until the site plan can be seen in transparency over the imagery at the parcel scale. Establish at least four locations (*links*) on the aerial imagery that can be precisely found on the site plan; e.g., property corners, streets, fence lines, or any permanent structure that can be found on both in the parcel/orthophoto imagery and the scanned site plan. Add these *links* in clockwise order and as spatially separate as possible (four or five parcel corners is preferred)
    c. Transform the site plan using a 1st polynomial order and then rectify to save the image as a new georeferenced image
    d. Save the GIS ArcMap document

3. Digitize buffers and boundaries into GIS environment

a. Digitize the wetland boundary from the georeferenced site plan and (*save/convert to feature*) to the standard format [A10_wb]
b. Digitize the permit buffer from georeferenced site plan and (*save/convert to feature*) to the standard format [A10_pb]
c. Digitize the ecologically significant buffer from georeferenced site plan and (*save/convert to feature*) to the standard format [A10_eb]
d. Merge all three features into one shapefile (A10_buffers)
e. Add a floating numerical field to the attribute table titled 'meters' and calculate geometry to meters
f. Labels: add a text field with ~twenty characters to the attribute table titled 'label' and calculate each feature record with the appropriate label; e.g., wetland boundary to ["wetland bnd"], permit buffer to ["permit buffer"], and ecologically significant buffer to ["eco buffer"]
g. Export the merged buffer attribute table to excel (A10_wb.xls)

4. Generate ten transect perpendicular from the wetland boundary to the permit buffer or ecologically significant buffer, whichever is the farthest away from the wetland boundary (as a visual feature only in Map2; no need for attribute calculations)
    a. Generate ten transects perpendicular from the wetland boundary to the permit buffer or ecologically significant buffer, whichever is the farthest away from the wetland boundary
    b. *Add* ten equally spaced points along the wetland boundary (*convert polylines to points*) [A10_trans_pnts]
    c. Digitize ten lines perpendicular to the wetland boundary from each of the ten points to the first feature; the permit buffer or the ecologically significant buffer and convert all ten transects to a single shapefile [A10_transects]
    d. Add a floating numerical field to the attribute table titled 'meters' and calculate geometry to meters
    e. Recalculate the 'ID' field in the attribute table to equal the 'FID' plus one to get sequential numbers from one to ten (*calculate field 'ID' = 'FID' + 1*)

5. Split transects at buffers
    a. Split the transects at the intersection of the permit buffer or the ecologically significant buffer if/where they occur (this is typically an edit function (*split feature*)
    b. Recalculate the 'ID' field in the attribute table to equal the 'FID' plus one to get sequential numbers from one to the highest transect section (*calculate field 'ID' = 'FID' + 1*)

c. Re-calculate geometry in the attribute table on the 'meters' field to equal meters (this must be done every time a shapefile is modified)
d. Export the attribute table to excel (A10_transects.xls)
e. Save GIS map document

6. Generate buffer areas
    a. Digitize the permit buffer area as the area between the wetland boundary and the permit buffer on the parcel and create a shapefile
    b. Digitize the ecologically significant buffer area as the area between the wetland boundary and the ecologically significant buffer on the parcel and create a shapefile
    c. Digitize the area where the ecologically significant buffer encroaches within the permit buffer as the non-ecobuffer area, if/where it exists
    d. Add a floating numerical field to all three attribute tables titled 'meters' and calculate geometry to square meters
    e. Export the attribute tables to excel (A10_pb_area.xls) (A10_eb_area.xls) (A10_non_eb_area)

7. Export maps
    a. Export as .jpeg at approximately 150dpi ([A10_draft_map.jgp] with a world file)
    b. Change the symbol properties on all features to a standard format and label each feature for mapping (transect ID's and buffers must be clearly visible)
    c. Export maps at the parcel level with the most current orthophoto and the appropriate features as necessary (transects, wetland boundary, buffers, parcel lines, and labels for GPS field work)
    d. Export georeferenced maps for GPS applications as necessary

8. GPS preparation
    a. Configure GPS to match GIS properties, coordinate systems, and units (WA Ecology standard)
    b. Import GIS maps to GPS
    c. Import the data dictionary to GPS
    d. Charge the GPS units overnight prior to field work

9. GPS fieldwork
    a. Create a new GPS project, choose data dictionary, set antenna height, and verify configuration
    b. Open background imagery and zoom to extent or parcel scale

c. Collect GPS points, lines, or polygon features representing the presence of an ecologically significant buffer and/or features representing the presence of non-ecologically significant buffer areas
d. Take digital photos and field notes

10. GPS to GIS
    a. Import GPS features and rename to standard format (A10_gps_eb)
    b. Add the GPS features to the map document and symbolize
    c. Split the transects at the GPS ecologically significant buffer feature if/where they intersect (this needs confirmation from wetland staff to determine if the segment is too short or relevant)
    d. Recalculate the 'ID' field in the attribute table to equal the 'FID' plus one to get sequential numbers from one to the highest transect section (*calculate field 'ID' = 'FID' + 1*)
    e. Calculate geometry in the attribute table on the 'meters' field to equal meters (this must be done every time a shapefile is modified)
    f. Export maps as .jpegs (A10_gps_map) and the attribute table to excel (A10_gps_transects.xls)
    g. Save GIS map document

GIS Feature Definitions and Attributes Values

1. Wetland boundary [A10_wet_bnd] - line feature digitized from a georeferenced site plan representing a wetland edge at the time of permit
2. Permit buffer [A10_pb] - line feature digitized from a georeferenced site plan representing the permit buffer
3. Ecologically significant buffer [A10_eb] - line feature digitized from a georeferenced site plan representing the ecologically significant buffer as delineated by the wetland scientist
4. Transects [A10_transects] – ten equidistant transects perpendicular to the wetland boundary extending to either the permit buffer or the ecologically significant buffer, whichever is encountered first.
5. Permit buffer areas [A10_pb_area] – the area(s) between the wetland boundary and the permit buffer on the parcel
6. Ecologically significant buffer areas [A10_eb_area] - the area(s) between the wetland boundary and the ecologically significant buffer on the parcel
7. GPS ecologically significant buffer [A10_gps_eb] – a GPS-collected feature on the site representing the presence of an ecologically significant buffer feature or area
8. Non-ecologically significant area – the non-ecologically significant area within the permit buffer on the parcel

buffer attributes

ID	label	meters
1	eco buffer	507.471
2	permit buffer	211.87
3	Wetland bnd	166.79

buffer area attributes

ID	label	sq_meters
1	ecologically significant buffer area	124.54
2	permit buffer area	211.87

transect attributes

ID	meters	ID	meters	ID	meters	ID	meters
1	79.5879	6	88.1123	12	11.8677	18	12.653
2	87.679	7	87.7908	13	11.5922	19	12.1846
3	87.8782	8	88.2891	14	13.1416	20	10.6867
4	87.8314	9	89.2119	15	13.2667	21	3.68929
5	87.6319	10	24.2884	16	12.3429		
		11	12.8342	17	11.0829		

GPS ecologically significant buffer attributes

ID	Max PDOP	Corr Type	GPS_Date	Feat Name	Positions	GPS Length	meters
1	9.5	postprocessed	5/21/2013	GPS_ecologically significant buffer	1247	1893.01	577.152

GPS Data Dictionary

Wetland Boundary, line
source
- site plan
- existing

access
- all
- most
- limited
- offset
- other, text, 30

Ecologically Significant Buffer, line
source
- site plan
- existing

access
- all
- most
- limited
- offset
- other, text, 30

Wetland Feature, point
existing
- edge
- outlet
- inlet
- plantings
- other, text, 30
- from background, text, 30

Nonecologically Significant Buffer, point, line, area
- non eco feature, text, 30

feature type
- lawn
- concrete
- gravel
- disturbed

Permit Buffer, line
source
- site plan
- existing
- other, text, 30

Spatial Data Standards - Projection and Coordinate system (WA Ecology standards)

Horizontal Datum	NAD 83 HARN
Vertical Datum	NAVD-88
Projection System	Lambert Conic Conformal
Coordinate System	Washington State Plane Coordinates
Coordinate Zone	South 4602
Coordinate Units	U.S. Feet
Accuracy Standard	+/- 3 feet or better

Figure E-1. Shows GPS-collected ecologically significant buffer (light pink line) and new area of non-ecologically significant buffer (light blue area). Compare to GIS-generated non-ecologically significant buffer (dark pink line) in Figure 5b (dark blue area).