Field Manual for Pilot Method to Apply Rapid Ecological Integrity Assessments in Wetlands of Riparian Areas in Maryland: Upper Coastal Plain

Prepared by Gwenda L. Brewer, Jason Harrison, and Peter Stango, Maryland Department of Natural Resources, Wildlife and Heritage Service, Annapolis, Maryland, January 2022. Photos by Gwenda Brewer, Jason Harrison, and Peter Stango (clockwise from top).

Additional Edits by Denise Clearwater, Wetlands and Waterways Program, Maryland Department of the Environment

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement CD 963478-01-3 to the Maryland Department of the Environment. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

TABLE OF CONTENTS **Page**

1.0 INTRODUCTION.....5

1.0.1 Background.....5

1.0.2 Ecological Assessment.....6

1.1 Purpose and Need.....6

1.2 General Procedures and Guidelines.....8

2.0 SITE BACKGROUND INFORMATION AND DELINEATION OF PROJECT AREA AND WETLAND ASSESSMENT AREA.....11

3.0 LANDSCAPE LEVEL ASSESSMENT.....12

3.1 Imagery and Tools for Landscape Level Assessments.....13

3.2 Buffer Metrics.....14

3.2.1 Buffer Perimeter.....14

3.2.2 Buffer Condition.....16

3.3 Aquatic Context.....18

3.4 Comparative Size.....19

3.5 Additional Features.....22

4.0 FIELD DATA COLLECTION.....22

4.1 Site/Assessment Area Information.....23

4.2 Environmental Information.....24

4.3 Classification of Assessment Area to Key Wildlife Habitat.....26

4.4 Soil/Substrate.....29

4.5 Hydrology.....31

4.5.1 Water Source.....31

4.5.2 Channel.....35

TABLE OF CONTENTS Page

4.5.3 Hydroperiod and Hydrologic Connectivity 37

4.6 Key Wildlife Habitat and Vegetation Composition.....39

4.6.1 Interspersion and Patch Richness.....39

4.6.2 Vertical Structure.....41

4.6.3 Standing and Downed Woody Debris.....44

4.6.4 Vegetation Composition.....46

4.6.5 Invasive Species.....46

4.6.6 Native Species.....47

4.6.7 Floristic Quality Assessment.....49

5.0 CALCULATION OF ECOLOGICAL INTEGRITY ASSESSMENT SCORES.....49

5.1 Overall Ecological Integrity Assessment Score/Rating.....51

LITERATURE CITED.....52

LIST OF FIGURES

Figure 1. Example Imagery for Use of Watershed Resources Registry.....14

Figure 2. Example Imagery for Buffer Perimeter Metric Calculation.....16

Figure 3. Example Imagery for Buffer Condition Metric Calculation.....17

Figure 4. Example Imagery for Aquatic Context Metric.....19

Figure 5. Interspersion Scoring Diagrams.....40

LIST OF TABLES

Table 1. General step-by-step guidelines for applying the Ecological Integrity Assessment (wetland delineation completed).....9

Table 2. General step-by-step guidelines for applying the Ecological Integrity Assessment (wetland delineation NOT completed).....10

Table 3. Guidelines for Identifying Natural Buffers.....15

Table 4. Buffer Perimeter Metric Rating Criteria.....15

TABLE OF CONTENTS **Page**

Table 5. Buffer Condition Metric Rating Criteria……17

Table 6. Aquatic Context Metric Rating Criteria……18

Table 7. Patch Type Definitions for Typical Spatial Patterning of Key Wildlife Habitats……20

Table 8. Comparative Size Metric Rating Criteria……21

Table 9. Landscape Position……24

Table 10. Water Source……24

Table 11. Hydrological Regime……25

Table 12. Maryland Key Wildlife Habitat Classification Key for Non-tidal Wetland Habitats of the Upper Coastal Plain, including HGM Class……26

Table 13. Maryland Key Wildlife Habitat Characteristic Species by Vegetation Layer: Coastal Plain Wetlands (Western Shore)……28

Table 14. Biogeochemical Cycling: Redox Concentrations Metric Rating Criteria ……29

Table 15. Microtopography Metric Rating Criteria ……30

Table 16. Soil Organic Matter Metric Rating Criteria ……30

Table 17. Organic Matter Accumulation Metric Rating Criteria ……30

Table 18. Water Source Metric Rating Criteria……32

Table 19. Channel Characteristics Metric Rating Criteria……35

Table 20. Channel and Hydroperiod Field Indicators by Key Wildlife Habitat……36

Table 21. Hydroperiod and Hydrologic Connectivity Metric Rating Criteria……38

Table 22. Patch Richness Scoring Metric……40

Table 23. Interspersion and Patch Richness Metric Rating Criteria……41

Table 24. Vertical Structure Metric Rating Criteria……42

TABLE OF CONTENTS **Page**

Table 25. Standing and Downed Woody Debris Metric Rating Criteria.....45

Table 26. Invasive Species Metric Rating Criteria.....47

Table 27. Native Species Metric Rating Criteria.....48

Table 28. Ratings and Points for Mean Core Factor Scores and Overall Ecological Integrity Score.....50

Table 29. Additional Points for Unique Resources.....51

LIST OF APPENDICES

Appendix 1. Key Wildlife Habitats for the Pilot Project Area: Upper Coastal Plain.....56

Appendix 2. Resources for Site Background Information and Assessment Area Determination.....69

Appendix 3. Field Data Sheets.....71

Appendix 4: Ecological Integrity Assessment Score Sheet.....75

Appendix 5: Condensed Scoring Tables for Field Use.....77

1.0 INTRODUCTION

1.0.1 Background

A watershed implementation plan (WIP) has been approved for the Chesapeake Bay and the State of Maryland and its local jurisdictions have waste load allocations to meet for reducing nutrients and sediment. An updated watershed management plan has also been developed for the Coastal Bays. There are certain practices in these plans (stream restoration, shoreline stabilization, and wetland restoration) which often require Maryland Department of the Environment (MDE) authorizations, and hundreds to thousands of additional applications are anticipated over the next few years. Although MDE must process incoming applications now and in a timely manner, by using existing policies, methods, guidance and tools, MDE seeks to continuously improve its methods, approaches, and tools to ensure that these activities are effective and that the processes MDE uses to review these activities are cost-effective and efficient.

Stream restoration is a creditable practice under the WIP for reducing nutrients and sediment. Proposals are made in settings with varying degrees of degradation. Some areas retain wetland characteristics and continue to provide important habitat benefits. In some cases, the stream restoration may result in tradeoffs in resource types and unintended consequences and effects. Potential unintended consequences and tradeoffs include: loss of riparian/wetland forest; conversion of vegetated wetland to open water; increased temperature in the stream; lowered dissolved oxygen in the stream; lowered pH in the stream; and blockages to passages to aquatic life.

There is a need to improve assessment and recommendations for restoration projects to reduce resource tradeoffs and unintended consequences. The assessment and guidance produced under this project will better ensure that restoration projects are designed in a manner to protect aquatic resources that may be present or dependent on the site while still resulting in restoration which may receive credit for reducing nutrients and sediment.

The field criteria include new office and field ecological assessments based on the Key Wildlife Habitats for nontidal stream/wetland complexes described in the Maryland State Wildlife Action Plan. Assessments will focus on rapid indicators (including plant communities; indicators of disturbance and wildlife use) for classifying the type of habitat and suitability for an appropriate type of restoration. The Maryland State Wildlife Action Plan may be viewed at:

http://dnr2.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx

The information will be used by the Department of Natural Resources (DNR) and MDE as funding and review agencies to provide guidance to restoration practitioners in designing

appropriate restoration projects which would improve existing resource condition, result in stream restoration qualifying as a creditable practice for nutrient and sediment reduction while also maintaining or enhancing the habitat conditions essential for the Species of Greatest Conservation Need, as identified in the Maryland State Wildlife Action Plan.

1.0.2 Ecological Assessment

An ecological integrity assessment can be defined as "an assessment of the structure, composition, and function of an ecosystem as compared to reference ecosystems operating within the bounds of natural or historic disturbance regimes" (adapted from Lindenmayer and Franklin 2002; Young and Sanzone 2002; Parrish et al. 2003). To have ecological integrity, an ecosystem should be relatively unimpaired across a range of ecological attributes and spatial and temporal scales. Identification of reference or benchmark conditions based on natural or historic ranges of variation, although challenging, can provide a basis for interpretation of ecological integrity (Swetnam et al. 1999). Ecological integrity is key to maintaining a diversity of natural communities of plants and animals across Maryland's landscape into the future.

This document describes the protocols for applying rapid, field-based Ecological Integrity Assessments (EIA) to stream-associated wetland ecological targets as modified from the Level 2 EIA methodology of Rocchio et al. 2016, Faber-Langendoen et al. (2012, 2016a,b,c), and Shappell et al. (2016). This assessment relies on a general conceptual model that identifies and scores ground-level major ecological factors to assess the level of integrity relative to reference site conditions; uses a remote sensing approach to assess landscape context; and uses ecological classifications (Key Wildlife Habitats) to refine the assessment of metrics and overall ecological integrity.

The EIA method enables consistent and repeated assessment of biodiversity sites to determine if value is conserved, enhanced, or diminished. For each of the EIA metrics described in this manual, see Faber-Langendoen et al. (2012) for additional information on background, rationale, rating, scaling, and citations.

1.1 Purpose and Need

Guidance, assessment methods, and recommendations are needed to better ensure that restoration projects are designed in a manner to protect aquatic/wetland resources that may be present or dependent on the site while still allowing for projects which can receive credit toward nutrient and sediment reduction. The guidance and assessment method presented here is intended for restoration practitioners, planners, and regulators. It is assumed that the user is familiar with requirements of "Wetland Delineation Manual" and regional supplements used in Maryland (U.S. Army Corps of Engineers, USACE 2010) and U.S. Fish and Wildlife Service classification systems for the National Wetlands Inventory (https://www.fws.gov/wetlands/). In

order to minimize the additional time and resources associated with conducting the assessment, much of its information is derived from what is also recorded during wetland delineations according to the relevant Federal Manual.

This document includes multiple tools and supporting information as part of the guidance:

1) A classification system based on the vegetation communities of Key Wildlife Habitat (KWH), which support designated Species of Greatest Conservation Need, according to the Maryland Wildlife Action Plan with corresponding hydrogeomorphic (HGM) classifications;

2) Description of Key Wildlife Habitats (KWH) excerpted from the Maryland Wildlife Action Plan, with accompanying photos.

3) Office and field assessment to characterize wetland condition (ecological integrity) in relation to reference communities of KWH.

Recommendations for restoration based on extent of degradation and condition of the KWH riparian resources present are summarized in a separate document.

The specific goal of this EIA is to provide a repeatable and rapid protocol that provides information on the condition of a wetland in terms of its ecological value to wildlife, especially those Species of Greatest Conservation Need identified in the Maryland State Wildlife Action Plan (Maryland DNR 2015), as well as its ecological integrity relevant to unaltered or reference wetlands. To meet these goals, this EIA focuses on the condition of Key Wildlife Habitats (Appendix 1), those habitats that support the animal species considered to be Species of Greatest Conservation Need (SGCN) and associated rare plants and natural communities. SGCN include all state- and federally listed Threatened or Endangered species, rare species, endemic species, declining species, and responsibility species for which Maryland harbors a significant portion of the overall population. The distribution and abundance of SGCN and other Maryland wildlife species are directly related to the condition, extent, and location of their habitats. Because of the strong tie between species and habitats, it is critical to identify those habitats that support SGCN in order to conserve them. These species are listed by KWH in the Maryland State Wildlife Action Plan.

Because vegetation typically reflects biological, geological, and ecological patterns across the landscape, Key Wildlife Habitats are structured as ecological cover types based primarily on vegetation (Maryland DNR 2015). They are organized into a simple classification scheme which is scalable, allowing for compatibility with other ecological classifications. At the local level, this classification scheme is closely related to Maryland's natural community classification (Harrison 2016). This classification is a relatively fine-scaled classification system that uses an ecologically-

based hierarchy and grouping of vegetation associations from the U.S. National Vegetation System (Federal Geographic Data Committee 2008) as the foundation.

In considering the potential impacts of stream restoration projects, an assessment of the current condition of Key Wildlife Habitats can be useful to determine how proposed projects may benefit or degrade existing wetlands associated with the stream. If an additional objective of the assessment is to determine whether the site is a rare community type in Maryland, then Harrison (2016) can be used to link to the standard plant associations and determine conservation status. Although the pilot method presented here focuses on the southern portion of the Upper Coastal Plain (Anne Arundel, Prince George's, Calvert, Charles, and St. Mary's counties), the methodology is designed to provide information on the condition of similar Key Wildlife Habitats in other areas of the state with modification as needed.

1.2 General Procedures and Guidelines

This EIA is designed to make use of data collected during the wetland delineation and site inspection process at an area proposed for a stream restoration project. This document provides the process for establishing assessment target boundaries (i.e., assessment area) and protocols for collecting data necessary to apply the EIA metrics at both landscape and site levels. Metric scoring is adjusted to wetland type where needed and is based on known reference conditions for U.S. National Vegetation Classification types (Meininger and McCarthy 1997, Thomson et al. 1999, Harrison and Knapp 2010, USNVC 2019, Harrison pers. comm.). Stressors are identified based on known impacts of threats to these systems. Once metrics are scored, they are rolled-up into four core ecological factors: landscape, soil/substrate, hydrology, and habitat structure and composition. These core factor scores are combined to calculate an overall EIA score/rank if useful for project objectives. Scores are meant to be compared only between similar Key Wildlife Habitats or associations. Stream restoration project reviewers may only be interested in the core metric scores, as they provide insight into current condition, stressors present, potential impacts of the project on KWH and the species that they support, and measures of success. On the other hand, if the goal is to compare or prioritize sites for conservation, restoration, or management actions between areas, an overall EIA score/rank may be needed. Overall EIA scores for ratings other than "Excellent" may be increased if the project site includes certain unique resources or limited habitat types.

The EIA will be carried out using a combination of office and field assessments, preferably carried out in conjunction with the wetland delineation required for stream restoration project planning and permit application. If a formal wetland delineation has already been performed, some additional office and field assessments will be necessary (Table 1). If a rigorous wetland delineation has not been performed or is not finalized, the general steps of the process are outlined in Table 2. Office assessments use current information for the stream restoration

project area to examine landscape context and priority resources present for the entire project area and to define the boundary of each Assessment Area (AA) associated with the stream restoration project. Assessment Areas are identified and sampled in a manner consistent with a typical wetland delineation for this region (USACE 2010), including completion of a wetland determination data form for each vegetation community. For projects or wetlands with multiple AAs, the procedures for the field assessment should be repeated at each AA to adequately characterize the representative diversity and variability in the project area. Field assessments will be used to refine AA boundaries as needed.

A landscape assessment for the entire stream restoration project area will be carried out using imagery and data layers available on the Maryland Watershed Resources Registry, and a field data form will be used to capture data in the field for the individual Assessment Area(s) within the entire restoration area. Assessment Areas will be classified to Key Wildlife Habitat type in the field to target condition evaluation and to provide a set of expected characteristics. In addition to the data collection required for wetland delineations (USACE 2010), the field assessment portion includes descriptive information for landscape position, water source, and hydrological regime. It also includes scored metrics for soil/substrate, hydrology, and Key Wildlife Habitat structure and composition.

Table 1. General step-by-step guidelines for applying the Ecological Integrity Assessment (wetland delineation completed).

Step 1	Identify the Assessment Areas (AAs) as each delineated wetland in the area of interest. (Section 2)
Step 2	Using imagery and tools available in the Maryland Watershed Resources Registry, establish the boundary for each AA and add buffers for landscape metric scoring (10m, 100m, 300m). Conduct the office assessment of landscape context surrounding each AA. (Section 3)
Step 3	Prepare for the additional field assessment. Become familiar with metrics and protocols to ensure they are measured correctly. Verify the appropriate season and other timing aspects of the field assessment. Assemble needed materials and supplies. (Section 4)
Step 4	Conduct the field assessment of additional on-site conditions for each AA using a site walkthrough approach (Section 4). The entire AA should be assessed, including--as much as is feasible--the 100 m buffer around the AA. Classify each AA to Maryland Key Wildlife Habitat (KWH) using the key provided in this document. Use the KWH type as needed to define metric scoring standards. If possible, use the vegetation and characteristics observed to classify the wetland to U.S. National Vegetation Classification Plant Association types that occur in Maryland (Harrison 2016). Use information from a Corps/MDE verified wetland delineation to reduce duplication in data collection.

Step 5	If needed based on field assessment, delineate final AA boundaries and adjust landscape and stressor scoring (Sections 2, 3, 4). Determine the size of the AA and score the Comparative Size metric (Section 3.3).
Step 6	Complete assessment scores and QA/QC Procedures (Section 5).

Table 2. General step-by-step guidelines for applying the Ecological Integrity Assessment (wetland delineation NOT completed- recommended).

Step 1	Assemble background information about the current condition, management, and history of the site. (Section 2)
Step 2	Identify a preliminary Assessment Area (AA) for each wetland type in the area of interest using project boundaries and other available information. (Section 2)
Step 3	If the AA is not likely to change based on the field visit, use imagery and tools available in the Maryland Watershed Resources Registry to establish the boundary for each AA and add buffers for landscape metric scoring (10m, 100m, 300m). Conduct the office assessment of landscape context surrounding each AA. (Section 3) If the AA boundaries depend on the field visit, complete the Steps in this order: 4, 5, 6, 3.
Step 4	Prepare for the field assessment. Become familiar with metrics and protocols to ensure they are measured correctly. Verify the appropriate season and other timing aspects of the field assessment. Assemble needed materials and supplies. (Section 4)
Step 5	Conduct the field assessment of on-site conditions for each AA using a site walkthrough approach (Section 4). The entire AA should be assessed, including--as much as is feasible--the 100 m buffer around the AA. Classify each AA to Maryland Key Wildlife Habitat (KWH) using the key provided in this document. Use the KWH type as needed to define metric scoring standards. If possible, use the vegetation and characteristics observed to classify the wetland to U.S. National Vegetation Classification Plant Association types that occur in Maryland (Harrison 2016).
Step 6	Delineate final AA boundaries based on the field assessment and adjust landscape and stressor scoring as needed (Section 2,3,4). Determine the size of the AA and score the Comparative Size metric (Section 3.3).
Step 7	Complete assessment scores and QA/QC Procedures (Section 5).

The EIA should preferably be carried out during the growing season for the characteristic plant community or communities of the wetland or wetlands to be assessed. In general, this window

is from mid-April through September for the pilot area, although vernal pools may need to be assessed starting in March and ending in May depending on seasonal rainfall. To assist with determining the best timing for identification of rare plant species that might be present (including wetland obligate and facultative species), fruiting and flowering times for signature species associated with Key Wildlife Habitats (Maryland DNR 2015) can be found in the expanded list of rare, threatened, and endangered plants of Maryland (Maryland Natural Heritage Program 2021).

2.0 SITE BACKGROUND INFORMATION AND DELINEATION OF PROJECT AREA AND WETLAND ASSESSMENT AREA

In advance of field data collection, review of available information on the stream restoration project area is invaluable to guide work at the site and to identify target areas for sampling. The Assessment Area (AA) is the targeted area within the proposed project that will be the focus of the Environmental Integrity Assessment sampling. The AA is "the entire area, subarea, or point of an occurrence of a wetland type with a relatively homogeneous ecology and condition" (Faber-Langendoen et al. 2016a,b,c). An AA should be composed of only one Key Wildlife Habitat, consistent with guidance for wetland determinations to sample a single vegetation community or major landscape unit. AA(s) are located in or adjacent to the proposed stream restoration project footprint. The approach for AA delineation in this project will be polygon-based. This polygon will define the area for field data collection. If a rigorous wetland delineation has been completed, polygons for all wetland types (KWH) present can be used as the AA boundaries as long as they meet the AA description above. If wetland areas at the project site are not delineated, an initial polygon for each AA will be created in advance of the field visit using GIS-based resources. Multiple AAs are needed if there is more than one KWH present in the stream restoration project area and AA boundaries may need to be adjusted based on the field site visit. Stream restoration project area boundaries may not include an entire target AA, however, due to extent of the restoration project or private lands considerations. To the extent possible, metrics should be scored for an entire AA to capture its ecological integrity and KWH condition.

To create a preliminary AA boundary for an area that has not already been determined in the field, map the wetland area to be assessed using readily observable ecological attributes such as vegetation, soil, and hydrological characteristics. Aerial and satellite imagery, both current and historical, will be useful in addition to information on soil types and topographic maps. It is highly recommended that the most recent data layers and aerial imagery are used as site conditions and land use can change drastically over short periods of time. Useful online map viewers and tools that include these and other data layers are listed in Appendix 2. Particularly

useful are layers found in the Maryland Watershed Resources Registry (NWI and DNR wetlands layers, nontidal Wetlands of Special State Concern, floodplain data, geology, soils, imagery) and USDA soils (interactive soil mapper). The layers can also aid in pre-identification of existing priority resources, as well as modeled rankings for restoration or preservation. These tools should be used to create preliminary, mapped AA boundaries for all distinct wetland vegetation types at the project location if that information is not already available. Outlines of the entire stream restoration project on aerial images will be needed for the Landscape Assessment (Section 3).

3.0 LANDSCAPE LEVEL ASSESSMENT

Landscape level assessments provide an important perspective on wetland ecological integrity, especially for wetlands associated with streams and rivers. Watershed features such as the presence of impervious surface, widespread clearing of upland forests, point source inputs, and stream channelization can impact wetland structure and function by increasing sedimentation that can alter the chemical and hydrological characteristics of wetlands. Wetlands can become disconnected from recharge areas or become fragmented, and flood regimes and the input and cycling of nutrients can be altered. Point sources, such as municipal industrial sites, and non-point sources, such as agricultural lands and urban runoff, add materials to ground water and surface water that upset the balance of wetland water chemistry and the biogeochemical cycling of materials in wetland ecosystems (Mitsch and Gosselink 2015). In this section, calculation of buffer metrics, aquatic context, and comparative size of the AA are used to provide information on the ecological integrity of the proposed stream restoration area. In addition, the mapped location of the stream restoration project area will be used to assess whether additional points should be added to the overall ecological integrity score of the AA within the project area (Section 5.3). Buffer metrics and aquatic context will be scored for the entire stream restoration project area and these scores will apply to each AA within the project area. Comparative size will be assessed for each individual AA.

The Landscape Level Assessment can be conducted prior to the field assessment when the boundary of the stream restoration project has been mapped out except when the project area is likely to be moved in the field. If the project area boundaries are likely to be moved, the Landscape Assessment portion should be completed *following* the field survey (Table 2). Viewing the aerial and satellite imagery in advance helps to identify potential stressors or ambiguous features that may be on the edge of the site (e.g., an abandoned ditch), in difficult to access areas, or are otherwise likely to be overlooked or inaccessible in the field. A review of the imagery may also assist with identifying stressors in the 100-m buffer outside of the stream restoration project area, especially those that are not easily viewed during the site visit.

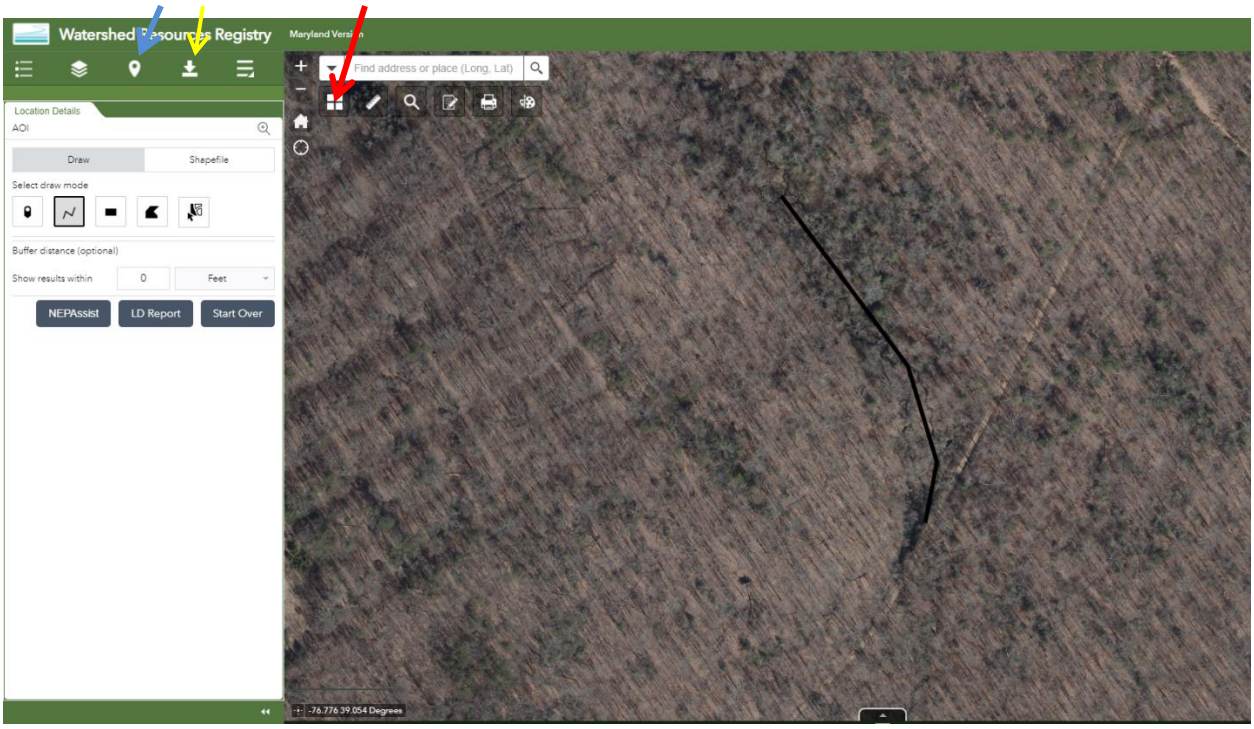
Depending on the landscape complexity and observer experience, this portion of the assessment may take 30-60 minutes to complete.

3.1 Imagery and Tools for Landscape Level Assessments

Aerial imagery, land cover data, data layers with additional resources, and tools available online in the Maryland Watershed Resources Registry (WRR) will be used for the landscape portions of the Ecological Integrity Assessment (https://watershedresourcesregistry.org/states/maryland.html). Note that a User Manual is available at this website link and that tutorials are available as described in the User Manual. To start, click on "View Map" at the website link. When you have reached the screen in Figure 1, use the button indicated by the red arrow to select a basemap image such as "Imagery with Labels", "Topographic", "MD NAIP Imagery" (growing season), "MD 6-inch" (non-growing season), or another layer that you can use to visualize the project area. Find the project area on the image or load a GIS file under the "Save Session" tab (yellow arrow) in the toolbar. In this example (Figure 1), the project area is represented by the black line drawn with the polyline tool (button highlighted in gray with jagged line) under the "Location Details" tab (indicated by the blue arrow). The project area can also be represented by a polygon, as may be the case with an uploaded GIS file or if you use the polygon button under the "Location Details" tab.

You will need to place buffers around the project area line or polygon. These images should be saved as described under the "Save Session" tab (yellow arrow) for use in subsequent analyses. Alternately, files with 10, 100, and 300m buffers around the outlined project area may be created in ArcGIS and imported into the WRR under the "Save Session" tab. To continue without uploading ArcGIS files with buffers, with your image including the project area line or polygon, select the "Location Details" tab (indicated by the blue arrow) and type in "10" and select "meters" for the buffer distance in the optional "Buffer distance" section. When you hit Enter, the buffer will be displayed as a red line around your project area line or polygon. This file should be saved or downloaded ("Save Session" tab) for use in the calculation of the Buffer Perimeter metric (Section 3.1.1). Next, type "100" in for the Buffer distance (making sure "meters" is still selected) and hit Enter. You will now have an image with the project area surrounded by a red line at 100m. Save or download this file for use in calculating the Buffer Condition metric (Section 3.1.2). Next, type "300" in for "Buffer distance" (with meters selected as units) and hit enter to get an image with a red line at 300m around the outside of the project area. Save or download this file for use in calculating the Aquatic Context metric (Section 3.2).

Figure 1. Example Imagery for Use of Watershed Resources Registry (WRR). The black line indicates the project area for the following examples. The blue arrow indicates the "Location Details" tab, yellow arrow "Save Session" tab, and red arrow "Basemap Gallery". For more details, see the User Manual for the WRR.



3.2 Buffer Metrics

These metrics are calculated for the stream restoration project area and applied to all AA within that project area. The buffers immediately surrounding the project area (within a 10m zone and within a 100m zone) are assessed using two metrics: percent of the perimeter with a natural buffer and condition of the buffer. Aerial photography and tools in Maryland Watershed Resources Registry (WRR) can be used in combination with observations in the field. Wetland buffers play a critical role in the condition of the wetland relative to key abiotic and biotic factors. Natural habitats in particular provide the greatest benefit. Natural habitats are defined in Table 3.

The buffer should be assessed in the field to the extent possible, and adjustments should be made to the score as needed based on actual observations. Demonstrated below are examples using the WRR.

3.2.1 Perimeter with Natural Buffer

For this metric, the percent of the perimeter within 10m of the project area that represents a natural buffer will be calculated. See instructions in Section 3.1 to create the necessary

imagery. Measurements can be made using the Drawing Tool (palette with brush symbol) in the WRR by selecting the polyline button and entering the units in meters. For this metric, you will need to estimate the length of the project area with a natural buffer and the length of the areas excluded from the natural buffer (Table 3) by drawing along the project line or the edge of the project polygon. Determine the total length of the project area with natural buffer habitat according to the definition in Table 3. To qualify as natural buffer, the area meeting the definition of natural must be at least 10 meters (33 feet) wide and extend along the perimeter of the wetland for at least 10 meters (33 feet) without a break. Open water is considered natural buffer. Use the length of natural buffer and the length of perimeter not in natural buffer to calculate the total perimeter length and the percent of natural buffer immediately surrounding the project area. Use Table 4 to rate the metric. An example of this process using the WRR is presented in Figure 2. In this case, the natural buffer perimeter is 421.2m and the total buffer perimeter is 421.2 + 43.8m = 465m. The percent of natural buffer is 90.5%, yielding a rating of "Good" (score of 3).

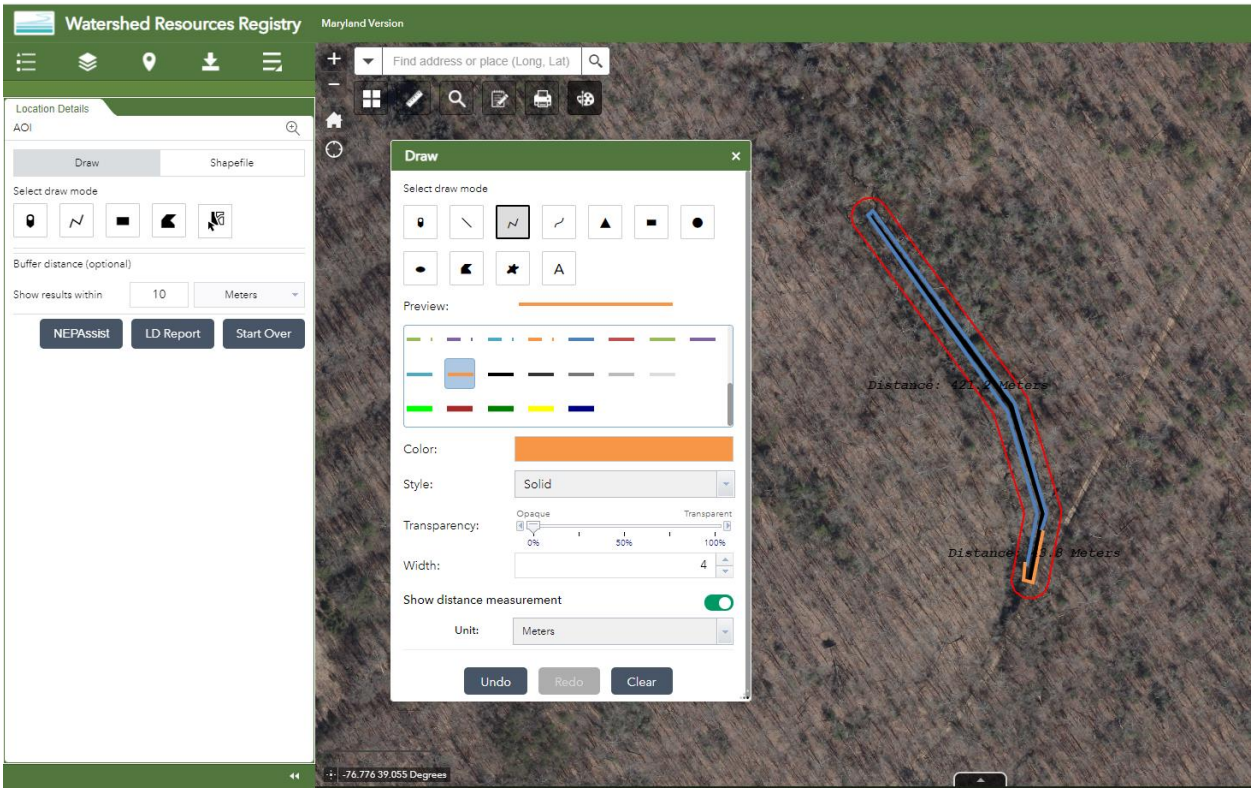
Table 3. Guidelines for Identifying Natural Buffers.

Examples of Land Covers Included in Natural Buffers	Examples of Land Covers Excluded from Natural Buffers
Natural plant communities; naturally vegetated rights-of-way; natural swales and ditches; open water including streams; wetlands	Parking lots; commercial and private developments; roads (all types); intensive agriculture; intensive plantations; orchards; vineyards; railroads; planted pastures (e.g., from low intensity to high intensity horse paddock, feedlot, etc.); planted hayfields; lawns; sports fields; traditional golf courses; fallow farm fields; ditches

Table 4. Buffer Perimeter Metric Rating Criteria.

Metric Rating	Rating Criteria
4 = Excellent	Natural buffer is >95% of perimeter
3 = Good	Natural Buffer is 85-95% of AA perimeter
2 = Fair	Natural Buffer is 75-84% of AA perimeter
1 = Poor	Natural Buffer is < 75% of AA perimeter

Figure 2. Example Imagery for Buffer Perimeter Metric Calculation. The red line indicates the 10m buffer around the linear project area. The blue line indicates the section of the perimeter that is in natural buffer (421.2 m) and the orange line indicates the sections of the perimeter that are not in natural buffer (43.8m) because of the presence of a road within a section of the 10m buffer. See text for scoring of the metric.



3.2.2 Condition of Buffer

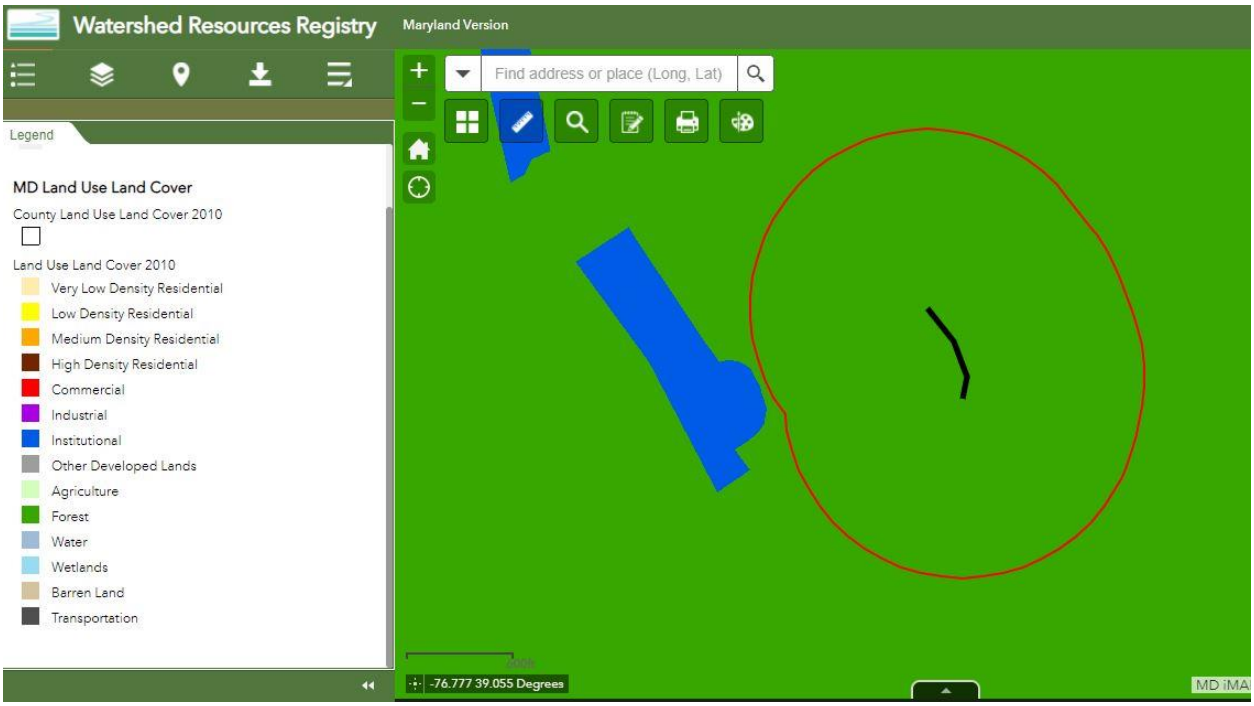
Buffer condition is estimated by determining the overall presence and condition of natural habitats within 100m of the project area. See instructions in Section 3.1 to create the necessary imagery. The evaluation can be made by using the MD Land Use Land Cover layer (under "Layers" tab second from the left, under Land Use/Land Cover) in the WRR in the office, followed by ground-truthing, as needed. For this exercise, natural habitats are those areas classified as Forest, Wetlands, and Water. Estimate the percent of the 100m buffer in these categories overall to represent the proportion of the buffer in natural condition. You can use the Polygon button in the Measurement Tool to outline individual sections within the 100m buffer around the project area if needed to calculate the total proportion of Forest, Wetland, and Open Water compared to the total area included in the 100m buffer. An example of this

process using the WRR is presented in Figure 3. In this case, all of the area within the 300m buffer is classified as “Forest”, so the rating would be “Excellent” (score of 4).

Table 5. Buffer Condition Metric Rating.

Metric Ratings	Buffer Condition
Excellent = 4	Buffer is characterized by abundant (> 90%) natural cover (Forest, Wetland, or Open Water categories)
Good = 3	Buffer is characterized by substantial (75–90%) natural cover.
Fair = 2	Buffer is characterized by a moderate (50–74%) natural cover.
Poor = 1	Low (< 50%) cover of natural habitats within the buffer.

Figure 3. Example Imagery for Buffer Condition Metric Calculation. The red line indicates the 100m buffer around the linear project area. The only Land Use Land Cover category present in the 100m buffer is “Forest”. See text for scoring of the metric.



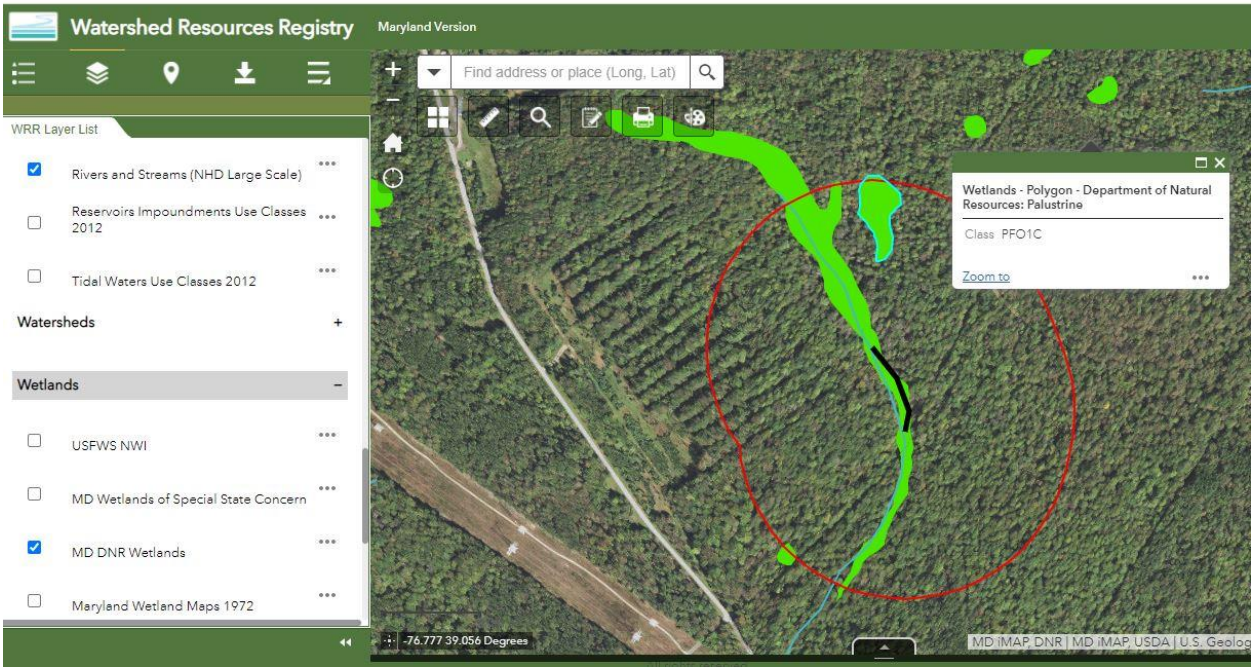
3.3. Aquatic Context

This metric will be calculated using the project area with a 300m buffer with the Watershed Resources Registry tools and imagery (see instructions in section 3.1). The MD DNR Wetlands Layer (under Wetlands tab) and Rivers and Streams layer (under Water tab) will be used to determine how many different wetlands and additional streams are included within the 300m buffer of the entire stream restoration project area. In order to determine the different types of wetlands present, you will need to select areas and click to see the wetland class. Additional small-scale wetlands such as Springs or Vernal Pools may need to be identified during field data collection. The metric rating is calculated by adding up the number of wetland types and streams or rivers in addition to the project area present according to the rating criteria in Table 5. An example of this process using the WRR is presented in Figure 4. In this case, there were more than four distinct wetlands (by geography or by type), so the rating would be “Excellent” (score of 4).

Table 6. Aquatic Context Metric Rating Criteria.

Metric Rating	Rating Criteria
Excellent = 4	4 or more types
Good = 3	3 types
Fair = 2	2 types
Poor = 1	0-1 type

Figure 4. Example Imagery for Aquatic Context Metric. The project area is represented be a black line and the red line indicates the 300m buffer. Wetlands are colored green. Clicking on a wetland causes it to be outlined in light blue and the class is shown on the screen as you see here.



3.4 Comparative Size

Wetland size, especially when assessing wetlands as entire polygons, is an important indicator of the overall integrity of the AA. Size does interact with landscape context, such that small wetlands embedded in entirely natural landscapes do not, necessarily, have less ecological integrity than a larger example of the same wetland in a fragmented landscape. Conversely, a large wetland in a fragmented landscape is likely to be more buffered from landscape stressors than a small wetland in a similar landscape. Thus, careful consideration is given to the appropriate manner in which to score size, taking into account this suite of contextual factors.

This metric examines the current absolute size (ha) of the entire wetland type polygon or patch, as well as indicator species and evidence of a reduction in size due to human-caused factors. It is assessed either with respect to expected patch-type sizes for the type across its range, or as a comparative size based on size distribution. Assessors are sometimes hesitant to use patch size as part of an EIA out of concern that a small, high quality example will be down-ranked unnecessarily. These concerns are addressed, to a degree, by providing an absolute patch-type scale for KWH in the pilot project area, so that types that typically occur as very small patches (Spring, Vernal Pool) can use a different rating than types that may occur over large, extensive

areas (e.g., Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp). Size is also more accurately assessed at finer scales of classification (e.g., plant association; see Harrison 2016). The presence or absence of any area-sensitive indicator species dependent on the KWH can also be useful to determine wetland condition related to size if this information is available. A good surrogate is to look for the Indicator species for different vegetation layers by KWH in Table 11. An estimate of size reduction for the metric rating should include consideration, to the extent possible, of human-caused factors including conversion or disturbance due to changes in hydrology due to roads, impoundments, development, human-induced drainage; or changes caused by recent cutting. Assigning a metric rating depends on the degree of reduction. Causes of the size of reduction should be indicated on the field data sheet.

Approximate size of the AA as a whole may include areas beyond the stream restoration project site. It is important to consider the size of the entire area encompassed by the KWH wetland type being evaluated as part or all of the AA. An assessment of size may require reference to aerial or satellite imagery or other data layers (see Appendix 2) in addition to information collected during the site visit, especially to refine AA boundaries. It is also important to know the spatial pattern typical of the wetland type being assessed based on knowledge of the typical sizes of KWH found in excellent condition in the pilot project area (Table 7). In order to complete scoring for comparative size, the AA will need to be classified to KWH using Table 12 and information on the presence of indicator species will be needed.

Table 7. Patch Type Definitions for Typical Spatial Patterning of Key Wildlife Habitats (modified from Comer et al. 2003; Harrison 2016).

Patch Type and Potential KWH	*DEFINITION*
Large Patch: Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp	Ecosystems that form large areas of interrupted cover and typically have narrower ranges of ecological tolerances than matrix types. Individual disturbance events tend to occupy patches that can encompass a large proportion of the overall occurrence (e.g., > 20%). Given common disturbance dynamics, these types may tend to shift somewhat in location within large landscapes over time spans of several hundred years. In undisturbed conditions, typical occurrences range from 50–2,000 ha (125-5,000 ac).
Small Patch: Coastal Plain Flatwood and Depression Swamp, Coastal Plain Seepage Bog and Fen, Coastal Plain Seepage Swamp	Ecosystems that form small, discrete areas of vegetation cover, typically limited in distribution by localized environmental features. In undisturbed conditions, typical occurrences range from 1–50 ha (3 – 125 ac).

Very Small Patch: Vernal Pool, Spring, Coastal Plain Seepage Swamp	Ecosystems that form very small, discrete areas of vegetation cover (f present), typically limited in distribution by localized environmental features. In undisturbed conditions, typical occurrences range from 50m^2 or less-1 ha (to 3 ac).
Linear: Coastal Plain Floodplain	Ecosystems that occur as linear strips. They are often ecotonal between terrestrial and aquatic ecosystems. In undisturbed conditions, typical occurrences range in linear distance from 0.5–100 km (1 – 60 mi).

After determining the KWH type in the AA, rate the Comparative Size Metric as informed by Patch Type (Table 7). Use Table 8 to assign a metric based on the wetland's patch type. Consider the degree of reduction from observations at the site or through aerial image or site history information (e.g., changes in hydrology due to roads, impoundments, development, human-induced drainage; or changes caused by recent cutting).

Table 8. Comparative Size Metric Rating Criteria. Use Table 13 for lists of Indicator Species by KWH and consider any evidence from the site or other resources to indicate whether the wetland has been reduced in size due to human activities resulting in conversion or disturbance.

Comparative size incorporating evidence of size reduction due to human activities	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Very large size compared to other examples of the same type, based on current and historical spatial patterns. Indicator species are all or almost all present. Occurrence is at, or only minimally reduced (< 5%) from its original, natural extent due to conversion or disturbance.
Good = 3	Large size compared to other examples of the same type, based on current and historical spatial patterns. Some indicator species are not present. Occurrence is only somewhat reduced (5-10%) from its original natural extent due to conversion or disturbance.
Fair = 2	Medium to small size compared to other examples of the same type, based on current and historical spatial patterns. Several to many indicator species are not present. Occurrence is modestly reduced (10-30%) from its original natural extent due to conversion or disturbance.
Poor = 1	Small size to very small compared to other examples of the same type, based on current and historical spatial patterns. Most or all indicator species are not present. Occurrence is substantially reduced (> 30%) from its original natural extent due to conversion or disturbance.

3.5 Additional Features

Additional metrics that characterize the project area in a broader context, especially in terms of its value as a KWH, may be found using data layers in the Maryland Watershed Resources Registry https://watershedresourcesregistry.org/states/maryland.html.

Bonus points are added to the Landscape metric assessment for features that are unique or indicate areas of high ecological integrity as described in Section 5.3. Some of these features may be observed in the field (see below). This information will be needed if the Overall Ecological Integrity Assessment rating is not "Excellent" (see Section 5.3 and Table 29).

Data Layers in Maryland Watershed Resources Registry:

- Priority Conservation Areas:
    - Targeted Ecological Areas
    - Biodiversity Conservation Network Tier 1, 2, or 3
    - Forest Interior Dwelling Species (FIDS) area: Class 1
- Stream Mitigation Framework Areas: Catchments with Low Impervious Cover (less than 5%)
- Wetlands: MD Wetlands of Special State Concern
- Biota: Stream Reaches with "Good" Combined Index of Biotic Integrity
- Wetlands adjacent to use III or IV waters

Determination from field observations:

- Other Maryland nontidal wetland(s) with significant plant or wildlife value (as defined by COMAR 26.23.01.01B80)
- Areas with state rare plants or state rare natural community noted during field data collection but not mapped in Biodiversity Conservation Network Tier 1, 2, or 3
- Dominated by native trees greater than 60cm or 24" diameter at breast height
- Dominated by native species that produce hard mast (i.e., acorns and nuts) in the tree strata

4.0 FIELD DATA COLLECTION

This section provides guidance on how to populate the field data sheets (Appendix 3) and scoring sheet (Appendix 4) for the Ecological Integrity Assessment using the information on measuring and scoring below. Scoring tables and figures are extracted into one abbreviated document for use in the field (Appendix 5). Data collected during the typical wetland delineation process for this region (USACE 2010) are used to measure certain metrics; measures

for other metrics will be collected using the field data sheet. Observations, modifications, or concerns due to abnormal circumstances should be recorded on the field data sheets. The completion of the data sheets and calculation of final scores will take place during a post-data collection office review. The first two sections below address basic site-level data. Thereafter, protocols for each metric and scoring are described. The majority of protocols used for the pilot EIA are the same as outlined by Faber-Langendoen et al. (2016a,b). Some metrics are scored depending on the Key Wildlilfe Habitat type present in the AA.

It is assumed that data will be collected during a walkthrough or meandering survey rather than by establishing plots, although especially for larger sites a point intercept method may be recommended for estimating vegetation cover (USACE 2010). In addition to standard footwear and attire for working in wetlands, the following materials and supplies are needed for applying the Ecological Integrity Assessment (EIA):

- EIA field data sheets (Appendix 3); wetland delineation form, if previously completed; clipboard, pencils; topographic map and aerial photos (printed and/or on phone or tablet)
- Local plant identification keys and field guides, hand lens; plastic bags for sample collection if needed, plant press (can be stored in vehicle)
- Compass, GPS receiver (NAD83 with sufficient memory and batteries or phone/tablet app), camera (with sufficient memory and battery charge), small trowel or shovel, pin flags and/or flagging/tape (helpful for assessment area layout).

4.1 Site/Assessment Area Information

The USACE (2010) manual should be followed when filling out information on site characteristics and determining the Assessment Area (AA). If multiple assessment areas are established at the site, provide a unique name/identifier for each assessment area. For example, if there are multiple AAs at a site called “Nanjemoy Creek” the individual AAs should be labeled something like “Nanjemoy Creek-01” and “Nanjemoy Creek-02”.

In the Site Description section on the first page or on a separate sheet of paper, indicate the following:

Plots: if vegetation plots are established within the site/AA, give them unique plot codes. If transects are used, indicate this in the Site Description section.

Photos: If photos are taken, please provide the photographer’s name and associated file names. Files names ideally should have the photographer’s initials and a numeric code (e.g., fjr_001). A brief description of each photo’s content should be documented in (1) a field notebook or (2) file name; or (3) in the photo’s metadata.

Site Description: Provide a written description of the site's characteristics. Focus on the setting in which the site occurs, ecological and vegetation patterns within and adjacent to the site, notable stressors or human activity, signs of wildlife, etc. A drawing may also be helpful.

4.2 Environmental Information

These data should be entered in the appropriate section of the field data sheets (Appendix 4):

Landscape Position: Select the landform feature (or features) that best fit the location of the AA and enter onto the data sheet; if needed, enter a landform not represented in Table 9.

Table 9: Landscape Position. (Check all features present on the data sheet).

Active floodplain (depression or terrace)	Beaver pond/Natural impoundment	Riparian-Depression (in floodplain)	Riparian terrace (outside seasonal flooding; historic floodplain or current terrace)
Headwater stream/spring	Saddle/Drainage Divide	Swale	Isolated Depression
Oxbow	Seep/groundwater discharge site	Streambank	Point bar
Flats	Wetland charged by groundwater seeps	Other- describe	

Water Source: Select the primary water source for the AA in Table 9 and enter onto the data sheet; if more than one water source is present, list them and indicate which is primary, secondary, etc.

Table 10: Water Source. (If more than one source is present, list and indicate primary, secondary, etc. on the data sheet).

Direct precipitation	Groundwater discharge	Natural surface flow	Urban run-off/culverts
Overbank flooding	Alluvial aquifer	Irrigation	Pipes/outfall (directly feeding wetland)

Hydrological Regime: Although not influenced by oceanic tides, Nontidal Water or Hydrological Regimes are defined in terms of the growing season which, for the purposes of this classification, begins with green-up and bud-break of native plants in the spring and ends with plant dieback and leaf-drop in the fall due to the onset of cold weather. During the rest of the year, which is defined as the dormant season, even extended periods of flooding may have little influence on the development or survival of plant communities. Select the regime that best matches conditions in the AA (Table 11).

Table 11: Hydrological Regime. (Adapted from Federal Geographic Data Committee FGDC–STD-004-2013 Classification of Wetlands and Deepwater Habitats).

Hydrological Regime	Definition
H Permanently flooded	Water covers the substrate throughout the year in all years.
G Intermittently exposed	Water covers the substrate throughout the year except in years of extreme drought.
F Semipermanently flooded	Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.
C Seasonally flooded	Surface water is present for extended periods (generally for more than a month) during the growing season, but is absent by the end of the season in most years. When surface water is absent, the depth to substrate saturation may vary considerably among sites and among years.
E Seasonally flooded-saturated	Surface water is present for extended periods (generally for more than a month) during the growing season, but is absent by the end of the season in most years. When surface water is absent, the substrate typically remains saturated at or near the surface.
B Seasonally saturated	The substrate is saturated at or near the surface for extended periods during the growing season, but unsaturated conditions prevail by the end of the season in most years. Surface water is typically absent, but may occur for a few days after heavy rain and upland runoff.
D Continuously saturated	The substrate is saturated at or near the surface throughout the year in all, or most, years. Widespread surface inundation is rare, but water may be present in shallow depressions that intersect the groundwater table, particularly on a floating peat mat.
A Temporarily flooded	Surface water is present for brief periods (from a few days to a few weeks) during the growing season, but the water table usually lies well below the ground surface for most of the season.
J Intermittently flooded	The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. Weeks, months, or even years may intervene between periods of inundation. The dominant plant communities under this regime may change as soil moisture conditions change. Some areas exhibiting this regime do not fall within our definition of wetland because they do not have hydric soils or support hydrophytes. This regime is generally limited to the arid West.
K Artificially flooded	The amount and duration of flooding are controlled by means of pumps or siphons in combination with dikes, berms, or dams. The vegetation growing on these areas cannot be considered a reliable indicator of regime. Examples of Artificially Flooded wetlands are some agricultural lands managed under a rice-soybean rotation, and wildlife management areas where forests, crops, or pioneer plants may be flooded or dewatered to attract wetland wildlife. Neither wetlands within nor resulting from leakage from man-made impoundments, nor irrigated pasture lands supplied by diversion ditches or artesian wells, are included under this Modifier. The Artificially Flooded Water Regime Modifier should not be used for impoundments or excavated wetlands unless both water inputs and outputs are controlled to achieve a specific depth and duration of flooding.

Size of the Assessment Area: Indicate the size of the AA, preferably using aerial or satellite imagery and adjusting as needed based on actual site conditions.

4.3 Classification of Assessment Area to Key Wildlife Habitat

Use the information on landscape position, water source, and the key in Table 12 to classify the Assessment Area to Key Wildlife Habitat. If possible, use the vegetation and characteristics observed to classify the wetland to U.S. National Vegetation Classification Plant Association types that occur in Maryland (Harrison 2016). The presence of characteristic and indicator species by vegetation layer in Table 13 may also be useful to determine the category for the AA. Full descriptions of KWH can be found in Appendix 1. If your assessment objective is to determine whether a site meets the criteria for a rare community type, classify the native wetland or riparian ecosystem type to the USNVC community type/plant association level and provide a global or state conservation rank (see Harrison 2016).

Table 12: Maryland Key Wildlife Habitat Classification Key for non-tidal wetland habitats of the Upper Coastal Plain, including HGM Class. For descriptions and examples of KWH, see Appendix 1. HGM classes are defined in Smith et al., 1995.

1a. Wetlands bordering streams and rivers with overland, non-tidal flooding regimes (i.e., floodplains). Distinct alluvial landforms (e.g., backswamps, levees, terraces) and indicators present (e.g., scour marks, recent sediment deposition, vegetation damaged/bent in one direction, soils with alternating deposits, channel banks with flood marks). Likely to be 3rd order and higher. Structurally and compositionally diverse vegetation present ranging from closed mixed forests to open, beaver-created pools with floating aquatics**……COASTAL PLAIN FLOODPLAIN** HGM Class: Riverine

1b.Wetlands primarily controlled via groundwater discharge often associated with depressional and slope geomorphic features as well as the margins of small stream (1st and 2nd order) floodplain wetlands.

> 2a. Wetlands associated with toe slopes and floodplains of small streams of the coastal plain where groundwater discharge is a major contributing input source (mixed hydrological regime: occurs in very narrow part of the groundwater driven complex that is influenced by overbank flooding) with alluvial landform a minor part of the complex; smaller order stream floodplain margins where groundwater input also contributes to overall hydrology. These areas are generally small features along streams and are usually not as well-developed as seepage swamps in larger stream systems……**COASTAL PLAIN FLOODPLAIN** HGM Class: Riverine or Slope
>
> 2b. Wetlands associated with distinct depressional and slope geomorphic features.
>
> > 3a. Basin wetlands, depressions, or very flat areas with evidence of ponded water, unidirectional flow not evident, lacks natural outlet, maintained by high water tables and seasonal precipitation. Hydrologic regimes range from saturated to seasonally flooded.

4. Seasonally flooded to saturated forested flats and depressions of broad coastal plain terraces (i.e., "wet flatwoods") with fluctuating water levels and intermittently ponded depressions. Soils are silt, sand, and clay loams, sometimes with a thin (< 30 cm [12 in]) mantle of coarse, fibric peat.

5a. Located on flat terraces and shallow depressions with seasonally perched water tables and braided channels…….. **COASTAL PLAIN FLATWOOD AND DEPRESSION SWAMP** Flatwood: HGM Class- Flat; Depression Swamp: HGM Class- Depression

5b. Small (<0.1 ha- 2 ha) shallow pools with a well-defined, discrete basin overlying a clay hardpan or other impermeable soil or rock layer impeding drainage, may or may not have vegetation in basin**……VERNAL POOL** HGM Class: Depression

3b. Slope wetlands associated with groundwater discharge zones (i.e., seeps, springs) and perennial, unidirectional flow towards a natural outlet such as a stream.

6a. Small (usually <1m^2), localized area of groundwater discharge, point source, generally mountain and piedmont regions only…..**SPRING** HGM Class: Slope

6b. Larger wetland systems with diffuse drainage patterns, widespread.

7a. Open wetlands characterized by predominately shrub and herbaceous vegetation and localized groundwater discharge zones. (*note. Lack of natural disturbances [e.g., fire, beaver activity, grazing] in these habitats often promote woody plant succession.)* Saturated "bog-like" wetlands along gently sloping headwater streams, seepage toe-slopes, and oligotrophic spring-heads with considerable accumulation of peat mosses (*Sphagnum spp*.) at varying depths, soils acidic and infertile (*note. The term "bog" applied here is a technical misnomer since none of these wetland systems in Maryland are ombrotrophic.)*…….**COASTAL PLAIN SEEPAGE BOG AND FEN** HGM Class: Organic Soil Flat; Slope

7b. Saturated forests of sloping stream headwaters, large spring seeps, lateral seeps in ravines and stream bottoms with diffuse drainage patterns. Braided stream channels, muck-filled depressions, and hummock-and-hollow microtopographic features evident……**COASTAL PLAIN SEEPAGE SWAMP** HGM Class: Slope

Table 13. Maryland Key Wildlife Habitat Characteristic Species by Vegetation Layer: Coastal Plain Wetlands (Western Shore)*.

Key Wildlife Habitat	Trees	Shrubs	Herbs	Vines	Indicator**	Exotic Spp.***
Coastal Plain Floodplain	*Platanus occidentalis, Liquidambar styraciflua, Liriodendron tulipifera, Quercus michauxii, Fraxinus pennsylvanica, Betula nigra*	*Lindera benzoin, Asimina triloba, Ilex opaca, Ilex verticillata, Carpinus caroliniana*	*Thelypteris noveboracensis, Mitchella repens, Arisaema triphyllum, Boehmeria cylindrica, Saururus cernuus, Cinna arundinacea, Galium circaezans, Medeola virginiana, Thalictrum thalictroides, Impatiens capensis, Glyceria striata*	*Toxicodendron radicans, Parthenocissus quinquefolia, Campsis radicans*	*Platanus occidentalis, Betula nigra, Thelyperis noveboracensis, Saururus cernuus, Cinna arundinacea*	*Microstegium vimineum, Glechoma hederacea, Rosa multiflora, Ligustrum sinense, and Lonicera japonica*
Coastal Plain Flatwood and Depression Swamp	*Quercus phellos, Quercus palustris, Quercus michauxii, Quercus pagoda, Liquidambar styraciflua*	*Eubotrys racemosa, Vaccinium corymbosum, Clethra alnifolia,*	*Woodwardia areolata, Osmunda cinnamomea, Mitchella repens, Osmunda regalis, Chasmanthium laxum*	*Smilax rotundifolia*	*Quercus pagoda, Quercus michauxii*	*Lonicera japonica, Phalaris arundinacea, Phragmites australis*
Vernal Pool	Varies	Varies	Varies	Varies		Varies
Spring	Varies	Varies	Varies	Varies		Varies
Coastal Plain Seepage Bog and Fen	*Nyssa sylvatica, Acer rubrum, Pinus rigida*	*Rhododendron viscosum, Toxicodendron vernix, Rubus hispidus, Ilex glabra, Clethra alnifolia*	*Carex atlantica, Andropogon glomeratus, Rhynchospora gracilenta, Eupatorium pilosum, Dichanthelium dichotomum var. dichotomum*	*Smilax pseudochina*	*Smilax pseudochina, Pinus rigida, Andropogon glomeratus, Rhynchospora gracilenta*	*Phragmites australis, Microstegium vimineum*
Coastal Plain Seepage Swamp	*Nyssa sylvatica, Acer rubrum, Magnolia virginiana*	*Clethra alnifolia, Viburnum nudum, Rhododendron viscosum*	*Woodwardia areolata, Osmunda cinnamomea, Osmunda regalis, Carex folliculata*	*Smilax rotundifolia*	*Magnolia virginica, Clethra alnifolia, Viburnum nudum*	*Microstegium vimineum*

*Species listed in each stratum represent species with high constancy values (>75%) for finer community types (i.e., association level) of Key Wildlife Habitats.

**Indicator species = High diagnostic value to type, high fidelity, and relative cover

***A list of invasive and exotic species in Maryland can be found at http://mdinvasives.org/species-of-concern/

4.4 Soil / Substrate

Conducting a rapid assessment of soil condition in wetlands is challenging. Soil data collection for wetland delineation (USACE 2010) will be followed by an assessment of soil health using easily observable factors. Metrics have been developed by and reviewed by an interagency team of the U.S. Army Corps of Engineers, MDE, MDNR, EPA, U.S. Fish and Wildlife Service SFWS, Natural Resources Conservation Service and Dr. Bruce Vasilas, University of Delaware for a draft assessment on wetland impacts, and are here adapted for specialized use in this assessment restoration projects. Metrics focus on organic matter, evidence of redox features, and continuing organic matter accumulation, which contribute toward healthy soil function to support plant life and biogeochemical processing for carbon and other nutrient storage and transformation. Prior to fieldwork, users should review expected reference soil characteristics as mapped for the site. Use Tables 14-17 to score soil metrics.

Table 14. Biogeochemical Cycling: Redox Concentrations Metric Rating Criteria.

All KWH (NOTE: if the floodplain does not naturally have hydric soils, and still does not have hydric soils under current conditions, skip this metric.)	
Score	Assign rating to category with majority of features present
Excellent = 4	Biogeochemical cycling excellent, with redox concentrations starting 0 to 6” from the soil surface and covering >10% of the surface area.
Good = 3	Biogeochemical cycling good, with redox concentrations starting >6” to 12” from the soil surface and covering >10% of the surface area OR redox concentrations start 0-6” from the soil surface and represent <10% of the surface area.
Fair = 2	Biogeochemical cycling fair, with redox concentrations starting >12” to 18” from the soil surface and covering >10% of the surface area OR redox concentrations start >6” to 12” from the soil surface and represent <10% of the surface area.
Poor = 1	Biogeochemical cycling poor, with redox concentrations starting >12” to 18” from the soil surface and covering <10% of the surface area OR no redox concentrations within 18” of the soil surface.

Table 15. Microtopography Metric Rating Criteria.

All KWH (NOTE: if the floodplain does not naturally have hydric soils, and still does not have hydric soils under current conditions, skip this metric.)	
Score	**Assign rating to category with majority of features present**
Excellent = 4	More than 50% of the AA shows at least a 3" increase in elevation over the base elevation of the AA.
Good = 3	30-49% of the AA shows at least a 3" increase in elevation over the base elevation of the AA.
Fair = 2	10-29% of the AA shows at least a 3" increase in elevation over the base elevation of the AA.
Poor = 1	<10% of the AA shows at least a 3" increase in elevation over the base elevation of the AA.

Table 16. Soil Organic Matter Metric Rating Criteria.

All KWH (NOTE: if the floodplain does not naturally have hydric soils, and still does not have hydric soils under current conditions, skip this metric.)	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Organic surface horizon present (any thickness).
Good = 3	Mineral surface layer(s) are $\geq$4" thick.
Fair = 2	Mineral surface layer(s) are <4" thick with matrix value $\leq$3 and chroma $\leq$2.
Poor = 1	Mineral surface layer(s) are <4" thick with matrix value >3 and ≤4 or chroma >2 and ≤3.

Table 17. Organic Matter Accumulation Metric Rating Criteria.

All KWH (NOTE: if the floodplain does not naturally have hydric soils, and still does not have hydric soils under current conditions, skip this metric.)	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Organic matter accumulation from root turnover is high as herbaceous ground cover is >75%.
Good = 3	Organic matter accumulation from root turnover is moderate as herbaceous ground cover is >50-74%.
Fair = 2	Organic matter accumulation from root turnover is low as herbaceous ground cover is >25-50%.
Poor = 1	Organic matter accumulation from root turnover is minimal as herbaceous ground cover is $\leq$25%.

4.5 Hydrology

After recording the hydrology indicators, field observations, and presence of wetland hydrology collected during the wetland delineation process, two additional metrics are to be evaluated and data recorded in the Remarks section on the first page of the form where indicated. Notes should be added to indicate why a particular rating was selected. The three factors used here, water source, channel characteristics, and hydrologic connectivity and hydroperiod, are not strictly independent. Hydrology is a complicated ecological factor to measure during a rapid assessment, and users will find that their evaluation of one metric partly relates to another. A simple way to portray the primary focus of each metric is as follows:

- Water Source: water coming into the wetland, including any unnatural diversions of water from the AA.
- Channel: characteristics of the stream channel in the project area.
- Hydroperiod and Hydrologic Connectivity: water level patterns and their duration within the wetland, regardless of source, and water exchange between wetland and surrounding systems.

The office assessment can work outward from the AA to include identification of unnatural water sources, such as adjacent intensive development or irrigated agriculture, nearby wastewater treatment plants, and nearby reservoirs. The Maryland Watershed Resources Registry (https://watershedresourcesregistry.org/states/maryland.html) is an excellent resource for this purpose. Unnatural water sources identified in the office can then be checked in the field and captured on the field data sheet. To score the metrics, assign the rating to the category with the majority of features present.

4.5.1 Water Source

Water source encompasses the forms, or places, of direct inputs of water to the AA, as well as any unnatural diversions of water from the AA. Diversions are considered an impact to natural water sources because they directly affect the hydrology of the AA. This metric can be assessed initially in the office using available imagery, and then revised based on the field visit. The metric focuses on direct sources of water, comparing the natural sources to unnatural (anthropogenic) sources (e.g., irrigation via direct application or seepage, urban run-off, culverts, pipes directly feeding wetlands). If available, include information on flooding recurrence interval.

Table 18. Water Source Metric Rating Criteria.

Coastal Plain Floodplain: Groundwater discharge not a major input	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Water source is natural. Site hydrology is dominated by overbank flow. Lacks point charge discharges into or adjacent to the site. Completely connected to floodplain (backwater sloughs and channels). No geomorphic modifications made to contemporary floodplain. Channel is not unnaturally entrenched.
Good = 3	Water source is mostly natural, but wetland directly receives occasional or small amounts of inflow from anthropogenic sources such as some road runoff, small storm drains, or other minor point source discharges emptying into the wetland. Minimally disconnected from floodplain with recent evidence of overbank flooding. Up to 25% of stream banks are affected due to dikes, rip rap and/or elevated culverts, or increased discharge due to other causes. Channel is somewhat entrenched (overbank flow occurs during most floods). Flooding at 2-year recurrence interval
Fair = 2	Water sources are moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Wetland is still connected to its natural water source (e.g., modified ponds on a floodplain that are still connected to alluvial aquifers, natural stream channels that now receive substantial irrigation return flows, many small/few large storm drains). Moderately disconnected from floodplain due to multiple geomorphic modifications. Between 25-75% of stream banks are affected (e.g., dikes, rip rap, concrete, and elevated culverts) or increased discharge due to other causes. Channel is moderately entrenched (overbank flow only occurs during moderate to severe floods, functioning at risk). Flooding at 10-year recurrence interval
Poor = 1	Water source contains a substantial amount of inflow from anthropogenic sources, such as major point source discharges into or adjacent to the wetland. Wetland has reduced connection to natural water source (e.g., loss of overbank flow). Channel is severely entrenched and entirely or extensively disconnected from the floodplain; > 75% of stream banks are affected (for example due to dikes, rip rap, concrete, and elevated culverts) or increased discharge due to other causes. Channel is substantially entrenched (overbank flow never occurs or only during severe floods-not functioning). No or minimal evidence of recent overbank flooding Flooding may or may not occur at 100-year storm or greater

Table 18. Water Source Metric Rating Criteria, continued.

Coastal Plain Floodplain: Mixed hydrologic regime	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Water source is natural. Lacks point charge discharges into or adjacent to the site. Connected to floodplain. Channel not unnaturally entrenched. No unnatural obstructions to lateral or vertical movement of ground or surface water. Flooding at 2-year recurrence interval.
Good = 3	Water source is mostly natural, but wetland directly receives occasional or small amounts of inflow from anthropogenic sources such as some road runoff, small storm drains, or other minor point source discharges emptying into the wetland. Minimally disconnected from floodplain with recent evidence of overbank flooding. Channel is somewhat entrenched. Minor restrictions to the lateral or vertical movement of ground or surface waters by unnatural features. Flooding at 2-year recurrence interval.
Fair = 2	Water sources are moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Wetland is still connected to its natural water source (e.g., modified ponds on a floodplain that are still connected to alluvial aquifers, natural stream channels that now receive substantial irrigation return flows, many small/few large storm drains). Moderately disconnected from floodplain due to multiple geomorphic modifications. Channel is moderately entrenched. Moderate restrictions to the lateral or vertical movement of ground or surface waters by unnatural features. Flooding at 10-year recurrence interval.
Poor = 1	Water source contains a substantial amount of inflow from anthropogenic sources, such as major point source discharges into or adjacent to the wetland. Wetland has reduced connection to natural water source (e.g., loss of overbank flow). Channel is severely entrenched and entirely or extensively disconnected from the floodplain; > 75% of stream banks are affected (for example due to dikes, rip rap, concrete, and elevated culverts) or increased discharge due to other causes. Channel is substantially entrenched (overbank flow never occurs or only during severe floods-not functioning). No or minimal evidence of recent overbank flooding Flooding may or may not occur at 100-year storm or greater interval.

Table 18. Water Source Metric Rating Criteria, continued.

All other KWH: Predominantly groundwater or precipitation water source, with potential limited flooding from small stream in relation to wetlands in riparian system	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Water source is natural. Lacks point charge discharges into or adjacent to the site. Groundwater or precipitation dominant or only water source; otherwise, no unnatural obstructions to lateral or vertical movement of ground or surface water, or, if perched water table, impermeable soil layer is intact. Rising water has unrestricted access to adjacent upland.
Good = 3	Water source is mostly natural, but wetland directly receives occasional or small amounts of inflow from anthropogenic sources such as some road runoff, small storm drains, or other minor point source discharges emptying into the wetland. Groundwater or Precipitation dominant: minor alteration to connectivity due to human activity (e.g., ditching, channel incision). Otherwise minor restrictions to the lateral or vertical movement of ground or surface waters by unnatural features, such as levees or excessively high banks (less than 25% of the site). If perched, impermeable soil layer partly disturbed. Flooding at 2-year recurrence interval
Fair = 2	Water sources are moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Wetland is still connected to its natural water source (e.g., modified ponds on a floodplain that are still connected to alluvial aquifers, natural stream channels that now receive substantial irrigation return flows, many small/few large storm drains). Groundwater or Precipitation dominant: moderate alteration of connectivity and water levels due to human activity. Otherwise moderate restrictions to the lateral or vertical movement of ground or surface waters by unnatural features or alteration. Between 25-75% of the site is restricted by barriers to drainage. If perched, impermeable soil layer moderately disturbed. Drainage back to the wetland is incomplete due to impoundment. Flooding at 10-year recurrence interval
Poor = 1	Water source contains a substantial amount of inflow from anthropogenic sources, such as major point source discharges into or adjacent to the wetland. Wetland has reduced connection to natural water source (e.g., loss of overbank flow). Groundwater or Precipitation dominant: substantial to full connectivity due to human activity. Otherwise essentially no hydrologic connection to adjacent wetlands or uplands. Most or all water stages are contained within artificial banks, levees, or comparable features. Greater than 75% of wetland is restricted by barriers to drainage. If perched, impermeable soil layer strongly disturbed. Flooding may or may not occur at 100-year storm or greater

4.5.2 Channel

Evidence of channel degradation or aggradation and connection to the floodplain should be noted on the field form and scored using Table 19. The metric should be assessed for the stream channel in project area, which will apply to all AA in the project area. Refer to Table 20 for field indicators of equilibrium, degradation, and aggradation. Information on lateral stability should be used if calculated at the time of the assessment, such as Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS).

Table 19. Channel Characteristics Metric Rating Criteria.

Channel in Project Area (including all AA present)	
Score	Assign rating to category with majority of features present
Excellent = 4	Indicators of channel equilibrium present. Minimal or no evidence of degradation or aggradation leading to channel instability or migration. Channel is not unnaturally entrenched. If calculated, BEHI/NBS scores low.
Good = 3	Minor channel incision. Channel is somewhat entrenched (overbank flow occurs during most floods). Some evidence of degradation or aggradation leading to a minimal level of channel instability or migration. If calculated, BEHI/NBS scores low.
Fair = 2	Channel is incised. Channel is moderately entrenched (overbank flow only occurs during moderate to severe floods, functioning at risk). Uncharacteristic aggradation or degradation is present leading to a moderate level of channel instability or migration. BEHI/NBS scores moderate.
Poor = 1	Channel is incised. Channel is substantially entrenched (overbank flow never occurs or only during severe floods-not functioning). Channel entirely or extensively disconnected from the floodplain. BEHI/NBS scores high, very high, or extreme.

Table 20. Channel and Hydroperiod Field Indicators by Key Wildlife Habitat.

Condition	*Field Indicators for Coastal Plain Floodplain – Channel and Hydroperiod*
Indicators of Channel Equilibrium	● The channel (or multiple channels in braided systems) has a well-defined usual high water line, or bankfull stage, that is clearly indicated by an obvious floodplain. A topographic bench represents an abrupt change in the cross-sectional profile of the channel throughout most of the site. ● The usual high water line (consistent with ACOE ordinary high water mark) or bankfull stage corresponds to the lower limit of riparian vascular vegetation. ● The channel contains embedded woody debris of the size and amount consistent with what is available in the riparian area. ● There is little or no active undercutting or burial of riparian vegetation.
Indicators of Active Degradation (Erosion)	● Portions of the channel are characterized by deeply undercut banks with exposed living roots of trees or shrubs. There are abundant bank slides or slumps, or the banks are uniformly scoured and unvegetated. ● Riparian vegetation may be declining in stature or vigor, and/or riparian trees and shrubs may be falling into the channel. ● The channel bed lacks any fine-grained sediment (unless it is the dominant bank material). ● Recently active flow pathways appear to have coalesced into one channel (i.e., a previously braided system is no longer braided).
Indicators of Excessive Aggradation (Sedimentation)	● The channel through the site lacks a well-defined usual high water line. ● There is an active floodplain with fresh splays of excessive sediment covering older soils or recent vegetation. ● There are partially buried tree trunks or shrubs. ● Excessive cobbles and/or coarse gravels have recently been deposited on the floodplain. ● There are partially buried, or sediment-choked, culverts.
Condition	*Hydroperiod Field Indicators for Other KWH Types*
Reduced Extent and Duration of Inundation or Saturation	● Upstream diversions, impoundments, pumps, ditching, or draining from the wetland. ● Water withdrawal (wells). ● Evidence of aquatic wildlife mortality. ● Encroachment of terrestrial vegetation. ● Encroachment of young, tall, vigorous trees if not usually present, shading of underlying mosses. ● Stress or mortality of hydrophytes or sphagnum. ● Compressed or reduced plant zonation. ● Organic soils occurring well above contemporary water tables. ● Increased discharges resulting in channel downcutting.

Increased Extent and Duration of Saturation	● Berms, dikes, or other water control features that increase duration of ponding (e.g., pumps). ● Diversions, ditching, or draining into the wetland. ● Late-season vitality of annual vegetation. ● Recently drowned riparian or terrestrial vegetation (e.g., beaver-created impoundment). ● Extensive fine-grained deposits on the wetland margins.

4.5.3 Hydroperiod and Hydrologic Connectivity

The metric for hydroperiod is an assessment of the characteristic frequency, level, and duration of inundation or saturation of a wetland during a typical year. Hydroperiod integrates the inflows and outflows of water and varies by major wetland type. For non- tidal KWH wetlands with fluctuating hydroperiods, such as Coastal Plain Floodplain, Vernal Pool, and Coastal Plain Flatwood and Depression Swamp, cycles are governed by seasonal or annual patterns of rainfall and temperature. For non-tidal wetlands with more stable, saturated hydroperiods, such as Spring, Coastal Plain Seepage Bog and Fen, and Coastal Plain Seepage Swamp, these seasonal patterns are often overridden by groundwater flows.

Changes in hydroperiod can affect the structure and composition of the wetland plant community. Common indicators are presented for the different KWH. A basic understanding of the natural hydrology or channel dynamics of the KWH wetland type being evaluated is required to apply this metric. During the field assessment, visually survey the AA for field indicators appropriate to the KWH as indicated in Table 13 (adapted from Collins et al. 2006). For KWH other than Coastal Plain Floodplain, an office-based review of diversions or augmentations of flows or alteration of saturated conditions to the wetland may be needed. After reviewing the entire AA and comparing the conditions to those described in Table 20, assign a metric rating based on criteria in Table 21 for the appropriate KWH type. Assign the rating to the category with the majority of features present.

Hydrologic connectivity represents the ability of the water to flow into or out of the wetland, or to inundate adjacent areas. The metric is assessed in the field by observing signs of alteration to horizontal water movement within the assessment area. For riverine wetlands and riparian habitats, Hydrologic Connectivity is assessed in part based on the degree of alteration of flooding regimes (e.g., channel entrenchment). Entrenchment varies naturally with channel confinement. Channels in steep canyons naturally tend to be confined, and tend to have small entrenchment ratios indicating less hydrologic connectivity. Assessments of hydrologic connectivity based on entrenchment must therefore be adjusted for channel confinement based on the geomorphic setting of the riverine wetlands. Prevention of river flooding by human-created levees and dikes, or impairments caused by shoreline rip-rap, are other ways in which changes to hydrologic connectivity can be assessed (Collins et al. 2006). Natural levees

may form as part of river dynamics, and may be breached during natural flooding events, also altering connectivity. Their form is distinct from human- created levees, helping to minimize misidentification.

Use the metrics appropriate to the KWH and other features where indicated in Table 21 for the Hydrologic Connectivity metric. Refer to *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0), U.S. Army Corps of Engineers*, for indicators of overbank flooding which indicate hydrologic connectivity to the floodplain. List information used in determining connectivity to the floodplain on the field data sheet, such as field indicators of hydrology and flooding, monitoring wells, bank height ratio, entrenchment ratio as well as modeled results for overbank flooding occurrence.

Table 21. Hydroperiod and Hydrologic Connectivity Metric Rating.

Coastal Plain Floodplain ___Low natural variation of hydroperiod ___High natural variation of hydroperiod	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Evidence of recent overbank flooding, no or little channel incision; plant community reflective of characteristic KWH or not altered by changes to hydroperiod. No major hydrologic stressors present that impact natural hydroperiod. If calculated, BEHI/NBS scores low.
Good = 3	Evidence of overbank flooding, limited channel incision; hydroperiod with minor alterations in frequency, levels, duration with little change in plant community resulting from hydrologic alterations. Flooding at 2-year storm interval.
Fair = 2	Some evidence of overbank flooding, likely during larger storm events, channel is incised, wetlands still present due to groundwater or other water inputs, but potentially reduced in extent and showing some plant community changes; or plant community changes due to increased unnatural water inputs. Flooding at 10-year recurrence interval.
Poor = 1	Overbank flooding generally no longer occurs, channel incised resulting in loss of floodplain connectivity and likely causing some drainage of groundwater; wetlands reduced in extent unless have high groundwater or other surface water inputs, plant community changes due to change in hydrology. Flooding may or may not occur at 100-year or greater recurrence interval storm.

Table 21. Hydroperiod and Hydrologic Connectivity Metric Rating, continued.

Other KWH ___Low natural variation of hydroperiod ___High natural variation of hydroperiod	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Overbank flooding present and recent but not predominant water source to wetland; no or little channel incision or effects on groundwater or other water sources; plant community reflective of characteristic KWH or not altered by changes to hydroperiod.
Good = 3	Evidence of overbank flooding, limited channel incision; hydroperiod with little alterations in frequency, levels, duration due to groundwater and other inputs; with little change in plant community resulting from hydrologic alterations. Flooding at 2-year storm interval.
Fair = 2	Some evidence of overbank flooding, likely during larger storm events, channel is incised, wetlands still present due to groundwater or other water inputs, but limited reduction in extent and showing some plant community changes; or some limited plant community changes due to increased unnatural water inputs. Flooding at 10-year recurrence interval.
Poor = 1	Overbank flooding generally no longer occurs, channel incised resulting in loss of floodplain connectivity and likely causing some drainage of groundwater; wetlands potentially reduced in extent if no other surface water inputs, plant community changes due to change in hydrology. Flooding may or may not occur at 100-year or greater recurrence interval storm.

4.6 Key Wildlife Habitat Structure and Composition

Vegetation structure and composition, including vegetation coarse woody debris and presence of invasive species, are of particular interest for assessing the condition of Key Wildlife Habitats based on the ecological needs of the animal Species of Greatest Conservation Need and Signature Plant Species that they support (Maryland DNR 2015). Metrics are added for these factors.

4.6.1 Interspersion and Patch Richness

An interspersion of vegetation patches and a variety of different obvious types of physical surfaces or features can provide habitat for aquatic, wetland, or riparian animal species. The interspersion metric is scored using the narratives below. Vegetative patches should represent at least 5% of the WAA in single or multiple locations. This metric is often reflective of the topographic complexity metric in many wetland types. Patch richness provides a measure of components that represent potential wildlife habitat. Count the number of the following features present in the AA and also within 10m of the AA boundary, as they also contribute:

spring or upwelling groundwater; depression; vegetated pool; unvegetated pool; unvegetated flat; island; animal mound or burrow; beaver dam or lodge; oxbow, swale, secondary channel; wind-thrown tree hole; mound; bank overhang with tree roots; tip-up tree root mound; brush piles; abundant deciduous leaf litter; partially buried natural debris; debris jam; plant hummock/tussocks; or other wildlife habitat**.** Figure 5 shows a visual representation of interspersion scoring by KWH type. For patch richness, count up the features present as stated above and use Table 22 to assign a score. Calculate the mean of the Interspersion and Patch Richness Metrics and use Table 23 to assign an overall score for this metric.

Figure 5. Interspersion Metric Scoring Diagrams.

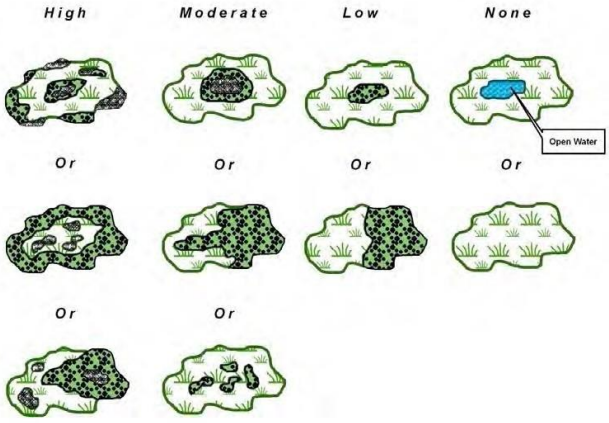
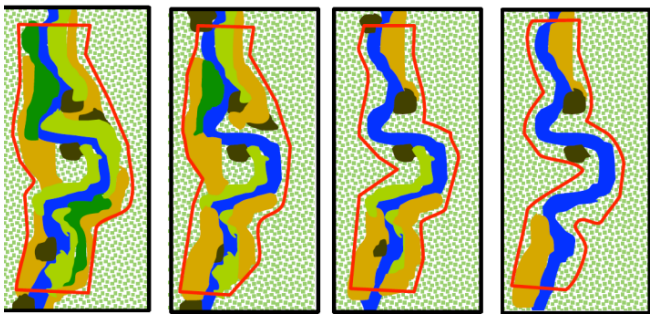
Coastal Plain Seepage Swamp, Coastal Plain Bog and Fen, Coastal Plain Flatwood and Depression Swamp, Vernal Pool, Spring. (Source: US ACE 2015 Texas Rapid Assessment Method) ***Scoring*: High = 4, Moderate = 3, Low = 2, None = 1**	**Coastal Plain Floodplain**: The red box represents the boundary of the AA and each color represents a unique plant zone. The speckled background represents the background matrix vegetation zone, and the blue represents the stream. (Source: California Rapid Assessment Methods for Wetlands Riverine Wetlands Field Book 2013) **Scoring: A = 4, B = 3, C = 2, D = 1**
	

Table 22. Patch Richness Scoring Metric.

Score	Coastal Plain Floodplain, Coastal Plain Seepage Bog and Fen, Coastal Plain Seepage Swamp	Coastal Plain Flatwood and Depression Swamp	Vernal Pool/Spring
4	≥ 6	≥ 7	≥ 4
3	5-6	6-7	3-4
2	3-4	4-5	2
1	≤ 3	≤ 4	≤ 2

Table 23. Interspersion and Patch Richness Metric Rating Criteria.

Score	Mean of Interspersion and Patch Richness Metric Scores
Excellent = 4	3.5 – 4
Good = 3	2.6 - 3.4
Fair = 2	1.6- – 2.5
Poor = 1	1 – 1.5

4.6.2 Vertical Structure

This metric provides an assessment of the overall structural complexity of vegetation layers and growth forms, including presence of multiple strata, age and structural complexity of canopy layer, and evidence of the effects of disease or mortality on structure. These metrics were adapted from Faber-Langendoen et al. (2008).

For forested wetlands, the protocol uses a visual evaluation of variation in overall structure of the tree stratum, including size and density of tree canopy, overall canopy cover, frequency of canopy gaps with regeneration, and number of different size classes of stems. For non-forested systems, an evaluation of the integrity of dominant growth forms is made (e.g., whether shrubs have been removed, killed, or increased or herbaceous layer has been reduced or homogenized by stressors). Wetland delineation field survey data may be used for estimating vertical structure. Use the correct section of Table 24 based on the KWH present, and assign the rating to the category with the majority of features present.

Table 24. Vertical Structure Metric Rating Criteria.

Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp, Coastal Plain Seepage Swamp **Vernal Pool:** assess vegetation structure in area surrounding basin, as only limited to sparse herbaceous vegetation is usually present in the basin area. **Note:** Recent beaver activity may lead to deviations from rating descriptions for Coastal Plain Floodplain. This should be noted on the data sheet and taken into account.	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Tree canopy or highest woody level present is a heterogeneous mosaic of patches of different ages or sizes. Gaps also of varying size. Multiple layers are created through presence of trees of varying ages and heights and the shrub layer. Large trees (>60 cm or 24" dbh) expected to be present. Large trees may be absent in early-seral stands, but, if so, then large stumps are not present (or few) and evidence of natural disturbance event is present (e.g., large downed wood from wind storms or fire scars, beaver activity).
Good = 3	Tree canopy or highest woody level present is largely heterogeneous in age or size. Multiple layers are present, but one layer missing or little variation in ages and heights of woody vegetation in at least one layer. Considering the natural stand development stage, there are more large trees (>60 cm or 24" dbh) than large cut stumps. Some (10-30%) of the old trees have been harvested. Minor presence of cutting, browsing, grazing and other degradation such as forest pests/pathogens.
Fair = 2	Tree canopy or highest woody level present is somewhat homogeneous in age or size. More than one layer present, but one or more layers missing. Little variation in ages and heights of woody vegetation in layers. Considering the natural stand development stage, there are around as many large trees as large cut stumps. Many (over 30%) of the old trees have been harvested. Moderate levels of cutting, browsing, or grazing, or other degradation such as forest pests/pathogens.
Poor = 1	Tree canopy or highest woody level present is very homogeneous, in age or size. Only one or two layers present. Considering the natural stand development stage, most, if not all, old trees have been harvested. None or rare old trees present. Major cutting, heavy browsing, grazing, or other degradation such as forest pests/pathogens.

Coastal Plain Seepage Bog and Fen	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Woody vegetation mortality is due to natural factors. Excellent potential for site recovery given structure present and lack of degradation (past or present).

	Bogs/acidic fens: Peatland structure includes shrub and herb strata (some tall and some short). When present (peatland not too wet), trees are relatively short and stunted with rounded tops and furrowed bark. Shrubs are < 50 cm and open enough to allow for a nearly continuous ground cover of *Sphagnum* and other expected vegetation. Circumneutral/rich fens: Primarily short-statured vegetation and nearly continuous cover of mosses (except in tall sedge fens - which are naturally more vigorous, homogenous, and often with little bryophyte cover). Shrubs may be present as a mosaic with open areas. Tree species, when present, do not form a closed canopy. *Sphagnum* and other mosses actively growing. Never more than local, small patches of degenerating *Sphagnum*.
Good = 3	Minor negative anthropogenic influences present, or the site is still recovering from major past human disturbances. Mortality or degradation due to grazing, peat mining, limited timber harvesting, or other anthropogenic factors may be present, though not widespread. The site can be expected to meet minimally disturbed conditions in the near future if negative influences do not continue. Bogs/acidic fens: Shrubs and herbs show minor alterations from expected conditions and may be some invasive species cover. A few areas of dense and tall shrubs (> 1 m) may occur (dense enough to eliminate *Sphagnum*/moss growth). Some trees may have been or killed due to anthropogenic stressors. Circumneutral/rich fens: Shrubs and herbs show minor alterations from expected conditions.
Fair = 2	Expected structural classes are not present. Shrubs and herbs moderately altered from expected conditions. The site will recover to minimally disturbed conditions only with the removal of degrading influences and moderate recovery times. Bogs/acidic fens: Shrub cover averages > 1 m tall and is beginning to reduce Sphagnum cover. Many trees have been cut or killed due to anthropogenic stressors. Circumneutral/rich fens: Trampling or other physical disturbance has moderately reduced moss cover where expected. Overall, evidence of degradation includes moderate levels of cutting, mowing, browsing, fire or grazing. *Sphagnum* still regenerating in open areas.
Poor = 1	Expected peatland structure is absent or much degraded due to anthropogenic factors, such as peat mining. Overall, evidence of degradation includes major cutting, mowing, browsing, fire or grazing. Woody regeneration is minimal and existing structure is in poor condition, unnaturally sparse, or depauperate. Shrubs and herbs substantially altered from expected conditions. Recovery to minimally disturbed condition is questionable without restoration, or will take many decades. Bogs/acidic fens: Most if not all *Sphagnum* cover has been eliminated due to extremely dense and tall (> 1 m) shrubs. Trees have all been cut or killed by anthropogenic stressors. Circumneutral/rich fens: Trampling or other physical disturbance has eliminated moss cover where it is expected. *Sphagnum* not regenerating, even in open areas.

Table 24. Vertical Structure Metric Rating Criteria, continued.

Spring	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Expected levels of abundance and diversity (some tall and some short) and/or low cover of shrubs or trees where appropriate. Overall, no evidence and little to no structural indicators of degradation evident.
Good = 3	For the most part, expected levels of abundance and diversity (some tall and some short) and/or low cover of shrubs or trees where appropriate. Minor structural degradation (cutting, mowing, browsing, grazing).
Fair = 2	Structural indicators of degradation are moderate. Overall, evidence of degradation includes moderate levels of cutting, mowing, browsing or grazing.
Poor = 1	Vegetation structure is greatly altered from minimally disturbed natural conditions. Structural indicators of degradation are strong. Overall, evidence of human and degradation includes major cutting, mowing, browsing or grazing.

4.6.3 Standing and Downed Woody Debris

Standing or fallen woody debris plays a critical role in a variety of wetland systems, especially riparian systems. Estimation of coarse woody debris should be based on a walkthrough of the entire AA if possible. For large AA, estimation along transects may be preferred. In forested KWH, pay special attention to the amount of coarse woody debris when surveying the AA. Select the statement from the rating table (Table 25) that best describes the amount of woody debris and/or litter within the AA depending on the KWH type. Riverine wetlands that have incised banks, no longer experience flooding, experience overgrazing, or are no longer at a dynamic equilibrium may lack coarse woody debris. For wetlands dominated by shrub and herb layers, note the quantity and distribution of litter compared with the baseline that may be expected in the landscape and rate according to Table 25. Active floodplain systems are typically low in litter. Peatlands are dominated by peat-forming species which contribute enough litter and debris to maintain carbon dynamics, playing a critical role in these systems that may naturally include little coarse woody debris.

Table 25. Standing and Downed Woody Debris Metric Rating Criteria.

Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp, Coastal Plain Seepage Swamp **Vernal Pool and Spring:** assess presence in immediate surrounding area as well as basin, which may only have scattered coarse woody debris, if any. If non-natural sources have created standing and/or downed woody debris, such as cutting or forest pests/pathogens, indicate this on the data sheet.	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Wide diversity of sizes for both standing and downed logs, including larger sizes [> 30 cm (12 in) DBH and > 2 m (6 ft) long)] present with 5 or more snags per ha (2.5 ac), but not excessive numbers (suggesting disease or other problems). Downed logs are in various stages of decay, from sound and intact to soft pieces that no longer maintain their shape.
Good = 3	Moderate diversity of sizes for both standing and downed logs, but larger sizes [> 30 cm (12 in) DBH and > 2 m (6 ft) long)] are rare. Larger size class present with 2-4 snags per ha, or an increased but not excessive number of snags (suggesting disease or other problems). Downed logs are in various stages of decay, with few soft pieces that no longer maintain their shape.
Fair = 2	Moderate-low diversity of sizes for both standing and downed logs, but larger sizes [> 30 cm (12 in) DBH and > 2 m (6 ft) long)] very rare or not present. Larger size class present with 1-2 snags per ha, or moderately excessive numbers (suggesting disease or other problems). Downed logs are in various stages of decay, but few to no soft pieces that no longer maintain their shape.
Poor = 1	Low diversity of sizes for both standing and downed logs. Larger size class [> 30 cm (12 in) DBH and > 2 m (6 ft) long)] present with < 1 snag per ha, or very excessive numbers (suggesting disease or other problems). Downed logs are mostly in early stages of decay.

Coastal Plain Seepage Bog and Fen	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Typical of the system. Woody vegetation mortality is due to natural factors. Peat accumulation appears to be stable or actively growing. Bogs/acidic fens: *Sphagnum* is nearly continuous and growing around tree/shrub bases AND in low hummocks, hollows, or other low areas. Circumneutral/rich fens: Dominant species are active peat-formers.

Good = 3	Minor alterations to system present. Bogs/acidic fens: Mortality or degradation of peat surface due to grazing, limited timber harvesting, anthropogenic fire or other anthropogenic factors may be present, but not widespread. Circumneutral/rich fens: Mortality or degradation of peat surface due to grazing, limited timber harvesting, anthropogenic fire or other anthropogenic factors may be present, but not widespread.
Fair = 2	Moderate alterations to system present. Bogs/acidic fens: Ground cover has as much bare peat as *Sphagnum* cover, or nearly so. Circumneutral/rich fens: Dominance of active peat-formers is being reduced in favor of non-peat-forming grasses and forbs.
Poor = 1	Substantial alterations to system present. Bogs/acidic fens: Ground cover is almost all bare peat with very little *Sphagnum* cover. Circumneutral/rich fens: Cover of active peat-formers dramatically reduced and site is now dominated by non-peat-forming grasses and forbs.

4.6.4 Vegetation Composition

Vegetation of the AA is characterized using the five strata version of the wetland delineation determination (USACE 2010). The species composition is assessed relative to the species expected in each stratum for the KWH in the Assessment Area (Indicator Species, Table 13), and whether exotic invasive species are present. This information is used to calculate two measures relevant to condition: coverage and abundance of invasive plant species, and composition of native plant species present. In addition, the sources of stressors or alterations to the native plant community are noted on the data sheet. The third page of the field data forms (Appendix 3) includes areas to record the information on vegetation (or copy from a completed wetland delineation form). Adjusted Floristic Quality Index and Native Mean Coefficient of Conservation will be calculated in the office using an online program and recorded on the scoring sheet (Appendix 4). Vegetation composition will be assessed in the field.

4.6.5 Invasive Species

Invasive species are non-native species that can spread into natural ecosystems, where they can displace native species and cause major alterations in KWH plant species composition and structure (Faber-Langendoen et al. 2016c). Potential negative impacts of invasive species to KWH include loss of habitat, loss of native biodiversity, decreased nutrition for herbivores,

impaired hydrologic function, and alteration of biomass, energy cycling, productivity, and nutrient cycling (Faber-Langendoen et al. 2016c). This metric uses the absolute cover of invasive species to determine a score and rating (Table 26). Table 13 lists typical invasive plant species by KWH. Additional invasive and exotic species in Maryland can be found at http://mdinvasives.org/species-of-concern/.

Table 26. Invasive Species Metric Rating Criteria.

Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp, Coastal Plain Seepage Swamp, Coastal Plain Bog and Fen **Vernal Pool and Spring:** assess vegetation structure in area surrounding basin, as only limited to sparse vegetation may be present in the basin area.	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Invasive species are absent from all layers or absolute cover in any one woody layer (if present) and herbaceous layer is <1%.
Good = 3	Invasive species are sporadic (no more than 5% absolute cover in any layer).
Fair = 2	Absolute cover of Invasive species is 5-10% in any one woody layer (if present) and/or present with moderate absolute cover (5-30%) in the herbaceous layer. Patches of native vegetation are reduced in size and complexity due to the presence of invasive species.
Poor = 1	Absolute cover of Invasive species is over 10% in any one woody layer (if present) and/or is very abundant (over 30%) in the herbaceous layer. vegetation reduced in size and complexity due to human disturbance. Patches of native vegetation are reduced in size and complexity due to the presence of invasive species.

4.6.6 Native species

Similar to invasive species presence, the presence and composition of native species provides an indication of KWH ecological integrity (Faber-Langendoen et al. 2012, 2016c). This metric uses the presence of indicator species and characteristic native species for the KWH in the AA (see Table 13) as well as the presence of diverse native vegetation or native species that indicate human disturbance. Metrics are adjusted for Coastal Plain Bog and Fen systems and some Spring KWH due to the importance of *Sphagnum*. Use Table 27 to score the native species metric by KWH.

Table 27. Native Species Metric Rating Criteria.

Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp, Coastal Plain Seepage Swamp, Coastal Plain Bog and Fen **Vernal Pool and Spring:** assess vegetation structure in area surrounding basin, as only limited to sparse vegetation is usually present in the basin area. **Note:** Recent beaver activity may lead to deviations from rating descriptions for Coastal Plain Floodplain. This should be noted on the data sheet and taken into account.	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Herbaceous and woody layers (if present) dominated by indicator native species. Layers may be sparse and patchy in areas with deeper flooding, with patches of vegetation confined to hummocks. In other areas, diverse native vegetation present unless there has been a recent natural disturbance. Bog and Fen, some Springs: *Sphagnum* is nearly continuous and growing around tree/shrub bases AND in low hummocks, hollows, or other low areas.
Good = 3	Some indicator native species absent or substantially reduced in abundance OR low cover (<10%) of native species indicative of human disturbance. Layer may be sparse and patchy in areas with deeper flooding. Bog and Fen, some Springs: *Sphagnum* and other mosses actively growing, but may be eliminated from some areas due to disturbance or invasive species.
Fair = 2	Few indicator species are present. Native species indicative of human disturbance are present with moderate cover (10-30%). Patches of native vegetation are reduced in size and complexity due to human disturbance. Bog and Fen, some Springs: *Sphagnum* cover reduced but still regenerating in open areas. Dominance of active peat-formers is being reduced in favor of non-peat-forming grasses and forbs.
Poor = 1	Few to no indicator species are present. Native species indicative of human disturbance are present with >30% cover. Patches of native vegetation are reduced in size and complexity due to human disturbance. Bog and Fen, some Springs; Very little *Sphagnum* cover. Cover of active peat-formers dramatically reduced and site is now dominated by non-peat-forming grasses and forbs:

4.6.7 Floristic Quality Index and Associated Measures

The species identified in the AA during data collection for the wetland delineation can be used to provide information on KWH condition using the methodology developed by Swink and Wilhelm (1979, 1994) for Floristic Quality Assessments. This method uses characteristics of the plant community to derive an estimate of nativity or habitat quality based on a combination of the tolerance to disturbance or environmental stress and fidelity to specific habitat integrity of individual plant species. This combination of tolerance and fidelity is expressed numerically as a coefficient of conservatism or C-value (Swink and Wilhelm 1979, 1994). The C-values of plant species present are combined with the richness of native species to create the Floristic Quality Index (FQI), a metric for habitat condition or quality. For both C-values and FQI, high-quality habitats typically have high scores, while low-quality habitats have low scores. C-values vary from 0 to 10, while FQI varies with species richness and their C-values. Previous studies have found that mean C-value for dominant species correlates well with C-values calculated using all species present at a site (Bourdaghs 2014; Chamberlain and Brooks 2016; Gianopulos 2018) and that the use of an Adjusted FQI better reflects the influence of disturbance on the quality of the habitat being evaluated (Miller and Wardrop 2006).

To derive the Adjusted FQI and mean C-value, an office exercise will be completed using the scientific names of the plant species noted during the wetland delineation process. For the mid-Atlantic region, a Floristic Quality Assessment can be accessed at https://universalfqa.org using the database entitled “Mid-Atlantic Coastal Plain with invasives”. Using this particular database is critical to make certain that the assessment includes invasive species, as it reflects the full database developed by the Mid-Atlantic Wetland Working Group. Record the Native Mean C and Adjusted FQI from the output of the online calculator in the places indicated on the data collection form (Appendix 3). Only Native Mean C will be used to calculate a score and metric rating for the overall vegetation condition according to the following scale: > 4: Excellent; 4-3 Good; <3-2 Fair; <2 Poor. The Adjusted FQI should also be recorded on the scoring sheet, as it is useful for comparison between sites with the same KWH type.

5.0 CALCULATION OF ECOLOGICAL INTEGRITY ASSESSMENT SCORES

The major components of the EIA include four core factors: landscape, soil/substrate, hydrology, and KWH and vegetation composition. Together these are the components that capture the structure, composition, processes, and connectivity of an ecological system. Whether one needs to roll up the individual metrics or core factor scores is dependent on the project objective. Land managers may only be interested in the core factor or individual metric scores, as they provide insight into management needs, goals, and measures of success. On the

other hand, if the goal is to compare or prioritize sites for conservation, restoration, or management actions, then an overall EIA score/rank may be needed. Individual Metric Scores and Mean Core Factor scores can be helpful for understanding current status of primary ecological drivers. Landscape context metrics address the "outer workings" while on-site condition metrics measure the "inner workings" of a wetland (Faber-Langendoen et al. 2016b). The individual Metric Scores take into account the stressors present in the AA and immediate surrounding buffer, providing further insight into site conditions and potential project impacts or opportunities. Addressing all of these characteristics and processes will contribute not only to understanding the current levels of ecological integrity, but to the resilience of the ecosystem in the face of climate change and other global stressors. The presence, scope, and severity of stressors noted for the AA, project area, and buffer in the course of the field and office evaluation provide further information on the condition of the site and potential future trajectory as well as suggesting actions to retain good condition or to improve conditions for the KWH and the species that it supports. Information on conservation actions for KWH can be found in Maryland DNR (2015) and guidance on the use of Metric, Mean Core Factor, and Overall Ecological Integrity ratings is provided in a separate guidance document.

Enter the scores and ratings for the Metrics, Mean Core Factor score, and Overall Core Factor score on the Ecological Integrity Assessment Score Sheet (Appendix 4). To calculate the Mean Core Factor score, add up the metric scores for that Core Factor and divide by the number of metrics. Use the 4-part scale in Table 28 to assign a rating if separate ratings for the four core factors are desired (Mean Core Factor Score). See Section 5.1 for calculation of the overall score and addition of points for unique resources.

Table 28. Ratings and Points for Mean Core Factor Scores and Overall Ecological Integrity Score.

Numerical Score	Rating
3.5 – 4	Excellent
2.5 – 3.49	Good
1.5 – 2.49	Fair
1 – 1.49	Poor

5.1 Overall Ecological Integrity Assessment Score/Rating

The Overall KWH Ecological Integrity Assessment (EIA) score is calculated using the Mean Core Factor scores. These values are combined using the following formula: (Landscape Mean Core Factor score *0.3) + (Soil/Substrate Mean Core Factor score*0.1) + (Hydrology Mean Core Factor score *0.2) + (KWH and Vegetation Composition*0.4). The associated rating for the EIA score is found in Table 28. The score and associated rating should be entered on the scoring form.

If the EIA score is not "Excellent", additional points should be added for each unique resource present at the project area from the WRR or from field observations as described in Section 3.5 and Table 29.

Table 29. Additional Points for Unique Resources. Apply only if EIA rating not "Excellent".

From WRR layers (see Section 3.5): -Non-tidal Wetlands of Special State Concern -Wetlands adjacent to use III or IV waters -Biodiversity Conservation Network Tier 1, 2, or 3 -Occurs in stream reach with "Good" Combined Index of Biotic Integrity -Stream mitigation framework area with low impervious cover (< 5%) From Field observations: -Other Maryland nontidal wetland(s) with significant plant or wildlife value (as defined by COMAR 26.23.01.01B80) (add + 0.2 for each wetland to the Overall EIA score) -Areas with state rare plants or state rare natural community noted during field data collection but not mapped in Biodiversity Conservation Network Tier 1, 2, or 3	Add + 0.2 to the Overall EIA score for each
-Dominated by native trees greater than 60cm or 24" diameter at breast height -Dominated by native species that produce hard mast (i.e., acorns and nuts) in the tree strata -Forest Interior Dwelling Species (FIDS) area: Class 1 -Targeted Ecological Areas	**A**dd + 0.1 to the Overall EIA score for each

Literature Cited

Bourdaghs, M. 2014. Rapid Floristic Quality Assessment Manual. Minnesota Pollution Control Agency, Saint Paul, MN.

California Wetlands Monitoring Workgroup (CWMW). 2013. California Rapid Assessment Methods for Wetlands Riverine Wetlands Field Book. 45 pp.

Chamberlain, S. J. and R. P. Brooks. 2016. Testing a rapid Floristic Quality Index on headwater wetlands in central Pennsylvania, USA. Ecological Indicators 60: 1142–1149.

Collins, J.N., E.D. Stein, M. Sutula, R. Clark, A.E. Fetscher, L. Grenier, C. Grosso, and A. Wiskind. 2006. California Rapid Assessment Method (CRAM) for Wetlands and Riparian Areas. Version 4.2.3. 136 pp.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, VA.

Faber-Langendoen,D., G. Kudray, C. Nordman, L. Sneddon, L. Vance, E. Byers, J. Rocchio, S. Gawler, G. Kittel, S. Menard, P. Comer, E. Muldavin, M. Schafale, T. Foti, C. Josse, and J. Christy. 2008. Ecological Performance Standards for Wetland Mitigation based on Ecological Integrity Assessments. NatureServe, Arlington, VA. + Appendices.

Faber-Langendoen, D., C. Hedge, M. Kost, S. Thomas, L. Smart, R. Smyth, J. Drake, and S. Menard. 2012. Assessment of wetland ecosystem condition across landscape regions: A multi-metric approach. Part A. Ecological Integrity Assessment overview and field study in Michigan and Indiana. EPA/600/R-12/021a. U.S. Environmental Protection Agency Office of Research and Development, Washington, DC.

Faber-Langendoen, D., W. Nichols, F.J. Rocchio, K. Walz, and J. Lemly. 2016a. An Introduction to NatureServe's Ecological Integrity Assessment Method. NatureServe, Arlington, VA.

Faber-Langendoen, D., W. Nichols, F.J. Rocchio, J. Cohen, J. Lemly, and K. Walz. 2016b. Ecological Integrity Assessments and the Conservation Value of Ecosystem Occurrences: General Guidance on Core Heritage Methodology for Element Occurrence Ranking. NatureServe, Arlington, VA.

Faber-Langendoen, D., B. Nichols, K. Walz, J. Rocchio, J. Lemly, and L. Gilligan. 2016c. NatureServe Ecological Integrity Assessment: Protocols for Rapid Field Assessment of Wetlands. V2.0. NatureServe, Arlington, VA. + Appendices.

Federal Geographic Data Committee. 2008. Vegetation Classification Standard, version 2 FGDC-STD-005, v2. Washington, DC.

Gianopulos, K. 2018. Performance of rapid floristic quality assessment indices for increasing cost-effectiveness of wetland condition evaluation. Ecological Indicators 95:502-508.

Harrison, J.W. 2016. The Natural Communities of Maryland: 2016 Natural Community Classification Framework. Maryland Department of Natural Resources, Wildlife and Heritage Service, Natural Heritage Program, Annapolis, Maryland. Unpublished report. 35 pp.

Harrison, J.W., and W.M. Knapp. 2010. Ecological classification of groundwater-fed wetlands of the Maryland Coastal Plain. Maryland Department of Natural Resources, Wildlife and Heritage Service, Natural Heritage Program, Annapolis, MD. Publication Number 033-1132012-544. June 2010. 98 pp.

Lindenmayer, D.B. and J.F. Franklin. 2002. Conserving forest biodiversity: A comprehensive multiscaled approach. Island Press, Washington, DC. 351 pp.

Mack, J.J. 2006. Landscape as a predictor of wetland condition: An evaluation of the Landscape Development Index (LDI) with a large reference wetland dataset from Ohio. Environmental Monitoring and Assessment 120: 221–241.

Maryland Department of Natural Resources. 2015. Maryland State Wildlife Action Plan. Annapolis, Maryland. https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_home.aspx.

Maryland Natural Heritage Program. 2019. Rare, Threatened, and Endangered Plants of Maryland, C. Frye Ed., Maryland Department of Natural Resources, Annapolis, MD. Publication Number 03-031319-136.

Meininger, J., and K. McCarthy. 1997. Forested Wetland Communities of Zekiah Swamp. Maryland Natural Heritage Program. Annapolis, MD. Unpublished report.

Miller, S.J. and D.H. Wardrop. 2006. Adapting the floristic quality assessment index to indicate anthropogenic disturbance in central Pennsylvania wetlands. Ecological Indicators 6:313-326.

Mitsch, W.J., and J.G. Gosselink. 2015. Wetlands (5th edition). John Wiley & Sons, Inc., Hoboken, NJ.

Parrish, J.D., D.P. Braun, and R.S. Unnasch. 2003. Are we conserving what we say we are? Measuring ecological integrity within protected areas. BioScience 53:851–860.

Rocchio, F.J., R.C. Crawford, and T. Ramm-Granberg. 2016. Field Manual for Applying Rapid Ecological Integrity Assessments in Wetlands and Riparian Areas in Washington State. Natural Heritage Report 2016-01. Washington Natural Heritage Program, Olympia, WA.

Shappell, L.J., A.L. Feldmann, E.A. Spencer, and T.G. Howard. 2016. New York State Wetland Condition Assessment Level 2 Rapid Assessment Method (NYRAM Version 4.2). New York Natural Heritage Program, Albany, NY.

Smith, R.D., A. Ammann, C. Bartoldus, and M.M. Brinson. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices. Technical Report WRP–DE–9, U.S. Corps of Engineers, Army Engineer Waterways Experiment Station, Vicksburg, MS. https://apps.dtic.mil/dtic/tr/fulltext/u2/a307121.pdf

Starr, Richard, Will Harman, and Sandra Davis. 2015. Final Draft Function-Based Rapid Stream Assessment Methodology. Habitat Restoration Division, Chesapeake Bay Field Office U.S. Fish and Wildlife Service. 149 pp.

Swetnam, T.W., C.D. Allen, and J.L. Betancourt. 1999. Applied historical ecology: using the past to manage for the future. Ecological Applications 9:1189–1206.

Swink, F. and G.S. Wilhelm. 1979. Plants of the Chicago Region, 3rd ed. Morton Arboretum, Lisle, IL. 922 pp.

Swink, F. and G.S. Wilhelm. 1994. Plants of the Chicago Region, 4th ed. Indiana Academy of Science, Indianapolis, IN.

Terry, R.D. and G.V. Chilingar. 1955. Summary of “Concerning some additional aids in studying sedimentary formations” In M.S. Shvetsov: Journal of Sedimentary Petrology 25(3):229-234.

Thomson, D., A.M.A. Gould, and M.A. Berdine. 1999. Identification and protection of reference wetland natural communities in Maryland: Potomac watershed floodplain forests. Final report. Maryland Department of Natural Resources, Annapolis, MD. 119pp.

U.S. Army Corps of Engineers. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0), ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-10-20. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

U.S. Army Corps of Engineers. 2015. The Texas Rapid Assessment Method (TXRAM). Wetland and Streams Modules, Version 2.0. Final.

USNVC [United States National Vegetation Classification]. 2019. United States National Vegetation Classification Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC.

Young, T. F. and S. Sanzone (editors). 2002. A framework for assessing and reporting on ecological condition. Prepared by the Ecological Reporting Panel, Ecological Processes and Effects Committee. EPA Science Advisory Board, Washington, DC. 142 pp.

Appendix 1

Key Wildlife Habitats for the Pilot Project Area: Upper Coastal Plain

The Maryland State Wildlife Action Plan forms the blueprint for the conservation of priority species and habitats over a 10-year period (2015-2025; Maryland Department of Natural Resources 2015 https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx). The plan identifies 610 animal species considered to be Species of Greatest Conservation Need (SGCN), including all state- and federally listed Threatened or Endangered species, rare species, endemic species, declining species, and responsibility species for which Maryland harbors a significant portion of the overall population. Because of the strong tie between species and habitats, it is critical to identify those habitats that support SGCN in order to conserve them. In general, the term "habitat" is described as the physical and biological environment that provides the necessary food, shelter, and other needs of a particular animal, plant, or other organism. Key Wildlife Habitats are no different in concept with the exception that the species dependent upon those habitats are considered Species of Greatest Conservation Need (SGCN). These habitats serve as critical foundations and support networks not only for SGCN but for all plant and animal species in Maryland.

Key Wildlife Habitats (KWH) are structured as ecological cover types based primarily on vegetation for most habitats, since vegetation typically reflects biological and ecological patterns across the landscape. Wetland and terrestrial KWH are organized into a simple classification scheme which is scalable, allowing for compatibility with other ecological classifications. At the local level, this classification scheme is closely related to Maryland's natural community classification (Harrison 2016). This classification is a relatively fine-scaled classification system that uses an ecologically-based hierarchy and grouping of vegetation associations from the U.S. National Vegetation System (Federal Geographic Data Committee 2008) as the foundation.

In riparian areas, terrestrial and wetland Key Wildlife Habitats are associated with stream and river habitats. These aquatic habitats are characterized into KWH types based on variables known to influence stream and river habitats at various spatial scales such as stream slope, size, elevation, climate, and geology. Stream and river KWH descriptions, as well as lists of SGCN associated with all KWH types, can be found at https://dnr.maryland.gov/wildlife/Documents/SWAP/SWAP_Chapter4.pdf

The best available current information regarding the description, condition, and distribution of primary and secondary target wetland Key Wildlife Habitats in the Upper Coastal Plain pilot project area (Anne Arundel, Prince George's, Calvert, and St. Mary's counties) is provided below (Maryland DNR 2015). Statewide general location maps and county distributions for KWH are presented in this document, along with statewide examples of public lands to visit, signature state rare plants, and state rare natural communities where relevant. These maps should be viewed as only generalized range maps, rather than depicting the full and complete distribution of habitats, especially for small wetland areas.

Coastal Plain Floodplain

The Coastal Plain Floodplain key wildlife habitat is characterized by a variety of flooded habitats that border Coastal Plain streams and rivers. These floodplain habitats are influenced by temporary or seasonal overbank flooding, groundwater seepage, and beaver activity. The vegetation of Coastal Plain Floodplains is both structurally and compositionally diverse, and often occurs as a mosaic of forests, woodlands, shrublands, and herbaceous communities. Species composition varies widely with stream order, soil type, and flooding regime. Floodplain forests of small intermittent streams and braided streams may support combinations of sycamore *(Platanus occidentalis)*, green ash *(Fraxinus pennsylvanica)*, red maple *(Acer rubrum)*, sweetgum *(Liquidambar styraciflua)*, black gum *(Nyssa sylvatica)*, river birch *(Betula nigra)*, swamp chestnut oak *(Quercus michauxii)*, and willow oak *(Quercus phellos)*. Diverse understories are often present and characterized by mixtures of American hornbeam *(Carpinus caroliniana)*, pawpaw *(Asimina triloba)*, American elm *(Ulmus americana)*, American holly *(Ilex opaca var. opaca)*, spicebush *(Lindera benzoin)* and herbs of Jack-in-the-pulpit *(Arisaema triphyllum)*, false nettle *(Boehmeria cylindrical)*, poison-ivy *(Toxicodendron radicans)*, Virginia creeper *(Parthenocissus quinquefolia)*, wood reedgrass *(Cinna arundinacea)*, and various sedges. Similarly, floodplain forests of larger Coastal Plain Rivers with well-drained terraces or natural levees will often support species such as tulip-poplar *(Liriodendron tulipifera)*, beech *(Fagus grandifolia)*, and box elder *(Acer negundo)*. Poorly drained floodplains, backswamps, and depressions of small Coastal Plain streams and rivers may support seasonally flooded swamps dominated by green ash, red maple *(Acer rubrum)*, and plants tolerant of fluctuating water levels such as lizard's-tail. Bald Cypress Swamps and Atlantic White Cedar Swamps are rare natural communities that are also associated with poorly drained settings in seasonally flooded floodplains. Both are associated with slow-moving Blackwater Streams such as those in the Pocomoke and Nanticoke River watersheds. Only 6 acres have been identified by the Maryland Department of Natural Resources as old growth on state lands.

Richard Wiegand, MD DNR

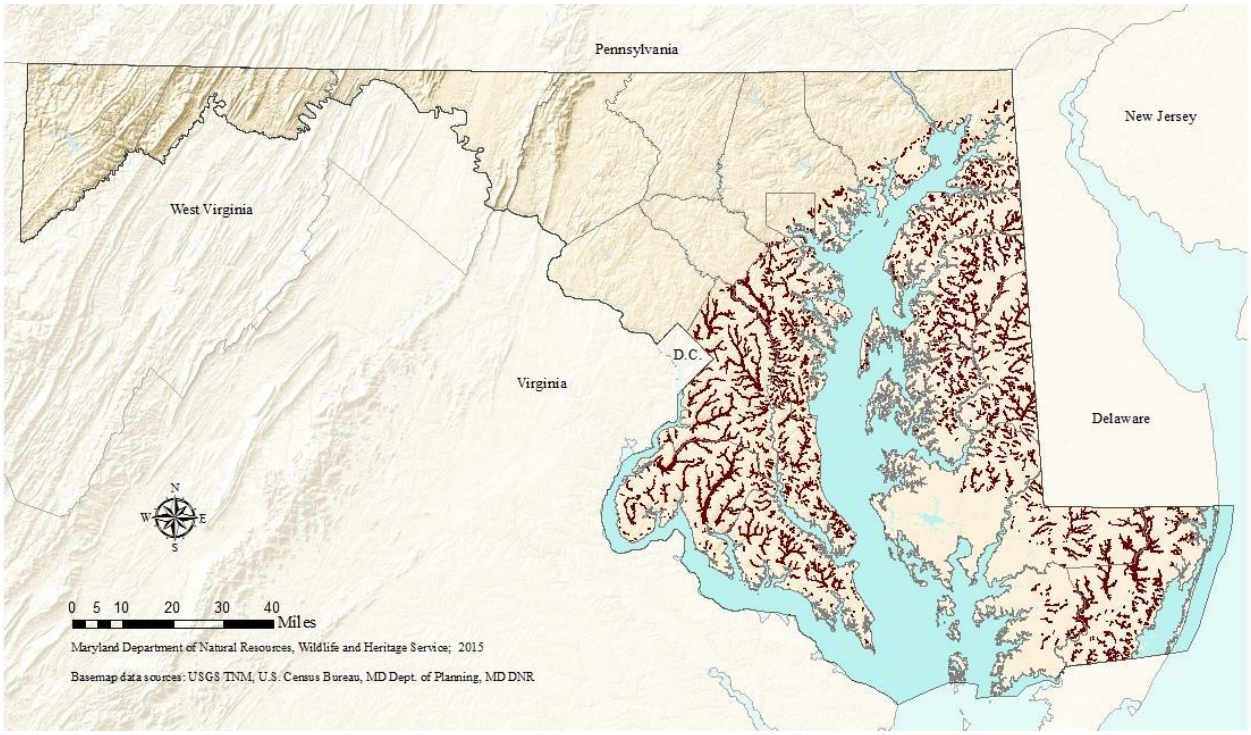
Floodplain pools, beaver ponds, and other open water habitats are also characteristic of Coastal Plain Floodplains. These habitats are subjected to irregular disturbances that change water levels, such as the breaching of beaver dams and storm events. These habitats are highly variable in size, structure, and species composition. They often support a variety of floating aquatic, emergent, and woody vegetation. Species common to these habitats include white water-lily *(Nymphaea odorata)*, spatterdock *(Nuphar advena)*, pondweeds *(Potamogeton* spp.*)*, duckweeds *(Lemna* spp.*)*, bladderworts *(Utricularia* spp.*)*, rice cutgrass *(Leersia oryzoides)*, common woodrush *(Luzula multiflora)*, smartweeds *(Polygonum* spp.*)*, pickerelweed *(Pontederia cordata)*, arrow-arum *(Peltandra virginica)*, three-way sedge *(Dulichium arundinaceum)*, broad-leaved cattail *(Typha latifolia)*, American bur-reed *(Sparganium americanum)*, swamp loosestrife *(Decodon verticillatus)*, and common buttonbush *(Cephalanthus occidentalis)*.

County Distribution: Anne Arundel, Baltimore, Calvert, Caroline, Cecil, Charles, Dorchester, Kent, Prince George's, Queen Anne's, St. Mary's, Somerset, Talbot, Wicomico, Worcester

Places to Visit: Merkle Wildlife Sanctuary, Idylwild Wildlife Management Area, Pocomoke State Forest

Signature State Rare Plants: Flat-stem Spikerush (*Eleocharis compressa*), water-plantain spearwort (*Ranunculus ambigens*), catchfly cutgrass (*Leersia lenticularis*), veined skullcap (*Scutellaria nervosa*), red turtlehead (*Chelone obliqua*)

State Rare Natural Communities: Bald Cypress Swamp, Atlantic White Cedar Swamp



Mapped Locations of Coastal Plain Floodplains in Maryland. Sources: MD DNR, FEMA.

Coastal Plain Seepage Swamp

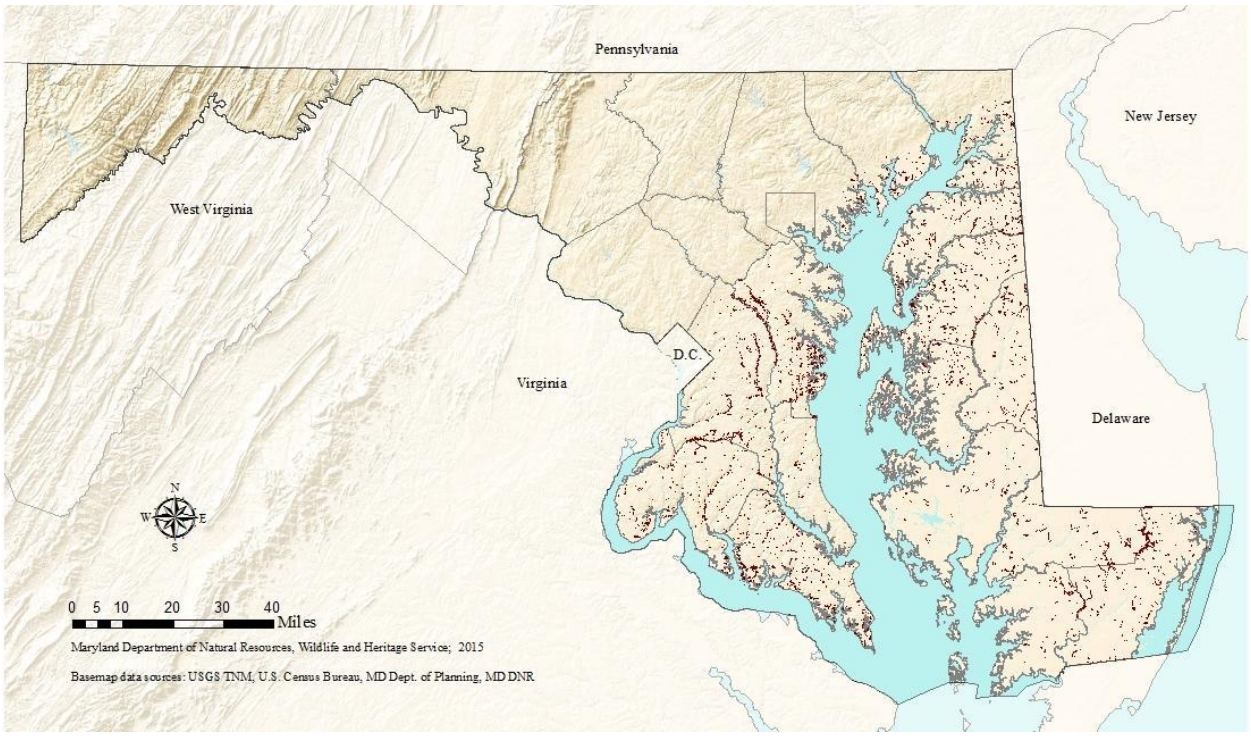
Richard Wiegand, MD DNR

The Coastal Plain Seepage Swamp key wildlife habitat is characterized by gently sloping forests of small headwaters, ravine bottoms, and toe-slopes where groundwater is discharged at ground surface and carried away as stream flow. Often the groundwater seepage is perennial and characterized by diffuse drainage and braided channels with sand, gravel, or peaty substrates. Soils are typically moderately to strongly acidic and nutrient-poor; however, basic seepage swamps may develop in ravines that have downcut into tertiary-aged shell marl deposits. Coastal Plain Seepage Swamps are associated with mostly closed to semi-open canopies of red maple *(Acer rubrum)*, black gum *(Nyssa sylvatica)*, tulip-poplar *(Liriodendron tulipifera)*, sweetbay magnolia *(Magnolia virginiana)*, green ash *(Fraxinus pennsylvanica)*, white ash *(Fraxinus americana)*, and pitch pine *(Pinus rigida)*. The shrub and herbaceous layers in many Coastal Plain Seepage Swamps are diverse and recognized by dense patches of skunk cabbage *(Symplocarpus foetidus)* and colonies of ferns such as cinnamon fern *(Osmunda cinnamomea)*, marsh fern *(Thelypteris palustris var. pubescens)*, royal fern *(Osmunda regalis var. spectabilis)*, New York fern *(Thelypteris noveboracensis)*, and netted chain fern *(Woodwardia areolata)*. Other notable plants include jewelweed *(Impatiens* spp.*)*, small green wood orchid *(Platanthera clavellata)*, Virginia bugleweed *(Lycopus virginicus)*, Jack-in-the-pulpit *(Arisaema triphyllum)*, false nettle *(Boehmeria cylindrical)*, and numerous sedges. In addition, hummocks of peat mosses can be quite abundant and diagnostic to Coastal Plain Seepage Swamps of acidic substrates. The shrub layer may include winterberry *(Ilex verticillata)*, sweet pepper-bush *(Clethra alnifolia)*, swamp azalea *(Rhododendron viscosum)*, spicebush *(Lindera benzoin)*, possum-haw *(Viburnum nudum)*, highbush blueberry *(Vaccinium corymbosum)*, and vines of poison-ivy *(Toxicodendron radicans)*, greenbrier *(Smilax* spp.*)*, and Virginia creeper *(Parthenocissus quinquefolia)*. Coastal Plain Seepage Swamps are naturally small-patched habitats vulnerable to hydrological disturbances, beaver activity, logging, and surface runoff.

County Distribution: Anne Arundel, Baltimore, Calvert, Caroline, Cecil, Charles, Dorchester, Harford, Kent, Prince George's, Queen Anne's, Somerset, St. Mary's, Talbot, Wicomico, Worcester
Places to Visit: Elk Neck State Forest, Tuckahoe State Park, Pocomoke State Forest

Signature State Rare Plants: Swamp pink (*Helonias bullata)*, dwarf huckleberry (*Gaylussacia dumosa)*

State Rare Natural Community: Coastal Plain-Piedmont Acidic Seepage Swamp



Mapped Locations of Coastal Plain Seepage Swamps in Maryland. Sources: MD DNR, USFWS.

Coastal Plain Flatwood and Depression Swamp

Scott Smith, MD DNR

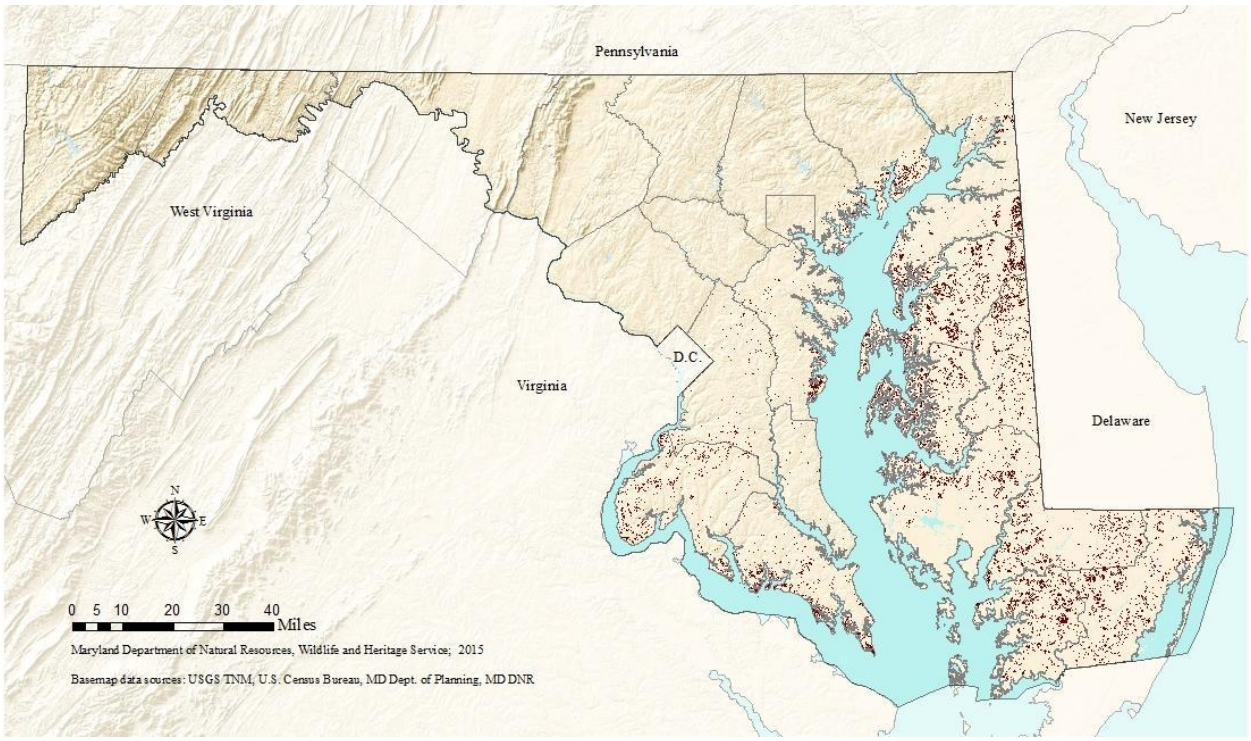
The Coastal Plain Flatwood and Depression Swamp key wildlife habitat includes seasonally flooded flatwoods and depressions of the Coastal Plain. These habitats develop on flat terraces and shallow depressions with seasonally perched water tables. This results in standing water throughout the early part of the growing season followed by a period of drawdown. Hydroperiods are variable between swamps and largely dependent on rainfall and drought cycles. The forested canopy structure of flatwoods and depression swamps range from open to closed with composition ranging from hardwood dominated to a mixtures of hardwoods and pines. Swamps dominated by oak species such as willow oak *(Quercus phellos)*, pin oak *(Quercus palustris)*, swamp chestnut oak *(Quercus michauxii)*, and cherrybark oak *(Quercus pagoda)* are generally considered as higher quality because much of today's remaining stands are characterized by successional hardwoods such as red maple *(Acer rubrum)*, sweetgum *(Liquidambar styraciflua)*, black gum *(Nyssa sylvatica)*, and American holly *(Ilex opaca var. opaca)*. Loblolly pine *(Pinus taeda)* is a prominent component of many flatwoods on the lower Coastal Plain. Other species commonly encountered in these habitats include green ash *(Fraxinus pennsylvanica)*, overcup oak *(Quercus lyrata)*, and swamp tupelo *(Nyssa biflora)*. State rare natural communities within this key wildlife habitat include depressions with mixtures of Atlantic white cedar *(Chamaecyparis thyoides)*, swamp tupelo, pond pine *(Pinus serotina)*, and sweetbay magnolia *(Magnolia virginiana)*. In the understory, shrubs and vines are common but variable, often including an abundance of common greenbrier *(Smilax rotundifolia)*. The herbaceous layer is often sparse and may include species of sedges, manna-grasses, and rushes. Slightly elevated hummocks of sphagnum mosses frequently form large patches. Coastal Plain Flatwoods and Depression Swamps have been greatly reduced in extent in Maryland through ditching, draining, logging, and conversion to agriculture and pine plantations.

County Distribution: Anne Arundel, Baltimore, Calvert, Caroline, Cecil, Charles, Dorchester, Harford, Kent, Prince George's, Queen Anne's, Somerset, St. Mary's, Talbot, Wicomico, Worcester

Places to Visit: Blackwater National Wildlife Refuge, LeCompte Wildlife Management Area, Millington Wildlife Management Area, Third Haven Woods (The Nature Conservancy)

Signature State Rare Plants: Three-angle spikerush (*Eleocharis tricostata)*, southern waxy sedge (*Carex glaucescens)*, white-bracted boneset (*Eupatorium leucolepis)*

State Rare Natural Communities: Coastal Plain Non-Riverine Hardwood Swamps, Atlantic White Cedar Swamp, Upland Depression Swamp



Mapped Locations of Coastal Plain Flatwoods and Depression Swamps in Maryland. Source: MD DNR

Coastal Plain Seepage Bog and Fen

Wesley Knapp, MD DNR

The Coastal Plain Seepage Bog and Fen key wildlife habitat is a rare, small-patched habitat associated with seepage toeslopes, small stream bottoms, and the margins of long established millponds and sandpits. They typically develop at the base of sand and gravel terraces near streams where groundwater seepage is abundant and forced to the surface by an impermeable clay lens or aquiclude. The soils are usually peaty or sandy, very acidic, infertile, and often covered by dense mats of mosses (*Sphagnum* spp.) that support a unique flora. The term "bog" as applied to these wetlands, is a technical misnomer, since not all of these habitats are true peatlands and none is an ombrotrophic (i.e., fed by rainwater) system. This term, however, is now so widely used in the southeastern United States as a descriptor for open, acidic seepage wetlands that we have adopted it here for consistency. In Maryland, Coastal Plain Seepage Bogs and Fens exist in a variety of open settings and many are relicts of older, larger systems. Many natural examples have been destroyed by hydrologic alterations (e.g., ditching, draining, and impoundment construction), beaver activity, and a long history of fire suppression across the landscape. Remaining sites that support bog flora persist in artificially maintained habitats such as millponds, powerline rights-of-way, and sandpits where woody plant succession is usually controlled. The vegetation of Coastal Plain Seepage Bogs and Fens is very heterogeneous and patchy with scattered shrubs and graminoid dominated patches. The small openings found along the margins of slow-moving streams, millponds, and abandoned sandpits often support shrubs such as leatherleaf *(Chamaedaphne calyculata)*, big cranberry *(Vaccinium macrocarpon)*, sweet pepper-bush *(Clethra alnifolia)*, swamp loosestrife *(Decodon verticillatus)*, and giant cane *(Arundinaria gigantean)*. Hummocks of *Sphagnum* mosses are characteristic and usually support species such as northern pitcher-plant *(Sarracenia* spp.*)*, white beak-sedge *(Rhynchospora alba)*, rose pogonia *(Pogonia ophioglossoides)*, St. John's-wort *(Hypericum* spp.*)*, and Virginia meadow-beauty *(Rhexia virginica)*. Orchids, sundews *(Drosera* spp.*)*, bladderworts *(Utricularia* spp.*)*, and yellow-eyed grasses *(Xyris* spp.*)* are also common. Near the fall-line, globally rare Magnolia Bogs occur and share many floristic similarities to the New Jersey Pine Barrens region. Unlike true bogs, Magnolia Bogs are not characterized by accumulations of peat or organic soils. Nutrient poor and acidic seepage flow from groundwater often forms mucky depressions and braided channels around hummocks of sphagnum mosses. Historic accounts of Magnolia Bogs describe these areas with sweet bay and various shrubs fringing and forming clumps within a more open center dominated by herbaceous plants. Today, remaining examples exist mostly as open woodlands of black gum *(Nyssa sylvatica)* and sweet bay *(Magnolia virginiana)* with very dense shrubs and very small, scattered herbaceous patches. Shrubs common to these habitats include sweet bay, swamp azalea *(Rhododendron viscosum)*, highbush

blueberry *(Vaccinium fuscatum),* fetterbush *(Leucothoe racemosa),* dangleberry *(Gaylussacia frondosa),* poison sumac *(Toxicodendron vernix),* and Southern wild raisin *(Viburnum nudum).* Herbaceous openings include species such as cinnamon fern *(Osmunda cinnamomea),* woolly panicgrass *(Dichanthelium acuminatum),* partridge berry *(Mitchella repens),* halberd-leaved greenbrier *(Smilax pseudochina),* wild yam *(Dioscorea* spp.*),* Indian cucumber-root *(Medeola virginiana),* and primrose-leaved violet *(Viola primulifolia).* Regionally uncommon or rare "bog" species persisting in Magnolia Bogs include bog goldenrod *(Solidago uliginosa var. uliginosa),* ten-angled pipewort *(Eriocaulon decangulare),* Long's rush *(Juncus longii),* spoon-leaved sundew *(Drosera intermedia),* red milkweed *(Asclepias rubra),* and sheep-laurel *(Kalmia angustifolia).*

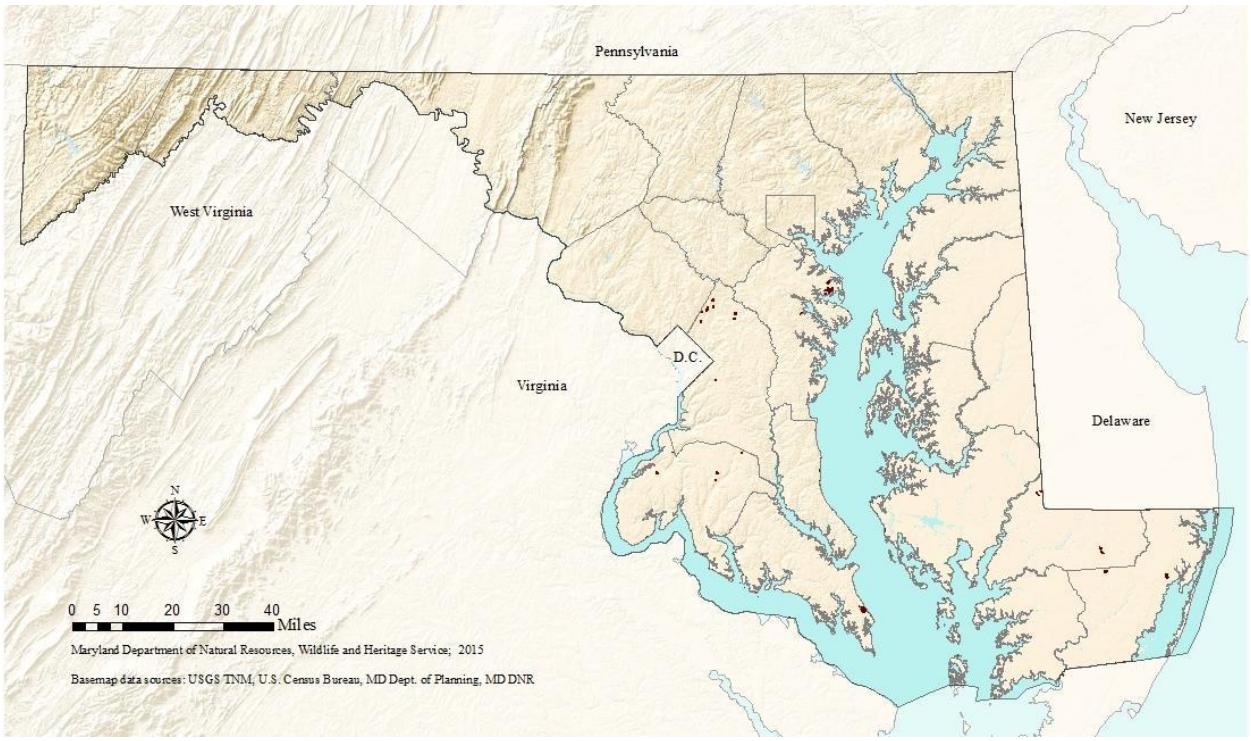
Sea-level Fens are small maritime seepage wetlands that occur above the high tide line at the bases of slopes where abundant groundwater discharges along the upper edges of estuarine bays. The hydrology of these sites is best characterized as saturated, although shallow standing water and small, muck-filled pools are locally present at all sites. Soils are characterized as organic and nutrient-poor. The vegetation exhibits characteristics of both inland seepage bogs and slightly brackish tidal marshes. Stands are generally a physiognomic mosaic of open woodland, scrub, and herbaceous patches. Woody species include red maple *(Acer rubrum),* black gum *(Nyssa sylvatica),* sweet bay *(Magnolia virginiana),* and southern bayberry *(Morella cerifera).* Characteristic herbs include twig rush *(Cladium mariscoides),* beaked spikerush *(Eleocharis rostellata),* white beaksedge *(Rhynchospora alba),* spoon-leaved sundew *(Drosera intermedia),* ten-angled pipewort *(Eriocaulon decangulare),* coinleaf *(Centella erecta),* brown-fruited rush *(Juncus pelocarpus),* and bladderworts *(Utricularia* spp.*).* Because of their small size and association with tidal salt marshes, Sea-level Fens are included as part of the Tidal Salt Marsh and Shrubland key wildlife habitat.

County Distribution: Anne Arundel, Calvert, Caroline, Cecil, Charles, Dorchester, Prince George's, Somerset, Wicomico, Worcester

Places to Visit: Suitland Bog

Signature State Rare Plants: New Jersey rush (*Juncus caesariensis),* Long's rush (*Juncus longii),* red milkweed (*Asclepias rubra),* leatherleaf (*Chamaedaphne calyculata),* brown-fruit rush (*Juncus pelocarpus),* northern pitcher plant (*Sarracenia purpurea)*

State Rare Natural Community: Coastal Plain-Piedmont Acidic Seepage Bog/Fen



Mapped Locations of Coastal Plain Seepage Bogs and Fens in Maryland. Sources: MD DNR, USFWS.

Vernal Pool


James McCann, MD DNR

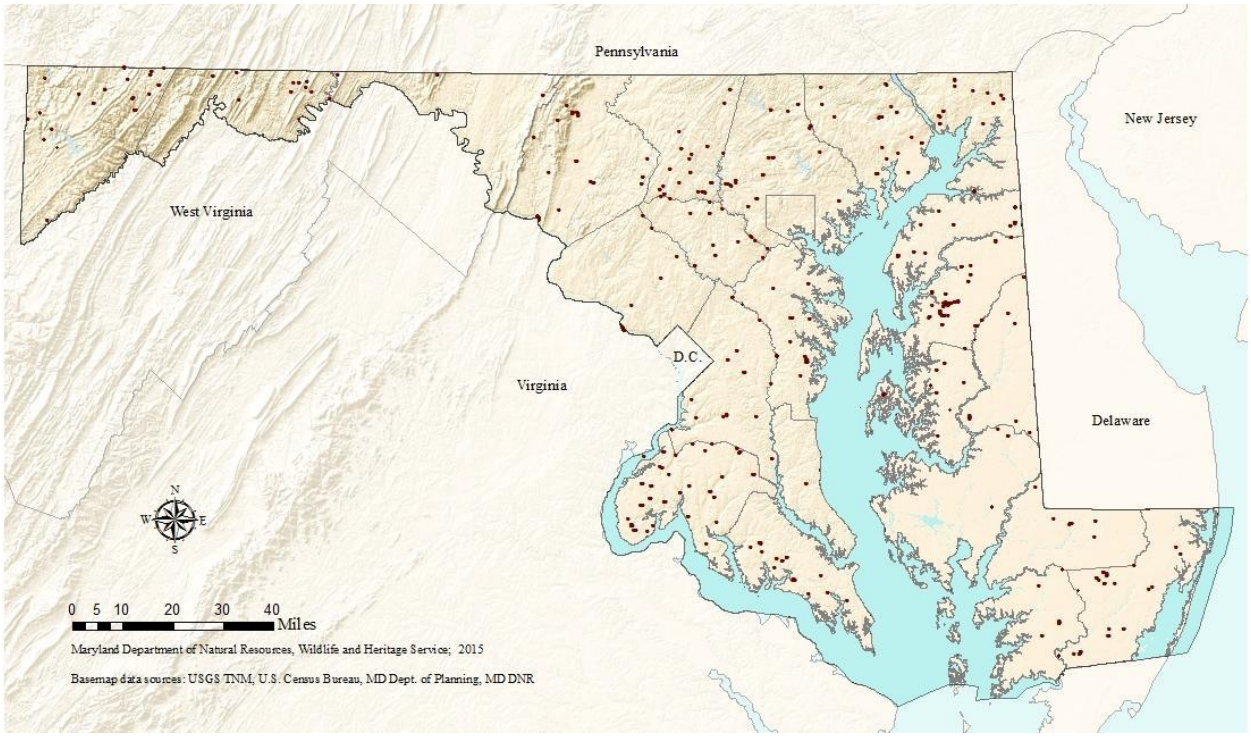
The Vernal Pool key wildlife habitat is defined as small (~0.1-2 ha), non-tidal palustrine forested wetlands. They exhibit a well-defined, discrete basin and lack a permanent, above-ground outlet. The basin overlies a clay hardpan or some other impermeable soil or rock layer that impedes drainage. As the water table rises in fall and winter, the basin fills forming a shallow pool. By spring, the pool typically reaches maximum depth (~0.5-2.5 m) following snowmelt and the onset of spring rains. By mid- to late summer, the pool usually dries up completely, although some surface water may persist in relatively deep basins, especially in years with above average precipitation. This periodic seasonal drying prevents fish populations from becoming established, an important biotic feature of Vernal Pools. Many species have evolved to use these temporary, fish-free wetlands. Some are obligate vernal pool species, so-called because they require a Vernal Pool to complete all or part of their life cycle. Vernal Pools occur throughout the state as scattered, isolated habitats. They are most numerous on the Lower

Coastal Plain, especially on the mid to upper Eastern Shore, and uncommon west of the Fall Line. They are typically situated in low areas or depressions in a forest, but they can also occur in floodplain forests as isolated floodwaters, among backwaters of old beaver impoundments, old sinkholes, or as perched spring- or seep-fed basins along mountain slope benches, or at the base of slopes. Vernal Pools may persist in cleared areas such as cropland, pastures, and clearcuts, but usually in a highly degraded ecological state. Because Vernal Pools occur throughout the state in a variety of forest types and settings, the vegetation in and around these habitats varies considerably. However, many Vernal Pools exhibit similar vegetative structure. For example, Pools tend to have a semi-open to closed forest canopy around them and the degree of canopy closure generally decreases with increasing pool size. The basin substrate consists of dense mats of submerged leaf litter and scattered, coarse woody debris. Herbaceous vegetation is usually absent to sparse in and around the basin, although small mossy patches frequently occur along the basin edge. A dense shrub layer may occur along the shoreline or in small patches within the basin, especially on the Coastal Plain, but many Pools also lack a well-developed shrub layer.

County Distribution: Statewide

Places to Visit: Seth Demonstration Forest

State Rare Natural Community: Vernal Pool



Mapped Locations of Vernal Pools in Maryland. Source: MD DNR.

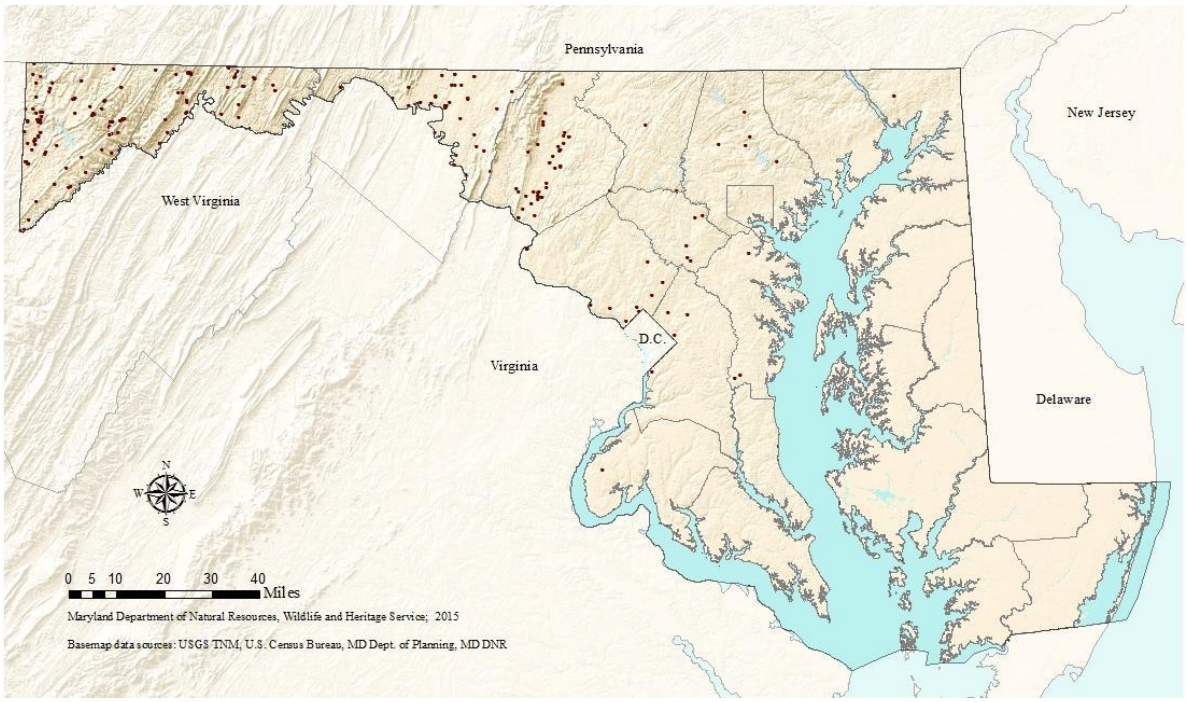
Spring

MD DNR

The Spring key wildlife habitat is a concentrated discharge of groundwater at a small (usually < 1 m^2), distinct site or opening in the ground. Springs are uncommon, isolated features and most occur west of the Fall Line. They provide critical habitat for highly rare aquatic snails and subterranean invertebrates, salamanders, crayfish and other invertebrates. Because some Springs discharge directly into streams or wetlands, they also play a vital role in maintaining the ecological integrity of these habitats which, in turn, may harbor species of conservation concern (e.g., pearl dace, brook trout, rare dragonflies and damselflies). Springs emit groundwater due to hydrostatic pressure resulting from gravity or artesian flow, although other physical forces may play a role (e.g., buoyant effect of dissolved gases). Several types of Spring key wildlife habitats exist in Maryland including contact, scree, and fault Springs. Perhaps the most common type is fracture or crevice springs. Here, groundwater moves downward due to gravity, flowing through fractures and crevices underneath the ground and emerging as a spring where a major fracture in a rock formation occurs at the earth's surface, usually along a ravine or swale. The flow or discharge rates of Maryland's Springs range from less than one gallon per minute to nearly 10,000 gallons per minute. Springs differ from seeps in that the latter appear on the ground surface as broad, diffuse zones of wetness or percolation rather than distinct discharge sites. Also, seeps and associated wetlands often support distinct plant communities while springs are essentially aquatic and geological features.

County Distribution: Statewide

Places to Visit: Henryton Spring, Annapolis Rock Spring



Mapped Locations of Springs in Maryland. Sources: MD DNR, Geographic Names Information System (USGS).

Appendix 2

Resources for Site Background Information and Assessment Area Determination

Current aerial imagery and additional layers:

Maryland Watershed Resources Registry:
https://watershedresourcesregistry.org/states/maryland.html

Relevant content: riparian, wetland, and upland preservation and restoration site scores; stormwater infrastructure scores; permit and site visit information; water quality; fish passage connectivity; coastal resiliency, historical shoreline, and floodplain data; aquatic biota; geology and soils; Protected Lands, parcel boundaries/SDAT data, NWI and DNR Wetlands.

US EPA, "MyWATERS": http://watersgeo.epa.gov/mwm/

Relevant content: base maps (satellite imagery from Bing Maps, topography, street maps); water quality status/permitting; rivers and streams (National Hydrography Dataset, NHD), and wetland data (National Wetlands Inventory, NWI).

USGS National Map Viewer: http://viewer.nationalmap.gov/viewer/

Relevant content: base maps (satellite, orthoimagery, topography), elevation contours, NHD including flow direction, National Land Cover Database (NLCD), protected areas (status, type, owner/manager), and wetland data (NWI). All of the data layers accessible here may be exported and viewed in ArcGIS or Google Earth.

Maryland Department of Natural Resources (MD DNR), "Merlin Online":
https://gisapps.dnr.state.md.us/MERLIN/index.html

Relevant content: base maps (satellite imagery, topography, street maps); parcel boundaries/SDAT data; watersheds, living resources, trail data, Protected Lands, Green Infrastructure, Soils, DNR Wetlands, and NWI wetland data (National Wetlands Inventory).

MD DNR, "The GreenPrint Map": https://geodata.md.gov/greenprint/

Relevant content: base maps (satellite imagery, topography, street maps); parcel boundaries/SDAT data; watersheds, living resources, trail data, Protected Lands, Green Infrastructure, BioNet, DNR Wetlands, Water Quality, and provides Conservation Benefits Assessment scores.

Historical aerial photos:

Google Earth for limited time periods

https://www.sciencebase.gov/catalog/item/4f4e4a94e4b07f02db658dba

http://www.mgs.md.gov/publications/mgs_data_preservation/aerial_photos.html.

Wetland, hydrography, and soils:

DNR Wetlands published by Maryland Department of Natural Resources (MDDNR) – downloadable here: https://data.imap.maryland.gov/datasets/maryland-wetlands-wetlands-polygon-department-of-natural-resources

NWI data published by US Fish & Wildlife Service (USFWS) - Interactive mapper, GIS & Google Earth data downloads: http://www.fws.gov/wetlands/

EPA WATERS data, Google Earth download - Includes NHDPlus surface water features, water quality feature: http://www.epa.gov/waterdata/viewing-waters-data-using-google-earth USGS National Hydrography Data: http://nhd.usgs.gov/data.html

USDA soils – Interactive mapper: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm GIS data: https://gdg.sc.egov.usda.gov/ or via interactive downloader: http://www.arcgis.com/home/item.html?id=4dbfecc52f1442eeb368c435251591ec

NatureServe's Ecological System's map (http://www.natureserve.org/conservation-tools/terrestrial-ecological-systems-united-states)

Maryland's interactive wetlands mapper (https://www.fws.gov/wetlands/Data/Mapper.html)

Appendix 3

Field Data Sheets

MARYLAND WETLAND ECOLOGICAL INTEGRITY ASSESSMENT

Project/Site Name:_____ **City/County:**_____ **Sampling Date:**_____
Assessment Area Name (if >1 AA): _____ **Observer(s):**_____
Delineation performed: ☐previously ☐ concurrently **Lat/Long:** _____ **AA size:** _____ **units** _____

Site Description: (general setting, topography, vegetation patterns, human and natural disturbance, photos, etc.)

LANDSCAPE ASSESSMENT FOR PROJECT AREA (Section 3; office or office/field assessment):

METRIC	**SCORE** (use tables in Section 3 to assign scores)
Buffer Perimeter: %Natural: ☐ >95% ☐ 85-95% ☐ 75-84% ☐ <75%	
Buffer Condition: %Natural: ☐ >90% ☐ 75-90% ☐ 50-74% ☐ <50%	
Aquatic Context: ☐ 4 or more aquatic resources ☐ 3 ☐ 2 ☐ 0-1	
Comparative Size: ☐ Very large ☐ Large ☐ Medium to small ☐ Small to very small	
Source(s) of size reduction: ☐ Beaver dam or lodge ☐ Trail ☐ Road ☐ Railroad ☐ Development ☐ Agriculture ☐ Impoundment ☐ Human-constructed drainage (into or out of wetland) ☐ Excavation ☐ Fill ☐ Groundwater extraction ☐ Other _____	

WETLAND ASSESSMENT AREA ONLY:

ENVIRONMENTAL INFORMATION (Section 4.2) Slope (deg/%):_____ Aspect: _____

Landscape Position: Circle all features present

☐ Active floodplain (depression or terrace)	☐ Beaver pond/Natural impoundment	☐ Riparian-Depression (in floodplain)	☐ Riparian terrace (outside seasonal flooding; historic floodplain or current terrace)
☐ Headwater stream/spring	☐ Saddle/Drainage Divide	☐ Swale	☐ Isolated Depression
☐ Oxbow	☐ Seep/groundwater discharge site	☐ Streambank	☐ Point bar
☐ Flats	☐ Wetland charged by groundwater seeps	☐ Other- describe	

Water Source: If more than one source is present, label as P (primary), S (Secondary), T (tertiary)

☐ Direct precipitation	☐ Groundwater discharge	☐ Natural surface flow	☐ Urban run-off/culverts
☐ Overbank flooding	☐ Alluvial aquifer	☐ Irrigation	☐ Pipes/outfall (directly feeding wetland)

Hydrological Regime: Circle the regime that best matches the conditions in the AA

H Permanently Flooded	G Intermittently Exposed	F Semipermanently Flooded	C Seasonally Flooded	E Seasonally Flooded-Saturated
B Saturated	D Continuously Saturated	A Temporarily Flooded	I Intermittently Flooded	K Artificially Flooded

CLASSIFICATION OF AA TO KEY WILDLIFE HABITAT AND HGM CLASS (Section 4.3)

Key Wildlife Habitat: _____ HGM Class: _____
Optional: NVC Community Type/Plant Association: _____

SOIL/SUBSTRATE (Use tables in Section 4.4 to assign score; if the floodplain does not naturally have hydric soils, and still does not have hydric soils under current conditions, skip this metric.)

Redox concentrations: >10% surface area and ☐ start 0-6" from soil surface ☐ start >6-12" ☐ start >12-18"
<10% surface area and ☐ start 0-6" from soil surface ☐ start >6-12" ☐ None within 18" **Score:** _____
Microtopography: ☐ ≥50% of Assessment Area ☐ 30-49% of AA ☐10-29% of AA ☐ <10% of AA **Score:** _____
Soil Organic Matter: ☐ Horizon present (any thickness) ☐ Mineral surface layer(s) ≥ 4" thick
☐Mineral surface layer <4" thick and ☐Matrix value ≤3 and chroma ≤2 ☐ Matrix value >3 and ≤4 or chroma >2 and ≤3 **Score:** _____
Organic Matter Accumulation (root turnover): Ground cover of herbaceous plants: ☐ >75% ☐ >50-74% ☐>25-50% ☐ ≤25% **Score:** _____

MARYLAND WETLAND ECOLOGICAL INTEGRITY ASSESSMENT

Project/Site Name:_____ **City/County:**_____ **Sampling Date:**_____

Assessment Area Name (if >1 AA): _____ **Observer(s):**_____

HYDROLOGY (Use tables in Section 4.5 to assign scores)

Water Source– *Identify dominant water source and natural/unnatural influence for the AA.*

☐ Natural ☐Unnatural/Manipulated: ☐Impoundment ☐Inflow from anthropogenic sources ☐Irrigation/pumping ☐Fill ☐Ditching/Channelization ☐Other

Point Source Discharge (into or adjacent to site): ☐ Lacking ☐Minor ☐Moderate ☐Major

Unnatural Obstructions: ☐ None ☐ Minor (<25%) ☐ Moderate (25-75%) ☐ Major (>75%)

Alteration to: ☐Overland Flow ☐Groundwater ☐Overbank Flooding ☐ Plant Community ☐ Wetland Extent

Timing: ☐Recent (within 5 years) ☐Historic ☐Permanent hydrologic change

Negative effect: ☐ flow and circulation within AA ☐redirects or confines flows into/through AA ☐reduced water table ☐reduced inundation ☐None

Score: _____

Channel *– Identify evidence of alteration to the stream channel in the project area.*

Features present: ☐ Braided channels coalesced ☐ Banks undercut, slides, and/or slumps ☐ Riparian vegetation declining ☐ Shrub/trees falling into channel

Evidence of channel instability/migration: ☐None/minimal ☐ Minor ☐ Moderate ☐ Substantial

Sources of channel instability/migration: ☐ Active incision/downcutting ☐ Lacks vertical controls (vegetation, wood, rock, etc.) ☐Excessive channel deposition/bar development ☐Historic channel alteration ☐Proximity and landscape position presents potential impact to AA hydrology

Evidence of bank instability: ☐None/minimal ☐ Minor ☐ Moderate ☐ Substantial

Sources of bank instability: ☐Vertical banks ☐Highly erodible materials ☐Raw unvegetated banks ☐Excessive bedload ☐Other _____

If available: Bank Erosion Hazard Index _____ Near Bank Stress _____ **Score:** _____

Hydroperiod and Hydrologic Connectivity – *Determine the natural variability and/or recent alteration of the duration, frequency, and magnitude of inundation/saturation in the AA by KWH type.*

Natural variation of hydroperiod: ☐ Low ☐ High

Information Sources: ☐Visual indicators ☐Monitoring Wells ☐Hydrology/Hydraulic analysis ☐ Bank Height Ratio _____ Entrenchment Ratio _____

Overbank flooding (if available): ☐ 2-year storm ☐ 10-year ☐ 100-year

Degree of connection to floodplain: ☐Complete Disconnection/entrenchment: ☐Minimal ☐Moderate ☐Disconnected and/or severely entrenched

Evidence of overbank flooding: ☐ Recent ☐ Evidence of overbank flooding ☐ Some evidence, likely during large storm events ☐ Generally no longer occurs

Change/Alteration of hydroperiod: ☐None ☐Due to natural events ☐Human influences (☐Minor ☐ Moderate ☐Substantial)

Backwater flooding from restrictions: ☐ List restrictions: _____

Score: _____

KEY WILDLIFE HABITAT (Use tables and figures in section 4.6 to assign scores)

Interspersion/Patch Richness –*interspersion of vegetation patches* ***and*** *number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian animal species.*

Interspersion of habitats/physical features (see examples in field manual): ☐ High ☐ Moderate ☐Low ☐ Minimal/None

Features present: ☐ Spring or upwelling groundwater ☐ Depression ☐ Vegetated pool ☐ Unvegetated pool ☐ Unvegetated flat ☐ Island ☐Animal mound or burrow ☐ Beaver dam or lodge ☐Oxbow, swale, secondary channel ☐Wind-thrown tree hole ☐ Mound ☐ Bank overhang with tree roots ☐ Tip-up tree root mound ☐ Brush piles ☐ Abundant deciduous leaf litter ☐ Partially buried natural debris ☐ Debris jam ☐ Plant hummock/tussocks

☐Other wildlife habitat: _____ **Score:** _____

Vertical Structure – *Refer to metrics for selected Key Wildlife Habitat Type for scoring.*

Forested systems: Canopy: Heterogeneous patches of different ages or sizes: ☐Yes ☐ Mostly ☐ Somewhat ☐ No

☐Gaps of varying sizes ☐Impacted by beaver activity ☐Impacted by forest pests/pathogens

Woody vertical layers: ☐Multiple layers present ☐ One layer missing or homogeneous ☐ >1 layer missing, little variation ☐ Only 1-2 layers present

Large trees (DBH>60cm or 24") harvested: ☐None/few ☐10-30% ☐ >30% ☐ Most/All

Degradation due to cutting, browsing,pests/pathogens: ☐Minimal ☐Moderate ☐ Extensive Source(s) of degradation: _____

Bog and Fen systems: Woody layer mortality: ☐Due to natural factors ☐ Minor human-caused ☐ Moderate human-caused ☐ Extensive human-caused

Potential for site recovery: ☐ Excellent ☐ Likely ☐ Uncertain ☐ Unlikely

Expected structure: ☐Present ☐Minor alteration ☐Moderate Alteration ☐ Extensive Alteration Score: _____

Standing and Downed Coarse Woody Debris – *Refer to metrics for selected Key Wildlife Habitat type for scoring.*

Forested systems: Standing snags and downed logs: Size diversity: ☐ High ☐Moderate ☐Moderate-low ☐ Low

Stage of downed log decay: ☐ Variable including advanced stage ☐ Variable with few advanced ☐ Variable with no advanced ☐ Low variability

Source(s) of woody debris if not natural (cutting, pest/pathogens, etc.): _____

Bog and Fen systems: Woody and litter: ☐ Typical, peat accumulation ☐ Human-caused alteration Minor ☐ Moderate ☐ Substantial

Ground cover alterations: ☐None ☐ Minor ☐ Moderate ☐ Substantial

Score: ____

MARYLAND WETLAND ECOLOGICAL INTEGRITY ASSESSMENT

Project/Site Name:_____ **City/County:**_____ **Sampling Date:**_____

Assessment Area Name (if >1 AA): _____ **Observer(s):**_____

VEGETATION (Section 4.6) (Additional species may be listed on a separate sheet. See manual for %cover examples. Species identified for each layer should meet the minimum required for wetland delineation)

Species:	Absolute % Cover	Species:	Absolute % Cover
Tree Stratum: woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger DBH			
1.		5.	
2.		6.	
3.		7.	
4.		8.	
Sapling Stratum: woody plants, excluding woody vines, approx.. 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH			
1.		4.	
2.		5.	
3.		6.	
Shrub Stratum: woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height			
1.		6.	
2.		7.	
3.		8.	
4.		9.	
5.		10.	
Herb Stratum: all herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody species, except woody vines, less than approximately 3 ft (1 m) in height			
1.		7.	
2.		8.	
3.		9.	
4.		10	
5.		11.	
6.		12.	
Woody Vine Stratum: all woody vines, regardless of height			
1.		4.	
2.		5.	
3.		6.	

KWH VEGETATION COMPOSITION (Use tables in Section 4.6 to assign scores).

Invasive Species:

Maximum invasive species cover in any one woody layer: ☐<1% ☐ 1- 5% ☐ >5-10% ☐ >10%

Absolute cover of invasive/disturbance species in herbaceous layer: ☐<1% ☐ 1-5% ☐ >5-30% ☐ >30% **Score:**_____

Native Species: *Refer to metrics for selected Key Wildlife Habitat Type for scoring.*

Woody layer (if present): ☐Dominated by diagnostic native species ☐ Some diagnostic species absent/reduced ☐Few diagnostic species ☐ Few/no diagnostic species present

Herbaceous layer: ☐Dominated by diagnostic native species ☐ Some diagnostic species absent/reduced ☐Few diagnostic species ☐ Few/no diagnostic species present Bog/Fen/Springs: Sphagnum cover - ☐Continuous ☐ Absent from small areas ☐ Reduced ☐ Very low

Cover of native species indicative of disturbance: ☐ 0-1% ☐ 2-10% ☐>10-30% ☐ >30% **Score:** _____

Floristic Quality Assessment: *(see manual for calculation):*

Native mean C-value _____ : ☐>4 ☐ 3-4 ☐ <3-2 ☐ <2

Adjusted FQI _____

Score: _____

Alterations/Stressors: *Indicate stressors affecting the vegetation composition of the AA.*

☐ Timber harvest (clearcut or selective cut) ☐ Tree plantation ☐Mowing or shrub cutting ☐ Herbicide use ☐ Trampling/ORV ☐Excessive animal herbivory ☐ Excessive pest damage ☐ Invasive plant species ☐ Recently burned/unnatural fire regime ☐ Other _____

Remarks and scoring rationales (continue on attached sheet I needed)**:**

Appendix 4

Ecological Integrity Assessment Score Sheet

MARYLAND WETLAND ECOLOGICAL INTEGRITY ASSESSEMENT SCORING FORM

Project/Site Name:_____ **City/County:**_____ **Sampling Date:**_____

Assessment Area Name (if >1 AA): _____ **Observer(s):**_____

Notes:

☐ *see attached details*

Scoring Scale: 3.5- 4 = Excellent 2.5-3.49 = Good 1.5-2.49 = Fair 1-1.49 = Poor

Core Factor	*Metric*	*Metric Score*	*Mean Core Factor Score*	*Calculation for Overall Score*	*Overall Core Factor Score*
Landscape (Assessment for project area)	Buffer Perimeter		(Sum of metric scores: _____) / 4 = _____	Mean Core Factor Score x 0.3	
	Buffer Condition				
	Aquatic Context				
	Comparative Size				
Soil/Substrate*	Redox Concentrations		(Sum of metric scores: _____) / 4 = _____	Mean Core Factor Score x 0.1*	
	Microtopography				
	Soil Organic Matter				
	Organic Matter Accumulation				
Hydrology	Water source		(Sum of metric scores: _____) / 3 = _____	Mean Core Factor Score x 0.2	
	Channel				
	Hydroperiod and Hydrologic Connectivity				
Key Wildlife Habitat and Vegetation Composition	Interspersion/Patch Richness		(Sum of metric scores: _____) / 6 = _____	Mean Core Factor Score x 0.4	
	Vertical Structure				
	Coarse Woody Debris				
	Invasive Species				
	Native Species Composition				
	Floristic Quality Assessment				
Sum of Overall Core Factor Scores = Overall KWH Ecological Integrity Assessment (EIA) Score*: * If Soil/Substrate metric not rated, see manual for adjusted calculation					
Additional points for unique resources in the project area if Overall EIA score not "Excellent": add + 0.2 to the Overall EIA score for each of the following: From WRR layers (see Section 3.): ☐ Non-tidal Wetlands of Special State Concern ☐ Wetlands adjacent to use III or IV waters ☐ Biodiversity Conservation Network Tier 1, 2, or 3 ☐ Occurs in stream reach with "Good" Combined Index of Biotic Integrity ☐ Stream mitigation framework area with low impervious cover (< 5%) From Field observations: ☐ Other Maryland nontidal wetland(s) with significant plant or wildlife value (as defined by COMAR 26.23.01.01B80) (add + 0.2 for each wetland to the Overall EIA score) ☐ Areas with state rare plants or state rare natural community noted during field data collection but not mapped in Biodiversity Conservation Network Tier 1, 2, or 3					
Additional points for limited habitats in the project area if Overall EIA score not "Excellent" : add + 0.1 to the Overall EIA score for each of the following if: ☐ Dominated by native trees greater than 60cm or 24" diameter at breast height ☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata ☐ Forest Interior Dwelling Species (FIDS) area: Class 1 ☐ Targeted Ecological Areas					
FINAL KWH EIA SCORE: _____					

Include Representative Site Photographs

Appendix 5

Condensed Scoring Tables for Field Use

Pilot Method to Apply Rapid Ecological Integrity Assessments in Wetlands of Riparian Areas in Maryland: Upper Coastal Plain

Scoring Tables and Diagrams for Field Metrics

-Refer to section indicated in field manual for further information
-Apply criteria for Key Wildlife Habitat being evaluated
-Assign score to category with majority of features present on field form

SOIL/SUBSTRATE (Section 4.4) *Assessment of soil health using easily observable factors. Prior to fieldwork, review expected reference soil characteristics as mapped for the site.*

Biogeochemical Cycling: Redox Concentrations

All KWH (NOTE: if the floodplain does not naturally have hydric soils, and still does not have hydric soils under current conditions, skip this metric.)	
Score	Assign rating to category with majority of features present
Excellent = 4	Biogeochemical cycling excellent, with redox concentrations starting 0 to 6" from the soil surface and covering >10% of the surface area.
Good = 3	Biogeochemical cycling good, with redox concentrations starting >6" to 12" from the soil surface and covering >10% of the surface area OR redox concentrations start 0-6" from the soil surface and represent <10% of the surface area.
Fair = 2	Biogeochemical cycling fair, with redox concentrations starting >12" to 18" from the soil surface and covering >10% of the surface area OR redox concentrations start >6" to 12" from the soil surface and represent <10% of the surface area.
Poor = 1	Biogeochemical cycling poor, with redox concentrations starting >12" to 18" from the soil surface and covering <10% of the surface area OR no redox concentrations within 18" of the soil surface.

Microtopography

All KWH (NOTE: if the floodplain does not naturally have hydric soils, and still does not have hydric soils under current conditions, skip this metric.)	
Score	**Assign rating to category with majority of features present**
Excellent = 4	More than 50% of the AA shows at least a 3" increase in elevation over the base elevation of the AA.
Good = 3	30-49% of the AA shows at least a 3" increase in elevation over the base elevation of the AA.
Fair = 2	10-29% of the AA shows at least a 3" increase in elevation over the base elevation of the AA.
Poor = 1	<10% of the AA shows at least a 3" increase in elevation over the base elevation of the AA.

Soil Organic Matter

All KWH (NOTE: if the floodplain does not naturally have hydric soils, and still does not have hydric soils under current conditions, skip this metric.)	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Organic surface horizon present (any thickness).
Good = 3	Mineral surface layer(s) are ≥4" thick.
Fair = 2	Mineral surface layer(s) are <4" thick with matrix value ≤3 and chroma ≤2.
Poor = 1	Mineral surface layer(s) are <4" thick with matrix value >3 and ≤4 or chroma >2 and ≤3.

Organic Matter Accumulation

All KWH (NOTE: if the floodplain does not naturally have hydric soils, and still does not have hydric soils under current conditions, skip this metric.)	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Organic matter accumulation from root turnover is high as herbaceous ground cover is >75%.
Good = 3	Organic matter accumulation from root turnover is moderate as herbaceous ground cover is >50-74%.
Fair = 2	Organic matter accumulation from root turnover is low as herbaceous ground cover is >25-50%.
Poor = 1	Organic matter accumulation from root turnover is minimal as herbaceous ground cover is ≤25%.

HYDROLOGY (Section 4.5)

Water Source (Section 4.5.1) *The forms, or places, of direct inputs of water to the AA, as well as any unnatural diversions of water from the AA.*

Coastal Plain Floodplain: Groundwater discharge not a major input	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Water source is natural. Lacks point charge discharges into or adjacent to the site. No unnatural obstructions to water source or impact on overland flow and overbank flooding. Plant community reflective of characteristic KWH or not altered by natural changes to water source.
Good = 3	Water source is mostly natural, but wetland directly receives occasional or small amounts of inflow from anthropogenic sources such as some road runoff, small storm drains, or other minor point source discharges emptying into the wetland. Up to 25% of stream banks are affected due to dikes, rip rap and/or elevated culverts, or increased discharge due to other causes. Little change in plant community resulting from unnatural alterations.
Fair = 2	Water sources are moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Between 25-75% of stream banks are affected (e.g., dikes, rip rap, concrete, and elevated culverts) or increased discharge due to other causes. Wetlands still present due to groundwater or other water inputs, but potentially reduced in extent and showing some plant community changes; or plant community changes due to increased unnatural water inputs.
Poor = 1	Water source contains a substantial amount of inflow from anthropogenic sources, such as major point source discharges into or adjacent to the wetland. > 75% of stream banks are affected (for example due to dikes, rip rap, concrete, and elevated culverts) or increased discharge due to other causes. Wetlands are reduced in extent unless high groundwater or other surface water inputs maintain them. Plant community changes are observed due to unnatural water inputs.

Coastal Plain Floodplain: Mixed hydrologic regime	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Water source is natural. Lacks point charge discharges into or adjacent to the site. No unnatural obstructions to lateral or vertical movement of ground or surface water. Plant community reflective of characteristic KWH or not altered by natural changes to water source.
Good = 3	Water source is mostly natural, but wetland directly receives occasional or small amounts of inflow from anthropogenic sources such as some road runoff, small storm drains, or other minor point source discharges emptying into the wetland. Minor restrictions to the lateral or vertical movement of ground or surface waters by unnatural features. Little change in plant community resulting from unnatural alterations.
Fair = 2	Water sources are moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Wetland is still connected to its natural water source (e.g., modified ponds on a floodplain that are still connected to alluvial aquifers, natural stream channels that now receive substantial irrigation return flows, many small/few large storm drains), but moderately disconnected from floodplain due to multiple geomorphic modifications. Moderate restrictions to the lateral or vertical movement of ground or surface waters by unnatural features. Wetlands still present due to groundwater or other water inputs, but limited reduction in extent and showing some plant community changes; or some limited plant community changes due to increased unnatural water inputs.
Poor = 1	Water source contains a substantial amount of inflow from anthropogenic sources, such as major point source discharges into or adjacent to the wetland. Wetland has reduced connection to natural water source (e.g., loss of overbank flow). Wetlands are potentially reduced in extent if no other surface water inputs maintain them. Plant community changes are observed due to unnatural water inputs.

Water Source (Section 4.5.1)

All other KWH: Predominantly groundwater or precipitation water source, with potential limited flooding from small stream in relation to wetlands in riparian system	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Water source is natural. Lacks point charge discharges into or adjacent to the site. Groundwater or precipitation dominant or only water source; otherwise, no unnatural obstructions to lateral or vertical movement of ground or surface water, or, if perched water table, impermeable soil layer is intact. Plant community reflective of characteristic KWH or not altered by natural changes to water source.
Good = 3	Water source is mostly natural, but wetland directly receives occasional or small amounts of inflow from anthropogenic sources such as some road runoff, small storm drains, or other minor point source discharges emptying into the wetland. Minor restrictions to the lateral or vertical movement of ground or surface waters by unnatural features, such as levees or excessively high banks (less than 25% of the site). If perched, impermeable soil layer partly disturbed. Little change in plant community resulting from water source alterations.
Fair = 2	Water source is moderately impacted by anthropogenic sources, but still a mix of natural and non-natural sources. Moderate restrictions to the lateral or vertical movement of ground or surface waters by unnatural features or alteration. Between 25-75% of the site is restricted by barriers to drainage. If perched, impermeable soil layer moderately disturbed. Drainage back to the wetland is incomplete due to impoundment. Wetlands still present due to groundwater or other water inputs, but limited reduction in extent and showing some plant community changes; or some limited plant community changes due to water source alterations.
Poor = 1	Water source contains a substantial amount of inflow from anthropogenic sources, such as major point source discharges into or adjacent to the wetland. Most or all water stages are contained within artificial banks, levees, or comparable features. Greater than 75% of wetland is restricted by barriers to drainage. If perched, impermeable soil layer strongly disturbed. Wetlands reduced in extent and show plant community changes due to water source alerations.

Channel (section 4.5.2) *Evidence of channel degradation or aggredation and connection to the floodplain. Assess for channel in project area, which will apply to all AA. Refer to Table 20 in text for field indicators of equilibrium, degradation, and aggradation.*

Channel in Project Area	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Indicators of channel equilibrium present. Minimal or no evidence of degradation or aggradation leading to channel instability or migration. Channel is not unnaturally entrenched. If calculated, BEHI/NBS scores low.
Good = 3	Minor channel incision. Channel is somewhat entrenched (overbank flow occurs during most floods). Some evidence of degradation or aggradation leading to a minimal level of channel instability or migration. If calculated, BEHI/NBS scores low.
Fair = 2	Channel is incised. Channel is moderately entrenched (overbank flow only occurs during moderate to severe floods, functioning at risk). Uncharacteristic aggradation or degradation is present leading to a moderate level of channel instability or migration. BEHI/NBS scores moderate.
Poor = 1	Channel is incised. Channel is substantially entrenched (overbank flow never occurs or only during severe floods-not functioning). Channel entirely or extensively disconnected from the floodplain. BEHI/NBS scores high, very high, or extreme.

Hydroperiod and Hydrologic Connectivity (section 4.5.3) *Characteristic frequency, level, and duration of inundation or saturation of a wetland; ability of water to flow into or out of the wetland. Refer to Table 20 in text for field indicators of changes in extent and duration of inundation or saturation.*

Coastal Plain Floodplain ___Low natural variation of hydroperiod ___High natural variation of hydroperiod	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Evidence of recent overbank flooding. Completely connected to floodplain (backwater sloughs and channels). No major hydrologic stressors present that impact natural hydroperiod or impact due to natural events (e.g., beaver dams). No unnatural obstructions to lateral or vertical movement of ground or surface water.
Good = 3	Evidence of overbank flooding. Minimally disconnected from floodplain. Minor alterations in frequency, levels, or duration of hydroperiod. Minor restrictions to the lateral or vertical movement of ground or surface waters by unnatural features. Flooding at 2-year storm interval.
Fair = 2	Some evidence of overbank flooding, likely during larger storm events. Moderately disconnected from floodplain due to multiple geomorphic modifications. Moderate restrictions to the lateral or vertical movement of ground or surface waters by unnatural features. Moderate flooding at 2-year storm interval.
Poor = 1	Overbank flooding generally no longer occurs. Disconnected from floodplain, likely causing some drainage of groundwater. Flooding may or may not occur at 100-year or greater storm interval.

Hydroperiod and Hydrologic Connectivity (section 4.5.3)

Other KWH ___Low natural variation of hydroperiod ___High natural variation of hydroperiod	
Score	**Assign rating to category with majority of features present**
Excellent = 4	Overbank flooding present and recent but not predominant water source to wetland. No unnatural obstructions to lateral or vertical movement of ground or surface water.
Good = 3	Evidence of overbank flooding but not predominant water source to wetland. Hydroperiod with minor alterations in frequency, levels, or duration due to groundwater and other inputs. Minor restrictions to the lateral or vertical movement of ground or surface waters by unnatural features.
Fair = 2	Some evidence of overbank flooding, likely during larger storm events. Hydroperiod with moderate alterations in frequency, levels, or duration due to groundwater and other inputs. Moderate restrictions to the lateral or vertical movement of ground or surface waters by unnatural features.
Poor = 1	Overbank flooding generally no longer occurs. Hydroperiod with substantial alterations in frequency, levels, or duration due to groundwater and other inputs. Substantial restrictions to the lateral or vertical movement of ground or surface waters by unnatural features.

KEY WILDLIFE HABITAT AND VEGETATION COMPOSITION

Interspersion and Patch Richness (section 4.6.1)

Interspersion of vegetation patches and number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian animal species.

Calculate the mean of the Interspersion and Patch Richness metrics below. Use the following table to assign an overall score for this metric.

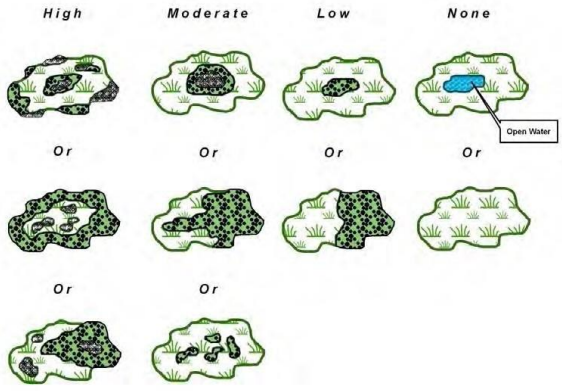
Score	Mean of Interspersion and Patch Richness Metric Scores
Excellent = 4	3.5 – 4
Good = 3	2.6 - 3.4
Fair = 2	1.6- – 2.5
Poor = 1	1 – 1.5

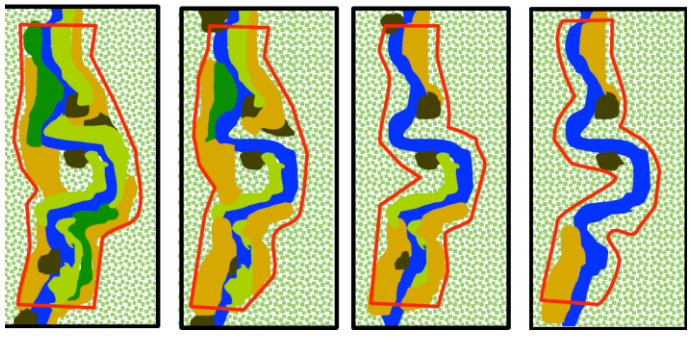
Interspersion: ____

Patch Richness: ____

The interspersion metric is scored using the diagrams below. Vegetative patches should represent at least 5% of the AA in single or multiple locations.

Coastal Plain Seepage Swamp, Coastal Plain Bog and Fen, Coastal Plain Flatwood and Depression Swamp, Vernal Pool, Spring. (Source: US ACE 2015 Texas Rapid Assessment Method) ***Scoring*: High = 4, Moderate = 3, Low = 2, None = 1**	**Coastal Plain Floodplain**: The red box represents the boundary of the AA and each color represents a unique plant zone. The speckled background represents the background matrix vegetation zone, and the blue represents the stream. (Source: California Rapid Assessment Methods for Wetlands Riverine Wetlands Field Book 2013) **Scoring: A = 4, B = 3, C = 2, D = 1**



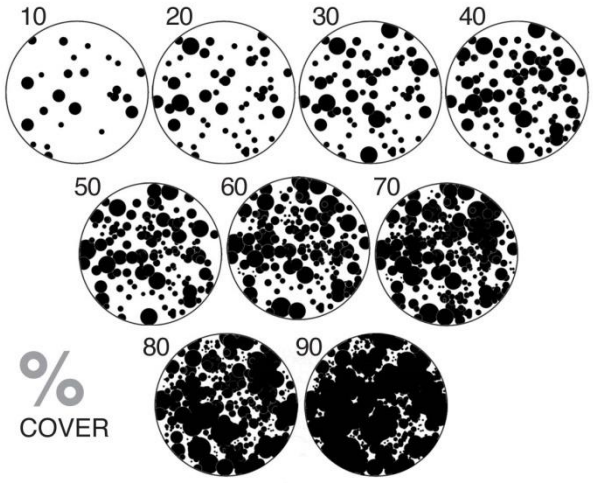


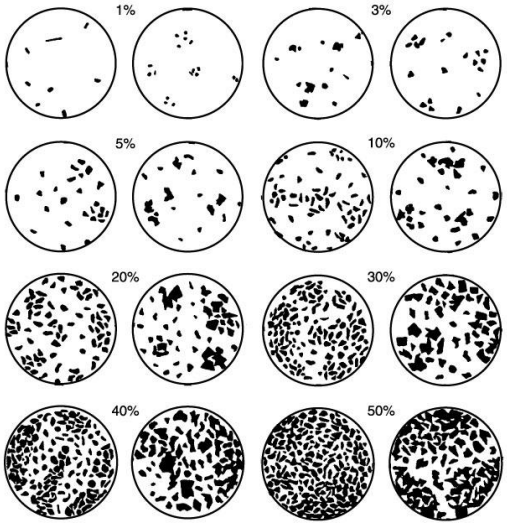
Patch Richness: *These components represent potential wildlife habitat. Count the number of the following features present in the AA and also within 10m of the AA boundary, as they also contribute.*

Features: Spring or upwelling groundwater; Depression; Vegetated pool ; Unvegetated pool; Unvegetated flat; Island; Animal mound or burrow; Beaver dam or lodge; Oxbow, swale, secondary channel; Wind-thrown tree hole; Mound; Bank overhang with tree roots; Tip-up tree root mound; Brush piles; Abundant deciduous leaf litter; Partially buried natural debris; Debris jam; Plant hummock/tussocks; Other wildlife habitat

Score	Coastal Plain Floodplain, Coastal Plain Seepage Bog and Fen, Coastal Plain Seepage Swamp	Coastal Plain Flatwood and Depression Swamp	Vernal Pool/Spring
4	≥ 6	≥ 7	≥ 4
3	5-6	6-7	3-4
2	3-4	4-5	2
1	≤ 3	≤ 4	≤ 2

% Cover Estimation Diagrams *(johnmuirlaws.com and Terry and Chilingar 1955)*





Vertical Structure (section 4.6.2) *Assess the woody layers and presence of large trees in the AA according to KWH type.*

Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp, Coastal Plain Seepage Swamp
Vernal Pool: assess vegetation structure in area surrounding basin, as only limited to sparse herbaceous vegetation is usually present in the basin area.
Note: Recent beaver activity may lead to deviations from rating descriptions for Coastal Plain Floodplain. This should be noted on the data sheet and taken into account.

Score	Assign rating to category with majority of features present
Excellent = 4	Tree canopy or highest woody level present is a heterogeneous mosaic of patches of different ages or sizes. Gaps also of varying size. Multiple layers are created through presence of trees of varying ages and heights and the shrub layer. Large trees (>60 cm or 24" dbh) expected to be present. Large trees may be absent in early-seral stands, but, if so, then large stumps are not present (or few) and evidence of natural disturbance event is present (e.g., large downed wood from wind storms or fire scars, beaver activity).
Good = 3	Tree canopy or highest woody level present is largely heterogeneous in age or size. Multiple layers are present, but one layer missing or little variation in ages and heights of woody vegetation in at least one layer. Considering the natural stand development stage, there are more large trees (>60 cm or 24" dbh) than large cut stumps. Some (10-30%) of the old trees have been harvested. Minor presence of cutting, browsing, grazing and other degradation such as forest pest/pathogens.
Fair = 2	Tree canopy or highest woody level present is somewhat homogeneous in age or size. More than one layer present, but one or more layers missing. Little variation in ages and heights of woody vegetation in layers. Considering the natural stand development stage, there are around as many large trees as large cut stumps. Many (over 30%) of the old trees have been harvested. Moderate levels of cutting, browsing, or grazing, or other degradation such as forest pest/pathogens.
Poor = 1	Tree canopy or highest woody level present is very homogeneous, in age or size. Only one or two layers present. Considering the natural stand development stage, most, if not all, old trees have been harvested. None or rare old trees present. Major cutting, heavy browsing, grazing, or other degradation such as forest pest/pathogens.

Coastal Plain Seepage Bog and Fen	
Score	Assign rating to category with majority of features present
Excellent = 4	Woody vegetation mortality is due to natural factors. Excellent potential for site recovery given structure present and lack of degradation (past or present). Bogs/acidic fens: Peatland structure includes shrub and herb strata (some tall and some short). When present (peatland not too wet), trees are relatively short and stunted with rounded tops and furrowed bark. Shrubs are < 50 cm and open enough to allow for a nearly continuous ground cover of *Sphagnum* and other expected vegetation around tree/shrub bases AND in low hummocks, hollows, or other low areas. Circumneutral/rich fens: Primarily short-statured vegetation and nearly continuous cover of mosses (except in tall sedge fens - which are naturally more vigorous, homogenous, and often with little bryophyte cover). Shrubs may be present as a mosaic with open areas. Tree species, when present, do not form a closed canopy. *Sphagnum* and other mosses actively growing. Never more than local, small patches of degenerating *Sphagnum*.
Good = 3	Minor negative anthropogenic influences present, or the site is still recovering from major past human disturbances. Mortality or degradation due to grazing, peat mining, limited timber harvesting, or other anthropogenic factors may be present, though not widespread. The site can be expected to meet minimally disturbed conditions in the near future if negative influences do not continue. Bogs/acidic fens: Shrubs and herbs show minor alterations from expected conditions. A few areas of dense and tall shrubs (> 1 m) may occur (dense enough to eliminate *Sphagnum*/moss growth). Some trees may have been or killed due to anthropogenic stressors. Circumneutral/rich fens: Shrubs and herbs show minor alterations from expected conditions.
Fair = 2	Expected structural classes are not present. Shrubs and herbs moderately altered from expected conditions. The site will recover to minimally disturbed conditions only with the removal of degrading influences and moderate recovery times. Bogs/acidic fens: Shrub cover averages > 1 m tall and is beginning to reduce *Sphagnum* cover. Many trees have been cut or killed due to anthropogenic stressors. Circumneutral/rich fens: Trampling or other physical disturbance has moderately reduced moss cover where expected. Overall, evidence of degradation includes moderate levels of cutting, mowing, browsing, fire or grazing. *Sphagnum* still regenerating in open areas.
Poor = 1	Expected peatland structure is absent or much degraded due to anthropogenic factors, such as peat mining. Overall, evidence of degradation includes major cutting, mowing, browsing, fire or grazing. Woody regeneration is minimal and existing structure is in poor condition, unnaturally sparse, or depauperate. Shrubs and herbs substantially altered from expected conditions. Recovery to minimally disturbed condition is questionable without restoration, or will take many decades. Bogs/acidic fens: Most if not all *Sphagnum* cover has been eliminated due to extremely dense and tall (> 1 m) shrubs. Trees have all been cut or killed by anthropogenic stressors. Circumneutral/rich fens: Trampling or other physical disturbance has eliminated moss cover where it is expected. *Sphagnum* not regenerating, even in open areas.

Spring	
Score	Assign rating to category with majority of features present
Excellent = 4	Expected levels of abundance and diversity (some tall and some short) and/or low cover of shrubs or trees where appropriate. Overall, no evidence and little to no structural indicators of degradation evident.
Good = 3	For the most part, expected levels of abundance and diversity (some tall and some short) and/or low cover of shrubs or trees where appropriate. Minor structural degradation (cutting, mowing, browsing, grazing).
Fair = 2	Structural indicators of degradation are moderate. Overall, evidence of degradation includes moderate levels of cutting, mowing, browsing or grazing.
Poor = 1	Vegetation structure is greatly altered from minimally disturbed natural conditions. Structural indicators of degradation are strong. Overall, evidence of human and degradation includes major cutting, mowing, browsing or grazing.

Standing and Downed Woody Debris (section 4.6.3) *Estimate coarse woody debris, including standing and downed wood, based on a walkthrough of the entire AA if possible.*

Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp, Coastal Plain Seepage Swamp **Vernal Pool and Spring:** assess presence in immediate surrounding area as well as basin, which may only have scattered coarse woody debris, if any. If non-natural sources have created standing and/or downed woody debris, such as cutting or forest pests/pathogens , indicate this on the data sheet.	
Score	Assign rating to category with majority of features present
Excellent = 4	Wide diversity of sizes for both standing and downed logs, including larger sizes [> 30 cm (12 in) DBH and > 2 m (6 ft) long)] present with 5 or more snags per ha (2.5 ac), but not excessive numbers (suggesting disease or other problems). Downed logs are in various stages of decay, from sound and intact to soft pieces that no longer maintain their shape.
Good = 3	Moderate diversity of sizes for both standing and downed logs, but larger sizes [> 30 cm (12 in) DBH and > 2 m (6 ft) long)] are rare. Larger size class present with 2-4 snags per ha, or an increased but not excessive number of snags (suggesting disease or other problems). Downed logs are in various stages of decay, with few soft pieces that no longer maintain their shape.
Fair = 2	Moderate-low diversity of sizes for both standing and downed logs, but larger sizes [> 30 cm (12 in) DBH and > 2 m (6 ft) long)] very rare or not present. Larger size class present with 1-2 snags per ha, or moderately excessive numbers (suggesting disease or other problems). Downed logs are in various stages of decay, but few to no soft pieces that no longer maintain their shape.

Coastal Plain Seepage Bog and Fen	
Score	Assign rating to category with majority of features present
Excellent = 4	Typical of the system. Woody vegetation mortality is due to natural factors. Peat accumulation appears to be stable or actively growing. Bogs/acidic fens: *Sphagnum* is nearly continuous and growing around tree/shrub bases AND in low hummocks, hollows, or other low areas. Circumneutral/rich fens: Dominant species are active peat-formers.
Good = 3	Minor alterations to system present. Bogs/acidic fens: Mortality or degradation of peat surface due to grazing, limited timber harvesting, anthropogenic fire or other anthropogenic factors may be present, but not widespread. Circumneutral/rich fens: Mortality or degradation of peat surface due to grazing, limited timber harvesting, anthropogenic fire or other anthropogenic factors may be present, but not widespread.
Fair = 2	Moderate alterations to system present. Bogs/acidic fens: Ground cover has as much bare peat as *Sphagnum* cover, or nearly so. Circumneutral/rich fens: Dominance of active peat-formers is being reduced in favor of non-peat-forming grasses and forbs.
Poor = 1	Substantial alterations to system present. Bogs/acidic fens: Ground cover is almost all bare peat with very little *Sphagnum* cover. Circumneutral/rich fens: Cover of active peat-formers dramatically reduced and site is now dominated by non-peat-forming grasses and forbs.
Poor = 1	Low diversity of sizes for both standing and downed logs. Larger size class [> 30 cm (12 in) DBH and > 2 m (6 ft) long)] present with < 1 snag per ha, or very excessive numbers (suggesting disease or other problems). Downed logs are mostly in early stages of decay.

Invasive Species (section 4.6.4) *Note the cover of invasive species and impact on the AA.*

Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp, Coastal Plain Seepage Swamp, Coastal Plain Bog and Fen **Vernal Pool and Spring**: assess vegetation structure in area surrounding basin, as only limited to sparse vegetation may be present in the basin area.	
Score	Assign rating to category with majority of features present
Excellent = 4	Invasive species are absent from all layers or absolute cover in any one woody layer (if present) and herbaceous layer is <1%.
Good = 3	Invasive species are sporadic (no more than 5% absolute cover in any layer).
Fair = 2	Absolute cover of Invasive species is 5-10% in any one woody layer (if present) and/or present with moderate absolute cover (5-30%) in the herbaceous layer. Patches of native vegetation are reduced in size and complexity due to the presence of invasive species.
Poor = 1	Absolute cover of Invasive species is over 10% in any one woody layer (if present) and/or is very abundant (over 30%) in the herbaceous layer. Vegetation reduced in size and complexity due to human disturbance. Patches of native vegetation are reduced in size and complexity due to the presence of invasive species.

Native Species (section 4.6.5) *Native species composition in all layers, including diagnostic species- see Table 13.*

Coastal Plain Floodplain, Coastal Plain Flatwood and Depression Swamp, Coastal Plain Seepage Swamp, Coastal Plain Bog and Fen (see Table for diagnostic native species) **Vernal Pool and Spring**: assess vegetation structure in area surrounding basin, as only limited to sparse vegetation is usually present in the basin area. **Note:** Recent beaver activity may lead to deviations from rating descriptions for Coastal Plain Floodplain. This should be noted on the data sheet and taken into account.	
Score	Assign rating to category with majority of features present
Excellent = 4	Herbaceous and woody layers (if present) dominated by diagnostic native species. Layers may be sparse and patchy in areas with deeper flooding, with patches of vegetation confined to hummocks. In other areas, diverse native vegetation present unless there has been a recent natural disturbance. Bog and Fen, some Springs: *Sphagnum* is nearly continuous and growing around tree/shrub bases AND in low hummocks, hollows, or other low areas.
Good = 3	Some diagnostic native species absent or substantially reduced in abundance OR low cover (<10%) of native species indicative of human disturbance. Layer may be sparse and patchy in areas with deeper flooding. Bog and Fen, some Springs: *Sphagnum* and other mosses actively growing, but may be eliminated from some areas due to disturbance or invasive species.
Fair = 2	Few diagnostic species are present. Native species indicative of human disturbance are present with moderate cover (10-30%). Patches of native vegetation are reduced in size and complexity due to human disturbance. Bog and Fen, some Springs: *Sphagnum* cover reduced but still regenerating in open areas. Dominance of active peat-formers is being reduced in favor of non-peat-forming grasses and forbs.
Poor = 1	Few to no diagnostic species are present. Native species indicative of human disturbance are present with >30% cover. Patches of native vegetation are reduced in size and complexity due to human disturbance. Bog and Fen, some Springs: Very little *Sphagnum* cover. Cover of active peat-formers dramatically reduced and site is now dominated by non-peat-forming grasses and forbs: